IMPACT OF WATER QUALITY ON SEAGRASS MEADOW AT TANJUNG KUPANG

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To my beloved family and friends

Thank you for everything

"Today we are nobody but tomorrow we will be somebody"

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ABSTRACT

Seagrasses which colonize near shore ecosystem may be used as indicator of environmental health since it is vulnerable to the changes of water and environmental quality. Six species of seagrasses were found at Tanjung Kupang, Johor which are identified as *Halophila ovalis*, *Halophila minor*, *Halophila spinulosa*, *Enhalus acoroides, Halodule pinifolia* and *Thalassia hemprichii*. Meanwhile three species were found at Teluk Buih, Mersing identified as *Enhalus acoroides, Halodule pinifolia* and *Cymodocea rotundata*. Heavy metals (As, Cd, Cr, Cu, Pb and Hg) were analyzed using ICPMS and *Halophila minor* have the highest accumulation of heavy metal among the species. *Thalassia hemprichii* turned out to be strongest accumulator for Cd (0.016 mg/g dry weight) and *Halophila ovalis* for Hg (0.044 mg/g dry weight). The results obtained for water quality analysis exceeded the Interim Marine Water Quality Standard except for Pb (0.0014 to 0.0066 mg/L) and Total Cr (0.1486 to 0.105 mg/L). Dredging activities for land reclamation could be a possible release of heavy metals to the seawater since the concentration of heavy metal decrease in the following order: sediment > water > seagrass leaves. Therefore, *Halophila minor* has the potential to be used as bioindicator since it accumulates higher concentration of heavy metal compared to other species. Two rivers, Sungai Pok Besar and Sungai Pok Kecil, situated near the seagrass bed is classified as Class III based on Water Quality Index.

ABSTRAK

Rumput laut yang tumbuh di kawasan perairan di pesisir pantai boleh digunakan sebagai petunjuk kepada tahap pencemaran kerana hidupan ini sangat sensitif terhadap perubahan kualiti air dan persekitaran. Enam spesies rumput laut yang dijumpai di Tanjung Kupang, Johor dikenalpasti sebagai *Halophila ovalis*, *Halophila minor*, *Halophila spinulosa*, *Enhalus acoroides*, *Halodule pinifolia* dan *Thalassia hemprichii*. Sementara itu, tiga spesies yang dijumpai di Teluk Buih, Mersing direkodkan sebagai *Enhalus acoroides*, *Halodule pinifolia* dan *Cymodocea rotundata.* As, Cd, Cr, Cu, Pb dan Hg dianalisis menggunakan ICPMS dan *Halophila minor* menunjukkan bacaan kandungan logam berat paling tinggi berbanding spesies lain, *Thalassia hemprichii* pula mengumpulkan kandungan logam berat bagi Cd (0.016 mg/g berat kering) dan *Halophila ovalis* untuk Hg (0.044 mg/g berat kering). Keputusan yang didapati untuk analisis kualiti air melebihi Piawaian Interim Kualiti Air Laut kecuali plumbum (0.0014 – 0.0066 mg/L) and Jumlah Kromium (0.1486 – 0.105 mg/L). Aktiviti pengorekkan untuk tebusguna tanah dikenalpasti sebagai penyumbang kehadiran logam berat di dalam air laut kerana kandungan logam berat berkurang mengikut aturan berikut: tanah > air > rumput laut. Oleh itu, *Halophila minor* mempunyai potensi untuk digunakan sebagai penunjuk biologi kerana mengumpul kandungan logam berat paling tinggi berbanding spesies rumput laut lain. Dua buah sungai, Sungai Pok Besar dan Sungai Pok Kecil yang terletak berhampiran dengan hamparan rumput laut dikenalpasti berada dalam Kelas III berdasarkan Indeks Kualiti Air.

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LIST OF SYMBOLS

AMWQC	ASEAN Marine Water Quality Criteria
AN	Ammoniacal Nitrogen
As	Arsenic
BOD	Biochemical Oxygen Demand
Cd	Cadmium
COD	Chemical Oxygen Demand
Cr	Chromium
Cu	Copper
DO	Dissolved Oxygen
DOE	Department of Environment Malaysia
Hg	Mercury
IMWQS	Interim Marine Water Quality Standard
INWQS	Interim Water Quality Standard
Pb	Lead
SOS	Save Our Seahorse
UTM	Universiti Teknologi Malaysia
WQI	Water Quality Index

CHAPTER 1

INTRODUCTION

1.1 Preface

Increasing human populations associated with port expansion, urbanization, industrial development and agricultural activities along the Johor Strait especially at Pulai River have focused intention on the risk of those activities to the estuaries and coastal. The largest seagrass bed in Peninsular Malaysia located in the coastal area of Johor, situated between Merambong Island and Tanjung Kupang. The green carpet in the sea could very well be a submerged is vegetation "bridge" connecting southwest Johor to Tuas in Singapore, given its sheer size of 38ha (New Strait Times, 2008). 60% of Malaysia's natural wetlands are located in Johor including the seagrass sites. It supports a rich biodiversity such as seaweeds, sea cucumbers and fishes that are facing the competition between development and preservation of natural ecosystem.

