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Macrozoobentos Diversity In The Mangrove Ecosystem In Bagan Asahan Village, North Sumatra Province

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Abstract

Macrozoobenthos are organisms that live by crawling, sticking, burrowing, and burrowing both at the bottom of the water and on the surface of the water bottom. Macrozoobenthos that live in mangrove areas mostly live on hard sediments to mud. The existence of macrozoobenthos can be influenced by various environmental factors such as the physical, chemical, and biological properties of water. This research aims to determine diversity, uniformity, and the macrozoobenthos dominance of the mangrove ecosystem in Bagan Asahan Village. The method used in this research is to combine two methods, namely the square method and the line transect method. The quadratic method is used to see the macrozoobenthos found in the quadratic method in a biological system, while the line transect method is used as a point to determine the description of the macrozoobenthos. The results of the research show that there are 8 species of macrozoobenthos consisting of 3 classes with a total of 179 individuals. The diversity of macrozoobenthos in the mangrove ecosystem area in Bagan Asahan Village is classified as moderate with a diversity index H'' ranging from 1.54-2.01, the uniformity index is classified as stable ranging between E= 0.76-0.99 and the dominance index is low, ranging between C= 0.14-0.31.

Keywords: Tanjung Balai, Macrozoobenthos, Mangrove, Diversity.

INTRODUCTION

This mangrove forest biological area is located in Bagan Asahan with coordinates 3° 01' 15" N and 99° 51' 10" E and is one of the cities in the Tanjung Balai sub-locality, Asahan area, North Sumatra region, Indonesia. Due to their true nature, mangrove forests can function as wave barriers and as barriers against marine disturbances and scoured areas. The process of decomposition of mangrove forests or mangrove forests that occurs can support the continuity of life that includes these biota. The mangrove forest in Bagan Asahan City is surrounded by private waste with uneven and sandy sediments, and can also be developed for educational and research purposes.

Seaside and marine areas in Indonesia have quite a big role, where these areas have main values such as natural wealth and natural resources which are called seaside assets. Natural assets are supposed to be able to help financial development in Indonesia, so these natural assets should be managed well to avoid ecological emergencies and provide consistent resources as the source of life. However, not many people can show the flora in the seaside area which from the start was just bushes that were poorly maintained and did not play a role. The seaside area where this type of plant grows is known as mangrove forest land (Romimohtarto and Juwana, 1999).

Macrozoobenthos are organisms that live by crawling, sticking, burrowing, and burrowing both at the bottom of the water and on the surface of the water bottom. Macrozoobenthos that live in mangrove areas mostly live on hard substrates to mud (Arief 2003). Macrozoobenthos includes invertebrate animals and lives in sediment or other substrates. The abundance and diversity of macrozoobenthos depend on different environmental tolerances and sensitivity to environmental changes (Fikri, 2014). The abundance and diversity of macrozoobenthic communities are also determined by the types of organisms in the

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waters, including producers which are a food source for macrozoobenthic animals, and predatory animals which will influence the abundance of macrozoobenthic animals (Setyobudiandi, 1997). According to Yunitawati (2012), macrozoobenthos is more widely used as a bioindicator because the diversity of macrozoobenthos can present the water quality of a place more specifically. Macrozoobenthos will have different sensitivities to environmental changes in each species. Macrozoobenthos as bottom aquatic organisms have a relatively fixed habitat. Changes in the quality of water greatly affect the life of the biota that live at the bottom of the waters, one of which is macrozoobenthos.

The existence of macrozoobenthos can be influenced by various environmental factors such as the physical, chemical, and biological properties of water. As animals that live in water, macrozoobenthos have a high level of sensitivity to the environmental conditions in which they live. Because of this, the level of macrozoobenthos diversity can be used as an indicator of pollution that occurs in an environment (Handayani, et al., 2000). According to Meynita (2016), macrozoobenthos can be an indicator of water because of the permanent nature of benthos and the habit of feeding by filter feeding and deposit feeding.

Mangrove forests are trees or plant tissue that live between the ocean and land as a result of the tidal phenomenon. Mangrove forest ecosystems are often found in locations where river estuaries and seawater meet and protect the land from very strong sea currents. The river flow supplies new water to the mangrove forest further afield, at high tide, the mangrove trees are surrounded by seawater (Arief, 2003).

