

Macrozoobenthoc Diversity on The Mangrove Ecosystem in The Gosong Telaga Selatan Mangrove Ecotourism, Singkil Utara District, Aceh Singkil District

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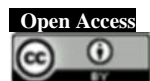
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Abstract

Macrozoobenthos is a group of organisms that live in or on the surface of bottom sediments and have a length of more than 1 mm. One of the macrozoobenthos habitats is the mangrove ecosystem in the Gosong Telaga Selatan Ecotourism Mangrove, North Singkil District, Aceh Singkil Regency. Knowledge that macrozoobenthos can provide food availability for other organisms and as an indication of the suitability of potential water quality, especially pollution indicators, and plays an important role in the decomposition process of organic material in sediment in the mangrove ecosystem, so that the macrozoobenthos community can be used as an indicator of the balance of the mangrove ecosystem. This research aims to identify the diversity, uniformity, and dominance of Macrozoobenthos in the Gosong Telaga Selatan Mangrove Ecotourism Area, North Singkil District, Aceh Singkil Regency. This research uses a combination of two transect methods, namely line transects and quadratic transects. Determining the research location used the purposive sampling technique. Data analysis uses qualitative and quantitative analysis. The research results show that there are 7 Macrozoobenthos species, consisting of 3 classes, with a total of 182 individuals. Macrozoobenthic diversity in the ecosystem area in the Gosong Telaga Selatan Mangrove Ecotourism, North Singkil District, Aceh Singkil Regency is classified as moderate with a diversity index of $H' = 1.35-1.75$, the uniformity index is classified as stable, ranging between $E = 0.76-0.93$, and the dominance index is classified as low.

Keywords: Macrozoobenthos, Mangrove Ecosystem, Diversity

1. Introduction

Coastal and marine areas in Indonesia play an important role, where this area has strategic value in the form of potential natural resources and environmental services called coastal resources. One of the coastal areas in Indonesia where the coastal area can be utilized as the location of the Gosong Telaga Selatan Mangrove Ecotourism Area is located in North Singkil District, Aceh Singkil Regency. Aceh Singkil Regency is located in the south of Aceh Province, located at coordinates $2^{\circ} 0' 20'' - 2^{\circ} 36' 40''$ LU and $97^{\circ} 04' 54'' - 98^{\circ} 11' 47''$ East. The Gosong Telaga Selatan Mangrove Ecosystem has an important role for the local community as a source of livelihood. Apart from being a source of livelihood, the Gosong Telaga area plays an important role as a habitat for living things that live on land and in water.

Mangrove ecosystems are ecosystems located in coastal areas that are influenced by tides so that they are always inundated with water. Mangrove ecosystems are located between the level of the highest rising tide to the level around or above mean sea level on protected coastal areas (Supriharyono, 2009). In the mangrove ecosystem there are many lives of various types of animals whose lives depend on mangroves. Many types of animals and microorganisms are associated with mangrove forests, both on the forest floor and attached to plants.

Mangrove ecosystems play an important role in the development of fisheries in coastal areas, because it is a breeding ground, spawning, and as a place of enlargement for several species of fish, shellfish, crabs, and shrimp (Kariada and Andin, 2014). For example, on sandy substrates, this

environment is dominated by animals such as mollusca, bivalves and so on.

The diversity of living things will not be separated from its role, one of which is the role of living things is as bioindicators of ecosystems. Bioindicator comes from two words, namely bio and indicator, bio means life and leads to living things, while indicator means clues that can show changes in the condition of living things themselves or their environment over time. Thus bioindicators are biotic components (living things) that are used as indicators (clues).

