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Macrozoobenthos Diversity As Bioindicator of Water Quality in The Namu Sira-Sira River, Durian Lingga Village, Langkat Regency, North Sumatra

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Abstract

Macrozoobenthos plays a role in biomonitoring of waters, because they tend to live in the bottom sediment of the waters. The purpose of this study was to determine the Diversity of Macrozoobenthos as a Bioindicator of Water Quality in the Namu Sira-Sira River, Durian Lingga Village, Langkat Regency, North Sumatra. Sampling was carried out at three stations. Station 1 (Upstream), Station 2 (Bathing Tourism), and Station 3 (Downstream). This research method uses purposive sampling. Sampling of macrozoobenthos at the bottom of the waters using a surber net measuring 30 x 30 cm. The parameters of this study include diversity index, dominance, density, uniformity, EPT and FBI. The results showed that the macrozoobenthos found in the Namu Sira-Sira River consisted of 7 orders from 18 families and 23 species. The Macrozoobenthos Diversity Index (H') in the Namu Sira-sira River at 3 stations ranged from 1.42-1.60 (moderate diversity category), the evenness level (E) ranged from 0.72-0.81 (quite even) and the Dominance index 0.14 - 0.21 (no dominant species). The water quality in the Namu Sira-sira River with a value of 3.97 - 4.57 (good). Environmental factors are one of the factors that influence macrozoobenthos diversity

Keywords: *Diversity; Macrozoobenthos; Namu Sira-sira river; Water quality*

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INTRODUCTION

The Namu Sira-sira river is a flow from the Bingai River which is located on the Plantation road, Durian Lingga, Sei Bingai, Belinteng Langkat Regency, North Sumatra. The geographical location of the Namu Sira-sira area is in the range of 3' 31' N and 98' 27' E. The Namu Sira-sira River is used by the community as a tourist attraction and agricultural irrigation channel. The Namu Sira-sira River is a lotic ecosystem, which is flowing water with rocky and sandy physical conditions.

Dimenta et al., (2020) state that The rocks and sand are home for river organisms such as benthos and periphytons.

Based on their size, benthos are grouped into three, namely microbenthos, meiobenthos and macrobenthos. Microbenthos are made up of microscopic benthic organisms that are small in size less than 0.1 mm. Meiobenthos is made up of small benthic organisms that are less than 1 mm in size but larger than 0.1 mm in size and Macrobenthos is made up of larger benthic organisms, visible to the naked eye, larger than about 1 mm. Macrozoobenthos are benthos animals that are larger than 1 mm in size and can be seen with the naked eye (Desmawati *et al.,* 2019).

Macrozoobenthos is one of the aquatic organisms that settle on the bottom of the water, which has relatively slow movement and can respond to river water quality conditions (Fadilla *et al.,* 2021). The quality of the water and the substrate in which it lives greatly affects the diversity of macrozoobenthos. This diversity is highly dependent on its tolerance and sensitivity to the surrounding environment. The large amount of pollutants can have an effect on aquatic organisms, especially on macrozoobenthos, which kills certain species (Bai'un *et al.,* 2021).

One of the parts of macrozoobenthos comes from the orders Ephemeroptera, Plecoptera and Trichoptera (EPT). Ephemeroptera, Plecoptera and Trichoptera are the most sensitive orders of insects to environmental changes in a water, so they are often used as indicators of water quality (Diantari, 2018). According to Widhiandari (2021) stated that macrozoobenthos play a role in biomonitoring of a water, because its life tends to settle in the sediments of the bottom of the waters, both soft substrates and hard substrates. Polluted waters will affect the life of macarozoobenthos, because this organism is one of the river biota that is easily affected by the presence of pollutants.

From the observations that have been made in the Namu Sira-sira river, it is known that the river is used as a tourist area by the surrounding community which results in the disturbance of the habitat of river biota, especially the diversity of macrozoobenthos. So the author is interested in conducting research on the Namu Sira-sira River with macrozoobenthos bioindicators to determine the quality of the waters.

METHOD

Time and Place of Research

The research was carried out in October – November 2023 along the Namu Sira–Sira river in Langkat Regency which is divided into 3 research stations, namely station 1 is located on Lubuk Mas beach, it is still natural, not used as a tourist attraction, located at 30 26.1' U – 980 28.8' E, station 2 is located in the bathhouse tourist area located at 30 26.1' N – 980 29.1' E, station 3 is at the DAM located at 30 26.4' N – 980 29.1' E. Identification and testing of physique parameters was carried out at PT. Shafera Enviro Pancur Batu Laboratory, Medan Tuntungan subdistrict.

