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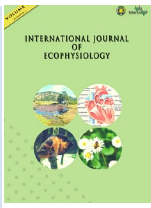

The Diversity of Fish in The Aek Sibundong District Dolok Sanggul Regency Humbang Hasundutan

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Abstract. The diversity of fishes in Aek Sibundong, Dolok Sanggul regency, Humbang Hasundutan district, was conducted from April to October2018. The aim of this research was to analyze variety of fishes and their physical-chemical factors related to fishesin Aek Sibundong. This research used purposive sampling method on four location based on human activities. The first location was stationed with no activities, the second location tofu waste disposal station, the third location was slaughter house station and last location was belonge to sand dredging station. Sampling used nets as trap for the fishes. Seven species of fishes had been found from the sites where classified into 3 order (spesies from ordo Cypriniformes 4, Perciformes 1 and Siluriformes 2). The result showed that station 1 had the highest fish density was 0,59 ind/m2 belong to Tor tambroides and the highest fish diversity index at 1,318. The temperature, light intensity, light penetration, phosphate, and Biochemical Oxygen Demand (BOD_5) had strongly correlated with fish diversity in the waters of the Aek Sibundong.

Keyword: Aeksibundong, diversity, fish, physical-chemical factors

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1. Introduction

The river is a form of aquatic ecosystem that has an important role in the hydrological cycle and functions as a water catchment area for the surrounding area, so that the condition of a river is strongly influenced by the characteristics possessed by the environment. Rivers have components and interact with each other to form an ecosystem that influences each other. River ecosystem components will integrate with each other to form an energy flow that supports the stability of the ecosystem [1]. Rivers are one of the important freshwater areas, according to [2] river is an

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ecosystem that has a very complex diversity of organisms, there are many aquatic plants, vertebrate animals that have adapted to certain habitats.

Aek Sibundong is one of the rivers that flows in Humbang Hasundutan district in Dolok Sanggul District and is the estuary or meeting place of a number of small rivers in Dolok Sanggul including urban drainage. Aek Sibundong is used by the surrounding community for activities such as washing, sand dredging and waste disposal and as a result of community activities along the Aek Sibundong river either directly or indirectly can result in the presence of an organism in the waters of Aek Sibundong. Human activities will affect the amount of waste that enters Aek Sibundong. According to [3] waste which can be regarded as garbage has the potential to pollute the aquatic environment. The impact of waste disposal, the most important sense is aquatic organisms (biological component). Rivers as a type of living medium for aquatic organisms are often unavoidable from the problem of decreasing water quality as a result of the development of human activities, such as industrial activities that stand around watersheds.The development of human activities will affect the life of organisms in the waters, one of the aquatic organisms is fish. The presence of fish in a waters is influenced by water physico-chemical factors.

According to [4], certain fish will avoid water conditions that experience environmental changes that interfere with their lives. However, fish also have a limited ability to choose areas that are safe for their lives, depending on the nature and levels of pollutants or toxicity of a waters. Knowledge of the diversity of fish species in a waters is very necessary because from time to time it undergoes changes, especially in the Aek Sibundong aquatic ecosystem which gets a lot of ecological pressure from various human activities. Therefore, it is necessary to do research on fish diversity and analyze the relationship of diversity to the physical-chemical factors of the waters in Aek Sibundong as an effort to support the interests of preserving fish species and as one of the initial information for the community in the area about the types of fish found in Aek Sibundong.

2. Research Methods

2.1. Time and Location of Research

The research was conducted from July-August 2018 in Aek Sibundong, Dolok Sanggul District, Humbang Hasundutan Regency, North Sumatra. Fish were identified at the Natural Resources and Environmental Management Laboratory, Department of Biology, Faculty of Mathematics and Natural Sciences, University of North Sumatra.

2.2 Area Description

2.2.1 Station 1 research location

This station is an activity-free area located in Matiti Village, the base substrate at this location is in the form of rocks and sand geographically located at 2º 15'23" N LU and 98º 44' 45" BT as in Figure 1.

