

## DISTRIBUTION AND DIVERSITY OF GASTROPODS (MOLLUSCS) IN INTERTIDAL WATERS IN RUPAT SUBDISTRICT, BENGKALIS DISTRICT

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### ABSTRACT

This study aims to determine the distribution pattern and diversity of gastropods in the Intertidal Waters of the Rupert Timur District. The research was conducted in February 2022. The research location consisted of 3 stations, each station was placed 3 transects from the highest tide to the lowest tide at different distances. Along the transect lines were placed 3 plots with a size of 3 x 3 m and each plot has a subplot with a size of 1 x 1 m. The method used in this research is the survey method. Parameters measured include gastropod species, distribution patterns, diversity, abundance, relative abundance, and water quality. The results of the study found gastropod species consisting of 9 (nine) families, 12 (twelve) genera, and 13 (thirteen) species. The distribution pattern of gastropods in the research location is clustered with the value of diversity ( $H'$ ) at a moderate level of diversity. Diversity is categorized as moderate. The highest abundance of gastropods was found on the beach of Sukarjo Mesim Village (a station I) with an abundance value of 25,600 ind/ha and the lowest abundance was found on the beach of Teluk Lecah Village (station III) with an abundance value of 11,100 ind/ha, while the highest abundance of gastropods between intertidal subzones was in the upper zone with an abundance value of 20,400 ind/ha and the lowest abundance was in the lower zone with an abundance value of 12,200 ind/ha. The highest relative abundance was *Indothais javanica* species with a relative abundance value of 18.30%, while the lowest relative abundance was *Oliva ornata* species with a relative abundance value of 0.85%. Temperature 29-30° C; salinity 28-30 ppt; pH 5-6; DO 5.2-6.4 mg/l. Sediment type in the station I was dominated by mud, station II was dominated by muddy sand and station III was dominated by sand with total sediment organic matter content of 0.46-23.33%.

**Keywords:** Gastropods, Distribution, Diversity.

### 1. INTRODUCTION

The intertidal zone or tidal zone is a part of the shore that is inundated with water at high tide (becomes water) but dry at low tide (becomes land)<sup>1</sup>. The intertidal zone is a habitat for various biotas, including mollusks. One of the mollusk classes that can be found in the intertidal zone is the gastropod class.

Gastropods are derived from the Latin words *gastro* which means stomach and *podia* which means foot. Gastropods are a

group of invertebrate animals that have shells and have the main characteristic of using their feet to walk. The distribution of these animals is almost all beaches in Indonesia and lives as macrozoobenthos animals that live on the surface of the substrate and in the substrate (infauna)<sup>1</sup>.

Rupert Sub-district is one of the sub-districts included in the administrative area of Bengkalis Regency. Geographically, Rupert Sub-district is bordered by North Rupert Sub-district to the North, Dumai City

to the West, Bengkalis Sub-district to the South, and the Malacca Strait to the East.

Activities carried out in the coastal waters of the Rupert Timur District such as the existence of a boat port for crossings, collecting gastropods for consumption, community activities looking for bamboo shells, and tourists taking gastropods for collection, can be an influence on the pattern of distribution and diversity of gastropods.

Many studies related to gastropods in the waters of various regions have been conducted, including by Sari et al.<sup>2</sup> which examines the community structure of macrozoobenthos in the coastal waters of Api-api Village, Bandar Laksamana District, Bengkalis Regency, Anggara et al.<sup>3</sup> which examines the structure of the macrozoobenthos community in Sambungo Village, Silaut District, Pesisir Selatan Regency, West Sumatra Province, and Maryanto et al.<sup>4</sup> which examined the distribution pattern and population density



Figure 1. Research location map

## Methods

The method used in the research is the survey method, which is direct observation of the research area as well as sampling and measuring water quality parameters in the field. Parameters to be measured include gastropod species, abundance, relative abundance, diversity, and distribution pattern. Then supporting data such as water temperature, salinity, pH, dissolved oxygen, total organic matter, and sediment fraction. Then the samples

of *Terebralia sulcata* gastropods in the Putri Sembilan estuary, Rupert Utara District, Bengkalis Regency.

However, research on gastropods has never been conducted in the coastal waters of the Rupert Timur District, and considering the important role of gastropods both in the economic and ecological fields and also the lack of information about the presence of gastropods in the coastal waters of the Rupert Timur District so it is necessary to conduct research on distribution patterns and diversity in the coastal waters of the Rupert Timur District.

## 2. RESEARCH METHOD

### Time and Place

This research was conducted in February 2022 in the Intertidal Waters of the Rupert Utara District (Figure 1) and in the Marine Biology Laboratory and Marine Chemistry Laboratory of the Department of Marine Science, Universitas Riau.

