Species and Density of Gastropods in The Rehabilitated Mangrove Ecosystems in the Kedaburapat Village Rangsang Pesisir Sub-District, Riau Province

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Abstract. This study aims to examine the species and density of gastropods in the rehabilitated mangrove ecosystem in Kedaburapat village Riau Province. The research was conducted in July 2020. The method used was a survey method. In 2018 mangrove planted, 2 transect lines were placed in the mangrove, and in each line, there were 6 plots (2 m x 2 m). Two plots were in the lower area, 2 plots in the middle area and other 2 plots were in the upper area. In 2019 mangrove planted, similar method was used to sampled the gastropods. The gastropods samplings were conducted manually during low tide. The gastropod were then identified in the laboratory. The substrate was studied visually. The difference in gastropods density between two mangrove areas was analyzed using the t-test. The results showed that the species of gastropods that lived in the mangrove areas planted in 2018 consisted Littoraria scabra, L. melanostoma, L. intermedia, L. lutea, Nerita balteata, Chicoreus capucinus. Meanwhile, in the mangrove areas planted in 2019 consisted, Littoraria scabra, L. melanostoma, L. intermedia, Nerita balteata, Chicoreus capucinus, Nassarius dorsatu, Sphaerassiminea miniata. The average density of gastropods in the mangrove area planted in 2018 was 6.68 ind/m², while in 2019 was 7.04 ind/m². The results of the t-test analysis showed that there was no significant difference in gastropod density between the two mangrove regions.

1. Introduction
The role of the mangrove ecosystem is increasingly felt because more and more beaches are being eroded. This is because the mangrove ecosystem has a function as a coastal protector. The mangrove ecosystem has an important role which can be grouped into ecological and economic roles. The mangrove ecosystem has a function as a source of food or coastal fertility, shelter, breeding or a place for enlargement of other marine biota [1]. Ecologically, mangroves can ensure the maintenance of the physical environment such as wave and wind resistance, and are a breeding ground for various species of marine life, such as fish, shrimp, crabs, shellfish, snails and other species of animals [2].

Mangroves are tropical and sub-tropical coastal vegetation communities that are dominated by several types of mangrove trees that can grow and develop in muddy coastal tidal areas. Mangrove forest vegetation in Indonesia has a high diversity of species. There were 202 mangrove species, consisting of 89 trees, 5 palm species, 19 lianas, 44 epiphytic species and 1 cycad species. However, there are only about 47 plant species specific to mangrove forests. At least in the mangrove forest there is one important / dominant true plant species belonging to four families: Rhizophoraceae (Rhizophora, Bruguiera, and Ceriops), Avicenniaceae (Avicennia), Sonneraticeae (Sonneratia), and Meliaceae (Xylocarpus) [2].

Currently mangrove forests are under threat, both by natural factors and by human factors which result in coastal abrasion. Many coastal areas experience abrasion due to the impact of sea waves, especially during certain wind seasons, including in Riau Province. One of the coastal areas experiencing relatively severe abrasion in Riau Province is on the east coast of Rangsang island, Kepulauan Meranti Regency, to be exact, Kedaburapat Village which is directly opposite the Malacca Strait. Tens or even hundreds of meters have retreated the coastline towards the land. A lot of agricultural land and buildings such as houses, schools enter the sea. This incident has haunted the public about the dangers it caused.

Besides being able to reduce the occurrence of coastal abrasion, the existence of the mangrove ecosystem can also increase the availability of fishery resources in these waters. This is due to the
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biological role of the mangrove ecosystem. The existence of the mangrove ecosystem can increase the catch of fishermen and the availability of fishery resources as a source of community protein. The biological role of the mangrove ecosystem, among others, is as a breeding ground for various types of marine life, such as fish, crabs, shellfish, shrimp, snails and various other types of biota [3].

To overcome the threat of continuous waves, rehabilitation has been carried out. These efforts to rehabilitate mangrove forests often fail, due to various factors, such as inappropriate types of planting, inappropriate planting time, untreated maintenance and so on. The rehabilitation of mangrove forests in Kedaburapat Village is one of the successful mangrove rehabilitation activities, although in a relatively small area. This rehabilitation activity was carried out by the Riau Province Marine and Fisheries Service and the Riau Province Environment and Forestry Service which involved Riau University lecturers. In the coastal area of Kedaburapat Village which is experiencing erosion, mangrove *Avicennia* sp was planted in 2017, 2018 and 2019, but only planting that was carried out in 2018 and 2019 grew well. Within two years, *Avicennia* sp has developed well which of course can also become a habitat for various mollusks and other biota.

