Habitat Degradation and Study of Macrozoobenthos Conditions in Homogeneous Mangrove Ecosystems

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Abstract: Habitat degradation that occurs in the mangrove ecosystem will have an impact on the presence of associated biota found in the ecosystem, including macrozoobenthos. If it continues, it will threaten the sustainability of macrozoobenthos resources which are characterized by decreasing abundance and it is not even impossible that one day they will become extinct. The purpose of this research is to analyze the species composition of macrozoobenthos and to analyze the composition of mangrove species. This research was conducted in the mangrove ecosystem of Naga Permai Beach, Gampong Lhok and Gampong Pulo, Kuala Pesisir District, Nagan Raya Regency, Aceh Province in December 2021. The research method was quadrat sampling. The results showed that the macrozoobenthos species found consisted of 2 phylum, 3 classes, 7 families with 16 species.

Keywords: Habitat degradation; Macrozoobenthos; Mangrove ecosystem

Introduction

Macrozoobenthos are basic organisms that are relatively large in size more than 1 mm (Munandar et al., 2016). Macrozoobenthos is one of the aquatic organisms that live on the bottom of the waters, the movement is relatively slow and can live relatively long, so it has the ability to respond to water quality conditions (Zulkifli & Setiawan, 2011).

Macrozoobenthos has a habitat that is at the bottom of the waters, either sessile, creeping or digging holes. These organisms have an important role in food webs. The existence of macrozoobenthos is strongly influenced by changes in water quality and the substrate in which it lives (Ulfah et al., 2012). Generally found in mangrove areas from class Crustacea, Polychaeta, Bivalves and class Gastropods (Afkar et al., 2014). One of the habitats that contain macrozoobenthos is the mangrove ecosystem area of Naga Permai Beach, Kuala Pesisir District, Nagan Raya Regency.

Nagan Raya Regency is one of the regencies in Aceh Province which has various mangrove areas, including those in Kuala Tudai Village, Tadu Raya District and in the Naga Permai Beach area, Lhok Gampong and Pulo Village, Kuala Pesisir District. This area is dominated by Nypa fruticans.

Mangrove ecosystems live various animal species whose lives depend on mangroves (Afif et al., 2014). Mangroves function as a spawning ground, nursery ground, and feeding ground for marine biota, one of which is macrozoobenthos (Maulud et al., 2017). Mangrove ecosystems provide enormous benefits to the environment in coastal areas, namely controlling coastal abrasion, preventing marine intrusion, improving water quality, increasing productivity of coastal waters, and as a habitat for the enlargement and protection of economically valuable biota in coastal waters and can improve the welfare of coastal communities.

The degradation that occurs in the mangrove ecosystem will have an impact on the presence of associated biota in the ecosystem, including macrozoobenthos. If it continues, it will threaten the sustainability of macrozoobenthos resources which are characterized by decreasing abundance and it is not

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even impossible that one day they will become extinct (Hasan in Pratiwi et al. 2021). Based on these problems, it is necessary to conduct research on the study of macrozoobenthos composition in the mangrove ecosystem area of Naga Pemai Beach, Kuala Pesisir District, Nagan Raya Regency, Aceh Province.

**Method**

**Place and Time of Research**

This research was conducted in the mangrove ecosystem of Naga Permai Beach, Gampong Lhok and Gampong Pulo, Kuala Pesisir District, Nagan Raya Regency, Aceh Province (Figure 1). Naga Permai Beach is a tourist attraction for local people and outside the region. This research was conducted in December 2021.

**Approach and Type of Research**

The research approach used in this study is a quantitative approach, which is an approach that sums or collects data/facts that can be used in order to obtain certainty and accuracy in answers to research questions and a qualitative approach, namely a descriptive approach in the form of written/oral words and behaviors that observable (Mulyadi, 2011). The type of research used is included in the type of basic research that is carried out by research with the aim of describing.

**Data Collection Technique**

The mangrove area is divided into 3 locations, namely location 1 near settlements, location 2 near land and location 3 bordering the sea. Each station is laid out 1 line transect line consisting of 5 plots of squared plots which are placed zig-zag along the line transect. The determination of observation stations and sampling points was chosen based on the aspect of representativeness, so that it can describe the presence of macrozoobenthos in certain mangrove species as a whole at the sampling location. Each station consists of 5 sampling points and at one point consists of nine sampling times. Sampling was carried out five times for mangrove data in one station and nine times for macrozoobenthos data collection in one station point.

