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POPULATION STRUCTURE OF THE *Meretrix meretrix* IN THE INTERTIDAL ZONE OF SRI TANJUNG VILLAGE RUPAT SUB-DISTRICT BENGKALIS DISTRICT

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ABSTRACT

This study aims to determine the population structure of *Meretrix meretrix* in the intertidal zone in Sri Tanjung Village, including abundance, distribution patterns, and size distribution. This research was conducted in February 2024 in Sri Tanjung Village, Rupat District, Bengkalis Regency. The research method used was the survey method. *M. meretrix* is one of the biota that lives in tidal areas where the subzone that experiences tides is divided into 3 (three) subzones (upper, middle, and lower). The research site is divided into two research stations. Each station is divided into 3 (three) transects, each consisting of 3 (three) plots with a size of 1 x 1 m^2. Environmental parameters include temperature, salinity, pH, substrate type, and organic matter. The results showed that the highest abundance was found in the Lower subzone at station I, with an average abundance of 8.66 ind/m^2, and at station II, with an average abundance of 4.33 ind/m^2. In comparison, the lowest abundance is found in the upper subzone at station I with an average value of 3 ind/$m^{2,}$ and the lowest abundance at station II with an average of 1 ind/m^2. The size distribution of *M. meretrix* at station 1 obtained seven classes, with the highest number of individuals in the 3rd class (2.33 - 2.92 cm), while at station 2, there were six classes where the highest number of individuals was in the 3rd class (1.47 - 1.81 cm). The distribution pattern of *M. meretrix* found is random and uniform. The analysis results of *M. meretrix* abundance between stations and *M. meretrix* abundance between intertidal subzones differed significantly.

Keywords: Population structure, *M. meretrix*, Intertidal zone, Sri Tanjung Village.

1. INTRODUCTION

As an archipelagic country, Indonesia has a vast coastal area and holds enormous potential, especially in fisheries. The center of interaction between land and sea is in the coastal area, where the coastal area can function as a buffer, protector, and filter between land and water[1]. Coastal areas are where freshwater from the land and saltwater from the sea meet. Tidal factors can influence the mixing of the two types of water, resulting in sediment particles that can cause sedimentation in coastal locations. The increasing sedimentation strongly influences the biota in this coastal location in the coastal area[2]. Among the biota found on the coast are Bivalves.

Sri Tanjung Village has a sloping beach with a muddy sand substrate. One of the bivalves found in Sri Tanjung Village Beach is *M. meretrix*. Bivalves, commonly called shellfish, can act as food providers for various other species. They can be used as indicators of water quality, so this group of organisms has an important role in the ecosystem. Bivalves are one group of invertebrates often found and live in intertidal areas[3]. Compared to other marine ecosystems, this zone is the narrowest in terms of area but more prosperous and

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diverse in species richness. This zone is highly productive and encompasses almost all ecosystems in the region[4]. *M. meretrix* is one of the biota that live in tidal areas where the intertidal zone is divided into upper subzone, which is the area affected by the highest tide, middle subzone, which is the middle area, and lower subzone, which is in the lowest tidal area. There are many types of bivalves or shellfish in the zone.

Meretrix meretrix was found in Sri Tanjung Village, Rupat Sub-district, Bengkalis Regency waters. In addition to its role in the food chain, *M. meretrix* has a high economic value because it has a savoury and delicious taste, so this clam is in great demand by the public. Many people catch these mussels directly in their habitat and ignore the number and size, which is thought to disrupt water quality and the survival of *M. meretrix*. Catching shellfish by local communities without paying attention to the size of the shellfish is believed to affect the size distribution of *M. meretrix* so that later large shellfish will rarely be found in the waters.

Therefore, it is necessary to research the abundance, distribution pattern and size distribution of *M. meretrix* in the intertidal zone of Sri Tanjung Village, Bengkalis, Riau Province. Therefore, it is necessary to research the abundance, distribution pattern and size distribution of *M. meretrix* in the intertidal zone of Sri Tanjung Village, Bengkalis, Riau Province.