In this regard, a study is needed to see the relationship between the presence of macrozoobenthos in the mangrove area of Bagan Asahan Village. Apart from that, there is not yet much research and data information regarding the diversity of macrozoobenthos types in the mangrove ecosystem in Bagan Asahan Village, Asahan Regency. Considering that the macrozoobenthic function of mangrove areas is so important, especially for the ecological balance and water productivity in the area, information about the study of macrozoobenthic communities in mangrove forests is important to see the condition of the area as a complete ecosystem for the sake of creating sustainable coastal and marine areas.

MATERIALS AND METHODS

Research Strategy

The method used in this research is to combine two transect methods, namely the quadratic transect method and the line transect method. Quadrate transects are used to see macrozoobenthos contained in quadrat transects in an ecosystem, while line transects are used as points to determine the description of macrozoobenthos in the mangrove ecosystem area in Bagan Asahan Village.

Research Location and Time

This research was conducted in September 2023, located on the coordinate lines 3° 01' 22" N and 99° 51' 31" E in Bagan Asahan City, Tanjung Balai Region, Asahan Regime, North Sumatra Region. Research activities are divided into three stages, namely the examination stage, the verification stage of the types of macrozoobenthos, and the information examination stage. Proving the differentiation of macrozoobenthos varieties has been completed in the MPSDP Lab at HKBP Nommensen Pematangsiantar College. For more details, the sampling area guide can be seen in Figure 3.1.

Determination of Research Areas

As shown by Faiqoh, *et al*., (2016). Deciding on completing the research area using a purposive examination strategy, namely choosing tests deliberately with extraordinary considerations e.g. The certainty of the station design considering the consequences of the review that has been carried out. The determination was not fully determined by 8 stations in the northern part of Bagan Asahan City which has a mangrove forest biological system

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area. Stations 1 and 2 are located close to the pier and local residential areas, Stations 3, 4, 5, and 6 are located around the mangrove forest area, while Station 8 and Station 9 are close to the biological system of the mangrove forest and waterways. Each station is distributed with a cutting line measuring 50 meters, at each cutting line there are 3 (three) square plots measuring 1 x 1 meter and vice versa, 50 meters apart.

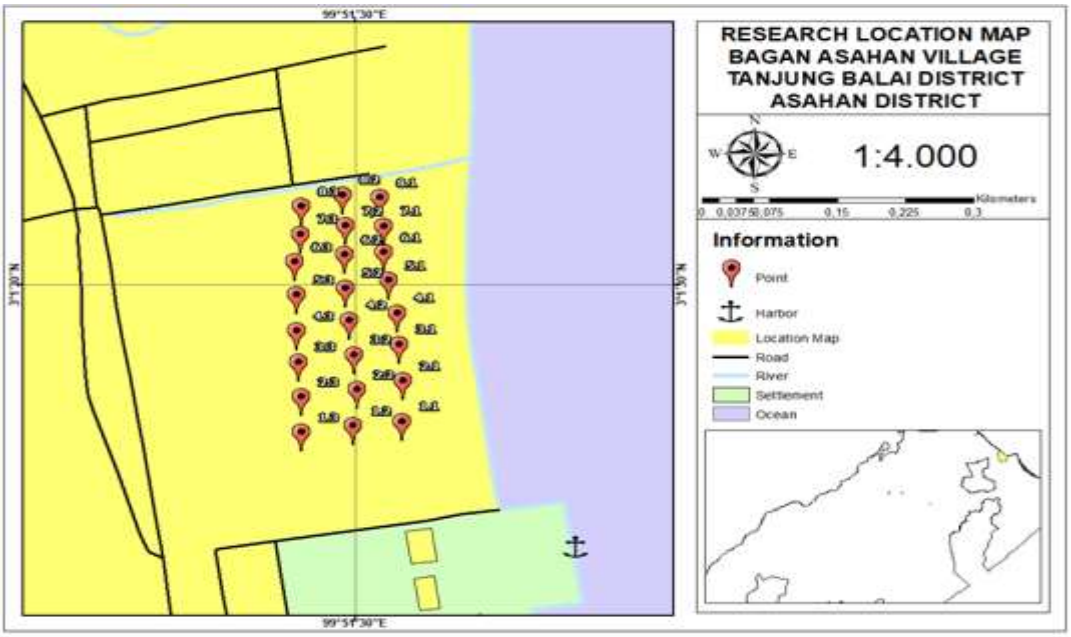
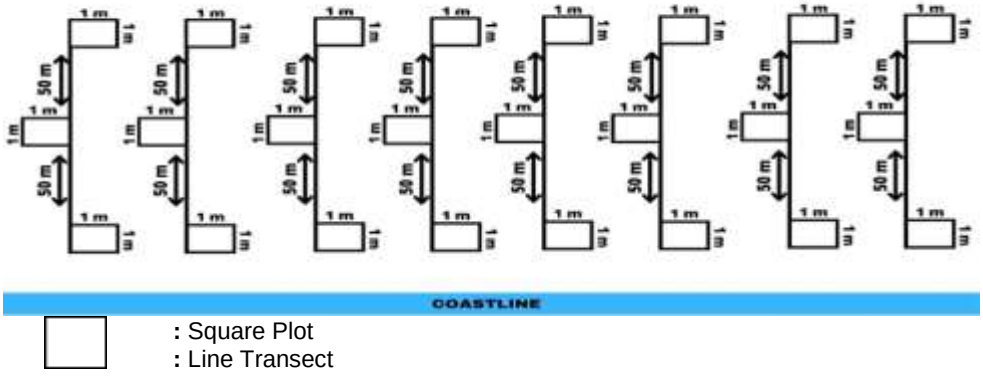


