Macrozoobentos Diversity As Anbioindicator Of The Water Quality In The Sungai Kualuh Labuhanbatu Utara

Arman Harahap, Paramadi Hrp, Ni Komang Ayu Ratna Dewi

Abstract: Sungai Kualuh is the largest river is of Labuhanbatu Utara North Sumatra Province and is located right in the densely populated urban areas. There are so many community activities that take place such as the Baths, Agriculture, Transfortation and Fisheries. The purpose of this study was to determine the diversity makrozoobentos as an bioindicator of water quality in Rantauprapat blades, as well as determining the quality of the river flow by the blades Rantauprapat physical properties, chemistry and biology has. This study was conducted from Nopember 2018 to Mei 2019, samples taken from five research stations. Decision pointis determined by the method of purposive random sampling. Samples were taken by using amesh surberner and then in the identification in the laboratory Department of Biology, Faculty of Mathematics and Natural Sciences, University of North Sumatra. From the research results obtained makrozoobentos which consisting of 4 grade, 7 orders, 11 families and 12 genera. The high estdensity value is agenus of Neanthes sp 18. 519 individu/m2 found at station 4 and genus of 18.519 individu/m2 sp tubifex were foundatstation 1 while the genus with the lowest density of1.235 sp Pleurocera individu/m 2 found at station 4. The value of diversity index (H') highest makrozoobentos 1 found the station 1at 2.052 and the lowe statstation 5 at 0.965. Person correlation analysis of the results showed that the DO, BOD5, Nitrate, Phosphate, COD, Substrate, Light Penetration, The solubility of oxygen, TSS, and TDS makrozoobentos diversity was positively correlated with pH and temperature while negatively correlated.

Keywords: Makrozoobentos, bioindicator and Sungai Kualuh

1. INTRODUCTION

Inland Water ecosystems can generally be divided into two, namely Lentic Water or also called calm waters, such as lakes, swamps, reservoirs, ponds, and lotic waters (Lotic Water) fast-flowing waters, such as rivers, streams, canals, trenches and so on. The main difference between lotic and lentic waters is in the velocity of water flow. The lentik waters have slow current velocities as well as the rapid accumulation of water masses. The Blade rivers include the waters (Lotic Water) or also called the calm waters [1]. Bilah River is a water that has been used by some sectors such as Sand Mining, agriculture, fishery, transportation and also drinking water source for people in Kanopan area. The existence of various human activities around the River that caused the River Bilah is allegedly contaminated. Bentos as the basic biota of relatively non-migratory waters is the group of biota that suffers most from water pollution. According to Odum [2] that the biotic component can provide an overview of the physical, chemical and biological conditions of a water. One biota that can be used as a biological parameter in determining the condition of a waters is Makrozoobentos. According to [3] the changing quality of a waters greatly affect the life of biota living in the bottom of the waters among them is Makrozoobentos. According to [4] Makrozoobentos is an organism that most or all of its life cycle is at the bottom of the waters, life sessil creep or dig a hole. Makrozoobentos is best used as a bioindicator in a waters because of its relatively fixed habitat of life. Changes in water quality and the substrate of his life greatly affect the abundance and diversity of macrozoobentos. This abundance and diversity is highly dependent on its tolerance and its sensitivity to environmental change.

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The tolerance range of macrozoobenths to the environment varies [5]. Environmental components both living (biotic) and dead (abiotic) affect the abundance and diversity of aquatic biota present in a waters, so that the high abundance of individuals of each species can be used to assess the quality of a water. Good quality waters typically have high species diversity and vice versa in poor or polluted waters [6]. So far, the diversity of Makrozoobentos and the water quality of the BilahRantaup River has not been known. The purpose of this research is to know the physical, chemical and biological properties of Bilah River waters in relation to water quality standard.

