THE DIVERSITY, DISTRIBUTION AND DENSITY OF SEAGRASS AND ALGAE IN BANGGI ISLAND, SABAH

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ABSTRACT

Balak Balak and Wak Wak in Banggi were diverse with 10 species of seagrass and 41 species of algae belonging to the Chlorophyta, Phaeophyta, and Rhodophyta with one unidentified species from Chlorophyta. The total mean percentage cover of seagrass and algae in Balak Balak seagrass, 87.38% (±97.47 SD) algae, 13.95% (±33.61 SD) and in Wak Wak seagrass covered 70.48% (±60.22 SD) and algae 5.48% (±13.08 SD). The mean total value of wet and dry of above and below biomass in these sites is 867.716±602.004g/20 m^2 and 170.888±100.618 g/20 m^2. The diversity, distribution and biomass of seagrasses and macroalgae were compared by sites.

DIVERSITI, TABURAN DAN BIOMAS RUMPUT LAUT DAN ALGA DI PULAU BANGGI, SABAH

ABSTRAK

Balak Balak dan Wak Wak di Banggi mempunyai kepelbagaian vegetasi dengan 10 spesies rumput laut dan 41 spesies alga yang dipunyai oleh Chlorophyta, Phaeophyta, dan Rhodophyta dengan satu spesies yang tidak dapat diidentifikasi daripada Chlorophyta. Purata jumlah peratus kawasan ditutupi rumput laut dan alga di Balak Balak, rumput laut adalah 87.38% ±(97.47 SD) dan alga 13.95% (±33.61 SD) dan di Wak Wak peratus rumput laut ialahand 70.48% (±60.22 SD) dan alga 5.48% (±13.08 SD). Purata jumlah nilai biomas basah dan kering di bawah dan atas permukaan lantai laut ialah 867.716±602.004g/20 m^2 dan 170.888±100.618 g/20 m^2. Kepelbagaian, taburan dan biomass rumput laut dan alga dibandingkan di antara lokasi kajian.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

GPS	Global Positioning System
ICZM	Integrated Coastal Zone Management
ID	Identity
SPSS	Social science – Statistical methods – Computer programs
H'	Estimate diversity
H'_{max}	Maximum possible diversity
k	Number of categories
fi	Number of observation in sample i
$\sum$	Sum
J'	Evenness
n	Population size of sample
m	Meter
m^2	Meter square
%	Percentage
SS	sum of square
DF	degree of freedom
pi	the proportion of the observations found in category i
T1	Transect line 1
T2	Transect line 2
T3	Transect line 3
BB	Balak Balak
WW	Wak Wak

CHAPTER 1

INTRODUCTION

1.1 STUDY BACKGROUND

Seagrass and algae played very important roles in structuring the marine community as they are the dominant primary producers and their population dynamics greatly affect those of all other organisms (Kong & Ang, 2004). Over the years, many mangroves, seagrasses and particularly the seaweeds, have become important coastal resources for industry, food and medicine (Calumpong and Menez, 1997). Detailed studies of communities' structure of tropical seagrass and algae are essential to understand their contribution in coastal productivity.

However, there is still very little knowledge about seagrass because of less study has been done especially in Southeast Asia region. In the East Asian Seas region, it was only in the last decade that seagrass beds were recognized as a separate and important coastal ecosystem along with coral reefs and mangroves. Among the ten member countries in the East Asian Seas region, only Australia, Indonesia, and the Philipines have fairly good knowledge of their seagrass habitats and resources (Fortes, 1997).

1.2 STUDY SITE

Banggi is an island at the North of Borneo separated 26 km from the mainland of Sabah. This island is situated between of the mainland of Sabah in the south and Philipines at the North. Apart of this main island there is more than 50 other small islands around it. Banggi archipelago is surrounded by the South China Sea at the west part, Sulu Sea at the east part and Balabak Strait at North part which separates Banggi archipelago with Philippines.

