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RELATIONSHIP BETWEEN SEDIMENT ORGANIC MATERIAL CONTENT WITH THE ABUNDANCE OF *Cerithidea obtuse* IN THE INTERTIDAL ZONE, BUKIT BATU DISTRICT, BENGKALIS REGENCY, RIAU

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ABSTRACT

This study was carried out in March-April 2024 in the intertidal zone of Bukit Batu District, Bengkalis Regency, Riau Province, with the aim of knowing the size distribution and the relationship between sediment organic matter content and the abundance of *C. obtusa*. This research uses a survey method by determining sampling stations using purposive sampling consisting of three stations. Each station has three transects consisting of plots measuring 3 m^2. To determine differences in abundance, the Kruskal Wallis test was carried out and to determine the relationship between sediment organic matter content and the abundance of *C. obtusa*, statistical correlation and linear regression tests were carried out. The results showed that the organic matter content of the sediment is included in the medium-high category, ranging from 15.82%-22.27%. The abundance of *C. obtusa* ranged between 5.12−6.96 ind/m^2. There were differences in the abundance of *C. obtusa* among stations, with details between stations 3 and 1 and stations 3 and 2 being significant, while between stations 1 and 2 it was not significant. There were no differences in the abundance of *C. obtusa* among intertidal subzones. The distribution of *C. obtusa* is clustered with a dominant size of 20.7−34.5 mm. There is a moderate relationship between sediment organic matter content and the abundance of *C. obtusa* with a correlation coefficient (r) of 0.4743 and interpreted in the equation Y = -0,0009 + 0,2775X

Keywords: *Cerithidea obtusa*, abundance, organic matter, Bukit Batu District

1. INTRODUCTION

Bukit Batu District is a coastal area located in Bengkalis Regency. It has waters widely used as transportation routes, fishing areas, and tourist areas. Coastal areas are formed by various ecosystems consisting of interrelated biotic and abiotic processes and human activities in the upper land area (Upland Areas) and the sea or ocean (Oceans). One of the animals that interact in this area is the Mollusca phylum group, such as *Cerithidea obtuse* or red-eyed snails, often used as processed food with economic value.

Cerithidea obtusa is included in the class of gastropods that live on the bottom of the waters, play an important role in aquatic ecosystems, and can be an indicator of environmental quality. The abundance and distribution of *C. obtusa* are determined by variations in environmental factors and are commonly found in intertidal areas with a wide distribution. The presence of this animal can be found in coral reef areas and mangrove forest areas; some bury themselves in sediment and attach themselves to substrate plants and plants. Ecologically, *C. obtusa* has a vital role in the food chain[1].

The species *C. obtusa* plays a role in the decomposition process of litter, neutralizing organic matter that is

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herbivorous and detrivorous, and plays a vital role in the trophic level of the food chain and ecosystem stability[2]. The abundance and distribution of *C. obtusa* in the waters of Bukit Batu are influenced by pressure and variations in environmental factors, food availability, predators, and competition. The distribution of organisms is related to the content of organic matter in sediment[3]. Organic matter is one indicator of environmental fertility and affects the availability of dissolved oxygen and variations in the abundance of aquatic organisms.

Research on red-eyed snails has been conducted by Nurliya et al.[4] on studying the ecology of red-eyed snails in the estuary ecosystem of the Jangkang River, Selat Baru Village, Bengkalis Regency. As well as research on the relationship between organic matter and macrozoobenthos by Yulandari et al.[5] in the waters of Sungaitohor Village, Meranti Islands Regency, Riau Province, Windy et al.[6] in the Mangrove Area of Anak Setatah Village, Meranti Islands Regency, Riau Province. However, there has been no research on the relationship between organic matter content in sediment and the abundance of red-eyed snails in the intertidal zone of Bukit Batu. This study aims to determine the size distribution and relationship between organic matter content in sediment and the abundance of *C. obtusa* in the intertidal zone of Bukit Batu District.

2. RESEARCH METHOD

Time and Place

This research was conducted in March-April 2024 in the intertidal zone of Bukit Batu District, Bengkalis Regency, Riau Province (Figure 1). *C. obtusa* samples were analyzed at the Marine Biology Laboratory, and sediment organic matter content was measured at the Marine Chemistry Laboratory, Department of Marine Sciences, Faculty of Fisheries and Marine Sciences, Universitas Riau.

