Study of bivalves infauna in mangrove ecosystems of Rigaih in Aceh Jaya

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Abstract. Bivalves Infauna is a Bivalve that lives in the bottom of the waters, including in the waters of the Rigaih mangrove ecosystem in Setia Bakti District, Aceh Jaya Regency, Aceh Province. The aim of the study was to analyze the population of Bivalve Infauna, analyze the dominance of the Bivalvia Infauna population and analyze the bottom substrate of each Bivalvia Infauna population in the waters of the Mangrove Ecosystem in Setia Bakti District, Aceh Jaya Regency, Aceh Province. The research activity was carried out in April and May 2019. The population of Bivalve Infauna used a destructive sampling method. Bivalves infauna dominance data were analyzed by dominance index, while population and environmental conditions were analyzed descriptively. The results of the study indicated that the population of Bivalves infauna in the waters of the mangrove ecosystem in the study area was Anadaragranosa, Geloinaerosa, and Dosinia sp. The dominance index of the population of Anadaragranosasa.67, Geloinaerosa is 0.22, and the index of dominance of Dosinia sp is 0.11. The results also show that the environmental conditions of the substrate are sand, mud and clay. Correspondingly, the study shows that there are three populations of Bivalve Infauna that dominate the ecosystem, namely Anadara granosa and found three bottom substrates in the ecosystem studied.

1. Introduction

The Rigaih Mangrove Ecosystem (RME) area is located in Setia Bakti District, Aceh Jaya Regency. The RME area has a variety of aquatic biota including members of the Bivalves Class that live on the bottom of the water and inside the watershed [1].

Bivalvia class is more commonly known as clam group, which consists of Bivalves Infauna and Bivalves Epifauna. Bivalves Infauna is a Bivalve that has a living habitat within the watershed, including clams. Meanwhile Bivalves Epifauna has a habitat on the bottom of the water, its life is attached to the bottom of the water substrate such as rocks, wood roots, gravel, or others, consisting of oysters with various species.
Many Bivalves Infauna and Bivalves Epifauna, live in various mangrove ecosystems found in Indonesia, especially in Aceh Province. Aceh Province which has a mangrove ecosystem with an area of 58,927.50 hectares, spread from Aceh Tamiang Regency in the East to Aceh Besar District in the North, and from Aceh Jaya Regency in the West, to Aceh Singkil Regency in the South of Aceh Province [2].

As a biota inhabiting the watershed in the area of mangrove ecosystem, Bivalve Infauna has various species which are included in the Mollusc-Phylum. Most species of Bivalve Infauna belong to the Genus Geloina or Polymesoda, and G.expansa[3]. Bivalve species Infauna from Geloina that live in the mangrove ecosystem include Geloinaerosa, G. expansa, G. coaxan, species from Anadara including Anadaragranosa, and A. anriquota.

Bivalvia Infauna, lives in the watershed with various types of substrate in the mangrove ecosystem area in Aceh Province, especially in Aceh Jaya Regency. The substrate occupied by Bivalvia species includes sandy substrates, dusty sand, or sandy clay substrates. The waters of the mangrove ecosystem found in Aceh Jaya Regency is 1234.34 hectares [4] including in the Rigaih area of Setia Bakti District. Based on the results of Ali’s research [5], various Bivalvia Infauna and Bivalvia Epifauna lives including blood clams (Anadara sp.), Mangrove shells (Geloina sp.), and oysters (Cracrostrea sp.). Bivalvia infauna and Bivalvia epifauna live in the substrate and on the substrate on bottom of the water, with its substrate including rock, sand, wood roots, and muddy sand.

Species from Bivalve Infauna found in the waters of the Rigaih mangrove ecosystem have not received clear data to date. Besides that, there is no clear information about Bivalve infauna, which dominates the Rigaih mangrove ecosystem in Setia Bakti District, Aceh Jaya Regency, Aceh Province. Therefore, to obtain accurate data and information about the existence of Bivalve infauna in Rigaih area, a study have been conducted to analyze the population of Bivalve infauna, dominance populations of Baivalvia infauna and analyze the bottom substrate of each Bivalvia infauna population in the mangrove ecosystem.

2. Method

2.1 Study area
The study was conducted in the Rigaih mangrove ecosystem, Setia Bakti District, Aceh Jaya Regency. The research was carried out starting in April to May 2019. The research area was divided into two locations: the Rigaih North mangrove area as location 1 and the mangrove areas in the southern part of Rigaih as location 2. The location was divided based on the conditions of the waters and the plant species that make up the location.

