Community structure of macrozoobenthos in Lamnyong River, Aceh Province

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Abstract. The purpose of this research was to determine the community structure of macrozoobenthos in the last three years (2017, 2018, and 2019) through analysis of diversity index, evenness index, dominance index, and density. The research was conducted on March 2017, April 2018, and March 2019 in the Lamnyong River. This research used purposive random sampling method, which consisted of 3 stations based on the width of the river namely the right, middle, and left edges of the Lamnyong River. The results showed that during the last three years, 2017, 2018, and 2019, the community structure of macrozoobenthos in the Lamnyong River was classified as unstable because of the dominance of several macrozoobenthos species, but the quality of the river waters could still be tolerated by macrozoobenthos. The types of benthos was found in the Lamnyong River in 2017 is 3 families of macrozoobenthos namely Anomidae, Mytilidae, and Mactridae. In 2018, was found 5 species of macrozoobenthos which Tellina palatam, Lopha cristagali, Scylla serrata, Pinna bicolor, and Balanus sp., and in 2019 there was found 1 species of macrozoobenthos, namely Mactra luzonica.

1. Introduction
Lamnyong River is one of the rivers located in Syiah Kuala sub-district, Banda Aceh. This river has an important role for local communities as providers of water needs, water sports areas, and domestic livelihoods. One form of domestic livelihood around the Lamnyong River is fishing and shellfish. In addition, based on direct observations in the field, many anthropogenic activities were carried out along the Lamnyong River, such as agriculture, plantations, fishing ports, traditional markets, shops, housing, and garage. This anthropogenic activity is thought to contribute - waste which can reduce the aesthetics of the Lamnyong River which is no longer suitable for its intended use, thus negatively affecting organisms living on the river.

One of the organisms living in the river Lamnyong is benthos. Benthos organisms are organisms attached to or resting on the bottom of the water and live in the bottom sediment (substrate) waters. Benthos staying or living in the seabed sediments called infauna while living on the surface of the seabed...
sediments called epifauna [1]. According to [2] benthos based on their size can be classified into: 1) Makrobenthos with a size of more than 1.0 mm; 2) Meiobenthos with sizes between 0.1 - 1 mm; 3) Microbenthos with a size of less than 0.1 mm. Makrobenthos is an organism that reaches a size of at least 3-5 mm at the time of maximum growth. Macrobenthos organisms usually consist of insects, molluscs, oligochaeta, crustaceans - amphipods, isopods, decapodes and nematodes [3].

In assessing the condition of the waters, in addition to fish the use of invertebrate community structures such as makrozoobenthos to describe the condition of an integrated aquatic ecosystem has begun to develop. Therefore, to see the condition of the Lamnyong river waters that are currently dense with domestic activities, the authors feel the need to examine the waters condition through makrozoobenthos community structure approach, so the purpose of this study was to determine the makrozoobenthos community structure in the last three years (2017, 2018, and 2019) through diversity -, evenness, dominance indices and density. The several studies that have been conducted on the Lamnyong River include the heavy metal pollution in bivalvia (Crassostrea sp.) [4]. Several research have been conducted on makrozoobenthos in Aceh Waters, i.e community structure of makrozoobenthos in several Susoh Estuarine, Aceh Barat Daya Regency [5], and the makrozoobenthos community structure in Gosong Lake Village [6].

2. Materials and Methods
2.1. Site and time
This research was conducted in Lamnyong River, Aceh Province on March 2017, April 2018, March 2019. The method of determining the station used in this study was purposive random sampling method, which consisted of 3 stations based on the width of the river namely the right, middle, and left edges of the Lamnyong river.

![Figure 1. Location of research in Lamnyong River](image)

2.2. Methods
Benthos sampling was carried out by random sampling method, where using a paralon (corring) pipe with a 10 cm corring diameter by plugging into the bottom of the water and then lifting a paralon pipe to the base of the surface and then using a benthos sieve. The sample was morphologically identified.
based on the benthos identification book [7]. Furthermore, water samples taken to measure benthos environmental parameters including temperature, salinity, depth, pH, and flow were carried out in situ.