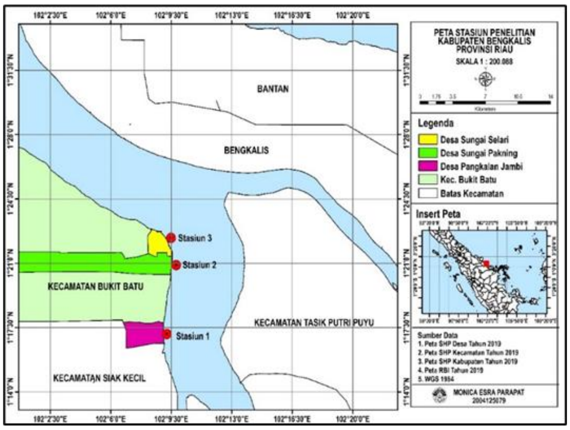

Figure 1. Map and research location

Procedures

Determination of Research Location

The sampling stations were determined by purposive sampling based on the criteria of the research location, which was divided into three stations. Station 1 is a mangrove conservation area by PT. Pertamina in Pangkalan Jambi Village, station 2 is a mangrove area close to anthropogenic activities in Sungai Pakning Village, and station 3 is in a mangrove environment with minimal anthropogenic activities in Sungai Selari Village.

Sample Collection and Handling

Sediment sampling was carried out using a PVC pipe with a diameter of ± 10 cm in each plot as much as ± 500 g, then put into a sample plastic. Sediment fraction analysis was carried out using the wet sieving and pipette methods to calculate the percentage of sediment particles. Sediment type classification is based on the proportion of gravel, sand, and mud particle size content, grouped in Sheppard's triangle[8]. Analysis of organic matter content in sediment was carried out using the Loss on Ignition method by burning sediment samples at 550°C.

Sampling of *C. obtusa* was carried out using the quadrant transect method. There were three transects at each station, and each transect was placed in 3 plots; in 1 plot, there were three subplots. Each plot was 3 m^2 and divided into nine subplots with a size of 1 m^2; sampling in each subplot was done randomly. *C. obtusa* epifauna samples were taken directly by hand, while infauna samples were taken using a shovel and then filtered using a 1 mm^2 filter mesh. The samples obtained were stored in labelled plastic bags, dripped with 70% alcohol, put into an ice box, and taken to the laboratory for identification and analysis. Analysis of the size distribution of *C. obtusa* samples was measured based on the length of the shell of the Sturges rule[7].

Sample Analysis

Analysis of organic content in sediment was carried out using the Loss on Ignition method[8], as follows:

$$BOT\ (\%) = (a-c)/(a-b) \times 100\%$$

Information:

a = Weight of cup and sample after drying temperature 105°C (g)
b = Weight of cup (g)
c = Weight of cup and sample after burning temperature 550°C (g)

The abundance of *C. obtusa* was calculated based on the number of individuals per unit area (ind/m²) according to Fachrul[9], as follows:

$$K = \frac{Ni}{A}$$

Information:

K = Abundance of *C. obtusa* (ind/m²)
Ni = Number of *C. obtusa* individuals
A = Area (m²)

The distribution pattern of *C. obtusa* was calculated using the Morisita Disperse index formula[10], as follows:

$$Id = n \frac{\sum X^2 - N}{N\ (N-1)}$$

Information:

Id = Morisita Dispersion Index
n = Total number of sampling units
N = Total number of individuals in the plot
$\sum X^2$ = Square of the number of individuals per plot

With the Morisita Dispersion Index criteria: Id < 1 = Uniform distribution pattern; Id = 1 = Random distribution pattern; and Id > 1 = Clustered distribution pattern

The size distribution of *C. obtusa* is grouped according to size class concerning Sturges' rules[7], as follows:

$$k = 1 + 3{,}322 \log n$$

Description:

k = Number of interval classes
n = number of data

The relationship between sediment organic matter variables and the abundance of *C. obtusa* was determined based on a linear regression correlation analysis approach using Microsoft Excel Software on the equation Y = a + bx.

To assess the closeness of the relationship between sediment organic matter and the abundance of *C. obtusa*, the correlation coefficient (r) was used with a relationship strength value between 0 > r < 1. The research data were presented in tables and graphs and then discussed descriptively statistically. Statistical analysis was carried out using the Kruskal Wallis test with the help of SPSS (Statistical Package for the Social Sciences) Software to determine the differences in abundance between stations.