Two sites with the presence of seagrass and algae were chosen to compare the diversity, density and biomass in the two sites. Balak Balak and Wak Wak are different islands around the main island of Banggi. These sites differ from each other in term of their sediments and plants, Balak Balak's site was dominated with mangrove on the shore, muddy and sloped to the sea and coral reef and Wak Wak is such a sandy, with coral rubble, flat area and bit far from the mangroves forest site.

In order to determine the importance of seagrass and algae ecosystems, and to detect changes that occur through perturbation both man-made and natural, the distribution, density and biomass of these existing seagrass and algae meadows need to be mapped and estimated.

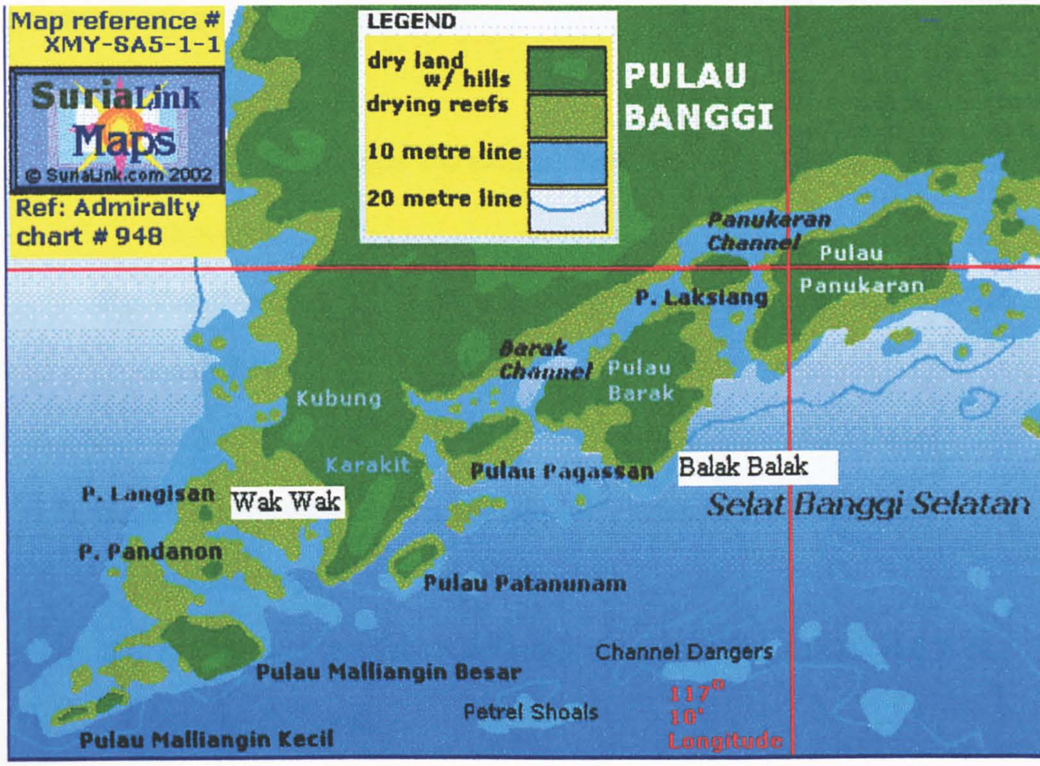

Figure1.1: Banggi Island map (from Surialink.com 2002)

1.3 OBJECTIVES

1) To identify the species of seagrass and algae in Balak Balak and Wak Wak.

2) To estimate the density of seagrass and algae in Balak Balak and Wak Wak

3) To estimate the biomass of seagrass and algae in Balak Balak and Wak Wak

4) To compare estimation of density and biomass of seagrass and algae in Balak Balak and Wak Wak.

1.4 HYPOTHESES

1) **H_0**: The diversity of algae and seagrass between Balak Balak and Wak Wak are similar.