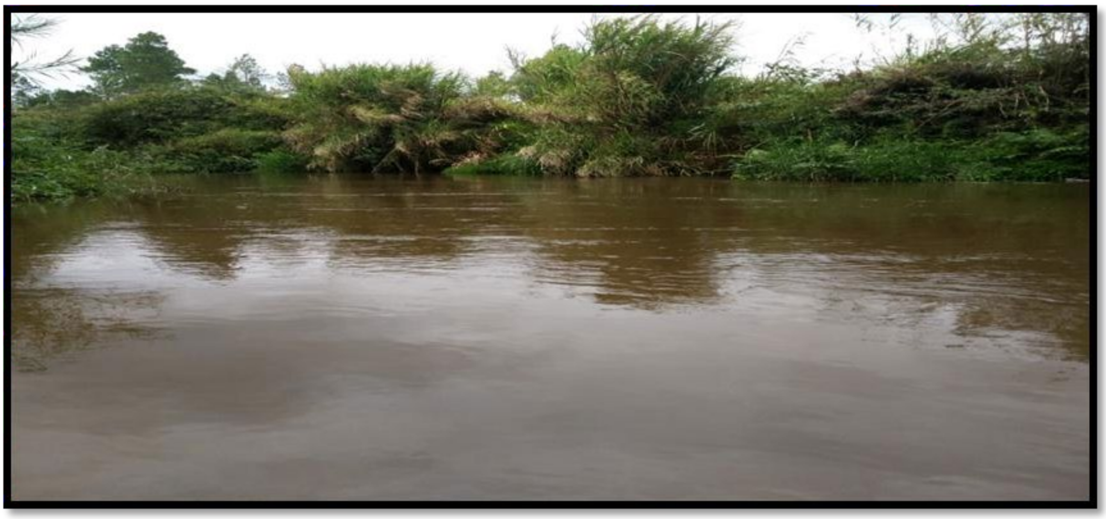

Figure 1 Research location at Station 1

2.2.2 Station 2 research location

This station is a tofu waste disposal area located in Desa Sihite, the base substrate at this geographically muddy location is located 2º 15'24" N LU and 98º 44' 90" BT as in Figure 2.

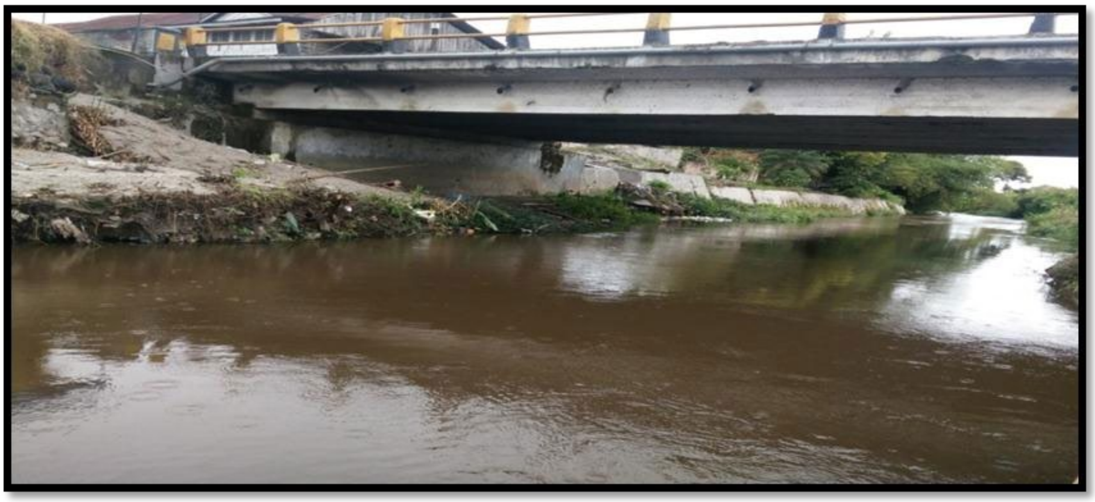

Figure 2 Research location at Station 2

2.2.3 Station 3 research location

This station is a waste disposal area of slaughterhouses, located in The Village of Aek Lung, the basic substrate at this location is geographically muddy located at 2º 13'50" N LU and 98º 46' 34" BT as in Figure 3.