Soegianto (2010) states that, one of the bioindicators of water quality is benthos. Benthos are organisms that live on the surface of the water or in the bottom of the water. Originally benthos were only classified as phytobenthos and zoobenthos. Simamora (2009) says that benthos based on their size are divided into macrobenthos (> 0.1 mm in size), meiobenthos (0.1 m-0.1 mm), and microbenthos (< 0.1 mm). Macrozoobenthos are more widely used as bioindicators because macrozoobenthos diversity is able to present the water quality of a place more specifically. Macrozoobenthos will have different sensitivity to environmental changes in each species. Macrozoobenthos as aquatic bottom organisms have a relatively fixed habitat. Changing the quality of a body of water greatly affects the life of biota that live in the bottom of the water, one of which is macrozoobenthos (Yunitawati, 2012).

The life of macrozoobenthos is strongly influenced by species diversity and dominance, including the destruction of natural habitats, chemical pollution, and climate change. These conditions can cause death for macrozoobenthos and reduce macrozoobenthos diversity in the habitat. One of the habitats affected by the above factors is the mangrove ecosystem area (Sunarto, 2010).

Relevant research has been conducted by several researchers. The results of research conducted on mangrove ecosystems in Daruba Beach, Morotai Island Regency, identified 11 species of macrozoobenthos spread over three stations. Consisting of 7 species from the

Gastropoda class, 1 species from Bilvania and 3 species from the Crustacea class.

Based on the above background and considering the importance of information on the diversity of macrozoobenthos in mangrove ecosystem areas that have a role in aquatic bioindicators and the process of decomposition of organic matter in sediments in mangrove ecosystems so that the macrozoobenthos community can be used as an indicator of the balance of mangrove ecosystems, it is necessary to conduct a study so that researchers want to conduct research entitled "Macrozoobenthos Diversity in Mangrove Ecosystems in Mangrove Ecotourism Gosong Telaga Selatan, North Singkil District, Aceh Singkil Regency".

Based on the background of the formulation of the problem in this study is to determine the Diversity Index, uniformity index, and dominance index in mangrove ecotourism Gosong Telaga District North Singkil Aceh Singkil. The purpose of this study, aims to determine the Diversity Index, uniformity index, and dominance index in mangrove ecotourism Gosong Telaga District North Singkil Aceh Singkil.

2. Methods

2.1. Data Collection Method

The data collection process began in September 2023 and included preliminary studies (literature), field observations, field data collection, and preparation of the final report. This research began at low tide in the Gosong Telaga Selatan mangrove forest ecotourism area in North Singkil District, Aceh Singkil Regency. The Line Transect method was used to collect samples at five different stations. Each station has four substations, each measuring 20 meters, and each substation measuring 1 x 1 meter. After that, the samples were identified at the PSDP Laboratory at HKBP Nommensen University Pematangsiantar.

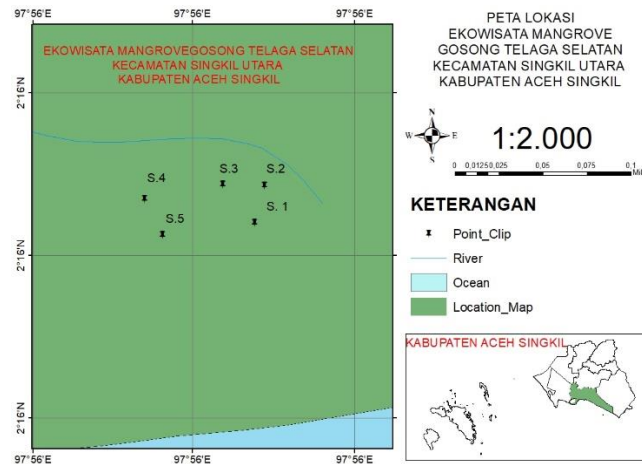


Figure 1. Map of the study area

Gosong Telaga Selatan Mangrove Forest Ecotourism Area is located in North Singkil District, Aceh Singkil Regency at coordinates 2° 27' 12" north latitude and 97° 94' 26" east longitude (Fig. 1). The picture of the mangrove forest ecotourism area shows that the station locations were randomly selected by considering safety factors. Each station was placed in a different place. Stations I, and II are in areas that have muddy sand substrates and are slightly drier, stations III and IV are near small streams with sandy mud substrates and slightly inundated by water, and station V is in an area that has muddy sand substrates and slightly overgrown with mangrove trees.