   H_A: The diversity of algae and seagrass between Balak Balak and WakWak are different

2) **H_0**: The distribution of algae and seagrass between Balak Balak and Wak Wak are similar

   H_A: The distribution of algae and seagrass between Balak Balak and Wak Wak are different

3) **H_0**: The density of algae and seagrass between Balak Balak and Wak Wak are similar

   H_A: The density of algae and seagrass between Balak balak and Wak Wak are different

CHAPTER 2

LITERATURE REVIEW

2.1 DIVERSITY OF ALGAE AND SEAGRASSES IN THE INDO-PACIFIC REGION

2.1.1 Seagrass

In the East Asian Seas region, it was only in the last decade that seagrass beds were recognized as a separate and important coastal ecosystem along with coral reefs and mangroves. Among the ten member countries in the East Asian Seas region, only Australia, Indonesia, and the Philipines have fairly good knowledge of their seagrass habitats and resources (Fortes, 1989)

The Banggi seagrass flora is closely related to the Philippines coastal flora because Banggi is quite close to the Philippines archipelago. The species of seagrasses found in Banggi are quite similar with the Philippines seagrass flora. There are two major types of seagrass meadows in the Philippines which are dependant on specific substrates. Those that thrive primarily on-sand dominated substrates are of the *Syringodium-Cymodocea-Halodule* association, while those that grow primarily on muddy substrate are of the *Enhalus Thallasia* assiociation (Calumpong and Menez, 1997).

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In Philippines, there are 12 species of seagrass that have been identified, belonging to the family Potamogetonaceae and Hydrocharitaceae and it is quite similar to the diversity of seagrass in Banggi, Sabah. This list (Table2.1) is the seagrasses that found in Philippines by Calumpong and Menez, (1997).

Table 2.1 Seagrasses found in Philippines (Calumpong and Menez, 1997)

Family: Potamogetonaceae	Family: Hydrochritaceae
Syringodium isoetifolium	*Halophila ovalis*
Halodule pinifolia	*Halophila spinulosa*
Halodule uninervis	*Halophila decipiens*
Thalassodendron ciliatum	*Halophila minor*
Cymodocea rotundata	*Enhalus acoroides*
Cymodocea serrulata	*Thallasia hemprichii*

2.1.2 The abundance, diversity, distribution and density factors of seagrasses

According to (Lanyon and Marsh, 1994), seagrass communities in tropics are often complex mixed species assemblages, the interactive effects of changes in individual species abundance were monitored to relate seasonal differences in seagrass abundance to community composition, and to the pattern and process of succession. There are two major impediments to comparable studies in tropics. First, it has been suggested that it is much difficult to separate abiotic from biotic effects in tropical seagrass communities, as there are much more diverse than corresponding temperate communities (Poiner *et al.*, 1989). Secondly, seasonal changes tend to be much more unpredictable in the tropics, particularly the wet dry tropics than in temperate latitudes. However a little changes are detectable even the trend is slight and wet season maxima in tropic seagrass (Brouns, 1982). Prey availability may also be an important factor influencing faunal abundance in tropical seagrass beds (Seok and Klumpp, 2003).

Fonseca and Kenworthy (1987), reported that seagrass diversity may be enhanced by mechanical disturbances associated with water movements. For all seagrass species examined there was always a greater biomass of below-ground than above ground parts (Lanyon and Marsh, 1994). Besides that, they also found that the percentage cover of total seagrass at their study site Cockle Bay was positively correlated with day length, rainfall and temperature and negatively correlated with exposure.

The distribution and abundance of seagrasses are controlled by a range of environmental conditions including light availability (Dennison and Alberte, 1985; Dennison, 1987), nutrient availability (Short, 1987), water motion (Fonseca and Kenworthy, 1987) and grazing (Lanyon *et al*., 1989). Generally high productivity of seagrass, is logically paralleled by high nutrient demand. In seagrass ecosystems, a number of plant-external processes such as hydrodynamic particle transport, nitrogen fixation and denitrification, are directly relevant to the availability of nutrients plants productivity (Hemminga *et al*., 1991). Agawin *et al*., (1996), studied about nutrient limitation of various species of seagrasses in tropical and they found that the growth and biomass of *Enhalus acoroides* and *Thalassia hemprichii* increased significantly in response to nutrient addition and biomass resources allocation was shifted towards the production of blade biomass, resulting in decline of the proportion of the biomass allocated to below-ground parts.