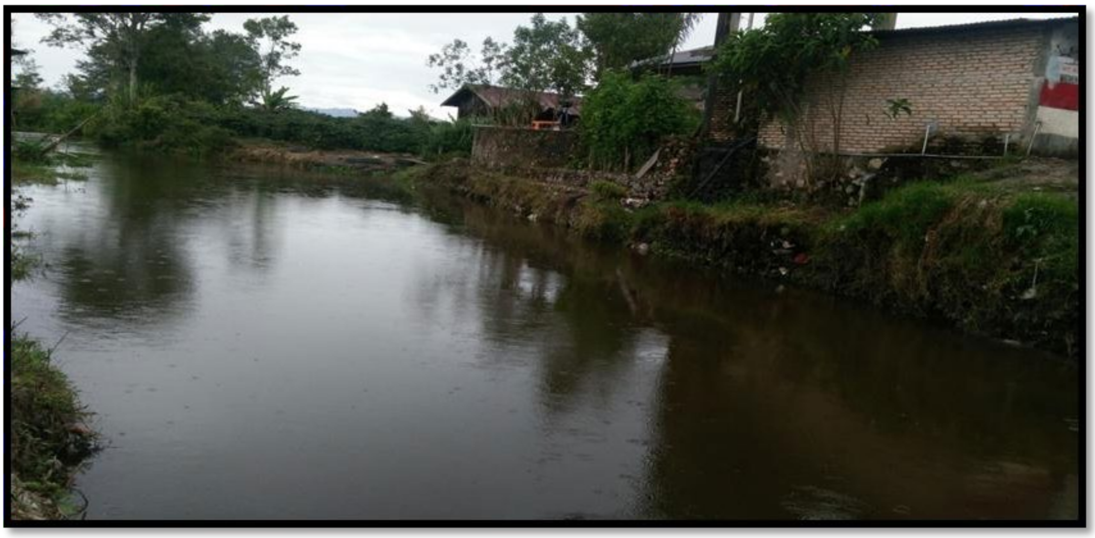

Figure 3 Research location at Station 3

2.2.4 Station 4 research location

This station is a sand-dredging area located in the village of Lumban Purba, the basic subsrat at this location rocks and sandy geographically trletak at 2º 13 ' 36 ' LU and 46º54 ' 98 ' BT as in Figure 4.

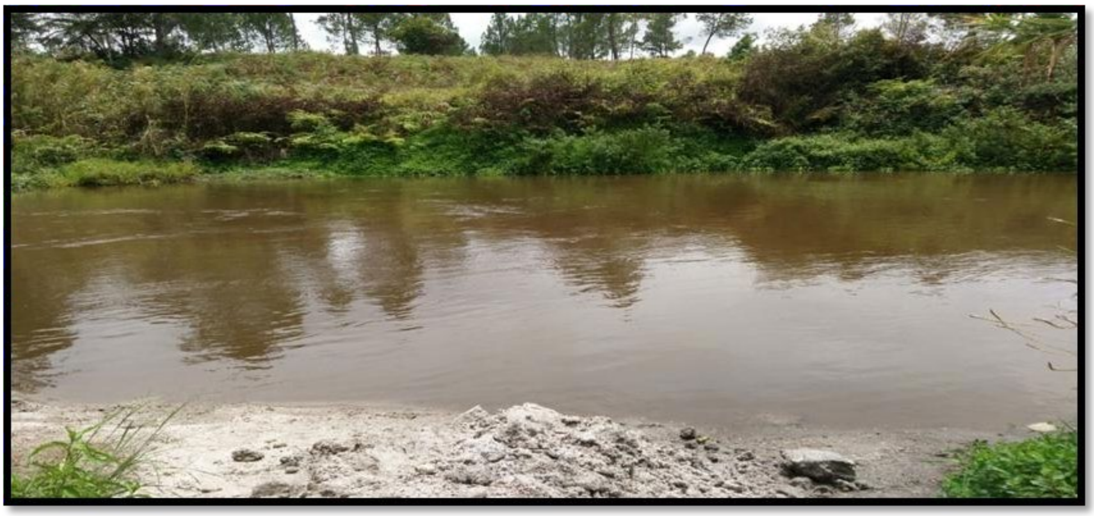

Figure 4 Research location at Station 4

2.3. Fish Sampling

The sampling location is determined based on the Purpose Sampling method by determining 4 research stations. Each station is determined based on the activities contained in Aek Sibundong. Fish sampling is carried out in conjunction with measurements of the physical-chemical of the waters. How to sample fish is done by spreading nets with an area of 12.56 m^2 and a net eye size of 1.5 cm 40 repeats at each station. The fish samples obtained are calculated in length and then measured in length using a ruler, weighed by digital scales and put in a plastic jar measuring 5 kg and preserved using 70% alcohol then taken to the laboratory to be identified using [5].

2.4. Measurement of the Chemical Physical Properties of Waters

2.4.1. Temperature

Temperature measurements are done using a thermometer with a scale of 0 to 100°C. The thermometer is inserted into the body of water and leaves it for a while and then reads the thermometer scale and records the results listed on the thermometer scale.

2.4.2. Light intensity

The lux meter is placed at the research site after it is first turned on and sets the lux meter at an magnification of 200,000, then records the value listed on the screen.

2.4.3 Penetration of light

Measurement of light penetration is done using pieces of sechii, the way with pieces of sechii is put into river water until the piece of sechii is not visible then measured the length of the rope.

2.4.4 Dissolved oxygen (DO)

Measurement of dissolved oxygen is done using the Winkler method, which is a sample of water inserted into a Winkler bottle, then adds 1 ml of $MnSO_4$ and KOH-KI respectively to the bottle and is homogenized. The sample is silenced briefly until a white deposit is formed, then added 1 ml of H_2SO_4, homogeneous and silenced until brown deposits are formed. The sample is taken 100 ml and put into the erlenmeyer and then titrated with $Na_2S_2O_3$ 0.0125 N to pale yellow, then the sample drips with 5 drops of amylase and is homogeneous until a blue solution is formed. Then the sample was titrated using $Na_2S_2O_3$ 0.0125 N until the discoloration became apparent. The volume of $Na_2S_2O_3$ 0.0125 N used is calculated and the result is recorded.