The existence of mangrove *Avicennia* sp has provided habitat for various biota of mangrove ecosystem, but so far there is no information about the presence of gastropods, which are the main aquatic biota in the mangrove ecosystem. Therefore, it is important to study gastropod diversity in rehabilitated mangrove ecosystems. The purpose of this study was to determine the species and density of gastropods in the mangrove ecosystem as a result of rehabilitation of *Avicennia* sp.

2. Material and Methods

This research was conducted in July 2020 in Kedaburapat Village Rangsang Pesisir Sub-district of Riau Province (Figure 1). The tools used for this research were meter, transect plot, thermometer, pH meter, hand refractometer and camera.

![Map of research locations](image)

**Figure 1.** The research locations in the Rangsang Pesisir sub-district.

The survey method was used in this study. The determination of the sampling point was done purposively, namely by placing two transects at different planting times of the mangroves, namely two on mangroves planted in 2018 and two transects on mangroves planted in 2019. In each transect was affixed with two plots of 2 m x 2 m in the upper, middle and lower mangrove areas.
2.1. Sampling

2.1.1. Species and Density of Gastropods

To obtain gastropod data in mangroves from the rehabilitation results of Kedaburapat Village, sampling was carried out by placing two transects on mangrove Avicennia sp planting in 2018 and two transects on planting mangroves in 2019. On each transect, two plots measuring 2 mx 2 m are placed on the upper, middle and upper parts, lower from the mangrove area. Furthermore, sampling was carried out by picking up the gastropods found in the plot, both those on the coast of the mangrove forest and those on the mangrove trees.

2.1.2. Environmental Parameter Measurement

Environmental quality parameters were measured in-situ at each sampling point. Measurements were made in 3 repetitions. Environmental parameters measured include pH, temperature, salinity. Measurement of environmental parameters is carried out to determine environmental conditions for aquatic biota. The substrate was studied visually.

2.2. Data Analysis

Species and density of gastropods were analyzed descriptively. The t test was used to analyze differences in gastropod density in the two mangroves with different planting periods.

3. Results and Discussion

3.1. General Conditions of Research Location

The location of the mangrove rehabilitated ecosystem in the village of Kedaburapat is in Dusun Parit Senang. These waters are directly facing the Strait of Malacca, with relatively strong waves and currents hitting the coast in the north and east monsoons. This has caused abrasion to most of the coast of Kedaburapat Village. The mangroves that are currently in the village are also affected by waves from the Malacca Strait, so that many are damaged and there was abrasion.

That area has been protected from strong wave using stones and mangrove Avicennia sp has been planted in that area. The existing stones have protected the coast from the impact of the waves, allowing the deposition of mud behind it. Along with the formation of this stretch of mud, Avicennia sp mangrove has been planted 3 times in a row in 2017, 2018 and 2019. However, only planting in 2018 and planting in 2019 grew well. This area has become a habitat for mangrove biota, especially from the gastropod class.

3.2. Water Quality Parameters

Measurement of water quality parameters that are measured include temperature, salinity and pH. The average results of measuring the quality of the waters around the mangrove rehabilitation results in Kedaburapat Village can be seen in Table 1.

| No | Parameters     | Transect 1 | Transect 2 | Transect 3 | Transect 4 |
|----|----------------|------------|------------|------------|------------|
| 1  | Temperature (°C) | 27.33      | 27.33      | 27         | 27         |
| 2  | pH             | 7.6        | 7.6        | 7.6        | 7.53       |
| 3  | Salinity (ppt) | 24.66      | 25.66      | 24         | 24.66      |

The results of measurements of water temperature during the research location are an average of 27°C at 11.00 AM and were expected to rise later in the day before receding. This temperature value is quite good for mangrove growth. Good temperature values for mangrove growth are approximately 30°C, while temperatures above 40°C tend not to have a significant effect on mangrove survival [4].
Salinity is one of the important factors affecting the growth, endurance and zoning of mangrove species. The salinity found in the mangrove areas which have been rehabilitated in Kedaburapat was about 24 ‰. Salinity in this area is classified as good for mangrove growth. Mangrove vegetation grows well in estuaries areas with a salinity of 10-30 ‰ [5].

The pH value of the waters in the mangrove rehabilitation area of Kedaburapat Village is classified as good so that there are many mangroves in this area. Each type of aquatic organism has a different tolerance for water pH. In general, aquatic biota can live properly on pH range 5-9.

