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THE EFFECTS OF PHYSICAL AND CHEMICAL CHARACTERISTICS, TO THE MACROZOOBENTHOS COMMUNITIES OF BABURA RIVER, MEDAN

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Abstract
This paper reports the identification of macrozoobenthos with physico-chemical factors in Babura River. The measured parameter is the richness of macrozoobenthos based on biotic and abiotic factors both in chemical and physical factors. Macrozoobenthos were taken using a quadrant, a Surber net or Eckman grab in 10 areas, while the chemical and physical were analyzed in BTKL Medan. The classes macrozoobenthos were found classified into 7 classes .are Diptera, Ephemeroptera, Plecoptera, Gastropods, Hirudinae, Oligochaeta, dan Chromadorea., suggesting the chemical and physical factors were able to support the live of macrozoobenthos. Macrozoobenthos were found as many as 397 individuals macrozoobentos consists of 14 species and classified into 7 classes.

Keywords: Identification, macrozoobenthos, physical factor, chemical factor and Babura River.

Introduction. Macrozoobenthos are invertebrate animals that are usually settled at the bottom of the river [1]. The organisms generally live in the bottom of the water and its motion is influenced by the water current. The organisms classified as macrozoobenthos exist in clean, lightly polluted waters to heavy contamination, so that they can be utilized as animal indicators in assessing the condition of the aquatic environments [2]. Macrozoobenthos can be used as biological indicators in determining the quality of waters in a river [3][4]. Macrozoobenthos in the water has important role is biological indicator of the waters [5]. These macro-organisms are relatively easy to be identified and are sensitive to the changes of environment in the waters [6]. These organisms are sessile, so they are often to be exposed by the contaminants that accumulate in the sediment. There are various types of zoo benthos which play role as primary consumers and the others as secondary consumers or consumers who occupy at higher places [7]. Throughout image observation, the macrozoobenthos communities show the change when their habitats are disturbed, suggesting that these animals depend to both chemical and physical factors of the aquatic ecosystem [8]. It has been reported macrozoobenthos play an important role in aquatic ecosystems as primary and secondary consumers and establish trophic relationships, and such role involves in the river characteristics including the density and biomass [2]. The macrozoobenthos community inhabiting locations will experience structural changes because macrozoobenthos are biota that has a close relationship with environmental conditions. [9].

Both physical and chemical factors provide significant roles to the life of macrozoobenthos. Water-river current causes macrozoobenthos to utilize existing food optimally [10], while the increasing of temperature by 10^{o}C affects the increment of metabolic rate by 2-3 times, which causes the reduced solubility of oxygen in aquatic condition. These conditions are caused by the temperatures involving to light intensity, geographical location, shelter, and internal conditions such as turbidity, depth, flow velocity, and organic matter in bottom aquatic. The temperature of the aquatic which is good for the development of aquatic organism lies on 24^{0}C-27^{0}C due to the presence of substrates consisted by mud, sand, clay, sandy clay, and rock which supports the macrozoobenthos to live [11]. Temperature can affect water quality because it can affect the growth of organism in waters. The optimal temperature that suitable for macrozoobenthos ranges from 29 to 40ºC [12] [13]. The structure of the base substrates will determine the abundance and composition of macrozoobenthos species of animals [14][15]. On the other hand, the turbidity is the large number of particles suspended in the aquatic. It can reduce the penetration of sunlight into the water, which is influenced by the angle of incidence of light and the intensity. Some kinds of insect larvae will react to the decrement of light intensity, suggesting the turbidity aquatic conditions macrozoobenthos are less preferred due to the disruption of the respiratory system [16], while the pH of 6.0 to 8.0 of aquatic ecosystems indicates no contaminants suggesting the presence of aquatic organisms [17]. This range of pH shows the amount of gas bound by aquatic molecules that can be produced from the marine organism or water plant photosynthesis naturally, and the DO is dissolved within the waters indicating by the colloidal phase [18]. The solubility of oxygen in aquatic ecosystem is strongly influenced by the temperature and dissolved minerals, which can reach maximally at the temperature of 0°- C° amounted to 14.16 mg / l, so that the Dipteral larvae, Coleopteran, *Cule sp.* larvae and pupae are able to live in low DO because they have open tracheal systems. *Tubifex sp* also can live in conditions of polluted aquatic of organic matter and DO poor surface because they can absorb DO instantly through all parts of the body that dangle into water. The Diversity Index values obtained below 1.0. this is due to dissolved oxygen values below 4 mg / L. so the value of diversity in the waters is low. besides due to the low oxygen concentration values can also be caused by the uneven distribution of macrozoobenthos in the community [19,20].

