

**SURFACE AND CORE SEDIMENT
CHARACTERISTICS OF MANGROVE IN
TIDAL DOMINATED ESTUARIES:
BRUNEI BAY, SABAH**

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UNIVERSITI MALAYSIA SABAH

**MARINE SCIENCE PROGRAMME
SCHOOL OF SCIENCE AND TECHNOLOGY
UNIVERSITI MALAYSIA SABAH**

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SPENCER RYAN JUSTIN

THIS IS A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT FOR THE
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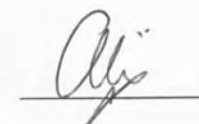
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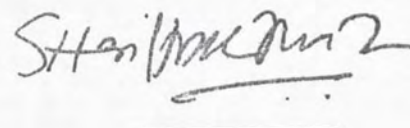
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ABSTRACT

The study was conducted to study the surface and core sediment characteristics of mangrove in tidal dominated estuaries in Brunei Bay, Sabah. Ten samples have been carried out in July, 2006 where two samples were taken at Weston area (transect 1), four samples at Sipitang (transect 2) and the other four samples were taken at the Menumbuk area (transect 3). Each sample were taken along the transect line where it was set up from the water edge to the back mangrove except sample that taken on transect 1 because the sampling location are situated at the small island. Samples were taken using hand corer. Particle sizes were studied using Particle Size Analyzer (PSA) as a measurement machine. Three statistical parameter (mean, sorting and skewness) for grain size sediment were analyzed. Organic matter content was measured by burning the sediment with temperature over 500°C. The dominant types of sediment in all station are silt where it was contained more than 52% in each core samples. Coarser sediment mostly founded more in the surface of the samples but there are cases that high percentages quantity value of coarser sediment occurred in the middle and at the bottom of core samples. There were no patterns formed by the distribution of sediment by different depth. There are not enough data to conclude that there are significant differences between the sediment criteria of different mangroves species. Organic matter content increasing towards the back mangrove except in station 1 and station 2 of transect 2 where there is a slight similarity in organic matter composition between both stations. Stations that located at transect 3 have not enough data to conclude that there are differences between samples in each stations of organic matter content. There are slight similarity trend where the organic matter content is increasing from the surface to the bottom of the core sample.



ABSTRAK

Kajian ini telah dijalankan untuk mengkaji ciri-ciri sedimen permukaan dan teras bagi kawasan paya bakau yang didominasi oleh air pasang surut di Teluk Brunei, Sabah. Sepuluh sampel telah diambil pada Julai, 2006 di mana dua sampel diambil berdekatan kawasan Weston (transek 1), empat sampel diambil berdekatan kawasan Sipitang (transek 2) dan selebihnya empat lagi diambil di kawasan Menumbuk (transek 3). Setiap sampel diambil sepanjang transek yang diunjur dari gigi air menuju ke dalam kawasan paya bakau kecuali transek 1 kerana kawasan geografinya yang seperti pulau. Sampel diambil menggunakan "hand corer". Saiz partikel di kaji menggunakan "Particle Size Analyzer" (PSA) sebagai mesin pengukur. Tiga parameter statistik (min, sisihan dan kepencongan) bagi saiz butiran sedimen dianalisis. Kandungan bahan organik di kaji dengan membakar sedimen menggunakan relau pada suhu 500°C. Sedimen jenis kelodak mendominasi kandungan sampel di keseluruhan sampel melebihi 52%. Sedimen yang kasar kebanyakannya ditemui pada permukaan sampel tetapi terdapat beberapa kes di mana peratus kandungan sedimen kasar yang tinggi terdapat pada bahagian tengah dan dasar sampel. Tidak ada corak yang terdapat pada keseluruhan taburan sedimen terhadap kedalaman. Data yang diambil adalah tidak mencukupi untuk membuat kesimpulan bahawa terdapat perbezaan yang signifikan di antara ciri-ciri sedimen bagi spesies bakau yang berlainan. Kandungan bahan organik meningkat menuju ke dalam kawasan bakau kecuali stesen 1 dan stesen 2 pada transek 2 di mana kandungan bahan organik di antara kedua-dua stesen ini adalah lebih kurang sama. Stesen-stesen pada transek 3 tidak mempunyai data yang mencukupi bagi mengatakan bahawa terdapat perbezaan kandungan bahan organik di antara stesen-stesen ini. Secara am, terdapat kesamaan di mana tren kandungan bahan organik meningkat daripada permukaan ke dasar sampel sedimen.