2.4.5 Degrees of acidity (pH)

The measurement of the pH of water is done using a pH meter. Previously calibrated pH to pH = 7. Then the pH meter is put into the water and then reads the values and records the results listed on the pH meter scale.

2.4.6 Speed of River Current

The speed of the current is measured using a pimpong ball inserted into the body of water along with turning on the stopwatch until it reaches a distance of 10 m. Then the stopwatch is turned off and the time is recorded.

2.4.7 Biochemical Oxygen Demand (BOD_5)

The BOD_5 measurement was taken after the water sample taken was inc incusted for 5 days, then measured using a DO meter, then recorded the listed value. The BOD_5 value is obtained from the results of the initial DO measurement with the final DO after the incubation period of 5 days.

2.4.8. Oxygen saturation

Oxygen saturation value (%) can be calculated using formula As follows:

$$\textbf{Oxygen saturation} = \frac{O2\,[u]}{O2[t]} x100\ \% \qquad (1)$$

Information

$O_2[U]$: Measured oxygen concentration value (mg/l)

$O_2[t]$: The concentration value corresponds to the temperature.

2.4.9 Nitrate levels (NO_3)

Water samples were taken as much as 5 ml, then added 1 ml of NaCl with volume pipette and added 5 ml H_2SO_4 75% then added 4 drops of Brucine Sulfate Sulfanic Acid. The solution formed is heated for 25 minutes. Then the solution is cooled and then measured with a spectrophotometer at $\lambda = 410$ nm. Then the values listed on the spectrophotometer.

2.4.10 Posfat Level (PO_4)

A sample of water is taken as much as 5 ml and then added 1 ml of armstrong reagent and 1 ml of ascorbic acid. The solution is left for 20 minutes, then measured with a spectrophotometer at $\lambda = 880$ nm. Then the values listed on the spectrophotometer.

2.5. Data Analysis

The fish data were analyzed by calculating population density, relative density, frequency of attendance, Shannon Wiener diversity index, uniformity index and equality index formula [6,7].:

2.5.1. Population Density (D)

$$D = \frac{Number\ of\ individuals\ of\ a\ type}{Number\ of\ sample\ units} \qquad (2)$$

2.5.2. Relative Density (RD)

$$RD = \frac{The\ density\ of\ a\ type}{Total\ density\ of\ all\ types} x100\ \% \qquad (3)$$

If kr >10% then a habitat is said to be suitable and suitable for the development of an oeganism [8]

2.5.3. Attendance Frequency (AF)

$$AF = \frac{The\ number\ of\ sample\ plots\ occupied\ by\ a\ species}{The\ total\ number\ of\ sample\ units} x100\ \%$$

(4)

Information :

0-25% = the constancy is very rare

25-50% = the constancy is rare

50% -75% = frequent constants

> 75% = the constancy is very frequent

2.5.4. Shannon Wiener Diversity Index (diversity)

$$H' = \sum_{=} pi \ln pi \quad (5)$$

Information :

H′ = diversity index Shannon Wiener

Pi = proportion of species to i in community (ni / N)

In* = *logaritme nature

0 < H' < 2,302 = Low Diversity

2,302< H' 6,907 = Moderate Diversity

H' > 6,907 = High Diversity

2.5.5. Equitability Index (Uniformity)

$$E = \frac{H'}{H\ Max} \quad \textbf{(6)}$$

E = Equitability Index

H max = ln S (S = number of genera).

2.5.6 Correlation analysis

Correlation analysis is used to determine environmental factors that correlate with the value of fish diversity. Correlation analysis is calculated using Pearson Correlation Analysis with the computerized method SPSS Ver.22

Information:

0.00-0.199 : Very low

0.20-0.399 : Low

0.40-0.599 : Medium

0.60-0.799 : Strong

0.80-1.00: Very strong

3. Result and Discussion

3.1. Biotic Environment

3.1.1 Types of fish

From the research that has been done on the Aek Sibundong, obtained 7 types of fish as seen in Table 1 below.

