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THE IMPACT OF COASTAL RECLAMATION ON THE EXISTENCE OF MACROZOOBENTHOS IN THE NAGARI MANDEH WATER AREA, PESISIR SELATAN DISTRICT, WEST SUMATRA

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ABSTRACT

This research aims to determine the description of the presence of macrozoobenthos which is thought to have been affected by coastal stockpiling which has recently been carried out around the Mandeh Tourism Area. This research was conducted in January - March 2022, the method used in this research is purposive sampling with sampling using the transect method. The results of this study indicate that the water quality of Nagari Mandeh is sufficient to support the life of macrozoobenthos, the macrozoobenthos found consist of 10 families, namely *Arciidae, Cardiidae, Cerithiidae, Fasciolariidae, Neritidae, Potamididae, Psammobiidae, Tellinidae, Turbinidae,* and *Strombidae*. The type of sediment in the waters of Nagari Mandeh consists of gravel sand, colloid, sandy silt, silty sand, and sandy gravel. The content of total organic matter (BOT) from sediments in the waters of Nagari Mandeh was found to be in the range of 8.08% - 15.25% (medium). Coastal reclamation activities do not have an impact on the presence and diversity of macrozoobenthos but have an impact on the types of individuals living around the reclamation area.

Keywords: Reclamation, Macrozoobenthos, Organic Material Content

1. INTRODUCTION

Mandeh area is located in Nagari Nanggalo, Koto XI Tarusan District, Pesisir Selatan Regency, which is directly adjacent to Padang City. This location is called the Mandeh Tourism Area because one of the areas in this area is called Nagari Mandeh which is in the middle of Carocok Tarusan Bay. The areas included in the scope of the Mandeh Area are Nagari Mandeh, Sironjong Besar Island, Sironjong Ketek, and Cubadak Island.

Various human activities in coastal areas can lead to changes in coastal structure from its natural condition, either naturally occurring such as siltation and erosion, or artificially such as coastal reclamation activities[1]. Coastal reclamation is the process of expanding land in coastal areas by filling the sea with certain materials, which can be rocks, soil, or sand to increase the benefits of the coastal area. With reclamation activities, the new land will be formed that can be utilized for various developments. However, before reclamation is carried out, it must require extensive planning and time-consuming discussions so that reclamation is agreed to be carried out in a coastal area.

Coastal reclamation can also result in changes or disturbances to the ecosystem around the reclaimed area. These may include changes in current patterns, erosion, sedimentation, and changes in the composition and abundance of biota living in the reclaimed water environment. Another impact of reclamation efforts is increased water turbidity. Beach filling without considering ecological aspects can be a threat to the ecosystem and the biota that live there.

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In general, coastal areas are home to macrozoobenthos, biota that can adapt after reclamation will be able to survive in the environment, while biota that cannot adapt will try to move to a place that is safer for them, while biota that cannot adapt and cannot move will certainly be buried and experience death which may occur extinction of these species in areas that have been reclaimed.

Thus, the existence of coastal reclamation in the Mandeh Tourism Area is thought to affect the presence of macrozoobenthos found there. Therefore, this study needs to be conducted to determine the presence of macrozoobenthos that are thought to be affected by the beach fill that has recently been carried out around the Mandeh Tourism Area, Pesisir Selatan, West Sumatra Province.

2. RESEARCH METHOD

Time and Place

This study was conducted in January - March 2022, and sampling was conducted in the Nagari Mandeh Tourism Area of West Sumatra Province.

