Fisheries Journal, 14(3), 1416-1427 (2024)
http://doi.org/10.29303/jp.v14i3.975

MACROZOOBENTHOS ABUNDANCE IN THE MANGROVE AREA OF TANAH MERAH SAMBOJA KUTAI KARTANEGARA EAST KALIMANTAN

Kelimpahan Makrozoobentos di Wilayah Mangrove Pantai Tanah Merah Samboja Kutai Kartanegara Kalimantan Timur

Irwan Ramadhan Ritonga, Irma Suryana, Elisar*

Aquatic Resources Management Study Program, Faculty of Fisheries and Marine Sciences, Mulawarman University

Gn. Tabur Street, Gn. Kelua, Samarinda Ulu District, Samarinda City, East Kalimantan 75242

*Coresponding author: elisarrr27@gmail.com

(Received June 19th 2024; Accepted September 24th 2024)

ABSTRACT

Tanah Merah Beach is a coastal area of Samboja in East Kalimantan, which is a local tourist destination. The association of coastal ecosystems can be shown by macrozoobenthos, as one of the biota components in coastal areas to mangroves. This study identifies the species, calculates the abundance, and analyses the ecological index of macrozoobenthos, as well as looking at the relationship between nutrients and sediment texture with the number of macrozoobenthos found. The purpose of this research is to determine the condition of nutrients in the sediment substrate to its abundance in the mangrove ecosystem area. Sampling was conducted at three points based on the percentage of mangrove canopy cover in the Monmang version 2.0 application, with each point represented by 3 quadrant points measuring 0.25 m^2. The results showed that the percentage of mangrove canopy cover was categorised as slight-moderate, the abundance of individuals was dominated by the Gastropoda class with 9 species and a small proportion of the Bivalve class. The ecological indices in order are the Diversity Index (H') in the low category, Diversity (E) in the low category, and dominance (C) found Cerithidae sp species dominating each point. The highest abundance was found at radius 2 canopy cover 77.24 - 83.13%. Nutrient content in sediment, nitrate (1.00-16.25 mg/L), phosphate (29.01-83.94 mg/L), organic carbon (2.23-3.24%) with confirmed sediment texture of sandy loam. Nitrate content ranged from 1.00-16.25 mg/L, Phosphate 34.65 - 44.51 mg/L and Organic carbon 2.23-3.24% (per mg) in the sediment and a significant effect of phosphate content on Macrozoobenthos abundance was found in the correlation test results.

Keywords: Macrozoobenthos, Organic Carbon, Sediment Substrate, Nitrate, and Phosphate

ABSTRAK

Pantai Tanah Merah adalah wilayah pesisir Samboja Kalimantan Timur, yang menjadi destinasi wisata lokal. Asosiasi ekosistem pesisir dapat ditunjukkan oleh makrozoobentos, sebagai salah

e-ISSN : 2622-1934, p-ISSN : 2302-6049

satu komponen biota di wilayah pantai hingga mangrove. Penelitian ini bertujuan mengidentifikasi jenis, menghitung kelimpahan, dan menganalisis indeks ekologi makrozoobentos, serta mengetahui hubungan antara nutrien dan tekstur sedimen dengan jumlah makrozoobentos yang ditemukan. Tujuan dari penelitan ini untuk mengetahui kondisi nutrien pada substrat sedimen terhadap kelimpahannya di wilayah ekosistem mangrove. Pengambilan sampel dilakukan di tiga titik yang berdasarkan persentase tutupan kanopi mangrove pada aplikasi Monmang versi 2.0, dengan tiap titiknya diwakili oleh 3 kuadran titik berukuran 0,25 m^2. Hasil penelitian menunjukkan persen tutupan kanopi mangrove berkategori sedikit-sedang, kelimpahan individu didominasi kelas Gastropoda dengan 9 spesies dan sebagian kecil kelas Bivalvia. Indeks ekologi secara berurutan adalah Indeks Keanekaragaman (H') berkategori rendah, Keseragaman (E) berkategori rendah, dan dominasi (C) ditemukan spesies *Cerithidae* sp mendominasi setiap titik. Kelimpahan tertinggi ditemukan pada radius 2 tutupan kanopi 77.24 – 83.13%. Kandungan nutrien pada sedimen, nitrat (1,00-16.25 mg/L), fosfat (29.01-83.94 mg/L), karbon organik (2.23-3.24%) dengan tekstur sedimen terkonfirmasi lempung berpasir. Kandungan Nitrat berkisar antara 1,00-16.25 mg/L, Fosfat 34.65 – 44.51 mg/L dan Karbon organik 2.23-3.24% (per mg) dalam sedimen serta ditemukan pengaruh signifikan dari kandungan fosfat terhadap kelimpahan Makrozoobentos dalam hasil uji korelasi.

