Faculty of Resource Science and Technology

Community Structure of Macrobenthos at Buntal Beach and Tanjung Datu, Sarawak

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Bachelor of Science with Honours
(Aquatic Resource Science and Management)
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Community Structure of Macrobenthos at Buntal Beach and Tanjung Datu, Sarawak

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A thesis submitted

In fulfilment of the requirements for degree of Bachelor of Science with Honours

(Aquatic Science)

Faculty of Resource Science and Technology
UNIVERSITI MALAYSIA SARAWAK
2019

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I hereby declare that the thesis is based on my original work except for citations which have been duly acknowledged. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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ABSTRACT

Macrobenthos communities of Buntal Beach and Tanjung Datu, Sarawak were described based on the sampling conducted on November and August 2018. The approaches were taken to determine the community structure among macrobenthos and the relationship between water parameters. Three replicates of samples were taken at each station from five stations in Buntal Beach while two replicates of samples from four stations were taken in Tanjung Datu. The distribution of macrobenthos were related to environmental parameters which using Pearson's correlation. The dominant group in Buntal Beach was polychaeta based on total species composition which indicated as 69% from total species followed by molluscs with 27% while in Tanjung Datu was polychaeta (84%) followed by molluscs (10%). From the analysis, it showed that temperature and salinity have been the important factors that influenced macrobenthos community of both studies areas.

Keywords: macrobenthos, Buntal Beach, Tanjung Datu, community structure

ABSTRAK

Kajian komuniti makrobentos di Pantai Buntal dan Tanjung Datu, Sarawak telah dikaji berdasarkan kepada persampelan yang dilakukan pada November dan Ogos 2018. Pendekatan telah diambil untuk menentukan corak komuniti makrobentos dan hubungankait dengan parameter air. Tiga replikasi sampel telah diambil pada setiap stesen daripada lima stesen di Pantai Buntal manakala dua replikasi sample daripada empat stesen telah diambil di Tanjung Datu. Taburan makrobentos telah dikaitkan dengan parameter air dengan menggunakan korelasi Pearson. Kumpalan dominan di Pantai Buntal adalah Poliket daripada jumlah komposisi spesis yang menunjukkan sebanyak 69% daripada semua spesis diikuti dengan Moluska sebanyak 27% manakala di Tanjung Datu adalah Poliket (84%) diikuti dengan Moluska (10%). Daripada analisis, ia menunjukkan bahawa suhu dan kemasinan sebagai faktor yang mempengaruhi komuniti makrobentos di kedua-dua tempat kajian.

Kata kunci: *makrobentos, Pantai Buntal, Tanjung Datu, struktur komuniti,*

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LIST OF ABBREVIATIONS

ANOVA	Analysis of variance
DO	Dissolved oxygen
TOM	Total organic matter
Chl *a*	Chlorophyll *a*
ST	Station
$Ind.m^{-2}$	Individual per 0.25 m^2
S	Number of species
d	Species richness index
H'	Species diversity index
J'	Species evenness index
km	Kilometre
µm	Micrometre
°C	Degree Celsius
PSU	Practical salinity unit
g	Gram
ml	Millilitre
LT	Low tide
HT	High tide

CHAPTER 1

INTRODUCTION

Macrobenthos is defined as marine invertebrate organisms that live in sediments or on sediments that retained on a 500 μm sieve (Henninger and Froneman, 2011). Macrobenthos can be separated into different phyla which are Polychaeta, Oligochaeta, Crustacea, Bivalvia, Gastropoda, Nemertinea, Echinodermata and others. The biomass of macrobenthos taxa such as polychaetes, molluscs, crustaceans and many others are reportedly high in marine environments (Snelgrove, 1998). Besides, there was a study conducted by Sanapi (2012) shown that polychaetes as the dominant one in Tanjung Bajong, Sebuyau, Sarawak. They play an important role in aquatic ecosystems as primary and secondary consumers. The distribution of macrobenthos communities can be affected by environmental conditions such as temperature, salinity, water current, oxygen content in water and sediment's organic content. The level of contaminants' tolerance can be seen from the macrobenthos as they can accumulate the contaminants and get the side effects over time.

Community structure is the result of the complex interaction between biotic and environmental variables in ecosystems. In addition, according to Moore (1983), it can be described by calculating and stating means of species composition and total number of species (species richness). From earlier pioneered studied of benthos, they investigated on natural history of the benthos and autecological relationship in order to get the community dynamics (Moore *et al,* 1970). Besides, these studies also revealed the relationship between macrobenthos with salinity, dissolved oxygen, temperature, pH and sediment characteristics.