Generally, the seagrass meadow are very important ecosystems especially for the fishing industry and therefore for food supplies, beside to ensure stabilisation of the coast as an important characteristic in view of rising sea levels and protection against coastal erosion. Moreover, the area also identified as habitat for rare marine animals like seahorses, pipefish and dugongs. There are between 70-76 species of fish in 41 families that have been observed in the seagrass beds and the adjacent mangrove areas in Tanjung Adang-Merambong (Aziz *et al*., 2006). Even with its importance role in food production, climate regulation, genetic resources and recreations, there have been minimal attempt to conserve the seagrass. According to

Choo (2006) the disappearance of a huge tract of seagrass bed was due to reclamation works by Port of Tanjung Pelepas (PTP), the Second Link project, a coal-fired power plant and a petrochemical hub. However the results have not been revealed.

Seagrass is identified as an aquatic flowering plant which lives completely submerged under saline environment. These marine angiosperms include 12 genera, which 7 are characteristic of the tropics; *Halodule, Cymodocea, Syringodium, Thalassondendron, Enhalus, Thalasia* and *Halophila*. Meanwhile 5 others are confined to temperate waters which are *Zostera, Phyllospadix, Heterozostera, Posidonia*, and *Amphibolis* (Mann, 2000).

1.2 Seagrass Distribution

Worldwide there are 60 described seagrass species and majority of species are found in the Indo-Pacific region where most of them grow in silty or sandy sediment (Choo, 2006). Australia was identified to have more seagrass species compared to other continent where 30 species can found there. Meanwhile, in Malaysia the occurrence of seagrass are scattered at 78 sites which involves mangroves, coral reefs, shallow inter-tidals, semi-enclosed lagoons and shoals areas (Japar *et al*., 2000). Along the west coast, mixed species of seagrass inhabit from sandy mud of Tanjung Rhu, Langkawi Island to sand-covered corals at Teluk Kemang, Negeri Sembilan and extend till Serimbun Island in Malacca. At depths of 2-2.7 m at Tanjung Kupang-Merambong area, the largest and highest numbers of seagrass species grows on calcareous sandy mud sub-tidal shoals.

At the east coastline, there are several species of seagrass that can be found which populate on substrates of fine sand along shallow inland coastal lagoons from Pengkalan Nangka, Kelantan to Paka, Terengganu. Meanwhile at Sibu Island, Tengah Island, Besar Island, Tinggi Island, Redang Island, Tioman Island and Perhentian Island, the seagrass communities occur in the water off-shore with

fringing coral reefs. In Sarawak, the presences of seagrass recorded at Bintulu River and estuary area of Punang-Sari- Lawas. The substrates of sand, muddy-sand and coral rubble of the inter-tidal region support the mixed species of seagrass along the west and south-eastern coast of Sabah. Figure 1.1 shows the major location of seagrass ecosystems in Malaysia.

