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Analysis of the Relationship between Organic Material Content and Sediment Grain Size with Macrozoobentos Abundance in Sungai Selari Village, Bengkalis Regency

Analisis Hubungan Kandungan Bahan Organik dan Ukuran Butir Sedimen dengan Kelimpahan Makrozoobentos di Desa Sungai Selari Kabupaten Bengkalis

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Abstract

Sungai Selari Village is an area in Riau Province that features a high density of water activities, including a port where many fishing boats are moored and also serves as a transportation route for fishermen seeking fish. This activity can cause water pollution, which leads to the silting of waters through sedimentation. The activity of sediment input into a body of water can cause changes in the ecosystem, including alterations in sediment texture, organic matter content, and the abundance of macrozoobenthos biota. One organism that can be affected by differences in ecosystems is the macrozoobenthos due to its sedentary nature. This study aims to determine the type of sediment, grain size, and organic matter content, as well as their relationship with macrozoobenthos abundance. This research was conducted in March and April 2023, utilizing purposive sampling techniques at four stations in total. The samples taken were sedimentary substrates and macrozoobenthos. The results indicated that the size of the dominating sediment stalk, specifically the mud fraction, ranged from 14.72% to 71.25%. The types of macrozoobenthos found are grouped into two classes, namely Gastropods and bivalves. Individual abundances range from 0.3 - 4.4 ind/m^2, with the highest abundance occurring at station 4 and the lowest occurring at station 1. The organic matter content ranges from 9.27- 34.2%. The relationship between organic matter content and macrozoobenthos abundance exhibits a moderate correlation of 0.506. The relationship between sediment grain size and macrozoobenthos abundance shows a fairly close correlation of 0.544.

Keywords: Organic Matter, Sediment Grain, Macrozoobentos Abundance

Abstrak

Desa Sungai Selari merupakan daerah di Provinsi Riau yang memiliki aktivitas perairan cukup padat, salah satunya aktivitas pelabuhan dimana banyak kapal-kapal penyebrangan bersandar dan juga jalur transportasi nelayan mencari ikan. Aktivitas ini dapat menyebabkan pencemaran perairan yang menjadikan pendangkalan perairan yang disebut sedimentasi. Adanya aktivitas masukan sedimen ke dalam suatu perairan dapat menimbulkan suatu perubahan dalam ekosistem tersebut, baik perubahan dari tekstur sedimen, kandungan bahan organik , dan kelimpahan dari biota makrozoobentos. Salah satu organisme yang dapat terpengaruh dengan adanya perbedaan ekosistem adalah makrozoobentos karena sifatnya yang menetap. Penelitian ini bertujuan untuk mengetahui jenis ukuran butir sedimen, kandungan bahan organik dan hubungannya dengan kelimpahan makrozoobentos. Penelitian ini dilaksanakan pada bulan maret- april

2023 menggunakan teknik *purposive sampling* dengan total empat stasiun. Sampel yang diambil berupa substrat sedimen dan makrozoobentos. Hasil penelitian menyatakan bahwa ukuran butur sedimen yang mendominasi yaitu fraksi lumpur berkisar antara 14,72% - 71,25%. Jenis makrozoobentos yang ditemukan dikelompokkan dalam 2 kelas, yaitu : Gastropoda dan bivalvia. Kelimpahan individu berkisar antara 0.3 - 4.4 ind/m2 dengan kelimpahan tertinggi terdapat pada stasiun 4 dan terendah terdapat pda stasiun 1. Kandungan bahan organik berkisar antara 9,27- 34,2%. Hubungan kandungan bahan organik dengan kelimpahan makrozoobentos memiliki korelasi cukup erat sebesar 0,506 . Hubungan ukuran butir sedimen dengan kelimpahan makrozoobentos menunjukkan hubungan yang cukup erat sebesar 0,544.

Kata kunci: Bahan Organik, Ukuran Sedimen, Kelimpahan Makrozoobentos.

1. Introduction

Sungai Selari Village is one of the villages in Indonesia located in Bukit Batu District, Bengkalis Regency, Riau. Sungai Selari Village is an area in Riau Province that features a high density of water activities, including a port where many ships are moored and transportation routes for fishermen. Human activities can cause pollution of waters, leading to silting of the waters through sedimentation. The presence of sediment in a body of water, whether in shallow or deep water, will have significance. Its function can have both ecological and physical impacts, for example, as a place to find food and a place to live for marine organisms, especially macrozoobenthos. Macrozoobenthos are organisms that live in the sediments of the ocean floor or at the bottom of lakes and rivers. If macrozoobentos is disturbed, it will cause the ecosystem to be disturbed as well. Polluted waters are characterised by the loss or reduction of specific species and the dominance of certain groups of species.

