RJOAS: Russian Journal of Agricultural and Socio-Economic Sciences
ISSN 2226-1184 (Online) | Issue 1(145), January 2024

UDC 630

CONNECTION BETWEEN MANGROVE DENSITY AND MACROZOOBENTHOS DIVERSITY IN PAGATAN BESAR VILLAGE OF SOUTH KALIMANTAN

Tony Frans, **Lestarina Putri Mudhlika**, **Rifa'i Muhammad Ahsin**, **Keliat Siska Adelia**
Department of Marine Science, Faculty of Fisheries and Marine Science,
University of Lambung Mangkurat, South Kalimantan, Indonesia

Iskandar Rina*
Department of Fisheries, Faculty of Agriculture, University of Achmad Yani Banjarmasin,
South Kalimantan, Indonesia

*E-mail: rina.oriens@gmail.com

ABSTRACT
The benefit of this research is to understand macrozoobenthos diversity and its connection to mangrove density in Pagatan Besar Village. Determination of observation stations by purposive sampling method. Research on macrozoobenthos was carried out in a 10 m × 10 m mangrove vegetation observation transect. The results showed that the macrozoobenthos found consisted of 12 species, namely Polymesoda bengalensis, Uca lactea annulipes, Scylla serrata, Episesarma, Chicoreus capucinus, Cerithidea quoyii, Cassidula aurisfelis, Telescopium Telescopium, Ellobium aurisjudae, Calliostoma zizyphinum, Nerita lineata and Littoraria scabra. The macrozoobenthos density index from the three stations produced various values. The diversity index of the three stations belongs to the moderate diversity category (H' 1 < H' < 3.322). The uniformity index of Stations 2 and 3 is included in the high uniformity category (0.6 ≤ E ≤ 1.0) and Station 1 is included in the medium uniformity category (0.4 ≤ E < 0.6). The dominance index values of the three stations indicate that there are macrozoobenthos species that dominate at each station because the value of D > 0.5. The results of a simple correlation analysis of "Pearson Product Moment" between mangrove density and macrozoobenthos density produce a fairly weak relationship with mangrove density where the equation shows a negative value (-).

KEY WORDS
Macrozoobenthos, mangrove, diversity, ecosystem, Indonesia.

Macrozoobenthos are animal species that live in mangrove ecosystems. These organisms play an important role as detritivores on mangrove substrates so that the macrozoobenthos community can be used as an indicator of the balance of the mangove ecosystem. One of the communities found in the mangrove ecosystem is the bivalve community which is known to have 8 species of bivalves found in the mangrove area of Mekarsari Village, including; Mactra violacea, Perna viridis, Mactra chinensis, Polymesoda erosa, Geloina expansa, Isognomon ephippium, Anadara antiquata and Polymesoda bengalensis. (Tony. F, et al. 2022).

The existence of mangrove ecosystems provides other benefits for coastal water ecosystems as a place to find food, spawning grounds and livestock. Rapid developments have had a negative impact on the environment, including the conversion of mangrove forests into ponds and tourist destinations, as well as the disposal of organic waste into coastal waters. The Amount value of biomass in the mangrove ecosystem in Mekarsari Village, Tanah Laut Regency, based on the results of the analysis, is 98.52 tons/ha. The Amount estimated amount of blue carbon stock in Mekarsari Village is 84.72 tons C/ha (Tony. F, et al. 2022).

When the quality of the habitat changes, the density of macrozoobenthos will change, depending on their tolerance or sensitivity to environmental changes. Mangroves grow on sloping beaches with muddy or sandy soil conditions. Mangroves cannot grow on beaches that are steep, have big waves, or have high tides and fast currents.

Due to the availability of sand and mud which are the main growth media, mangroves will develop in large numbers on beaches near river mouths or river deltas (Nontji, 2015). One of the conservation areas in South Kalimantan, the mangrove area is in Pagatan Besar Village. Existence of mangrove forests in the estuary area of the Pagatan Besar Beach Ecotourism Area and important ecological functions for ponds and their natural ecosystem.

The mangrove ecosystem area must continue to be maintained and conserved for the life of macrozoobenthos in the mangrove ecosystem area, bearing in mind that the exploitation of mangrove forests is increasingly uncontrolled which is a macrozobenthos habitat, another interesting factor to study is the existence of macrozoobenthos species in the village of Pagatan Besar, South Kalimantan. (Sari, et al. 2016).