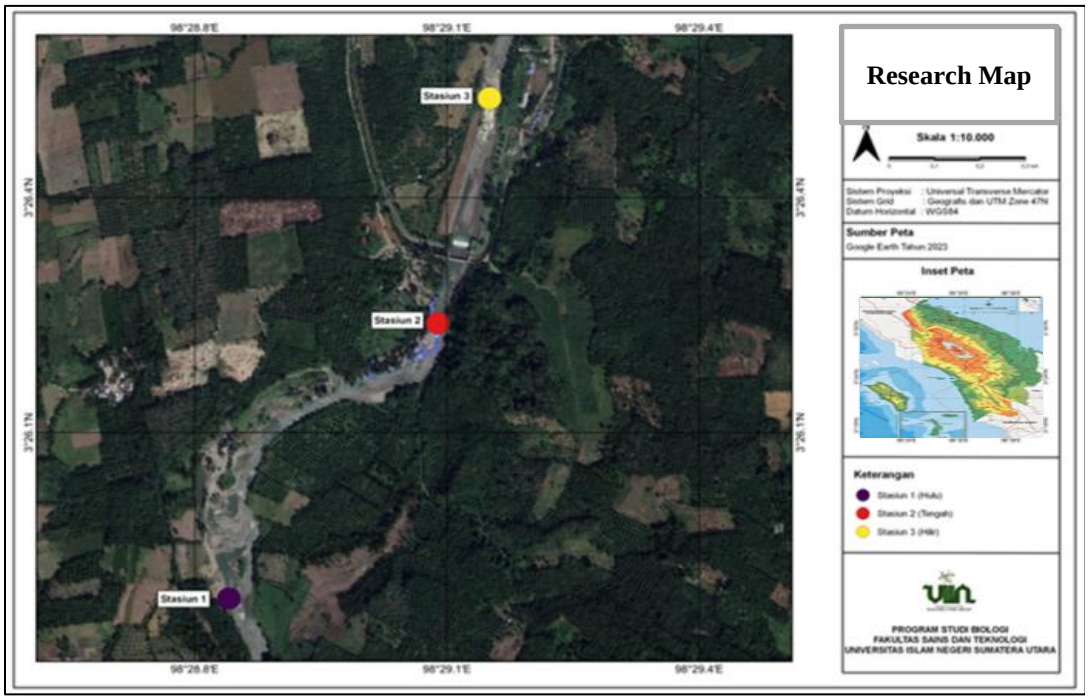

Figure 1. Map of sampling locations

Tools and Materials

The tools used in this study are *Surber net* 30x30, thermometer, pH meter, stereo microscope, water sample bottle, plastic bag, tray, sample bottle, label paper, coolbox, stationery, marker, turbidimeter, digital camera and Makrozoobenthos identification book. The materials used in this study are water samples measured based on physical and chemical parameters, 70% alcohol, substrate samples (rocks, sand, twigs) and Macrozoobenthos as biological parameters identified as bioindicators of water quality.

Research Procedure

The implementation in the field includes sampling carried out at 3 stations with 3 repetitions at each station. Macrozoobenthos sampling was carried out with a square net (surber net) measuring 30 x 30 cm. The square position is placed on the surface of the river in a way that is opposite the water current so that Macrozoobenthos organisms can be accommodated in the net. The surber net is placed at the bottom of the water with a depth of 10-20 cm for approximately 5 minutes. The substrate that enters the mesh is sorted and then rinsed on a plastic tray and taken macrozoobenthos that stick to the substrate. After that, the surber net is lifted and the macrozoobenthos carried in the net are placed in a plastic tray to then be transferred into plastic that has been labeled based on the station point and given alcohol (70% solution) to preserve the macrozoobenthos to be identified. Then measurements of aquatic physicochemical factors such as pH, DO, BOD, and Temperature measurements are carried out.

The implementation in the laboratory includes the results of sorting macrozoobenthos into sample bottles labeled stations, sampling time, and repeats, then preserved with alcohol (70% solution). It was then observed with a streo microscope and identified macrozoobenthos starting from the order-family-genus level with reference to Borror et al., (1976) and Nickle (1984) book.

