



UNIVERSITI PUTRA MALAYSIA

***BIODIVERSITY AND RELATIONSHIP BETWEEN BIOMASS OF
EPIPHYTIC MACROALGAE AND HABITAT IN SIBUTI
MANGROVE, SARAWAK, MALAYSIA***

HASMIDAH BINTI MD ISA

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By

HASMIDAH BINTI MD ISA

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

October 2016

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

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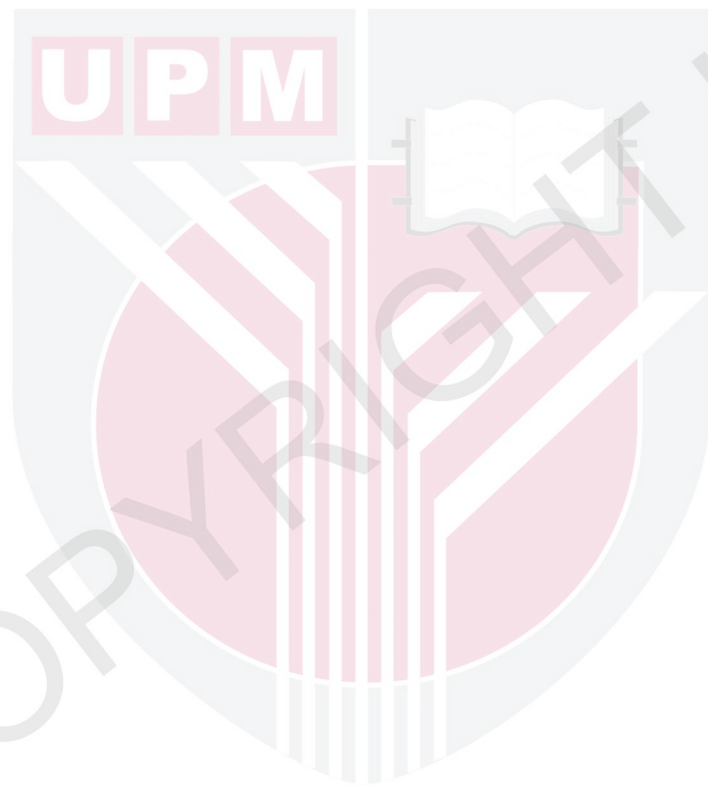
October 2016

Chairman : Abu Hena Mustafa Kamal, PhD
Faculty : Agriculture and Food Sciences (Bintulu)

Mangrove macroalgal species is considered to be an important marine and brackish water plant that supports diversely in coastal and estuarine ecosystems. They provide nutrients to the primary consumers in the aquatic food web, and reported to be a substantial contributor in the coastal and marine ecosystems. This study was aimed to investigate the epiphytic macroalgal species, and their biomass and habitat characteristics in Sibuti mangrove forest, Sarawak, Malaysia. A total of eight species of mangrove macroalgae were recored and identified from this estuarine forest ecosystems. The abundance of macroalgal species was higher in the mouth of the river (Station 1) compared to the middle (Station 2) and upper estuary (Station 3). Three groups of mangrove macroalgae were identified, in which 5 species were from Rhodophyta (*Caloglossa ogasawaraensis*, *Caloglossa adhaerens*, *Caloglossa stipitata*, *Bostrychia anomala* and *Hypnea* sp.), 2 species were from Chllorophyta (*Chaetomorpha minima* and *Chaetomorpha* sp.) and 1 species was from Phaeophyta (*Dictyota* sp.). The *Bostrychia anomala* and *Caloglossa adhaerens* species were the first distributional record of mangrove macroalgae in Malaysian coastal waters.

Macroalgal diversity and biomass were influenced by habitats namely nutrient concentrations of water, tidal level, turbidity, salinity and soil characteristics in this mangrove forest. Macroalgal biomass was higher in Station 1 (246.64 mg/cm²) followed by Station 3 (240.18 mg/cm²) and Station 2 (144.29 mg/cm²). Macroalgae *Hypnea* sp. was hardy and it can survive and withstand in fluctuated environment in the estuarine habitats and found be grown in all stations during the study period. The finding of this study suggests for further investigation of macroalgal diversity in other mangrove forests in Sarawak to identify the suitable species for biodiversity conservation, culture development, biomonitoring and bioindicator purposes. It is also aspected that macroalgae as an ecosystem indicator species, the finding of the study

would help to detect and manage the healthy mangrove ecosystems in Malaysian waters.