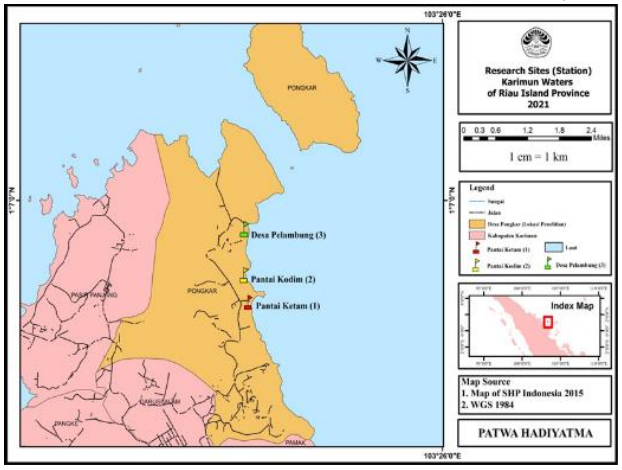

Figure 1. Map of research locations

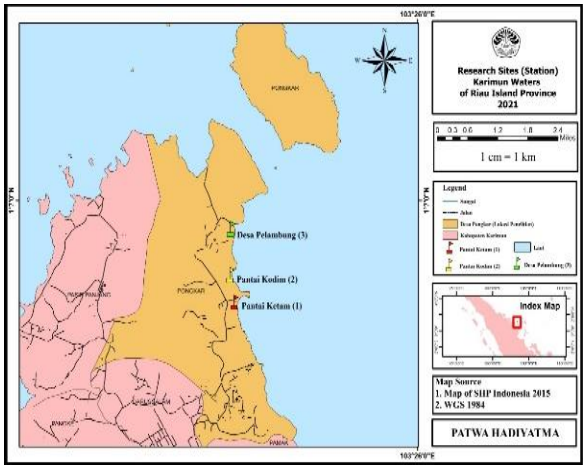

Figure 2. Research station map

Method

Sampling stations were determined based on purposive sampling techniques, station 1 on the beach with mangrove conditions that have been damaged by beach filling (around the coastal reclamation area), and station 2 on the beach with mangrove conditions that are quite good (in areas that are estimated to be minimally affected by coastal reclamation), and station 3 on the beach with mangrove conditions that are still in good condition (in areas that are estimated not to be affected by coastal reclamation at all).

Procedure

Data collection was conducted at the lowest tide to obtain a wider *sampling* area to facilitate the sampling of macrozoobenthos. The *sampling* technique was carried out using the transect method, each transect is given three quadrants (plots). Sampling in the plots was done by taking direction and sieving, namely by digging the substrate as deep as ± 20 cm and then sieving using a sieve to separate the sample from the substrate.

In addition to macrozoobenthos samples, this study also measured water quality, namely temperature using a Thermometer, salinity using a hand refractometer, temperature using universal paper, and sediment sampling was also carried out to analyze sediment type and total sediment organic matter content.

Furthermore, the data obtained was analyzed quantitatively using the following formulas:

Species Diversity Index (H')

The species diversity index was calculated using the Shannon and Wienner index[2]:

$$H' = -\sum_{i=1}^{n} pi\ Ln\ pi$$

Note:
H' = diversity index
Pi = ni / N ni= number of individuals of each i-th species
N = total number of individuals
Ln = Logarithmic nature

The diversity index categories according to Shannon-Wiener are defined as follows: H' value < 1: low species diversity; value 1< H'<3: medium species diversity; H' > 3: high species diversity

Index of Uniformity (E)

The uniformity index was calculated using the following formula[2]:

$$E = \frac{Hi}{Hmax}$$

Note:
E = uniformity index
H' = Shannon Wiener's diversity index
Hmax = ln S
S = number of species

The Shannon-Wiener uniformity index categories are defined as follows: 0 ≤ E < 0,4: Low uniformity; 0,4 ≤ E < 0,6: Medium uniformity 0, 6 ≤ E < 1: High uniformity.

Dominance Index (C)

The dominance index was calculated based on Simpson's dominance index formula[2]:

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

Note:
C = dominance index
ni = number of i-th individuals
N = total number of individuals

With the Shannon - Wienner dominant index category: C close to (0 to 0.5) = no dominating species; C close to (0.5 to 1) = there is a dominating species

Sediment Fraction and Type Analysis

Analysis of sediment fractions in the laboratory follows procedures referring to Rifardi[3], namely analysis of sediment grain size for the sand and gravel fraction using the wet sieving method, and for the mud fraction analyzed by pipette method. The results of calculations on the particle size content of gravel, sand, and mud in surface sediments were classified according to *Sheppard* diagrams to determine the type of sediment.

