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POPULATION STRUCTURE AND HABITAT CHARACTERISTICS OF CLAM *(Meretrix meretrix)* IN THE INTERTIDAL ZONE OF TELUK LANCAR VILLAGE, BENGKALIS REGENCY

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ABSTRACT

Clam *(Meretrix meretrix)* is an economically and ecologically significant bivalve mollusk. This study aimed to determine the population structure and habitat characteristics of *M. meretrix* in the intertidal zone of Teluk Lancar Village, Bengkalis Regency. The research employed a survey method from November 2024 to February 2025, focusing on one station divided into three subzones (Upper, Middle, Lower). Results revealed that the sediment substrate was predominantly sandy mud with organic matter content ranging from 0.5% (middle zone) to 2% (upper zone). The highest abundance of *M. meretrix* was found in the middle subzone (3.1 ind/m²), while the lowest was in the upper subzone (2.0 ind/m²). No significant differences in abundance were observed between stations or intertidal subzones. Size distribution analysis revealed that the 2.68-3.17 cm class was the most common (15 individuals), while the 1.18-1.67 cm and 4.16-4.67 cm classes were the least represented (1 individual each). The distribution pattern of *M. meretrix* was uniform (Id < 1).

Keywords: Intertidal zone, *M. meretrix*, population structure, Teluk Lancar Village

1. INTRODUCTION

Bengkalis Regency boasts a vast coastal and marine area, characterised by high biodiversity of natural resources and potential for the development of fisheries and aquatic activities. The eastern coast of Bengkalis Island, particularly Teluk Lancar Village, is renowned for its rich bivalve populations, including the species of clam known as M. meretrix. In this area, the capture of *Meretrix meretrix* is a widely consumed source of protein by the local community.

The clam is a species of mollusc of the bivalve class that plays a significant role in the Southeast Asian region, both economically and ecologically. As filter-feeding organisms, these shellfish play a crucial role in maintaining the balance of aquatic ecosystems by filtering organic particles and microorganisms from the water. This species generally inhabits the intertidal zone, the dynamic area between the highest and lowest tidal boundaries[1].

Various biotic and abiotic factors influence the abundance of clam populations in the intertidal zone. Recent research by Li et al.[2] demonstrates that substrate characteristics play a crucial role in determining the distribution and abundance of *M. meretrix*. Clams tend to be more abundant on sandy substrates with moderate organic matter content, and seasonal fluctuations also affect population abundance. The primary habitat of the clam *M. meretrix* is in waters with relatively calm muddy sand, where they live in groups. In addition to physical, chemical, and biological factors, the substrate plays an important role for clams, serving as both a habitat and a source of food. The growth of M. meretrix can be observed by measuring the length of clams[3].

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Overexploitation is one of the main threats to the abundance of clam populations in the intertidal zone. Unobservant and continuous capture can result in a significant decline in clam populations. This not only affects the number of individuals but also impacts the overall population structure. As a result, there is a disruption in population growth characterised by smaller catch sizes, decreased individual weight, and a reduced number of catches[4].

Several studies on the bivalve clam *M. meretrix* have been conducted, including the population structure of *M. meretrix* in the intertidal zone of Sri Tanjung Village, Rupat District, Bengkalis Regency by Khoiriyah et al.[5] and the population dynamics of the exploited white shells at the Kambu River Estuary, Southeast Sulawesi[6].

This study was conducted to study the population of clams in the intertidal zone of Teluk Lancar Village, Bengkalis Regency. Its main objective is to analyse clams' abundance, size class distribution, and distribution patterns to obtain comprehensive scientific information. This study will investigate population structure, habitat characteristics, and potential threats to the sustainability of the species, which can inform the development of conservation strategies and the sustainable management of clam resources.

2. RESEARCH METHOD

Time and Place

This research was carried out from November 2024 to February 2025. The sampling location was carried out in the intertidal zone of Teluk Lancar Village, Bengkalis Regency (Figure 1). Sample analysis was conducted at the Laboratory of Marine Biology, the Laboratory of Physical Oceanography, and the Laboratory of Marine Chemistry, all within the Department of Marine Science, Faculty of Fisheries and Marine Science, Universitas Riau.