Biological Oxygen Demand (BOD) represents the amount of oxygen required by aerobic organisms for his activity. High BOD values indicate organic matter content in high aquatic, suggesting the aquatic contains a lot of organic material [15]. Indicators of heavy pollution is characterized by the presence of species of Nails, Chironomus, Tubifex and Erastalis. Species Chironomus Sp can be found in polluted, muddy and bodies of water that are covered by vegetation. Chironomus Sp. is a species can survive in waters that contain high organic matter [21] [3]. The difference in the content of organic matter in the river can be caused by rain or flood, while large flow aquatic causes the organic matter content is low [21]. The levels of BOD suggesting the pollutions occurred within the ecosystem, as lower than 3.0 ppm, 3.0 – 4.9 ppm, and more than 15ppm are not polluted, lightly polluted and heavily polluted respectively. According [22], agricultural organic waste contributes to the degradation of high macrozoobenthos. Excessive levels of nitrogen compounds in aquatic may also cause pollutions. The high nitrogen content can be affected by domestic sewage, industrial agriculture, live stock, and agricultural use of fertilizer nitrate/nitrogen around the water shed of agricultural land. Nitrate is deadly toxic to the aquatic organisms. On the other hand, the amount of phosphorus content contained in the aquatic is generally no more than 0.1 mg/l, except in waters that receive waste from house holds and certain industries, as well as from agricultural areas that received phosphate fertilizer. Aquatic containing with the range high levels to exceed of phosphate based on the normal requirements of aquatic organisms will cause eutrophication [36][37].

This research aims to, to determine the factors associated with the presence of macrozoobenthos, physical (temperature, water current, TDS), chemical (pH, DO, BOD) factors in Babura River, so that types of macrozoobenthos can be identified regard to aquatic condition. This research is necessary to monitor the quality of environment. On the center side of Babura River, the variety of macrozoobenthos is different with the upstream and the downstream [38][39].

Research Method. The presence of macrozoobenthos in the Babura River is influenced by physical factors and aquatic chemical factors. The research was conducted at 10 areas: (1) upstream (forest) in the village of Keci-Keci Bingkawang Sibolangit, (2) the village of Durin Pitu closed canopy plants, (3) sand mining in Simalingkar B, (4) banana plantation area in Simalingkar B, (5) in Tebing Ganjang Namurambe, (6) residence of the Royal Sumatra, (7) in the Sluice Kwala Bekala (settlement), (8) local market in Padang Bulan, (9) crossing the Sudirman Park, and (10) confluence Deli and Babura in Petisah Municipality of Medan. Sampling using a quadrant five times at each station, so that the data obtained was more accurate. This research is expos de facto, only disclose data obtained and are already available in the field (field research) [40][41].

