Study of the macrozoobenthos community structure in the mangrove ecosystem gampong Gosong Telaga, Aceh Singkil district

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Abstract. This study aims to analyze the community structure of macrozoobenthos in the mangrove ecosystem of Gampong Gosong Telaga, Aceh Singkil. This study was conducted in May 2016. The method used in this research is survey method with purposive sampling carried out at 5 stations with 3 repetitions. There are seven species found were classified into 3 classes: gastropods, bivalves and crustaceans. From the research data, it is known that the Diversity Index (H ') at each station is worth between 1.8 - 2.52, Uniformity Index (E) 0.82 - 0.90, Dominance Index (C) 0.19 - 0, 33 and Density Index (D) 48.33 - 75.33 ind /m^2. The type of mangrove at the location of this study was Rhizopora apiculata with a density of 1.11 - 0.58 individuals / m^2.

1. Introduction

Gosong Telaga is one of the villages in North Singkil Sub-district, Aceh Singkil District which was affected by the Nias Earthquake in 2005. The main impact of the incident not only destroyed buildings but also caused damage to infrastructure, destruction of mangrove forests and changing the structure of mangrove forests in the region that.

Chaudhuri and Choudhury [1] stated that the high density of mangroves can increase the diversity and population of marine biota, including increased macrozoobenthos that live in the area. One of these biota is an invertebrate group which is an important component of mangrove ecosystems and provides various food sources for humans and other animals with higher trophic levels. Macrozoobenthos itself plays an important role in the process of litter decomposition and mineralization of organic matter and also plays a role in nutrient cycles in the bottom of the waters [2].

Macrozoobenthos is a water organism found in mangrove ecosystems. According to their habitat, macrozoobenthos can be grouped into two, namely infauna and epifauna. Infauna is makrozoobenthos whose life is buried in the substrate of the water by digging holes, some of these animals are sessile. While Epifauna is a macrozoobenthos that lives on the surface of the bottom of the water, its movements are slow on the surface of the substrate which is soft or sticks firmly to the solid substrate found at the base [3].

This study aims to determine the community structure of macrozoobenthos in mangrove ecosystem Gampong Gosong Telaga, Aceh Singkil Regency, including abundance, diversity, uniformity, dominance, density of mangroves, and assessing environmental conditions including temperature, dissolved oxygen (DO), pH, salinity, and substrate. Where later the results of this study

can be used as information for management in the area because macrozoobenthos can have a function as a bioindicator of the quality of an aquatic and also be a decomposer of nutrients contained on the substrate.

2. Materials and Methods

This research was conducted in May 2016 in mangrove area of Gosong Telaga, Aceh Singkil Regency (Figure 1). Determination of the location of the study was carried out based on purposive sampling method. The tools and materials used are meters, stationery, raffia, sample plastics, sieves, shovels, pH meters, refractometers, GPS, identification books, DO meters, cameras and 70% alcohol.