The purpose of this research is to study community structure of macrobenthos at the Buntal, Sarawak as there were limited study that had been done throughout these years. Besides, it is important to add up new information about macrobenthos which give big contribution towards Malaysia's economy. For example, fishermen get their source of income in catching macrobenthos such as molluscs and bivalve. By doing this study, it will also show the importance of macrobenthos towards the ecosystem in future time because of their tolerance in pollutions. The objectives of this study are:

i. To determine the community structure of macrobenthos in intertidal area of Buntal Beach and Tanjung Datu, Sarawak.
ii. To study the relationship between the macrobenthos and water parameters at both sampling areas.

CHAPTER 2

LITERATURE REVIEW

2.1 Macrobenthos

Macrobenthos are organisms that live at the bottom of the water column, in or an aquatic substrate that retained on the mesh size of 0.55 mm. Examples of macrobenthos are from phylum Arthropoda, Mollusca, Annelida and Sipuncula. Macrobenthos are very important as they can be a potential tool in biological monitoring programmed for species richness which is the number of species present in a particular community. They also can determine the species diversity that functions as a measure of community complexity consists of species richness also species evenness and indicator ratio. Macrobenthos are being use as the biological monitoring techniques because of their characteristics that ubiquitous in all aquatic ecosystems, limited mobility, long lifespan and species richness with varying sensitivity to pollution (Azrina *et al.,* 2006). In addition, the distribution is depending on the environmental factors and internal factor which they have their own specialised to adapt in the area. The abundance of macrobenthos can be carried out by determining the species diversity, species richness and species distributions. Based on their diversity in particular stations, they compared to get the diversity indices. Besides, they give important role as the main source of diet for both migratory and permanent fauna including higher predators in the food chain (Ibrahim *et al.*, 2006).

The term "community" is used to explain macrobenthos in terms of related species distribution, grouping organisms that frequently occur together under similar environmental conditions and are a part of each other biological environment (Sanapi, 2012). Meanwhile, according to George *et al.* (2009), macrobenthos play an important role in marine ecosystem which includes mineralization, mixing of sediments and flux of oxygen into sediment, cycling of organic matter and assessing the quality of inland water. For instant, flux of oxygen into sediment happens when some species of macrobenthos transport oxygen through pumping behaviours. In most ecosystems, community structure emerges as a result of complex interactions between biotic and environmental variable. Environmental factors such as nutrients and food availability are also important in structuring the macrofaunal community (Shabdin *et al.*, 2014).

The analysis of aquatic macrobenthos is the most used method for the assessment of the environmental quality. Some taxa response very sensitive to pollutants, resulting as good indicators of water quality, while others are extremely resistant (Mancini *et al.*, 2003). In addition, benthic communities are widely used in monitoring the effect of marine pollution as the organism are mostly sessile and integrate the effects of pollutants over time (Gray *et al.*, 1990).

2.2 Macrobenthos in Malaysia

A typical tidal-flat profile in a landward direction consists of a lower intertidal sand flat, a middle intertidal mixed consist of sand and mud flats, and an upper intertidal mud flat can obtain in tide dominated shorelines. Mud flats include in the upper zone of tidal flats which depositional processes being dominated by the fallout of sediments consist of sortable silts, flocs and aggregates (Chang *et al.*, 2007; Flemming, 2012). According to Reineck and Singh (1980); Schafer (1972), polychaetes, gastropods and bivalves are being the common producers in modern mud flats.

In addition, mixed flats are characterized by alternating bedload sedimentation and fallout from suspension which occur across transition between sand flats (<5% mud content) and mud flats proper (>95% mud content). The intensity of bioturbation is typically moderate (Reineck and Singh, 1980). Lastly, sand flats occupy the lower zones of tidal flats and are dominated by bedload transport of sand-sized sediment. They are the most variable intertidal areas in terms of both sedimentary facies differentiation and trace-fossil content, this variability being essentially controlled by the intensity of tidal currents in combination with wave action (Mangano and Buatois, 2004; Reineck and Singh, 1980). In macrotidal settings characterized by high-current velocities, migration of large-scale bedforms (i.e., two-dimensional and three-dimensional dunes) is the dominant process (Boyd *et al.,* 2006; Dalrymple, 2010; Dalrymple and Rhodes, 1995).

Table 1: The list are previous studies that has been conducted in Malaysia.