Based on the description above, it is necessary to conduct research on Community Structure of Macrozoobenthos in the Mangrove Ecosystem of Pagatan Besar Village, Takisung District, Tanah Laut Regency, South Kalimantan. Hopefully this research can provide relevant scientific data on macrozoobenthos diversity and its relationship with mangroves.

MATERIALS AND METHODS OF RESEARCH

Time and place of research: May–August 2022, mangrove area of Pagatan Besar Village, South Kalimantan.

Table 1 – Tools and Material used in Research

No	Tools	Function
1	Shovel	Lifts Sample
2	Meter Roll	Measures Transect Distance
3	Sample Bag	Holds Samples
4	Stationery	Writing Measurement Data
5	Camera	Documentation
6	Pocket Book	Assist Sample Identification
7	Thermometer	Measure Temperature
8	Sieve 0,5 mm	Separate Samples
9	Refractometer	Measure Salinity
10	DO Meter	Measure DO
11	pH Meter	Measure pH
12	Transect	Mapping Biota
13	Alcohol 70%	Preserve Biota

The determination of data collection stations in the field was carried out in Pagatan Besar Village, Takisung District, Tanah Laut Regency, South Kalimantan. There are 3 research stations, which are located in the vicinity of Pagatan Besar Village, which is adjacent to the coastal area of the Pagatan beach area and the mangrove area..

Purposive random sampling is used to select stations, which requires cutting the sample location into layers or strata based on certain characteristics and random sampling. The research station is divided into three locations which are expected to represent macrozoobenthos data found in the research location.

Data collection technique by direct observation of the research objects. Conceptually, research stations and plots were selected based on the description of the research location. Through zoning of mangrove habitat, the location of the station is determined by the relationship of the coastline which is perpendicular to the land. Based on the location representation, the transect line is pulled 50 meters, or the distance between one station and the next, to create three observation stations. Each transect is equipped with three plots measuring 1x1 m2, each with a distance of 10 meters between plots. The following image illustrates this.

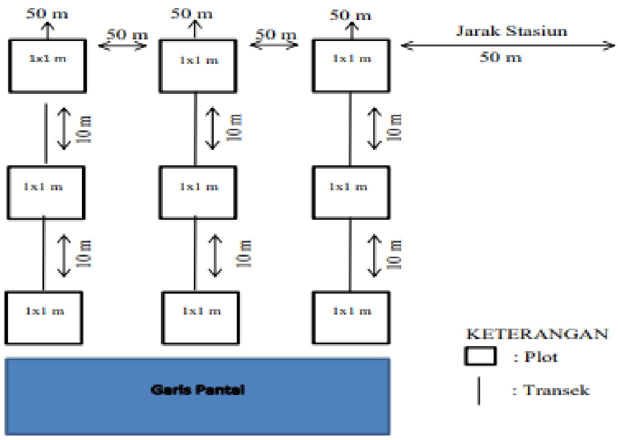

Figure 1 – Schematic of Data Retrieval of Macrozoobenthos (Source: Alwi, et al. 2020)

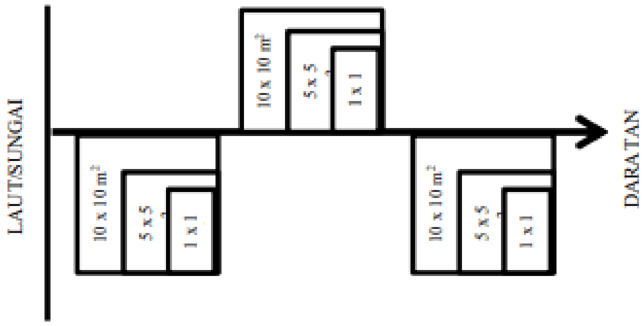

Figure 2 – Mangrove data collection scheme (Source: English et al, 2012)

Mangrove data collection was carried out using the line transects plot method. This method is a method of sampling the population of an ecosystem with a sample plot approach that is on a line drawn through the ecosystem area. Transect is prepared perpendicular to the shoreline inland for 50 meters. Transects are separated from each other at a distance of 50 meters and parallel to each other. A plot of 10 m x 10 m (tree category) diameter >10 cm was made for each transect (English et al, 2012).