2.2. Tools and materials

The tools and materials used in taking macrozoobenthos are listed in the following table:

Tools	Ingredients
Roller Meter	<i>Aquades</i>
Sieve or colander	Alcohol 70%
Raffia Rope	Plastic Sample
Stationery	Label Paper
Camera	
Actuator Tools	
Knife	
Kayu Pacak	
Booties	
Laptop	
pH Meter	
<i>Refractometer</i>	
Thermometer	

2.3. Data Analysis

Descriptive and quantitative analysis were used in this study. Descriptive analysis is the analysis of data that describe / describe the object or subject of the research results while quantitative analysis is the analysis of data in the form of numbers obtained using formulas or other statistical techniques. In this quantitative research, the data will be presented in the form of numbers, followed by a description or explanation. The following variables were calculated using information collected from field measurement results:

The formula for calculating the diversity, uniformity and dominance index used in this research is the formula:

a. Indeks Diversity (H')

The diversity index is calculated using the Shannomn-Wiener formula (Odum, 1993).

$$H' = - \sum \left(\frac{n_i}{N} \right) \ln \left(\frac{n_i}{N} \right)$$

Information :

H'= Species Diversity Index

n_i = Number of individuals of the type

N = Total number of individuals

b. Uniformity Index (E)

The uniformity index is calculated using the Evennes Index formula (Odum, 1993).

$$E = \frac{n_i}{\ln S}$$

Information :

E= Species uniformity index

H' = Species diversity index

S = Number of types of organisms

c. Dominance index (C)

Dominance index is calculated using the Dominance of Simpson formula (Odum, 1993).

$$C = \sum \left(\frac{n_i}{N} \right)^2$$

Information :

C = dominance index

n_i = Number of individuals of each type

N = Total number of individuals

The research parameters that will be observed in situ consist of the number of species and the number of macrozoobenthos individuals found in the Gosong Telaga Selatan Mangrove Forest Ecotourism area, North Singkil District, Aceh Singkil Regency and supporting parameters for the presence of macrozoobenthos in the area. Supporting parameters measured include water temperature, water pH and water salinity.

3. Result and Discussion

3.1. Identification results

The results of the macrozoobenthos found in the Gosong Telaga Selatan Mangrove Ecotourism, North Singkil District, Aceh Singkil Regency were 7 species of macrozoobenthos consisting of 3 classes, namely Gastropods consisting of 5 species, namely: *Neritina turnita*, *Neritina semiconica*, *Cerithidea alata*, *Nerita melanotragus*, *Cassidula aurisfelis*. Bivalves consist of 1 species, namely *Polymesoda erosa* and Malacostraca consist of 1 species, namely *Scylla sp.* Of all the macrozoobenthos species found in the Gosong Telaga Selatan Mangrove Ecotourism, the macrozoobenthos that is most commonly found and spread throughout the station is the macrozoobenthos type *Neritina turnita* with a total of 76 individuals. *Neritina turnita* is a macrozoobenthos species originating from the gastropod class Neritidae family. According to Sarong and Mursawa (2017), the main habitat of Neritidae is in water areas. The waters that are the main habitat include fresh, brackish and salt waters and have a high level of tolerance to incoming pollutants. Which can be seen in the table below.

Table 1. Results of Macrozoobenthos Identification

Station	Class	Species	Number of individuals
I	Gastropoda	<i>Neritina turnita</i>	22
		<i>Neritina semiconica</i>	8
		<i>Cerithidea alata</i>	3
		<i>Cassidula aurisfelis</i>	2
		<i>Polymesoda erosa</i>	4
	Bivalvia		
	Malacostraca	<i>Scylla sp</i>	2

II	Gastropoda	<i>Neritina turnita</i>	13
		<i>Neritina semiconica</i>	8
		<i>Cerithidea alata</i>	9
Bivalvia	<i>Polymesoda erosa</i>	8	
Malacostraca	<i>Scylla sp</i>	2	