Table 1.Types of Fish obtained at a research station on the Aek Sibundong

No.	Class	Ordo	Family	Species	Station			
					1	2	3	4
1	Actynopterygi	*Cypriniformes*	*Cyprinidae*	*Cyprinus carpio*	-	-	-	+
				Puntius binotatus	+	+	+	+
				Rasbora sumatrana	+	-	-	-
				Tor tambroides	+	-	-	-
		Siluriformes	*Bagridae*	*Mystus nemurus*	-	-	-	+
			Clariidae	*Clarias tjesmani*	-	+	+	-
2	Osteichtyes	*Perciformes*	*Cichlidae*	*Oreochromis niloticus*	+	+	+	+
		Total			4	3	3	4

Information : : + Found - : Not found

Table 4.1 shows that the types of fish obtained from the four research stations consist of 3 orders of 5 families and 7 species of fish. The most common types of fish in the family cyprinidae which number 4 types, this is because the family cyprinidae has a wide variety of species and is able to adapt to changes in environmental conditions. According to [9] Cyprinidae is the largest family of freshwater fish, consisting of 220 genera and 2,420 species. The number of species from the family Cyprinidae demonstrates the ability of this family to adapt and multiply rapidly. *Clarias tjesmani* and *Puntius binotatusa* are the types of fish found at every research station because the physical-chemical condition of the waters supports the growth and development of these fish.

Clarias is a species that adapts easily to its environment and has a high survival, this species tends to like mud-substrat water. *Clarias tjesmani* is a species that has additional breath organs that allow it to live in an environment lacking oxygen and outside the water so that its habitat is on a muddy substrate, flooded and shallow water so that it can move even though there is no running water [5]. Puntius binotatus can be found in various types of waters and conditions of chemical physics parameters of different waters living in the freshwater waters of the tropics with a pH range of 6.0-7.5 and water temperatures of 24-26º C and have a lifestyle of eating all kinds of food in the waters [10]

Description of fish:

1. ***Puntius binotatus*** **(Kaperas fish)**

Round and flat body shape, superior mouth type, cycloid scale type, homocercal tail type silvery gray body color. This fish has a total length: 9- 13.4 cm; standard length: 6.9-8.1 cm; head length: 1.5-,2.3 cm; height: 2.3-3.5 cm; tail length: 2.2-4.3 cm; mouth opening width: 0.5- 1.3 cm.

Figure 5 *Puntius binotatus*

2. ***Tor tambroides*** **(Jurung Fish)**

Slender and flat body shape, inferior mouth type, cycloid scale type, homocercal tail type white body color of belly fins. This fish has a total length of 8- 10.53cm; standard length 6.2-8; head length 2-2.5cm; tail length 2.3cm-3; height 3.5 cm-4cm.

Figure 6 *Tor tambroides*

3. *Cyripnus carpio* (Golden fish)

The body shape of the fish is elongated and slightly flattened sideways, terminal mouth type, cycloid scale type, homocercal tail type, reddish yellow fish body color. This fish has a total length: 11-24.7 cm; standard length: 9.2-20 cm; head length: 2.8-4.9 cm; height: 4.2-10.8 cm; tail length: 4.2-6.7 cm; width of mouth opening: 2.2- 4.8 cm.

Figure 7 *Cyripnus carpio*

4. *Rasbora sumatrana* (Seluang Fish)

The body shape of the fish is small and slender terminal mouth type, stenoid scale type, homocercal tail type, silvery black body color.the tip of the tail is brownish color has nountah at the end of the tail. This fish has a total length: 9-20.5, cm; standard length: 7.9-15 cm; head length: 2.3-4.5, cm; height: 2.2- 8.8 cm; tail length: 2.5-5.7 cm; width of mouth opening: 0.1- 09 cm.

Figure 8 *Rasbora sumatrana*

5. *Oreochromis niloticus* (Ikan nila)

The body shape of the fish is flat, the body is covered with brownish scales, terminal mouth type, stenoid scale type, heterocercal tail type. It has an upright line of upright black color on the tail fin and reddish-colored tail fin and several stripes of color bands on the body. This fish has a total length: 10-16.7 cm; standard length: 6-12.2 cm; head length: 1.5-2.1 cm; height: 3-4 cm; tail length: 0.8-1.5 cm; width of mouth opening: 0.5- 1 cm.

Figure 9 *Oreochromis niloticus*

6. *Mystus nemurus* (Baung Fish)

Body shapeanguiliform, inferior mouth type, homocercal tail type, flat flat head of slightly flattened body and elongated black and slippery. The body of the fish is covered by thick petals on the jaws there are 3-4 pairs of long touch breech, short dorsal fins, have a pair of patils and have additional dorsal fins or fat fins. The tail fin is alert and is not related to the dorsal fin or anal fin. The anal fin is short and the pectoral fin has very strong hard fingers and jagged. This fish has a total length: 9.2-13.3 cm; standard length: 5-9 cm; head length: 1.5-2.4 cm; height: 2.1-3.5 cm; tail length: 1.6-2.7 cm; width of mouth opening: 1.2-2.2 cm.