2. RESEARCH METHOD

Time and Place

This research was conducted in February 2024. The sampling location is in the Sri Tanjung Village Intertidal Zone, Rupat District, Bengkalis Regency, Riau Province. Sample analysis was performed at the Marine Biology Laboratory, Chemical Oceanography Laboratory and Physics Laboratory of the Department of Marine Science, Faculty of Fisheries and Marine Sciences, Universitas Riau.

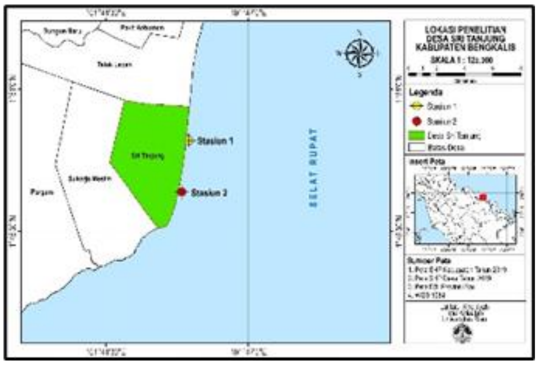

Figure 1. Map of research location

Method

The method utilized in this study involved a survey, where samples were collected directly from each station in the field, specifically within the intertidal zone of Sri Tanjung Village, Rupat District, Bengkalis. The environmental parameters measured included temperature, pH, salinity, brightness, substrate type, and organic matter content.

Procedures

Determination of Sampling Points

The research station was selected using purposive sampling based on the characteristics of the *M. meretrix* area at the station. The study was conducted at two stations. The first station is a natural beach with minimal human activity, resulting in lower environmental pressure than beaches with more human involvement. The second station is in a restaurant area with high human activity. The restaurant directly discharges dishwashing waste into the water. These two stations were chosen to compare the abundance, size distribution, and distribution patterns of *M. meretrix* between the two environments.

The distance between the first and second stations is approximately 700 meters. The research site is divided into three zones: zone 1, the upper intertidal zone; zone II, the middle intertidal zone; and zone III, the lower intertidal zone. The research station has three transects, each consisting of 3 sampling points, and the distance between transects is 100 m. The measurement of the distance between sub-zones is approximately 85 m.

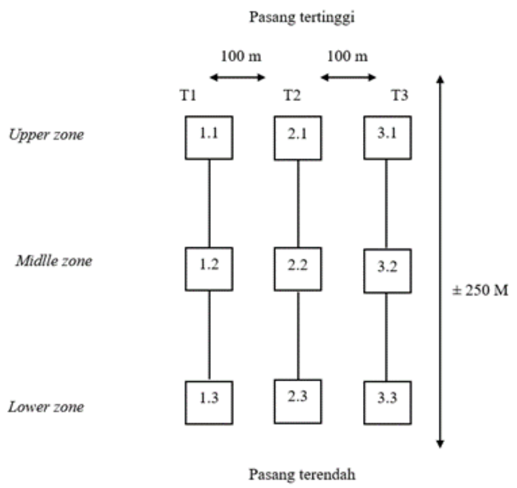

Figure 2. Scheme for determining plots at stations

Sampling and Handling of *M. meretrix*

Sampling of *M. meretrix* was conducted using quadratic transects by dividing the station into some plots. Clam sampling was performed when the waters were at their lowest ebb. *M. meretrix* was collected in each 1x1 m plot using a curved iron rake, dug to a depth of about 10 cm. Furthermore, the samples were put into plastic labelled at each sampling point and then stored in an ice box to be analyzed at the Marine Biology Laboratory of the Faculty of Fisheries and Marine Sciences.

Sediment Fraction Analysis

Two methods were used to analyze the sediment fraction: the multistage sieving method and the pipette method. The stratified sieving method is to obtain the Ø1-Ø4 sized sediment fraction, while the pipette method uses a goiter pipette to obtain Ø5-Ø7[5].