Data Analysis

Diversity Index Calculation

The *Diversity Index* shows the level of individual dispersal in a station or sample ecosystem according to its criteria calculated based on the Shanon Wiener index. If the value of H >3 indicates a high level of diversity, and 1< H< 3 indicates moderate diversity, and H < 1 indicates a low diversity value (Rahmasari et al., 2015).

$$H' = - \sum_{i=1}^{n} Pi \; In \; Pi$$

Information:
H' = Diversity index.
Pi = ni/N (number of individuals of a species / total number of individuals of all species).
Ni = the number of individuals of each species.
N = total number of individuals of all types.

Dominance Index

The Dominance Index can take into account the stability of the community structure, so that the existence of ecological pressure for biota in a sample area can be known. The biota community is said to be stable if the dominance index is close to 0, and it is known that there is a dominant population if the dominance index results are close to 1 (Lutfiana, 2022).

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

Information:
C = Simpsons Dominance Index
Ni = Number of Individuals per type (number of individuals per species)
N = Total number of individuals (sum of all individuals of each species)

Density Index

One of the functions of the density index is to find out water quality indicators that can also be affected by food sources, water pH, temperature, and water salinity. The density index is determined by the data of the number of individuals in each plot to then be calculated based on the formula (Putri et al., 2021).

$$\bar{x} = \sum [\,] \frac{Xn}{n}$$

Information:
$\bar{x}$ = Density index
XN = number of species
n = number of plots or sampling.

Uniformity Index

The diversity of species in an ecosystem can be known based on the uniformity index, so that the smaller the value, the different the distribution of individuals of each species, in other words there is a tendency to dominate one of its types (Febrian et al., 2022).

$$E = = \frac{H'}{H'max} \frac{H'}{In\ s}$$

Information:
E = Uniformity Index
H' = Shannon – Wiener Diversity Index
Hmax = Ln s
S = Number of species

Ephemeroptera, Plecoptera and Trichoptera (EPT) Index

The calculation of the EPT Index will describe the state of the polluted status of an area or not, so the calculation is often used to determine concrete steps to improve water quality (Singkam et al., 2022).

$$\text{Isignal} = \frac{\sum ti}{n}$$

FBI Index (Biotic Family Index)

The calculation of the FBI value is carried out to determine biomonitoring by indicating whether a water is polluted by organic matter at the family level (Rokhmah et al., 2020).

$$\text{FBI} = \frac{\sum xiti}{N}$$

Information:
Xi = Number of individuals in the 1st family
Ti = 1st family tolerance value
N = Total number of organisms in the sample

RESULTS AND DISCUSSION

Species of Macrozoobenthos in the Namu Sira-Sira River

Based on the results of research that has been carried out at 3 (three) stations in the Namu Sira-sira River, the types of macrozoobentos can be seen in the following table 1.

Table 1. Types of Macrozoobenthos Macrozoobentos in the Namu Sira-sira River

Class	Ordo	Family	Species	Station			Total
				1	2	3	
Insecta	Ephemersoptera	Baetidae	*Heterocloeon* sp.	19	0	0	19
			Baetis sp.	78	40	43	161
		Amelitidae	*Ameletus* sp.	21	16	2	39
		Heptageniidae	*Heptagenia* sp.	1	1	3	5
			Leucrocuta sp.	4	0	0	4
		Ephemerellidae	*Ephemerella* sp.	33	1	3	37
	Plecoptera	Perlidae	*Neoperla* sp.	27	7	11	45
	Trichoptera	Lepidosmatidae	*Lepidostoma* sp.	2	0	0	2

Class	Ordo	Family	Species	Station			Total
				1	2	3	
		Hydropsychidae	*Hydropsyche* sp.	30	4	1	35
			Cheumatopsyche sp.	3	0	4	7
		Philopotamidae	*Chimarra* sp.	5	0	2	7
	Coleoptera	Elmidae	*Optioservus* sp.	40	0	1	41
			Stenelmis sp.	2	0	2	4
			Macronychus sp.	0	2	0	2
		Gyrinidae	*Gyrinus* sp.	3	0	0	3
		Psephenidae	*Psephenus* sp.	1	1	0	2
	Diptera	Simuliidae	*Simulium* sp.	185	0	6	191
		Chironomidae	*Chironomus* sp.	96	6	23	126
		Limoniidae	*Hexatoma* sp.	1	2	0	3
		Culicidae	*Culex* sp.	4	3	0	7
		Athericidae	*Atherix* sp.	1	0	0	1
	Odonata	Gomphidae	*Ophiogomphus* sp.	3	0	1	4
	Megaloptera	Corydalidae	*Corydalus* sp.	0	0	2	2
		Total		**559**	**84**	**104**	**747**