2.3. Data Analysis
Data analysis used in this research is the biological index, such as:

2.3.1 Density of macrozoobenthos. The density calculation refers to [8] using the following formula:

\[ D = \frac{\sum N_i}{A} \]

where, \( D \) is Macrozoobenthos dan mangrove density (ind/m\(^2\)); \( N_i \) is number of individuals (individual); and \( A \) is area (m\(^2\)).

2.3.2 Diversity of macrozoobenthos with Shannon-Weiner formula [1]:

\[ H' = -\sum p_i \log_2 p_i \]

where, \( H' \) is Shannon-Wiener Diversity Index; \( p_i \) is number of individuals \( i \)/total number of individuals; \( n_i \) is number of individuals of a type; \( N \) is total number of individuals; \( \log_2 p_i = 3.321 \times \log p_i \). Diversity index values can be classified as follows [9]: \( H' < 1 \) is small diversity and low community stability; \( 1 < H' \leq 3 \) is moderate diversity and moderate community stability; and \( H' > 3 \) is great diversity and high community stability.

2.3.3 Similarity Index using the following formula [9]:

\[ E = \frac{H'}{H_{\text{max}}} \]

where, \( E \) is Similarity Index; \( H' \) is Diversity Index; \( H_{\text{max}} \) is 3.321928 Log S; and S is number of species that found. Similarity index values range from 0 - 1. If the similarity index approaches a value of 0, then the individual distribution of each species is not the same and in the ecosystem there is a tendency for species domination to be caused by instability of environmental and population factors. If the uniformity index approaches a value of 1, then the ecosystem is in a relatively stable condition, i.e. the number of individuals per species is relatively the same [8].

2.3.4 Dominance of Simpson using the following formula [1]:

\[ C = \frac{\sum (n_i N)^2}{N^3} \]

where, \( C \) is Dominance Index, \( n_i \) is number of individuals of a type; and \( N \) is total number of individuals. Dominance index values can be classified as follows [9], where 0 \( < C \leq 0.5 \) is Low dominance; 0.5 \( < C \leq 0.75 \) is medium dominance; and 0.75 \( < C \leq 1.00 \) is high dominance.

3. Result and Discussion

3.1. Density of Macrozoobenthos (D)
Based on the results of research on the Lamnyong river in 2017, the were 3 family of macrozoobenthos were found, namely Anomidae, Mytilidae, Mactridae. In 2018 were found 5 family of macrozoobenthos species Tellinidae (Tellina palatum), Ostreidae (Lopha cristagali), Portunidae (Scylla serrate), Pinnidae (Pinna bicolor), Balanidae (Balanus sp.) and by 2019 there were 1 family of macrozoobenthos is Mactridae (Mactra luzonica).

Macrozoobenthos is an aquatic organism that lives at the bottom of the waters. According [10], [11], macrozoobenthos organism is easily available, has diverse types and sensitive to the different types of pollutants. Macrozoobenthos is also a good indicator to predict an aquatic habitat condition [11] [12]. Based on this study conducted in estuary of Lamnyong River, Gastropod and Bivalve which belong to the dominating class of macrozoobenthos. This result is consistent with the study conducted by [13],
14], [15], and [16], which stated that the type of macrozoobenthos of classes Gastropod and Bivalvia were most commonly found in estuary of Donan River. This showed that Gastropod has an adaptability and enough broad range of tolerance to environmental conditions. This is in accordance with the statements of [16], [17], [18] stated that Gastropod has a fairly high adaptability and considerably high tolerance to the water condition and different seasons. Study conducted by [19] [20] stated that Gastropoda was found in a large number in Songculan Lagoon (Philippines).

The highest macrozoobenthos density was found in 2018 on all three stations of the Lamnyong River. In contrast, the lowest density was found in 2019 on all three observation stations (Figure 2). This suggests that the overall density of macrozoobenthos relatively low compared to other studies similar to those [10] on the river Donan, Cilacap, [11], [12], and [13].