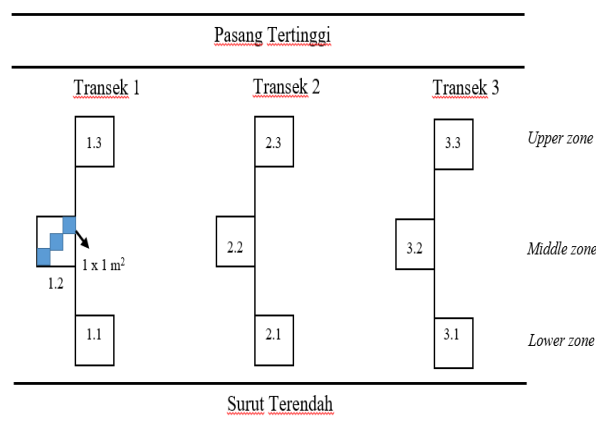


Figure 2. Quadrant mapping plan

were identified and analyzed at the Marine Biology and Marine Chemistry Laboratory, Department of Marine Science, Faculty of Fisheries and Marine Sciences, Universitas Riau.

### Procedure

Determination of the station is determined by purposive technique, namely the determination of the station to represent the intertidal zone of the coastal waters of the Rupert Timur District.

The sampling location is determined to be 3 stations; station 1 is located in Sukarjo Mesim Village where in this area there is a crossing port so this port has a lot of shipping activities. Station 2 is located in Sri Tanjung Village where in this area community activities are looking for bamboo shells. Then station 3 is located in Teluk Lecah Village, where there are community activities. Each research station is divided into three subzones, namely: 1) upper intertidal zone, 2) middle intertidal zone, and 3) lower intertidal zone (Figure 2).

Water quality parameters measured were temperature, pH, DO, and salinity. Each research station has 3 transects, each transect consists of 3 plots with a quadrat size of 3 x 3 m<sup>2</sup> and subplots measuring 1 x 1 m<sup>2</sup>. Each sample found on the surface of each quadrat plot was picked up, while those in the substrate were dug ±5 cm deep.

In this study, sediment samples were also taken to measure organic matter and sediment fractions. Sediment samples were taken using a 10 cm diameter pipe stuck with a depth of 5 cm.

### Data Analysis

Samples obtained in the field were brought to the laboratory and then cleaned, grouped, and identified based on the form obtained using the Dharma identification book<sup>5</sup> in the Marine Biology Laboratory. Furthermore, the number of species obtained was counted, then analyzed and calculated.

### Gastropod Distribution Pattern

The distribution pattern of gastropods can be known by using the Morisita dispersal index<sup>6</sup> which is as follows:

$$Id = N \frac{\sum x^2 - \sum x}{(\sum x)^2 - \sum x}$$

Description:

Id = Morisita dispersion index

$\sum x$  = Number of individuals per plot

$\sum x^2$  = Squared number of individuals per plot

N = Number of sampling plots

### Gastropod diversity

The diversity index can be calculated with the Shannon-wiener index<sup>7</sup> with the equation:

$$H' = - \sum_{i=1}^s pi (\ln pi)$$

Description:

H' = Diversity index

pi = ni/N

ni = Number of individuals of all species

N = Total number of individuals of all species

s = Number of species

### Gastropod abundance

The abundance of gastropod individuals refers to the abundance formula according to Fahrul<sup>7</sup>, namely:

$$Ki = Ni / A$$

Description:

Ki = Species abundance (ind/m<sup>2</sup>)

Ni = Number of species of the i-th species (ind)

A = Area of observation (m<sup>2</sup>)

### Relative Abundance

Relative abundance was calculated using the formula according to Fachrul<sup>7</sup> as follows:

$$KR = \frac{ni}{N} \times 100$$

Description:

KR = Relative abundance (%)

ni = Number of individuals of a species

N = Total of all individuals

### Sediment Fraction and Total Organic Matter

The sediment fraction analysis used 2 methods, namely the wet sieving method and the pipette method. The graded sieve method was used to obtain Ø1 - Ø4, while the pipette method used a volumetric pipette to obtain Ø5-Ø7. To analyze the type of sediment fraction, Rifardi<sup>8</sup> was used. The concentration of total organic matter in the sediment was measured using

a formula that refers to Heiri *in* Prasetia et al.<sup>9</sup> as follows:

$$BOT = \frac{(Wt-C)-(Wa-C)}{Wt-C} \times 100\%$$

Description:

Wt = the total weight (*crucible* + sample) before burning,

Wa = the total weight (*crucible* + sample) after burning, and

C = weight of the empty *crucible*

The environmental parameters measured in this study are chemical and physical, while the physical parameters measured are temperature, salinity, and the chemical parameters measured are pH.