2. METHODS

This research was conducted in Water flow of Sungai Kualuh Kota Labuhanbatu Utara Regency of North Sumatra. namely when the River Bilah in a state after the flood. Based on the existing environmental zones 5 different observation stations are assigned. The sampling of macrozoobenthos was done by using Purposive Random Sampling method by determining 5 (five) observation stations. Taking samples of macrozoobentos was performed as much as 9 repetitions at each station. Sampling Station 1 is an area where there is no community activity in the upper reaches of the river, geographically located at 2'06'20.78 "LU 99'49'31" BT. The sampling station 2 is a community bathing and agricultural activity, located in the upper river basin, geographically located at 2'06'29.72 "LU 99'49'.35" BT. Sampling Station 3 is a sand mining site and Rantauprapat community bath, Geographically located at 2'06'22.71 "LU 99'45'49.82" BT. The sampling station 4 water is agricultural activity, Geographically located at 2'06'23.17 "LU 99'49'26.20" BT. The sampling station 5 is a sand mining site and Rantauprapat community bath and is located downstream of the slats, Geographically located at 2'06'22.71 "LU 99'49'34.92" BT. The macrozoobentos samples were taken using a surber mesh and the mesh was placed at the bottom of the river, then the substrate was dredged so that macrozoobentos netted in the mesh of the surber. The

samples obtained were sorted by hand for large samples and floating methods for small samples (which can not be sorted). The sample was cleaned with water and soaked with 4% formaldehyde for 1 day, then washed and dried, the sample was put into a 70% alcohol-filled sample bottle as a preservative, then labeled. Samples were taken to the laboratory to be identified using reference books [7] and [8].
The physical and chemical factors measured in this study are as shown in Table 1.

***Table 1**. FaktorFisik-Kimia Air.*

No	Paramater	Unit	Equipt.
1	Water temp.	^{0}C	Do Meter
2	BOD_5	mg/L	Incubation
3	COD	mg/L	Do Meter
4	Light Intensity	Candela	Do Meter
5	Water pH	-	Do Meter
6	DO	mg/L	Do Meter
7	Nitrate	mg/L	Do Meter
8	Phosphate	mg/L	Spectrophotometer
9	Organic substrate	%	-

3. RESULTS AND DISCUSSION

The macrozoobentos identified in this study consisted of 3 invertebrate phyla: Annelida consisting of 2 classes, Arthropods consisting of 1 class and Molusca consisting of 1 grade, as shown in Table 2.

***Table2.** The type of macrozoobenthos*

No	Phylum	Ordo	Family	Species
1	Annelida	Haplotaxida	Tubificidae	Tubifex sp.
2		Errantia	Serpulidae	Neanthes sp.
3	Arthropoda	Diptera	Chironomidae	Chironomussp.
4		Odonata	Aeshinidae	Boyeriasp.
5			Gomphidae	Gomphussp.
6			Coenagrionidae	Argiasp.
7			Libellulidae	Miathyriasp.
8		Hemiptera	Naucoridae	Pelocorissp.
9				Naucorinaesp.
10		Ephemeroptera	Leptophlebiidae	Paraleptophlebiasp.
11			Pleuroceridae	Pleurocerasp.
12	Moluska	Megastropoda	Pleuroceridae	Goniobasissp.

2..Index of diversity (H')

Based on the data analysis, the value of diversity index (H ') of macrozoobenthos in each station as shown in Table 3 as follow

***Table 3**.Index of Diversity.*

INDEX	STATION				
	1	2	3	4	5
Index of Diversity (H')	2.052	1.632	1.63	1.624	0.965

In Table 3 it can be seen that the value of the diversity index (H ') obtained from the 5 research stations ranges from H' between 2.052-0.965. The highest index value of diversity (H ') is at station 1 that is 2,052. The high index of diversity in station 1 is suspected because the substrate is essentially a soft muddy sand and the presence of rock that supports the life of macrozoobentos. And the absence of community activity that took place at the station 1. According to [12] smooth muddy substrate and rocks are the best habitats for macrozoobenthos to obtain food, shelter from the currents and attach themselves while the gravel substrate with sand is easily carried by water currents making it difficult for macrozoobentos to attach themselves or to settle on the substrate. According to [1] that a community is said to have a high species diversity when there are many species with individual numbers each. The species is relatively evenly distributed. In other words that if a community consists of only a few species with an uneven number of individuals, then the community has a low diversity. The lowest Shannon-Wienner Diversity Index value (H ') is at station 5, which is 0.965. The low value of this diversity index is due to the abundance of the number of Goniobasis sp. thus causing the spread of the number of individuals in each species uneven. According to [2] species diversity is influenced by the distribution or distribution of individuals of each species, because of a community, although many species, but if the individual spread is uneven, the species diversity is low. Based on the Shannon Wiener (H ') Diversity Index of macrozoobenthos at each observed study site, a classification of the degree of environmental pollution can be made. According to [13] the classification of the degree of water pollution based on diversity index can be classified as follows:

H' < 1,0 : Heavily polluted
H' = 1,0-1,6 : Moderately polluted
H' = 1,6-2,0 : Lightly polluted
H' > 2,0 : Not polluted

Based on these groupings along with the data obtained, station 1 belongs to a group of unaffected waters with a diversity index of 2.052, while stations 2, 3, 4 and 5 with its diversity index of 1.632 are included into the mildly polluted group, this is presumably because around the river slats there are many community activities, such as baths, agriculture, and sand mining. so that the waste entering this keperairan tends to be organic pollution material which can ultimately affect the contribution of the index value of macrozoobenthic diversity. In these conditions only Gastropods that have a wide spread range dominate the waters at station 1. Insecta presence suspected these waters have been subjected to pressure or contamination. This is in accordance with the opinion [14] which classifies Insecta in the status of a tolerant organism which is a key indicator in determining the level of pollution in the waters. The value of uniformity shows a real dominance, The Uniform Index (E) value obtained from five research stations ranged from 0.891 to 0.539. The highest uniformity

index is at station 2 of 0.911 and the lowest at station 5 is 0,539. At stations 1, 2, 3, 4 the number of species of each species obtained is always dominant, the whole species does not spread evenly. At station 5 there are a few species and there are dominant species that is Goniobasis sp.

Index ofSimilariy

Based on data analysis, the value of Similarity Index (IS) of macrozoobenthos in each station as shown in Table 4. Similarity Index (IS) values obtained in 5 research stations ranged from 62.5% to 84.21%.

Table 4*.Index of Similarity.*

STATION	1	2	3	4	5
1		77.78 %	66.67%	70.59%	70.59%
2			82.35%	73.68%	84.21%
3				62.5%	62.5%
4					77.78%
5					-

From Table 4 above it can be seen that the similarity index between station 1 and 2 is 77,78%, station 1 and 3 are 66,67%, station 1 and 4 are 70,59%, station 1 and 5 are 70,59% . It can be concluded that the similarity index between station 1 and 5 is quite similar. Then stations 2 and 3 of 82.35%, 2 and 4 of 73.68%, 2 and 5 of 84.21% are quite similar. This is because some of the physical chemical factors of water between the stations are quite similar. Stations 3 and 4 are 62.5%, stations 3 and 5 are 62.5%. And stations 4 and 5 of 77.78% are quite similar. This is because some of the physical chemical factors of water between the stations are similar.

Water Quality Parameters.

Based on research conducted on the five research stations in the rivers waters Rantauprapat obtained the average value of chemical physics factors in Table 5 as follows:

Table5. *The values of water quality parameters.*

No	Parameter	Unit	Station				
			1	2	3	4	5
1	Temperature	°C	23,5	23	24,5	24,5	24
2	DO	mg/l	7,2	7,2	7,1	7,1	6,9
3	BOD_5	mg/l	5	4,4	3,6	3,1	2,9
4	NO_3	Mg/l	2,248	1,164	1,325	0,386	0,762
5	PO_4	Mg/l	0,614	0,473	0,412	0,386	0,258
6	pH	-	7,8	7,8	8	8,1	8,1
7	COD	mg/l	72,12	64,48	68,12	59,02	49,92
8	Substrate	%	8,153	2,317	3,383	5,644	5,017
9	Light Penetration	M	0,15	0,2	0,13	0,13	0,13
10	Saturation of Oxy.	%	86,53	85,91	86,79	86,79	83,63
11	TSS	Mg/l	164	128	142	138	112
12	TDS	Mg/l	46	38	40	40	36

