

REVEAL THE DIVERSITY OF ICTHYOFAUNA TAMBATAN's RIVER NORTH LABUHANBATU REGENCY

Livia Dewi¹ and Rivo Hasper Dimenta^{2*}

^{1&2}Department of Biology Education, Faculty of Teacher Training and Education,
Labuhanbatu University, Indonesia

*E-Mail : rivohd11@gmail.com

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ABSTRACT: The study aimed to determine the diversity of ichthyofauna species has been done in the Tambatan's River, North Labuhanbatu Regency. This research applied by purposive sampling method to decided sampling collection which based on the environmental conditions of Tambatan's River. Fish samples were collected using cast nets and gillnets. The collected data were analyzed using the Shannon-Wiener diversity index, evenness index, dominance index, similarity index, and Pearson's correlation analysis. The results found 20 fish species from 5 families on Tambatan's River. The largest family of fish species found from Cyprinidae's (12 species), Bagridae's (5 species), and the lowest found from Siluroidae's, Mastacembelidae's, Gobidae's family an each 1 species. The result of the diversity index indicated that the 3 stations were classified in the medium category with range of 0.53-1.87. The result of pearson's correlation describe fish biodiversity has strong positive correlation value to current velocity (0.927) and water transparency (0.927).

Keywords: Diversity, Ichthyofauna.



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INTRODUCTION

The diversity of fish species in Indonesia ranges from approximately 8.500 species of fish, of which 800 species found in freshwater and brackish. The number of each type of fish on the large islands in Indonesia has variety different. There are around 394 fish species from Kalimantan with 149 endemic species (38%), 272 species from Sumatera with 30 endemic species (11%), 132 species from Java with 52 endemic species (9%), and 68 species from Sulawesi with 52 endemic species (76%) (Nooryanto *et al.*, 2014). Machrizal *et al.* (2019) inform that the wide variety of fish species and their distribution play an important role in the establishment of the ecosystem fish is a bio-indicator of the quality of river waters.

Hariyadi *et al.* (2019) explained that heterogeneity and water quality are two factors causing fish diversity in a river. According to Mutiara & Sahadin (2017), the more increasing activities (agro-industry and general industry) around rivers result in reduced fish habitat and decreased population of the fish. Rahman & Khairoh (2017) reported that freshwater fish such as *Oreochromis niloticus* could be bioindicators of the quality of river waters. The condition of a river is strongly influenced by the characteristics of the surrounding environment. The Tambatan's River is one of the tributaries that disemboques into the Kualuh River





in Bandar Durian Village, with an altitude of around 25 m AMSL. Bandar Durian is one of the villages in Aek Natas, North Labuhanbatu Regency. Hariyadi *et al.* (2019) inform the large of river will describe reflection of alleged the ichthyofauna diversity, which the structural diversity and habitat richness of inshore zones and connected floodplains.

The huge benefits contained in the river ecosystem make the river highly vulnerable to environmental degradation and community activities. Furthermore, the activities carried out by the community around the Tambatan's River are fishing with various fishing gear, such as fishing rods, cast nets, or gillnets. It is conducted to fulfill their life necessities. Apart from that, the local community also uses the river for traditional stone and sand mining activities.

Several studies related to fish diversity and its relation to water quality in rivers around in Sumatera have been conducted by Mutiara & Sahadin (2017); Ridho & Patriono (2017); Atifah & Lubis (2017); and Samitra & Rozi (2018). However, to date, none of those reports the fish diversity in the Tambatan's River. Therefore, this study aims to determine the diversity of fish species found in the Tambatan's River, Bandar Durian Village. Information regarding fish diversity is highly important to study because it is a key factor of ecology related to the rules and functions of aquatic ecosystems.

METHOD

This study was conducted from October 2020 to January 2021. The research stations were placed around the Tambatan's River whom locate at Bandar Durian Village, North Labuhanbatu Regency. In this study, researchers applied a purposive sampling method, in which this method allows the sampling points to be determined based on certain considerations to make the obtained data more representative.