No	Title	Author
1.	Community structure of the macrobenthos in Tanjung Bajong, Sebuyau, Sarawak	Sanapi, N. (2012)
2.	Macrobenthos composition, distribution and abundance within Sungai Pulai estuary, Johor, Malaysia	Shi *et al.*, (2014)
3.	Macrofauna community structure on seagrass meadows of Sampadi Island, Lundu, Sarawak	Shabdin *et al.*, (2014)
4.	Intertidal flat macrobenthos community and marine oligochaete species of Sarawak coastal waters	Taufek, Z. M. (2017)

2.3 Macrobenthos in Sarawak

There was a study conducted by Shabdin, *et al.*, (2012), which stated that their study area which is at Sampadi Island, Lundu was dominated by amphipods. This is because of the availability of dissolved oxygen, food and shelter for those macrobenthos. Besides, according to Taufek (2017), polychaete was the dominant one followed by crustaceans and molluscs in the community at intertidal flats of Buntal Beach due to its sediment characteristics and food availability.

2.4 Macrobenthos and environmental parameters

According to Reise (1985), macrobenthos' habitats in intertidal area represent as extremely harsh ecosystems in which some species are able to inhabit the entire tidal range and different animal communities live in different areas within the tidal area. In tide dominated shorelines, a typical tidal-flat profile in a landward direction consists of a lower intertidal sand flat, a middle intertidal mixed (sand and mud) flat, and an upper intertidal mud flat. Landward of the mud flat, supratidal salt marshes may be present (Figure 1). The variables like temperature, exposure, salinity, dissolved oxygen and desiccation are very important in regulation of the differences in community structure between tidal influence and varying elevation. Macrobenthos are not just affected by the physico-chemical parameters but also influenced by biotic factors within them. In addition, macrobenthos also are useful indicators of water quality because of their wide range of pollution tolerance amongst various species and can be found distributed at polluted places or environment. The interplay of salinity, temperature, substrate type, food supply and sediment mobility also hydrodynamic energy are mostly controlled the benthic faunas in intertidal settings.

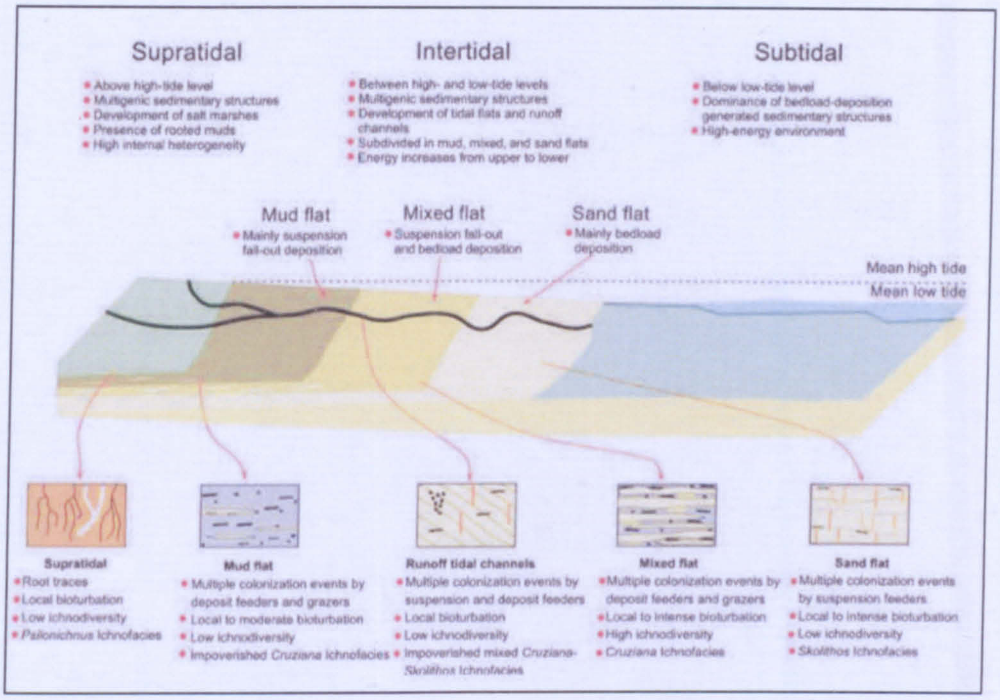

Figure 1: Integrated sedimentological and ichnological model for intertidal to supratidal environments (Desjardins, *et al.*, 2012).

Salinity can strongly affect the type of organism and the biogenic structures of tidal flats which may range from the open shoreline to the fluvio-estuarine transition (Mangano and Buatois, 2004). Periodical fluctuations in salinity are typically related to periodical emersions and submersions of the intertidal zone also combine with wind and solar radiations. In addition, the salinity also affected by the seasonal rainfall and drainage from the continent. In general, salinity tolerance controls the zonal distribution of intertidal animals, with euryhaline species being particularly abundant in the upper intertidal zone (Newell, 1979). Others than that, it can be a major influencing parameter for the distribution and abundance of marine organisms. Thus, the extrinsic factors can give impact towards the high variability of other water quality parameters which occur during their seasons. According to Newell (1979); Reise (1985), in the upper intertidal zone, there are commonly dramatic in salinity shifts, together with changes in exposure and temperature.