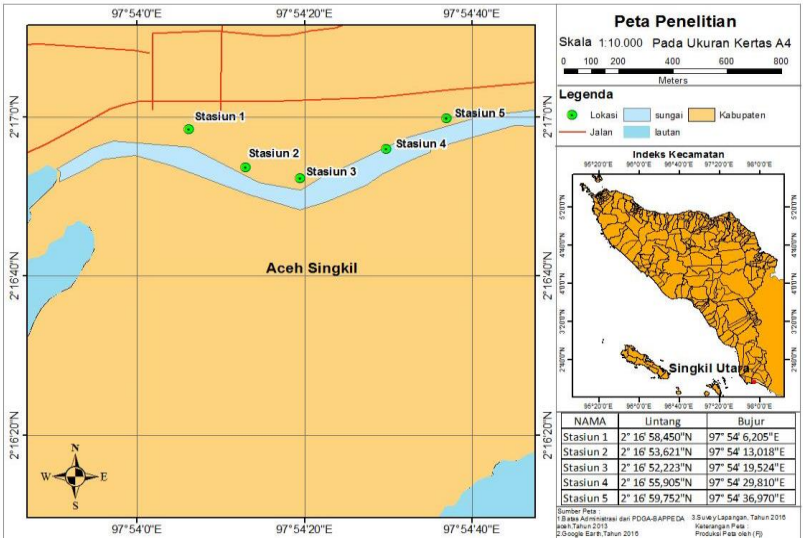

Figure 1. Location Reseach in mangrove ecosystem Gosong Telaga

Sampling was carried out at 5 different stations, parallel to the coastline with a distance between stations of 100 meters and each station carried out 3 repetitions (Figure 1) where each research location was placed a 10 x 10 meter quadratic transect to measure the density of mangroves, then inside the plot is placed a 1 x 1 meter squared transect to take a sample of macrozoobenthos.
Data analysis used in this research such as :

2.1. Density of macrozoobenthos dan mangrove
The density calculation refers to Brower and Zar [4], using the following formula:

$$D = \frac{\sum Ni}{A}$$

where, D is Macrozoobenthos dan mangrove density (ind/m^2); Ni is number of individuals (individual); and A is area (m^2).

2.2. Diversity of macrozoobenthos with Shannon-Weiner formula [5] :

$$H' = -\sum pi \, Log_2 \, pi$$

where, H' is Shannon-Wiener Diversity Index; Pi is number of individuals i/total number of individuals; ni is number of individuals of a type; N is total number of individuals; $Log_2\ pi$ = 3.321 x log pi.

Diversity index values can be classified as follows [4]; H'<1 is small diversity and low community stability; 1<H'≤ 3 is moderate diversity and moderate community stability; and H'>3 is great diversity and high community stability.

2.3. Similarity Index using the following formula [6]:

$$E = \frac{H'}{H\ max}$$

where, E is Similarity Index; H' is Diversity Index; H max is 3,321928 Log S; and S is number of species that found.

Uniformity index values range from 0 - 1. If the uniformity index approaches a value of 0, then the individual distribution of each species is not the same and in the ecosystem there is a tendency for species domination to be caused by instability of environmental and population factors. If the uniformity index approaches a value of 1, then the ecosystem is in a relatively stable condition, ie the number of individuals per species is relatively the same [4].

2.4. Dominace of Simpson using the following formula [5] :

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

where, C is Dominance Index, ni is number of individuals of a type; and N is total number of individuals.

Dominance index values can be classified as follows [7], where 0 <C ≤ 0.5 Low dominance; 0.5 <C ≤ 0.75 Medium dominance; and 0.75 <C 00 1.00 High dominance.

2.5. Calculation of Sediment Weight Percentage

Calculation of the weight percentage of the sediment fraction was calculated using Sheppard's [8], Poerbandono and Djunasjah [9] equation:

Percent weight of the sediment fraction i = (weight of sediment i/ weight of sediment sampel) x 100%

where, Fraction weight i = weight of each grain size fraction (g)

3. Results and Discussion

Based on the results of a total macrozoobenthos study that was found from five locations, there were 1,006 individuals. There are 7 species identified from 1,006 individuals, namely *Faunus atter, Terebralia palustris, Telescopium, Neritina natalensis, Neritina semiconica, Geloina erosa,* and *Scylla serrata,* it can be seen that the most collected samples are at station 4 with 226 samples. Very few samples were found at Station 1, which were 145 samples (Table 1).

The percentage of the number of species encountered varies based on the number or number of individuals per species encountered. The highest percentage species were *Faunus atter* species (30%) and *Neritina natalensis* (26%). The least percentage is in *Scylla serrata* species (1%) (Figure 2). The results of the analysis of research data on diversity, uniformity, dominance and density of

macrozoobenthos at the five stations in the mangrove ecosystem rehabilitation area can be seen in Table 2.