There were three research stations in this study. They were determined using the *Global Positioning System* (GPS) (Figure 1). Station one was located at 2°21'28.37" N, 99°41'20.38" E, this station near community settlements. At this station, the substrate of the river channel mostly consists of sand with a calm current and is surrounded by community-owned oil palm plantations. Many local people use this location as a source of livelihoods, such as mining stones & sand and washing. Station two was located at 2°21'42.58" N, 99°40'40.88" E, this station far from community settlements. At this station, the substrate of the river channel mostly consists of rock with a moderate current and is surrounded by woods. Station three was located at 2°21'38.26" N, 99°40'52.18" E, this station is also in Jarinjing Village which far from community settlements. At this station, the substrate of the river channel mostly consists of sand and rock with a moderate current. Identification of fish and data analysis was carried out in the Ecology Laboratory, Faculty of Teacher Training and Education, Labuhanbatu University.



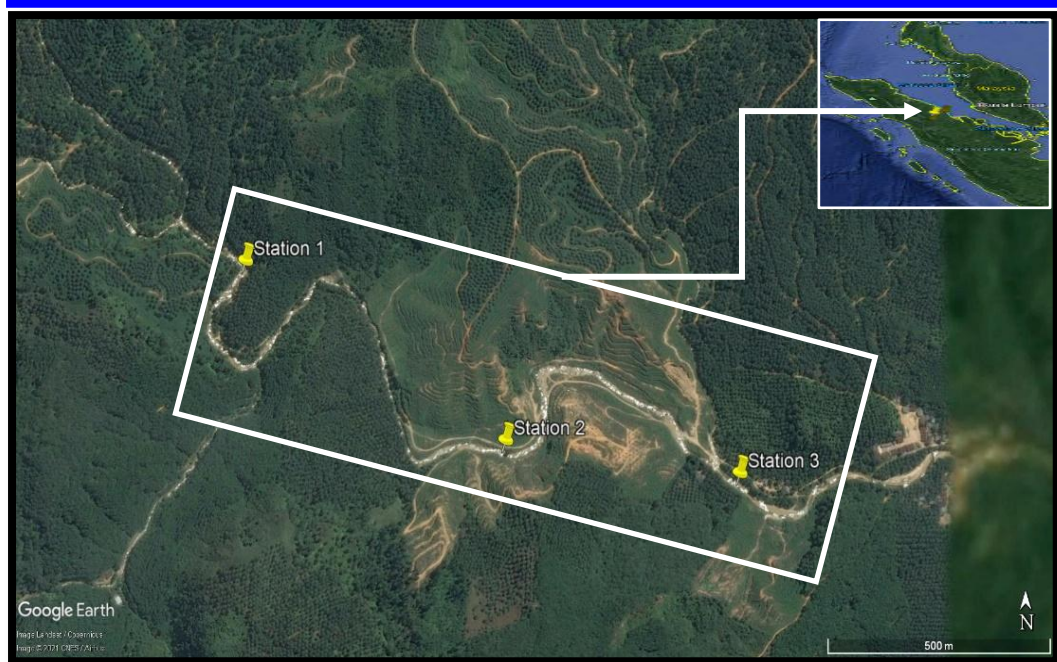


Figure 1. The Map of Research Location.

The instruments used in this research activity were a thermometer to determine water quality (temperature), pH papers to determine pH level of water, a mini-disk to determine water transparency, a fishing line and a ping-pong ball to determine current velocity of water, Kottelat *et al.* (1993), Weber & de Beaufort (1913), and Weber & de Beaufort (1916), as identification book to identify of ichthyofauna, digital camera to document the research activities, cast nets (with a diameter of 200 cm and a mesh size of $\frac{1}{2}$ - 1 inch), and gillnets (with a size of 100 cm x 700 cm and a mesh size of $\frac{1}{2}$ - 1 inch).

Sampling Procedure

Sampling was conducted using cast nets and gillnets. The gillnets are installed 08.00 AM - Collected at 05.30 PM (daylight sampling) and at 07.00 PM - Collected at 05.30 AM (daynight sampling). They were installed parallel to the riverbanks in the shade position and with calm currents. The cast nets were used by throwing them 30 times to the edge or into the middle of the river in order to get maximum results. All types of fishing gear used were applied at each station. All of those activities were carried out during the day.

The observed water quality parameters were water temperature, pH, transparency, and current velocity. Measurements were carried out directly in the field (in situ). After that, the data of the measurement of water quality parameters are presented in the form of a table and analyzed with the SPSS program v. 22. Then, the results are analyzed descriptively to obtain a correlation between the physical and chemical factors of water quality parameters and the fish diversity index (H') in the Tambatan's River.



