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Effect of Total Suspension on Macrozoobenthos in the Aek Pala River

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Abstract

The Aek Pala River is a water used by the surrounding community for various activities. In addition to fishing activities by the local community, the Aek Pala river is also a natural tourist spot that causes turbidity from suspended solids. This situation affects biodiversity, especially macrozooebenthos in these waters. Macrozooebenthos is a group of animals that live on the bottom of the waters and are often found living in association with other organisms. This study aims to determineeffect of total suspended solids on macrozoobenthos in the Aek Pala river. The sampling technique in this study used a purposive random sampling technique, while the research used a descriptive method. The results showed that the total suspended solids content in the waters of the Aek Pala . riverranged from 105.20 mg/l -135.15 mg/l. The largest value was found at station IV amounting to 135.15 mg/l, while the lowest value was at station II amounting to 105.20 mg/l. There are 5 types of macrozoobenthos found in the Aek Pala river, namely zooplankton, bivalves, annelids, crustaceans and gastropods. The results of the calculation of the community structure of various types of macrozooebenthos were found in the form of calculation results, namely the highest diversity index (H') was at station III amounting to 0.7035, the highest uniformity index (e) was at station III amounting to 0.437, dominance index (C) is the highest at station I amounting to 0.766, andrelative abundance index (KR),the highest is at station I amounting to31,650.

Keywords
Total suspended solids; Macrozooebenthos; Aek Pala river

I. Introduction

River hydrologically has a role as one of the transportation routes for surface runoff, which is capable of transporting various types of substances and materials. Ecologically the river is a habitat for various types of aquatic organisms that can provide an overview of the quantity and quality of the ecological relationships that exist in it. The river is one of the dynamic systems in which there are activities in and around it of various environmental components. These dynamics will cause the river to be in ecological balance as long as it does not receive foreign materials from the outside. At a certain range, the influence of foreign materials can still be tolerated and the balance condition can still be maintained (Eti Wahyuningsih, et al, 2022).

Indonesia has many river waters and has an accompanying water component, currently there are 5,950 Watersheds (DAS) recorded at the Ministry of Environment (Zulfan, et al, 2018). Indonesia's territorial waters are very functional which can be used as a vehicle for transportation, ports, sources of income, residential areas, fisheries cultivation and tourist attractions (Winnarsih, 2016). The Aek Pala River is a natural tourist attraction

filled with various human activities, the impact of these activities can cause direct entry of polluting waste into the river, one of which is an increase in total suspended solids.

According to Mubarak (2014) Total suspended solids are suspended materials (diameter >1m) contained in a millipore sieve with a pore diameter of 0.45m. Total suspended solids consist of fine sand, silt and micro-organisms which are mainly caused by soil erosion and soil erosion carried into water bodies.These suspended solids come from the land to the sea through rivers and are then carried by currents. Suspended solids are also solids that cause turbidity in water, are not dissolved, and cannot precipitate.

Suspended solids are particles that have a smaller size or weight than sediment, such as clay, certain organic materials and others. These particles can reduce the intensity of light suspended in water generally consist of zooplankton, phytoplankton, plant and animal residues, animal waste, human waste and industrial waste. Eti Wahyuningsih, et al, 2022). According to Jiyah, et al. (2016), high total suspended solids can cause a decrease in the photosynthetic activity of plants in the water, both micro and macro so that the oxygen released by plants is reduced and can disrupt the macrozoobenthos community.

The function of macrozoobenthos as a very important ecological, among others, has a role in the process of neutralizing organic material in sediments, transferring energy through the food chain, and being a nutritional balancer in the aquatic environment. Such is the importance of the role of macrozoobenthos in aquatic ecosystems so that if the macrozoobenthos community is disturbed, it will certainly cause ecosystem disruption.

From several previous studies, total suspended solids have an effect on macrozoobenthos based on the results of research by Arif Mustofa, (2018). Stating that the total suspended solids content has a very strong effect (r=0.934) on the abundance of macrozoobenthos with a relative abundance range between 10.969%-34.00%. Research conducted by Muhammad Yasir, et al, (2015), stated that the total suspended solids can affect the structure of the macrozoobenthos community although in this case the amount is very small. The purpose of this research is to find outeffect of total suspended solids on macrozoobenthos in the Aek Pala river.

Based on the potential inventory data of the Aek Pala area, Labuhanbatu Regency is very vulnerable to decreasing water quality due to several bad activities carried out by the community.(Winarti & Harahap, 2021). Several other activities such as fishing and providing campsites for tourists around the Aek nutmeg area, Labuhanbatu Regency can also increase the risk of disturbing the stability of the aquatic ecosystem. (Kedaton & Harahap, 2021). Therefore, this study was conducted to determine the level of diversity of Macrozoobenthos.