Figure 3.1. Map of Macrozoobenthos Sampling Locations



: Square Plot
: Line Transect

Figure 3.2.sampling Scheme

Data analysis

To test this, the following formula is used to calculate diversity, uniformity, and dominance:

a. Diversity Index Value (H')

The species diversity index value was determined using the Shannon - Wiener equation (Odum, 1993).

$$H' = -\sum_{i=1}^{n} Pi \ln Pi$$

Where:
H' = Diversity index
Pi = ni / N ni = number of individuals of each type i
N = Total number of individuals
Ln = Natural logarithm

b. Uniformity Index (E)

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The uniformity index value is determined using the equation Brower et al., (1998).

$$E = \frac{H'}{\ln S}$$

Where:
E = Species uniformity index
H' = Species diversity index
S = Number of species

c. Dominance Index (C)

The dominance index is determined using the Simpson equation (Odum, 1993).

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

Where:
C = Dominance index
ni = Number of individuals of each type
N = Total number of individuals

RESULTS AND DISCUSSION

Result

In the table below, 8 types of macrozoobenthos are found consisting of 3 classes, namely:

a. Gastopoda with 6 types obtained: *Cerithidea alata*, *Cassidula aurisfelis*, *Ellobium aurisjudae*, *Littoraria undulata*, *Strombiidae*, *Cerithidea obtuse*.
b. Bivalves consist of 1 type: *Polymesoda expansa*.
c. Crustacea consist of 1 type: *Scylla olivacea*.

Gambar 2. Desain pengamatan dan pengambilan data di lapangan.

Station	Class	Species	Number of Individuals
I	*Gastropoda*	*Cerithidea alata*	15
		Cassidula aurisfelis	2
		Ellobium aurisjudae	2
		littoraria undulata	4
		Cerithidea obtuse	2
	Bivalvia	*Polymesoda expansa*	2
	Crustacea	*Scylla olivacea*	2
II	*Gastropoda*	*Cerithidea alata*	7
		Cassidula aurisfelis	3
		Ellobium aurisjudae	5
		Cerithidea obtuse	3
	Crustacea	*Scylla olivacea*	3
III	*Gastropoda*	*Cerithidea alata*	10
		Cassidula aurisfelis	3
		Ellobium aurisjudae	4
		littoraria undulata	3
		Strombiidae	1
	Crustacea	*Scylla olivacea*	2
IV	*Gastropoda*	*Cerithidea alata*	12
		Cassidula aurisfelis	3
		Ellobium aurisjudae	3
		Cerithidea obtuse	4
	Bivalvia	*Polymesoda expansa*	2
	Crustacea	*Scylla olivacea*	3
V	*Gastropoda*	*Cerithidea alata*	15
		Cassidula aurisfelis	3
		Ellobium aurisjudae	3
		littoraria undulata	1
		Strombiidae	3
		Cerithidea obtuse	1
	Bivalvia	*Polymesoda expansa*	1
	Crustacea	*Scylla olivacea*	2
VI	*Gastropoda*	*Cerithidea alata*	3