Sediment Total Organic Matter Content

Analysis of BOT content was carried out using the loss on ignition (LOI) method[4].

$$\text{BOT } (\%) = \frac{\text{a-c}}{\text{a-b}} \text{x } 100\%$$

Note:
a = the total weight (cup + sample) after drying at 105 ^{o}C,
b = the weight of the cup, and
c = weight of cup + sample after combustion at 550 ^{o}C

3. RESULT AND DISCUSSION

Macrozoobenthos

Macrozoobenthos found at Station 1 consisted of different *families* namely *Fasciolariidae* (*Latirus philberti*), *Neritidae* (*Nerita polita*), *Potamididae* (*Cerithidea cingulata* and *Potamididae archives*), and *Strombidae* (*Strombus pugilis*), can be seen in Table 1.

Macrozoobenthos found in Station 1 (coastal reclamation area) found as many as 8 species consisting of 5 families, and the most commonly found species is Cerithidea cingulata, this biota is found attached to the rocks around the reclamation area and on mangrove trees. This species has a thick and strong shell, with this shell making it possible for this biota to adapt to various environmental conditions. This is reinforced based on the results of research by Arfah et al.[5] which said that the abundance of Cerithidea cingulata was found attached to rocks, mangroves, and also in industrial areas.

The macrozoobenthos found at this station was only from the gastropod class, this is thought to be since during sampling in the lower zone it was found that the substrate smelled foul due to the mixture of reclamation materials on the area, the discovery of bivalves in the form of shells also strengthens the suspicion that these bivalves are biota that cannot move and cannot adapt to the impact of coastal reclamation on the area.

Table 1. Macrozoobenthos samples at station 1

No.	Species Name	Plot 1	Plot 2	Plot 3	Total
1	*Cerithidea cingulata*	8	13	2	23
2	*Latirus philberti*	3	2	-	5
3	*Nerita Polita*	1	6	-	7
4	*Potamididae archives*	3	1	-	4
5	*Strombus pugilis*	-	-	1	1

Table 2. Macrozoobenthos samples at station 2

No.	Species Name	Plot 1	Plot 2	Plot 3	Total
1	*Clypeomorus batillariaeformis*	26	13	3	42
2	*Latirus philberti*	-	1	-	1
3	*Nerita Polita*	-	1	2	3
4	*Potamididae archives*	1	-	-	1
5	*Septifer bilocularis*	-	-	1	1
6	*Telescopium telescopium*	-	-	1	1

Table 3. Macrozoobenthos samples at station 3

No.	Species Name	Plot 1	Plot 2	Plot 3	Total
1	*Cerithidea cingulata*	3	1	-	4
2	*Clypeomorus batillariaeformis*	4	7	-	11
3	*Latirus philberti*	1	-	-	1
4	*Nerita planospira*	-	1	-	1
5	*Nerita Polita*	-	2	1	3
6	*Potamididae archives*	10	4	-	14
7	*Telescopium telescopium*	-	1	-	1
8	*Turbo cinereus*	1	6	-	7

Macrozoobenthos obtained at Station 2 consists of 6 different *families* namely *Cerithiidae* (*C.batillariaeformis*), *Fasciolariidae* (*L.philberti*), *Neritidae (N.polita*), *Potamididae* (*P.archives,* and *T.telescopium*) (Table 2).

Macrozoobenthos found at the *sampling* point at Station 2 were 8 different species consisting of 6 families*;* the most common species found at Station 2 was *C.batillariaeformis.* This species is a biota commonly found in the intertidal zone with relatively low current speed, sandy substrate, and normal temperature. The content of organic matter contained in this station was found to be higher than other stations so many macrozoobenthos samples were found despite the dominance of species, this is because this station is a sandy substrate and which is indeed the habitat of *C.batillariaeformis*. This is reinforced by the results of research by Judika et al.[6] which said that the relative abundance of gastropods that were more dominant in the intertidal zone of Kalangan Beach was the type of *C.batillariaeformis* at station I with the environmental conditions of high-temperature waters and calmer currents making organic matter at

station I more deposited in the water substrate.

Macrozoobenthos found at Station 3 consists of 7 different *families* namely *Potamididae* (*C.cingulata, P. archives,* and *T.telescopium*), *Cerithiidae* (*C.batillariaeformis*), *Fasciolariidae* (*L.philberti)*, *Neritidae* (*N.planospira,* and *N.polita*), and *Turbinidae* (*T.cinereus)* (Table 3). Macrozoobenthos found in station 3 there are as many as 10 different species consisting of 7 *families, the* most common species found are *Potamididae archives.* This biota is a type of gastropod that is found in mangrove ecosystems that do provide high organic matter content, and water quality tends to be good. This is reinforced based on the results of research by Hasan et al.[7] explained that the Potamididae family is always present in every mangrove forest zone (front, middle, or back zone) with the highest species composition found in the back bone of the mangrove forest.

