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Diversity of Fish in Idanoi River and It's Relationship to Physical Factors of Water Chemistry

Ternala Alexander Barus[1], Claudya Vera Ayu Putri Zebua[1],

[1]*Departement of Biology, Faculty of Mathematics and Natural Sciences, Universitas Sumatera Utara, Medan, Indonesia*

Abstract. A river is an area through which a body of water moves from a high place to a low place either through the surface or underground which has an average width equal to or more than 5 meters. One of the rivers in Indonesia is the Idanoi river, located in the North Sumatra region, Ononamolo 1 Lot village, Gunungsitoli Selatan sub-district, Nias. This river is inseparable from human activities which affects the condition of river waters as a habitat for aquatic biota. The purpose of this study was to analyze the diversity of fish species in the river Idanoi and to analyze the physical-chemical factors of waters which correlate with the diversity of fish species in the river Idanoi. This study uses the Random sampling method. The results of the research obtained from the four research stations found 1 class, 5 orders, 7 families and 7 species. The highest density value was found at station 1 with a value of 0.023 ind / m2, fish diversity index ranged from 1.072 - 1.829 and the fish uniformity index ranged from 0.92 to 0.98. DO, BOD5 values and oxygen saturation correlated very strongly with fish diversity in river Idanoi village Ononamolo 1 Lot.

Keyword: Chemical physics Factors, Diversity of Fish, Idanoi River

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1 Introduction

A river is an area where a body of water moves from a high place to a low place either through the surface or underground that is an average width equal to or more than 5 meters [1]. This river is one type of freshwater ecosystem as a habitat for water biota. The river plays an important role for the community that can be used as a source of water in meeting the needs of the community and as the main supporting means in improving national development based on Government Regulation No. 82. 2001 on Water Quality Management and Water Pollution Control. Indonesia has many rivers that flow in various regions of Indonesia. According to [2] there are about 5,590 rivers in Indonesia. One of the rivers in Indonesia is the Idanoi river located in north Sumatra, Ononamolo Village 1 lot of South Gunungsitoli subdistrict, Nias. The Idanoi River has never studied the state, shape and diversity of water biota contained in it. This river is

**Corresponding author at: Departement of Biology, Faculty Mathematics and Natural Science, Universitas Sumatera Utara, Medan, Indonesia

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inseparable from human activities such as bathing, washing and leaving the house, garbage dumps such as household waste and tofu factory waste, where to dispose of animal waste and others. Human activity in the Idanoi river greatly affects the condition of river waters as a water biota habitat.

Polluted river water conditions can interfere with life in the river. The entry of pollutants into rivers can alter the physical condition of environmental chemistry, thereby changing the diversity of water biota communities. The species contained in rivers are not all tolerant to the pressures of environmental conditions, but have tolerance limits [3].

In the waters there are groups of organisms that are intolerant and groups that are tolerant to contaminants. Organisms used as biological indicators in polluted waters are organisms that respond to little or no amount of contaminants. Intolerant organisms will experience a decrease in abundance and will even disappear from the aquatic environment. Intolerant organisms can be used as indicators of clean and normal water quality [4] . Fish is a key ecological factor related to the rules and functions of river ecosystems and also water biota that can be used as an indicator of the level of pollution that occurs in water. The diversity and abundance of fish in the river is influenced by environmental conditions, in addition fish also have a high enough economic value so that the surrounding population uses it for consumption needs by netting, fishing and electrocuting it. Sustainable fishing activities can result in reduced population and diversity of fish species, therefore research is needed to determine fish diversity and also the relationship of physical factors in aquatic chemistry with the presence of fish in the Idanoi river. Idanoi River is a river located in Ononamolo Village 1 Lot Of South Gunungsitoli Subdistrict, Nias is one of the rivers that have a diversity of fish species in it. Until now fish diversity data and its relationship to the physical-chemical factors of waters in rivers have never been studied so it is necessary to study data on fish diversity as a source of information.

2. Research Methods

2.1. Time and Location of Research

The study was conducted in May - December 2018. The research was conducted in Idanoi River Gunungsitoli Idanoi Subdistrict, Gunungsitoli City. The samples obtained were taken for identification to the Natural Resources and Environment Management Laboratory, Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Sumatera Utara, Medan.