Data obtained in the form of calculations are presented in tables and graphs and then discussed descriptively. To determine the distribution pattern of gastropods compared with the distribution pattern index criteria, to determine the diversity of gastropods compared with the

diversity index criteria, and to determine the difference in gastropod abundance between stations and between subzones conducted one-way ANOVA test using Statistical Program for Social Science (SPSS). Because it was significantly different, LSD (Least Significance Difference) further test was conducted

### 3. RESULT AND DISCUSSION

#### Water Quality

The measured water quality parameters include physical parameters, namely temperature and salinity, and chemical parameters, namely acidity (pH) and dissolved oxygen (DO), which are useful for seeing how the waters in the Rupert Timur District were at the time of the research. The results of the measurement of water quality parameters can be seen in Table 1.

**Table 1.** The average quality of coastal waters in Rupert Timur

Station	Temperature (° C)	Salinity (ppt)	pH	DO (mg/l)
I	29	30	6	6,4
II	30	28	5	5,2
III	30	30	6	6
Average	29,7	29,3	5,7	5,8

The temperature at each research station can be said to support the life of gastropods. Gastropods can carry out metabolic processes optimally in the temperature range between 25-35°C, with these temperatures the waters can be said to be suitable for gastropod survival. The measured salinity range is still suitable for gastropod survival. This is in line with the opinion of Hawan et al.<sup>10</sup>, gastropods generally tolerate salinity ranging from 25-40‰.

Measurements of acidity (pH) and dissolved oxygen (DO) are categorized as good in line with the opinion of Setiyowati<sup>11</sup>, dissolved oxygen (DO) which is good for the growth of marine biota is >5.

#### Gastropod Species

Based on the data obtained, some types of gastropods in the coastal waters of the Rupert Timur District were obtained 13 species from three stations, namely, *Batillaria zonalis*, *Turricula javana*, *Littoraria scabra*, *Indothais javanica*, *Murex tribulus*, *Muricodrupa fiscellum*, *Nassarius lavanonoensis*, *Nassarius stolatus*, *Nerita articulata*, *Oliva ornata*, *Cerithidea quoyii*, *Pirenella cingulata*, and *Terebra dislocate*. *L.scabra* is the most species found from all research stations; this is because the substrate at the research site dominates mud and is close to mangroves.

Factors that cause the large number of *L.scabra* found are thought to be caused by the mangrove ecosystem around the

research site, where there is a lot of organic material produced by mangrove tree litter and the type of substrate around the research site is muddy. The muddy substrate is a substrate that is rich in nutrients. The normal condition of the water environment at the research site is also thought to be the cause of the large number of *L.scabra* found.

According to Syahrial & Karsim<sup>12</sup>, *L.scabra* snails are very fond of mud surfaces or areas with large enough standing water and above the mangrove soil surface. *L.scabra* obtains food at low tide, both in the roots and trunks of mangrove trees, where they feed on various macroscopic and microscopic autotrophs. According to Nurfitriani & Kaseng<sup>13</sup>, *L.scabra* can live in unstable conditions compared to other species; *L.scabra* rises vertically to avoid drowning by the tide and moves vertically downward to spawn.

### Gastropod Distribution Pattern

The results of the calculation of the gastropod dispersion index in the coastal waters of the Rupert Timur District range from 1.66-2.30, the distribution pattern at each station is clustered. The clustered distribution pattern is thought to be caused by the environmental conditions of the study waters are still categorized as good in line with the quality standards of seawater for gastropod life, the type of substrate that supports the life of gastropod species and food sources so that the distribution pattern formed is clustered and eating habits that aim to make it easier to obtain food and reproduce.

This distribution pattern is in line with the research of Harif et al.<sup>14</sup>, on Kambang Beach, Lengayang District, Pesisir Selatan Regency, West Sumatra, which is clustered. This is thought to be due to the clustering distribution pattern which is closely related to several factors such as the condition of the aquatic environment which still supports the life of gastropods following quality standards, the type of sandy substrate which is rich in organic

matter, and food sources so that the distribution pattern formed is clustered and eating habits which aim to make it easier to obtain food and reproduce. The results of the calculation of gastropod distribution patterns can be seen in Table 2.