The presence of sediment entry activities in a body of water can lead to changes in the ecosystem, including alterations in sediment texture, total organic matter content, and the abundance of macrozoobenthos biota. One organism that can be affected by differences in ecosystems is the macrozoobenthos due to its sedentary nature. This study aims to determine the type of sediment, grain size, and organic matter content, as well as their relationship with macrozoobenthos abundance.

2. Material and Method

2.1. Time and Place

The study will be conducted from March to April 2023. The research was conducted in the coastal waters of Sungai Selari Village, Bengkalis

2.2. Methods

The method used in this study is a survey method with sampling using the purposive sampling method. Sampling in the form of sediments and macrozoobenthos by taking aquatic bottom substrate using Ekman Grab. Sediment samples were taken using a grab sampler with a water depth of approximately 100 cm, and the biota collected was macrozoobenthos contained within the sediment substrate. Macrozoobenthos samples were separated from the sedimentary substrate using a 0.5 mm sieve. The sample was placed in a plastic bag, then immersed in 4% formalin, and subsequently stored in an icebox before being taken to the Laboratory of Marine Physics, Marine Chemistry, and Marine Biology, Department of Marine Sciences, Faculty of Fisheries and Marine, Universitas Riau. Physical and chemical water quality parameter measurements are carried out in situ, which include brightness measurements using secchi disks, temperature and pH measurements using pH meters, and salinity measurements using hand refractometers.

2.3. Data Analysis

2.3.1. Organic Matter Content

Analysis of organic matter content was carried out using the Loss on Ignition (LOI) method (Heiri et al., 2001). The LOI method aims to determine the total organic matter content in the sediment, thereby establishing the deposition environment and understanding the process of sediment occurrence based on the organic carbon content of the sample. Furthermore, the level of organic matter present in the sediment is calculated by the formula:

$$\text{BOT} = \frac{(Wt-C)-(Wa-C}{Wt-c}\ x100$$

Information:

Wt = Total weight (aluminum foil + sample) before burning (g)

Wa = Total weight (aluminum foil + sample) after burning (g)
C = Weight of empty aluminium foil (g).

2.3.2. Sediment Grain Size

Determination of sediment type in the laboratory follows the procedure referring to Rifardi (2008), namely the analysis of sediment grain size for sand and gravel fractions using the wet sieving method, for sludge fractions analyzed by pipette method, as for the procedure by drying samples on aluminium foil containing wet samples dried in a 105°C oven (one day). The sample is weighed and then given a 3-5% solution of hydrogen peroxide to taste. The determination of the type of sediment is carried out using the Shepard triangle calculation method. The calculation is based on the proportion of particle size content of gravel, sand and mud.

2.3.3. Abundance of Macrozoobenthos

The abundance of macrozoobenthos is calculated based on the number of individual unity areas (ind/m^2) using the Shannon-Wiener formula (Odum, 1993).

$$K = \frac{a\ x\ 10.000}{b}$$

Information:
K : Type abundance index (ind/m^2)
a : Number of filtered macrozoobenthos (ind)
b : Ekman Grab tool opening area (cm^2)

3. Result and Discussion

3.1. Oceanographic Parameter

The results of water quality measurements (physical and chemical parameters) can be used as one of the considerations for the distribution and abundance of macrozoobenthos in Sungai Selari Village, Bengkalis. Water quality measurements are presented in Table 1.

Table 1. Average value of aquatic ecological parameters

Parameter	Unit	Station			
		1	2	3	4
Temperature	ºC	30	31	31	28
Brightness	cm	25,5	24	28,5	19
pH	-	7,8	7	8	7
Salinity	ppt	26	26	24	25

The results of temperature measurements in the coastal waters of Sungai Selari Village show an average value that is not significantly different between the four stations. The average temperature is 28 to 31^0C. The results of the temperature measurement are still within the normal category for aquatic life, so it does not affect the existence of macrozoobenthos in Sungai Selari Village. According to Widyastuti in Nurlinda et al. (2019), a suitable temperature range for macrozoobenthos growth is 25–32 °C. The results of water brightness measurements ranged from 19 cm ± 28.5 cm with an average of 24.2 cm. The lowest water brightness is found at station 4 (mangrove), which is 19 cm, while the highest water brightness is found at station 3 (residential area), which is 28.5 cm. This is due to the station's location, which is close to the settlement. According to Hasan (2012), high turbidity is caused by the large amount of organic matter from households that is suspended in the water.