Figure 1. Map of the research location

Procedures

Determination of Sampling Point

The determination of the research station was carried out using a purposive sampling technique, which is based on the characteristics of the M. meretrix area at the research station. Where the research was only conducted at one station, the research location was divided into three sampling subzones, namely: 1) upper intertidal zone, 2) middle intertidal zone, and 3) lower intertidal zone, by dividing the intertidal zone perpendicular to the coast. The research station features three transects, each comprising six sampling points, with a plot size of 1 m x 1 m. The distance of each transect is 150 m, and the distance between sampling points in the same subzone is 150 m, while the distance between sampling points in the same subzone is 10 m, and the width of the intertidal zone is ±300 m (Figure 2).

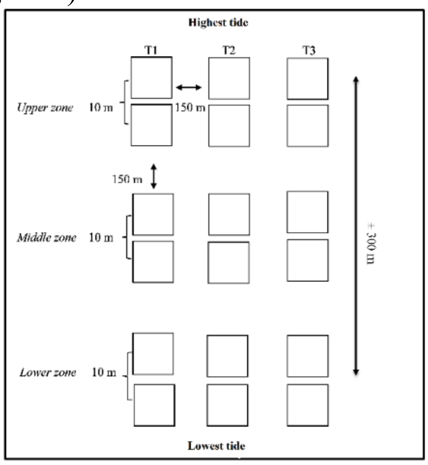

Figure 2. Transect laying scheme and plot

Sample Collection and Handling of Clam *(M. meretrix)*

Meretrix meretrix sampling was carried out at the lowest recede, taken on each plot measuring 1m x 1m using a knife by dredging with a substrate depth of 5-10 cm. The samples were then placed in plastic bags, labelled with each sampling point, and stored in an icebox to be taken to the Marine Biology Laboratory, Department of Marine Science, Faculty of Fisheries and Marine Science, for analysis.

Sediment Sample Collection and Handling

Sediment sampling was carried out at the same location as *M. meretrix* sampling to determine the condition of the substrate and the content of organic matter in each intertidal subzone using a small shovel. The sample was taken in quantities of up to 500 g, placed in a labelled plastic bag, and then stored in an ice box for transportation to the laboratory for analysis.

Sample Analysis of Clam *(M. meretrix)*

Samples taken at the research site are transported to the laboratory and washed with fresh water. After washing, the *M. meretrix* samples were measured using a calliper to determine their length and grouped by size. Then, the abundance of *M. meretrix* was calculated, and the size distribution and distribution pattern were determined using a predetermined formula.

Sediment Faction Analysis

Sediment fraction analysis was performed using two methods: the multi-stage sieving method and the pipette method. The multi-stage sifting method is used to obtain sediment fractions Ø1-Ø4, whereas the pipette method utilizes pipettes to obtain Ø5-Ø7.

Analysis of Sediment Organic Matter

Organic matter analysis is calculated using the formula of Mufaidah et al.[7] as follows:

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

Information:

BOT = Total organic weight
Wt = Total weight before furnace after ovening
Wa = Total weight after furnace
C = Weight of empty cups

Analysis of the Abundance of Clams *(M. meretrix)*

The abundance data obtained based on the number of individuals per unit area is calculated using the formula Dwirastina[8] as follows:

$$\text{K} = \frac{\text{N}}{\text{A}}$$

Information:

K = Type abundance (ind/m^2)
N = Number of individuals of a species (ind)
A = Plot area (m^2)

Then, statistical testing was conducted using One-Way ANOVA to determine the differences in abundance among the subzones. Furthermore, if there is a significant difference between the intertidal subzones, a follow-up LSD (Least Significant Difference) test is carried out.

Analysis of the Size Class of Clams *(M. meretrix)*

Determining the number of long size classes of clam samples found, an interval class was made by referring to the Sturges formula Putra et al.[9] as follows:

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

Information:

k = Number of interval classes
n = Amount of data

To calculate the width of the class of each size group (c), use the formula Tamsar et al.[10] as follows:

Coverage (J) = a-b ;Class width (c): $c = \frac{\text{J}}{\text{k}}$

Information:

k = Number of class size groups
J = Range
a = Maximum length of clams
b = Minimum length of clams

Analysis of Distribution Patterns of Clams *(M. meretrix)*

The distribution pattern data of *M. meretrix* obtained in the intertidal zone of Teluk Lancar Village, Bengkalis Regency, was used to calculate the Morisita Distribution Index[11,] which is as follows:

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

Information:

Id = Distribution index of the clam *M. meretrix*

N = Number of plots

N = Total number of individuals in n plots

$\sum X^2$ = Square of the number of individuals per plot

3. RESULT AND DISCUSSION

Water Quality

The measured water quality consists of temperature, salinity, and pH. The results of water quality measurements in each intertidal subzone in Teluk Lancar Village are presented in Table 1.