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Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
Sebagai memenuhi keperluan untuk ijazah Master Sains

**BIODIVERSITI DAN HUBUNGAN DIANTARA EPIFIK
MAKROALGA BIOMAS DENGAN HABITAT BAKAU DI SIBUTI
SARAWAK, MALAYSIA**

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Spesis makroalga bakau adalah dianggap menjadi komponen penting pada tumbuhan air marin dan payau dalam menyokong kepelbagaian ekosistem pantai dan muara. Mereka menyediakan nutrien kepada pengguna utama dalam jaringan makanan akuatik, dan ia dilaporkan untuk menjadi penyumbang terbesar dalam ekosistem marin. Kajian ini bertujuan untuk menyiasat spesis macroalgae epifit, biomas dan ciri-ciri habitat di muara hutan bakau Sibuti, Sarawak, Malaysia. Sebanyak lapan spesis makroalga bakau telah direkod dan dikenalpasti daripada ekosistem hutan ini. Kelimpahan spesis makroalga adalah tinggi di muara sungai (Stesen 1) berbanding dipertengahan (Stesen 2) dan muara atas (Stesen 3). Tiga kumpulan makroalga bakau telah dikenal pasti di mana 5 spesis terdiri daripada Rhodophyta (*Caloglossa ogasawaraensis*, *adhaerens Caloglossa*, *Caloglossa stipitata*, *Bostrychia anomala* dan *Hypnea* sp.), 2 spesis dari Chllorophyta (*Chaetomorpha minima* dan *Chaetomorpha* sp.) dan 1 spesis daripada Phaeophyta (*Dictyota* sp.). *Bostrychia anomala* dan *Caloglossa adhaerens* adalah spesis baru makroalga bakau yang telah direkod di persisir pantai Malaysia.

Kepelbagaian makroalga dan biomass adalah berkaitan dengan habitat seperti kepekatan nutrient air, ketinggian pasang surut, kekeruhan, kemasinan dan ciri-ciri tanah di dalam hutan bakau ini. Biomas makroalga bakau adalah lebih tinggi di Stesen 1 (246,64 mg / cm²) diikuti dengan Stesen 3 (240,18 mg / cm²) dan Stesen 2 (144,29 mg / cm²). *Hypnea* sp. adalah makroalga yang tahan lasak kerana ia boleh hidup dan tahan dengan perubahan keadaan yang berlaku di persekitaran habitat muara dan dijumpai tumbuh di ketiga-tiga stesen sepanjang tempoh kajian. Dapatan kajian ini mencadangkan, siasatan lanjut kepelbagaian macroalgal di hutan bakau lain di Sarawak adalah perlu untuk mengenal pasti spesis yang sesuai untuk tujuan pemuliharaan biodiversiti, pembangunan penternakan, pemantauan biologi dan petunjuk biologi. Ia juga dijangkakan, yang makroalga sebagai spesis penunjuk

ekosistem. Dapatan kajian ini akan membantu untuk mengesan dan menguruskan ekosistem bakau yang sihat di perairan Malaysia.



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

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LIST OF ABBREVIATIONS

RDA	Redundancy Analysis
MFS	Miliphore Filtering System
NED	Naphthylethylenediamine
PW	Pore Water
RW	River Water



CHAPTER 1

INTRODUCTION

Mangroves play important role in aquatic and terrestrial ecosystems in the tropical and sub-tropical regions worldwide (Kathiresan and Bingham, 2001). These vegetations are commonly understood to be made up of a collection of woody plant species associated with fauna and flora (Snedaker and Snedaker, 1984). They are believed to be offered habitats for numerous benthic floral and faunal communities living nearby and other associated environment (Farooq and Siddiqui, 2011). These benthic communities in the mangrove ecosystems offer themselves as food for coastal and estuarine animals.