In Table 5 it can be seen that the temperature of the water at the five research stations ranges from 23 - 24,50C. The temperature at the five stations is relatively the same, not fluctuating, because the weather conditions during the temperature measurement are relatively the same, so the temperature does not change. In general the temperature range is a normal range for aquatic life creatures including macrozoobentos. Tropical fluctuations in tropical waters generally throughout the year have relatively low airflow fluctuations that result in fluctuations in water temperatures also not too large [1]. The water temperature values of river waters compared to the criteria of Water Quality Standard I and class II based on Government Regulation Number 82 Year 2011 are still suitable for household, fishery, livestock and agriculture because the water temperature is still within tolerable limits. The value of dissolved oxygen (DO) obtained from five research stations ranged from 6.9-7.2 mg / l, with the highest values being found in stations 1 and 2 of 7.2 mg / l, this is due to lower station temperature and the organic content is too low. the lowest dissolved oxygen value at station 5 was 6.9 mg / l. the low value of dissolved oxygen at stations 1 and 2 indicates that there are many organic compounds and chemical compounds that enter into the aquatic bodies, so that the presence of organic compounds will lead to aquatic processes conducted by microorganisms that will directly aerobically (requires oxygen). According to [15] the entry of organic materials such as food waste causes the increase of microorganisms in water and consume O2 dissolved in water for respiration resulting in decreased levels of O2. Based on Water Quality Standard I and class II according to Government Regulation Number 82 Year 2001 for class I the minimum allowable DO limit is 6 mg / l and for class II the minimum limit is allowed there is 4 mg / l. DO levels at observation stations are greater than DO levels on water quality criteria of class I and class II then these waters deserve to be used as class I and II water. BOD5 values in five research stations ranged from 0.6 to 5 mg / l with the highest values found at station 1 of 5 and the lowest at station 5 of 2.9 mg / l. the difference of BOD5 value in each research station is caused by the amount of different organic material in each station, which is related to the oxygen deficit because the oxygen is used by microorganisms in the process of decomposition of organic matter so that BOD5 value increases. The high value of BOD5 at station 1 is suspected because of the large number of community activities in the upper reaches of Bilah River, thus increasing the organic content in these waters. The low BOD_5 on station 3 is due to the location of this little community activity found at this station. The mean value of nitrate (NO3 ¬-N) in the Raganuprapat river range, ranging from 0.386 to 2.248 mg / l. the highest nitrate value was found at the location of station 1 and lowest at the station location 4. The optimal nitrate content for macrozoobenthic growth was 3.9-15.5 mg / l [10]. The high nitra element at the location of station 1 is allegedly derived from the number of community activities that produce domestic waste and agricultural waste using fertilizers which resulted in increased levels of nitrate in the body of water. High nitrate-containing water is often found close to the farm. its concentration within the waters will increase as it gets closer from the point of disposal (decreasing as far away from the point of discharge caused by microorganism activity). Microorganisms oxidize ammonium into nitrite which eventually becomes nitrate. The lowest nitrate content

