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ANALYSIS OF ORGANIC MATTER CONTENT IN SEDIMENTS AND MACROZOOBENTHOS ABUNDANCE IN PAKNING RIVER WATERS, BENGKALIS REGENCY, RIAU PROVINCE

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ABSTRACT

This research was conducted in April 2021 to analyze organic matter content in the sediment and the abundance of macrozoobenthos. The purpose of this study was to analyze the content of organic matter in sediments and their relationship with the abundance of macrozoobenthos in the waters of the Pakning River, Bengkalis Regency, Riau Province. Sediment and macrozoobenthos samples were taken from the waters of the Pakning River, Bengkalis District, Riau Province. The method used in this research is a survey method. Sampling was determined using purposive sampling at four different stations. The results of this study indicate that the organic matter content of sediment in the waters of the Pakning River has a percentage of 6.73-12.76%. The highest organic matter content is at station 1 of 12.76% and the lowest organic matter content is at station 4 of 6.73%. The highest average abundance of macrozoobenthos was 19.26 ind/m^2 at station 1 with the dominant species being *Anadara granosa.* Connection between organic sediment and abundance of macrozoobenthos has a linear regression equation y = 1.8442 +0.1662x with a coefficient (R^2) of 0.1491 which means that the effect of organic matter in the waters of the Pakning River is 14.9% while 85.1% is influenced by other factors. The value of 0.38 indicates that the relationship between organic matter and the abundance of macrozoobenthos is, a moderate relationship.

Keywords: Sediment, Macrozoobenthos, Organic content, Pollution.

1. INTRODUCTION

The waters of the Pakning River are where the Siak River empties. This causes these waters to not only receive waste from activities along these waters but also receive waste from activities along the Siak River because along this river various industries discharge their waste into the waters. These waters are close to Pertamina (RU) II Sei - Pakning and there is also the Pakning River port which is a Port Branch of PT Pelabuhan Indonesia I (Persero) which serves domestic ships such as cargo ships, ferries, and also foreign ships. Various activities around the waters of the Pakning River and input from the overflow of Siak River water contribute organic matter that can affect the life of the biota in it.

In the aquatic ecosystem of the Pakning River, mangroves grow along the coastal waters which can grow well. Mangrove areas that can grow well will certainly be able to attract other organisms to live there such as macrozoobenthos. According to Zulkifli & Setiawan[1] that macrozoobenthos is one of the aquatic organisms that settle at the bottom of the waters which has relatively slow movements and a relatively long life cycle so that it can respond continuously to water quality conditions. Various studies have shown that components of aquatic biota (fish, plankton, and benthos) can be used

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for biomonitoring of environmental conditions. If the substrate changes, the macrozoobenthos community structure will also change.

The survival of organisms at the bottom of the waters depends on the availability of organic matter because organic matter is needed by basic organisms so that their development and growth can take place. However, if the organic matter is excessive, it will become a source of pollution for these waters. The high organic matter in the waters will have an extreme effect on the availability of dissolved oxygen if this situation lasts a long time will cause the waters to become anaerobic so that aerobic organisms will die[2].

One of the organisms that directly feels the influence of organic matter is the benthos because these organisms live relatively sedentary lives. Therefore the authors are interested in researching the content of organic matter in sediments and their relationship with the abundance of macrozoobenthos in the waters of the Pakning River, Bengkalis Regency, Riau Province.

2. RESEARCH METHOD

Time and Place

This research was conducted in April 2021. Measurements of water quality and sampling of sediments and macrozoobenthos were carried out in the waters of the Pakning River, Bengkalis Regency, Riau Province.