II. Research Method

2.1 Research Time and Place

The time of the research was carried out from May 2022 to July 2022.This research was conducted in the Aek Pala River, Aek Pala Street, Afdeling I, Rantau Prapat, West Bilah District, Labuhan Batu Regency, North Sumatra Province. Image 1.

2.2 Tools and materials

Activities in this research phase use tools and materials, namely writing utensils, masks, 1x1 m squares, roller meters, sample bags and macrozoobenthos samples.

2.3 Retrieval Method

The sampling technique in this study used a purposive random sampling technique, while the research used a descriptive method.

2.4 Data analysis

1. Diversity Index (H')

The diversity index (H') describes population diversity mathematically to facilitate the analysis of the number of individuals from each type of a community. The calculation of the diversity index (H') refers to the equation (Sannon-Weiner) in (Sandra Devita Kusumaningsari, 2015).

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

Where: H'= Sannon-Weiner diversity index
S= Number of species
Pi= Number of individuals each (i=1,2,3...)

2. Uniformity Index (e)

The uniformity index or Evennes index (e), was used to determine the structure of the macrozooebenthos community in the research plot as follows:

$$e = \frac{H'}{\text{In(S)}}$$

Where: e= Specific Evenness Index
H'= Shannon's Index
S= Number of species found

3. Dominance Index (C)

The dominance index is used to obtain information about the dominant species in a community. The formula is as follows (Odum) in (Rusdi Machrizal, et al, 2020):

$$C = \sum_{i=1}^{n} \left(\frac{ni}{N}\right)^2$$

Where: C = Index of dominance (index of dominance)
Ni= Value of each species (ith number of individuals)
N= Total value of all species (total number of individuals found)

The dominance index value ranges from 0-1. A value of C close to 1 means that there is one species with high abundance at one location. A C value close to 0 indicates that no high abundance species was found in one location.

4. Relative Abundance (KR)

It is the percentage between the abundance of species and the total number of species found. The formula is as follows:

$$KR = \frac{Jumlah\ Jenis\ ke\ i}{Jumlah\ seluruh\ jenis} X\ 100\%$$

III. Result and Discussion

2.1 Total Suspended Solids

There are many aquatic ecosystems in Labuhan Batu Regency, one of which is the Aek Pala River. The Aek Pala River is a water used by the surrounding community for various activities. In addition to fishing activities by the local community, the Aek Pala river is also a natural tourist spot that can increase the income of the local community. The area of Labuhan Batu Regency has an area of ± 2,561.38 ha, with a population of 499,982.00 people. Measurement of chemical-physical parameters in the Aek Pala river has a temperature range of 25.3-28.4°C.

According to Rizkia Nurul Fadillah, et al (2021), sunlight entering the waters will affect the temperature of the waters caused by the absorption of water, thus converting it into heat energy. The results of the analysis of total suspended solids from the Aek Pala river water samples are shown in the table below:

Table 1. Total Suspended Solid Content of Each Station

Station	Total Suspended Solids (mg/l)
I	113.43
II	105,20
III	122.45
IV	135.15

Table 1 shows that the total suspended solids in the Aek Pala river ranged from 105.20 mg/l -135.15 mg/l. The largest value was found at station IV amounting to 135.15 mg/l, while the lowest value was at station II amounting to 105.20 mg/l. The high value of total suspended solids in the Aek Pala river area causes increased pollution and suspended solids in these waters. The table above also shows that from station III the total suspended solids amounted to 122.45 mg/l and station I amounted to 113.43 mg/l. This value describes in general that activities from the mainland contribute more to the suspended solids content in the waters of the Aek Pala river.

According to Arif Mustofa, (2018), the total content of suspended solids in the waters affects the life of the organisms that inhabit them. To support their life, organisms need optimal water quality with a total suspended solids content of <80 mg/l. Facing a situation like this, there are two possibilities carried out by organisms that cannot move or will die. Organisms that can move will avoid it and look for new, more optimal habitats. Likewise with macrozooebenthos that inhabits the bottom of river waters, the impact of increasing the total suspended solids content in the waters causes changes in abundance by moving to new places of life.

According to Muhammad Tahriir Islam Kansi, (2019), total suspended solids are solids that cause water turbidity and cannot settle directly. Total suspended solids is one of the factors that can indirectly affect the quality of a waters. With a high concentration of total suspended solids in the waters, it will affect the increase in the value of the turbidity of the waters, and this greatly affects the penetration of light that enters the waters so that it interferes with the photosynthesis process which requires sunlight.

2.2 Macrozoobenthos Abundance Structure

According to Eti Wahyuningsih,ddk (2022), macrozoobenthos are plant and animal organisms that live attached to or in the substrate. Both on the substrate of sand, mud, gravel, or rocks, pieces of wood and others with relatively limited movement.