obtained at station 4 is suspected because in the river area the blades have water plants and swift currents of water so that nitrate is absorbed by plant roots and drifted into the stream downstream. the nitrate content according to the criteria of Water Quality Class I and II is 10 mg / l while the nitrate content of all research stations is far below the standard set so that the water is suitable for use. The measured phosphate in river blades during the study ranged from 0.258 to 0.614 mg / l. the highest phosphate is found at the location of station 1 while the lowest value is found at station 5. This is due to the entry of wastes entering the water bodies, thus increasing the phosphate value. Phosphorus is mainly derived from sediments which will then infiltrate into ground water and eventually enter into open water systems (aquatic bodies). Moreover it can come from the atmosphere and along with rainfall entering into the water system [1]. Overall, the phosphate content of the measurements in the five observation stations is still below the Standard Water Quality of class I and class II which is allowed to be 0.2 mg / l, thus the waters are suitable for class I and class II. From the data contained in the Table above can be seen the value of pH measurement results in five observation stations ranged between 7.8-8.1. pH values at five different observational stations are different, but there are also the same depending on the conditions of the waters at each research station. The highest pH values were at stations 4 and 5 of 8.1 and the lowest at stations 1 and 2 of 7.8. The pH values obtained from the five research stations still support the life and development of macrozoobenthos. A normal pH value indicates that the amount of dissolved organic material is small. The more amount of dissolved organic matter will cause the pH value to decrease, because the concentration of CO2 is increasing due to microbial activity in decomposing organic matter. The composition of CO2, HCO3-, bicarbonate ions and carbonate, CO32- in water is an effective buffer system and the normal pH contains predominant HC03- and a pH of about 8.3 containing bicarbonate. The maximum degree of acidity (pH) allowed for class I and II water is 6-9, while in the observation station is between 5.7-7.4, thus the waters are still suitable for class I and II water. The mean value of COD river blades in this study ranged from 49.92 to 72.12 mg / l. The highest COD is obtained at station 1 and the lowest at Station 5. Based on the oxidation ability, the determination of COD value is best considered in describing the existence of organic matter, either biologically or decomposed. waters containing high levels of COD, requiring oxygen for chemical oxidation processes, this reduces the oxygen reserves in water. Based on Water Quality Standard I and class II according to Government Regulation Number 82 Year 2001 for Class I, the maximum limit of COD allowed is 10 mg / 1 and grade 11 25 mg / l. thereby the stations 1,2,3,4 and 5 have exceeded the standard value so it is not feasible to be used as class I water but it is suitable for class III. this is caused by the number of community activities such as baths, agriculture, sand mining and waste Palm Oil Factory located in the upper reaches of the river. The value of substrate organic content obtained at five observation stations ranged from 2,317-8,153%. the highest substrate organic content was obtained at station 1 of 8.153%, while the lowest at station 2 was 2.317%. Overall, the value of organic content of substrate obtained from the five research stations in this river river is classified and very high. The basic substrate of a waters is an important factor for the life of macrozoobentos animals as the animal's habitat. Each species has a different tolerance range to the substrate and the organic content of the substrate. The existence of different types of substrate base also causes different types of macrozoobentos obtained in each research station. This is in accordance with the statement [16], that the existence of different substrate causes different fauna or macrozoobenthic community structure. In addition, the differences in the size of sediment particles are related to organic matter content, where waters with fine sediments have a high percentage of organic matter due to the calm environmental conditions that permit sedimentation of sludge followed by the accumulation of aquatic base organic materials, while sediment coarse ones have a lower organic content because finer particles can not settle and the presence of species within a macrozoobenthic community is supported by a high organic content, but it does not necessarily guarantee the abundance of the macrozoobenthos, since the substrate type also determines. From the data contained in Table 4.6 above can be seen that the penetration of light is ranged from 0.2-0.15 m. the highest penetration is at station 2 and the lowest station is at station 1. This is due to various factors such as the presence of high soluble and suspended solids, as well as high organic matter, so that the sun is difficult to penetrate the body of the water. The highest oxygen saturation value from the research result is found in station 3 and 4 that is equal to 86,79% and the lowest is at station 5 equal to 83,63%. This indicates that at Five stations have a smaller oxygen deficit while also providing information that this area has a low level of pollution. From the measurements that have been done can be seen that the value of TSS (Total Suspended Solid) ranged from 112-164mg / l. The highest value of TSS is at station 1 which is 164 mg / l, and the lowest is in station 5 that is 112 mg / l. The high value of TSS at station 1 is caused by rain in the upper stream and various community activities that produce a lot of suspended solids such as organic compounds, clays that do not directly settle causing turbidity at this station. And so are Station 2,3,4 and 5 because of the many activities such as sand and stone dredging, causing high suspended solids in the river of this bar. According to Kep-51 / MENLH / 1995 about the maximum quality standard of TSS of 250 mg / l, it can be concluded that TSS content in all stations is high because it is close to the established standard. Total suspended solid or suspended solids are solids that cause water turbidity, are not dissolved and can not precipitate directly. Suspended solids consist of particles of lesser size and weight than sediments such as certain organic materials, clay and others. For example, surface water contains clays in suspended form. From the measurements that have been done can be seen that the value of TDS (Total Dissolved Solid) ranged between 36-46 mg / l. The highest TDS was found in station 1, which was 36 mg / l and the lowest was in station 5, which was 46 mg / l. Low TDS at station 5 is due to this station there is little community activity that may produce organic compounds that cause turbidity in water bodies as in station 1. According to Government Regulation No. 82 of 2001, that the maximum quality standard of TDS is 1000mg / l, it can be concluded that TDS levels in all stations are good because they are still far below the established standard.