Kata Kunci: Makrozoobentos, Karbon Organik, Substrat Sedimen, Nitrat, Fosfat

INTRODUCTION

Tanah Merah Samboja Beach is a fairly well-known tourist attraction located in Samboja Kutai Kartanegara, just like beaches in general, this beach is also influenced by both human activities and natural activities that can be one of the influences on the quality of the waters. The mangrove ecosystem in coastal areas has a very important role in maintaining environmental balance, the mangrove ecosystem not only protects the coast but also provides a habitat for organisms as a place to find food and support various other activities (Isman *et al*., 2018). The mangrove ecosystem has the capacity to produce organic matter that functions as an indicator of water quality and supports the life of organisms around it, one group of organisms that interact with organic matter in sediments in the coastal mangrove area is macrozoobenthos. According to Nordhaus *et al*. (2012) stated that macrozoobenthos are organisms that live on the bottom of the waters with sedentary behavior and limited movement, and function as indicators of environmental quality. Factors that can affect the life of macrozoobenthos include pH, salinity, dissolved oxygen, type of sediment substrate. Basically, sediment substrates in coastal areas can affect the composition and fertility of marine ecosystems, this can be caused because sediment substrates are able to store nutrients needed for the growth and development of aquatic ecosystems. Riniatsih *et al*. (2001) stated that substrates at the bottom of the waters consisting of sandy mud in general, contain high nutrients and have an impact on the sustainability and development of marine organisms in coastal areas including macrozoobenthos. In addition, the diversity of macrozoobenthos structures is an indicator of water quality because the composition and density of macrozoobenthos are influenced by the level of tolerance or sensitivity to environmental changes. Macrozoobenthos is a group of organisms with a sedentary life phase that functions as a filter feeder and deposit feeder, and is able to filter polluted materials through their own bodies (Ulfa *et al*., 2017). One way to find out the role of nutrients in sediment substrates in mangrove areas on macrozoobenthos is by conducting investigations in mangrove areas, this is a habitat for the sustainability of life and the development of macrozoobenthos. Ecosystem changes caused by human activities such as forest conversion and tourism activities can have great potential to affect the environment and abundance of macrobenthos in the mangrove ecosystem. Research on macrobenthos has been conducted in several locations including East

e-ISSN : 2622-1934, p-ISSN : 2302-6049

Kalimantan (Irawan, 2003; Makri & Supriyadi, 2018) and North Kalimantan (Mislan, 2021), but in these studies only discussed the abundance of macrobenthos in coastal areas, and have not and have not discussed the relationship between sediment nutrients and their abundance in the mangrove ecosystem area. Therefore, the purpose of this study was to determine the nutrient conditions in the sediment substrate on the sustainability of macrobenthos life in the mangrove area of Tanah Merah Samboja Beach, Kutai Kartanegara Regency, East Kalimantan.

METHODS

The time and implementation of the research were carried out within a period of 3 months starting from April - July 2023, sampling was carried out in the mangrove area of Tanah Merah Samboja Beach, Kutai Kartanegara Regency, East Kalimantan Province. The tools used include sample bottles, cool boxes, cores (3-inch PVC pipes), DO meters, 50x50cm quadrants, macrozoobenthos filters, meters, cellphones, hand refractometers, markers, shovels, and the Compendium of Seashells identification book (Abbott & Dance, 1998). The materials used are 70% alcohol, distilled water, macrozoobenthos samples and sediment.

Figure 1. Map of Research Location

Location determination was carried out at the lowest ebb using the purposive sampling method, based on the condition of the mangrove canopy cover using the Monmang application version 2.0. Sampling points were placed based on the percentage of mangrove cover that could represent dense, medium and low canopies. Macrobenthos sampling was carried out directly to a depth of ± 0 - 10 with the help of a shovel. Then continued with sieving so that the sediment and macrobenthos were separated. Macrobenthos samples were separated based on their sampling points and collected in bottles with maceration of distilled water and alcohol (1:1). All samples were stored until the identification stage in a coolbox. Sediment sampling was also carried out for each point using a core tool (modified with PVC) to a depth of 20 cm (Isman *et al*., 2018). Analysis of macrobenthos abundance index using the following formula:

1. Individual abundance, using the formula from (Odum, 1993):

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

Description:
Di : macrobenthos abundance (ind/m^2).
∑Ni : Number of macrobenthos at point (ind).
A : Transect area (m^2).

e-ISSN : 2622-1934, p-ISSN : 2302-6049

2. Diversity Index (H'), using the Shannon-Wiener formula (Choirudin *et al*., 2014):

$$H' = \sum_{i=1}^{s} pi \, ln \, pi$$

Description:
H' : Diversity index species
Ni : Number of species individuals
N : Total number of individuals
Pi (ni/N) : Number of individuals of each species (i = 1,2,3,…)

Diversity index category:
- H' = < 1 → low diversity.
- H' = 1 – 3 → moderate diversity.
- H' = > 3 → high diversity.

3. Uniformity Index (E), using the formula (Odum, 1993):

$$E = \frac{H`}{\text{In S}}$$

Description:
E : Species uniformity index
H' : Species diversity index
In S : Number of organism species

Uniformity index category:
- E > 0.6 : High uniformity.
- 0.4 < E < 0.6 : Moderate uniformity.
- E < 0.4 : Low uniformity.

4. Dominance Index (C), using the Dominance of Simpson formula (Odum, 1993):

$$C = \sum[\frac{ni}{N}]^2$$

Description:
C : Dominance index
Ni : Number of individuals of each species
N : Total number of individuals

Dominance index value category:
0<Di<0.5 : no species dominates.
0.5 < Di < I : there are dominant species.