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LIST OF SYMBOL

μm	micrometer
mm	millimetre
cm	centimetre
ml	millilitre
$^{\circ}\text{C}$	degree Celsius
Φ	phi



LIST OF ABBREVIATION

ST	Station
TR	Transect
PSA	Particle Size Analyzer



CHAPTER 1

INTRODUCTION

1.1 Introduction

There are various definitions of mangroves. According to Garrison (2005), mangroves are a low and muddy coast in a tropical and some subtropical areas often home to tangled masses of trees. Hogarth (1999), defines mangroves as woody trees or shrubs that grow in coastal habitats or mangal. Mangrove forests play important roles in various aspects such as coastal stabilizer, protection against winds and storms, producers of nutrients, forest resources and nursery, and habitat for various marine organisms. Generally, mangrove ecosystems dominate tropical and subtropical shorelines within the geographical zone between 25° N and 25° S latitude (Yuk and Nora, 1995).

Mangroves support unique ecosystems, especially on their intricate root systems. In areas where roots are permanently submerged, mangroves is a host to a wide variety of organisms, including algae, barnacles, oysters, sponges, and bryozoans, which all require a hard substrata for anchoring while they filter feed. Mangroves are excellent buffers



between the violent ocean and the fragile coast especially during hurricanes which can bring powerful storm surges onto shores. The massive mangrove root system is quite efficient at dissipating wave energy. This same root system also helps prevent coastal erosion. The roots system traps and holds sediments around the plant by interfering with the transport of suspended particles by currents (Garrison, 2005).

The transport of sediment in mangrove swamps is controlled by 3 dominant processes (Wolanski *et al.*, 1990). First, the process where water draining the swamp including flocculation, tidal pumping, baroclinic circulation, trapping of the smallest particles in the turbidity maximum zone and the effect of the mangrove tidal prism. Second, the mechanical and chemical reactions in mangrove water destroying flocs of cohesive sediment in suspension and third are the biological processes that have a dominant influence of the clay particles in mangrove. This sediment transports influences the sediment characteristics includes the grain sizes, shapes, textures and composition (Dyer, 1990).

Studies on the mangrove sediment characteristics in Sabah, Malaysia are scarce. Thus, there is very little information about mangrove sediment characteristics especially on the sediment grain sizes, shapes, textures, composition and distribution. Realizing this, research on the sediment characteristics in mangroves is considered important.



1.1.1 Significance of Study

Sediment is one of the important factors determine the distribution and existing of mangroves in a particular area. This study will provide useful data and information that can be used for coastal zone management and planning, as well as for future study.

1.2 Study Area

This study was done in Brunei Bay, Sabah, Malaysia. Brunei Bay is located in south west of Sabah including Menumbuk, Weston and Sipitang area as shown in Figure 1.1 and Figure 1.2. Sampling point chosen as shown in Table 1.1.

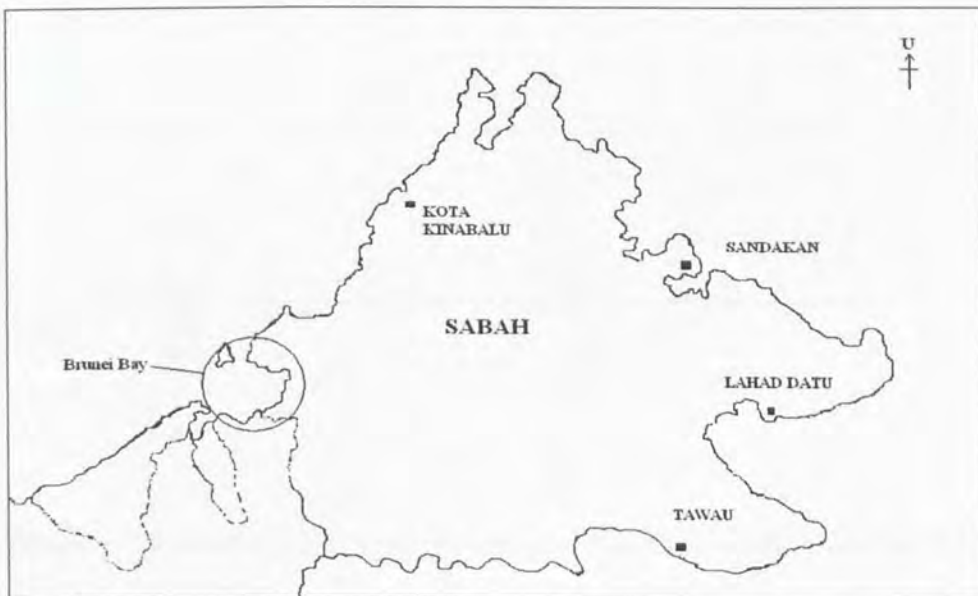


Figure 1.1 Sabah map (Not to scale).