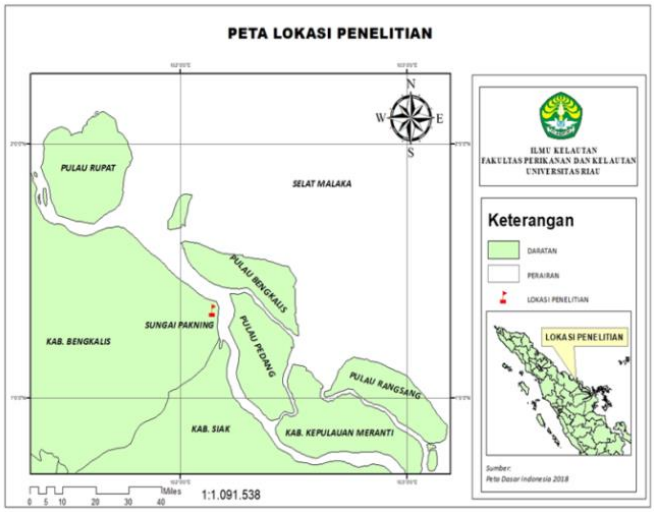

Figure 1. Map of research locations

Methods

The method used in this research is the survey method and purposive sampling.

Procedure

Location Determination

Sampling locations were determined by 4 stations which were considered to represent the research area. At each station, 3 repetitions were carried out. Station 1 is located in the tourist area of the Pangkalan Jambi mangrove forest, Station 2 is in Dompas Village with mangrove forests around it, Station 3 is in the vicinity of the Pertamina RU (II) Sei-Pakning Refinery and Station 4 is located at Sei Selari Harbor.

Sediment Sampling and Macrozoobenthos

Sediment sampling was carried out at low tide as much as 500 g and put into plastic which had been labeled based on the station. Macrozoobenthos samples were taken with 3 repetitions for each sampling point. The samples obtained were then filtered using a 1 mm sieve. The macrozoobenthos obtained were stored in plastic bags which were labeled based on the sampling station and point and

preserved using 10% formalin. Then the sample was put into an ice box and taken to the laboratory for analysis.

Analysis of Organic Matter Content and Macrozoobenthos Abundance

To determine the total organic matter content in the sediments, analysis was carried out using the Pett[3]. For macrozoobenthos samples, they were observed and identified, regarding and guided by the identification books [4-6]. The analysis of sediment fractions, it was analyzed in the laboratory in stages following the instructions of Rifardi[7].

The organic matter content in the sediment is calculated by the formula:

$$\text{Organic matter (\%)} = \frac{a-c}{a-b} \times 100\%$$

Information:

a = Weight of the cup and sample after drying at 105^0C (g)
b = cup weight (g)
c = Weight of the cup and sample after burning at 550^0C (g)

To determine the abundance of macrozoobenthos based on the number of individuals per unit area, it is calculated using the formula according to Odum[8], as follows:

$$K = \frac{N}{A} \times 10.000$$

Information:

K = Species Abundance (ind/m^2)
N = total number of macrozoobenthos individuals caught in A (ind)
A = Petersan grab opening area 25 cm x 30 cm (3 x repetitions) (cm^2) 10,000 is the conversion from cm^2 to m^2

Data Analysis

Data on macrozoobenthos abundance and sediment organic matter content are discussed descriptively. Differences in macrozoobenthos abundance and sediment organic matter content between study stations were analyzed using the Oneway ANOVA test with the help of Microsoft Excel Software and Statistical Package for Social Science (SPSS) version 16.0. The comparison is also supported by water quality and sediment fraction data. The relationship between organic matter content and the abundance of macrozoobenthos can be determined by carrying out a simple linear regression test.

$$Y = a + Bx$$

Information:

Y = The abundance of macro-zoobenthos (ind/m^2)
a and b = Constants and regression coefficients
X = Content of organic matter (%)

3. RESULT AND DISCUSSION

The general condition of the research location

Pakning River is the capital of Bukit Batu District, Bengkalis Regency, Riau Province. Pakning River is located in the south of Bengkalis Island which is separated by the Bengkalis Strait. To the north of Bengkalis Island is bordered by the Malacca Strait, one of the busiest straits in the world. Bukit Batu District has an area of 1,128 km². Bukit Batu has a fairly long coastline because it is located on the coast of the Bengkalis Strait – the Malacca Strait. On average, the Bukit Batu area is composed of peat and clay soils. Based on the nature and geographical form, sea transportation facilities and infrastructure are very important in efforts to improve the economy and development in this region. Bengkalis Strait waters are dense waters of human activity.