In table 1, it can be seen that macrozoobentos are found from the insect class with 7 orders from 18 families and 23 types. The order with the most families comes from the order Diptera with a total of 5 families. The order Diptera has extensive environmental adaptations, making it easier for it to live in all types of aquatic habitats compared to other orders of aquatic insects. According to Kawirian et al., (2020) stated that Diptera was found to be abundant because this order has the ability to process organic matter and can tolerate low dissolved oxygen, high salinity conditions, and can survive in hot spring conditions. The orders with the least number of families are Plecoptera, Odonata and Megaloptera where each order has only 1 family. All three orders were found in clean research sites and devoid of human activity. Riniatsih et al., (2018) stated the impact of activities by human activities on land that cause increased sedimentation and the entry of pollutants in waters.

The family with the most types comes from the Elmidae family with a total of 3 types. This is because the Elmidae family has morphological and physiological adaptations that make them live in various types of aquatic habitats ranging from rivers with strong currents to calm currents. The family with the least number of species is from the family Corydalidae. This family lives in very specific habitats. Usually in clean, high-oxygen waters and with strong currents. And not all waters have suitable conditions to support the life of this family because in the Namu Sira-Sira River the current speed is moderate and this is one of the factors that make this family have few types.

The high and low number of species and families between stations is certainly

closely related to various environmental factors, one of which is the physico-chemical conditions of the waters and habitats that affect the presence of macrozoobentos.

The existence of this order of aquatic insects is commonly found in healthy river ecosystems. A healthy river ecosystem can support a very diverse population of aquatic insects. The more different species are found, the healthier the ecosystem is. Some of the species found in healthy ecosystems are dragonflies (Ephemeroptera), rock flies (Plecoptera), cadis flies (Trichoptera), dragonfly nymphs (Odonata) and other types of insects from the fly group (diptera) and water beetles (Coleoptera).

Station 1 is a station with no activity, so the condition of this habitat is still relatively natural. The station also has a substrate that is very supportive for the presence of various types of macrozoobentos and is characterized by moderate currents that are ideal for the insect class or aquatic insects. Meanwhile, at station 2 (bathing tour) which is a tourist area, it is suspected that there has been a habitat disturbance that affects macrozoobentos and is a factor that affects the presence of macrozoobentos. At station 3, there was an increase in the number of species and families, allegedly because the disturbance factor had begun to decrease. However, the habitat structure is less supportive because the location consists of many large boulders and the depth of the river is not ideal for aquatic insects that prefer shallow habitats.

Diversity (H'), Uniformity (E) and Dominance (D) Index

Based on the results of the study, the calculation of the macrozobenthos community by looking for the Diversity Index and the Uniformity and Dominance Index at each research station can be seen in table 2.

Table 2. Diversity Index (H') and Uniformity Index (E) and Dominance (D) values at each research station

Index	Stasiun		
	1	2	3
H’	1,96	1,42	1,60
E	0,81	0,72	0,76
D	0,14	0,21	0,15

Based on Table 2, it is known that the value of the macrozoobentos diversity index in the Namu Sira Sira River at the three stations ranges from 1.60 - 1.96 which means that the macrozoobentos in the river are classified as a moderate level of diversity. Station 1 (H' = 1.96) , Station 2 (H' = 1.42) Station 3 (H' = 1.60). According to Insafitri (2010), the diversity index (H') can be interpreted as a systematic depiction that depicts the structure of the community and can facilitate the process of analyzing information about the types and numbers of organisms. At station 1, the number of macrozoobentos species was found to be more diverse than at stations 2 and 3, but the diversity index value still showed a medium diversity category. This is due to the many types of macrozoobentos found but not accompanied by an even number of each type. Insafitri (2009) statement the diversity of biota in a body of water is highly dependent on the number of species in its community. The more species found, the greater the diversity, although this value is highly dependent on the number of individuals of each

species. A large and even number of individuals will increase the value of the diversity index. Because of this, the value of the diversity index between stations is not much different.