Organic matter content analysis

Sediment organic matter content was analyzed using the Loss on Ignition method[6].

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

Description:

BOT : Total Organic Matter
Wt : Total Weight before the furnace
Wa : Total weight after furnace
C : Weight of empty cup

Analysis of *M. meretrix* Samples

The obtained *M. meretrix* samples were analyzed at the Marine Biology Laboratory. Then, taxonomic identification of M. meretrix samples will be performed using the WoRMS reference. The shell of *M. meretrix* is triangular and flat, and the outer shell is shiny. The outer shell of *M. meretrix* has several colors, such as white, brownish to blackish brown. It is generally shiny white with some color on the blackish sides, while the inner shell is white.

M. meretrix Shell Measurements

Measurements of *M. meretrix* shells were taken using a calliper to measure the length of the shells[7].

Figure 3. Sample measurement scheme *M. meretrix* shell

Clam length data were collected to calculate the shell size distribution of *M. meretrix*.

Abundance of *M. meretrix*

The abundance analysis of mussel species used the abundance formula[8]:

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

K : Abundance (Ind/m²)
ni : Number of individuals of a species (Ind)
A : Area (m²)

Meretrix meretrix Size Distribution

Determining the number of classes based on the sample length obtained refers to the Sturges formula[9]:

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

Description:

k = number of size groups
n = amount of data

To calculate the class width of each size group (c), use the formula[10]:

$$c = \frac{a-b}{k}$$

Description:
k = number of size groups
a = maximum length of clam
b = minimum length of shells

Distribution pattern of *M. meretrix*

To determine the distribution pattern of *M. meretrix* on the coast of Sri Tanjung Village, Morisita's distribution index was used, namely[11]:

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

Description:

Id	=	*M. meretrix* dispersal index
n	=	Number of plots
N	=	Total number of individuals in n plots
$\sum X^2$	=	Square of the number of individuals per plot

With the following criteria: Id<1: distribution pattern is uniform; Id=1: random distribution pattern; Id> 1 clustered distribution pattern.

Analysis Data

The data obtained were tabulated and discussed in descriptive statistics concerning the literature. Then, to see the difference in abundance between stations, a t-test was conducted. Furthermore, to see the difference in abundance between subzones, the One-Way ANOVA test can be done, and if there is a real difference between subzones, then the LSD (Least Significant Difference) test is done.

3. RESULT AND DISCUSSION

Water Quality

The results of water quality parameters in Sri Tanjung Village in the intertidal subzone at each station can be seen in Table 1.

Table 1. Water quality parameters in each Intertidal subzone in Sri Tanjung Village

Station	Subzone	Temperature (˚C)	Salinity (‰)	Brightness (cm)	pH
	Upper	31.00	22.00	20.00	7.50
1	Middle	30.00	25.00	31.00	7.70
	Lower	28.00	26.00	43.00	7.70
Average		29.60	24.30	31.30	7.60
	Upper	31.00	21.00	19.00	7.30
2	Middle	29.00	25.00	27.00	7.70
	Lower	28.00	26.00	32.00	7.70
Average		29.30	24.00	26.00	7.50

The temperature at station 1 and station 2 ranged from 28-30˚C, with an average temperature at station 1 of 29.60 ˚C, while the average temperature at station 2 was 29.30 ˚C. The salinity value at station 1 ranges from 22-26 ppt with an average salinity of 24.30 ppt. At station 2, the salinity value ranges from 21-26 ppt, averaging 24 ppt. The results of pH measurements at station 1 ranged from 7.50 – 7.70 with an average pH of 7,60. While at station 2, the pH value ranged from 7.30-7.70, with an average of 7.50. The average brightness value of station 1 is 31.30 cm, while the brightness value of station 2 is 26 cm.

Sediment Total Organic Matter

Based on the calculation results, the highest sediment organic matter content at station 1 is 2.7% in the upper subzone, and the lowest is 0.42% in the lower subzone. At station 2, the highest organic matter content was 2,30% in the upper subzone, and the lowest was 0.4% in the middle subzone (Table 2).