Nutrient analysis includes phosphate analysis using the Olsen method at a wavelength of 700 nm, nitrate analysis using the Morgan Wolf method at a wavelength of 460 nm and organic carbon analysis using the Walkey and Black method at a wavelength of 560 nm with a spectrophotometer. Analysis of sediment substrate texture and fractions using the pipette method and classified using the Wenworth scale then determination of soil texture using the USDA soil texture triangle (Foth, 1998). Data analysis using Microsoft Windows Excel 2010. Furthermore, the relationship between nutrients and macrozoobenthos was analyzed using polynomial regression. The level of significance used in this study was α = 0.05 with a confidence level of 95%.

e-ISSN : 2622-1934, p-ISSN : 2302-6049

RESULT

a. Physical and Chemical Parameters

The results obtained are as follows presented in Table 1.

Table 1. Physical and Chemical Parameters of Waters in the Mangrove Area of Tanah Merah Samboja Beach

Physical and Chemical Parameters	Value	Quality Standards*
Salinity (ppt)	28 ppt	33 – 34
Temperature (°C)	29°C	28 – 32
pH	7.0	7-8.5
Dissolved Oxygen (mg/L)	6.4	>4

Source: Decree of the Minister of Environment of the Republic of Indonesia (2004) concerning seawater quality standards for marine organisms.

C

b. Identification and Composition of Macrozoobenthos

The results of the identification of the names of gastropod and bivalve species are presented in Figure 2.

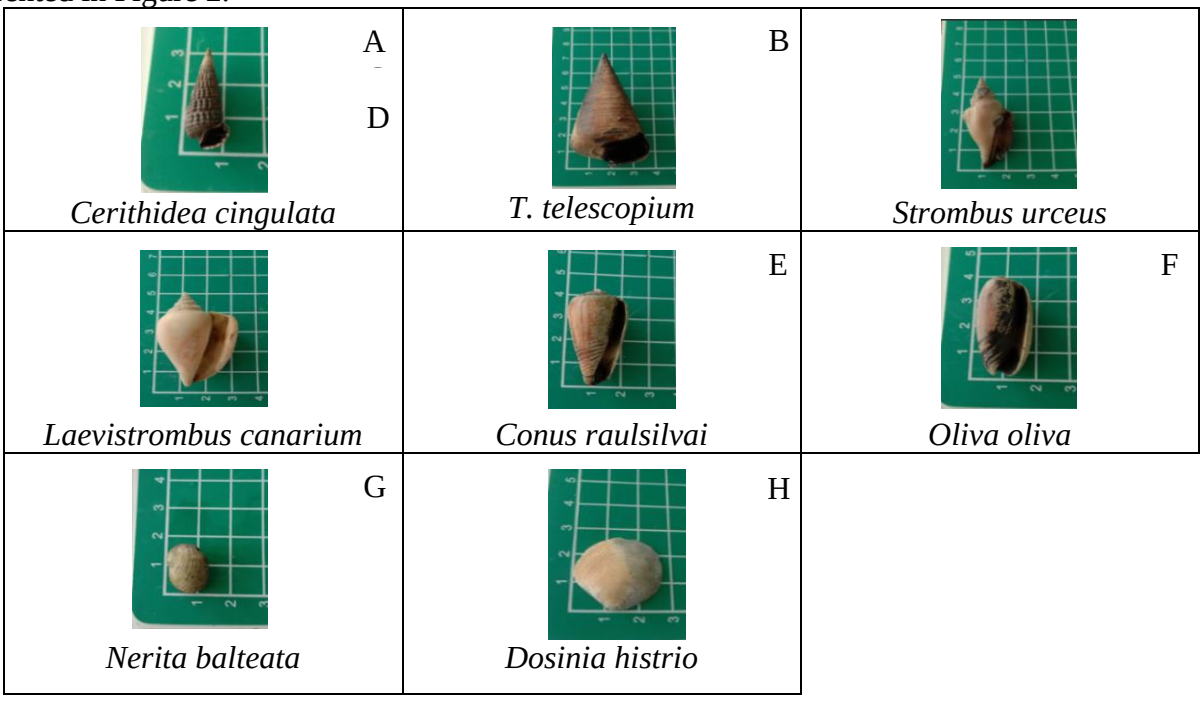

Figure 2. Types of Macrozoobenthos Identified; A. *Cerithidae cingulata*, B. *T. telescopium*. C. *Strombus urceus*, D. *Laevistrombus canarium*, E. *Conus raulsilvai*, F. *Oliva oliva*, G. *Nerita balteata*, H. *Dosinia histrio*.