Figure 10 *Mystus nemurus*

7. *Clarias tjesmani* (Catfish)

The body shape of the fish is slightly flattened, slippery, elongated and has a kind of long mustache, sticking out from around the mouth. Anal fin, tail fin and pungung fin do not come together. This fish has a total length: 12.5-16.2 cm; standard length: 8.1-12.2 cm; head length: 2-2.1 cm; height: 2-2.1 cm; tail length: 1.4-2 cm; width of mouth opening: 0.4-0.8 cm..

Figure 11 *Clarias tjesmani*

3.1.2 Density, Relative Density, and Frequency of Fish Presence

Rasbora sumatrana is only found in station 1 because station 1 is an activity-free area and is a rocky area control area that has clear waters and calm influences. According to [11]

Rasbora sumatrana species like calm, clear waters do not have a heavy impact and live behind rocks and sandy, the temperature range suitable for this species is 20-26ºC and pH 6.5-7.

The highest K, KR and FK values at station 1 are *Tor tambroides*, the height of the species because it has life expectancy and likes waters that do not flow profusely, clear waters and is an active swimmer species. According to [12] the habitat of Tor tambroides likes deep water, can live at a temperature of 18-28 ºC pH 6-6.8 and live in clear and calm water and more quickly adapt to the environment. The types that have the highest abundance have the ability to adapt and can utilize the potential of existing resources to make ends meet.

Mystus nemurus species have the highest K, KR, and FK values at station 2. This species is only found in stations 2 and 3 which are tofu waste disposal areas and slaughterhouses have murky water conditions. The high density value of such species because it likes murky waters. According to [9] family bragidae is a freshwater mustachioed fish that can live in murky water and is active all day often found in rivers, swamps and lakes.

The highest K, KR and FK values on station 4 are *Oreochromis niloticus* and are only found in station 4. The high value of the species is because station 4 is a sand-dredging area that has environmental conditions suitable for the habitat of *Oreochromis niloticus* who likes slow-flowing water and sand-substrate and has a high tolerance to temperature. According to [13]. *Oreochromis niloticus* inhabits freshwater habitats including shallow waterways, rivers and lakes. In addition, station 4 has a higher oxygen saturation between the four research stations so that the presence of dissolved oxygen in this station is more optimal and more supportive of the growth of the species, the suitable temperature in this species ranges between 14-38ºC and pH 5-9.

Cyprinus carpio is only found in station 4 because *Cyprinus carpio* likes freshwater habitats whose water is not too deep and the flow is not too heavy, such as on the banks of rivers or lakes. According to [14] Cyprinus carpio is very sensitive to changes in environmental quality. This species is one of the fish that live in fresh waters that are not too deep and the flow of water is not too heavy, Cyprinus carpio can live at a temperature of 25-30 ° C

Table 2 Density Values (ind/m2), Relative Density (%) and Frequency of Presence (%) of Fish at Each Research Station in Aek Sibundong.

No	Species	Station 1			Station 2			Station 3			Stattion 4		
		K	KR	FK	K	KR	FK	K	KR	FK	K	KR	FK
1.	*Clarias tjesmani*	0,023	18,25	15	0,015	24,5	17,5	0,015	30,61	17,5	0,023	26,74	20
2.	*Cyprinus carpio*	-	-	-	-	-	-	-	-	-	0,019	22,09	20
3.	*Mystus nemurus*	-	-	-	0,025	40,6	20	0,017	34,69	15	-	-	-
4.	*Oreochromis niloticus*	-	-	-	-	-	-	-	-		0,025	29,06	25
5.	*Puntius binotatus*	0,019	15,07	20	0,021	34,4	22,5	0,017	34,69	20	0,019	22,09	20
6.	*Rasbora* sumatrana	0,025	19,84	25	-	-	-	-	-	-	-	-	-
7.	*Tor tambroides*	0,059	46,82	32,5	-	-	-	-	-	-	-	-	-
	Jumlah	**0,126**	**99,98**	**92,50**	**0,061**	**99,50**	**60**	**0,049**	**99,90**	**52,50**	**0,086**	**99,98**	**85**

Information:

Station 1: Activity-free area

Station 2: Tofu waste disposal area

Station 3 : Abattoir waste disposal area

Station 4 : Sand borering waste disposal area

3.2. Species Diversity Index (H') and Equitability Index (E)

The uniformity index value (H') of the fish uniformity index (E) can be seen in table 3 below.

Table 3 Diversity Value (H') and Fish Uniformity Index (E) at each research station in Aek Sibundong.