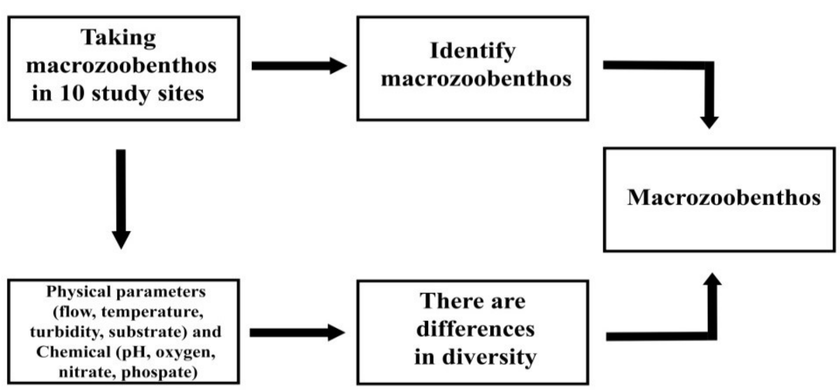

Figure 1. Roadmap of research

Research Procedures

Physical parameters were based on water currents, temperature, and aquatic based substrates. The turbidity, DO, BOD, phosphate, and nitrate were analyzed in the Environmental Health and Engineering Center for Disease Control (BTKLPP) [42].

Water Sampling

Dark bottles of 1.5 l were put inside the water. The opening of the bottle was placed to the direction of water flows, so that when the water flows into the bottles fully, their openings were closed inside the bottles, which contained samples. And these samples were collected to be analyzed in the BTKL [43].

Macrozoobenthos samples were taken by using Surber nets/Eckman Grab [23,25] as much as 5 times at each area. Substrate rocks mixed with the filtered macrozoobenthos were placed on the multilevel filter (filter diameter of 0.5 x 0.5 mm and 1.0x1.0mm. These samples were put in a different collection of bottles and alcohol 70%, identified with books of [24,26].

The Description of the research

The existences of macrozoobenthos were found in the river Babura based on physical and chemical parameters, which only reveal and expose the data already available in the field [44].

Results. Macrozoobenthos were found as many as 397 individuals macrozoobentos consists of 14 species and classified into 7 classes (Table 1). The classes macrozoobenthos were found classified into 7 classes .are Diptera, Ephemeroptera, Plecoptera, Gastropods, Hirudinae, Oligochaeta, dan Chromadorea. According to [25] the classes macrobenthos were found classified into 7 classes are Bivalvia, Polychaeta, Oligochaeta, Cruetacea, and Gastropoda. According to [26] has reported that, macrozoobenthos found in Babura river are *Chironomus sp, Eristalis sp, Simulium sp, Tabanus sp, Wriggler sp, Ephemerella sp, Baetis sp, Amnicolidae sp, Haemopsis Anthoca sp, Acroneura sp, and Achromadora sp*.

Table 1. Types of Macrozoobenthos found in The Babura River [45].

Class	Order	Family	Genus	Species
Diptera	Nemathocera	Chironomidae	Chironomus	*Chironomus sp*
		Culicidae	Wriggler	*Wriggler sp*
	Brachycera	Syrphidae	Eristalis	*Eristalis sp*
		Simulidae	Simulium	*Simulium sp*
		Tabanidae	Tabanus	*Tabanus sp*
		Tipulidae	Anthoca	*Anthoca sp*
Ephemeroptera		Ephemeridae	Ephemerella	*Ephemerella sp*
		Baetidae	Baetis	*Baetis sp*
Plecoptera		Perlidae	Acroneuria	*Acroneuria sp*
Gastropods	Mesogastropoda	Amnicolidae	Akiyoshia	*Amnicolidae sp*

		Pleuroceridae	Pleurocera	*Pleurocera sp*
Hirudinae		Haem idae	Haemopi	*Haemopsis sp*
Oligochaeta	Haplotaxida	Tubificidae	Tubifex	*Tubifex sp*
Chromadorea	Chromadorida	Chromadoroidea	Chromadoria	*Chromadoria sp*

Babura River is more in the form of larvae, namely 9 (species the classes are diptera, ephemeroptera, and plecoptera) of 14 species found. This shows that place is suitable for the life of the larvae.

Table 2. Numbers of Individuals Macrozoobenthos Found.