c. Abundance of Macrozoobenthos Individuals

The following is the result of the bar diagram of macrozoobenthos abundance (ind/m^2):

e-ISSN : 2622-1934, p-ISSN : 2302-6049

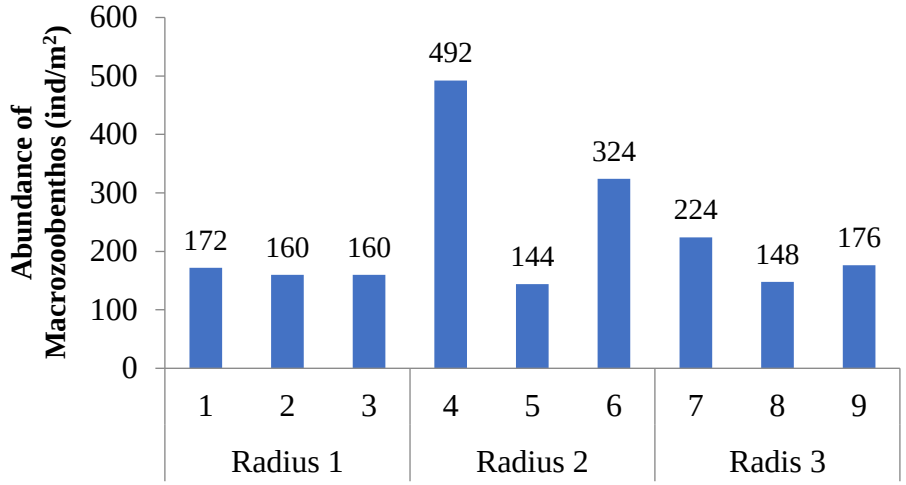

Figure 3. Diagram of Abundance of Individual Macrozoobenthos (ind/m^2)

d. Macrozoobenthos Index

Table 2. Value of Diversity Index (H'), Evenness (E), and Dominance (C)

Radius	(H')	Category	(E)	Category	(C)	Category
1	0.195	Low	0.281	Low	0.907	Dominate
2	0.170	Low	0.122	Low	0.936	Dominate
3	0.342	Low	0.191	Low	0.864	Dominate

e. Substrate and Nutrient Analysis in Tanah Merah Samboja Beach Sediment

Table 3. Percentage of Mangrove Canopy and Sediment Content

Point		1	2	3	BM
Nutrient	Nitrate (Mg/L)	1	5.5	15.25	0.008
	Phosphate (Mg/L)	44.51	34.65	41.69	0.015
	Organic Carbon (%)	2.23	2.9	3.24	
Sediment Fraction	Sand (%)	25.39	21.38	25.45	-
	Clay (%)	57.59	45.09	57.62	-
	Dust (%)	17.02	33.53	16.39	-
	Category	Sandy loam	Clay	Sandy loam	-
Mangrove Canopy Cover		67.03% - 61.22% (*poor*)	77.24% - 80.95% (moderate)	72.78% - 81.10% (moderate)	
Mangrove Types (visual)		*Avicennia* sp, *Nypa fruticans*	*Rhizhopora* sp	*Avicennia* sp, *Nypa fruticans*	

Processed Primary Data (2023)

f. Relationship of Nutrients (Nitrates, Phosphate, and Organic Carbon) with Macrozoobenthos

e-ISSN : 2622-1934, p-ISSN : 2302-6049

The following is a graphical image of the relationship between nutrients (nitrates, phosphates, and organic carbon) with macrozoobenthos:

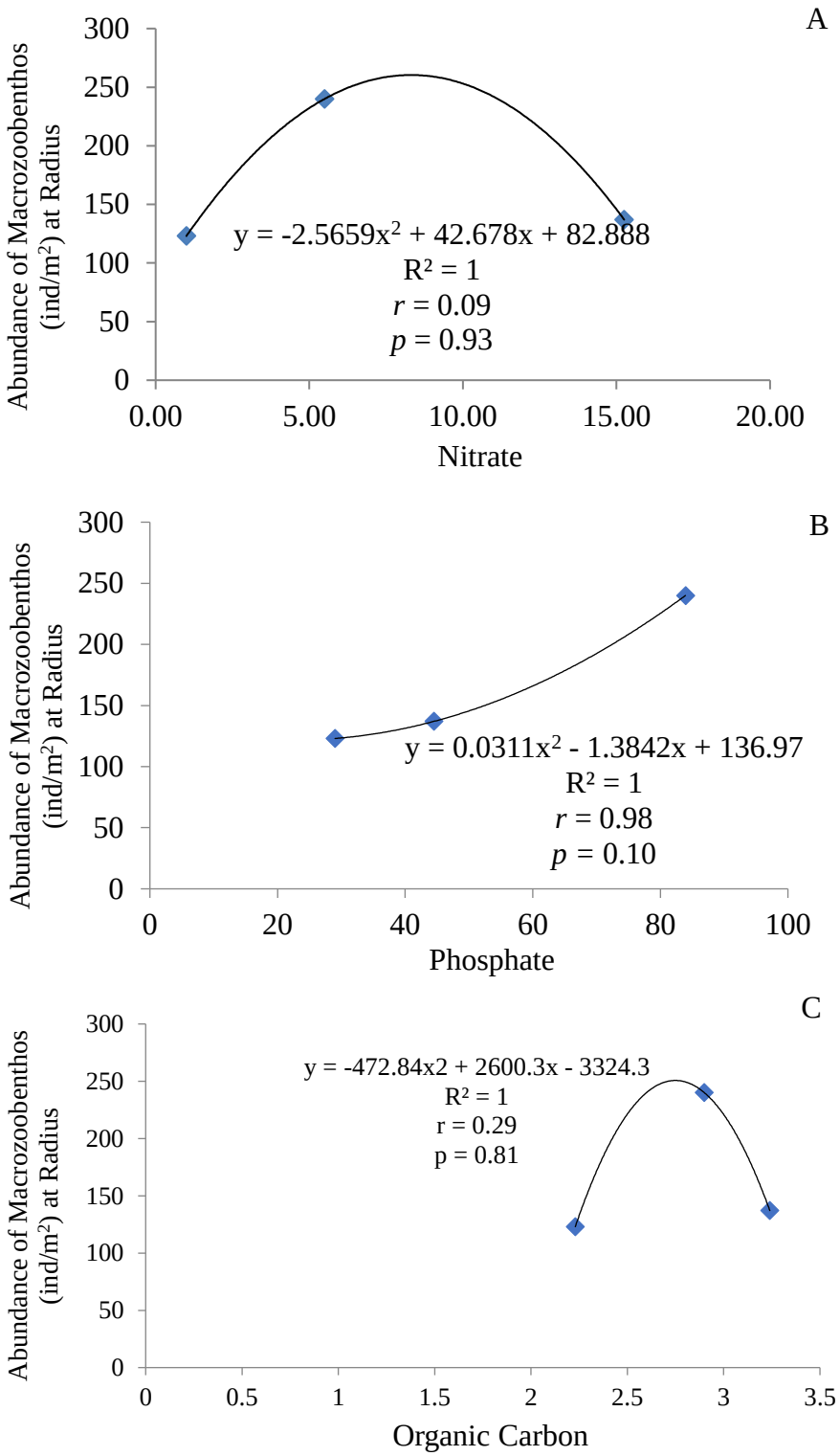

Figure 4. Graph of the Relationship Between Nutrients (Nitrate (A), Phosphate (B), and Organic Carbon (C)) and Macrozoobenthos

DISCUSSION

a. Environmental Parameters

The results of the salinity data (Table 1) of the waters obtained 28 ppt in this case, the

e-ISSN : 2622-1934, p-ISSN : 2302-6049

salinity in these waters is low from the standard quality standards set by the Decree of the Minister of Environment of the Republic of Indonesia (2004). Low salinity values can be influenced by several factors, one of which is the entry of fresh water, high rainfall, this can cause low salinity because rainwater dissolves and reduces salt concentration, in these waters, in addition, the flat topography causes the area to be inundated by water. Previous research results Dewi & Herawatiningsih (2017) stated that low salinity was caused by a mixture of sea water and fresh water from rivers and rainfall. The water temperature at the research location was 29°C, in this case it is still in accordance with the standard quality provisions set by the Decree of the Minister of Environment of the Republic of Indonesia (2004), which is between 28 - 32°C, this indicates that the temperature at the research location is ideal for macrozoobenthos habitat. The pH value obtained was 7.0, which is normal and in accordance with the standard quality values set. The value (DO) obtained was 6.4 mg/L, this is still in accordance with the standard value that has been set. The higher the dissolved oxygen concentration, the more macrobenthic life (Bai'un *et al*., 2021).

The pH value obtained in this research area was 7.0, which shows that the pH value is included in normal conditions and is suitable for the life of organisms. This is in accordance with the standards of the Decree of the Minister of Environment of the Republic of Indonesia (2004) concerning seawater quality standards for marine organisms. Dissolved Oxygen (DO) was obtained at 6.4 mg/L, this is in accordance with the Decree of the Minister of Environment of the Republic of Indonesia (2004) concerning seawater quality standards for marine organisms. Basically, the amount of oxygen content has an impact on the life of a body of water, the higher the dissolved oxygen concentration, the more macrobenthic life (Bai'un *et al*., 2021). Meanwhile, the condition of mangrove canopy cover and sediment content can be seen in table 3. Mapped at the sampling location, radius 1 is near the water flow, radius 2 is on the edge of the water flow and radius 3 is the furthest from the water flow. Measurements of the percentage of mangrove canopy cover at the three points did not have dense cover, so there were only 2 categories of canopy cover obtained in Macrozoobenthos sampling.

b. Identification and Composition of Macrozoobenthos

Based on the identification results (Figure 2), 2 types of classes and 8 species were obtained, namely the type of gastropod consisting of 7 species, namely *Cerithidea cingulata, T. telescopium, Strombus urceus, L. Canarium, Conus raulsilvai, Oliva oliva, Nerita balteata*, and bivalvia has 1 type of species, namely *Dosinia histrio*. In the results of the type of composition obtained at each point, it is dominated by the Cerithidea cingulata species. This species is a native animal inhabiting the mangrove area (Budiman, 1991) and is included in the group of gastropods that are relatively strong and can adapt well to extreme habitats. Yusuf & Handoyo (2004) stated that the *Cerithidea cingulata* species has a fairly fast breeding pattern, and lives in groups in this case *Cerithidea cingulata* has the ability to move, move, and adapt well to its surroundings.