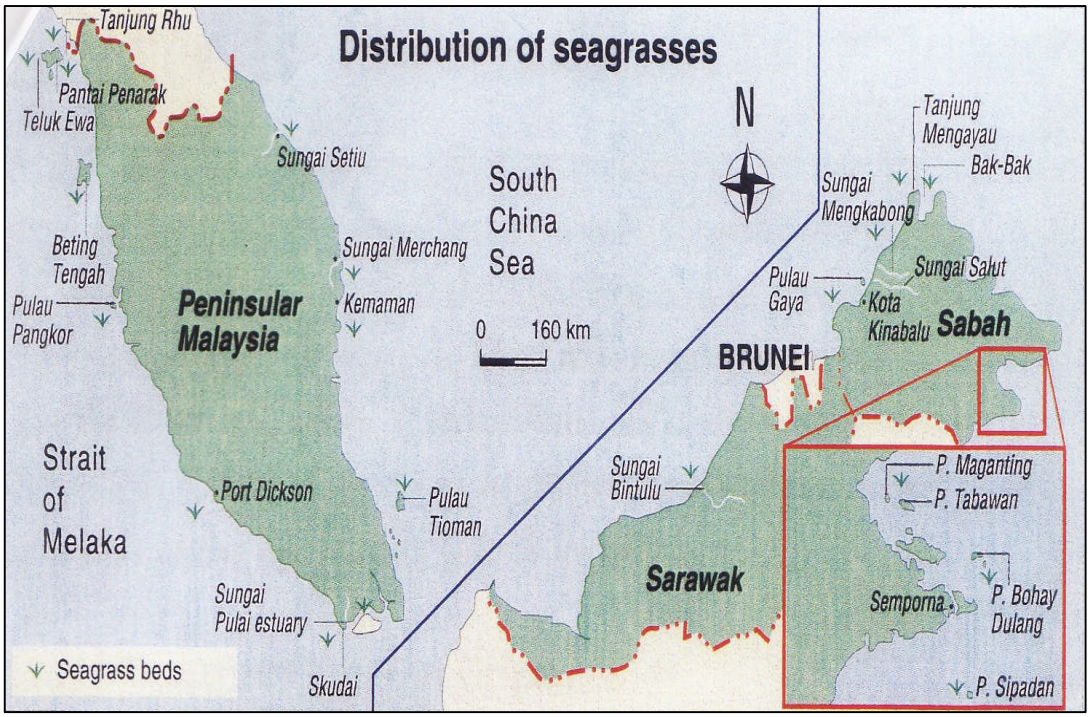


Figure 1.1: Seagrass distribution at Malaysia (The Encyclopedia of Malaysia, The Seas, 2001)

1.3 Problem Statement

Coastal environments are subjected to contamination especially metals through inputs from point sources and diffuse sources which transported via river discharge and atmospheric deposition. The pollution entering in coastal systems will incorporated into biota and may interferences the chemical and biological processes in the water column, sediments and biota. Meanwhile, seagrasses are the least studied and least protected among marine habitat and they are very sensitive and vulnerable to the changes of water and environmental quality. Hence, seagrasses which colonize near coastal ecosystem have potential as indicator of environmental

health. Pulai River's mangrove forest is the most extensive wetland site in Malaysia and exposed to human activities at Pulai River catchment area. The lost of mangrove which act as buffer zone may propel sediment loading and siltation to seagrass bed located near the Pulai River estuary.

Port of Tanjung Pelepas (PTP) located at the mouth of Pulai River is included under Iskandar Development Region (IDR) in order to enhance economic achievement. It is a strategic location to develop a mega port since the Sungai Pulai mouth is located at the southern tip of Peninsular Malaysia and the confluence of the international trade lanes which go right into one of the world's busiest route, the Straits of Malacca (BERNAMA, 2007). In the other hand, the largest privatized coal-fires power plant located at Tanjung Bin is on the opposite bank. The latest development is an integrated petrochemical facility on 40.5ha of reclaimed island at the estuary and it is expected to handle annually 60 million tones of petroleum products - industrial and marine fuel oils, diesel, jet fuel and biodiesel (The Star, 2007). With all the activities occurring in the area it seem that the country's most extensive seagrass meadow ecosystem is in danger of being destroyed and requires more intention to preserve the unique bio-ecology system.

1.4 Objective of Study

The objective of the study is to assess the seagrass occurrence at Tanjung Kupang via the following evaluation:

1. To identify the marine life include plants and animals associated with seagrass
2. To determine water quality at the surrounding area of seagrass meadow
3. To determine heavy metal concentration in sediment at seagrass meadow
4. To assess possibility of seagrass as bio-indicator of heavy metal concentration through extraction of its leaves

1.5 Study Area

The study area is located near the Pulai River estuary (illustrated in Figure 1.2). It emphasizes the seagrass bed, which lay between Merambong Island and Tanjung Kupang in given size of 38ha.

