



**UNIVERSITI PUTRA MALAYSIA**

**SEDIMENT ACCRETION AND VARIABILITY  
OF SEDIMENTOLOGICAL CHARACTERISTICS  
OF A TROPICAL ESTUARINE MANGROVE:  
KEMAMAN, TERENGGANU**

**SHAHBUDIN SAAD**

**ITMA 1996 1**

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**MASTER OF SCIENCE  
UNIVERSITI PERTANIAN MALAYSIA**

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**By**

**SHAHBUDIN SAAD**

**Thesis Submitted in Fulfillment of the Requirements  
for the Degree of Master of Science in the  
Faculty of Applied Science and Technology  
Universiti Pertanian Malaysia**

**December 1996**



## **DEDICATION**

This work is dedicated to my parents  
and my beloved wife, Junaida Taharim

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## LIST OF ABBREVIATIONS

AAR	Average Accretion Rate
AVG	Average
C	Coarse
F	Fine
HT	High Tide
IM	Intermonsoon
Lat	Latitude
Long	Longitude
LT	Low tide
M	Monsoon
MAX	Maximum
MHW	Mean high water
MIN	Minimum
MLW	Mean low water
MT	Mid tide
NM	Non-monsoon
PSA	Particle Size Analyser
SD	Standard Deviation
TR	Transect
VC	Very coarse
VF	Very fine
Ø	phi



Abstract of thesis submitted to the Senate of Universiti Pertanian Malaysia in fulfilment of the requirements for the degree of Master of Science.

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ESTUARINE MANGROVE: KEMAMAN, TERENGGANU**

**By**

**SHAHBUDIN BIN SAAD**

**DECEMBER 1996**

**Chairman : Dr. Hj. Mohd. Lokman Husain**

**Faculty : Faculty of Fisheries and Marine Science**

The study on the sediment accretion and variability of sedimentological characteristics were conducted on an estuarine mangrove in the Kemaman district with the aims of determining the average annual accretion rate, the monthly accretion rate variability, sediment distribution and its variability within the mangrove area. The study was conducted over a two year period starting from September 1993 to August 1995.

The average accretion rate for the first and second year of study were found to be 0.66 cm/yr and 1.46 cm/yr respectively, while the average for the entire study period was 1.06 cm/yr. Accretion rate was found to be higher at the front mangrove and gradually becoming smaller towards the back mangrove. This trend was found to be true for both the monsoon and the non-monsoon seasons. Nevertheless, the accretion rate on the entire mangrove area was higher during the monsoon months compared to the non-monsoon months.



Sedimentologically, the surface sediment of the Kemaman mangrove consists of sediment ranging from very fine sand to medium silt. The surface sediment tended to become finer, better sorted and more positively skewed towards the back mangrove. The average of mean size of surface sediment was found to be 4.17 phi (coarse silt). The average of standard deviation, skewness and kurtosis of the surface sediment were 1.99 phi (poorly sorted), 0.05 (symmetrical) and 2.33 phi (very leptokurtic), respectively. While the parameters of mean size and skewness do not differ between the monsoon and the non-monsoon seasons, the parameters of standard deviation and kurtosis tended to become better sorted and more peaked respectively during the monsoon season.

The higher accretion rates indicate that the Kemaman mangrove is still in the process of finding an equilibrium level with the major environmental forces affecting it. It is also interesting to note that the accretion rates during the monsoon season are significantly high compared to the non-monsoon season indicating the role of the monsoon in supplying sediments to the mangrove area.



Abstrak tesis yang dikemukakan kepada Senat Universiti Pertanian Malaysia sebagai memenuhi keperluan untuk Ijazah Master

**PENIMBUNAN SEDIMEN PERMUKAAN DAN  
KEPELBAGAIAN KRITERIA SEDIMEN DI HUTAN PAYA BAKAU  
MUARA TROPIKA: KEMAMAN, TERENGGANU.**

**OLEH**

**SHAHBUDIN BIN SAAD**

**DISEMBER 1996**

**Pengerusi : Dr. Hj. Mohd. Lokman Husain**

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Kajian terhadap penimbunan sedimen dan kepelbagaian kriteria sedimen telah dijalankan di hutan bakau jenis muara di daerah Kemaman, bertujuan untuk menentukan purata kadar penimbunan sedimen secara tahunan, kepelbagaian kadar penimbunan sedimen secara bulanan, taburan dan kepelbagaian sedimen di setiap bahagian hutan bakau. Kajian ini telah dijalankan selama dua tahun bermula dari bulan September, 1993 hingga ke bulan Ogos, 1995.

Purata kadar penimbunan bagi tahun pertama dan kedua ialah 0.66 cm/thn dan 1.46 cm/thn, manakala purata bagi kedua-dua tahun tersebut ialah 1.06 cm/thn. Kadar penimbunan sedimen didapati lebih tinggi di bahagian hadapan hutan bakau dan nilainya semakin menurun ke arah belakang hutan bakau. Corak perhubungan ini adalah sama bagi musim monsun dan bukan monsun. Walau bagaimanapun, kadar penimbunan sedimen bagi keseluruhan kawasan paya bakau adalah lebih tinggi semasa bulan monsun berbanding dengan bulan bukan monsun.