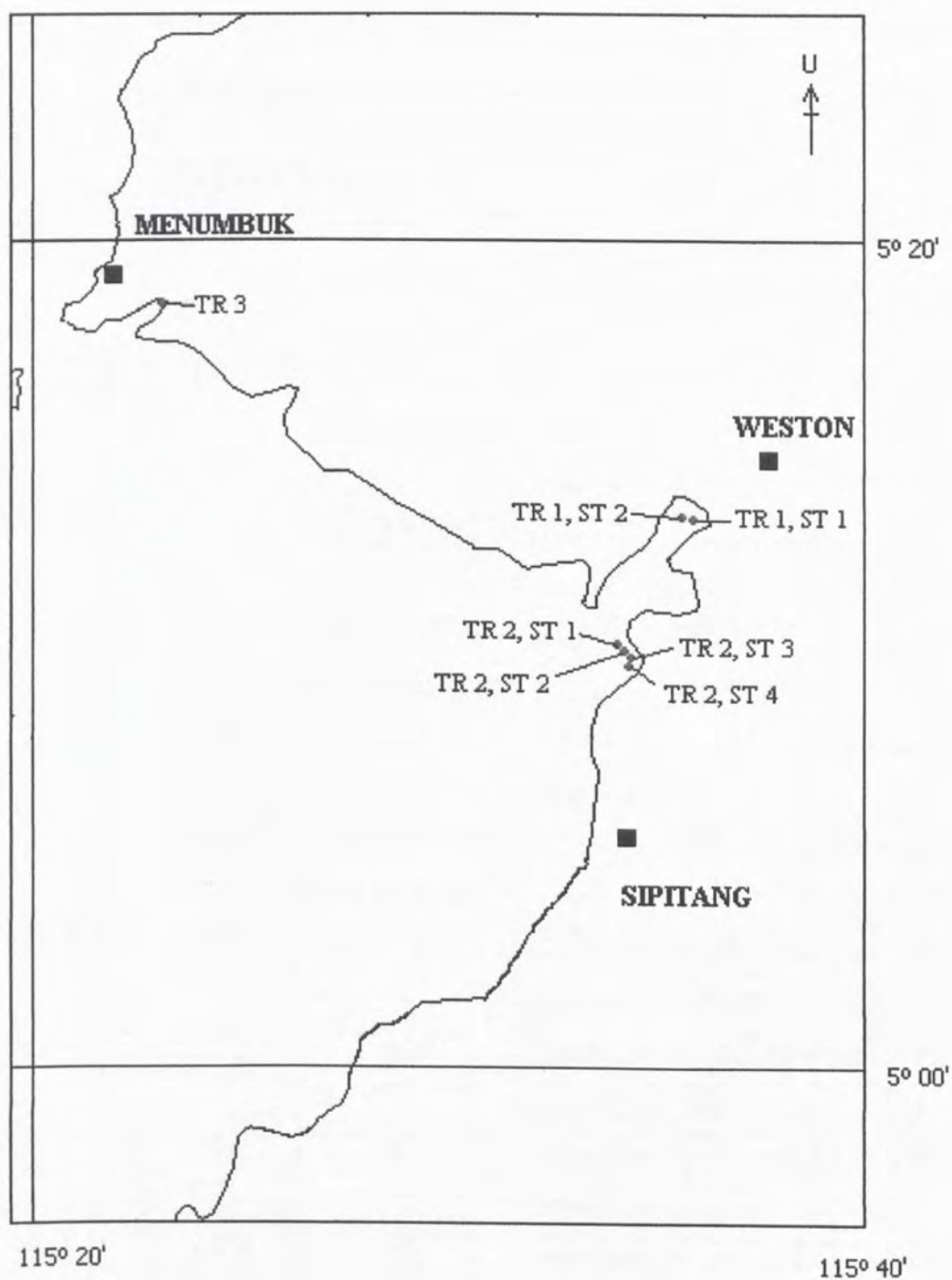


Figure 1.2 The Brunei Bay area including Menumbuk, Weston and Sipitang.