2.2. Research Methods

Determination of the sampling location point in this study was done by purposive random sampling method, namely by determining 4 sampling stations. Each station is determined based on the activities in the area.

2.3 Area Description

2.3.1 Station 1 research location

Station 1 is in Ononamolo Village 1 Lot, Hamlet 3, South Gunungsitoli Subdistrict. This station is a control area. At this station, no activity is carried out. The base substrates at this location are sand and rocks geographically located at 1o 12'41' N LU and 97o 39'32' BT.

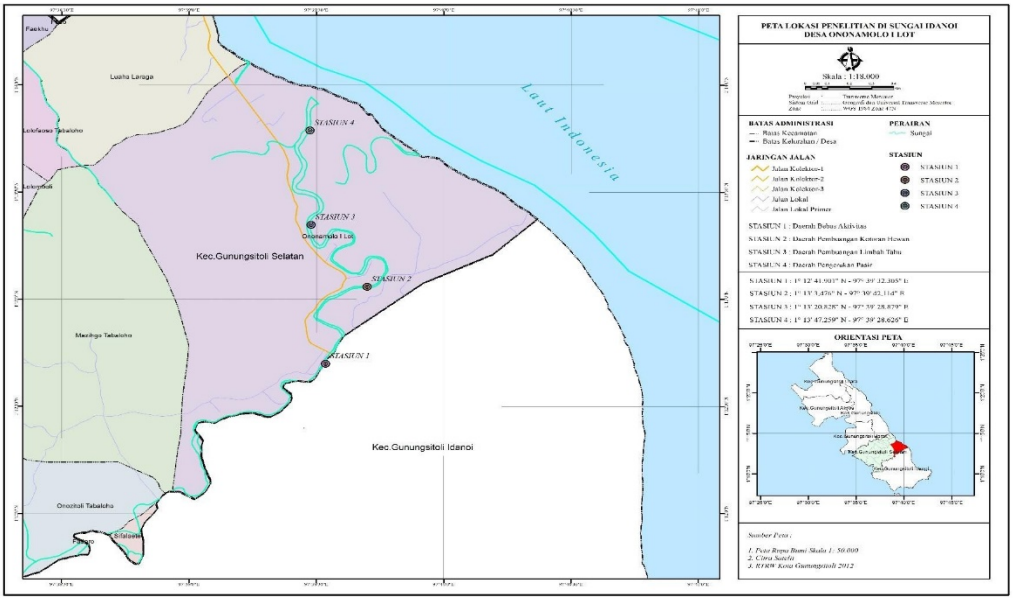

Figure 1 Research Location Station 1,2,3 and 4

2.3.2 Station 2 research location

Station 2 is in Ononamolo Village 1 Lot, Hamlet 3, South Gunungsitoli Subdistrict. Station 2 is an animal waste disposal area as well as household waste not far from the river stream. The base substrate of this location is sand, and the rocks are geographically located at 1o 13'34' N LU and 97o 39'42' BT.

2.3.3 Station research location 3

Station 3 is in Ononamolo Village 1 Lot, Hamlet 2, South Gunungsitoli Subdistrict. Station 3 is a tofu waste dump not far from the river stream. The base substrate of this location is sand and slightly muddy geographically located at 1o 13'20" N Lu and 97° 39'28' BT

2.3.4 Station research location 4

Station 4 is in Ononamolo Village 1 Lot, Hamlet 1, South Gunungsitoli Subdistrict. This station is a sand dredging area. The basic substrate at this location is sand and stone geographically located at 1° 13'47' N LU and 97° 39' BT

2.4. Fish Sampling

Fish sampling using scattered nets was conducted at sampling points at each randomly selected research site. The spread of nets at one of the sampling sites was carried out as much as 45 times the spread of the net. The size of the spreader mesh used is 12.56 m2. Fish sampling is done in conjunction with measurements of aquatic chemical physical factors. The fish samples obtained were put in 10 kg of plastic and preserved using 70% alcohol to be further taken to the laboratory for identification using the identification book [5].