Macrozoobenthos are aquatic biota that are easily affected by the presence of pollutants, whether physical, chemical, biological, mud, sand or strong water. This is because zoobenthos cannot move quickly and their habitat is at the bottom which is generally a place for piling up pollutants, mud and sand. These animals play an important role in the destruction and mineralization of organic material that enters the waters and occupies several levels in the food chain.

There are 5 types of macrozoobenthos found in the Aek Pala river, namely zooplankton, bivalves, annelids, crustaceans and gastropods. Based on the identification of the observed samples, data on the number of macrozoobenthos were found, as follows:

Table 2. Macrozooebenthos data in the Aek Pala . River

Type	Station I	Station II	Station III	Station IV	Amount
Zooplankton	4	1	5	7	17
Bivalves	5	2	2	2	11
Annelida	2	1	4	3	10
Crustaceans	1	1	3	1	6
gastropod	82	32	65	74	253
Amount	94	41	79	87	297

In the table above, it can be seen that gastropods were found at station I, station II, station III and station IV with the highest number compared to other types of macrozoobenthos. There is a total number of macrozooebenthos gastropod species is 253 tails. The second was 17 macrozooebenthos zooplankton, the third was 11 bivalve macrozooebenthos, the fourth was annelid macrozooebenthos, 10, and the fifth was 6 crustacean macrozooebenthos.

The results of the calculation of the community structure of various types of macrozooebenthos found in the observations are presented in the form of the results of the calculation of the diversity index, uniformity index, dominance index and relative abundance index. The identification results can be seen in table 2,which are as follows:

Table 3. Macrozooebenthos Abundance Data Results in the Aek Pala . River

Index	Station I	Station II	Station III	Station IV
Diversity (H')	0.540	0.576	0.704	0.595
Uniformity (e)	0.335	0.358	0.437	0.369
Dominance (C)	0.766	0.753	0.686	0.732
Relative abundance (KR)	31,650	12,458	26,599	29,293

The table above explains that the highest diversity index (H') is at station III amounting to 0.7035, the second is at station IV amounting to 0.595, the third is at station II amounting to 0.576, and the fourth is at station I amounting to 0.540. According to Chaterina Agusta Paulus, (2020), the variation of high and low diversity of macrozooebenthos that if H'=<1, indicates a low population diversity condition, the condition of the community structure and aquatic environment is in a state of stress, then if H'=1-3, it can indicate that the condition of moderate population diversity, the condition of the community structure and the aquatic environment is under pressure and if H'=>3,

According to Lia Hikmatul Maula (2018), high species diversity indicates that a community has high complexity, because in that community there is a high level of species interaction. So in a community that has high species diversity, species interactions will

occur involving energy transfer (food webs), predation, and the division of niches which are theoretically more complex.

Indexuniformity (e) is explained in the table above that the indexthe highest is at station III amounting to0.437, secondare at station IV totaling0.369,The third is at station II totaling0.358,and the fourth is at station I totaling0.335. According to Sandra Devita Kusumaningsari, (2015),indexUniformity will reach its maximum value if the abundance of individuals per species is evenly distributed. The uniformity index value ranges from 0-1, the greater the value, the more uniform the number of individuals obtained. And the smaller the uniformity index, the smaller the uniformity of species or genera in the community, meaning that the distribution of the number of individuals of each species or genera is not much different and the dominance of certain species or genera is very small or there is no dominance.

The dominance index (C) is explained in the table above that the indexthe highest is at station I amounting to0.766, secondare at station II totaling0.753,the third is at station IV amounted to0.732,and the fourth is at station III totaling0.686.According to Lia Hikmatul Maula (2018),the dominance index is between 0-1, if the index is close to 0 it means that the community structure is unstable. This index is used to determine the quality of waters with a large number of species or with high species diversity.

According to Muhammad Yasir, et al (2015), relative abundance is the result of individual abundance of macrozooebenthos from all species at each station. The relative abundance index (KR), explained in the table above that the indexthe highest is at station I amounting to31,650, secondare at station IV totaling29,293,the third is at station III amounting to 26,599,and the fourth is at station II totaling12,458.

IV. Conclusion

The conclusion obtained from this study is the total suspended solids content in the waters of the Aek Pala . riverranged from 105.20 mg/l -135.15 mg/l. The largest value was found at station IV amounting to 135.15 mg/l, while the lowest value was at station II amounting to 105.20 mg/l. There are 5 types of macrozoobenthos found in the Aek Pala river, namely zooplankton, bivalves, annelids, crustaceans and gastropods. The results of the calculation of the community structure of various types of macrozooebenthos were found in the form of calculation results, namely the highest diversity index (H') was at station III amounting to 0.7035, the highest uniformity index (e) was at station III amounting to 0.437, dominance index (C) is the highest at station I amounting to 0.766, andrelative abundance index (KR),the highest is at station I amounting to31,650.

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