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		Cassidula aurisfelis	2
		Ellobium aurisjudae	2
		littoraria undulata	2
		Strombiidae	2
		Cerithidea obtuse	1
	Bivalvia	*Polymesoda expansa*	3
	Crustacea	*Scylla olivacea*	4
VII	*Gastropoda*	*Cerithidea alata*	3
		Cassidula aurisfelis	4
		littoraria undulata	3
		Strombiidae	3
	Crustacea	*Scylla olivacea*	4
VIII	*Gastropoda*	*Cerithidea alata*	2
		Cassidula aurisfelis	3
		littoraria undulata	3
		Strombiidae	2
		Cerithidea obtuse	1
	Crustacea	*Scylla olivacea*	3
	Total		**179 Ind**

Diversity, Uniformity, and Dominance Index

a. Diversity Index (H')

For each station, the diversity index results ranged from 1.54 to 2.01. The lowest data diversity value is at stations I and II, namely 1.54 and the highest data diversity value is at station VI at 2.01. Based on the diversity index category, all stations are in the medium class, because the ecological conditions at each station have almost the same sediment conditions, namely sandy mud and slightly waterlogged, and the natural boundaries are not much different. especially the appearance temperature ranging from 28.6°C - 29.6°C, pH 7.1-7.6, and salinity 4.2-5.5 ppt. The results of the diversity value estimation show that the area at each station is still classified as useful and is still very good for the macrozoobenthos natural environment, especially in the Gastropod class which is most often found at each station.

Table 2. Results of Diversity, Uniformity, and Dominance Index Analysis

Index	**Station**							
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**
Diversity (H')	1,54	1,54	1,55	1,57	1,58	2,01	1,60	1,73
Uniformity (E)	0,79	0,96	0,86	0,88	0,76	0,97	0,99	0,97
Dominance (C)	0,31	0,23	0,26	0,26	0,31	0,14	0,20	0,18

In general, macrozoobenthos diversity in the mangrove forest environment of Bagan Asahan City is in the medium classification. This is because the diversity index value shows that the efficiency of each area is moderate, the condition of the biological system is adjusted, and environmental pressure is moderate. Natural tension is a reduction in the development of diversity due to ecological tension that continues to change over time. Odum (1993) added that the mangrove forest environment experiences real pressures such as climate, water flow, contamination, etc. which cause low diversity.

b. Uniformity Index (E)

The uniformity index value obtained at each station changed from 079 to 0.99. The lowest record consistency value was at station V at 0.76 and the highest file consistency value was at station VII at 0.99. In general, the consistency of the incentive data for all stations is in the Stable/High

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class, because almost a large number of macrozoobelton found are in abundance, which means that the development of other organic entities in the same area is not too high. not hampered.

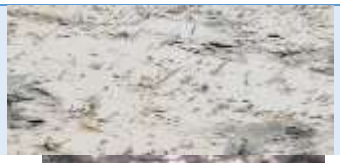
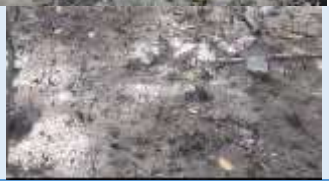
The uniformity of macrozoobenthic classification at each station shows that macrozoobenthic species in the mangrove forest biological system are evenly distributed. It can be said that each station has natural conditions that help the development and increase of macrozoobenthos. Odum (1998) added that the consistency of benthic creatures in a body of water is not entirely determined in the consistency list. The simpler the consistency list, the simpler the local consistency of the species. This shows that the distribution of human quantities for each species is not the same, there is a tendency for the number of certain animal varieties to be large.

c. Dominance Index (C)

The results of the dominance index at each station ranged from 0.14 to 0.31. The lowest dominance index was at station VI, namely C= 0.14, and the highest dominance index was found at stations I and V, C= 0.31. Overall, the dominance index (C) of all stations is in the Low category.