Many plants, including all seagrass species are capable of both sexual and asexual reproduction (Phillips *et al*., 1983), because of that, the growth will not easily stop or vanish even if there's natural disaster such as strong wave because of wind. Theories that take into account the ability of clonal plants to reproduce both sexually and asexually are likely to offer better explanation of seagrass population dynamics (Eriksson, 1989; Eriksson and Froborg, 1974). Some seagrass species produce seeds that are capable of remaining dormant and viable in the sediment for extended period of time producing a "seed bank" from which recovery can occur (McMillan, 1983). Habitats suitable for many tropical seagrass species are restricted to shallows bay and estuaries that are often geographically isolated (Lee Long *et al.*, 1983).

2.1.3 Algae

The algae are belonging to a group (kingdom) of organism called protista. The algae are the major primary producers of oceans and other aquatic ecosystems forming the base of food chains in these systems. There are seven major division of algae differentiated primarily by their dominant pigmentation. The three main and important algae is the marine red (Rhodophyta), green (Cholorophyta) and brown (Phaeophyta) algae. (Calumpong and Menez, 1997)

a. Green algae

Chlorophyta is similar to land plants. Both have pigments chlorophyll a and b, starch as storage product, and cellulose cell wall. They are easily differentiated by their yellow-green to light to dark green coloration. They are unicellular, colonial, coenocytic (a cell with many nuclei) or siphomous (one or more cell with many nuclei), filamentous, sheet like, tubular and parenchymatous. Some species are calcified (with calcium carbonate) like the *Halimeda* species with a major contributor in reef building and production of beach sediments (Calumpong and Menez, 1997)

b. Brown algae

The brown algae (Phaeophyta), unlike the green and red algae, are strictly marine. The simplest forms of brown algae are erect, branched or unbranched filaments arising from a prostrate, filamentous basal system (heterotrichous organization). Thalli of some phaeophytes are similar to land plants (parenchymatous). This is derived from the ability of cells to divide in various planes forming a true tissue which may be filamentous or sharp-shaped in form. Some species have developed specialized structures for flotation. There are no unicellular or colonial brown algae (Calumpong and Menez, 1997)

c. Red algae

In comparison of the green algae and brown algae, the red algae are most diverse in tropics. Red algae owe their color to water-soluble pigments called phycobillins. They are usually red, especially those that occur in deeper waters, but sometimes they may appear light to dark green or even dark brown to black when found in the shallow intertidal. But always, when held up against the light, tints of red or pink color become apparent (Calumpong and Menez, 1997). Below are some of the algae species found in Kudat area, the nearest land from Banggi.

Table 2.2 : The species of algae found in Kudat (Greenforce unpub data)

Algae class	Species
Phaeophyta	*Codium arabicum*
	Dictyota dichotoma
	Hydroclathrus clathratus
	Tubinaria luzonesis
	Padina gymnospora
	Sargassum binderi
	Sargassum cristaefolium
	Sargassum cinctum
	Sargassum oligocystum
	Sargassum paniculatum
	Tubinaria decurrens
Chlorophyta	
	Cholorodesmis sp.
	Boergesenia forbessi
	Boodlea composite
	Bornatella oligospora
	Bornatella sphaerica
	Caulerpa cupressoides
	Caulerpa lentilifera
	Caulerpa peltata
	Caulerpa rasemosa
	Caulerpa serrulata
	Culerpa taxifolia
	Cladophora dalmatica
	Codium bartlettii
	Codium geppii
	Enteromorpha intestinalis
	Halimeda macroloba
	Halimeda opuntia
	Halimeda valasquezii
	Neomeris sp.
	Tydemania expeditionis
	Udotea geppii
	Ulva sp.
	Valonia ventricosa
Rhodophyta	
	Actinotrichia fragilis
	Asparagopsis taxiformis
	Gracillaria arcuata
	Gracillaria salicornia
	Halimena durvillaei
	Kappaphycus alvarezii
	Laurencia papilosa
	Scinaia hormoides

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