c. Abundance of Macrozoobenthos Individuals

The abundance of macrozoobenthos in the Tanah Merah Samboja Beach area is highest in Figure 3, obtained radius 2 (points 4 - 6) with an average abundance value of 320 ind/m^2, followed by radius 3 (points 7 - 9) with an average of 183 ind/m^2 and the lowest at radius 1 (points 1 - 3) with an average value of 164 ind/m^2. If viewed from the supporting parameters analyzed at the research location (Tables 1 and 3), it can be seen that in addition to the influence of high phosphate tendencies, then from the type of texture it is known that radius 2 is categorized as clay, where the clay texture is more inhabited by the Gastropoda class which is easily adaptable compared to Bivalvia. In addition, clay texture is a characteristic of mangrove habitat and the original habitat of *Cerithidae cigulata*. Mislan (2021) stated that gastropods are

e-ISSN : 2622-1934, p-ISSN : 2302-6049

relatively stronger in adapting to extreme habitats and live relatively on sandy and muddy substrates. Almost the same as gastropods, the presence of the bivalve class at this research location is because this organism also has a fairly good tolerance to environmental changes. This finding is in line with the results of research conducted by Islami (2013) which shows that the bivalve community has an environmental tolerance range, namely from 24°C - 31°C in seawater bottom sediments which can be muddy, clayey, to sandy sediments.

d. Macrozoobenthos Index

Based on the macrozoobenthos diversity index, the results obtained are included in the low category. The low diversity is caused by the waters being infertile. Odum (1993) stated that if the diversity index value is low, it indicates that the waters can be categorized as polluted waters. In general, the uniformity index value of the three radii is relatively low, which indicates that the species uniformity is uneven and the ecosystem is unstable, and indicates pollution in water quality. The value of the dominance index is included in the dominant category because the dominance of the gastropod class is at all points. In the research results of Marpaung *et al*. (2013), which also found dominant gastropod species, because of the ability of these species to adapt.

e. Substrate and Nutrient Analysis in Sediment of Tanah Merah Samboja Beach

Based on Table 3, it can be seen that the Nitrate and Phosphate content is above the quality standard, according to the Decree of the Minister of Environment Number 51 of 2004. Wardoyo (1982) stated that if the nitrate level is >3.5 mg/L, it can endanger waters which results in a decrease in the quality of the aquatic environment, which is negative for mangrove fertility and causes a decrease in the abundance and diversity of macrozoobenthos in the mangrove area. High Nitrate in sediment can be caused by the decomposition of ammonia which undergoes oxidation, so that the process of producing nitrite compounds in the sediment will also trigger the formation of Nitrate in organic form (Radja *et al*., 2023). According to the 2004 KLH standard, the phosphate quality limit for marine biota is 0.015 mg/L, this shows that the phosphate content in Samboja Beach, the mangrove area, has a very high value. According to the results of a study conducted by Yahra *et al*. (2020) also found that the phosphate content was higher than the nitrate content, which was caused by the large amount of waste from human activities that came to visit the beach. Phosphate as a nutrient can come from the weathering or decomposition process of the remains of organisms, the decomposition of dead plants, and waste disposal from various sources on land, including domestic, industrial, agricultural and livestock waste, this can disrupt the stability of pH and other organic materials in the soil.

Reynolds (1971) stated that there are types of organic carbon categories, namely, very low less than 1%, low 1-3%, moderate 3-6%, high 6-17%, and more than 17% is very high. Organic carbon in table 3 has a different classification group where the third radius (3.24%) is included in the moderate category, and the first radius (2.23%) and second (2.90%) are included in the low category. The highest organic carbon content is in the third radius. Measurement of canopy cover at point 3 showed the highest percentage of canopy cover, namely between 72.78% - 81.25% with mangrove health included in the moderate category based on measurements using the MonMang application version 2.0. Canopy cover greatly affects the storage of organic matter, because dense canopy cover has a significant impact on the storage of organic matter because it can maintain moisture and nutrient availability. In this area there are many leaf litter and tree branches that fall to the surface of the soil which then become a food source for benthos.

The sediment fraction shows the categories of Clay and Sandy Loam, the difference in the category of this type of substrate has a different capacity to store organic matter, which is due to the difference in texture density. According to Barus *et al*. (2019), that substrates

e-ISSN : 2622-1934, p-ISSN : 2302-6049

containing sandy clay can increase the absorption of organic matter and in Rizki & Leilani (2020) stated that the absorption of organic matter in sediment is supported by the growth of mangrove vegetation, which is in fairly calm waters and quite close to human activities. Meanwhile, for types of clay such as those found in the second radius, they have very fine particles and fairly small pores compared to sand which has large pores and larger particles (Asrar.A & Nuraisyah, 2019). This allows the clay substrate to precipitate organic matter in quite large quantities compared to sandy substrates, but because radius 2 is located close to the water flow, some organic matter can allow organic matter to be carried away by the current.

f. Nutrient Relationship (Nitrate, Phosphate, and Organic Carbon)

The relationship between nitrate content and macrobenthos, (image A) shows a polynomial with the equation $y = -2.5659x^2 + 42.678x + 82.888$, coefficient of determination (R^2) = 1, and correlation (r) = 0.09. This finding shows that nitrate has a relationship to macrobenthos abundance of 100%. (image B) shows the equation $y = 0.0311x^2 - 1.3842x + 136.97$, coefficient of determination (R^2) = 1, and correlation (r) = 0.98. This finding shows that phosphate has an effect on macrobenthos of 100%. The significant value of nitrate obtained was 0.93 ($\alpha = 0.05$) with a low correlation value (r = 0.09), indicating that there was no significant effect. The significant value of phosphate obtained was 0.10 ($\alpha = 0.05$) with a correlation value included in the very strong category (r = 0.98) and did not influence each other. Therefore, nitrate and phosphate do not play a significant role in influencing the existence of macrozoobenthos. According to Kurniawan *et al*. (2016) phosphate can come from household, industrial, agricultural, livestock, and fishery waste. High phosphate concentrations can be influenced by fertilizers, detergents, industrial and household waste, Azzahra *et al*. (2022) stated that the decomposition of organic matter in sediment is also the main source of phosphate. The high and low levels of nutrients in waters have an impact on the entry of organic matter carried by water currents.