Index	Station 1	Station 2	Station 3	Station 4
H'	1,318	1,075	1,092	1,308
E	0,950	0,979	0,994	0,995

The diversity index value in this study ranges from 1,075-1,318 which is classified as a low diversity value. The diversity index value at each station is influenced by the individual, the number of species and the spread of individuals within each species. The low value of diversity at the research site is due to the small number of species and the uneven distribution of the spread of the number of species. According to [15] diversity is low when H'<1, moderate diversity when 1<H'<3 and diversity is high when H'>3. The highest diversity index (H') is found in station 1 with a value of 1,318, this is because the number of species in station 1 is more than other stations.

According to [4] a community is said to have a high species diversity when there are species with a high abundance of each species, while low species diversity when there are only a few species that are abundant. This is in accordance with the diversity of fish species that have been obtained in Aek Sibundong belongs to the category of low diversity. The uniformity index (E) at the four research stations ranged from 0.950-0.995 with the highest value found at station

4. The high value of the uniformity index at station 4 is due to the presence of each type of biota in the waters in even conditions. Overall, the uniformity index value at all four stations is relatively low. .

According to [15] the value of the uniformity index ranges from 0-1. The criteria for the uniformity index value is that if E is close to 0 then the equality between species is low, meaning that the individual wealth that each species has is very much different and if E is close to 1 then the equality between species is relatively even or the number of individuals of each species is the same. Based on the results of the diversity and uniformity index shows that fish in these waters are classified as less diverse (H'<1) and E close to 0.

3.2 Parameters of Physical Chemical Factors

Measurement of the physical chemical factors of the waters in Aek Sibundong from the results of research at each station can be seen in Table 3 below:

Table 3 Aquatic physics-chemical parameters at each research station in Aek Sibundong.

A	Physical parameter	Units	Station 1	Station 2	Station 3	Station 4
1.	Temperature	ºC	23	25	25	27
2.	Intensity of light	Candela	380	370	378	390
3.	Light penetration	CM	65	41	40	60
4.	Current speed	m/ det	0,111	0,125	0,125	0,123
B.	Chemical Parameters					
5.	Dissolved oxygen (DO)	mg/l	7,2	6.5	6,0	7
6.	BOD5	mg/l	6,2	5,6	5,2	6
7	Degrees of acidity (pH)	-	2,07	3,5	3,4	2,3
8.	Oxygen saturation	%	73,98	69,05	64,11	76,33
9.	Nitrate level (NO_3)	mg/l	3,21	4,32	3,77	4,20
10.	Phosphat level (PO_4)	mg/l	0,02	0,02	0,02	0,03

Information:

Station 1: Activity-free area

Station 2: Tofu waste disposal area

Station 3 : Abattoir waste disposal area

Station 4 : Sand borering waste disposal area

3.3.1 Temperature

The water temperature value at the research site is in the range of 23-27ºC. The lowest temperature is in station 1 which is 23 ºC and the highest temperature is in station 4 which is 27 ºC. The temperature value at station 4 is higher than other stations can be caused by the intensity of light at the station is relatively high so that the penetration of light entering the water is also higher which results in higher temperatures at the station. According to [16] the optimum temperature range for organisms in tropical waters is 20 ºC -30 ºC. If the temperature is low the fish will lose its appetite, so that its growth is hampered, on the contrary, if the temperature is too high the fish will stress and even die of lack of oxygen.

3.3.2. Intensity of light

The intensity of light at each location of this study ranged from 370-390 candela. The highest value is at station 4 while the lowest is at station 2. The intensity of light greatly affects phytoplankton and periphytons in a water. According to [17] most periphytons act as producers who can carry out photosynthetic activities. Photosynthesis can take place well if the intensity of light that perifiton receives is sufficient. Therefore light is an environmental factor that determines the productivity of a water. Phytoplankton and periphytons are partly the natural food of fish.

3.3.3. Light Penertation

Light penetration at each study site ranges from 40-65 cm. The highest value is found at station 1 because the water is still clear at this station and the lowest at station 2. The low value of light penetration in station 2 is due to the presence of dissolved materials such as waste and also due to rainfall that causes the color of water to become cloudy so as to inhibit light from penetrating the waters. According to [6] the condition of turbid water caused by suspended solids will affect water quality because it will reduce the ability to penetrate light. High levels of turbidity can interfere with fish life in search of food, vision, and breathing. The higher the level of turbidity, the light that enters the body of water will also decrease, consequently disrupting the process of vision of prey / food [18]

3.3.4 Potential of Hydrogen (pH)

The results of the measurement of the degree of acidity in the research location ranged from 6-7.5. This pH range is still at the threshold for tropical waters and supports fish life. According to [2] life in water can still survive if the waters have a pH range of 5-9. The pH at the research site is still suitable for fish growth.