Based on the value of the diversity index at each station, which is calculated based on the Shannon-Wiener formulation, it can be assessed that the water quality of the Namu Sira-sira River is moderately polluted. Heavily polluted water, H' < value 1. If the value is around 1 < H' < 3), then the waters are moderately polluted. Then the category of clean waters from pollution with a value of H' > 3. Therefore, through the Diversity Index in this study, it indicates that the Namu Sira-sira River at all research stations is moderately polluted.

The evenness index at each Namu Sira-sira river station ranged from 0.72 -0.81. The highest evenness index value is found at station 1 (0.81) and the lowest is station 2 (0.72), as well as station 3 has an evenness index that is not much different (0.76). A high evenness index value (close to 1) indicates that the condition of the species present is relatively stable (Baderan et al., 2021). A Dominance Index close to 1 indicates that the presence of certain types of macrozoobentos is dominant in the community. The Dominance Index between stations in this study has a value of 0.14 – 0.21, which means that there is no type of macrozoobentos that dominates at each research station.

Density, Relative Density and Frequency of Macrozoobenthos Presence

Based on the results of the research, the calculation of the macrozobenthos community was carried out by looking for the value of Density, Relative Density, and Frequency of Macrozoobentos Presence can be seen in table 3. Based on the table 3, it can be seen that the Density (K), Relative Density (KR) and Frequency of Presence (FR) at each station vary. At Station 1, the largest density value is found in the genus Simulium (family: Simulidaae) as much as 685 ind/m^2, Relative density 33.1 % and Frequency of attendance 100%. The abundance of this type is due to several factors such as habitat conditions and seasons. Station 1 is a location located in the upper reaches of the free river. activity, this location has a current with a fairly heavy and clear flow. Where *Simulium* sp. Pre-adult sp likes a very distinctive breeding ground in the form of clear water with a strong stream. This species is, according to some reports, a species whose distribution varies spatially in response to various environmental factors such as flow size, depth of flow temperature, rainfall. In addition, the seasons also have an influence on density *Simulium* sp. especially in November to December where the population *Simulium* sp. abundant in fresh waters (Ya'cob *et al*., 2016).

At Station 2, the highest density is found in the genus *Baetis* SP as much as 149 ind/m2, with a relative density of 47% and a frequency of 100%. Although Station 2 is a location where there are water ecotourism activities, such as baths, and various tourist visitor activities that can cause changes in the conditions of the aquatic environment and the natural habitat of macrozobenthos. *Baetis* sp. found in abundance at this location because there are many substrates in the form of aquatic macrophytes in the rocks. *Baetis* sp. is a taxa that is often found in high densities associated with plant substrates, such as aquatic microalgae, macrophytes, and marginal vegetation. However, when viewed as a whole, other taxa at this station are not abundant and have the lowest diversity (see in Table 3).

Table 3. Values of Density, Relative Density, and Frequency of Presence of Macrozoobentos

	Species	Station 1			Station 2			Station 3		
		K (Ind/m 2)	**KR (%)**	**FK (%)**	**K (Ind/m 2)**	**KR (%)**	**FK (%)**	**K (Ind/m 2)**	**KR (%)**	**FK (%)**
1.	*Heterocloeon* sp.	70	3,4	33,3	-	-	-	-	-	-
2.	*Baetis* sp.	288	14,0	33,3	148	47,6	100,0	159	41,4	100,0
3.	*Ameletus* sp.	77	3,8	66,7	59	19,0	66,7	7	1,9	33,3
4.	*Heptagenia* sp.	3	0,2	33,3	3	1,2	33,3	11	2,9	33,3
5.	*Leucrocuta* sp.	14	0,7	33,3	-	-	-	-	-	-
6.	*Ephemerella* sp.	122	5,9	66,7	3	1,2	33,3	11	2,9	33,3
7.	*Neoperla* sp.	100	4,8	66,7	25	8,3	100,0	40	10,6	100,0
8.	*Lepidostoma* sp.	7	0,4	33,3	-	-	-	-	-	-
9.	*Hydropsyche* sp.	111	5,4	33,3	14	4,8	66,7	3	1,0	33,3
10.	*Cheumatopstce* sp.	11	0,5	33,3	-	-	-	14	3,8	66,7
11.	*Chimarra* sp.	18	0,9	33,3	-	-	-	7	1,9	33,3
12.	*Optioservus* sp.	148	7,2	66,7	-	-	-	3	1,0	33,3
13.	*Stenelmis* sp.	7	0,4	33,3	-	-	-	7	1,9	66,7
14.	*Macronychus* sp.	-	-	-	7	2,4	33,3	-	-	-
15.	*Gyrinus* sp.	11	0,5	33,3	-	-	-	-	-	-
16.	*Psephenus* sp.	3	0,2	33,3	3	1,2	33,3	-	-	-
17.	*Simulium* sp.	685	33,1	100,0	-	-	-	22	5,8	33,3
18.	*Chironomus* sp.	355	17,2	100,0	25	8,3	100,0	85	22,1	100,0
19.	*Hexatoma* sp.	3	0,2	33,3	7	2,4	66,7	-	-	-
20.	*Culex* sp.	14	0,7	33,3	11	3,6	66,7	-	-	-
21.	*Atherix* sp.	3	0,2	33,3	-	-	-	-	-	-
22.	*Ophiogomphus* sp.	11	0,5	66,7	-	-	-	3	1,0	33,3
23.	*Corydaulus* sp.	-	-	33,3	-	-	-	7	1,9	33,3
		2070	**100**		**311**	**100**		**385**	**100,0**	-