III	Gastropoda	<i>Neritina turnita</i>	13
		<i>Neritina semiconica</i>	5
		<i>Cerithidea alata</i>	1
	Bivalvia	<i>Nerita melanotragus</i>	1
		<i>Cassidula aurisfelis</i>	3
		<i>Polymesoda erosa</i>	4
Malacostraca	<i>Scylla sp</i>	2	

IV	Gastropoda	<i>Neritina turnita</i>	14
		<i>Neritina semiconica</i>	7
		<i>Cerithidea alata</i>	2
	Bivalvia	<i>Nerita melanotragus</i>	2
		<i>Cassidula aurisfelis</i>	5
		<i>Polymesoda erosa</i>	8
Malacostraca	<i>Scylla sp</i>	4	

V	Gastropoda	<i>Neritina turnita</i>	14
		<i>Neritina semiconica</i>	7
		<i>Cerithidea alata</i>	3
	Bivalvia	<i>Nerita melanotragus</i>	1
		<i>Polymesoda erosa</i>	3
		Malacostraca	<i>Scylla sp</i>

Total 184 Ind

3.1. Diversity, Uniformity, Dominance Index

Tabel 2. Results of Diversity, Uniformity and Dominance Index analysis

Station	Diversity	Uniformity	Dominance
I	1,37	0,76	0,35
II	1,49	0,93	0,24
III	1,59	0,82	0,27
IV	1,75	0,90	0,20
V	1,35	0,76	0,16



a. Diversity Index (H')

The results of the analysis of diversity index values at all stations ranged from 1.35 – 1.75. The lowest diversity index was found at station V, namely $H' = 1.35$ and the highest diversity index was found at station IV, namely $H' = 1.75$. Based on the diversity index category at stations I, II, III, and V are in the Medium category, while at station IV it is in the high category. The high level of macrozoobenthos diversity found at station IV is due to the greater number of species and several other dominant species found.

Overall, macrozoobenthos diversity in the Gosong Telaga Selatan Mangrove Ecotourism, North Singkil District, Aceh Singkil Regency is included in the medium category because the diversity index value is in the medium category, meaning that the productivity of each community is quite good, the ecosystem condition is balanced, and the ecological pressure is moderate.

According to Barus (2004), the diversity index is influenced by factors such as the number of species and the distribution of individuals of each species. Increasing the number of individual species and an even distribution of the number of individuals in each species will increase the diversity index value. This states that the environmental condition of the mangrove ecosystem in Mangrove Ecotourism, Gosong Telaga Selatan, North Singkil District, Aceh Singkil Regency is still in balance.

b. Uniformity Index (E)

The results of the uniformity index analysis obtained at all stations ranged from 0.76 – 0.93. The lowest uniformity index is at stations I and V, namely $E = 0.76$, while the highest uniformity index is at station I, namely $E = 0.93$. Overall, the macrozoobenthos uniformity index in Mangrove Ecotourism, Gosong Telaga Selatan, North Singkil District, Aceh Singkil Regency is included in the Stable Community (High) category. The community is stable because almost all types of macrozoobenthic species found are evenly distributed, it can be seen that each station has a number of species that does not differ much so that it does not hinder the development of other organisms in the same community. The uniformity of benthic animals in a body of water can be determined from the uniformity index. The smaller the uniformity index, the smaller the species uniformity in the community, meaning that the distribution of the number of individuals for each species is not the same, there is a tendency for certain species to dominate (Odum, 1998). The stable level of macrozoobenthos uniformity in the Gosong South Telaga Mangrove Forest Ecotourism indicates that the distribution of macrozoobenthos in the Gosong South Telaga Mangrove Forest Ecotourism area is even.

c. Dominance Index (C)

The analysis results for the dominance index at all stations ranged from 0.16 to 0.35. The lowest dominance index was found at station V, namely $C = 0.16$, while the highest dominance index was found

at station I, namely $C = 0.35$. Overall, the macrozoobenthos dominance index in the Gosong Telaga Selatan Mangrove Ecotourism area, North Singkil District, Aceh Singkil Regency is in the Low category. No macrozoobenthos dominance was found because environmental conditions were very favorable and supported the growth of the 7 species found at each station. Therefore, it can be concluded that for every macrozoobenthos species in the South Telaga Gosong Mangrove Ecotourism, each individual at the observation station has the same and maximum opportunity to utilize the resources in the area.