The macrozoobenthic community structure analysis includes density, diversity index, uniformity index, and dominance index equipped with criterion values for each formula, while mangrove density analysis includes species density.

Individual abundance in Makrozoobenthos can be calculated using the Shannon-Winner index (Odum, 1971):

$$\mathrm{Y} = \frac{10.000}{B} \text{ x } a$$

Where: Y = Number of Organisms (ind/m²); a = Number of Individuals (ind); b = Area Squared (m²).

In Effendy (1993), the relative abundance of each Macrozoobenthos was determined using the Cox formula from 1967:

$$\mathrm{R} = \frac{ni}{\mathrm{N}} \text{ x } 100\%$$

Where: R = Relative abundance; Ni = Number of Each Individual Type; N = Amount.

According to Shannon-Winner, species were counted as follows in Krebs (1994) to determine the diversity index (H'):

$$H' = - \sum \left(\frac{ni}{N}\right) \text{ x In } \left(\frac{ni}{N}\right)$$

Where: H = Diversity Index, ni =Number of each Individual Type, N =Amount Number of Individuals.

The diversity index (H') includes the following criteria:
H'>3.0 = Indicates a high level of diversity;
H' 1.6-3.0 = displays many variations;
H' 1.0-1.5 = Shows simple diversity;
H' < 1 = Shows low diversity.

These types can use a temporary formula to determine the Uniformity Index (E). The Shannon Index of Diversity's Evennex Index is as follows:

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

Where: E = Uniformity Index, H' = Diversity Index, S = Species.

The three criteria that make up the uniformity index value are as follows:
E<0.4 = Low level of homogeneity;
0.4<E<0.6 =Medium level of homogeneity;
E>0.6 = Significant homogeneity level.

The Simpson Dominance Index formula was used to determine the dominance index (Odum, 1971):

$$\mathrm{C} = \Sigma \frac{ni}{\mathrm{N}}$$

Where: C = domination index, ni = Number of biota in each type, N = Amount number of biota.

The three criteria that make up the value of the dominance index are as follows:
0 < C ≤ 0.5 = Small domination;
0.5 < C ≤ 0.7 = Moderate dominance;
0.7 < C ≤ 1 = Big dominance.

Mangrove species density was calculated using the Bengen (2000) formulation:

$$\mathrm{Dm} = \frac{ni}{\mathrm{A}}$$

Where: Dm=Mangrove species density (eng.m2), ni = All population of type m stands, A = Entire sample area (plot area).

The number of type I (ni) stands was compared with the Amount number of stands for all species (∑n).

$$RDi = \frac{ni}{\Sigma n} \text{ x } 100\%$$

Where: RDi = Relative Density, ni = Amount number of type I, ∑n = Amount number of species stands.

The link between the abundance of macrozoobenthos and the density of mangrove vegetation in Pagatan Besar Village can be seen and analyzed using a simple correlation analysis with Microsoft Office Excel (Arifin, 2017). Correlation is used to determine the magnitude of the relationship between a pair of data groups, which consist of two random variables, for example (Xi, Yi). The value of the correlation coefficient is expressed as r, which in MS Excel is calculated based on a formula made by Karl Pearson which is commonly known as the "Pearson Product Moment" correlation. The value of r = +l shows a perfect positive correlation. The value of r = -l shows a perfect negative correlation. Meanwhile, r=0 indicates no correlation. The closer the value of r is to zero, the lower the correlation that occurs between the two variables or data pairs (LIPI, 2003). The "Pearson Product Moment" formula used is:

$$rxy = \frac{\Sigma xy}{\sqrt{\Sigma x2}).(\Sigma y2)} \text{ x } 100\%$$

Where: r xy = Correlation Coefficient, ∑x = X Overall Score, ∑y = Overall Score Y.