**Table 2.** Distribution pattern of gastropods in the coastal waters of Rupert Timur

Place of Observation	Id	Distribution Pattern
Station I	2,3	Clustering
Station II	1,69	Clustering
Station III	166	Clustering
Research Location	2,96	Clustering

According to Mardatila et al.<sup>15</sup>, the distribution pattern of a biota is influenced by habitat type which includes physico-chemical factors of water as well as food and adaptability of a biota in the ecosystem. Clustered distribution patterns will make it easier for individuals to relate to each other for various needs such as reproducing and finding food. The distributions of factors that are very instrumental in the distribution process of gastropods in the habitat include substrate conditions, circulation of seawater and freshwater, and availability of nutrients.

Based on Morisita's distribution criteria,  $Id > 1$ , it can be concluded that the distribution pattern of gastropods in the coastal waters of the Rupert Timur District is clumped. Distribution is influenced by habitat type which includes physical and chemical factors of water as well as food and adaptability of a biota in an ecosystem.

### Gastropod Diversity

The gastropod diversity index values obtained from the three stations ranged from 1.47-1.72. From the results of the research that has been done, the highest gastropod diversity index is found at station II of 1.72, this is thought to be due to the many types of gastropods found. The lowest diversity index is at station I with a value of 1.47, the low index of gastropod diversity is caused by the few types of



species obtained compared to station II and station III. The results of the calculation of gastropod diversity can be seen in Table 3.

**Table 3.** Gastropod diversity in the coastal waters of the Rupert Timur

Place of Observation	Diversity Index (H')
Station I	1,47
Station II	1,72
Station III	1,64
Research Location	1,61

The high and low level of diversity is influenced by the fertility of the habitat that can support the life of each species that occupies the place. Overall, the value of the gastropod diversity index between stations is not much different. The value obtained is quite large compared to the results of research by Sianu et al.<sup>16</sup> in Tomini Bay Waters which ranged from 0.51-0.81.

According to Persulesy & Arini<sup>17</sup>, the diversity of a species is strongly influenced by the number of species and the total number of individuals of each species found, otherwise if the number of species is small and the total number of individuals of each species is small then the species diversity is low.

Based on the diversity index criteria, it can be concluded that the category of gastropod diversity in the coastal waters of the Rupert Timur District is in the moderate category, where the index value of  $1 \leq H' \leq 3$  indicates that, species diversity in the coastal waters of the Rupert Timur District is moderate, productivity is sufficient, ecosystem conditions are quite balanced, ecological pressure is moderate.

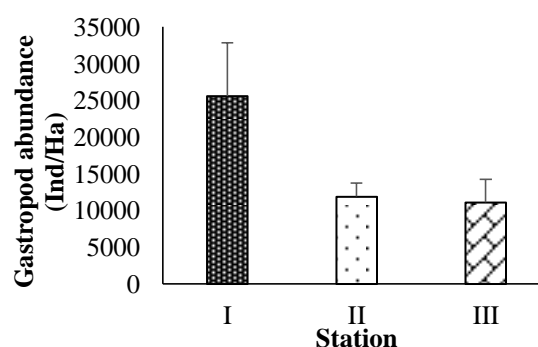
### Gastropod Abundance

The results of the calculation of the abundance of gastropods in the coastal waters of the Rupert Timur District showed that the highest gastropod abundance value was found at station I, namely 25,600 ind/ha, and the lowest abundance was found at station III, namely 11,100 ind/ha. The high abundance value at station I is thought

to be due to the physico-chemical factors of the water, namely the type of muddy substrate favored by gastropods, and also the temperature, pH, and salinity at station I is still in a normal state to support the life of gastropods. In addition to the muddy substrate type, a station I also still has a mangrove ecosystem that supports the life of gastropods in the area.

The low abundance of gastropods at station III may be due to biological factors such as predation and competition in nature. The results of statistical tests using ANOVA showed that the abundance of gastropods at the study site obtained a significant value of 0.036 where  $p < 0.05$  which states that the abundance between stations at the study site is significantly different.

Based on the results of LSD further test analysis, it was found that the abundance between station I and station II and between stations I and station III showed a significant value of  $p < 0.05$  which means significantly different, and the abundance between station II and station III had no significant difference. The abundance of gastropods at each observation station in the coastal waters of the Rupert Timur District is presented in Figure 3.