### 3.3. Gastropods Species

The species of gastropods found in the mangrove areas planted in 2018 and 2019 in Kedaburapat Village respectively can be seen in Table 2.

#### Table 2. Species of gastropods in mangrove rehabilitated ecosystem in Kedaburapat

| Family            | Species                | Mangrove Planting Period 2018 | Mangrove Planting Period 2019 |
|-------------------|------------------------|-------------------------------|-------------------------------|
| Littorinidae      | Littoraria scabra      | +                             | +                             |
|                   | Littoraria melanostomata | +                             | +                             |
|                   | Littoraria intermedia  | +                             | +                             |
|                   | Littoraria lutea       | +                             | +                             |
| Neritidae         | Nerita balteata        | +                             | -                             |
| Muricidae         | Chicoreus capucinus    | +                             | +                             |
| Nassariidae       | Nassarius dorsatus     | -                             | +                             |
| Assmineidae       | Sphaerassiminea miniata | -                             | +                             |

Information:

+ : present  
- : non

Based on Table 2, it can be seen that the species of gastropods living in the mangrove areas planted in 2018 consisted of six species which include *Littoraria scabra*, *Littoraria melanostomata*, *Littoraria intermedia*, *Littoraria lutea*, *Nerita balteata* and *Chicoreus capucinus* which are included in the three family namely Littorinidae, Neritidae and Muricidae. Meanwhile, in the mangrove areas planted in 2019, there are seven species including *Littoraria scabra*, *Littoraria melanostomata*, *Littoraria intermedia*, *Nerita balteata*, *Chicoreus capucinus*, *Nassarius dorsatus* and *Sphaerassiminea miniata* which are included in five families, namely Littorinidae, Neritidae and Muricidae, Nassariidae and Assmineidae.

The number of gastropod species in the mangrove planting area in 2019 which was relatively higher even though with a younger planting period of one year it is estimated that it is related to the type of substrate in the mangrove area planting season 2019 which is more muddy. Gastropods prefer the silt substrate because of its fine texture and higher nutrient content than coarse textured substrates [5]. The number of gastropods found at each location, due to their high adaptability in both hard (sandy) and soft (mud) substrates [6]. This was because the organic matter was younger to settle in the fine particles and this was very good for the survival of Gastropods. The number of gastropods was less than that obtained by [7] and [8] in the mangrove ecosystem as a result of rehabilitation in Tongke-tongke, namely 22 species from 11 families and [9] obtained 29 types of gastropods from 19 families in the mangrove rehabilitation area and natural mangroves in the village of Nipah, North...
Sumatra. The number of species obtained in this study was also lower than that found in the rehabilitation mangroves of Aceh Besar and Banda Aceh, namely 14 species [10]. This was presumably because these mangroves are relatively young and the existence of the mangrove ecosystem as a result of the rehabilitation of Kedaburapat is far from natural mangrove forests.

3.4. Gastropod density at two different mangrove planting periods

The results of the calculation of the density of gastropods of each species and the total found in the mangrove ecosystem as a result of rehabilitation with the planting period in 2018 and 2019 can be seen in Table 3 and Figure 2.

Table 3. Density of gastropods (ind./m²) during the 2018 and 2019 mangrove planting period

| Gastropoda species       | Mangrove Planting Period 2018 | Mangrove Planting Period 2019 |
|--------------------------|-------------------------------|-------------------------------|
| Littoraria scabra        | 1,08                          | 1,40                          |
| Littoraria melanostoma   | 5,23                          | 2,31                          |
| Littoraria intermedia    | 0,08                          | 2,21                          |
| Littoraria lutea         | 0,08                          | 0,00                          |
| Nerita balteata          | 0,06                          | 0,48                          |
| Chicoreus capucinus      | 0,15                          | 0,50                          |
| Nassarius dorsatus       | 0,00                          | 0,13                          |
| Sphaerassiminea miniata  | 0,00                          | 0,02                          |
| Total                    | 6,69                          | 7,04                          |

Based on Table 3, it can be seen that the average density of Littorina melanostoma species was high in both areas, namely 5.23 ind/m² in the mangrove area during the 2018 planting period and 2.31 ind/m² for mangroves with a planting 2019. This species is a gastropod that inhabits mangrove trees, both on the stems and leaves. [11] states that the mangrove environment as a micro habitat, fauna can be distinguished, among others, under the canopy, the roots of the trunk, branches, above and below the surface of the soil, in permanent waterlogging and not. [12] obtained Littoraria scabra as the species with the highest density.
The average density of astropods in the mangrove area planted in 2018 was 6.69 ind / m², while in the mangrove area planted in 2019 was 7.04 ind/m². The density of gastropods in the mangrove area for younger years was relatively difference is not too far away, while the base substrate or mangrove floor is relatively different. The silt content in the mangrove base substrate for planting in 2019 was higher than in 2018. The high value of the density of these organisms is influenced by the condition of the substrate in the form of sandy mud [6]. The size of the gastropods for the same species was relatively smaller in the mangroves planted in 2019 compared to the gastropods in the areas planted in 2018.

