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CORRELATION BETWEEN THE AMOUNT OF ORGANIC MATTER AND THE ABUNDANCE OF MACROZOOBENTHOS IN THE COASTAL WATERS OF DUMAI CITY

Fazrianty Octalina[1*], Yeeri Badrun[1], Sri Fitria Retnawaty[1]
[1]Faculty of Mathematics and Natural Sciences, University of Muhammadiyah Riau
Jl. Tuanku Tambusai, Pekanbaru, Riau, 28294, Indonesia
*fazriantyoctalina@gmail.com

ABSTRACT

This research was conducted in March 2022 in the Coastal Waters of Dumai City. This study aims to analyze the amount of organic matter and the abundance of macrozoobenthos and the relationship between the amount of organic matter and the abundance of macrozoobenthos. The method used is a survey method consisting of 10 stations with 2 replications at each station. And 1 station is a control station located on the north coast of North Rupat District, Bengkalis Regency. Sediment sampling was carried out in the field and then taken to the Marine Chemistry Laboratory, Riau University for analysis of organic matter and macrozoobenthos analysis. Based on a simple linear regression test, the relationship between the amount of organic matter and the abundance of macrozoobenthos obtained a correlation value (r) = -0. 4637 with the mathematical equation y = -4.884x + 98.896. The test results show a weak and inverse relationship between the amount of organic matter and the abundance of macrozoobenthos. This means that with the increase in the amount of organic matter, the abundance of macrozoobenthos in the coastal waters of Dumai City will decrease. The value of the coefficient of determination (R^2) is 0.2146. This figure shows that the effect of organic matter on the abundance of macrozoobenthos is small, namely 21.46%.

Keywords: Dumai, Macrozoobenthos, Organic Matter

1. INTRODUCTION

Dumai City waters are one of the waters in Sumatra which is very dense with shipping and industrial activities and has a muddy substrate. The dense shipping and industrial activities produce a lot of waste which can result in decreased water quality and pollution. One of the very common contaminants found in contaminated areas is organic matter. Organic waste that settles on the bottom will affect the characteristics of aquatic sediments and can have a significant influence on the balance of marine biota ecosystems, especially macrozoobenthos.

The Coastal Area of Dumai City is widely used for industrial activities and domestic activities. According to Lintano et al.[1] the central area of Dumai City is an area of settlements and urban activities while the downstream area is an area for domestic ship transportation and freight transportation[2].

Organic matter is needed in water because it is a nutrient for the biota in the waters. However, if the amount of organic matter produced exceeds the threshold it will trigger water pollution[2]. This situation can cause the accumulation of organic matter which can interfere with the life of organisms in the waters, one of which is macrozoobenthos.

Macrozoobenthos is closely related to the organic matter contained in the substrate because organic matter is a source of nutrients for macrozoobenthos where these organisms live relatively sedentary lives. However, if the organic matter is excessive

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it will become a source of pollution of this waters[4]. The presence of macrozoobenthos can be used as an indicator to see the entry of organic matter into the waters. Waters that are still good can support the abundance of macrozoobenthos that live in these waters. On the other hand, waters with poor macrozoobenthos diversity will decrease or be few in number [4].

2. RESEARCH METHOD

Time and Place

The research was carried out in March 2022. Locations for sampling macrozoobenthos and organic matter in sediments in the coastal waters of Dumai City. Determination of the research location using a purposive sampling method by assigning 9 observation stations based on the characteristics of activities along the coastal waters of Dumai City which consist of industrial activities, fishing settlement activities, mangrove areas, and urban domestic activities and 1 control station.

Tools and Materials

The tools and materials that will be used in the sampling of this study are current meters which function to measure current velocity, TDS (Total Dissolved Solid) meters function to measure water TDS, Echosaunder functions to measure water depth, Refractometer functions to measure water salinity, Grab Sampler functions to collect sediment samples, sample bottles function to store water samples, 10% formalin as a macrozoobenthos preservative, plastic sediment samples to store sediment samples so they are not contaminated/mixed with other samples, GPS to determine the location of the research point, cool box as a sample storage container.