2.5. Measurement of the Chemical Physical Properties of Waters

2.5.1. 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.

2.5.2. 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.

2.5.3 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.

2.5.4 Speed of river currents

The ping pong ball is inserted into the body of the river along with the stopwatch, until it reaches a distance of 10 m. Then the stopwatch is turned off and the time is recorded. The current speed measurement is carried out as many as 5 reps.

2.5.5 Degrees of acidity (pH)

The measurement of the pH of water is done using a pH meter. The previous pH was calibrated to pH 7. The measurement of the pH of the water is done by way of the pH end of the meter inserted into the surface of the body of water and then reading the values listed on the pH meter and recording the results obtained.

2.5.6 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.

2.5.7 Biochemical Oxygen Demand (BOD_5)

Bod5 measurements were taken after water samples were taken, incsessed for 5 days, then by the winkler method using chemical reagents $MnSO_4$ and KOH-KI, H_2SO_4, $Na_2S_2O_3$ and amylase. Water samples are put into a Winkler bottle, then added 1 ml of MnSo4 and KOH-KI to their respective bottles and are homogeneous. 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. The BOD_5 value is the initial DO value that is reduced to the final DO value.

2.5.8. Oxygen saturation

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

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

Information

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

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

2.5.9 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 H2SO4 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 λ = 410 nm. Then the values listed on the spectrophotometer.

2.5.10 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 λ = 880 nm. Then the values listed on the spectrophotometer. Measurements of the overall physical factors of aquatic chemistry along with the units and tools used can be seen in Table 1.

Table 1. Tools and units used in the measurement of aquatic-chemical factors

No.	Physical-chemical parameters	Unit	Tool	Place measurement
1.	Temperature	^oC	Termometer	In situ
2.	Light penetration	Meter	Keping secchi	In situ
3.	Intensity of light	Candela	Lux meter	In situ
4.	pH water	-	pH meter	In situ
5.	Current speed	m/det	*Stopwatch,* ball of teble tennis, and metered	In situ
6.	DO	mg/l	Winkler Methods	In situ
7.	BOD_5	mg/l	Winkler Methods and incubation Inkubasi	Laboratory
8.	Oxygen saturation	%	-	Laboratory
9.	Nitrate level (NO3)	mg/l	Spectrophotometry	Laboratory
10.	Phosphat level (PO_4)	mg/l	Spectrophotometry	Laboratory
11.	Turbidity	-	Turbidity meter	In situ
12.	Conductivity	p mhos/cm	DO meter	In situ
13.	TSS (Total Suspended Solid)	mg/l, Spectrophotometry		Laboratory
14.	TDS (Total Dissolved Solid)	mg/l, Spectrophotometry		In situ

2.6. Data Analysis

2.6.1 Fish

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].:

a. Population Density (D)

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

b. Relative Density (RD)

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

c. Attendance Frequency (AF)

$$AF = \frac{The\ number\ of\ sample\ plots\ occupied\ by\ a\ species}{The\ total\ number\ of\ sample\ units} x100\ \% \quad (4)$$

Information :

0-25% = the constancy is very rare

25-50% = the constancy is rare

50% -75% = frequent constants

> 75% = the constancy is very frequent [14]

d. 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

e. Equitability Index (Uniformity)

$$E = \frac{H'}{H\ Max} \quad (5)$$

E = Equitability Index

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

2.6.2 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

The type of fish obtained at each station on the Idanoi River can be seen in table 2. Here:

No.	Class	Ordo	Family	Species
1.	*Actinopterygii*	1. *Clupeiformes*	1. *Pristigasteridae*	1. *Ilisha megalotera*
		2. *Cypriniformes*	2. *Balitoridae*	2. *Homaloptera ripleyi*
			3. *Cyprinidae*	3. *Tor tambra*
		3. *Mugilifomes*	4. *Mugildae*	4. *Mugil cephalus*
		4. *Perciformes*	*5. Ambassidae*	*5. Ambassis nalua*
			6. Carangidae	*6. Carangoides malabaricus*
		5. *Siluformes*	7. *Clariidae*	*7. Carngoide.Ambassis nalua*
				8. *Clarias teijsmanni*