The pH of Sungai Selari Village waters varies. At station 1, located on the outskirts of the river village beach, the average pH is 7.8. The pH value at station 2, located around the port, is 7. Station 3, located in residential areas, has a pH range value of 8, and Station IV, in the mangrove area, has a pH range value of 7. All stations that have been studied have differences in the average pH value, but not much. The pH range at the four stations is 7–8, which is relatively normal. It is an area close to residential areas where a sewer line carries fresh water from the bathrooms of residents. Therefore, the salinity at Station 3 has been affected by the presence of fresh water. Stations 1 and 2 have the highest salinity levels of 26 ppt, which is due to the areas surrounding these stations being directly facing the sea. Salinity in brackish areas or mangrove ecosystems ranges from 0 to 28 ppt (Choirudin et al., 2014).

3.2. Organic Matter

The results of the analysis of organic matter content in Sungai Selari Village are presented in Table 2.

Table 2. Organic matter content of Sungai Selari Village

Station	Organic matter content (%)
1	0.93
2	0.59
3	5.96
4	7.13

The results of the analysis of the average organic matter content in the waters of Sungai Selari Village ranged from 0.59 – 7.13%. The highest sediment organic matter was found at station 4, which was 7.13%, while the lowest sediment organic matter was found at station 2, which was 0.59%. The average value of sediment organic matter at station 1 was 0.93%, and at station 3, it was 5.96%. Station 2, which is the port activity area, has the lowest organic matter content compared to other stations (Table 2). The low content of organic matter at station 2 is influenced by the condition of the sediments, which are new sediment formations, and the absence of mangroves or ponds around the research site, which are sources of organic matter. Stations 3 and 4 are areas that receive input from residential areas and mangrove vegetation around the research site, allowing for the introduction of additional organic matter into the water.

3.3. Sediment Grain Size

Analysis of sediment grain fractions at each station in Sungai Selari Village Waters consists of two types of sediment fractions: muddy sand and sandy mud, with the latter being the dominant fraction. The difference in sediment grain size is related to the origin of the sediment source. The size of sediment grains directly facing the high seas will be rougher, indicating that the source of sediment comes from the sea, which then undergoes a transportation process until it is finally deposited in each location. Station 1 on the coast has a composition dominated by shells of marine life, foraminifera, and other marine organisms that have died, resulting in these deposits, including biogenic sediments. In addition, some sediments originating near the coast were found to contain trigenic deposits, consisting of fine-sized rocks, clay minerals, and plant remains, which characterise the influence of land.

3.4. Abundance of Macrozoobenthos

The results of laboratory observations on macrozoobenthos types yielded nine distinct species types. The most common species is the species *Nerita costata*. The classification of the macrozoobenthos found is presented in Table 4.

Table 4. Types and abundance of macrozoobenthos individuals

st	species	sum	Ni	Abundance (ind/m^2)
1.1	*Pirenella incisa*	2	7	1,2
	Anadara granosa	5		
1.2	*Litorina* scabra.	2	2	0,3
1.3	*Turris crispa*	4	6	0,9
	Ergalatax margaliticola	2		
2.1.	*Nerita balteata*	2	8	1,3
	N. costata	6		
2.2	*A.granosa*	3	3	0,5
2.3	*P. incisa*	4	6	1,0
	Cerithidea obtusa	2		
3.1	*Telescopium*	3	15	2,5
	N. costata	12		
3.2	*N. balteata*	6	6	1,0
3.3	*P. incisa*	4	4	0,7
4.1.	*N. costata*	16	26	4,4
	Telescopium	10		
4.2	*P. incisa*	5	7	2,8
	L. scabra	2		
4.3	*C. obtusa*	6	18	1,3
	N. balteata	12		

3.5. Relationship of Organic Matter to Macrozoobenthos Abundance and Sedimentary Grain Size with Macrozoobenthos Abundance

Based on the results of the regression correlation test between organic matter and the abundance of macrozoobenthos, a correlation coefficient of 0.506 was obtained. The results indicated a reasonably close relationship between the content of organic matter and the abundance of macrozoobenthos in the waters of Sungai Selari Village, Bengkalis. The value of the coefficient of determination indicates that 25.6% of the variation in sedimentary organic matter is related to the abundance of macrozoobenthos, while other factors account for 74.4%.

Based on the results of the regression correlation test, a determination coefficient was obtained, which showed that 29.6% of the variation in grain size affected the abundance of macrozoobenthos, while other factors influenced the remaining 70.4%. The correlation coefficient value (r) of the two variables is 0.544. The coefficient value shows a reasonably close correlation between sediment grain size and macrozoobenthos abundance

4. Conclusions

The abundance of macrozoobenthos in Sungai Selari Village is moderate, with a varied species composition. The organic matter in the waters of Sungai Selari Village is also medium; however, it is higher around the mangroves. The type of sedimentary grains from the four stations is dominated by mud. Correlation between

organic matter and sediment grain size with the abundance of macrozoobenthos belonging to the medium category. The organic matter content affects the abundance of macrozoobenthos, while the grain size of sediment does not influence the abundance of macrozoobenthos.

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