The temperature is a determinant factor in salinity gradient which increase in temperature can trigger in increasement of salinity profile as evaporation of sea water occurs. Temperature rapidly changes in tidal flats as a result of periodical subaerial exposure which is a limiting factor particularly (Mangano *et al.*, 2002). However, in the tropical regions, it may not suitable in upper intertidal area as it is extremely inhospitable for marine organisms due to very high temperature also long periods of exposure and abnormal salinities. Thus, the communities can be found with higher density in the lower intertidal area as the result (Terwindt,1988).

Besides, vertical and horizontal differences in the degree of substrate consolidation influence the diversity, abundance, and distribution of intertidal organisms (Newell, 1979; Reise, 1985). The pore-fluid content within the sediment can vary during a tidal cycle, the tidal-flat surface at low tide being characterized by the presence of tidal pools within a commonly emerged area, resulting in a range of substrate conditions along an isochronous surface.

CHAPTER 3

MATERIALS AND METHODS

3.1 Study area

The study areas were conducted at Buntal Beach and Tanjung Datu. The field sampling in Buntal Beach, was completed on November 2018 during low tide while in Tanjung Datu on August 2018. A transect line was plotted along from low to high tide which in distance of one kilometres (km) for the study areas.

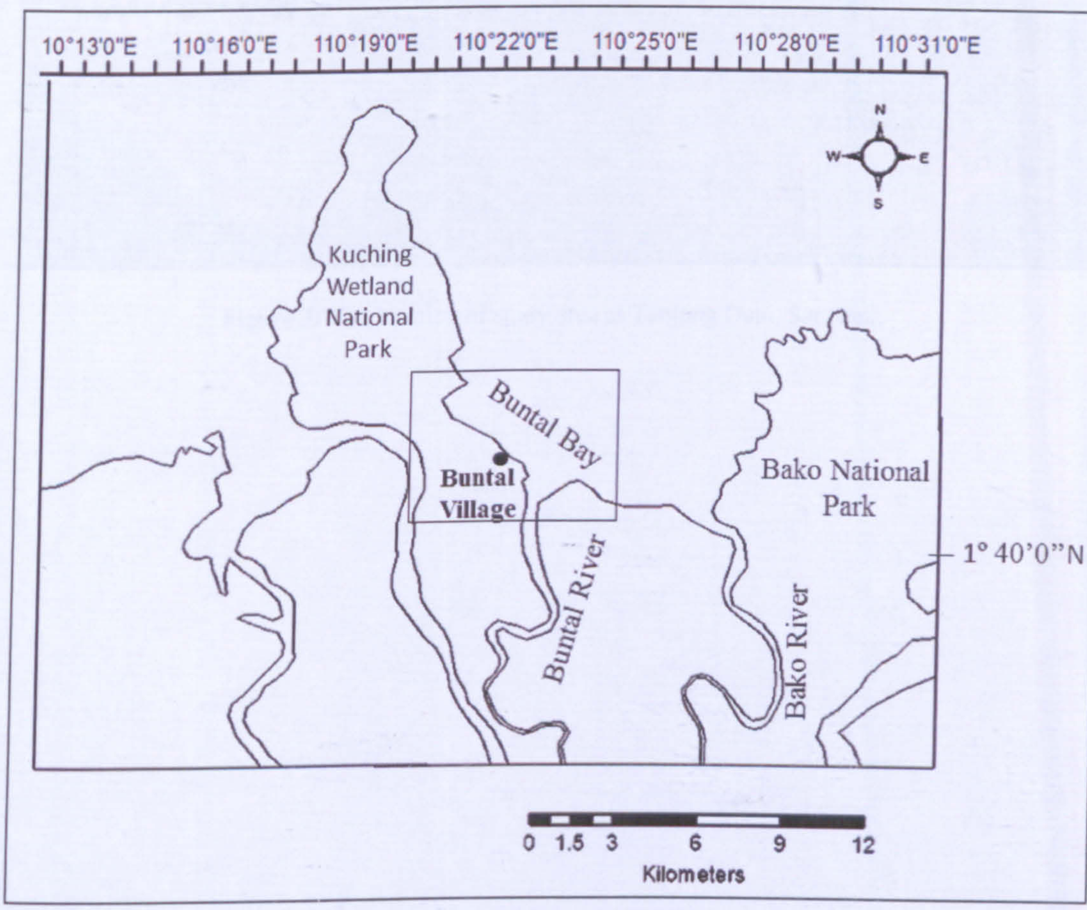

Figure 2: The location of study area at Buntal Beach, Sarawak.