Based on table 2. It can be seen that the acquired fish consists of 1 class, 5 orders, families of 7 and 7 species. Each type of fish obtained is different from each species and has different characteristics and characteristics in terms of morphology, can be seen as follows:
Description of the fish:

1. ***Ilisha megaloptera***

Morphology: weight of fish: 19.4 grams; total length: 12.5 cm; Standard length: 10.5 cm; Head length: 2.6 cm; Tail length: 2.3 cm; Width: 3.5 cm; Compressed body shape, superior mouth type, stenoid scale type, homocercal tail type, yellowish-white body color and body surface covered by scales.

Figure 2 Morphology of the *Megaloptera ilisha* fish

2. Homaloptera ripleyi

Morphology: weight of fish: 8,9 gram; total length: 10,9 cm; Standard length: 8.5 cm cm; ; head length 1.5 cm; tail: 2 cm; width: 1.5 cm; anguilliform body shape, superior mouth type, blind tail type, yellowish brown body color with black patches, slippery body surface, small head and eyes located on the surface of the head

Figure 3 Morphology of *Homaloptera ripleyi*

3. *Tor tambra*

Morphology: weight of fish: 8,9 gram; total length:: 21 cm ; Standard length:16.5 cm; Head length: 4 cm; Tail length: 4.5 cm; Width: 5.2 cm; Fusiform body shape, terminal mouth type, stenoid scale type, homocercal tail type, yellowish silver body color and body surface covered by scales, small heads and kisses.

Figure 4 Morphology of *Tor tambra* fish

4. ***Mugil chepalus***

Morphology: weight of fish: 45,8 gram ; total length: 16 cm ; Standard length: 13 cm; Head length: 1.5 cm; Tail length: 3.5 cm; Width: 3.7 cm; Compressed body shape, terminal mouth type, stenoid scale type, homocercal tail type, yellowish silver body color and surface covered by scales, small heads and kisses.

Figure 5 Morphology of *Cephalus mugil* fish

5. Ambassis nalua

Morphology : weight of fish: 4,8 gram ; total length : 7,8 cm ; Standard length: 5.8 cm; Head length: 1.5 cm; Tail length: 2 cm; Width: 2 cm; compressed body shape, superior type of mouth; type of homocercal tail; The white body color is clear and the surface is slippery.

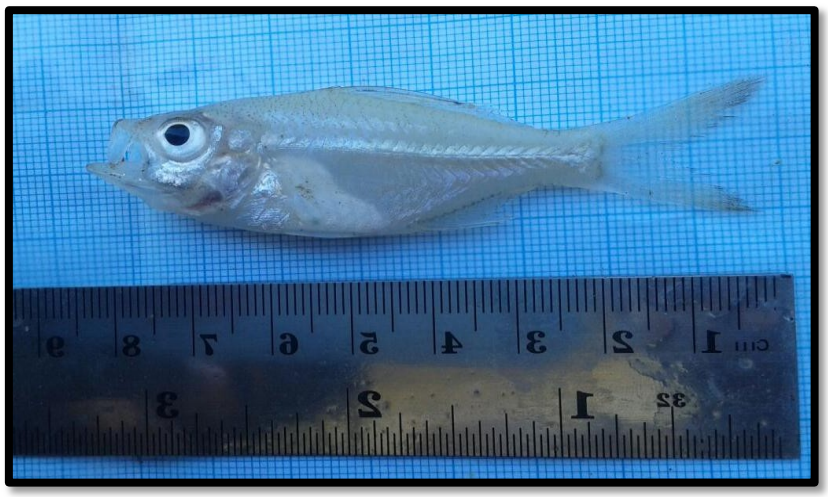

Figure 6 Morphology of *Ambassis nalua*

6. *Carangoides malabaricus*

Morphology: weight of fish: 60.2 grams; Total length: 16.5 cm; standard length: 13 cm; Head length: 3.5 cm; Tail length: 3.5 cm; Width: 5 cm; compressed body shape, superior mouth type, homocercal tail type, white body color.