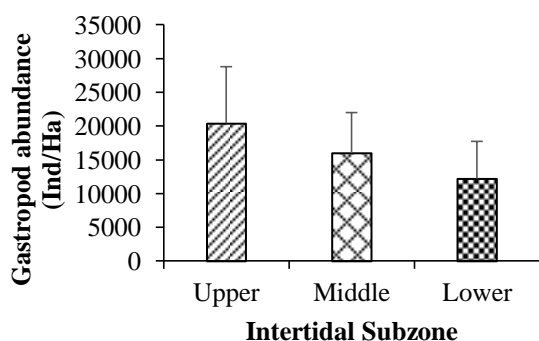
**Figure 3.** The abundance of gastropods in the coastal waters of the Rupert Timur District

Abundance in each intertidal subzone, the upper zone had the highest abundance of 20,400 ind/ha, while the lowest abundance was in the lower zone at 12,200 ind/ha. The high value of abundance in the

upper zone is thought to be due to physical factors of water chemistry, namely the amount of organic matter in the area is high at 16.94%.

This is due to the presence of mangrove ecosystem vegetation, which facilitates the entry of organic matter in the form of mangrove litter around the edge of the coastal waters of the Rupert Timur District. While the low abundance of gastropods in the lower zone is thought to be influenced by the low content of organic matter compared to other subzones, which is 3.64% with a muddy sand substrate.

The ANOVA test results obtained a significant value of 0.531 where  $p > 0.05$  which means that the abundance of gastropods between subzones is not significantly different. The abundance of gastropods in each observation subzone in the coastal waters of the Rupert Timur District is presented in Figure 4.



**Figure 4.** The abundance of gastropods in each observation subzone in the coastal waters of Rupert Timur

The abundance value of gastropods in the coastal waters of the Rupert Timur District is low compared to research conducted by Sesfao et al.<sup>18</sup> in the intertidal zone of oebon beach, oebon village, kualin sub-district, south-central Timor district at 26,500 Ind/ha, and Harif et al.<sup>14</sup> on Kambang Beach, Lengayang District, South Coastal Regency, West Sumatra, which was 33,860 Ind/ha. According to Nurrachmi & Marwan<sup>19</sup>, benthic animals are closely related to the availability of organic matter contained in the substrate, because organic matter is a source of nutrients for biota

which is generally found in the bottom substrate.

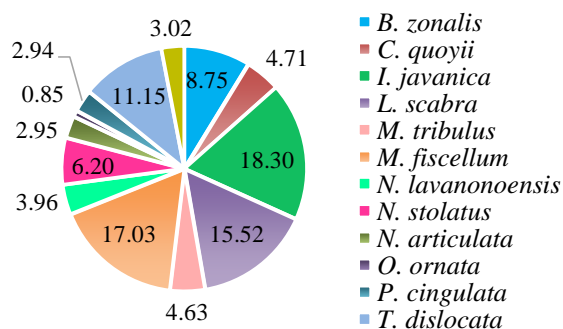
According to Nurrachmi & Marwan<sup>19</sup>, sandy bottom substrates do not provide a stable place for organisms because wave action continuously moves substrate particles while on muddy substrates benthic organisms will easily adapt by digging the substrate or forming permanent channels. According to Handayani<sup>20</sup>, the high and low abundance of an organism is influenced by various factors including the physic-chemical factors of water which include temperature, salinity, current, pH, water depth, and bottom substrate.

### Relative Abundance of Gastropods

The results of the calculation of the relative abundance of gastropods in the coastal waters of the Rupert Timur District show that *I.javanica* has the highest relative abundance value compared to other species found in the study site with a relative abundance value of 18.30%, while the species that has the lowest relative abundance is *O. ornata* with an abundance value of 0.85%.

The high relative abundance of *I.javanica* species is thought to be caused by physic-chemical factors, including temperature, salinity, pH, current, and substrate that support the life of *I.javanica*. While *O.ornata* has the lowest relative abundance level, it is thought to be due to biological factors, namely the presence of predators and competition in nature. The sandy type of substrate that affects the availability of nutrients also affects the abundance of these gastropods. The relative abundance of gastropods in the coastal waters of the Rupert Timur District is presented in Figure 5.

The high and low abundance of an organism is influenced by various factors including physic-chemical waters, temperature, salinity, pH, current, and bottom substrate.



**Figure 5.** Relative abundance of gastropods in coastal waters of Rupert Timur

#### 4. CONCLUSION

Based on the research conducted, the types of gastropods found in the coastal waters of the East Rupert District consist of 13 species, namely, *B. zonalis*, *T. javana*, *L.scabra*, *I.javanica*, *M.tribulus*, *M.fiscellum*, *N.lavanonoensis*, *N.stolatus*, *N.articulata*, *O.ornata*, *C.quoyii*, *P.cingulata*, and *T.dislocate*. The distribution pattern (Id) at the study site has a clustered distribution pattern. Diversity (H') at the study site, has moderate gastropod diversity.

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