Data collection for macrozoobenthos and mangroves used a survey method and a quadrat sampling (Figure 2). Data collection for macrozoobenthos and mangroves followed a line transect with a size of 100 m for macrozoobenthos species using a square plot measuring 1 mx 1 m (Afkar et al., 2014), while for mangrove species it was carried out in a plot with a size of 10 mx 10 m (Annisa et al. , 2017). Observations were limited to the types of macrozoobenthos and mangroves, the number of individuals and the number of species of both.

Observations were made from points 0 to 100 m, with a width of 10 m to the left and 10 m to the right of the transect line, then measurements were made again at the next station. Observations were made by looking at the number of species and individuals of macrozoobenthos in mangroves. The sampling method is destructive and non-destructive. Measurements of the values of environmental conditions were carried out at each observation station including water pH, water temperature, and salinity. The type of substrate observed at each station was recorded.

**Analyzing of Data**

The composition of macrozoobenthos and mangroves was described according to the observation station including the type, morphology and number of macrozoobenthos in mangroves. The sampling method is destructive and non-destructive. Measurements of the values of environmental conditions were carried out at each observation station including water pH, water temperature, and salinity. The type of substrate observed at each station was recorded.

\[
K = \frac{I}{N} \times 100 \%
\]

Information:
- \( K \) = composition value
- \( I \) = number of species at station
- \( N \) = total species at station
Table 1. Macrozoobenthos species found in the Naga Permai Beach Mangrove Ecosystem Area

| Scientific Name            | Station | 1 | 2 | 3 | Σ  | (%)  |
|----------------------------|---------|---|---|---|----|------|
| *Stenomelania denisoniensis* | 13      | 5 | - | 18 |    | 6.59 |
| *Melanoïdes plicaria*     | -22     | - | 22 |    |    | 8.06 |
| *Thiara Scabra*           | 33      | 16 | 7 | 56 |    | 20.51|
| *Mieniplotia scabra*      | -3      | 3 | - | 3  |    | 1.10 |
| *Melanoïdes turbeculata*  | 14      | - | 19 | 33 |    | 12.09|
| *Neritina (vittina)*      | -10     | 4 | 14 |    |    | 5.13 |
| *natalensis*              |         |   |   |    |    |      |
| *Vittina turrita*         | -11     | 3 | 14 |    |    | 5.13 |
| *Vittina natalensis*      | -6      | 6 | - | 6  |    | 2.20 |
| *Neripteron auriculatum*  | 3       | - | 3 | -  |    | 1.10 |
| *Clithon corona*          | -3      | 3 | - | 3  |    | 1.10 |
| *Filopaludina sumatrensis*| 15      | 7 | 8 | 30 |    | 10.99|
| *Faunus ater*             | 14      | 15 | 10 | 39 |    | 14.29|
| *Pila ampullacea*         | 5       | - | 4 | 9  |    | 3.30 |
| *Geloina sp*              | 8       | - | 4 | 12 |    | 4.40 |
| *Corbicula javanica*      | -6      | 6 | - | 6  |    | 2.20 |
| *Parapenaeopsis hardwickii* | 1     | 4 | - | 5  |    | 1.83 |
| **Total**                 |         |   |   |    | 273| 100% |

The total number of species found was 273 individuals. The most species were found at station 1 with 106 individuals, station 2 with 93 individuals. The least number of species found at station 3 was 74 individuals. The density of macrozoobenthos during the study in the mangrove ecosystem area of Naga Permai Beach showed that the highest density was at station I and the lowest was at station III.

The large number of individual densities found at station I is due to the water substrate which is a loamy sand substrate and is a high seagrass ecosystem so that food supplies such as plankton and plants can be found at this station.

Based on Figure 3, it is known that the composition of macrozoobenthos at station 1 is 38.83% in the low category, the composition at station 2 is 34.1% in the low category, and the composition at station 3 is 27.1% in the low category. The low composition of macrozoobenthos at the location of data collection is influenced by environmental factors, where the condition of the water is high so that the discharge and water level are high so that it becomes the main obstacle during the data collection process in the field.