No	Species	Area										Total
		I	II	III	IV	V	VI	VII	VIII	IX	X	
1	*Chironomus sp*	-	-	2	6	4	5	13	4	2	2	38
2	*Eristalis sp*	-	-	2	1	2	4	4	-	2	-	15
3	*Simulium sp*	-	-	3	4	2	2	2	-	2	-	15
4	*Tabanus sp*	-	-	-	-	-	-	2	-	-	-	2
5	*Wriggler sp*	-	-	-	-	-	62	38	9	29	4	142
6	*Ephemerella sp*	-	-	-	-	-	2	-	2	-	-	4
7	*Baetis sp*	6	3	-	-	-	7	-	2	-	2	20
8	*Amnicolidae sp*	-	-	-	-	-	2	-	4	-	-	6
9	*Haemopsis sp*	-	-	-	8	4	-	-	-	-	-	12
10	*Pleurocera sp*	-	-	-	2	2	-	-	-	-	-	4
11	*Tubifex sp*	-	-	4	7	3	-	24	27	9	8	82
12	*Anthoca sp*	-	-	-	-	-	-	7	-	-	2	9
13	*Acroneuria sp*	4	5	3	-	-	-	-	-	-	2	14
14	*Achromadora sp*	-	-	-	-	-	-	7	20	7	-	34
	Total	10	8	14	28	17	84	97	68	51	20	**397**

Based on the results, macrozoobenthos which were consisted of 3 species belongs to three classes i.e. Gastropods, Oligochaeta, and Insects [31]. Macrozoobenthos in Suhuyon River consisted of 3 Phylum, 4 Classes, 10 orders, 21 Families and 22 Genus [27/33].

According to Table 2, the dominant macrozoobentos found in the waters of the Babura River were the Diptera class, especially *Wriggler sp*. According [28] the presence of Tubifex at station 3 is an indicator of pollution of organic matter because this species is very tolerant of low dissolved oxygen content and high suspended particles in the river.

Table 3. The Frequency of attendance and richness of each species at all sampling stations

No	Species	Frequency (%)	Richness (ind/m2)
1	*Chironomus sp*	80	3.7

2	*Eristalis sp*	60	1.5
3	*Simulium sp*	60	1.5
4	*Tabanus sp*	10	0.2
5	*Wriggler sp*	50	14.2
6	*Ephemerella sp*	20	0.4
7	*Baetis sp*	20	2.0
8	*Amnicolidae sp*	20	0.6
9	*Haemopsis sp*	20	1.2
10	*Pleurocera sp*	20	0.4
11	*Tubifex sp*	70	8.1
12	*Anthoca sp*	20	0.9
13	*Acroneuria sp*	40	1.4
14	*Achromadora sp*	30	3.4

Based on table 3 the frequency of attendance of *Chironomus sp* includes the frequency of the presence of absolute, *Tubifex sp* , *Eristalis sp*, *Simulum sp*, and *Wriggler sp* including the frequency of being present, *Acreneuria sp* and *Achromadora sp* including the frequency of attendance is rare, *Ephemerella sp*, *Baetis sp*, *Amnicolidae sp*, *Haemopsis sp*, *Pleurocera sp*, dan *Antocha sp*, dan *Tabanus sp* including frequency is very rare,. The frequency of the presence of each species is not the same becauce the habitat of each species is different, as well as the physics and chemical factors that affect it. The frequency difference for each species is influenced by physical and chemical factors of the water, where species that have a high frequency of presence indicate that the environment is gastropda habitat [34]. Chironomidae is a moderate to severe polluted water indicator [35].

The presence of one species in many stations did not determine its abundance, the highet abundance was *Wriggler sp* occupying 5 research stations, secondly *Tubifex sp* with 7 research stations, third *Chironomus sp* occupying 8 research stations, fourth *Achromadora sp* occupying 3 research stations, and the most the lowest is *Tabanus sp* by occupying 1 research stations. According to [29] that Phylum Annelida was least dominant during the study with 5 genera. In class Oligochaeta genera Lumbriculus and Tubifex were present at 15 stations out of 18 with 118 and 129 individuals.