RESULTS AND DISCUSSION

Based on the research that has been carried out, it is known that there are 12 macrozoobenthos species found in the mangrove forest area of Pagatan Besar Village, including: Polymesoda bengalensis, Uca lactea annulipes, Scylla serrata, Episesarma, Chicoreus capucinus, Cerithidea quoyii, Cassidula aurisfelis, Telescopium Telescopium, Ellobium aurisjudae , Calliostoma zizyphinum, Nerita lineata and Littoraria scabra. The distribution of these types of macrozoobenthos can be seen per station in the following table:

Table 2 – Composition of Macrozoobenthos Types at Each Station

Class	Species	Station 1 2 3	Amount
Gastropoda	*Calliostoma zizyphinum*	+ + +	11
	Cassidula aurisfelis	+ + +	177
	Cerithidea quoyii	+ + +	164
	Chicoreus capucinus	+ + +	96
	Ellobium aurisjudae	+ + +	69
	Nerita lineata	- + +	9
	Littoraria scabra	+ - +	30
	Telescopium telescopium	+ + +	44
Bivalvia	*Polymesoda bengalensis*	+ - -	1
	Uca lactea annulipes	+ + +	18
Crustacea	*Scylla serrata*	+ + +	10
	Episesarma	+ + +	73

Note: +: Found; -: Not found. Source: Primary Data, 2022.

Based on an investigation conducted on the abundance of macrozoobenthos at Station 1, Cassidula aurisfelis had the highest abundance, while Polymesoda bengalensis had the lowest abundance, Telescopium telescopium and Calliostoma zizyphinum with values 1,111 Ind/m^2.Investigation Data of Macrozoobenthos Individual Abundance Index at location 1 Mangrove Village of Pagatan Besar.

Table 3 – Data of Macrozoobenthos Individual Abundance Index at location 1 Mangrove Village of Pagatan Besar

Station 1.1.		
Species	Amount Ind	Y (Ind/m^2)
Chicoreus capucinus	2	2,222
Cerithidea quoyii	10	11,111
Cassidula aurisfelis	70	77, 777
Telescopium Telescopium	1	1,111
Ellobium aurisjudae	2	2,222
Stationn 1.2.		
Cassidula aurisfelis	48	48, 888
Ellobium aurisjudae	3	3, 333
Cerithidea quoyii	20	22,222
Calliostoma zizyphinum	1	1,111
Scylla serrata	3	3, 333
Episesarma	19	19,999
Station 1.3.		
Ellobium aurisjudae	1	1,111
Polymesoda bengalensis	1	1,111
Chicoreus capucinus	64	64,664
Cassidula aurisfelis	52	52,556
Cerithidea quoyii	5	5,555
Uca lactea annulipes	4	4,444

Source: Primary Data, 2022.

The type Telescopium telescopium had the highest value in the individual abundance analysis at station II, with a value of 42.224 Ind/m2, and the species with the lowest abundance were Ellobium aurisjudae and Nerita lineata with a value of 1.111 Ind/m2.

Episesarma species had the highest individual abundance values at station III with a value of 25.555 Ind/m2, while the lowest value was Telescopium Telescopium, Calliostoma zizyphinum, and Littoraria scabra with a value of 1.111 Ind/m2.

Table 4 – Data Results of Analysis of Macrozoobenthos Individual Abundance Index at Station 2 Mangrove Village of Pagatan Besar

Station 2.1.		
Species	Amount Ind	Y (Ind/m2)
Nerita lineata	1	1,111
Cerithidea quoyii	29	29,999
Cassidula aurisfelis	4	4,444
Calliostoma zizyphynum	7	7,777
Ellobium aurisjudae	1	1,111
Station 2.2.		
Ellobium aurisjudae	4	4,444
Cerithidea quoyii	7	7,777
Calliostoma zizyphinum	3	3, 333
Episesarma	29	29,999
Station 2.3.		
Ellobium aurisjudae	10	11,111
Chicoreus capucinus	5	5,555
Cerithidea quoyii	14	14,444
Uca lactea annulipes	6	6,666
Scylla serrata	5	5,555
Telescopium Telescopium	42	42,224

Source: Primary Data, 2022.