2.2 Measurement of bivalves
Location 1 with the muddy sand substrate, which is dominated by Avicennia marina and Acrosticum sp. Mangrove species, with waters that have water salinity of salty brackish location 2 with sandy clay bottom with mangrove species Fimbrystilis sp., and Nypah sp., with freshwater to brackish water conditions. At each sampling location, five sampling is randomly assigned.

All sampling plots were damaged referring to the destructive sampling method. All parts in each sampling plot were damaged, then sorted all the biota contained in the sampling plot. All biota, especially species from Bivalvia Infauna obtained in each sampling plot are collected and put into the sample site, which has been prepared in advance. All individuals from Bivalvia Infauna are counted and tabulated in the observation table that has been prepared in advance.

2.3 Data analysis
All species and individuals of each species are described, so that data was that occupy the area obtained. Environmental factors include the substrate found in the sampling area was analyzed descriptively. Meanwhile, each species was analyzed by the dominance level indexd formula based on [6] as follows.


\[ D = \sum_i^2 \frac{p_i}{n_i} \]  

(1)

\( D = \) Dominance with a range of values = 0-1, and \( p_i = n_i / N \), \( n_i = \) number of species, \( N = \) total species. If \( D = 0.00-0.50 \) means that the level of dominance is low, if \( D = 0.50-0.75 \) means the level of dominance is moderate, and if \( D = 0.75-1.00 \) means the level of dominance is high [7].

3. Results and Discussion

3.1 Bivalvia infauna species

The Bivalvia Infauna species in the Rigaih mangrove ecosystem, Setia Bakti District, Aceh Jaya Regency, is shown in Table 1. Five species from Bivalve Infauna were found in the area of the mangrove ecosystem. Each species of Bivalvia Infauna has a variety of shells and habitat conditions. Each shell possessed by each species has a different shape, color, size, and outer surface of the shell. Anadara granosa and Anadara (Cuneearca) pilula have a white outer shell color, with prominent lines on the surface of the shell. The condition of the umbo and the direction of the position of the line on the surface of the shell are different, thus causing differences in each species. A. granosa a shell measuring 30-58 mm, on the outside it has a yellowish white color, with lines on the surface of the shell protruding and straight parallel to the right and left side of the shell [8].

Geloina eros a and G. expan sa have shells with protruding ostracum on the surface of the shell [9]. The shape and size of the shell is different, which indicates a different species name. The G. eros a shell has both sides of the same length, and the bulb is located almost in the middle of the shell [10]. Meanwhile G. expan sa has a shell on one side that is longer, compared to the position of the other shell. [11][12] state that Geloina eros a has an almost identical shell on both sides, while G. expan sa has one side of the shell with a length that is different from the other side of the shell.

Dosinia sp. have a shell that has the same size of the right and left sides, the side of the shell between the umbo posterior part of the shell and the anterior part where the chiffon is slightly flat. The part of the shell where the chiffon comes out to the opposite side is very long, compared to the width of the shell. The condition of the shell has various variations, especially the color, length, and shape of the shell.

| No | Species Name                     | Location | Figure | Description                                                                 |
|----|----------------------------------|----------|--------|----------------------------------------------------------------------------|
| 1. | Anadara granosa                  | 1, 2     | ![Image](image1.png)           | The morphology of the shell on the outside is the appearance of a line extending anterior posterior to the shell. The bottom substrate of the waters as its habitat, dominated by fine sand. The area occupied is a river estuary that has salinity leading to marine salinity. |
| 2. | Anadara (Cuneearca) pilula       | 1, 2     | ![Image](image2.png)           | The upper surface of the outer shell has a straight line. The Umbo with ligamentum. |
3. Geloina erosa

The shell has the same length, umbo is in the same far position between the two sides. Living in the brackish water base area, with the basic texture of muddy sand waters.

4. Geloina expansa

The shell that is owned by one part is longer than the other part.

5. Dosinia sp.

The color of the outer shell is yellow, with the surface of the shell having a prominent line.