7. *Clarias teijsmanni*

Morphology: weight of fish: 55.6 grams; total length: 18.5 cm; standard length: 16 cm; Head length: 4 cm; Tail length: 2.2 cm; Width: 4 cm; anguilliform body shape, subterminal mouth type and has slur, diphicercal tail type, brown body color, black patches of white body and slippery body surface.

Figure 7 Morphology of *Carangoid malabaricus*

Figure 8 Morphology of *Clarias teijsmanni* fish

3.1.2 Density, Relative Density and Frequency of Fish Presence

Based on Table 2 it can be seen that the type of fish that has the highest density is found at station 1, namely the species *Homaloptera ripleyi* which has a density of 0.008 ind / m^2. This is because station 1 is an activity-free area that is a sandy and rocky area that allows *Homaloptera ripleyi* fish species to live in it. According to [8], this type of *Homaloptera ripleyi* fish is only found in rivers that have a lot of rocks upstream. Environmental conditions with very heavy currents cause this type of aquatic biota such as fish in these waters will have different physical characteristics and patterns of adaptation to fish that live in temperate or calm waters. According to [9], stating that one of the heavy current fish attached to river rocks such as homaloptera ripleyi species has an attractive body color that is a yellowish-black pattern on the dorsal so that it has the potential to be developed into ornamental fish. The lowest density values are at stations 3 and 4. The rare species found at station 3 are *Homaloptera ripleyi* while at station 4 the low species are *Mugil*

cephalus and *Clarias teijsmani*. This is because in station 3 the substrate of the base is sandy and muddy so *Homaloptera ripleyi* is rarely found in distasiun. *Homaloptera ripleyi* is able to live in stone areas to protect itself from enemy threats, so the stones can be used as shelter. In station 4 it can be known that *Mugil cephalus* and *Clarias teijsmani* the lowest density value is 0.001 ind/m^2. Every type of fish in order to live and breed properly must be able to adjust to the environmental conditions in which the fish live. The composition and distribution of fish is strongly influenced by physical, chemical, and biological changes. According to [10], changes in river habitat caused by humans can lead to limited distribution of fish. Some types of fish require different habitats at each stage of development such as catfish (*Clarias* sp.) which are isolated in one particular place and can also disrupt their life cycles leading to population decline.In table 2 it can be known that the type of fish that has the highest relative density value (KR) found at station 3 is *Tor tambra* with a value of 43.75%. If the KR value is more than 10% then it can be said that the type of tambra tor fish can live and thrive in areas where the substrate is sand and slightly muddy. According to [11], the habitat of tambra fish (*Tor tambra*) in general can be explained, namely the water base is generally in the form of rocks, gravel and sand substrate, clear water color, slow to heavy water currents, and the river environment is mostly primary forest. According to [12], Cyprinidae are the largest family of freshwater fish, consisting of 220 genera and 2,420 species. The number of species of the family Cyprinidae indicates the ability of this family to adapt and multiply rapidly. The lowest relative density (KR) value at station 4 is *Clarias tjeismanni* with a value of 4.34%. *Clarias tjeismanni* is a freshwater fish species that can be tolerant to the environment of this species. The family Cyprinidae can live well in river areas that have strong currents and weak currents with good water quality. Cyprinidae are a family with a relatively large number of species in fresh water [13] but it can be known that at station 4 this rare type of catfish was discovered because station 4 is a station located adjacent to the mouth of the river. Catfish cannot survive in salt water because it so interferes with the osmotic pressure level of fluid in its body that the fish must make adjustments to its environment to survive. According to [14] that the ability of fish to survive at the maternity site depends on the ability to regulate body fluids so as to maintain a constant level of osmotic pressure and changes in salinity levels also affect the osmotic pressure of the fish's body fluids, therefore the fish must make adjustments or arrangements of internal osmotic work so that physiological processes in its body can work normally again. According to [15] the further the isoosmotic conditions, the higher the osmotic workload to balance the osmolarity pressure on the fish's body so that the energy wasted on osmotic performance becomes greater.The highest frequency of presence (FK) is found in statiun 1, *Mugil cephalus* with a value of 8.88. If the frequency value of attendance is 0-25% then the presence of species in the location is very rare. This can be due to a lack of efficient sampling at this location as it tends to hide behind rocks making it difficult to catch using nets. *Mugil cephalus* is a marine fish that can live in river estuaries and live in groups. According to [16], fish can tell

of the presence of water currents only if the fish are in the layer where they are and touch the bottom of the water. Relative fish that live in the river surface column do not develop the morphological or behavioral structures necessary to survive strong river currents.