3.3. Water Quality Parameter Measurement Results

Table 3. Results of Water Quality Measurements in South Telaga Gosong Mangrove Ecotourism

Station	Ph	Temperature	
		(°C)	Salinity (ppt)
I	3	7,0	4,5
		28	
II	3	7,0	4,0
		29	
III	5	7,0	3,5
		28	
IV	4	7,0	3,0
		28	
V	1	7,0	4,0
		29	

Environmental conditions greatly influence the development of macrozoobenthos species diversity and the growth of mangrove ecosystems. In an ecosystem, of course, there are various environmental parameters that determine the characteristics of the mangrove ecosystem, such as pH, temperature and salinity.

Noor. S and Ngabito (2018) stated that water pH is one of the important parameters determining the quality of waters. The pH range obtained in the mangrove ecosystem in the Gosong Telaga Selatan Mangrove Ecotourism, North Singkil District, Aceh Singkil Regency ranges from 7.01 – 7.12. This is in accordance with Alimuddin's (2016) statement that the pH range between 7-9 is quite suitable for the growth and development of macrozoobenthos. The degree of acidity (pH) is very important to support the survival of aquatic organisms because pH can influence the composition of substances in the aquatic environment that provide nutrients and the toxicity of trace elements (Pratiwi, 2017).

Temperature can limit the geographic distribution of benthic animals. The growth and development of an organism is influenced by temperature so that the life of basic organisms will be affected directly or indirectly. The temperature range obtained is between 28°C-29°C. According to Zahidin (2008), the ideal water temperature for macrozoobenthos growth is between 25°C-35°C. These values indicate the ideal temperature range for macrozoobenthos growth. This is in accordance with the research results of Bai'un *et al.*, (2021) which found a temperature range between 29°C-31.5°C. This value is still within normal limits for macrozoobenthos life.

The salinity obtained in the mangrove ecosystem in the Gosong Telaga Selatan Mangrove Forest Ecotourism, namely 3-4ppt, is relatively low. The low salinity value found at each station is because the South Telaga Gosong Mangrove Ecotourism area is far from the river mouth, so that at high tide, the water entering the South Telaga Gosong Mangrove Ecotourism Area is via the river flow so that the influence of fresh water is more dominant than water. Salinity for brackish areas or mangrove ecosystems ranges from 0-28 ppt (Choirudin, *et al.*, 2014). This states that the waters in the Gosong Telaga Selatan Mangrove Ecotourism, North Singkil District, Aceh Singkil Regency are brackish waters. This agrees with the research results of Yasir (2017) where the salinity found was in the range of 3 -7 ppt, where the salinity value is relatively low because the location of the three stations is further from the mouth of the Talo River estuary so that the influence of fresh water is more dominant than sea water.

4. Conclusion

The results of macrozoobenthos identification in the Gosong Telaga Selatan Mangrove Ecotourism found 7 species consisting of 3 classes, namely: Gastropoda, Bivalvia and Malacostraca classes. The results of calculating the index of diversity, uniformity and dominance of macrozoobenthos found at each station in the Gosong Telaga Selatan Mangrove Forest Ecotourism, North Singkil District, Aceh Singkil Regency, diversity (H') ranges between 1.35-1.75. The highest macrozoobenthos diversity index results were obtained at station IV in the High category, while the lowest diversity index was at station V. Uniformity (E) ranged between 0.76-0.93 in the Stable category, the highest uniformity value was obtained at station II and the lowest value obtained at stations I and V and Dominance (C) ranged from 0.16-0.27 in the Low category.

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