Table 1. Density of Macrozoobenthos

No	Spesies	Station				
		1	2	3	4	5
	(Gastropods)					
1	*Faunus atter*	71	53	48	55	72
2	*Terebralia palustris*	27	20	34	23	23
3	*Telescopium*	21	11	18	39	21
4	*Neritina natalensis*	26	74	62	51	48
5	*Neritina semiconica*	0	40	44	43	36
	(Bivalve)					
6	*Geloina erosa*	0	0	13	11	12
	(Crustacean)					
7	*Scylla serrata*	0	2	2	4	2
	Total	145	200	221	226	214

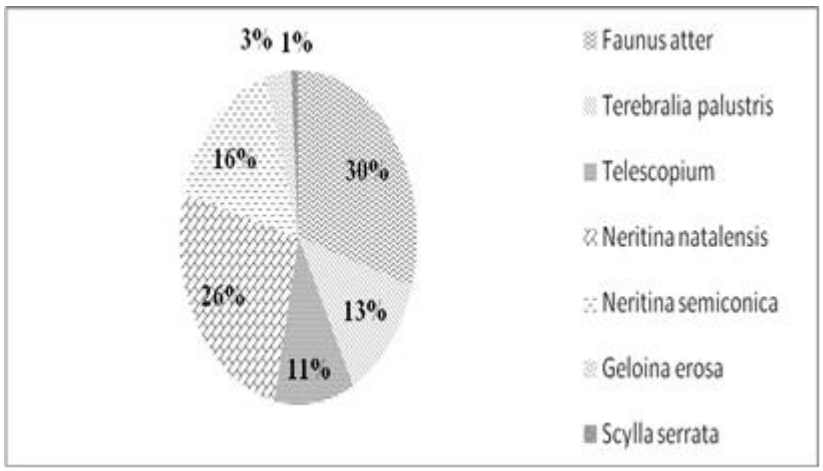

Figure 2. The percentage of individuals in 7 species found

Table 2. Diversity (H'), Similarity (E), Dominance (C) and Density (D Ind/m2) of Macrozoobenthos

Station	Macrozoobenthos						
	H'	Category	E	Category	C	Category	D (Ind/m^2)
1	1,8		0,90		0,33		48,33
2	2,13		0,82		0,26		66,67
3	2,47	moderate	0,88	stable	0,20	moderate	73,67
4	2,52		0.90		0,19		75,33
5	2,42		0,86		0,22		71,33

Diversity Index (H '), Uniformity (E), Dominance (C) and Density (Ind / m2) are index studies that are often used to estimate the condition of an aquatic environment based on biological components. Diversity index, uniformity, dominance and density of macrozoobenthic organisms on observation stations can be seen in Table 2.

Table 2 shows that the macrozoobenthos (H ') diversity index value in the mangrove ecosystem of Gosong Telaga Village, Aceh Singkil District ranged between 1.8-2.52, based on the criteria of the Shanon-Wiener index, the diversity index classified as medium. This condition shows that the

macrozoobenthos species found are quite diverse or varied. The highest diversity index (H ') is at station 4, which is 2.52. The high value of the diversity index at this station shows good environmental conditions and supports the life of macrozoobenthos in it. While the lowest (H ') diversity index is at station 1, which is 1.8.

Uniformity index value (E) obtained from the five research stations ranged from 0.90 to 0.82. The highest uniformity index (E) is at stations 1 and 4 which is 0.90, while the lowest uniformity index is at station 2, that is 0.82, this value is included in the relatively stable category.

Dominance value (C) is close to a value of 1 which means that each station is dominated by one type of species but not in much different amounts [5]. At station 1 has the highest dominance value of 0.33 and the lowest dominance value is at station 4 which is 0.19. The highest value of density (Ind / m2) is at station 4 which is 75.33 ind / m^2, while the lowest value is 48.33 ind / m^2 which is found at station 1.

In this study, mangrove areas have only one type of species, namely *Rhizophora apiculata*. This is because this area is a rehabilitation area that is only planted by 1 type of mangrove. The density of mangrove species obtained with the highest value is located at station 3 with a value of 1.11 individuals / m^2, while the lowest density value is located at station 1 with a value of 0.58 individuals / m^2 is presented in (Table 3).