This is in line with the statement Fuller, (1979) that the majority of macrozoobenthos prefer to live in mud to sand sediments. Besides having a good substrate for macrozoobenthos, the temperature at station I is 30°C with a salinity reaching 2.1 ppm and a water pH of 7.2 which is good for macrozoobenthos life. Next Odum, EP, (1993) stated that the main factors that determine the distribution of macrozoobenthos are aquatic substrates in the form of mud, clay, sand, gravel, stone, and each determines the composition of the macrozoobenthos species.

Mangrove Species Composition

The results showed that the mangrove ecosystem area of Naga Permai Beach was found as many as 10
species belonging to the true mangrove category, namely plants that grow in tidal areas and form pure stands. This type of mangrove rarely combines with land plants Mujiono et al., (2020); Ponder, WF et al., (2022). As in general mangrove forests in Indonesia, the composition of mangrove species on Naga Permai Beach is dominated by the Rhizophoraceae and Arecaceae families, this is presumably because the environmental conditions at the research site support the spread and growth of this family so that the adaptation process runs well.

The number of this species is very low compared to the total mangrove which is usually found in Aceh Province. The plants that make up the mangrove ecosystem consist of various species, including Rhizophora apiculate, Rizophora mucrosa, Acanthus ilicifolium, Aegiceras corniculatum, Bruguiera gymnorrhiza and Nypa fructicans (Ali et al., 2020).

### Table 2. Mangrove Species Found in the Mangrove Ecosystem Area of Naga Permai Beach

| S | Scientific Name       | Local Name | Type    | Habitus |
|---|-----------------------|------------|---------|---------|
|   |                       |            | Mangrove|         |
| 1 | Nypa fructicans       | Nipah      | E       | T       |
|   | Acrostichum aureum    | Paku       | E       | B       |
|   | Eclipta alba L.        | Laut       | E       | B       |
|   | Eichhornia crassipes   | Eceng      | E       | B       |
|   | Premna serratifolia    | Buas-buas  | E       |         |
| 2 | Nypa fructicans       | Bakau      | E       | T       |
|   | Rhizophora sp          | Paku       | E       | B       |
|   | Acrostichum aureum    | Laut       | E       | B       |
|   | Acrostichum speciosum | Laut       | E       | B       |
|   | Eichhornia crassipes   | Teki       | E       | B       |
|   | Eichhornia crassipes   | Gondok     | E       |         |
|   | Flacourtia rukam      | Rukam      | E       | T       |
| 3 | Nypa fructicans       | Nipah      | E       | T       |
|   | Sonneratia alba       | Perapat    | E       | T       |
|   | Eichhornia crassipes   | Eceng      | E       | B       |
|   | Eclipta alba L.        | Gondok     | E       | B       |
|   | Eichhornia crassipes   | Teki       | E       | B       |

Information: S: station; E: Experience; R: Rehabilitation; T: Tree; B: Bush.

According to Wahab et al., (2020) species composition is the composition and number of species contained in a plant community, so there are three important keywords, namely species, composition and number. Nypa fructicans predominates in all growth phases. Nypa fructicans dominates at every growth because this species is superior in obtaining nutrients, light, and space to grow. Nypa fructicans is intolerant of fresh water for long periods, likes soil mixed with mud and sand, sometimes on coral rocks often found in coastal locations protected from wave action, also in estuaries and around offshore islands.

Based on Table 2, the mangrove species found in the mangrove ecosystem area of Naga Permai Beach are natural mangrove ecosystems. The population in the tree habitus is more dominant than the bush habitus. Estuary areas generally contain several species of mangrove which are a source of nutrients and organic matter which is a source of food for aquatic biota and macrozoobenthos in the vicinity. Ulfah et al., (2012) stated that the estuary ecosystem has a fairly high biodiversity, including macrozoobenthos that live in and on water sediments and relatively live in digging holes, creeping and sticking.

Based on Figure 4, it is known that the composition of mangroves at station 1 is 29.41% in the low category, the composition of mangroves at station 2 is 41.18% in the low category, and the composition of mangrove species at station 3 is 29.41% in the low category. One of the reasons for the low composition of mangrove species in the Naga Permai Coastal Area is that the area is dominated by Nypa fructicans.

The density or abundance of various species in an environment is different. If the environment changes, there may be a reduction in the number of individuals so that the rarest species are likely to be wiped out. The low abundance of the above species at each station is due to the low tolerance of these species to changes in the...
conditions of the waters they inhabit Hartoto & Marwoto, (1986).