3.2 The dominance index of bivalvia infauna species

Dominance index of Bivalvia Infauna species found in Rigaich mangrove ecosystem in Setia Bakti District, Aceh Jaya Regency, shown in Table 2.

| No | Species Name       | Location 1 | Location 2 | Individual Count Ind/m² | Dominance Index | Dominance Level |
|----|--------------------|------------|------------|--------------------------|-----------------|-----------------|
| 1  | Anadaragranosa     | 37         | 30         | 67                       | 0.68            | Moderate        |
| 2  | Anadarapilula      | 10         | 5          | 15                       | 0.15            | Low             |
| 3  | Geloinaerosa       | 6          | 2          | 8                        | 0.08            | Low             |
| 4  | Geloinasp.         | 1          | 4          | 5                        | 0.05            | Low             |
| 5  | Dosinia sp.        | 1          | 3          | 4                        | 0.04            | Low             |
|    | **Total**          |            |            | **99**                   | **1.00**        |                 |

Table 2 explained that in the RME of Setia Bakti District, Aceh Jaya Regency, there were 5 species of Bivalve Infauna. Bivalve Infauna species were Anadaragranosa, Anadarapilula, Geloinaerosa, Geloinasp., and Dosinia sp. The dominance index obtained by each species ranged from 0.04 to 0.68, which indicates that there are different levels of dominance. Meanwhile [13] states that if there is a dominance index (D) of 0.00 to 0.50, it means the dominance level is low, D of 0.50 to 0.75 means moderate dominance, and if D is 0.75 to 1.00, it means a high level of dominance. This shows that only one species has a moderate dominance, while the other species has a low dominance.

The species that has a moderate dominance is A. granosa. A. granosa is one of the species of shellfish, which requires habitat of sandy substrate. This condition is in accordance with the needs of the watershed habitat for A. granosa life is sandy. This is in accordance with the opinion (14) states that A. granosa requires a sandy area with a salinity of more than 30 ppt as its place of life. Meanwhile [15] stated that the bottom of the water substrate occupied by G. erosa and G. expansa had muddy sand texture in the base area of the mangrove ecosystem.
In general, bivalvia infauna species found in the RME in Setia Bakti District, Aceh Jaya Regency, was no dominating. Bivalvia species of Infauna found in the RME are generally species that are used by the community as food dishes. This species is utilized every time, so that the existence of this species in nature continues to decrease in number. Meanwhile [16] states that if the community always uses water-based biota, especially sand shells continuously, it can have an impact on their survival and result in a decline in members of the population in the region. Meanwhile [17] state that salinity in brackish areas ranges from 0.5-30 ppt, and outside of this condition can affect this aquatic biota. Meanwhile [18] states that the content of organic matter less than 1 is very low, 1-2 low, 2-3 medium, 3-5 high and the content of organic ingredients greater than 5 means very high.

3.3 Texture of mangrove substrate
The bottom substrate of the mangrove ecosystem of the RME is shown in Table 3.

| No | Location | Substrate | Condition |
|----|----------|-----------|-----------|
| 1  | 1 (The water area is directly connected to the Indian Ocean) | Sandy | Sandy |
| 2  | 2 (The area is directly related to flow and upstream river) | Muddy sand | Low muddy sand |
| 3  | Sandy clay | Almost all at subtract surface |
| 4  | Muddy | |

Table 3. Bottom substrate of the Mangrove Ecosystem of Rigaih area

The bottom substrate of the RME in Setia Bakti District, Aceh Jaya Regency, consists of sand, sandy clay, muddy sand, and mud. Fine sand substrate is found in the in the estuary area which is directly related to the Indian Ocean. River that have brackish water areas after the estuary leading to the freshwater area (towards the upstream) are found with sandy clay substrate, and muddy sand, which shows a difference in the composition of each substrate constituent in the bottom waters. Junaidi [19] states that the bottom substrate of muddy waters is favoured and will determine the life of basic aquatic biota, both freshwater, brackish biota and salty water base biota.

In the mangrove ecosystem area with brackish water conditions that are directly related to the upstream of the river, found substrate of muddy waters, muddy clay, and sandy clay. This is a habitat that can be inhabited by certain Bivalve species including Geloina sp., and more Bivalvia species, especially Anadonta sp. This is in accordance with [20, 21] state that the river and upstream areas that have brackish and fresh salinity will be inhabited by biota that are able to survive in the bottom of the waters that have a tolerance to brackish and fresh salinity. It shows that the area becomes a good habitat for the life of certain biota.

4. Conclusion
After all data from bivalve infauna species were obtained and analyzed descriptively and statistically, it can be concluded that there are five species bivalvia infauna populations. Bivalvia infauna population has moderate dominance is A. granosa, while four other populations are low in dominance. There are four bottom water substrate bivalvia infauna habitat, sandy clay, muddy sand, and mud.

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