3. RESULT AND DISCUSSION

Water Quality Parameters

The measurements of water quality parameters in the Bukit Batu District intertidal zone showed that the water temperature at the research station point location ranged from 30-33 °C with an average of 31.3 °C. The salinity values obtained ranged from 14-17 ppt. The pH level of the water ranged from 7.03-7.15, with an average of 7.11 (Table 1).

Organic Matter Content of Sediment

The analysis of sediment substrate types at each station in Bukit Batu District showed that stations 1 and 2 had mud substrates, and station 3 had sandy mud substrates. Sediment substrate types are based on the percentage of gravel, sand, and mud fractions that affect the distribution of organic matter in waters. Smaller and finer sediment particles can trap more organic matter than larger and coarser sediment particles[11].

Table 1. Results of water quality parameter measurements in Bukit Batu District

No.	Water quality parameters	Station1	Station 2	Station 3	Average
1.	Temperature (^{o}C)	33	30	31	31,3
2.	Salinity (‰)	14	17	17	16
3.	pH	7,03	7,15	7,15	7,11

Table 2. Organic matter content in sediment in Bukit Batu District

Station	Transect 1	Transect 2	Transect 3	Mean ± Std. Dev
1	26,497	14,960	14,670	18,71 ± 8,284
2	23,563	19,547	19,210	20,77 ± 4,096
3	19,340	13,820	11,877	15,01 ± 6,105

The organic matter content between stations ranges from 15.0 to 20.77% and is included in the medium-high category. The highest organic matter content value was at station 2 in Sungai Pakning Village, with an average of 20.77%, followed by station 1 in Pangkalan Jambi Village, with an average of 18.71%, and the lowest organic matter content was at station 3, which is in Sungai Selari Village with an average of 15.01% (Table 2). The high percentage of organic material content at station 2 can occur because this area has a mud substrate type and calmer water flow conditions, so fine sediment fractions and organic material will more easily settle to the bottom of the water.

Abundance of *C. obtusa*

The abundance of *C. obtusa* varies at each station. The results of the calculation of the abundance of *C. obtusa* can be seen in Figure 2.

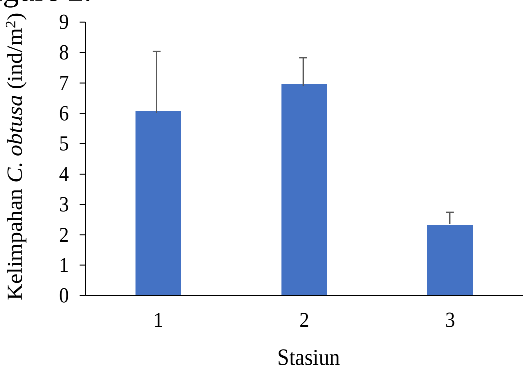

Figure 2. Comparison of average abundance of *C. obtusa*

The highest abundance of *C. obtusa* was found at station 2 in the intertidal zone of Sungai Pakning Village with an average of 6.96 ind/m^2, then at station 1 in the intertidal zone of Pangkalan Jambi Village with an average of 6.07 ind/m^2 and the lowest abundance was at station 3 in Sungai Selari Village with an average of 2.33 ind/m^2.

Based on the statistical analysis of the Kruskal-Wallis Test, the Assymp Sig value was obtained <0.001 or p<0.05, indicating a difference in the abundance of *C. obtusa* between stations. The results of further tests of the significance of abundance between stations showed a difference between stations 3 and 1 and stations 3 and 2, while between stations 1 and 2, it was not significant.

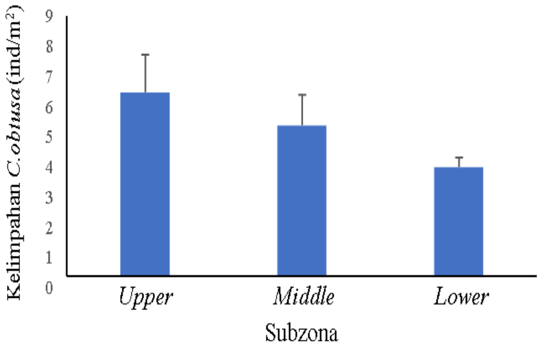

Figure 3. Comparison of average abundance of *C. obtusa* in the intertidal zone

The abundance of *C. obtusa* varies in each intertidal subzone. Statistical analysis of the Kruskal-Wallis Test obtained an

Assymp Sig value of <0.207 or p> 0.05, indicating no difference in the abundance of C. obtuse between intertidal subzones. The results of the calculation of the abundance of *C. obtusa* can be seen in Figure 3.