The composition of mangrove species in the mangrove ecosystem area of Naga Permai Beach is dominated by Nypa fructicans, this is presumably because the environmental conditions at the study site support the spread and growth of this species so that the adaptation process runs well. It is supported by (Heriyanto & Subiandono, 2016) who said that in the Alas Purwo National Park area, several mangrove species are very good at utilizing solar energy, nutrients/minerals and water as well as competitive characteristics so that they dominate other species Hidayatullah & Pujiono, (2014).

The condition of mangroves is basically influenced by the influence of tides, but in the mangrove forest area of Naga Permai Beach, young seawater enters the area. The adaptability of each species to environmental conditions causes differences in the composition of mangrove forests with distinctive boundaries. Mughofar et al., (2018) stated that this was one of the causes of the zoning conditions of mangrove vegetation that were not optimal and caused by the influence of soil conditions, salt content, duration of inundation and tidal currents. So that the conditions shown in the zoning pattern formed are not in accordance with the proper mangrove zoning.

Conclusion

The composition of macrozoobenthos species associated with mangrove ecosystems in the mangrove ecosystem area of Naga Permai Beach, Kuala Pesisir District, Nagan Raya Regency, which consists of 2 phyla, 3 classes, 7 families with 16 species. The composition of mangrove species in the mangrove ecosystem area of Naga Permai Beach, Kuala Pesisir District, Nagan Raya Regency consists of 10 different species.

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References

Afif, J., Ngabekti, S., & Pribadi, T. A. (2014). Keanekaragaman makrozoobentos sebagai indikator kualitas perairan di ekosistem mangrove wilayah Tapak Kelurahan Tugurejo Kota Semarang. Life Science, 3(1). Retrieved from https://journal.unnes.ac.id/sju/index.php/UnnesJLifeSci/article/view/2982

Afkar, A., Djufri, D., & Sarong, M. A. (2014). Asosiasi makrozoobenthos dengan ekosistem mangrove di Sungai Reuleng Leupung, Kabupaten Aceh Besar. Jurnal Edubio Tropika, 2(2). Retrieved from https://journal.unsyiah.ac.id/JET/article/view/5261

Ali, M., Saputri, M., & Mursawal, A. (2020). Wajah Pesisir Aceh. Syiah Kuala University Press.

Faidiban, D. (2017). Keanekekaragaman Gastropoda Dan Bivalvia Di Pantai Segara Indah, Biak Timur, Papua. Universitas Atma Jaya Yogyakarta (UAJY).

Fuller, S. L. H. (1979). Pollution Ecology of Estuarine Invertebrates. Academic Press, New York, 01(01), 78-117 pp.

Hartoto, D. I., & Marwoto, I. M. (1986). Struktur komunitas gastropoda dan distribusi spasi Melanoides plicaria di Cibinua Ujong Kulon. Berita Biologi, 3(4), 155–158. http://dx.doi.org/10.14203/beritabiologi.v3i4.1341

Heryanto, N. M., & Subiandono, E. (2016). Peran biomassa mangrove dalam menyimpan karbon di Kubu Raya, Kalimantan Barat. Jurnal Analisis Kebijakan, 13(1), 1-12. https://dx.doi.org/10.20886/jakk.2016.13.1.1-12

Hidayatullah, M., & Pujiono, E. (2014). Struktur dan komposisi jenis hutan mangrove di Golo Sepang-Kecamatan Boleng Kabupaten Manggarai Barat. Jurnal Penelitian Kehutanan Wallacea, 3(2), 151–162. http://dx.doi.org/10.18330/jwallacea.2014.vol3iss2pp151-162

Lok, A., Ang, W. F., Ng, P. X., Ng, B. Y. Q., & Tan, S. K. (2011). Status and distribution of Faunus ater (Linnaeus, 1758)(Mollusca: Cerithioidea) in Singapore. Nature in Singapore, 4, 115-121.