Table 5 – Data Results of Analysis of Macrozoobenthos Individual Abundance Index at Station 3 Mangrove Village of Pagatan Besar

Station 3.1.		
Species	Amount Ind	Y (Ind/m2)
Cerithidea quoyii	20	21,222
Nerita lineata	6	6,666
Chicoreus capucinus	22	22,222
Littoraria scabra	24	24,224
Calliostoma zizyphynum	1	1,111
Ellobium aurisjudae	9	9,999
Station 3.2.		
Chicoreus capucinus	3	3, 333
Littoraria scabra	5	5,555
Nerita lineata	2	2,222
Cassidula aurisfelis	3	3, 333
Ellobium aurisjudae	13	13, 333
Cerithidea quoyii	31	31, 331
Calliostoma zizyphinum	1	1,111
Episesarma	25	25,555
Station 3.3.		
Ellobium aurisjudae	20	22,222
Littoraria scabra	1	1,111
Cerithidea quoyii	28	28, 888
Uca lactea annulipes	8	8,888
Scylla serrata	2	2,222
Telescopium Telescopium	1	1,111
Calliostoma zizyphinum	4	4,444

Source: Primary Data, 2022.

Table 6 – Relative Abundance of Macrozoobenthos Mangrove in Pagatan Besar Village

Class	Species	Relative Abundance (%) Station 1 2 3	Amount
Gastropoda	*Calliostoma zizyphinum*	0,68 0,41 0,15	11
	Cassidula aurisfelis	7,54 5,12 4,16	177
	Cerithidea quoyii	8,24 3,26 2,79	164
	Chicoreus capucinus	5,62 4,12 2,99	96
	Ellobium aurisjudae	2,77 3,45 1,92	69
	Nerita lineata	0 0,14 0,24	9
	Littoraria scabra	0 2,92 0	30
	Telescopium telescopium	2,5 1,62 0,76	44
Bivalvia	*Polymesoda bengalensis*	0,1 0 0	1
	Uca lactea annulipes	0,16 2,4 1,1	18
Crustacea	*Scylla serrata*	0,2 1,52 1,26	10
	Episesarma	4,21 2,17 3,2	73
	Amount	100 100 100	702

Source: Primary Data, 2022.

Based on the results of the study, the type Cerithidea quoyii had the largest Relative Abundance (KR) value at station 1 with a value of 8.24%, while Polymesoda bengalensis had the lowest value at station I with a value of 0.1.

Table 7 – Results of Data Analysis on Diversity, Uniformity, and Dominance of Marozoobenthos at Mangrove Station 1 in Pagatan Besar Village

Species	Amount	H'	E	D
Calliostoma zizyphinum	1	0,02	0,01	0,0002
Cassidula aurisfelis	170	0,35	0,17	1,3
Cerithidea quoyii	35	0,32	0,16	0,0857
Chicoreus capucinus	66	0,19	0,09	0,2706
Ellobium aurisjudae	6	0,12	0,06	0,0024
Telescopium telescopium	1	0,02	0,01	0,02
Amount	279	1,03	0,5	1,659

Source: Primary Data, 2022.

Table 8 – Results of Data Analysis on Diversity, Uniformity, and Dominance of Marozoobenthos at Mangrove Station 2 in Pagatan Besar Village

Species	Amount	H'	E	D
Calliostoma zizyphinum	4	0,18	0,11	0,0406
Cassidula aurisfelis	4	0,10	0,04	0,0091
Cerithidea quoyii	50	0,4	0,21	0,76
Chicoreus capucinus	5	0,08	0,04	0,005
Ellobium aurisjudae	21	0,41	0,22	0,127
Telescopium Telescopium	42	0,13	0,07	0,35
Nerita lineata	1	0,04	0,02	0,0006
Amount	127	1,34	0,71	1,2923

Source: Primary Data, 2022.

Table 9 – Results of Data Analysis on Diversity, Uniformity, and Dominance of Marozoobenthos at Mangrove Station 3 in Pagatan Besar Village

Species	Amount	H'	E	D
Calliostoma zizyphinum	6	0,13	0,06	0,001
Cassidula aurisfelis	3	0,07	0,02	0,0027
Cerithidea quoyii	79	0,45	0,17	0,62
Chicoreus capucinus	25	0,22	0,08	0,0747
Ellobium aurisjudae	42	0,42	0,16	0,202
Telescopium Telescopium	1	0,03	0,01	0,0003
Nerita lineata	8	0,13	0,05	0,0062
Littoraria scabra	30	0,28	0,1	0,0937
Amount	194	1,73	0,65	1,006

Source: Primary Data, 2022.