The benthic communities exist in the mangrove ecosystems, macroalgal assemblages grow epiphytically on pneumatophores, prop roots and stems (Zuccarello *et al.*, 2001). They are unique to certain mangrove habitats, and an understanding of their occurrence and abundance may indicate the health of mangroves (Tanaka and Chihara, 1987). The algal mats associated within mangrove ecosystems represent a major source of primary producers (Karsten *et al.*, 1994), energy source (Kuenzler, 1974), carbon sink and storage (Rodriguez and Stoner, 1990), habitat for small estuarine invertebrates (Melville *et al.*, 2005), sediment trappers and builders (Hoffman, 1999) and nitrogen fixers (Hoffman, 1999).

This mangrove macroalgae are unique plant and its can be found growing epiphytically on the pneumatophores, prop roots, stems, sediment and other substrates (Zuccarello *et al.*, 2001). The understanding of the natural variation in species abundance and distribution are important to know the ecology that contributes for the macroalgae growth. Macroalgae in mangroves are exposed by the estuarine environment such as temperature, salinity, light, nutrients and tide cycles (Sena and Menghini, 2012). The distribution of macroalgae associated with mangrove forest documented the tolerances and adaptations of the species that are related with the abiotic parameters (Oliveira, 1984).

Generally, macroalgae associated with the mangrove are very important for the food web as a primary producer in the estuarine ecosystem. The nutrient produced can be contributed in the production of organic matter and cycling in the same system (Davey and Woelkerling, 1985; Mc Cluskey and Elliot, 2004). Fauna of mangrove habitat such as grazing marine animals and small estuarine invertebrates were depend on the macroalgae as a food source for them to survive (Melville *et al.*, 2005; Aikanathan and Sasekumar, 1994). Macroalgae also contribute as an additional important source of carbon in the mangrove ecosystem especially in the estuarine food chain (Rodriguez and Stoner, 1990).

Variety of mangrove fauna and flora studies have appeared since 1950, but this small plant was received less attention elsewhere (Lugo and Snedaker, 1974). Macroalgae from mangroves are the microscopic plants that can be identified based on the colour and body structure. The taxonomic characteristics are divided into three divisions namely Chlorophyta, Phaeophyta and Rhodophyta (Ismail, 1995). In recent years, these macroalgae have been used for constituents and antibiotic activities (Oliveira, 1984), bioindicators of contamination (Melville and Pulkownik, 2006) and biomonitors of metal contamination (Melville and Pulkownik, 2007) in estuarine areas.

The study conducted on mangrove forest mostly reported on accumulation, productivity, macroalgae and biomass in the peninsular Malaysia (Aikanathan and Sasekumar, 1994). However, only a few studies have yet been conducted in the Sarawak mangroves on the associated macroalgae (Silva *et al.*, 1996). Previously, researches on mangrove macroalgae have been done by Aikanathan and Sasekumar (1994) in Peninsular Malaysia and ten species of mangrove macroalgae were reported namely, *Catenella nipae*, *Caloglossa leuprii*, *Caloglossa adnata*, *Bostrychia radicans*, *Enteromorpha* sp., *Gladophora*, *Gracilaria blodgettii*, *Colpomia* sp., *Rhizoclonium* sp. and *Dictyota dichotoma*.

The systemic study on benthic community structure especially on epiphytic macroalgae in mangrove habitats toward the development of sustainable marine ranching, purification of aquaculture waste water, food source, pollution status and biotechnological prospect especially in Sarawak, Malaysia is scarce. It is expected that the benthic epiphytic macroalgal communities in the mangrove ecosystems in Sarawak may have wide number of varieties those probably have economical and ecological significance. The lack of the studies on mangrove macroalgal can make the incomplete understanding of the mangrove functions and ecological diversity in Sarawak, Malaysia. Therefore, keeping this view in mind, this study was undertaken to assess the baseline information on existing benthic macroalgal community structure from mangrove ecosystems in the Sibuti, Sarawak, Malaysia. It is believed that the findings of this study would help to explore the macroalgal diversity and information in Sarawak mangroves, Malaysia. Besides, this study would also help to understand the habitat characteristics and ecological contribution on the growth performance of mangrove macroalgae in Sarawak coastal waters.

1.1 Objectives of the Study

The objectives of the study were:

1. To assess and identify the species composition of macroalgae in Sibuti mangrove forest, Sarawak.
2. To estimate the biomass and habitat characteristics of epiphytic macroalgae from Sibuti mangrove forest.

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