Water Quality Parameters

Water quality parameters were measured at each station. The results of water quality measurements in the waters of the Pakning River are presented in Table 1.

The results of measuring water quality parameters can be seen that the waters of the Pakning River have a temperature between 29 - 32 °C and have a pH of 7, and the salinity of the Pakning River waters ranges from 24 - 25 ppt which a brackish water salinity. The highest brightness is at station 3, namely in the

Pertamina RU II Sei-Pakning Water Refinery area, in this area, there are no mangrove forests, while the lowest brightness is at Sei Selari Harbor. The average current speed from all stations is the same, namely <0.3 m/s which indicates that these waters are slow-moving waters.

Table 1. Water quality parameters

No.	Parameter	Station			
		1	**2**	**3**	**4**
1.	Temperature (^{0}C)	29	31	32	29
2.	pH	7	7	7	7
3.	Salinity (ppt)	24	24	25	25
4.	Brightness (cm)	22.5	22	28.5	19
5.	Current Speed (m/s)	00.8	0.08	0.2	0.09

Sediment Organic Matter Content

Sediment organic matter content at four stations in Pakning River waters can be seen in Table 2. Differences in sediment organic matter content at each station were analyzed using Oneway ANOVA analysis. The ANOVA test results obtained a significant value of 0.385, meaning that the P value > 0.05 which describes the organic matter content of the sediment between stations was not significantly different.

Table 2. Sediment organic matter content

Station	Sampling Point	Material Content organic (%)	Mean ± SD (%)
1	1.1	18,11	12.76±6.22
	1.2	14,24	
	1.3	5.92	
2	2.1	10.89	9.14±1.56
	2.2	8,64	
	2.3	7.90	
3	3.1	8.45	7.22±1.23
	3.2	5.98	
	3.3	7,22	
4	4.1	6,67	6.73±0.98
	4.2	5.78	
	4.3	7,74	

The highest sediment organic matter content was located at Station 1, namely, the mangrove forest area with an average of 12.76%, followed by Station 2 in the Dompas Village area with an average of 9.14%, Station 3 in the Pertamina Oil Refinery area with an average of 7.22% and the lowest is Station 4 in the Sei Selari Harbor area with an average of 6.73%. The high organic matter in the sediment at Station 1 is due to the condition where mangrove vegetation grows around the study area which can contribute organic matter to the waters. The organic matter that has the lowest percentage is found at Station 4, namely 6.73%, which is the port area with less mangrove vegetation than Station 1. According to Fahlifi[9], Macrozoobenthos is closely related to the availability of organic matter contained in the substrate, because organic matter is a source of nutrients for biota which are generally found on the basic substrate.

According to Irmawan[10], in fine sediments the percentage of organic matter is higher than in coarse sediments, this is also influenced by environmental conditions, where a calm environment

allows the deposition of silt followed by the accumulation of organic matter to the bottom of the waters, whereas in coarse sediments, low organic matter content because the finer particles do not precipitate.

Table 3. Calculation of the pakning river sediment fraction

Station	Point sampling	Sediment Fraction (%)			Type sediment	Type Sediment Station
		Gravel	Sand	Mud		
1	1.1	4,33	25,60	70,68	Mud sandy	Mud sandy
	1.2	3.76	28,14	67,10	Mud sandy	
	1.3	2.71	47,23	50.05	Mud sandy	
2	2.1	1.03	37,71	61,26	Mud sandy	Mud sandy
	2.2	3,22	27,57	69,20	Mud sandy	
	2.3	0.70	29,23	70.07	Mud sandy	
3	3.1	0.38	33,17	66.45	Mud sandy	Mud sandy
	3.2	0.56	13.47	85.98	Mud	
	3.3	5,48	27.98	66,54	Mud sandy	
4	4.1	0.19	7,64	92.17	Mud	Mud
	4.2	0.50	17,17	82,32	Mud	
	4.3	0.12	18.06	81,82	Mud	

The results of the analysis of sediment characteristics in the waters of the Pakning River are grouped into the percentage of sediment fractions. Based on Table 3, the sediment fraction of Pakning River waters are dominated by sandy silt. The dominant mud fraction is found in currents that have a relatively large velocity so that they will carry fine-sized particles. The distribution of coastal sediments or the transport of coastal sediments is the movement of sediments in coastal areas caused by waves and currents. Then it was also stated that the distribution of sediment was influenced by tidal currents and waves, with unstable currents[1].