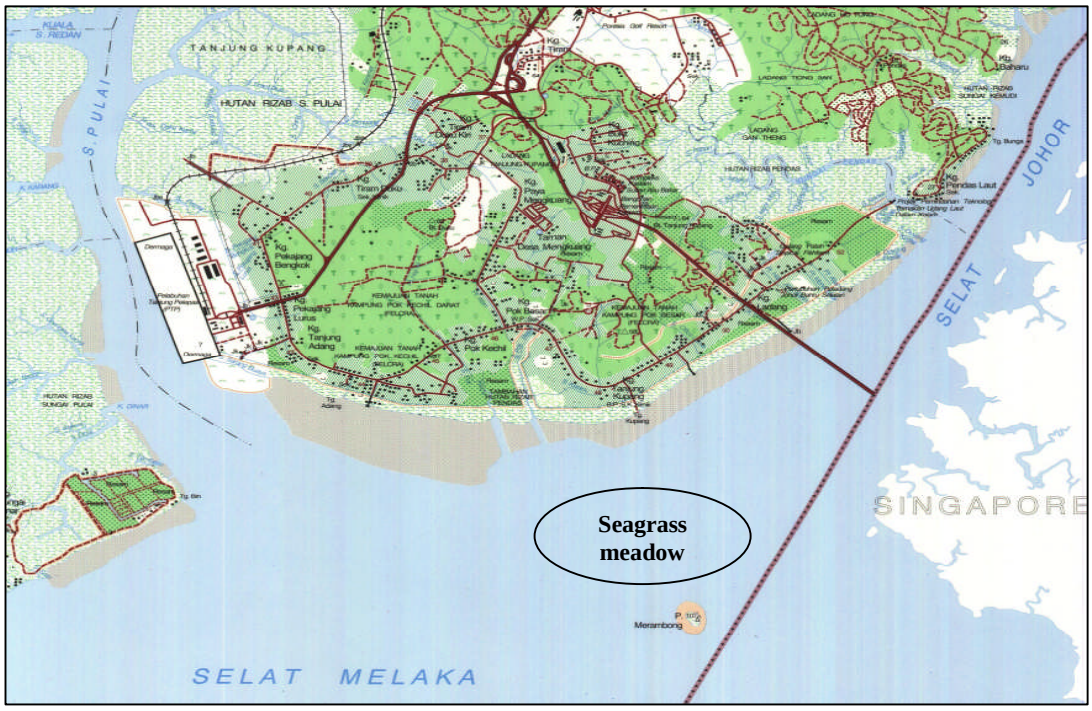
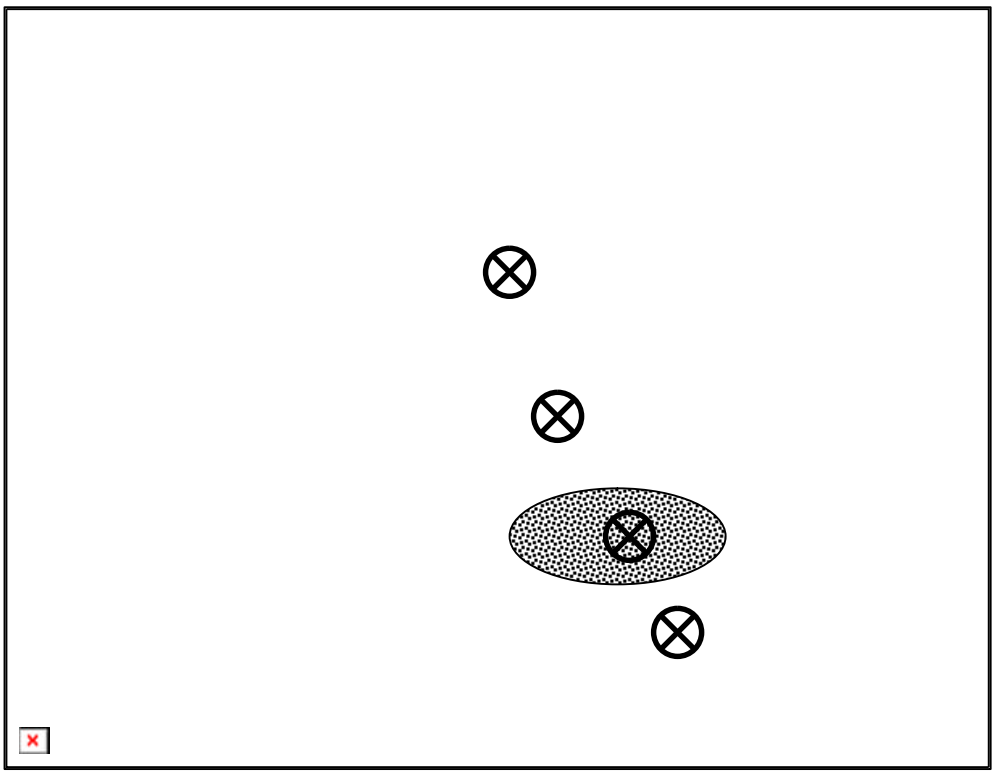
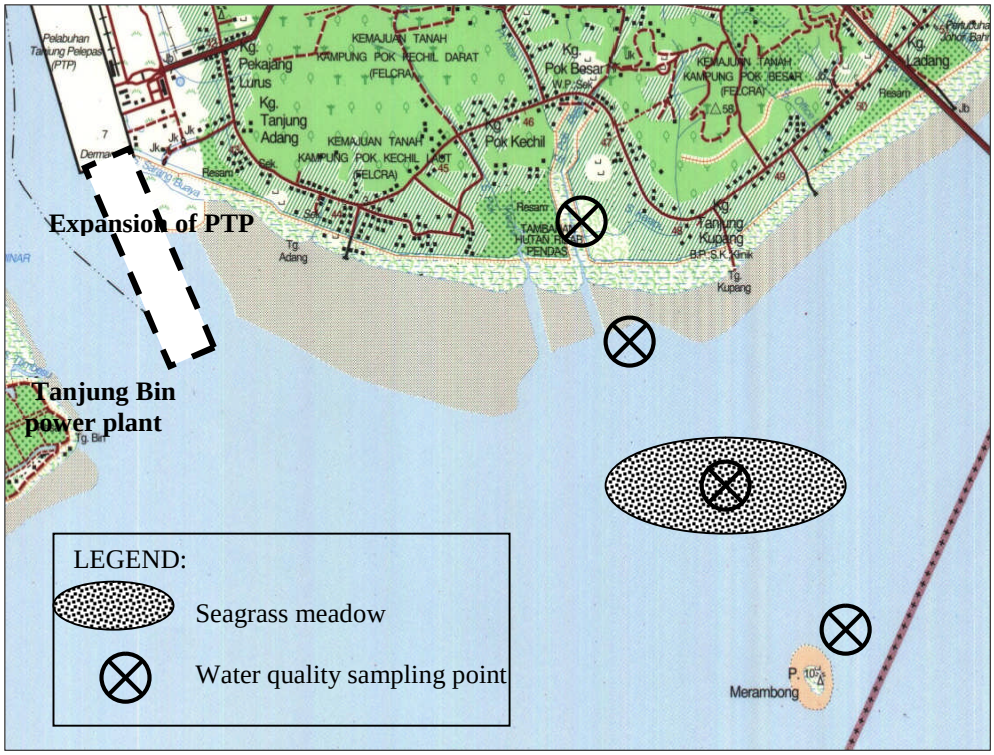