The relationship between organic matter and the abundance of macrozoobenthos obtained a polynomial equation $y = -472.84x^2 + 2600.3x - 3324.3$ with a coefficient of determination (R^2) = 1 and correlation (r) = 0.29. This shows that organic matter affects the abundance of macrozoobenthos 100%. Research by Barus *et al*. (2019) stated that sandy clay sediment substrates are more effective in binding organic matter compared to sand substrates that have a coarse and separate texture. The significant value of organic carbon obtained was 0.81 ($\alpha = 0.05$) while the correlation value obtained was included in the very low category (r = 0.29). It was concluded that the relationship between organic carbon content and macrozoobenthos had a low relationship and did not influence each other. Of all the locations, only one point (radius) has a muddy texture (Table 3), this is stated in Barus *et al*. (2019) who stated that muddy sediment substrates are better at binding organic matter than sand substrates which do not bind much organic matter because they have a rough texture and are separate.

CONCLUSION

Based on the research data that has been obtained, the mangrove area of Tanah Merah Samboja Beach has 2 types of macrozoobenthos, namely gastropods and bivalve. There are 7 species of gastropods found, including *Cerithidea cingulata, T. telescopium, Strombus urceus, L. Canarium, Conus geographus, Olivia reticulata, Nerita balteata*, and bivalve has 1 type of species, including *Dosinia histrio*. The composition of gastropods is dominated by the *Cherithidea cingulata* species found at all points, this type of bivalve gastropod is the least found. The highest abundance of macrozoobenthos is at radius 2 with an average value of 320 ind/m^2, followed by the third radius with an average value of 183 ind/m^2, and finally radius one with an average value of 164 ind/m^2. The sediment substrate is dominated by sandy clay. Diversity Index (H') are all included in the low category, uniformity index (E) are all included

e-ISSN : 2622-1934, p-ISSN : 2302-6049

in the low category. and dominance index (C) are all included in the dominating category. The relationship between nutrients and the abundance of Macrozoobenthos obtained strong determination values from Nitrate, Phosphate and Organic Carbon, weak correlation values by Nitrate, very strong by Phosphate, and strong by Organic carbon, but the p value showed no significance for the three types of nutrients.

ACKNOWLEDGEMENT

Thank you to all parties who have helped this research so that the research can be completed.

REFERENCES

Abbott, R. T., & Dance, S. P. (1998). *Compendium of seashells: a color guide to more than 4200 of the world's marine shells*. Odyssey Publishing.

Asrar.A, M., & Nuraisyah. (2019). *Pengaruh Variasi Debit Pengaliran Terhadap Laju Infiltrasi Pada Saluran Drainase Berselinder Pori (Skripsi)*. Universitas Muhammadiyah Makssar 2019.

Azzahra, A. F., Munasik, M., & Djunaedi, A. (2022). Kandungan Nitrat (NO3-) dan Fosfat (PO4-3) pada Sedimen terhadap Kondisi Penutupan Lamun di Pantai Prawean Jepara. *Journal of Marine Research*, *11*(4), 648–656. https://doi.org/10.14710/jmr.v11i4.33924

Bai'un, N. H., Riyantini, I., Mulyani, Y., & Zallesa, S. (2021). Keanekaragaman Makrozoobentos Sebagai Indikator Kondisi Perairan Di ekosistem Mangrove Pulau Pari Kepulaun Seribu. *JFMR-Journal of Fisheries and Marine Research*, *5*(2), 227–238. https://doi.org/10.21776/ub.jfmr.2021.005.02.7

Barus, B. S., Aryawati, R., Putri, W. A. E., Nurjuliasti, E., Diansyah, G., & Sitorus, E. (2019). Hubungan N-Total dan C-Organik Sedimen Dengan Makrozoobentos di Perairan Pulau Payung, Banyuasin, Sumatera Selatan. *Jurnal Kelautan Tropis*, *22*(2), 147. https://doi.org/10.14710/jkt.v22i2.3770

Budiman, A. (1991). *Penelaahan beberapa gatra ekologi moluska bakau Indonesia*. Depok.

Choirudin, I., Supardjo, M. ., & Muskananfola, M. . (2014). Stusi Hubungan Kandungan Bahan Organik Sedimen dengan Kelimpahan Makrozoobenthos di Muara Sungai Wedung Kabupaten Demak. In *Diponegoro Journal of Maquares* (Vol. 3, Issue 3, pp. 168–176).