Based on the results of the t test analysis, it showed that there was no significant difference in density between the two mangrove regions (sig. value >0.05). The difference in mangrove planting period for one year did not have a significant effect on gastropod density. The density of gastropods in Kedaburapat was lower than the average density of gastropods in Segara Anakan which reached 58.2 ind./m² [13], but was higher than [14] in newly planted mangroves with the Rhizophora species in the Thousand Islands, namely 3 - 4 ind./m².

4. Conclusions
The number of gastropod species found in the mangrove areas planted in 2019 was more than those planted in 2018. There was no significant difference in gastropod density between the two areas. The number of species and density of gastropods was influenced by the type of substrate.

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References
[1] Kusmana, C., Onrizal, and Sudarmaji. 2003. Types of Mangrove Trees in the Bay. Bintuni Papua. Bogor: Faculty of Forestry, Bogor Agricultural University, Bogor.
[2] Bengen, D.G. 2002. Technical Guidelines for the Introduction and Management of Mangrove Ecosystems. Center for the Study of Coastal and Ocean Resources Bogor Agricultural University. Bogor.
[3] Fachrul, M.F. 2007. Bioecological Sampling Method. Bumi Aksara, Jakarta.

[4] Supriharyono. 2007. Conservation of Biological Resources Ecosystems in Coastal Areas and Tropical Seas. Yogyakarta: Pustaka Pelajar.

[5] Febrita, E., Darmawati, and J. Astuti. 2015. Diversity of Gastropods and Mangrove Forest Bivalves as Learning Media in the Concept of Biodiversity in Class X SMA. Jurnal Biogenesis 11 (2): 119-128.

[6] Candri, D.A., B. Junaedah, H. Ahyadi, Y. Zamroni. 2018. Diversity of Molluscs in Mangrove Ecosystems on the Island of Lombok. BioWallacea Jurnal Ilmu Ilmu Biologi, 4(2): 88-93.

[7] Andi Omar, S.B., R. Sirante, Suwarni and M. Litaay. 2012. Diversity of Gastropods (Molluscs) in the Mangrove Ecosystem of Sinjai Regency, South Sulawesi. Paper presented at the III Mollusca National Seminar, Makassar, 14 June.

[8] Ernawati, SK, A. Niartiningsih, M. N. Nessa and S.B. Andi Omar. 2013. Macrozoobenthic Succession in Natural Mangrove Forest and Rehabilitation in Sinjai Regency, South Sulawesi, Jurnal Bionature, 14 (1): 49-60.

[9] Rabiah, R., E. H. Kardhinata, A. Karim. 2017. Structure of the Macrozoobenthic Community in the Rehabilitation Area of Mangroves and Natural Mangroves in Nipah Village, Serdang Bedagai Regency, North Sumatra, BioLink 3 (2): 125-141.

[10] Irma, D dan K. Sofyatuddin. 2012. Diversity of gastropods and bivalvia in mangrove ecosystem rehabilitation areas in Aceh Besar and Banda Aceh regency, Indonesia, AACL Bioflux 5(2): 55-59.

[11] Tomlinson, PB. 1986. The Botany of Mangrove. Cambridge University Press, Cambridge.

[12] Idris A., M. Novita and S. Kamal. 2019. Mollusca species in mangrove ecosystem Baitussalam district Aceh Besar regency as a supporting reference Biodiversity material, Jurnal Biotik, 6 (2): 87-96.

[13] Pribadi, R., R. Hartati, C.A. Suryono. 2009. Composition of species and distribution of Gastropods in the Mangrove Forest Area of Segara Anakan, Cilacap, Ilmu Kelautan 14 (2): 102-111.

[14] Syahrial, D. Salekby, R.D. Pangaribuan, S. P.O. Leatemiac, N.R. Putri. 2019. Status of adherent biota after planting mangrove Rhizophora spp. in the Thousand Islands: A Case Study of Phylum Molluscs, Journal of Fisheries and Marine Research 3(2): 172-182.