Maulud, A., Purnawan, S., & Nurfadillah, N. (2017). Kelimpahan Biota Penempel yang Terdapat Pada Mangrove di Muara Alue Naga Kecamatan Syiah Kuala Kota Banda Aceh. Jurnal Ilmiah Mahasiswa Kelautan Perikanan Unsyrat, 2(4). https://jim.unsyiah.ac.id/fkp/article/view/7770

Mughofar, A., Masykuri, M., & Setyono, P. (2018). Zonasi dan komposisi vegetasi hutan mangrove pantai Cengkrom desa Karanggandu kabupaten Trenggalek provinsi Jawa Timur. Jurnal Pengelolaan Sumberdaya Alam Dan Lingkungan (Journal of Natural Resources and Environmental Management), 8(1), 77-85. https://doi.org/10.29244/jplsl.8.1.77-85

Mujiono, N., Marwoto, R. M., & Heryanto, H. (2020). Diversity of Aquatic and Terrestrial Molluscs from Simeulue Island, with Notes on Their Distribution
and Some New Records. *Biogenesis: Jurnal Ilmiah Biologi*, 8(1), 79-88. https://doi.org/10.24252/bio.v8i1.13212

Mulyadi, M. (2011). Penelitian Kuantitatif Dan Kualitatif Serta Pemikiran Dasar Menggabungkannya. *Jurnal Studi Komunikasi Dan Media*, 15(1), 127-138. https://doi.org/10.31445/jskm.2011.150106

Munandar, A., Ali, M. S., & Karina, S. (2016). Struktur Komunitas Makrozoobenthos Kabupaten Aceh Jaya Community Structure Macrozoobenthos Estuari Kuala Rigaih District Of Setia Bakti. *Jurnal Ilmiah Mahasiswa Kelautan Dan Perikanan Unsyiah*, 1(November), 331-336. https://jim.unsyiah.ac.id/fkp/article/view/1605

Odum, E. P. (1993). *Dasar-Dasar Ekologi Edisi Ketiga (Terjemahan Tjahjono Samingan)*. Gadjah Mada University Press.

Ponder, W. F., Hallan, A., Shea, M. E., Clark, S. A., & Richards, K., Klonzinger, M. W., and Kessner, V. (2022). *Australian Freshwater Molluscs*. Revision A1. Retrieved from https://keys.lucidcentral.org/keys/v3/freshwater_molluscs/

Pratiwi, Y. S., Febrianto, T., Anggraeni, R., Karlina, I., Suhana, M. P., & Nugraha, A. H. (2021). Asosiasi Kerang Lokan (Geloina erosa) Pada Ekosistem Mangrove Di Tanjung Unggat Kecamatan Bukit Bestari Kota Tanjungpinang. *Jurnal Enggano Vol*, 6(1), 11-24. https://doi.org/10.31186/jenggano.6.1.11-24

Suarni, E. (2020). Deteksi Adanya Gen toxR, tdh, trh Vibrio parahaemolyticus pada Sampel batissa violacea L dan Faunusater Linn. *Syifa’MEDIKA: Jurnal Kedokteran Dan Kesehatan*, 1(2). https://doi.org/10.32502/sm.v1i2.2849

Sulphayrin, H. A. (2018). Komposisi dan Jenis Makrozoobenthos (Infauna) Berdasarkan Ketebalan Substrat Pada Ekologi Lamun di Perairan Nambo Sulawesi Tenggara. *J. Menejemen Sumber Daya Perairan*. Univ. Halu Oleo, 3(4), 343–352. Retrieved from http://ojs.uho.ac.id/index.php/JMSP/article/view/5307

Susiana, S. (2015). Analisis kualitas air ekosistem mangrove di estuari Perancak, Bali. *Agrikan: Jurnal Agribisnis Perikanan*, 8(1), 42-49. https://doi.org/10.29239/j.agrikan.8.1.42-49

Ulfa, Y., Widianingsih, W., & Zainuri, M. (2012). Struktur Komunitas Makrozoobenthos di Perairan Wilayah Morosari Desa Bedono Kecamatan Sayung Demak. *Journal of Marine Research*, 1(2), 188–196. https://doi.org/10.14710/jmr.v1i2.2037

Wahab, I., Nurafni, N., & Rahamati, A. (2020). Abundance Telescopium Telescopium at Mangrove Ecosystem in Daruba Pantai Village, Morotai Island. *Musamus Fisheries and Marine Journal*, 38-47. https://doi.org/10.35724/mfmj.v3i.3171

Zulkifli, H., & Setiawan, D. (2011). Struktur komunitas makrozoobentos di perairan sungai musi kawasan Pulokerto sebagai instrumen biomonitoring. *Jurnal Natur Indonesia Wacana Sains Indonesia*, 14(1), 95–99. http://dx.doi.org/10.31258/jnati.14.1.95-99