Sediment Fraction

The results of the analysis of sediment fraction in Sri Tanjung Village consisting of gravel, sand and mud can be seen in Table 3.

Table 2. Organic matter content in each intertidal subzone at two stations in Sri Tanjung Village, Rupat Sub-district, Bengkalis Regency.

Station	Subzone	Total organic matter (%)
1	Upper	2.70
	Middle	1.10
	Lower	0.42
2	Upper	2.30
	Middle	0.40
	Lower	0.50

Table 3. Sediment fraction in each intertidal subzone at two Sri Tanjung Village, Rupat District, Bengkalis Regency stations.

Station	Subzone	Sediment type			Type
		Gravel (%)	Sand (%)	Mud (%)	
1	Upper	0.68	23.64	75.68	Mud
	Middle	0.13	60.78	39.09	Muddy sand
	Lower	0.49	89.74	9.79	Sand
2	Upper	1.25	66.49	32.26	Muddy sand
	Middle	0.05	67.48	32.47	Muddy sand
	Lower	0.09	92.22	7.70	Sand

The sediment type at station 1 in the upper subzone is mud, the middle subzone is muddy sand, and the lower subzone is sandy. In contrast, the sediment type at station 2 in the upper subzone is muddy sand, the middle subzone is muddy sand, and the lower subzone is sandy.

Abundance of *M meretrix*

Based on the results of the abundance of *M. meretrix*, it is known that the highest abundance is in the lower subzone at station 1 with an average value of 8.66 ind/m^2 and at station 2 with an average value of 4.33 ind/m^2. At the same time, the lowest abundance is found in the upper subzone at station 1, with an average value of 3 ind/m^2 and station 2, with an average value of 1 ind/m^2. In contrast, the lowest abundance is found in the upper subzone at station 1, with an average value of 3 ind/m^2 and station 2, with an average value of 1 ind/m^2.

Table 4. The abundance of *M. meretrix* (ind/m^2) in each intertidal subzone at two stations in Sri Tanjung Village, Rupat District, Bengkalis Regency

Transect	Station 1			Transect	Station 2		
	Upper	Midle	Lower		Upper	Middle	Lower
1	2	4	8	1	0	2	3
2	3	6	11	2	1	3	6
3	4	3	7	3	2	1	4
Total (ind/m^2)	9	13	26	Total (ind/m^2)	3	6	13
Average	3	4,33	8.66	Average	1	2	4,33
Standard deviation	1	1,52	2.08	Standard deviation	1	1	1,52

Table 5. Size distribution of *M. meretrix* in each intertidal subzone at two stations in Sri Tanjung Village, Rupat Sub-district, Bengkalis Regency

Station 1					
No	Size Group (cm)	Upper	Middle	Lower	Frequency
1	1.13 – 1.72	0	4	3	7
2	1.73 – 2.32	4	6	6	16
3	2.33 – 2.92	5	2	11	18
4	2.93 – 3.52	0	1	3	4
5	3.53 – 4.12	0	0	2	2
6	4.13 – 4.72	0	0	0	0
7	4.73 – 5.32	0	0	1	1
Station 2					
No	Size Group (cm)	Upper	Middle	Lower	Frequency
1	1.12 – 1.46	0	0	2	2
2	1.47 – 1.81	2	3	3	8
3	1.82 – 2.16	3	2	2	7
4	2.17 – 2.51	1	2	3	6
5	2.52 – 2.86	1	1	1	3
6	2.87 – 3.21	0	0	3	3

The highest abundance between stations is found at station 1, where this station is still natural. The high abundance of mussels at the station was due to the lack of anthropogenic activities[12]. Habitat conditions and high human activity can affect the abundance of bivalves in the water[13]. While station 2, which is close to food stalls, has the lowest abundance compared to station 1, this is due to the large number of community activities and food stall waste directly discharged into the waters. Different environmental conditions can affect the growth of *M. meretrix*[14]. Polluted ecological conditions can inhibit the growth of *M. meretrix*.