3.3.5 Dissolved Oxygen (DO)

Dissolved oxygen (Dissolved Oxygen) is needed by all living organisms for respiration, metabolic processes or the exchange of substances which then produce energy for growth and reproduction [19]. Water dissolved oxygen in Aek Sibundong at each station was in the range of 5.2-6.2 mg/L with the highest value at station 1 and the lowest at station 3. The highest dissolved oxygen value was at station 1, which was 6.2 mg/L. L because this research station is an area not exposed to human activities. According to [20] water conditions are suitable for supporting fish life, the amount of oxygen content is above 6 ppm. The rate of diffusion of oxygen from the air depends on several factors, such as water turbidity, temperature, and the movement of water masses (currents and waves).

3.3.6 Biochemical Oxygen Demand (BOD_5)

The result of measuring the BOD_5 value at the four stations is a determination of the level of pollution of a waters. The BOD_5 value at each research station was in the range between 2.07-3.5 mg/L. Good waters that have BOD_5 levels ranging from 0-10 mg/L, while BOD values ranging from more than 10 mg/L are categorized as polluted. Biological oxygen demand is the amount of oxygen needed by microorganisms in environmental water to break down (degradate) organic waste materials in the environmental water. The number of microorganisms depends on the level of cleanliness of the water. Clear water usually contains relatively few microorganisms compared to water that has been polluted by waste materials (Wardhana, 2004).

3.3.7 Nitrate

Nitrates have an important role for the life of fish in the waters, the measurement results of the four research stations are in the range between 3.21-4.32 mg/L. The highest value is at station 2, the lowest is station 1, this is because the factors that affect water quality at station 2 are tofu waste disposal areas. Nitrates can be used to classify water fertility levels. Oligotrophic waters have nitrate levels between 0-1 mg/L, mesotrophic waters have nitrate levels between 1-5 mg/L, and eutrophic waters have nitrate levels ranging from 5-50 mg/L [2]. Nitrate levels in Aek Sibundong are still good enough to support fish growth.

3.3.8. Phosphate

The results of measurements of phosphate levels at the four research stations ranged from 0.02-0.03 mg/L, the highest value of phosphate levels was at station 2. According to Silalahi (2010), the phosphate content in the waters generally does not exceed 0.1 mg. / L, except in waters polluted by household and industrial waste, as well as agricultural areas that use phosphate fertilization that enters the river through drainage and rainwater flows.

3.4 Pearson Correlation Analysis Values

Pearson Correlation Analysis was obtained by analyzing the relationship of diversity and physical-chemical factors of Aek Sibundong waters using the pearson method. The correlation index value (r) can be seen in the following table 4.

Table 4 Pearson Correlation Values Between Fish Diversity and Physical-Chemical Properties of Aek Sibundong Waters

No.	Parameters	Correlation Value
A.	Physical Parameters	
1.	Temperature	-0,009
2.	Current speed	+ 0,860
3.	Intensity of light	+ 0,813
4.	Light Penetration	+0,562
B.	Chemical parameters	-0,577
5.	Dissolved oxygen (DO)	+0,568
6.	BOD5	-0,863
7.	Acidity level (pH)	+0,563
8.	Oxygen Saturation	-0,578
9.	Nitrate (NO3-N)	- 0,928
10.	Phosphate (PO)	-0,009

Description : + = Positive correlation (Unidirectional)

- = Negative correlation (opposite)

The results of the correlation test between the physical-chemical parameters of the waters and the diversity of fish in Aek Sibundong differed cholera rates. The value of light intensity, light penetration, BOD_5 and correlated phosphate is very strong against fish diversity. PH values, strong current, DO, oxygen saturation, moderately correlated nitrates and correlated temperatures are very low to fish diversity.

The intensity of light affects the process of photosynthesis of the waters. The process of photosynthesis affects the availability of oxygen in waters that fish or other heterotrophic organisms need for metabolic processes in producing energy. If the intensity of light is less, the process of photosynthesis is hampered and the availability of oxygen is reduced, causing the death of fish. Light penetration plays a role in determining the presence of fish, if the penetration is high to reach the bottom of the waters then the availability of oxygen to the bottom of the waters is quite good. Fish can be on the surface and bottom of the waters and cause various types of fish can live in every part of the water.

Phosphate plays a role in determining aquatic fertility because phosphate can be used by aquatic plants including algae and phytoplankton as the basic ingredients of photosynthesis and for their growth in waters. Aquatic plants include some natural foods for insects and fish.

4. Conclusion

The conclusions of this study are:

a. The types of fish obtained at the four research stations are classified as 3 orders, 4 families and 7 species.

b. The highest density value is found in the tor tambroides species, which is 0.059 ind/m^2.

c. The diversity index at the research site is relatively low with a value of 1,075 1,318.

d. Light intensity, light penetration, BOD_5 and entrenched phosphate are very strong against fish diversity in Aek Sibundong Humbang Hasundutan Regency.

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