This can be caused by a lack of habitat type. High levels of wealth are often attributed to the apparent heterogeneity of habitats in such bodies of water because heterogeneous conditions can favor species with different ecological preferences. Several studies have shown that the spatial heterogeneity of the riverbed is a major factor that regulates the taxonomic richness of aquatic insects in rivers. At station 3, the highest density is also found in the genus *Baetis* sp. as much as 149 ind/m2, with a relative density of 41% and a frequency of 100%. There is an increase in the number of taxa at this station, this is due to a more heterogeneous habitat.

Biotic Family Index (FBI)

Based on the results of the study, the calculation of the Biotic Family Index, which is the method used to pollute a water using macrozobenthos bioindicators, is found in table 4.

Table 4. Macrozoobentos Family Biological Index

No	Family	Tolerance Value (ti)	ST 1		ST2		ST3	
			Number of Species(Ni)	de*ni	Number of Species(Ni)	de*ni	Number of Species(Ni)	de*ni
1.	Baetidae	5	97	485	56	280	43	215
2.	Ameletidae	0	21	0	16	0	2	0
3.	Heptagenidae	4	5	20	1	4	3	12
4.	Ephemerellidae	1	33	33	1	1	3	3
5.	Perlidae	2	27	54	7	14	11	22
6.	Lepidostomatidae	1	2	2	0	0	0	0
7	Hydropsychidae	4	33	132	4	16	5	20
8.	Philopotamidae	3	5	15	2	6	2	6
9.	Elmidae	4	46	184	0	0	3	12
10.	Gryrinidae	4	185	740	1	4	0	0
11.	Psephenidae	4	1	4	0	0	0	0
12.	Simulidae	6	185	1110	0	0	6	36
13.	Chironomidae	6	96	576	7	42	23	138
14.	Tipuliidae	3	1	3	2	6	0	0
15.	Culicidae	8	4	32	3	24	0	0
16	Athericidaae	4	1	4	0	0	0	0
17.	Gomphidae	3	3	9	0	0	1	3
18.	Corydalidae	4	0	0	0	0	2	8
	Total Amount		745	3403	100	397	104	475
	FBI index			**4,57**		**3,97**		**4,57**

Based on the table 4, it can be seen that the FBI (*Family Biotic Index*) value shows that the index value is not too different between stations. The value of the family index

ranges from 3.97 - 4.57. The value of this index is a category that shows that the water quality in the Namu Sira-sira river at all stations is still in good to very good condition, with a slight degree of pollution to some organic pollution. The biotic index is an index that can evaluate water quality through the aquatic biota family, which in this study is seen through the macrozoobentos family.

In general, the presence of Macrozoobentos, a type of aquatic insect such as EPT, is a type that gives an indication that the environmental condition of river waters is still relatively good. EPT is a group of aquatic insects that are very sensitive and sensitive to pollutants that cause environmental changes in waters, because this group of organisms is part of their life cycle in waters so that the presence of pollutants affects their presence at each research station.

River Water Quality Assessment using EPT

Based on the results of the study, a River Water Quality Assessment using EPT was carried out in table 5.