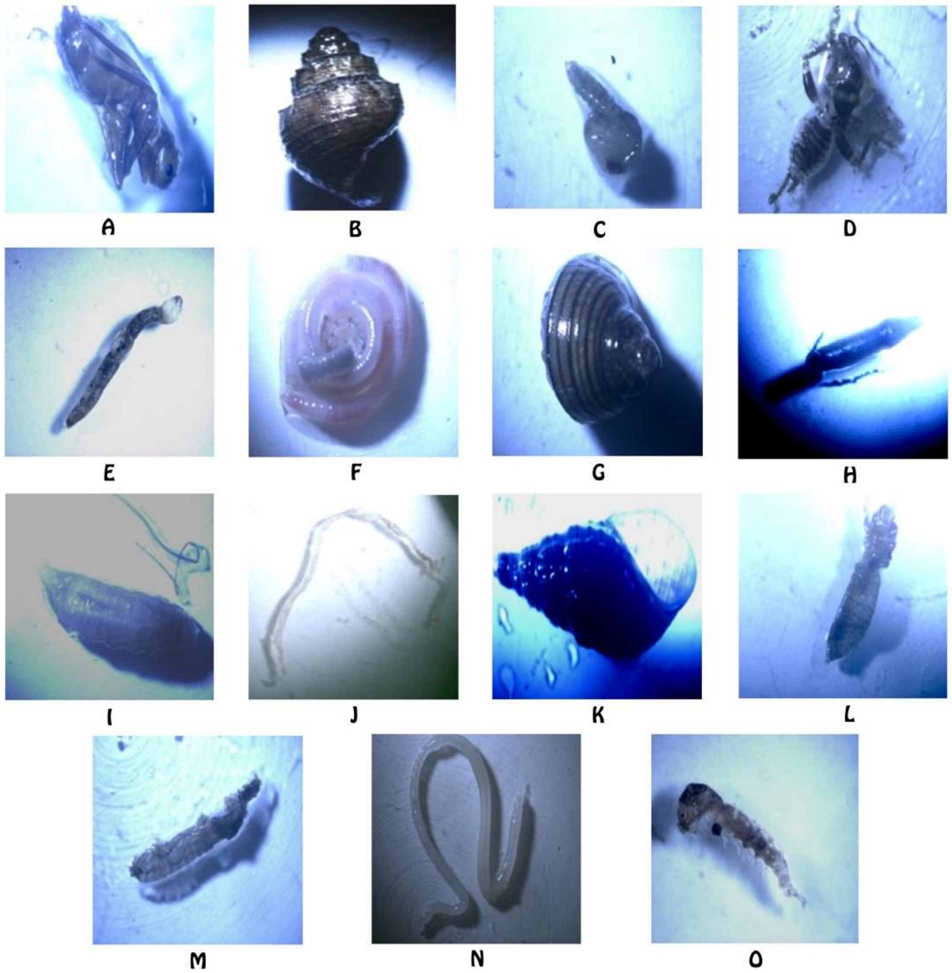

Figure 2. The photographic images of macrozoobenthos found in Babura River (A) *Acroneuria sp*; (B) *Amnicolidae sp*; (C) *Anthoca sp*; (D) *Baetis sp*; (E) *Chironomus sp*; (F) *Chromadoria sp*; (G) *Compeloma sp*; (H) *Ephemerella sp*; (I) *Eriatalis sp*; (J) *Haemopsis sp*; (K) *Pleucera sp*; (L) *Simulium sp*; (M) *Tabanus sp*; (N) *Tubifex sp*; (O) *Wriggler sp.*

Babura watershed has an area of ± 4921.88 ha. The upstream is a forest area as water recharge areas in the Deli Serdang district to the down stream in Petisah Medan. In terms of physical potential, most of the areas in Medan City have a potential resource both from surface aquatic and ground water. Babura River is part of the Deli River crossing the municipal societies along Medan city (discharge area). Areas 1 and 2 of Babura River are naturally flows, while areas 3 to 5 are across the area of agriculture, plantation, and people settlement. Mean while, areas 6 to 10 are a cross the area dense settlement, so that the waste that goes into the aquatic bodies in accordance with the watershed. Macrozoobenthos in area 3 to 10 are more diverse than at areas 1 and 2.