Table 1.1 Sample location and observation for surface and core sediment characteristics of mangrove sediment in Brunei Bay, Sabah.

TRANSECT	STATION	LOCATION	OBSERVATION
TR 1	ST 1	N 05° 13.220' E 115 ° 35.692'	Water edge. Front tree dominated by <i>Nypa</i> sp. <i>Sonneratia</i> sp. presence in small numbers.
TR 1	ST 2	N 05° 13.248' E 115 ° 35.666'	Sample taken at the middle of transect 1. <i>Nypa</i> sp. and <i>Rhizophora</i> sp. babies presence.
TR 2	ST 1	N 05° 10.116' E 115 ° 33.906'	Near shore. Front trees dominated by <i>Sonneratia</i> sp. Back tree are <i>Nypa</i> sp.
TR 2	ST 2	N 05° 10.073' E 115 ° 33.921'	With the presence of <i>Sonneratia</i> and <i>Avicennia</i> sp.
TR 2	ST 3	N 05° 10.067' E 115 ° 33.950'	Presence of <i>Sonneratia</i> , <i>Avicennia</i> and <i>Brugeira</i> sp.
TR 2	ST 4	N 05° 10.070' E 115 ° 33.963'	<i>Nypa</i> sp. and <i>Rhizophora</i> sp. presence.
TR 3	ST 1	NA	Dominated by <i>Rhizophora</i> sp. with the presence of <i>Nypa</i> sp..
TR 3	ST 2	NA	Dominated by <i>Rhizophora</i> sp. with the presence of <i>Nypa</i> sp..
TR 3	ST 3	NA	Dominated by <i>Rhizophora</i> sp. with the presence of <i>Nypa</i> sp..
TR 3	ST 4	NA	Dominated by <i>Rhizophora</i> sp. with the presence of <i>Nypa</i> sp..

Transect 1 and transect 2 sample were collected on 22nd July 2006 while Transect 3 sample collected on 23rd July 2006. Transect 1 located in Weston side at the Padas River area that locally known as Panjamarun. Transect 2 located in Sipitang area while Transect 3 located in Menumbuk area.

Transect 3 coordinate location cannot be taken using the GPS (Global Positioning Satellite) because the mangrove area were very dense. Transect 3 was applied based on the water edge coordinate N 05° 18.391' E 115 ° 23.130'. Station 1 sample were taken about 3 metre form the water edge, station 2, 3 and 4 sample taken about 20 metre to 80 metre from each other location depend on the geography situation. Transect 3 area dominated by *Rhizophora* sp. and *Nypa* sp. also presence.



1.3 Objective

This project aim is to gather and study the physical data especially on mangrove surface and core sediment characteristics. Thus, there are five objectives:

1. To determine the surface and core sediment grain size characteristics of mangrove sediments.
2. To determine the differences of core sediment grain size characteristics by different depth.
3. To determine the percentage of organic and inorganic matter.
4. To determine the differences of organic and inorganic contents by different depth.
5. To compare the sediment criteria of different mangroves species.

Sediment criteria of different mangroves species compared only with presence of the *Sonneratia* sp., *Avicennia* sp., *Bruguiera* sp., *Rhizophora* sp. and *Nypa* sp. because of its existence in study area.



CHAPTER 2

LITERATURE REVIEW

2.1 Grain Size

A grade scale of size that is most commonly used is the Udden-Wenworth scale that had been modified by Krumbein (Dyer, 1990). A smaller unit is used for grain size scale; it is the micron (μm) where 1 micron equal to $1/1000\text{mm}$ but Krumbein proposed the logarithmic scale; the phi (Φ) scale where $\Phi = -\log_2(\text{size in mm})$ (Dyer, 1990). Grain size scale for sediments by Wentworth with Krumbein modified, show as Table 2.1.

2.2 Sediment

Sediment is particles of organic and inorganic matter that accumulate in a loose, unconsolidated form. The particles originate from the weathering and erosion of rocks, from the activity of living organisms, from volcanic eruptions, chemical process and even from space (Garrison, 2005). The basic unit from which all of the important sedimentary particles are made is silica tetrahedron (Dyer, 1990). Sediment can be classified by grain



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