![Figure 2. Density of Lamnyong River macrozoobenthos in the last three years](image)

The macrozoobenthos density in the Lamnyong River on 2017, 2018 and 2019 is low compared to several similar studies [10], [11], [12], and [13]. This is presumably due to the possibility of not too much sampling and a small amount of organic matter.

Based on Table 1, indicated the diversity index of macrozoobenthos in Lamnyong River is low both in 2017, 2018, until 2019. Furthermore, the overall index of evenness index approaching a value of 0, which means uneven distribution of macrozoobenthos and dominance index showed a value of 1, indicating tend the dominance of several species.

**Table 1. Diversity index, similarity index, and dominance index in Lamnyong river’s macrozoobenthos in the last three years**

| Station | Year | 2017 | 2018 | 2019 |
|---------|------|------|------|------|
|         | H'   | E    | C    | H'   | E    | C    | H'   | E    | C    |
| 1       |      | 0    | 0    | 1    | 0.87 | 0.5  | 0.69 | 0    | 0    | 1    |
| 2       |      | 0.81 | 0.08 | 1    | 0.13 | 0.01 | 0.83 | 0    | 0    | 0    |
| 3       |      | 0    | 0    | 1    | 0.41 | 0.02 | 0.45 | 0    | 0    | 0    |
Based on Table 2, parameters of Lamnyong River water quality in the last three years, it is seen that overall physical and chemical factors waters still classified as suitable for macrozoobenthos life.

3.2. Discussion
The macrozoobenthos diversity index in the Lamnyong River during the last three years was relatively low, so the community structure of macrozoobenthos was classified as unstable. High and low levels of diversity are also influenced by sediment conditions and various other water parameters that can support the life of each species that occupies the place [21] [22]. According [22] [24], a community has a high diversity if the community is composed by many types and with an abundance of the same or almost the same type, whereas if the community is composed of very few species and if only a few species are dominant then diversity is low.

Furthermore, the evenness index of three years approaches a value of zero (0), then the individual distribution of species is not the same and in the ecosystem and there is a tendency for dominant species - caused by instability of environmental and population factors. Moreover, the dominance index shows a value of 1, which means that there has been domination in the macrozoobenthos community on the Lamnyong River.

The waters quality - of the Lamnyong River in the last three years is considered suitable for the life of macrozoobenthos, because it is still within the tolerance limits of the organism. The range of physical and chemical parameters in the Lamnyong River from 2017, 2018, and 2019 is for salinity i.e. 15 - 25 ‰, the pH range is 7 - 8, the temperature range is 30 ℃ - 32.5 ℃, the depth range is 0.4 m - 3 m, and the current is 0.05 m / s - 9.8 m / s.

4. Conclusion
Based on the results of the research for the last three years, namely 2017, 2018, and 2019 showed that the macrozoobenthos community structure in the Lamnyong River was classified as unstable because of the dominance of several macrozoobenthos species such as Gastropods and Bivalve, but the quality of the river waters could still be tolerated by macrozoobenthos. The types of benthos found in the Lamnyong River in 2017 found 3 families of macrozoobenthos namely Anomidae, Mytilidae, Mactridae. In 2018, there was 5 species of macrozoobenthos were found, namely Tellina palatam, Lopha cristagali, Scylla serrata, Pinna bicolor, Balanus sp., and in 2019 there was 1 species of macrozoobenthos, Mactra luzonica.

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| Station | Salinity (‰) | pH | Temperature (℃) | Depth (m) | Current (m/s) |
|---------|--------------|----|-----------------|-----------|---------------|
| 2017    | 20           | 8  | 8               | 8         | 2.15          | 3.15          |
| 2018    | 25           | 7.1| 30              | 30        | 1.3           | 2.3           |
| 2019    | 15           | 7  | 30              | 30        | 0.4           | 0.7           |
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