The low dominance of macrozoobenthos in the Mangrove Ecosystem in Bagan Asahan Village means that there are no dominant macrozoobenthos species at all research stations so all macrozoobenthos species have the same opportunity to make maximum use of the resources that exist in the southern area.

Gambar 1. Histogram Perhitungan Indeks Keseragaman

No	Station	Temperature (°C	pH	Salinity (ppt)	Sediment
1	Station I	29,4	7,2	4,3	
2	Station II	29,6	7,1	5	
3	Station III	28,7	7,4	4,2	
4	Station IV	29,2	7,6	4,5	
5	Station V	28,7	7,4	4,7	

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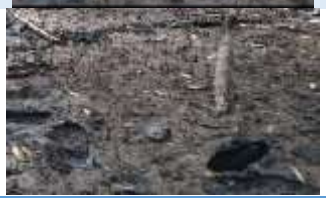
6	Station VI	28,7	7,2	4,9	
7	Station VII	28,6	7,1	5,	
8	Station VIII	28,9	7,2	4,8	

Temperature which influences the life cycle and distribution of biota in the water is a significant variable. The temperature range is 28.9°C to 29.6°C. According to Hawkes' 1978 statement, the temperature range for macrozoobenthos improvement is between 28°C and 31°C, with a base temperature as low as 35°C. Because it can kill macrozoobenthos and increase mortality. The research results (2016) state that the ideal temperature for the development of macrozoobenthos is around 25°C -35°C. In this way, the temperature at all stations is stable, because it is < 35°C. These qualities indicate the ideal temperature range for the development of macrozoobenthos.

The pH range obtained in macrozoobenthos research in the Bagan Asahan City mangrove forest biology system ranged from 7.1 to 7.6. This is by Izzah's statement, 2016, which states that marine biota have a high vulnerability to change. Benthic life forms tend to have a pH of around 7.8 in the climates where they live. If the pH is <7, there will be a decrease in benthic life forms. It can be assumed that macrozoobenthos can survive in the pH range of 7-8.

Salinity values from 4.2 to 5.5 ppt were measured in this study, meaning that the lowest salinity values were obtained in the water area. The low salinity values obtained at all stations are due to the mangrove forest ecosystem being close to the river flow. The mangrove forest environment in Bagan Asahan is more dominated by the influence of freshwater than seawater because water enters the mangrove forest environment through river flows. Salinity in areas affected by salt and mangrove forest environments ranges from 0 to 28 ppt (Choirudin) In Bagan Asahan City, Tanjung Balai Regency, and Asahan Province, it is clear that the water in the mangrove forest ecosystem is bitter.

Macrozoobenthos can live without a rocky substrate, but if the substrate contains a higher content of natural materials then the habitat will be rich in macrozoobenthos. The types of sediment collected at each testing station are muddy and sandy sediments. This is based on (1981): Mud and sand sediments are the preferred habitat for macrozoobenthos. Gastropods like muddy sediment because the surface is smooth and the nutrient content is higher than coarse sediment. This is by the assessment of Widiyanto et al. 2016, who found that sand incorporated into endless clay contains many important components that can be used as food. Many species of Gastropods can be found in these deposits.

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CONCLUSIONS AND SUGGESTIONS

Conclusion

Types of macrobenthos were found and identified in Bagan Asahan, Tanjung Balai subdistrict at 8 stations including 8 types of macrobenthos, 6 types of Gastropoda class, namely Cerithidea alata, Cassidula aurisfelis, Ellobium aurisjudae, littoraria undulata, Strombiidae, Cerithidea obtus. One species belongs to the Bivalvia class Polymesoda expansa and one species belongs to the Crustacea class, Scylla olivace. The results of calculating the index values for diversity, uniformity, and dominance of macrozoobenthos species found at all stations in the Bagan Asahan mangrove area, Tanjung Balai sub-district, Asahan Regency. The diversity index (H') varies between 1.54 and 2.01 for the medium category. The uniformity index (E) ranges from 0.76 to 0.99 in the Stable category and the dominance index (C) ranges from 0.14 to 0.31 in the low category.

Suggestion

The mangrove ecosystem area in Bagan Asahan (Tanjung Balai Regency, Asahan Province) needs to be surveyed periodically to monitor physical changes and their function.

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