Table 3 Data on density (ind/m^2), relative density (%) and Frequency of Presence (%) of Fish at each observation station

No	Spesies	Location 1			Location 2			Location 3			Location 4		
		K (ind/m^2)	KR (%)	FK (%)	K (ind/m^2)	KR (%)	FK (%)	K (ind/m^2)	KR (%)	FK (%)	K (ind/m^2)	KR (%)	FK (%)
1	*Ilisha megaloptera*	-	-	-	-	-	-	-	-	-	0.005	21.7	6.66
2	*Homaloptera ripleyi*	0.008	40	6.66	0.003	18.75	2.22	0.001	6.25	2.22	0.003	13.04	4.44
3	*Tor tambra*	0.007	35	6.66	0.003	18.75	4.44	0.007	43.75	6.66	0.005	21.7	6.66
4	*Mugil cephalus*	0.005	25	8.88	0.005	31.25	6.66	0.003	18.75	4.44	0.001	4.34	2.22
5	*Ambassis nalua*	-	-	-	-	-	-	-	-	-	0.005	21.7	6.66
6	*Carangoides malabaricus*	-	-	-	-	-	-	-	-	-	0.003	13.04	4.44
7	*Clarias teijsmanni*	-	-	-	0.005	31.25	6.66	0.005	31.25	6.66	0.001	4.34	2.22
	Total	**0.02**	**100**		**0.016**	**100**		**0.016**	**100**		**0.023**	**99.86**	

Information:

Station 1: activity-free area

Station 2: Animal sewage area

Station 3: tofu waste disposal area

Station 4: Sand dredging area

3.1.3 Diversity Index (Shannon-Wienner) (H') and Indices Uniformity (E)

The diversity index (Shannon-Wienner) and the fish uniformity index at each station on the Idanoi River can be seen in the following 4 table.

Table 4 Diversity Index (H') and Fish Uniformity Index (E) data on Every observation station

	Station 1	Station 2	Station 3	Station 4
H'	1.072	1.365	1.277	1.829
E	0.97	0.98	0.92	0.94

Based on Table 4 it can be seen that the value of the diversity index in the four stations ranged from 1,072 to 1,829 which came under low diversity scores. The low value of diversity at the research site is due to the small number of species and the uneven rate of species dispersal. The value of diversity at each station is influenced by the individual, the number of species and the individual dispersal of each species.

The highest diversity index was at station 4 at 1,829. This is due to the good water conditions for the presence of fish and can survive due to the many food sources contained in these locations. According to [17], a community is said to have a high species diversity when there are many species with a relatively even number of individuals per species. In other words, that if a community consists of only a few species with an uneven number of individuals, then it has a low diversity. According to [4], a community is said to have a high species diversity when there are many species with an abundance of each species is high, whereas species diversity is low when there are only abundant species. Stations that have a low diversity index are found at stations 1. This is because station 4 is an activity-free area and environmental conditions whose vegetation does not support the growth of fish in the station. According to [18] explained that an increase in water temperature will increase the solubility of compounds in water. In toxic compounds, then the toxic strength of this compound generally increases with increasing temperature so that it can make the survival of the fish will be disrupted. Uniformity index (E) value on each station shown in table 4 ranges between 0.92-0.98 with the highest uniformity value found at station 3 of 0.98. The high uniformity value at station 2 is due to the presence of each type of fish in the waters is relatively evenly distributed. According to [19], the uniformity index value of fish species ranges from 0-1. The criteria for the uniformity value of fish species is the value of E is close to 0, then the spread of individuals between types is relatively unequal and it is found that there is a group of certain types of individuals that are abundant.