Table 10 – Mangrove Ecosystem Density in Pagatan Besar Village

Station	Type	Amount	Dm	Di	RDi
1	*Rhizophora mucronate*	22	0,073	733	75,86
	Bruguierra gymnorhiza	7	0,023	233	24,14
	Amount	29	0,097	967	100
2	*Avicennia Marina*	23	0,077	767	31,51
	Sonneratia alba	2	0,007	67	2,74
	Rhizophora mucronate	1	0,003	33	1,37
	Rhizophora apiculate	14	0,047	467	19,18
	Avicennia rumphiana	1	0,003	33	1,37
	Avicennia officinalis	32	0,107	1067	43,84
	Amount	73	0,243	2433	100
3	*Rhizophora mucronata*	81	0,270	2700	100
	Amount	81	0,270	2700	100

Source: Primary Data, 2022.

The density value describes the condition of the mangrove ecosystem. The condition of the ecosystem itself is influenced by several factors including community activities, land use change and environmental conditions in the surrounding area. Pagatan Besar Village has a natural mangrove ecosystem, based on the results of the mangrove density analysis at station 3 and station 2 respectively, which were 2700 ind/ha and 2433 ind/ha while station 1 was 967 ind/ha.

The relationship between mangrove density and macrozoobenthos density can be seen in Figure 4.6. from the value of the correlation coefficient r = 0.315 or 31.5%, which means that the density of macrozoobenthos has a fairly weak relationship with the density of mangroves. However, considering that the view of Talib (2008) agrees with this, it is not very influential, not all macrozoobenthos have a close association or relationship with mangrove vegetation.

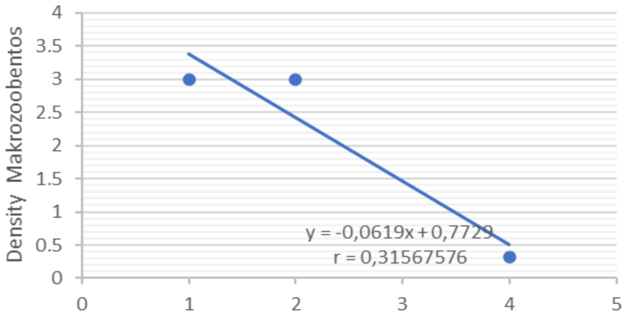

Figure 3 – Correlation of Mangrove with Macrozoobenthos Density

The weak relationship between mangrove density and macrozoobenthos density is due to the predominantly muddy surface substrate fraction of the mangrove area, which has been said previously that the silt fraction is able to cause a decrease in macrozoobenthos density. This is presumably because the sludge fraction has little oxygen and this is not good for macrozoobenthos, considering that oxygen is a gas element that is needed by living things to carry out the respiration process so that macrozoobenthos requires extra effort to adapt to the surrounding environment, the way to live depends on the limbs mangroves such as roots, stems and leaves (treefauna).

As stated by Rumalutur (2004) that the density of mangroves both in terms of tree structure, saplings (panang) and seedlings has no significant effect on macrozoobenthos abundance, especially gastropods. Tis'in (2008) also added that mangrove density is closely related to the availability of organic matter found in the environment which supports the growth of decomposers to decompose organic matter, such as dissolved oxygen (DO), salinity and substrate.

Mangroves and macrozoobenthos density have a close relationship in coastal water ecology. Some literature and research has shown a correlation between these two things. Research by Kristiawan et al. (2014) in Semarang showed that wider mangrove types have higher density of macrozoobenthos. This could be due to more food sources and shelter available over a wider area. Additionally, the study by Dahdouh-Guebas et al. (2005) demonstrated that mangroves can act as a natural defense against natural disasters such as tsunamis. Mangroves can reduce the strength of the waves and minimize damage to the coast protected by mangrove.

On the other hand, research by D'Croz and O'Dea (2007) shows that the nutrient content obtained from upwelling affects the macrozoobenthos density in coastal waters. Upwelling is the process of lifting deep seawater which is rich in nutrients to the surface of the sea, which then becomes a food source for macrozoobenthos. Apart from that, a study by Alongi (2008) discusses the benefits of mangroves in dealing with natural disasters such as tsunamis and global climate change. This study also discusses the role of mangroves in supporting the survival of macrozoobenthos and their impact on coastal water productivity. Based on the literature and research, it can be concluded that mangroves and macrozoobenthic density have a close relationship in coastal ecology. Mangrove conservation and management can help support the survival of macrozoobenthos and maintain coastal water productivity.