Table 5. Water Quality Using EPT

Class	Ordo	Species	Number of types
Insekta	Ephemeroptera	*Heterocloeon* sp. *Baetis* sp. *Ameletus* sp. *Heptagenia* sp. *Leucrocuta* sp. *Ephemerella* sp.	6
	Plecoptera	*Neoperla* sp.	1
	Trichoptera	*Lepidostoma* sp. *Hydropsyche* sp. *Cheumatopsyche* sp. *Chimarra* sp.	4
Total Amount	**3**		**11**
EPT			**3,7**

Based on the table 5, the value of the macrozoobenthos EPT index is 3.7. The value of this index is a category that shows that the water quality criteria in the Namu Sira-sira river are in moderate disturbance. Where the criteria for water conditions based on EPT metrics are > 10 undisturbed, 6-10 mild disturbances, 2-5 moderate disturbances and 0-1 severe disturbances.

There are three aquatic insects that are sensitive to pollution, namely Ephemeroptera, Plecoptera and Trichoptera or commonly known as EPT. The EPT value is an ecological indicator used to assess water quality. The EPT value in the Namu Sira-Sira River is classified as moderate disturbance due to environmental factors such as tourist activities. Tourist activities that can affect water quality disturbances include bathing, using shampoo in the river, using diterjen and throwing food waste in the river.

Physic-Chemical Factors of Waters

The value of aquatic physico-chemical factors at each research station can be seen in Table 6. Water quality measurements with chemical-physical parameters carried out in this study include temperature, pH, BOD, DO, current velocity, and substrate type. The pH and temperature values at all stations are not much different, where Station 1 (Upstream/Lubuk Mas Beach) is worth 6.93, Station 2 (Bath Tour) is worth 6.64 and Station 3 (Downstream/Dam) is worth 6.81. pH values ranging from 6.31-7.90 are normal and still tolerable for macrozoobentos life in nature. The temperature between stations ranged from 25-26^{oC,} where the temperature ranged from 25 to 30°C was a suitable temperature for the growth of macrozoobentos (Rotvit & Jacobsen, 2013).

Table 6. Measurement Value of Physical and Chemical Factors of Water Quality in the Namu Sira-Sira River

No.	Parameter	Unit	Station 1 (Upstream-Lubuk Mas Beach)	Station 2 (Bath Tour)	Station 3 (Downstream-Dam)
Chemistry					
1.	pH	-	6,93	6,64	6,81
2.	Temperature	℃	25, 7	25	26
Physics					
3.	BOD (*Biologycal Oxygen Demand*)	(mg/L)	0,2	0,2	0,2
4.	DO (*Dissolve Oxygen*) (mg/L)	(mg/L)	6,7	7,2	7,1
5.	Current Speed	(m/s)	0,23	0,40	0,26
6.	Substrate type	-	sandy stone	sandy stone	sandy stone

The DO value ranged from 6.7 - 7.1 mg/L, the DO (*Dissolve Oxygen)* range from 5 to 7.1 mg/L was a value that was still within the limits of normal conditions that supported the life of macrozoobentos. The BOD (*Biological Oxygen Demand*) value is the same for each station, i.e., 0.2 mg/L. Based on PP RI No. 22 of 2021, the value obtained is still relatively good and still within the standard threshold of water quality and supports the existence of Macrozoobentos in aquatic ecosystems. The higher the BOD value in a water indicates that the concentration of organic matter is also getting higher. The level of pollution is still low if the BOD value is 0-10 mg/L, while the level of pollution is moderate if the BOD value is 10-20 mg/L (Salmin, 2005). The current velocity ranges from 0.23-0.40 m/s. The river flow speed is included in the category of medium flow river (0.25 –0.50 m/s) and for the substrate type for all stations are rock and sand. Substrates are one of the factors that greatly affect the life, development and diversity of macrozoobenthos.

CONCLUSION

The Macrozoobenthos found in the Namu Sira-Sira river consists of 23 genera from 18 Families and 7 orders, consisting of the orders Ephemeroptera, Pllecoptera, Trichoptera, Coleoptera, Diptera, Odonata and Megaloptera. The Macrozoobentos Diversity Index (H') in the Namu Sira-Sira River at 3 stations ranges from 1.42 - 1.60 which is included in the category of moderate diversity, with the level of evenness (E) ranging from 0.72 - 0.81 which is included in quite evenly with a Dominance index value of 0.14 – 0.21 which means that there is no dominant type at each station. The water quality in the Namu Sira-sira river based on *the Family Biotic Index* (FBI) with a value of 3.97 - 4.57 is still in the good category.

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