Figure 1. Map of research locations

Methods Used

This research uses survey methods and laboratory analysis methods. Determination of research locations using a purposive sampling method. Parameter measurements of the aquatic environment carried out were salinity, TSS (Total Suspended Solid), TDS (Total Dissolved Solids), pH, turbidity, current velocity, and depth. The samples taken were sediment samples and macrozoobenthos. The samples analyzed in the laboratory were sediment samples to determine the amount of organic matter and macrozoobenthos samples to be identified.

Water Quality Measurement and Sampling

Water quality parameters measured in this study include chemical and physical parameters. The first physical parameter to be measured is TDS (Total Dissolved

Solids) by dipping the tip of the TDS meter into water 5 cm deep in the on position and holding it for about 2-3 minutes until the marker number on the digital monitor stabilizes. The second measures depth by sending wave vibrations from the surface to the bottom of the waters and recording the time until the echosounder returns from the bottom of the waters. The third is to measure the direction and speed of the current by using a current meter in the form of a propeller-shaped device connected to a recorder box (a monitor that will record the number of revolutions as long as the propeller is in the water) then put it into the sea where the flow velocity will be measured.

The first chemical parameter that is measured is salinity by dripping seawater into the refractometer section and then looking at the tip of the refractometer there will be one or more scale numbers. The second is the acid-base level of the water using a pH meter by dipping the tool into the water with the on position until the iron contained in the wet tool is exposed to water until the marker number on the digital monitor stabilizes. A 1 L sample of water was taken and put into a sample bottle and stored in a coolbox. Water samples were used to analyze TSS in the laboratory.

Sediment Sampling and Handling

Sampling was carried out in aquatic sediments using a 30 kg grab sampler with an opening of 847 cm by doing 2 repetitions for each sampling point, which is 300 m from the shoreline. Sediment samples are put in plastic and labeled and then taken to the laboratory for analysis. The samples taken were 50 g for the analysis of the amount of organic matter.

Sample Collection and Handling of Macrozoobenthos

The macrozoobenthos samples were taken using a 30 kg greb sampler with an opening of 847 cm by doing 2 repetitions for each sampling point. After that, the sample obtained was filtered using a 1 mm sieve. The macrozoobenthos samples obtained were put in labeled plastic bags and preserved using 10% formalin. Samples that have been given a formalin solution are put into an ice box.

3. RESULT AND DISCUSSION

Salinity measurements ranged from 10.16 – 10.23 ppm. This salinity measurement aims to determine the level of salt dissolved in the water. When compared to station 10, has the highest salinity value (10.27 ppm) compared to the observation station. Based on the water quality standard no 22 of 2021, the standard value for salinity is 33-34 ppm. This means that the level of salinity at the research location is still below the quality standard.

TSS values ranged from 86 – 137 mg/L. TSS measurements are carried out to see suspended solids in sediments and water. The highest TSS value is found at station 9 and the lowest is at station 1. Measurements of TSS concentrations at 9 observation stations as a whole are higher than station 10 (Table 1.).

Water turbidity measurements range from 5.93 - 29.12. The lowest turbidity level is at station 2 and the highest turbidity level is at station 8. When compared to station 10, station 10 has a lower turbidity level (4.91 NTU) compared to the observation station. Based on water quality standard number 22 of 2021, the standard value for the turbidity level is 5 NTU.

TDS ranges from 5128 – 9858 ppm. TDS measurement is carried out to measure the total solids (minerals, salts, or metals) that are in the water. While the depth parameter ranges from 10.7 – 18.9 m. The shallowest station is located at station 3 which has no current speed and the deepest is at station 4 which has a current speed of 0.58 m/s. Water pH measurements ranged from 6.8 to 8.3 indicating neutral water quality.

Analysis of organic matter at the observation stations has different values. The percentage of the amount of sediment organic matter in the coastal waters of Dumai City can be seen in Table 2.