Dari aspek sedimentologi, sedimen permukaan di hutan bakau Kemaman terdiri daripada sedimen yang berjulat di antara pasir yang paling halus sehingga ke kelodak yang bersaiz sederhana. Sedimen permukaan adalah cenderung ke arah saiz yang lebih halus, penyisihan yang lebih baik dan kepencongan yang lebih positif ke arah belakang hutan bakau. Purata saiz sedimen ialah 4.17 phi (kelodak kasar). Purata penyisihan, kepencongan dan kurtosis ialah masing-masing 1.99 phi (penyisihan tidak sempurna), 0.05 (simetri) dan 2.33 phi (sangat leptokurtik). Parameter seperti saiz sedimen dan kepencongan tidak menunjukkan perbezaan di antara musim monsun dan bukan monsun, sebaliknya parameter seperti penyisihan dan kurtosis adalah cenderung ke arah penyisihan yang lebih baik dan keluk yang lebih tajam semasa musim monsun.

Purata kadar penimbunan yang tinggi menunjukkan bahawa hutan bakau di Kemaman masih di peringkat yang belum matang dan masih berada di dalam proses untuk mencapai tahap keseimbangan dengan daya-daya persekitaran utama yang bertindak terhadapnya. Kadar penimbunan sedimen semasa musim monsun yang lebih tinggi berbanding dengan musim bukan monsun menunjukkan bahawa musim monsun adalah berperanan dalam membekalkan sedimen kepada hutan bakau.

## CHAPTER I

### INTRODUCTION

Mangroves are areas situated between the ocean and land and are submerged by tidal waters at least once a day. They are one of the most important ecosystems in the world with roles ranging from biological to physical. This mangrove ecosystem dominates tropical and subtropical shorelines throughout the world within the geographical zone between 25° N and 25° S latitude lines (Kuenzler, 1974). They are known to act as nursery and feeding grounds for many commercial fish and prawns (Beazley, 1993). Intertidally located, they store large amounts of fine sediments and have lush vegetations. They provide significant quantities of nutrients and organic detritus, which form the base of a complex food web supporting estuarine, coastal and certain offshore fisheries to the nearshore areas (Odum and Heald, 1975). Physically, by virtue of them being in the intertidal areas, they absorb energy from waves and strong currents, thus aiding in reducing coastal erosion and other damages associated with flooding and storm surges (Carter, 1959; Macnae, 1968; Savage, 1972; Carlton, 1974; Odum et al., 1982; Soegiarto, 1990; Beazley, 1993).

Although there seems to be a lot of information concerning the importance of mangroves, most mangroves, however, still received very little attention. Large areas of mangroves are still being destroyed and degraded at an alarming rate (Linden and Jernelov, 1980; Mercer and Hamilton, 1984). Gong and Ong (1990) reported that for 30 years since 1990, Malaysian mangroves have been destroyed at a rate of 1% annually. Overexploitation of mangrove resources for land



clearance, coastal aquaculture, agriculture and land reclamation for urban development are among the most common causes for mangrove area destruction. Destruction of mangroves will inevitably lead to increasing coastal erosion and reduction in the production of some commercially important marine organisms.

Fortunately, most of the mangroves on the East coast of Peninsular Malaysia are still relatively intact. Nevertheless, if the misconception of mangroves as useless and mosquito breeding areas are still prevalent among the public and officials, the rate of degradation of mangrove areas at 1 % annually may not only continue but rise as the pressure for land increases as Malaysia progresses in her economy and increases her population.

Mangrove ecosystem are an open system allowing exchange of energy and matter with adjacent marine and terrestrial ecosystem (Amarasinghe and Balasubramaniam, 1992). As mangroves are situated in intertidal areas, the exchange is done via tidal waters. Some physical factors such as tide, current, wind and rainfall can play an important role in influencing the exchange and deposition of sediment via tidal waters (Mohd.-Lokman *et al.*, 1994). The influence of these factors determine the process of sedimentation inside mangrove. The stability of these processes will affect the composition and tidal landform (Dieckmann *et al.*, 1987). However the importance of these processes inside mangroves are not well established (Gehrell and Leatherman, 1989).

Presently sea level rise is a phenomenon of great importance that can affect the stability of land and coastal resources including mangroves. Several studies showed that the rise in sea level will affect estuaries and intertidal areas (Jones, 1994; Dieckmann *et al.*, 1987 and Ellison, 1991). Estuaries will become wider and deeper as the sea level rises (Bird, 1973). The alteration of tidal level may extend the

tidal penetration further upstream and will ultimately alter the tidal range. This phenomenon have repercussions on sedimentation patterns where sediment dominated by river will be deposited further inland, thus depriving the coast of part of its long shore drift material.

In Malaysia, information about the physical aspects such as size, distribution of sediment and sedimentation are scarce. Little effort was spent on the study of sediment accretion and sediment characteristics variability in mangroves. Most of the earlier works concern the biological and ecological aspects of the mangroves particularly those in the West Coast. Some of these studies are those by Chai, 1982; Rahman, 1989; Othman, 1989; Shamsudin, 1989; Bujang, 1989; Gong and Ong, 1990.

Realising the paucity of information concerning mangrove sedimentation and having considered the potential of the mangrove in various aspects of the environment, research on sediment accretion and sediment characteristics must be considered vital. These aspects of sedimentology are directly related with the ability of mangrove to maintain their position in an equilibrium stage in the coastal landscape. Thus this study attempts to gather physical data, especially accretion data on mangroves and the variability of the deposited sediments by collecting monthly data on accretion and analysing the type of deposited sediment on a monthly basis.

The objectives of this study are :

- a) To determine the average annual accretion rate on an estuarine mangrove.
- b) To determine the monthly variability of accretion at various parts of the mangrove.



- c) To determine the monthly variability in the sedimentological characteristic of surface deposits.