Figure 1.2: The position of study area that is near to Pulai River estuary, Second Link Bridge and Singapore

There are only a few villages located along the coastal area nearby to the seagrass bed which includes Kampung Tanjung Adang, Kampung Pok Besar and Kampung Pok Kechil. Most of villagers are fisherman and some of them are involved in agriculture and palm oil plantation. From Figure 1.3 several sampling points have been chosen that is significant to the study located at the seagrass meadow, Pok River and Pulai River estuary, Merambong Island, Tanjung Adang and near the Second Link Bridge. Pok River is the nearest waterway which brings runoff from inland waters. Therefore, water quality level at the river will also be taken into consideration.



(a)



(b)

Figure 1.3: Location of seagrass field and sampling location

Johor Port at Pasir Gudang have expanded rapidly since it commencing operation 1977 and growth prediction showed that the port would suffer capacity problems by 2000 (Renkema and Kinlan, 2000). On 1990 the Johor Port Authority start a study to find a site for a new port that can cater all future demands for cargo traffic. Based on a site selection study, Tanjung Pelepas was selected as the most strategic location for Johor's new port because it protected by a deep water bay. Moreover, it amidst the world busiest international shipping lane which guarantees a good opportunity for it to become a port of call for ships passing through these waters (Johor Port Authority, 2008). Nowadays, PTP have been covered on 1935 acre of reclamation land growth rapidly and in the year 2000, it was awarded 'Best Emerging Container Terminal' on Llods list for excellent throughout its operations (Johor Port Authority, 2008). In order to achieve world class port and fulfil the future demand, PTP plans to expand their port up to 95 berths with terminal handling capacity of 72 million TEUs. This future expansion area is including seagrass area and if the plan is continue, the meadow will disappear forever.

1.6 Scope of Study

The study emphasizes on the following methodology analysis, which are:

1. *In-situ* and Ex-situ test; Dissolved Oxygen (DO), Biochemical Oxygen Demand (DO), Chemical Oxygen Demand (COD), pH, salinity, phosphorus, nitrogen, Suspended Solid (SS) and Secchi disk depth
2. Rapid assessment using time search method and fisheries sampling for marine life identification
3. Analysis of seagrass based on extraction of leaves and sediment
4. Using secondary data to assess the future and current development at the nearby area (Tanjung Pelepas, Tanjung Bin, Tanjung Adang and Tanjung Kupang coastal area)

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