3.2 Abiotic environment

The measurement of physical-chemical factors in the waters of the Idanoi River can be seen in Table 5 follows.

Table 5 Physical-Chemical Factor Measurement Data of Idanoi River Waters on Each Observation Station

A	Physical parameter	Units	Station 1	Station 2	Station 3	Station 4
1.	Temperature	^{o}C	30	25	26	25
2.	Current speed	m/det	28	15	45.8	4.6
3.	Intensity of light	Candela	557	344	411	426
4.	Light penetration	M	0.5	1.5	1.5	1.5
B.	**Chemical Parameters**					
5.	Dissolved oxygen (DO)	mg/l	2.9	3.4	4.1	5.2
6.	BOD_5	mg/l	1.1	1.8	1.3	5

7	Degrees of acidity (pH)	-	7.5	7	6.8	7.4
8.	Oxygen saturation	%	38	41	51	64
9.	Nitrate level (NO_3)	mg/l	1.5	1.5	5	5
10.	Phosphat level (PO_4)	mg/l	0.1	0.1	0.1	0.1

Information:

Station 1: activity-free area

Station 2: Animal waste disposal area

Station 3: tofu waste disposal area

Station 4: Sand dredging area

3.2.1 Parameters of Physics

Based on Table 5 the measurable temperature at each station ranges from 25-30 °C. The highest temperature at station 1 is 30 °C. This variation is due to differences in the influence of dense vegetation around the waters. River. The temperature observed at each station is still ideal for fish growth. According to [20], fish sintasan increases with a steady increase in water temperature and reaches optimal conditions at stable temperatures between 29°C to 32°C. In these conditions, the entire physiological process of fish can run normally so that the vitality of the body can be maintained properly. According to [21], the optimal temperature range for organisms living in tropical waters is 20°C to 30°C.

Current speeds at each station range from 15-46 m/s. The current top speed is at station 1 which is 46 m/s. This is because station 4 is a sand dredging area. According to [22] states that the speed of currents is influenced by the slope, depth and width of the river. The range of currents obtained is generally found in tropical waters. According to[23], waters are categorized in waters that have a very heavy impact if the current speed >1 m / det, the impact is 0.5-1 m / det, the moderate impact is 0.25 m / det, the moderate impact is 0.25 m / det, the moderate impact is 0.25 m / det. 0.5 m/det, slow impact 0.1-0.5 m/det and very slow 0.1-0.25 m/det.

The light intensity at each measurable station ranges from 344-557 x 200,000 Candela. The highest light intensity is at station 1, which is 557 candela while the low intensity is at station 3 at 344 candela. This is due to differences in plant vegetation at each station. According to [17] states that if the intensity of sunlight is reduced then the process of photosynthesis will be inhibited so that oxygen in the water will be reduced.

The penetration of light measured at each station ranges from 0.5 m – 1.5 m. The penetration of light distasiun 2, 3 and 4 1.5 m while at station 1 is 0.5 m. According to [24]states that the higher the depth of the disk the deeper the penetration of light into the water which will further increase the thickness of the productive water layer.

3.2.2 Chemical Parameters

Based on Table 5 the oxygen solubility (DO) values measured at each station range from 2.9 -5.2 mg/l. This value is still ideal for the growth rate of fish present at each station. According to [25] that A good DO value for fish growth is at 5 mg/l. It can be known that there are 3 stations whose oxygen solubility value is below 5 because the river conditions have been polluted so that it can cause a higher risk of death for fish life. A BOD value is the amount of oxygen needed by microorganisms to decompose organic compounds. Bod values that can be at each station range from 1.1 - 5 mg / l this means that the condition of each station has been polluted. According to [26] that waters are categorized as unpolluted if BOD_5 ranges from 5 - 10 mg/l. If at stations 2,3 and 4 the bod5 value is low this indicates that in these waters it contains compounds that are not biodegradable biological.