The percentage of gravel fraction ranges from 0.12 to 5.48 where the lowest percentage is at sampling point 4.3 while the highest is at sampling point 3.3. The percentage of the sand fraction ranges from 7.64 to 47.23 where the lowest percentage is at sampling point 4.1 while the highest is at sampling point 1.3. Then the percentage of silt fraction ranged from 50.05 to 92.17 where the lowest percentage was at sampling point 1.3 and the highest at sampling point 4.1. This condition illustrates that the silt fraction sediment material comes from the mainland of the Pakning River, while the sand fraction sediment comes from the Bengkalis Strait and Siak River.

This illustrates that the current strength is transported in a flow system with weak current strength. According to Nugroho & Basit[12], the presence of fine sediments was deposited in very calm currents and waves, while coarse sediments indicated that the currents and waves in the area were relatively strong.

Types and Abundance of Macrozoobenthos

The average abundance of macrozoobenthos at each station can be seen in Table 4. Based on the ANOVA test, a significant value of 0.185 was obtained, meaning that the P value > 0.05 which describes the abundance of macrozoobenthos in these waters was not significantly different between stations.

The highest average abundance was at station 1 with a value of 19.26 ind/m^2 which was located in the Pangkalan Jambi mangrove forest area, while the lowest average abundance of macrozoobenthos was at stations 3 and 4 with a value of 11.85 ind/m^2 located at Pertamina refinery and Sei Selari port. The most common

macrozoobenthos were found at Station 1 with 13 individuals, in an area with lots of mangrove vegetation which has a high organic matter value. The number of individuals at Station 3 was the least followed by Station 4. This was because the organic matter at Station 3 and Station 4 contained organic matter that did not differ much. Mangrove vegetation at Station 3 and Station 4 is not too much, only a few grow on the coast.

The abundance of macrozoobenthos in waters is influenced by factors which include physical, chemical, and biological factors. These factors include temperature, pH, turbidity, brightness, dissolved gases, and interactions with other organisms[13]. According to Makri[14] the level of benthic diversity and abundance found in certain aquatic environments is a reflection of variation rather than tolerance to ranges of environmental parameters. With the existence of sessile benthic groups and varying adaptability to environmental conditions, benthic animals are often used as a guide for water quality assessment. The presence of tolerant species and the absence of intolerant species can be used as indicators of pollution.

The types of macrozoobenthos found can be seen in Table 5.

Table 4. Average abundance of macrozoobenthos in Pakning River waters

Station	Substation			Mean ± SD (Ind/m^2)
	1	2	3	
1	26,67	8.89	22,22	19.26±3.082
2	22,23	17.78	13,34	17.78±4.445
3	17.78	8.89	8.89	11.85±5.132
4	17.78	13,33	4,44	11.85±6.792

Table 5. Types of macrozoobenthos in Pakning River

Class	family	Species	St. 1	St. 2	St. 3	St. 4
Gastropods	Mitridae	*Strigatella litterata*	5	-	-	-
	Nassariidae	*Nassarius echinatus*	1	1	-	-
	Potamididae	*Cerithidea obtuse*	3	-	-	4
	Nassariidae	*Nassarius olivaceus*	-	2	-	-
	Tegulidae	*Tectus niloticus*	-	1	-	-
	Littorinidae	*Littorina* sp.	-	2	-	-
	Naticidae	*Natica* sp.	-	-	1	-
Bivalve	Arcidae	*Anadara granosa*	1	3	5	-
	Mesodesmatidae	*Atactodea* sp.	-	-	1	-
crustaceans	Coenobitidae	*Coenobita perlata*	1	2	-	2
Malacostraca	Varunidae	*Cylograpsus* sp.	-	1	-	-
Arachnids	Salticidae	*Ancilla* sp.	2	-	-	2