Based on the observations of *C. obtusa* in the intertidal zone of Bukit Batu District, the highest abundance was found at station 2, which has a denser and shadier mangrove ecosystem condition compared to stations 1 and 3. The abundance of *C. obtusa* is often found in mangrove forests with Rhizophora, and it has a muddy substrate type with sufficient organic matter content[12]. Higher abundance was found at stations 1 and 2, with a sandy substrate type, and the lowest at station 3, with a sandy mud substrate type. Muddy sediments tend to accumulate more organic matter compared to sandy sediments.

Based on the coastal intertidal zone, the highest abundance was sequentially found in the upper, middle, and lower zones. Macrozoobenthos from the Cerithidea class, such as *C. obtuse*, live around mangrove roots, which are included in the upper intertidal subzone. The condition of the aquatic environment affects the abundance of *C. obtusa* at each station. Higher or lower water temperatures can disrupt biota's metabolism, reproduction, and life cycle.

The pH value of the waters obtained is still in good and optimum condition for macrozoobenthos and can support the mineralization process of organic matter. The good salinity value for Gastropods such as *C. obtusa* ranges from 15-30 ppt[13]. The high and low abundance of *C. obtusa* is also influenced by the community's activities, which consider snails animals for consumption and commercial purposes. Red-eyed snails are gastropods with a delicious taste, high mineral and protein content, and high economic value[14].

Distribution Pattern of *C. obtusa*

The distribution pattern of *C. obtusa* has the same properties in each zone between stations. The results of the calculation of the distribution pattern of *C. obtusa* can be seen in Table 3.

Table 3. The distribution pattern of *C. obtusa* in Bukit Batu District

Station	Intertidal Subzone			Distribution Pattern
	Upper	Middle	Lower	
1	3,23	3,32	2,88	Grouping
2	3,03	2,91	2,87	Grouping
3	2,94	2,68	2,77	Grouping

The distribution pattern of *C. obtusa* in each zone between stations ranged from 2.68-3.32 (Id > 1). These results indicate that *C. obtusa* is distributed or clustered in the research location. The clustered distribution pattern of biota occurs because species tend to forage together[15]. If a habitat can provide sufficient food sources, there is no competition between biota, even though they have the same food sources. Various environmental factors, both biotic and abiotic water quality, can influence the clustered distribution pattern. *C. obtusa* is a mangrove litter eater that absorbs organic sediment material. Gastropods such as *C. obtusa* are associated and can be found in abundance in environmental conditions with denser mangrove vegetation[13], especially at station I of the study. The pattern of grouped distribution with various grouping levels is the most common form of distribution[16]. Individuals gather in the face of weather and seasons, changes in habitat, and the reproductive process, so competition between individuals in obtaining food and moving space increases. This also occurs because individuals in the population tend to form groups of various sizes.

Size Distribution of *C. obtusa*

The size distribution of *C. obtusa* varies in each class at each station. *C. obtusa* is grouped into five size classes of Sturges' rule[7]. The distribution of *C. obtusa* between stations is dominated by a size of 19.39–23.51 mm, and the least found is 7–11.12 mm. The size distribution of *C. obtusa* varies between stations; the smallest *C. obtusa* found is 7 mm, and the largest is 48.3 mm (Figure 4).

The analysis of *C. obtusa* individuals showed that the most common size was found in the 3rd size class at station 2, with a total of 68 individuals. Meanwhile, the smallest *C. obtusa* was found at stations 1 and 3, namely 44.17-48.30 mm. The dominance of *C. obtusa* at 19.39–23.51 mm can be influenced by various environmental factors, such as food availability and competition with other biota in the food chain. The smaller the size of *C. obtusa*, the higher the potential for being preyed on by predators such as crabs, fish and birds because its shell is still thin