Table 1. The results of measuring water quality parameters in each intertidal subzone in Teluk Lancar Village.

Subzone	Temperature (°C)	Salinity (‰)	pH
Upper	29	27	7
Middle	29	28	7
Lower	27	28	7
Average	28.3	27.6	7

In Table 1, it can be seen that the temperature measurements in the intertidal subzone ranged from 27 to 29 °C, with an average of 28.3°C. Salinity values ranged from 27 to 28‰, with an average of 27.6‰, and pH values had an average of 7. Based on this, the waters in the intertidal zone of Teluk Lancar Village are still in good condition and support the life of the clams. This follows the statement by Marwanto et al.[12], which indicates that the appropriate temperature range for bivalve life is 28-31°C. Salinity is 27-28‰, which is within the habitat of mussels where mussels can survive in the range of 25-30‰, and the ideal pH for mollusk growth is 7 and 8.5.

Abundance of Clams *(M. meretrix)*

The results of *M. meretrix* abundance in each subzone in Teluk Lancar Village are presented in Table 2.

Table 2. An abundance of M. meretrix in each intertidal subzone in Teluk Lancar Village, Bengkalis Regency

Transect	Plot	Upper	Middle	Lower
1	1	2	3	3
	2	3	5	3
2	1	1	3	3
	2	2	2	2
3	1	2	2	1
	2	2	4	3
Total		12	19	15
Average±Std dev		2 ± 0.6	3.1 ± 1.1	2.5 ± 0.8

Table 2 shows that the highest abundance of *M. meretrix* is found in the middle subzone with an average of 3,1 ind/m2, and the lowest abundance of *M. meretrix* is found in the upper subzone with an average of 2.0 ind/m^2. The abundance of *M. meretrix* in the intertidal zone of Teluk Lancar Village showed the highest value in the *middle* subzone, characterised by sandy sediment, and the lowest value in the upper subzone, characterised by sandy mud sediment. However, the organic matter content in the *upper* zone is higher due to its proximity to the mangrove ecosystem. Silaban et al.[3] stated that high organic matter content can lead to habitat incompatibility and decrease shellfish abundance. Dirani et al.[13] found that *M. meretrix* dislikes muddy substrates due to its limited adaptability. Yulma et al.[14] explained that mangrove ecosystems contribute high amounts of litter as a source of nutrients for aquatic biota. However, water quality parameters (temperature, salinity, and pH) remain important factors affecting shellfish abundance[15].

Distribution of clam size classes *(M. meretrix)*

The results of the distribution of *M. meretrix* size classes in each intertidal subzone of Teluk Lancar Village are presented in Table 3.

Table 3. Distribution of *M. meretrix* size classes in each intertidal subzone in Teluk Lancar Village, Regency of Bengkalis

No	Class (cm)	Upper	Middle	Lower	Frequency
1	1.18 – 1.67	0	1	0	1
2	1.68 – 2.17	5	5	1	11
3	2.18 – 2.67	1	2	5	8
4	2.68 – 3.17	4	7	4	15
5	3.18 – 3.67	2	3	3	8
6	3.68 – 4.17	0	1	1	2
7	4.18– 4.67	0	0	1	1

Based on Table 3, the distribution of the size class was calculated, and in Teluk Lancar Village, the largest size class was identified, specifically the size class of 2.68-3.17, comprising a total of 15 individuals. Meanwhile, the smallest size class was found in the 1.18-1.67 and 4.16-4.67 size classes, where only one individual was observed.

The distribution of *M. meretrix* in Teluk Lancar Village is dominated by individuals of 2.68-3.17 cm in the middle zone, with a sandy substrate, while sizes of 1.18-1.67 cm and 4.16-4.67 cm are represented by smaller individuals and are absent in the upper zone with a sandy mud substrate. Dirani et al.[13] emphasized the importance of substrates for shellfish habitats and abundance, attributing size variation to catches and environmental conditions. Shellfish that are <4 cm in size require nutrients to grow, with growth slowing down with age[15].