A data significance test conducted based on the total number of macrozoobenthos samples grouped by zone at each station found that there is a significant difference in the total number of samples between zones. This is reinforced by the data found in this study that were found in the middle and upper zones compared to the lower zone of the research station. Not only that but during sampling, it was also found that there were some macrozoobenthos that were only shelled in the lower zone of the research station.

Water Quality

Insitu water quality measurements were carried out along with sampling, carried out 3 times repetition at each station, and found that the average temperature value was 30.11^{o}C, the average salinity value was 30.11‰, the average brightness value was 90%, the average pH value was 6 (Table 4).

Table 4. Water quality measurement results

No.	Water Quality	St.1	St 2	St.3	Average
1	Temperature (^{o} C)	29	29,66	31,66	30,11
2	Salinity (‰)	30,33	32,33	27,66	30,11
3	Brightness (%)	80	100	90	90
4	pH	6	6	6	6

The lowest temperature is found at Station 1 which is 29^{o} C. Temperature measurements at this station were taken in the morning with cloudy sunny weather, Station 1 is a coastal reclamation area where around the station is stockpiled with rocks of considerable size and is also located not far from the mouth of the river through which boats are used as a means of tourist transport. While the highest temperature is found at Station 3 which is 31.66^{o}C, temperature measurements at this station were carried out at noon with sunny weather conditions. Station 3 is located adjacent to a small river located around the research area along the banks of the river overgrown with mangroves in the form of mangroves. According to Nurlinda et al.[8], a good temperature range for macrozoobenthos growth is 25-32 °C. Based on the temperature measurements that have been carried out, it can be said that the Nagari Mandeh water area has a temperature that is still in the normal range according to seawater quality standards and is still within normal limits to support the life of macrozoobenthos.

The highest salinity is found at Station 2 which is 32.33‰, Station 2 is a sampling point that is not affected by the flow of freshwater (river) and also not affected by coastal reclamation activities. While the lowest salinity is found at Station 3 which is 27.66‰, the low salinity at this station is due to the influence of freshwater flow which is not far from the sampling

point. According to Izzah & Roziaty[9], the range of salinity is good for the life of macrozoobenthos is between 15 - 45‰, because in waters that have low or high salinity can be found macrozoobenthos such as annelids, gastropods, and bivalves. Based on salinity measurements that have been done can be said that the waters of Nagari

The highest level of brightness was found at Station 2, namely (100%) which at Station 2 if observed directly still looks good and clear. While the lowest level of brightness at the time of the study was found at Station 1, namely (80%), this is because this area is a reclamation area and is also a harbor for Nagari Mandeh fishermen. According to Kurniawan[10], states that the brightness value measured using a secchi disc has an average value of 90%, meaning that the brightness of the waters is still in accordance with the quality standards and the waters are still included in the waters that are still good.

Temperature measurements in the research area conducted in the Nagari Mandeh water area ranged from 6-7 which means it is still within the standard for the survival of macrozoobenthos, the pH value obtained in the Nagari Mandeh water area is not good because it is below the normal range of seawater pH for biota. According to Effendi[11], most aquatic biotas are sensitive to changes in pH and like pH values ranging from 7.0-8.5.

Species Diversity Index (H'), Uniformity Index (E), and Dominance Index (C)

The results of the calculation of the analysis of macrozoobenthos samples found around the waters of Nagari Mandeh obtained species diversity index (H') ranging from 0.62 - 1.7, uniformity index (E) ranging from 0.35 - 0.82, and dominance index (C) ranging from 0.22 - 0.74, can be seen in Table 5.