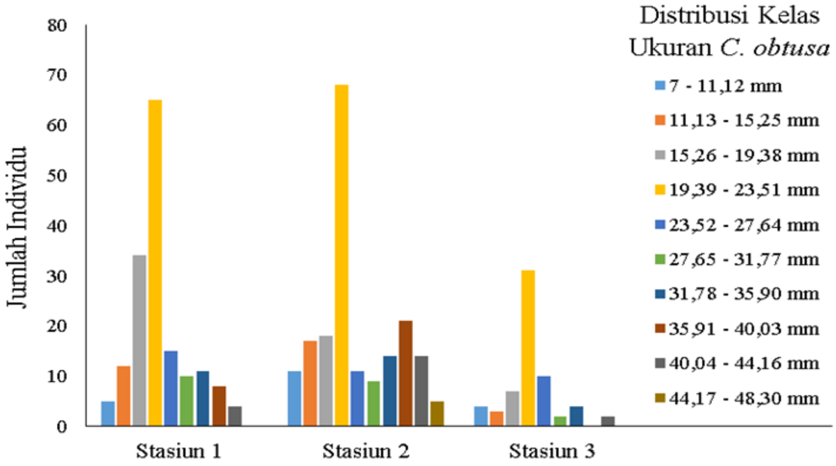

Figure 4. Comparison of the size of *C. obtusa*

Habitats that provide sufficient food sources allow *C. obtusa* to grow better at various optimal size levels. Population density can also affect the size distribution of *C. obtusa*; competition for resources can inhibit more significant growth. Age and breeding season factors also affect the size distribution preferences of biota. In addition, shellfish hunting by the community can also affect the size distribution of *C. obtusa*.

Relationship Between Organic Matter Content of Sediment and Abundance of *C. obtusa*

The results of the correlation and linear regression analysis of the relationship between the total organic matter content of sediment and the abundance of *C. obtusa* in the intertidal zone of Bukit Batu District can be seen in Figure 5.

The correlation test and simple linear regression results are interpreted in the equation Y = -0,0009 + 0,2775X. The value of X (0,2775) is positive, which states that the organic matter content of sediment (X) has a positive effect on the abundance of *C. obtusa* (Y). The correlation coefficient value (r) of 0,4743 indicates a moderate relationship between the organic matter content of sediment and the abundance of C. obtuse. This shows that the abundance of *C. obtusa* is influenced by sediment's total organic matter content. With each increase in the organic matter of sediment by one unit, the abundance of *C. obtusa* can increase by 0,4743. The coefficient of determination value (R^2) = 0,225 indicates that the effect of organic matter content on the abundance of *C. obtusa* is 22%. The increase in the abundance of *C. obtusa* is only influenced by BOT by 22%. The rest can be influenced by other factors outside the test, such as variations in environmental factors. The increasing organic matter content of sediment results in a greater abundance of *C. obtusa* at the research location.

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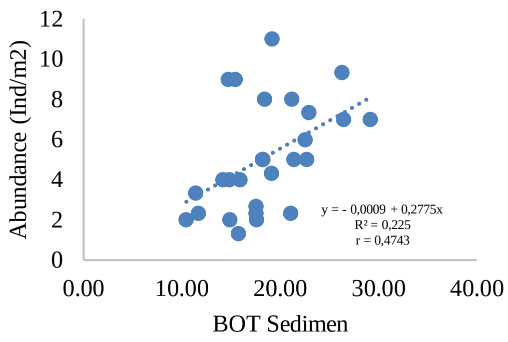

Figure 5. The equation of the relationship between organic matter content in sediment and the abundance of *C. obtusa*

The *C. obtusa* is often found in mangrove forest areas that are overgrown with Rhizophora and have muddy substrates that accumulate more organic matter than sandy sediments. Organic matter is a soil-forming material from plant and animal remains, either in the form of original tissue or that has undergone weathering[4]. Sediments with high organic matter can experience decomposition that reduces dissolved oxygen. The abundance of *C. obtusa* is closely related to the availability of organic matter in the substrate because it is a source of nutrients for basic aquatic biota[17]. However, if organic matter exceeds a reasonable threshold, the position of the organic matter is considered a pollutant. Not all organic matter in sediment has the same nutritional value or supports the habitat of *C. obtusa* in the same way.

4. CONCLUSION

The highest abundance *of C. obtusa* and the highest sedimentary BOT content were found in stations with high mud substrates and good mangrove forest density. The abundance of *C. obtusa* between stations differed significantly, while between subzones it did not. *The distribution of C. obtusa* is grouping and has a different size distribution from the size of the dominant medium group. There was a moderate relationship between the content of sedimentary organic matter and the abundance of *C. obtusa* with a correlation value of 0.4743 and interpreted at the equation Y = -0.0009 + 0.2775X.

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