Table 1. Measured parameters

Station	Salinity (‰)	TSS (mg/L)	TDS	pH	Turbidity (NTU)	Current(m/s)	Depth (m)
1	10,17	86	6926	7,6	9.48	0.09	16,9
2	10,16	76	5294	6,8	5.93	0.22	10,9
3	10,18	93	5128	7,1	15.95	0	10,7
4	10,22	89	7532	8,3	10.94	0.58	18,9
5	10,22	88	7844	7,5	14.32	0.46	12,1
6	10,23	102	7532	8,3	27.08	0.25	18,9
7	10,21	89	9858	8,1	7.31	0.13	10,9
8	10,20	115	7128	7,7	29.12	0.38	11,2
9	10,19	137	7044	8,1	22.81	0.19	10,8
10*	10,27	73	5893	8,3	4.91	0.55	4

Table 2. Total organic matter (%)

Station	Total organic matter (%)
1	10.94
2	11.43
3	13,29
4	16,16
5	10,14
6	12,18
7	6,56
8	7,54
9	11,19
10*	0.48

The amount of sediment organic matter in the coastal waters of Dumai City ranges from 6.56 - 16.16%. The highest amount of sediment organic matter was found at station 4 as much as 16.16%. This station is in the PKS (Palm Oil Factory) area. The high amount of organic matter at station 4 comes from organic waste which is directly discharged from the OPM into the waters. According to Mauludy[5], the high amount of organic matter in the factory industrial area is due to the fact that the area receives organic material input directly from the factory itself.

The lowest amount of organic matter is located at station 7 which is in an industrial area with 6.56%. The low amount of organic matter at this station is due to the type of sediment fraction at station 7 which is a type of sandy mud. The coarser the sediment fraction obtained, the less amount of organic matter.

Macrozoobenthos Analysis

The results of the identification of macrozoobenthos in the coastal waters of Dumai City found 22 species of macrozoobenthos consisting of 5 classes namely Gastropods, Bivalvia, Clitella, Holothuroidea classes. The abundance of macrozoobenthos can be seen in Figure 2.

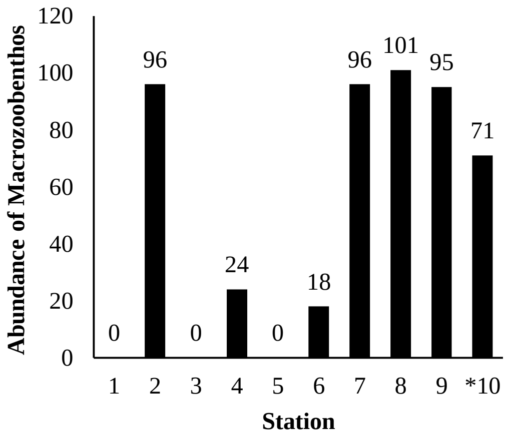

Figure 2. Macrozoobenthos abundance

The most abundance of macrozoobenthos found at Station 8 which is a secondary mangrove area has an abundance value of 101 ind/m^2 with a relative abundance value of 100%. The types of species found came from several classes, namely the Gastropod Class (*Tympanotonos fuscatus, Barleeia creutzbergi*, *Aliculastrum cylindricum*). Class Bivalvia (*Anadara granosa*, *Corbicula fluminea, Polymesoda erosa, Tellina variegata, Pholas dactylus*). Class Clitella (*Glycera* sp).

The high abundance at Station 8 is due to the fact that this area is located in a secondary mangrove area which has a muddy substrate. According to Barus et al[6], the abundance of macrozoobenthos in the mangrove area is due to the stable amount of organic matter because it is far from industrial activities.

Macrozoobenthos tend to live sedentary and attached to muddy substrates, rocks, and plants so they are sensitive to environmental changes. The lowest macrozoobenthos abundance was found at Stations 1,3 and 5 having an abundance value of 0 ind/m^2 and a relative abundance value of 0% because at Stations 1,3 and 5 no macrozoobenthos species were found but it does not rule out the possibility of meiobenthos and microbenthos species.