Table 3. Density of mangrove

Station	Species	Total (ind)	Di (ind/m^2)
1	*Rhizophora apiculata*	58	0,58
2	*Rhizophora apiculata*	103	1,03
3	*Rhizophora apiculata*	111	1,11
4	*Rhizophora apiculata*	107	1,07
5	*Rhizophora apiculata*	96	0,96
	Total	475	

Table 4. Parameter of waters physic - chemical

No	Unit	Station				
		1	2	3	4	5
1	Salinity (‰)	28	26	26	26	25
2	Temperature ^oC	27	26	26	28	27
3	pH	6.82	6.79	6.75	6.65	6.67
4	DO (mg/L)	8.9	9.15	9.09	9.18	9.17

In this study measured physical and chemical factors carried out in situ in each habitat where this factor greatly affects the life of the gastropod itself. In Table 4 shows the results of salinity measurements at the five stations ranging from 25 28 - 28 ‰. Furthermore, the temperature of the environment in each habitat is an average of 26-28 ° C, gastropods can perform optimal metabolic processes in the temperature range between 25-32 ° C. This states that at temperatures above 32 ° C the metabolic process in the gastropod will be disrupted. It turns out that for the temperature tolerance of each gastropod is different, there are several gastropods that have a high tolerance to temperature. For waters pH of Hynes [10], it was suggested that freshwater gastropods generally live optimally in an environment with a pH range of 5.0-9.0, and from the above statement if we look at the pH obtained in each habitat which is between 6.65- 6.82, these habitats are still very good to be a breeding ground for gastropods themselves.

The results of dissolved oxygen (DO) measurements measured at the five stations ranged from 8.9 mg / l - 9.28 mg / l. The five stations that were measured had similar value differences, Effendi

[11] stated that dissolved oxygen levels in natural waters are usually less than 10 mg / l. Oxygen levels obtained at the site are still able to support macrozoobenthos life.

Table 5. Type of Sediment in 5 Station

St	Calculation	Mesh Size (mm)					Total	Information
		0,5	0,25	0,125	0,068	0,038		
1	Sampel weight		47	44,45	55,41	53,14	200	
	% Fraksi		23,50	22,225	27,705	26,57	100	
	Grain size (d)		0,059	0,028	0,019	0,010	0,115	Very fine sand
2	Sampel weight		7,0	8,0	90,90	94,10	200	
	% Fraksi		3,50	4,00	45,45	47,05	100	
	Grain size (d)		0,009	0,005	0,031	0,018	0,063	Silt
3	Sampel weight	1,10	2,5	14	90,30	92,1	200	
	% Fraksi	0,55	1,25	7	45,15	46,05	100	
	Grain size (d)	0,003	0,003	0,009	0,031	0,017	0,063	Silt
4	Sampel weight		38,565	40,815	60,413	60,207	200	
	% Fraksi		19,2825	20,408	30,207	30,104	100	
	Grain size (d)		0,048	0,026	0,021	0,011	0,106	Very fine sand
5	Sampel weight		52,95	55,35	47,874	43,826	200	
	% Fraksi		26,475	27,675	23,937	21,913	100	
	Grain size (d)		0,066	0,035	0,016	0,008	0,125	Very fine sand

Substrate at stations 1, 4 and 5 have not much different values, namely 0.115 mm, 0.106 mm, and 0.125 mm, so that they can be categorized as very fine sand. While the substrate at stations 2 and 3 has a value of 0.063 mm which means that the substrate at this station is included in the silt category.

4. Conclusion

Number of individuals macrozoobenthos 1,006 individuals belonging to 7 species from 3 classes, namely Gastropoda (*Faunus atter, Terebralia palustris, Telescopium, Neritina natalensis*, and *Neritina semiconic*a), Bivalvia (*Geloina erosa*) and Crustacea (*Scylla serrata*). The highest presentation of species is Faunus atter by 30%, and the lowest is Scylla serrata species, which is 1%. One to five stations have a range of diversity (H ') 1.8-2.52, uniformity (E) 0.82-0.90, dominance (C) 0.19-0.33, and density (D) 48, 33-75,33 ind /m^2. The type of mangrove encountered was Rhizopora apiculata with the highest number found at station 3, namely 111 ind / m^2 and the lowest was found at station 1 which was 58 ind / m^2, while the type of substrate in this study belongs to the category of very fine and silty sand.

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