4. CONCLUSION

a. Based on the parameters of physics, chemistry and biology by using storet method according to Water Quality Standard in Station 1, 2, 4 and 5 are included Class 3. So including medium contaminated class.
b. The composition and the total number of macrozoobenthos obtained are all 4 classes: Oligochaeta, Polychaeta, Insecta, and Gastropoda. The highest type of macrozoobenthos composition is Insecta followed by Gastropoda, Oligochaeta and Polychaeta. The types found in rivers river Rantauprapat amounted to 12 species.
c. The value of the macrozoobenthic diversity index (H ') in the five stations ranged from 0.965 to 2.052, indicating that from all research stations belonging to the mildly polluted groups.
d. The values of the Similarity Index (IS) obtained in five research stations ranged from 62.5% -84.21%, and were included in similar conditions.

REFERENCES

[1] Harahap, Arman , 2018, Macrozoobenthos diversity as bioindicator of water quality in the Bilah river, Rantauprapat, Medan. J. Phys.: Conf. Ser. 1116 052026
[2] K.Khairul, R Machrizal, A Harahap,2019. Biological aspects of fish indo pacific tarpon (Megalops cyrinoides Broussonet, 1782) at Belawan River IOP Conference Series: Earth and Environmental Science 348 (1), 012028 vol: | issue : 2019
[3] Purnomo, K. 1989. Struktur & Komunitas Makrozoobentos dalam Kaitan Pemantauan Dampak Aktivitas Manusia di Daerah Sungai Cikao, KabupatenPurwakarta,Jawa Barat.
[4] Barus, T. A , 1996, Metode Ekologi untuk Menilai Kualitas Suatu Perairan Lotik. Program StudiBiologi USU FMIPA – USU, Medan
[5] Marsaulina, L. 1994. KeberadaandanKeanekaragamanMakrozoobentos di Sungai Semayang Kecamatan Sunggal. KaryaTulis. Lembaga Penelitian USU, Medan.
[6] Fachrul, M. F. 2007. Metode Sampling Bioekologi. BumiAksara. Jakarta.
[7] Edmonson, W. T. 1959, Fresh Water Biology, John Willey and Sons. New York.
[8] Pennak, R. W. 1978. Fresh Water Invertebrates of United States. Second Edition. A. Willey Interscience Publ. John Willey and Sons, New York
[9] Koesbiono. 1979. Dasar-dasar Ekologi Umum, Bagian IV (Ekologi Perairan). Sekolah Pasca Sarjana Program Studi Lingkungan. Insitut Pertanian Bogor, Bogor.
[10] Michael, P. 1984. Metode Ekologi untuk Penyelidikan Ladangdan Laboratorium. Universitas Indonesia Press. Jakarta.
[11] Sugiyono. 2005. StatistikuntukPenelitian. Alfabeta. Bandung.
[12] Sahri, A. Budiman, W. Andriyana, N. 2000. Keragaman Makrobethos pada Berbagai Substrt Buatan di Sungai Ciglagah Cilacap, Jurnal Biosfera.
[13] Sastrawijaya, A. T. 2000. Pencemaran Lingkungan. EdisiKedua. RinekaCipta. Jakarta.
[14] Rini, D. A. 2007. Mengenal Makroinvertebrata Bentos. Warta Konservasi Lahan Basah. Hlm. 3. http://onrizal.files.wordpress.com/2008/09/onrizal.wk/6-15-3okt 2007
[15] Mulia, R.M. 2005. KesehatanLingkungan. GrahaIlmu, Yogyakarta.
[16] Nybakken, J. W. 1992. BiologiLaut: SuatuPendekatanEkologis. Gramedia, Jakarta