In area I, two species of macrozoobenthos were found. This may occur because the water body covered with a canopy of trees that block the sunlight, so that the water temperature accounted for

18^0C. Based on the physical factors, the ideal temperature for aquatic organisms are in the range of 24^0C-27^0C [11]. The BOD loadings obtained indicated the waters in areas have not been contaminated. As for the area III, IV, and V, species that can survive in polluted conditions were found namely *Chironomus sp, Eristalis sp, Simulum sp, Haemopsis sp, Pleurocera sp,* and *Tubifex sp*, and these findings are in accordance based on the several reports [17].

The physical observations in the research area are, at area I and II substrate rocks with a little sand, at area III and IV sandy bit rocky, while V and VI area a little muddy sand stone. And the area VII to X is almost the same substrates of sandy clay and muddy.

Table 4. The results of measurement of physical and chemical parameters in Babura river

No	Parameter	Unit	Station									
			I	II	III	IV	V	VI	VII	VIII	IX	X
Physical												
1.	Temperature	ºC	18	22	27	28	25,5	26	28	26	26	24
2.	Current flow	m/s	1,80	3,20	3,00	2,80	2,60	5,8	6,6	7,8	6,0	6,3
3.	Light Intensities	Lux	506	545	659	783	632	560	1400	1060	960	320
4.	Turbidity	mg/l	0,80	2,65	15,55	5,20	5,80	13,19	15,87	14,86	13,17	10,37
5	TDS	mg/l	99	108	358	202	225	260	361	280	270	240
Chemical												
1.	pH	-	6,93	6,54	5,75	4,90	4,89	6,65	5,60	5,44	5,52	5,05
2.	DO	mg/l	8,14	7,44	7,32	7,13	7,04	0,45	1,66	1,51	1,59	0,93
3.	BOD	mg/l	0,6	4,8	5,2	5,0	6,6	4,4	3,4	4,5	5,8	7,9
4	Nitrate	mg/l	0,7	0,2	3,4	2,7	2,3	0,9	0,4	0,5	0,3	3,8
5	Phosphate	mg/l	0,28	0,29	2,0	1,0	0,6	1,71	1,66	1,51	1,59	0,58

Based on the BOD value in area II, VI, VII, and VIII, these areas were polluted waters classified as mild contaminations. Area III, IV, V, and IX, and X were classified as contaminated area although macrozoobenthos were found as these were relatively polluted [35]. Area VI to X of the substrate are essentially muddy and sandy, but bivalves were not found, it may happen because of many factors including the cliff/ steep wall of river bodies, a lightly heavy water flow, and a lot of trash bins.

PH value obtained from that in the area I, II, and VI have pH range were decent for the life of the organisms while at area III, IV, V, VII, VIII, IX, and X pH value were not proper for the life aquatic organisms, because pH range which can support zoo benthos life is in the range of 5-9 [17]. At the area V to X oxygen content were low, yet macrozoobenthos as *Chironomus sp* and *Tubifex sp*, where both species can live in polluted water conditions and poor in organic matter dissolved oxygen were found.

The phosphate contents in Babura River were high because Babura some watersheds are agricultural areas, which at present contain agricultural fertilizer. Nevertheless, the eutrophication is not presence in these areas. Phosphate content found in waters is generally not more than 0.1 mg/l, except in waters that receive waste from certain households and industries, as well as from agricultural areas that receive phosphate fertilization. Therefore, waters containing a high level of phosphate that exceeds the normal requirements of aquatic organisms will cause eutrophication. However, even though the phosphate value exceeds 0.1 mg/l, eutrophication does not occur, possibly influenced by other factors

Conclusions. Based on the results of the study it can be concluded as follows Macrozoobenthos are found 14 species in 7 classes. The classes macrozoobenthos were found classified are Diptera, Ephemeroptera, Plecoptera, Gastropods, Hirudinae, Oligochaeta, dan Chromadorea. Chemical and physical factors found in the Babura River support the river ecosystems for macrozoobenthos properly.

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