The low abundance of macrozoobenthos is because this area is a place for loading and unloading activities from industrial ships, such as loading and unloading coal and industrial chemicals. Meanwhile, during the loading and unloading process, industrial chemical spills often occur in seawaters which can result in macrozoobenthos not being able to survive. This of course will affect the abundance of macrozoobenthos. One of the causes of the decreased abundance of macrozoobenthos is decreased water quality, namely increased turbidity values, which can cause visual and respiratory system disturbance activities of aquatic organisms[7].

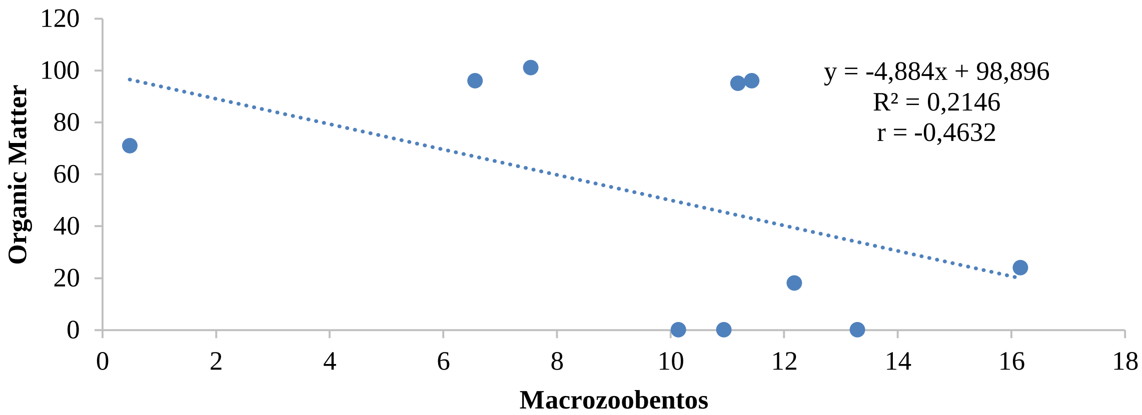

Figure 3. Graph of the Relationship between the Amount of Organic Matter and the Abundance of Macrozoobenthos

Compared to the control station, the abundance of macrozoobenthos found was 71 ind/m^2. Because the control station is not affected by various activities such as the activities at the observation station. At the control station. The types of species found came from several classes, namely the bivalve class (*Tellina variegata, Polymesoda erosa, Corbicula fluminea*), the gastropod class (*Umbonium elegans, Odetta lirata*), and Malacostrata (*Acetes indicus*). According to opinion Rahayu et al.[8] the differences in the abundance values of each station 10 are closely related to the differences in the availability of organic matter, substrates, and human activities in each water area. The abundance of organic matter has a relationship with the abundance of macrozoobenthos (Figure 3).

Based on a simple linear regression test, the relationship between the amount of organic matter and the abundance of macrozoobenthos is obtained by a mathematical equation y = -4.884x + 98.896. The test results showed an inverse relationship between the amount of organic matter and the abundance of macrozoobenthos. The amount of organic matter was too increased at the study site, accompanied by a decrease in macrozoobenthos.

Correlation value (r) = -0.4637 which is of moderate value. The value of the coefficient of determination (R^2) = 0.2146 this number indicates that the effect of the amount of organic matter on the abundance of macrozoobenthos is small, namely only 21.46%.

4. CONCLUSION

The amount of organic matter at 9 research stations in the coastal waters of Dumai City ranged from 6.56 to 16.16%, and the control station at North Rupat had an organic matter amount of 0.48%. The abundance of macrozoobenthos at 9 research stations in the coastal waters of Dumai City ranged from 0-101 ind/m2. When compared to the Control Station, it had an abundance value of 71 ind/m2. The relationship between the amount of organic matter and the abundance of macrozoobenthos in the coastal waters of Dumai City is inversely proportional, with a correlation value (r) = -0.46 and a coefficient of determination (R2) = 0.21.

The suggestion from this study is that for further research, it is advisable to examine more deeply at 3 stations where no macrozoobenthos species were found. Because it does not rule out the 3 stations there are types of meiobenthos and microbenthos.

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