The pH measured at each station ranges from 6.8 to 7.5. The highest PH at station 4 with a pH of 7.5 while the lowest at station 2 with a pH of 6.8. Such pH conditions do not harm the organisms in it due to the normal pH state. According to [21] that most aquatic biota are sensitive to changes in pH and support pH 7-8.5. Highly acidic or highly alkaline river conditions will endanger the survival of the organism because it causes metabolic and respiration disorders. Oxygen saturation at each station ranges from 38-64%. The highest oxygen saturation value is at station 1 which is 64% while the lowest oxygen saturation value is 38%. According to [27] that the higher the temperature of the water, the lower the level of saturation. Dissolved oxygen concentrations that are too low will cause fish and other aquatic animals that need oxygen to die. Conversely, too high a concentration of dissolved oxygen also leads to a faster smelting process because oxygen binds to the hydrogen that coats the metal surface.

3.3 Pearson Correlation Analysis Values

Pearson Correlation Analysis was obtained by analyzing the relationship of diversity and physical-chemical factors of Idanoi river waters using the pearson method. The correlation index value (r) can be seen in the following table 6.

Table 6 Pearson Correlation Values Between Fish Diversity and Physical-Chemical Properties of Idannoi River Waters

No.	Parameters	Correlation Value
A.	Physical Parameters	
1.	Temperature	-0,734
2.	Current speed	-0,437
3.	Intensity of light	-0,442
4.	Light Penetration	+ 0,654
B.	**Chemical parameters**	
5.	Dissolved oxygen (DO)	+ 0,918
6.	BOD_5	+ 0,967
7.	Acidity level (pH)	+ 0,133
8.	Oxygen Saturation	+ 0,892
9.	Nitrate (NO_3-N)	+ 0,604
10.	Phosphate (PO)	+ 0,005

Description : + = Positive correlation (Unidirectional)

- = Negative correlation (opposite)

Table 4.5 shows the results of correlation tests between the physical-chemical parameters of the waters and the diversity of fish in the Idanoi river with different degrees of correlation. The values of DO, BOD5, temperature, penetration of light and nitrate (NO3-N) and oxygen saturation are strongly correlated with the diversity of fish. The current values of light intensity and speed are quite correlated with the diversity of fish. PH and phosphate (PO) values are lowly correlated with diversity. BOD5, DO and oxygen saturation have a very strong effect on fish diversity if bod, DO and oxygen saturation values are high then fish diversity will be high.

It plays a role in determining the presence of fish. Tolerance to high oxygen solubility in water has a major effect on the physiological activity of fish. If the solubility of oxygen is high then the growth of fish will be maximized. But in this case, if the DO is getting higher then the diversity of small fish and vice versa.

BOD values affect fish diversity because BOD still has a relationship with dissolved oxygen levels in water. Bod value will cause the amount of oxygen to be reduced so that the fish will lack oxygen for metabolic and respiration processes. The high value of BOD indicates that the amount of organic compounds found in water is also high. Fish can also utilize organic compounds for additional food. The presence of organic compounds can support the growth of plankton which is the main food of fish, especially fish that have small mouths.

Water temperature has a role in regulating aquatic life, especially in metabolic processes. If the temperature is too high it will cause stress conditions in the fish that can cause death in the fish. In this case, when the temperature gets higher then the diversity of fish will be low n and vice versa.

Penetration of light also plays a role in determining the presence of fish. If the light penetration is high enough to reach the bottom of the water then the availability of oxygen to the bottom of the water is quite good. So that fish can be on the surface and underwater and cause various types of fish can live in every part of the water.

Oxygen saturation also determines the growth and diversity of fish. If the oxygen saturation condition is good or reaches 100% then the amount of dissolved oxygen reaches the maximum result which indicates that the water quality is good for fish growth.

4. Conclusion

The conclusions of this study are:

a. Conclusions obtained from four research stations found as many as 1 class, 5 orders, 7 families and 7 species. The highest density values were found at station 1 with a value of

0.023 ind/m2, the fish diversity index ranged from 1.072 - 1.829 and the fish uniformity index ranged from 0.92– 0.98.

b. The values of DO, BOD5, temperature, penetration of light and nitrate (NO3-N) and oxygen saturation correlated strongly with the diversity of fish in the Idanoi river of ononamolo village of 1 Lot.

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