The highest abundance in the intertidal zone of Sri Tanjung Village was in the lower subzone with sandy sediment type, while the lowest abundance was in the upper subzone with muddy sediment type, where *M. meretrix* prefers sandy substrates over muddy substrates. *M. meretrix is* found in Marudu Beach, which has the highest abundance in beach areas dominated by sandy textures compared to mud and clay[15]. *M. meretrix* is more commonly found in sandy areas because it lives by immersing itself in the water, and sandy substrates are more accessible to excavate[16].

The lowest abundance of *M. meretrix* in the upper zone could be due to the low brightness value found in the Kendari Bay River Estuary, which has a brightness value ranging from 19-40 cm. This makes the abundance in the area low[17]. Low brightness has an impact on the ability of mussels to filter food mixed with particles, causing the mussels to have difficulty breathing because the feeding and breathing mechanisms are united, which results in the death of the mussels[18].

Size Distribution of *M. meretrix*

There is a size class difference based on the shell length findings obtained. The size class aims to observe the variation in size growth of *M. meretrix* in different habitats. Different species have different sizes due to other factors affecting growth[19]. At station 1, the size classes of clam shells found were more numerous than those found at station 2. The surrounding community often catches shellfish at station 1, close to food stalls. The presence of *M. meretrix* in the waters shows different sizes, and the clam fishing activities of the surrounding community can influence this. Size differences in shellfish can be influenced by people who often catch shellfish without considering the survival and life cycle of the shellfish[20].

In the lower subzone, *M. meretrix* was more abundant in all size classes compared to the other subzones. This is due to better conditions in the lower subzone, such as lower temperatures and higher brightness, compared to the upper and middle subzones. M. meretrix was found in only a few size classes in the upper subzone. This was due to higher temperature, lower brightness, and less favorable substrate conditions. Sub-optimal environmental conditions cause differences in frequency and variations in ecological location, substrate, temperature, and water quality[21]. Low salinity and brightness in the water can affect the growth of *M. meretrix*[14].

Distribution Pattern of *M. meretrix*

The results of the distribution pattern of *M. meretrix* in the intertidal zone of Sri Tanjung Village can be seen in Table 6.

Table 6. Distribution pattern of *M. meretrix* in each intertidal subzone at two stations in Sri Tanjung Village, Rupat Sub-district, Bengkalis Regency

Station	Subzone	Morisita Distribution Index	Distribution pattern
1	Upper	0,83	Uniform
	Middle	0,92	Uniform
	Lower	0,96	Uniform
2	Upper	1,00	Random
	Middle	0,80	Uniform
	Lower	0,92	Uniform

Based on Table 6, it is known that the morisita distribution index in each intertidal subzone at station 1 obtained an id value < 1, which means that the resulting distribution pattern is uniform, while at station 2 in the Upper subzone obtained an id = 1 which means that the resulting distribution pattern is random. Competition among individual mussels may result in a uniform distribution pattern, promoting an even allocation of space; in addition to individual competition, the uniform physical and chemical properties of the waters in the region cause this consistent distribution pattern[22]. Environmental conditions mainly influence organisms with uniform distribution patterns in their habitat[23]. This distribution pattern is believed to result from ecological characteristics and limited food availability, leading to competition among individuals for the same space[24]. Random distribution patterns are rarely found in nature[25]. Random distribution patterns are uncommon due to the lack of clustering in a uniform environment[24].

4. CONCLUSION

Based on the research that has been carried out, the following conclusions can be drawn: The abundance of *M. meretrix* has the highest and lowest abundance, for the highest abundance between each station is at station 1, while the highest abundance between intertidal subzones in Sri Tanjung Village is in the lower subzone. The size distribution of *M. meretrix* at station 1 obtained seven clam shell size classes, and there were six clam shell size classes at station 2.

Based on the research, further research is needed on unstudied water quality parameters, such as water quality that affects the population structure of *M. meretrix.*

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