Distribution Pattern of clams *(M. meretrix)*

The results of the calculation of the distribution pattern of *M. meretrix* in the intertidal zone of Teluk Lancar Village can be seen in Table 4.

Table 4. Distribution pattern of *M. meretrix* in each intertidal subzone in Teluk Lancar Village

Subzone	Morisita distribution index	Distribution pattern
Upper	0.75	Uniform
Middle	0.88	Uniform
Lower	0.88	Uniform

Based on the Morisita distribution index calculation in each intertidal subzone, an Id value of <1 was obtained, which means that the resulting distribution pattern is uniform. The distribution pattern of *M. meretrix* in the intertidal zone of Teluk

Lancar Village is uniform, with the highest Morisita index in the middle zone (0.8842), followed by the lower zone (0.8831) and the upper zone (0.75). Nadia et al.[16] attribute this pattern to competition between individuals and high competence, while Wardiatno et al.[4] attribute it to homogeneous environmental conditions. This uniform pattern aligns with the findings of Wulandari et al.[15] in Padang Regency; however, it differs from the results of Dirani et al.[13], who reported random and grouped patterns.

Total Sediment Organic Matter

The results of the analysis of sedimentary organic matter content in Teluk Lancar Village in each intertidal subzone are presented in Table 5.

Table 5. The content of organic matter

Subzone	BOT (%)
Upper	2.0
Middle	0.5
Lower	1.9

Based on the calculation results, the highest sediment organic matter content is 2% in the upper subzone and the lowest is 0.5% in the lower subzone. The content of sediment organic matter in the intertidal zone of Teluk Lancar Village showed variation, with the highest value of 2% in the upper zone and the lowest value of 0.5% in the middle zone, where the types of mangroves growing along the coast and the sediment types were influencing factors.

Supriyantini et al.[17] explained that the source of sediment in the mangrove area comes from both the land and the mangrove itself, in the form of heaps of leaf falls, twigs, and decomposed dead organisms, which contain a high content of organic matter and minerals. Meanwhile, the low level of organic matter in the middle zone is attributed to the type of sandy sediment, as stated by Anwari et al.[18], who noted that organic matter is not abundant in sandy substrates because it is easily washed away by water flow.

Sediment Type

The results of the sediment fraction analysis in Teluk Lancar Village are presented in Table 6.

Table 6. Sediment Type in each intertidal subzone in Teluk Lancar Village, Bengkalis Regency

Subzone	Types of sediment			Type
	Gravel (%)	Sand (%)	Mud (%)	
Upper	1.36	30.98	67.66	Sandy Mud
Middle	2.30	83.48	14.22	Sandy
Lower	4.28	73.45	22.27	Muddy Sand

Table 6 shows that the sediment type in the upper subzone is sandy mud, the middle subzone is sandy, and the lower subzone is muddy sand. The type of substrate in the intertidal zone of Teluk Lancar Village shows varied characteristics, with the upper zone having a sandy mud substrate formed from a combination of input of sand particles from the mainland and sediment fractions of mud fractions from mangrove vegetation along the coastline, by the findings of Supriyantini et al.[17] who stated that sediments in the mangrove area come from the mainland. The mangroves themselves are in the form of piles of leaf falls, twigs, and dead organisms. At the same time, the lower zone is characterized by a type of muddy sand sediment formed due to the influence of tidal waves, currents, transport of mud sediment from estuary areas, waves, wind, and several other factors[19].

4. CONCLUSION

Based on the research, it can be concluded that the highest abundance of *M. meretrix* was found in the middle subzone, while the lowest abundance was found in the upper subzone. The size distribution of *M. meretrix* revealed seven size classes of shells. The most common size class was 2.68-3.17, with a total of 15 individuals. Meanwhile, the least abundant size classes were 1.18-1.67 and 4.16-4.67, each of which had only one individual. The distribution pattern of *M. meretrix* in Teluk Lancar Village shows uniform characteristics.

Based on the results of this study, several recommendations can be made for developing an integrated management system for clams, including setting catch size limits, establishing conservation areas, conducting periodic monitoring, and implementing sustainable management of shellfish resources. This involves regulating shellfish fishing to prevent population decline and maintain ecosystem balance.

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