CONCLUSION

The Diversity Index (H') of medium Macrozoobenthos is station 1, 2, and 3. The Uniformity Index (E) is then lowest at station 1, followed by station 2, which is high, and station 3 which tends to be balanced. And for the Dominance Index (D) station 1 has the highest value compared to station 2 which is low and station 3 which is the lowest. The water quality conditions at the three study sites were good in the morning, afternoon and evening, these conditions were able to affect the life of macrozoobenthos because the concentration levels tended to be stable compared to the aquatic environment in general. The results of the relationship between mangrove density and macrozoobenthic density, the correlation coefficient value is r = 0.315 or 31.5%, which means that macrozoobenthos density has a fairly weak relationship with mangrove density.

REFERENCES

1. Alongi D.M. (2008) Mangrove forests: Resilience, protection from tsunamis, and responses to global climate change. Estuarine, Coastal and Shelf Science, 76(1):1-13.
2. Alwi, J. E., E. H. Kardhinata, and F. Susilo. 2020. Diversity of Mangrove Types in Tanjung Rejo Village, Percut Sei Tuan District. Medan Area University, Medan.
3. Arifin, S. 2017. The Relationship between Mangrove Density and Gastropod Populations in Gisi Village. Faculty of Marine Science and Fisheries. Haji Raja Ali Marine University.
4. Dahdouh-Guebas F. et al (2005) How effective were mangroves as a defence against the recent tsunami? Current Biology, 15(12):R443-7.
5. D'Croz L., O'Dea A. (2007) Variability in upwelling along the Pacific shelf of Panama and implications for the distribution of nutrients and chlorophyll. Marine Ecology Progress Series, 333: 43-55.
6. English, S. et al, 1997. Manual of Tropical Marine Surveys Resources (2nd Edition). Marine Science Institute of Australia. The Marine ASEAN-Australia Project.
7. Kristiawan M., Irsyam M., Santoso E. (2014) Diversity of macrozoobenthic species in three types of mangroves in Kedung Malang Village, Semarang. Journal of Fisheries Resources Utilization Management and Technology, 3(2): 40-46.
8. LIPI. 2003. What Microsoft Excel Can Do to Analyze Data.
9. Malik F. Talib 2008. Mangrove structure and zoning patterns (distribution) of macrozoobenthos living side by side in Tanah Merah and Oebelo. Kupang District village, small. Thesis. Studying science and technology from the Faculty of Fisheries, Marine Sciences and the Agricultural Institute of Marine Sciences, Bogor.
10. Marine. Oceana Journal, Volume XXVIII, Number 4, 2003: 7 – 16.
11. Nontji, Anugrah., 2015. Marine Archipelago. Bridge. Jakarta.
12. Rumalutur, L.M. 2004. Composition of Gastropods in Mangrove Forest Communities on Tameni Island and Raja Island in Gita Village. Central Halmahera Regency, North Maluku. Thesis. Faculty of Fisheries and Marine Sciences, University of Riau, 59 hal.
13. Sari, F. L. Suratno, Susanti, K. 2016. Species of Gastropods in Mangrove Forest Communities on Tameni Island and Raja Island, Gita Village, Central Halmahera Regency, North Maluku. Bogor Agricultural Institute.
14. Tis'in, M. 2008. Mangroe Typology and Relationship to Gastropod Littorina neritoides (LINNE, 1758) populations in the Tanakeke Archipelago, Takalar Regency, South Sulawesi. Scientific Publications. Thesis. Graduate School. ITB. Bogor.
15. Tony. F., Lestarina. P.M., Ilmy. Novreza D. Y., Iskandar R. 2022. The Relationship Of Bivalvia Affairs To Mangrove Density In Pt Arutmin Indonesia Kintap Mining Area Mekarsari Village, Tanah Laut Regency South Kalimantan Province. (IJEAB). ISSN: 2456-1878, DOI: 10.22161/ijeab.
16. Tony. F., Lestarina. P.M., Son. A., Iskandar R. 2022. Amount Stock of Blue Carbon in Mangrove on the Area of Pt Arutmin Indonesia Kintap Mine Mekarsari Village, Tanah Laut Regency, South Kalimantan. International Journal of Environment, Agriculture, and Biotechnology (IJEAB). ISSN: 2456-1878, DOI: 10.22161/ijeab.