Dewi, S. K., & Herawatiningsih, R. (2017). Kondisi tanah dalam kawasan mangrove di Desa Nusapati Kabupaten Mempawah Kalimantan Barat. *Jurnal Hutan Lestari*, *5*(2), 177–182.

Foth, H. D. (1998). *Dasar-dasar Ilmu Tanah*. Penerbit Gadjah Mada.University Press.

Irawan, A. (2003). *Asosiasi Makrozoobentos Berdasarkan Letak Padang Lamun di Estuaria Bontang Kuala Kota Bontang Kalimantan Timur* [Institut Pertanian Bogor]. https://doi.org/10.24843/JBIO UNUD.2016.v20.i01.p03.

Isman, M., Mashoreng, S., Werorilangi, S., Isyrini, R., Rastina, Faizal, A., Tahir, A., & Burhanuddin, A. I. (2018). Komunitas Makrozoobentos pada Kondisi Mangrove Berbeda: Hubungannya dengan Karakteristik Kimia-Fisika Sedimen. *Torani: Journal of Fisheries and Marine Sciences (JFMarSci)*, *1*(2), 40–47. smashoreng@unhas.ac.id

Kurniawan, K., Ida, A., & Purwiyanto, A. I. S. (2016). Hubungan Nitrat, Fosfat Dan Ammonium Terhadap Keberadaan Makrozoobentos Di Perairan Muara Sungai Lumpur Kabupaten Ogan Komering Ilir Sumatera Selatan Relationship of Nitrate , Phosphate , and Ammonium To the Existence of Macrozoobenthos in Lumpur Estuary,. *Maspari Journal*, *8*(51), 101–110. https://doi.org/https://doi.org/10.56064/maspari.v8i2.3486

M.Islami, M. (2013). Pengaruh suhu dan salinitas terhadap bivalvia. *Oseana*, *38*(2), 1–10. https://www.researchgate.net/publication/274842040%0APengaruh

e-ISSN : 2622-1934, p-ISSN : 2302-6049

Makri, & Supriyadi, F. (2018). Keanekaragaman Makrozoobentos Di Estuari Sungai Mahakam Bagian Tengah Provinsi Kalimantan Timur. *Maspari Journal*, *10*(2), 179–184. https://doi.org/https://doi.org/10.56064/maspari.v10i2.5952

Marpaung, A. A. F., Yasir, I., & Ukkas, M. (2014). Keanekaragaman makrozoobenthos di ekosistem mangrove silvofishery dan mangrove alami di Kawasan Ekowisata Pantai Boe, Kabupaten Takalar, Sulawesi Selatan. *Bonorowo Wetlands 4*, *4*(June), 1–11. https://doi.org/10.13057/bonorowo/w040101

Mislan. (2021). *Studi keanekaragaman makrozoobentos Di Pantai Timur Pulau Sebatik Kabupaten* (Issue March). Universitas Borneo Tarakan.

Odum, E. P. (1993). *Dasar-dasar ekologi/ penerjemah Tjahjono Samingan.Ed.3* (Srigando (ed.)). Yogyakarta Gadjah Mada University Press.

Radja, C. H., Nauli, L., Toruan, L., & Kangkan, A. L. (2023). Variabel Kondisi Lingkungan pada Ekosistem Mangrove di Kota Kupang. *Jurnal Vokasi Ilmu-Ilmu Perikanan (JVIP)*, *4*(November), 19–28. https://doi.org/http://dx.doi.org/10.35726/jvip.v4i1.1740

Reynolds, S. G. (1971). *A manual of introductory soil science and simple soil analysis methods* (South Paci). South Pacific Commission.

Rizki, & Leilani, I. (2020). Sebaran Jenis Tumbuhan Mangrove Di Teluk Buo Bungus Padang Indonesia. *Biotropika: Journal of Tropical Biology*, *8*(1), 1–7. https://doi.org/10.21776/ub.biotropika.2020.008.01.01

Ulfa, M., Julyantoro, P. G. S., & Sari, A. H. W. (2017). Keterkaitan Komunitas Makrozoobentos dengan Kualitas Air dan Substrat di Ekosistem Mangrove Taman Hutan Raya Ngurah Rai Bali. *Journal of Marine and Aquatic Sciences*, *4*(2), 179. https://doi.org/10.24843/jmas.2018.v4.i02.179-190

Wardoyo, S. T. H. (1982). *Water Analysis Manual Tropical Aquatic Biology Program. Biotrop, SEAMEO. Bogor. 81 pp*.

Yahra, S., Harahap, Z. A., Yusni, E., & Leidonald, R. (2020). Analisis Kandungan Nitrat Dan Fosfat Serta Keterkaitannya Dengan Kerapatan Mangrove Di pantai Labu Kabupaten Deli Serdang. *Jurnal Enggano*, *5*(3), 350–366. https://doi.org/https://doi.org/10.31186/jenggano.5.3.350-366

Yusuf, M., & Handoyo, G. (2004). D ampak Pencemaran Terhadap Kualitas Perairan dan Strategi Adaptasi Organisme Makrobenthos di Perairan Pulau Tirangcawang Semarang. *Ilmu Kelautan*, *9*(1), 10–12. https://doi.org/https://doi.org/10.14710/ik.ijms.9.1.41-49

e-ISSN : 2622-1934, p-ISSN : 2302-6049