Relationship between Sediment Organic Matter Content and Macrozoobenthos Abundance

The results of a simple linear regression test, the effect of organic matter content on the abundance of macrozoobenthos during the study obtained a moderate relationship, indicated by the mathematical equation y = 1.8442 + 0.1662x with a coefficient of determination (R^2) = 0.1491 and a correlation coefficient r = 0. 38 (Figure 2).

Through a simple linear regression test, the effect of organic matter content on the abundance of macrozoobenthos has a mathematical equation: y=1.8442+0.1662x with a coefficient of determination (R^2) of 0.1491. The correlation coefficient (r) obtained was 0.38 which illustrates that the organic matter content of the sediment has a

moderate relationship to the abundance of macrozoobenthos in the waters of the Pakning River. Following the opinion of Sabri & Hastono[15] the value of the correlation coefficient 0.00-0.25 has a weak relationship, 0.26-0.50 has a moderate, 0.51-0.75 has a strong, and 0.76-1 .00 has a very strong. Based on the regression results, the organic matter content and the abundance of macrozoobenthos have a positive relationship, that is, if the organic matter content is high, the abundance of macrozoobenthos will also be high.

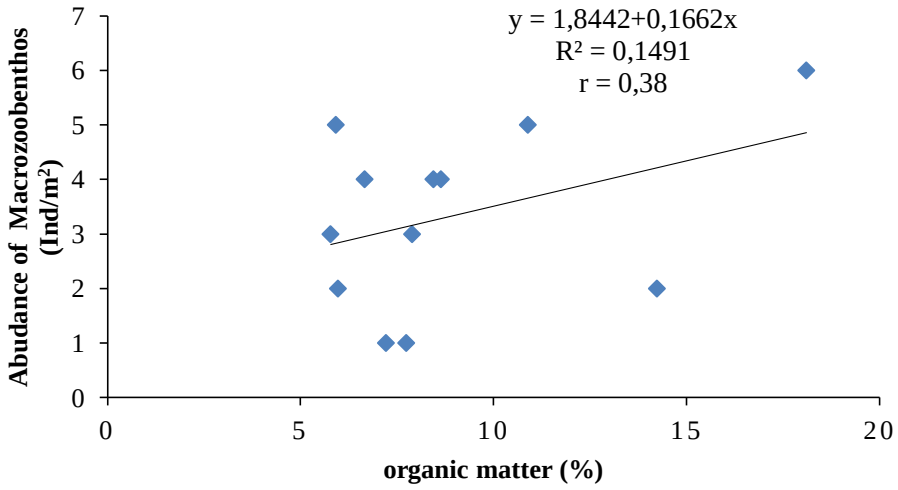

Figure 2. Graph of the relationship of Pb metal content in slug snails with sediments

The effect of sediment organic matter on the abundance of macrozoobenthos was obtained from the results of a linear regression test with a value of R2 = 14.9%, meaning that 85.1% was influenced by other factors. The other environmental factors that affect the abundance of macrozoobenthos include aquatic physicochemical factors such as dissolved oxygen, COD, and BOD.

4. CONCLUSION

The content of organic matter in the sediments in the waters of the Pakning River has a percentage of 6.73-12.76%. The highest organic matter content was at station 1 at 12.76% and the lowest organic matter content was at station 4 at 6.73%. The highest average abundance of macrozoobenthos was 19.26 ind/m^2 at station 1 with the dominant species being *Anadara granosa*. The relationship between the content of sediment organic matter and the abundance of macrozoobenthos has a linear regression equation y = 1.8442 + 0.1662x with a coefficient (R^2) of 0.1491, which means that the influence of organic matter in the waters of the Pakning River is 14.9% while 85.1 % influenced by other factors. The value (r) of 0.38 indicates that the relationship between organic matter and the abundance of macrozoobenthos is moderate.

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