Table 5. Results of macrozoobenthos sample analysis

No.	Data Analysis	St 1	St 2	St 3	Average
1	Species Diversity (H')	1,21	0,62	1,7	1,17
2	Uniformity (E)	0,75	0,35	0,82	0, 64
3	Dominance (C)	0,39	0,74	0,22	0,45

Based on the criteria for species diversity according to Shannon-Wienner, the results show that Station 1 with a value of H' = 1.21 is a sampling point classified as moderate diversity, the distribution of the number of individuals is moderate, and the waters have been moderately polluted. Station 2 with a value of H' = 0.62 is a sampling point classified as low diversity, low individual distribution, low community stability, and waters have begun to be polluted. Then Station 3 with a value of H' = 1.7 is classified as moderate diversity (quite high compared to station 1), the distribution of individuals is moderate, and the waters are starting to be moderately polluted, this is due to the influence caused by the flow of river water around Station 3.

The uniformity index (E) at Station 1 was found to be 0.75, which means that the species uniformity at Station 1 is high. The uniformity index at Station 2 is E = 0.35 which means that the species uniformity at Station 2 is classified as medium. Then the uniformity index at Station 3 is E = 0.82 which indicates that the uniformity index at Station 3 is high, a high uniformity index indicates that the distribution of macrozoobenthos species is evenly distributed, and a moderate uniformity index indicates that the distribution of species is less evenly distributed. The results of uniformity (E) obtained at Station 1 (reclamation area) conducted in the waters of Nagari Mandeh of 0.7 is high because, in a similar study conducted by Dewi & Widyorini[12], they mentioned that

the uniformity index (E) found in the reclamation area around Marina beach waters of 0.65.

The value of the dominance index (C) at Station 1 was found to be 0.39 which indicates that at this station there are no dominant species. The dominance index value (C) at Station 2 was found to be 0.74 which proves that there is a dominant species (*C.batillariaeformis* with Ci= 0.73). Then the dominance index value (C) found at Station 3 is 0.22 which indicates that at this station there are no species that dominate the macrozoobenthos community.

Sediment Fraction and Type

The results of the analysis of sediment samples in the waters of Nagari Mandeh found that the type of sediment in the waters of Nagari Mandeh consists of gravelly sand, colloid, sandy mud, muddy sand, and sandy gravel with the calculation results can be seen in Table 6.

Table 6. Percentage of sediment fractions and types

No.	Sampling Point	% Fraction			Sediment Type
		Gravel	Sand	Mud	
1	1.1	33,53	51,16	15,31	Gravelly Sand
2	1.2	27,82	26,73	45,45	Colloids
3	1.3	12,16	18,06	69,78	Sandy Mud
4	2.1	26,67	58,22	15,11	Gravelly Sand
5	2.2	5,94	73,48	20,57	Silty Sand
6	2.3	18,27	45,80	35,93	Silty Sand
7	3.1	31,28	59,30	9,42	Gravelly Sand
8	3.2	44,93	53,43	1,64	Gravelly Sand
9	3.3	65,47	30,20	4,33	Sandy Gravel

Sediment Total Organic Matter (BOT) Content

The results of the analysis of the total organic matter (BOT) content of sediments found in the Nagari Mandeh water area were found to range from 8.08% - 15.25% (classified as moderate), the results of the BOT analysis see Table 7.

Table 7. Organic matter content

No.	Sampling Point	% BOT	Average	Reynold's criteria (1971)
1	1.1	5	8,08%	Medium
2	1.2	6,68		
3	1.3	12,55		
4	2.1	8,37	15,25%	Medium
5	2.2	8,83		

The highest organic matter content is found in sediments at Station 2 with an index of 15.25, and the lowest is found at Station 1, which are 8.08. According to Gurning et al.[13], sediment organic matter content is influenced by anthropogenic activities, namely the supply of organic matter originating from activities on land and entering the waters, then settling at the bottom of the waters and being absorbed by the sediments. The content of organic matter in waters will increase, among others, as a result of household waste, agriculture, industry, rain, and surface water flow[14].

4. CONCLUSION

The Nagari Mandeh water area still has good water quality for macrozoobenthos survival.

Macrozoobenthos found consists of 10 *families* namely *Arciidae, Cardiidae, Cerithiidae, Fasciolariidae, Neritidae, Potamididae, Psammobiidae, Tellinidae, Turbinidae,* and *Strombidae.* Coastal reclamation activities have no impact on the presence and diversity of macrozoobenthos but do affect the types of individuals that live around the reclamation area.

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