Data Analysis

Diversity Index (H')

In calculating the value of the fish diversity index, the researchers using the Shannon-Wiener equation by Krebs (1978).

$$H' = - \sum_{i=1}^s (p_i \cdot \ln p_i)$$

Where:

H' = Diversity Index;

S = Number of Species;

\ln = Logarithm of Nature;

p_i = Number of Individuals of Each Type ($i = 1, 2, 3, \text{etc.}$).

The result from the calculation was then interpreted using the Shannon-Wiener diversity index criteria. According to Wilhm & Dorris (1968), interpretation of the value of index (H') is if $0 < H' < 2,302$, it means the diversity of fish population in low category; if $2,302 < H' < 6,907$, means the diversity of fish population in medium category; $H' > 6,907$, means the diversity of fish population in high category.

Evenness Index (E)

The evenness index was calculated using Krebs (1978) formula, as follows.

$$E = \frac{H'}{\log^2(s)} = \frac{H'}{H_{\max}}$$

Where:

E = Evenness Index;

S = Number of Species Found;

H' = Shannon-Wiener Diversity Index;

H_{\max} = $\log^2(s)$.

According to Rappe (2010), $0,00 < E \leq 0,50$ indicates small population or depressed community, $0,50 < E \leq 0,75$ indicates moderate population or unstable community, and $0,75 < E \leq 1,00$ indicates high population or stable community.

Dominance Index (C)

The dominance index was calculated using Odum (1993) formula, as follows.

$$C = \sum_{i=1}^s \left(\frac{n_i}{N} \right)^2$$

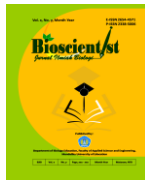
Where:

C = Dominance Index;

n_i = Number of Individuals;

N = Total Number of Individuals.





Similarity Index (SI)

The similarity index was calculated using formula Krebs (1978), as follows.

$$SI = \frac{2c}{a+b} \times 100\%$$

Where:

SI = Similarity Index;

a = Number of Species at The Location a;

b = Number of Species at The Location b;

c = Number of Species at The Locations a and b.

The result from this calculation was then interpreted using the criteria proposed by Odum (1993); Hariyadi *et al.* (2019), where if the SI value ranges from 1-30%, it means that the level of similarity is in a low category. If the SI ranges from 31-60%, it means that the level of similarity is in a medium category. If the SI ranges from 61-91%, it means that the level of similarity is in a high category. If the SI is > 91%, it means that the level of similarity is in a very high category.

Correlation Analysis (Between The Physical and Chemical Factors and Diversity Index)

The correlation test between the physical-chemical factors and the diversity index (H') was carried out using the SPSS v. 22 program. The result of this analysis will be interpreted according to Wahyuni & Zakaria (2018), where the correlation coefficient is a measure or index related to the relationship between two variables. The correlation coefficient ranges from +1 to -1. The positive and negative signs indicate the meaning or direction of the correlation coefficient relationship. If it is positive, then the two variables have a unidirectional relationship. This means that if the value of variable X is high, then the value of variable Y will be high as well. Conversely, if it is negative, then the two variables have an inverse relationship. This means that if the value of variable X is high, then the value of variable Y will be low or vice versa.

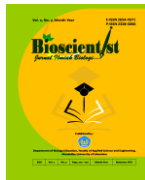
To make it easier to interpretation the strength of the relationship between the two variables, the researchers applied the criteria for the level of relationship. If the coefficient of the internal relationship level ranges from 0,00 to 0,199, it is categorized as "very low". If it ranges from 0,20 - 0,399, it is categorized as "low". If it ranges from 0,40 - 0,599, it is categorized as "moderate". If it ranges from 0,60 - 0,799, it is categorized as "strong". At least, if it ranges from 0,80 - 1,000, it is categorized as "very strong".

RESULT AND DISCUSSION

Biodiversity of Ichthyofauna

Based on the results of the fish caught at 3 observation stations in the Tambatan's River, 20 species of fish were obtained (Table 1): Silver barb (*Barbodes gonionotus*), Spotted barb (*Barbodes binotatus*), Spanner barb (*Barbodes lateristenga*), Flying foxes (*Epalzeorhynchus kallopterus*), Hampala





barbs (*Hampala macrolepidota*), Bellybarred pipedfish (*Hippichthys spicifer*), Bumblebee catfish (*Leiocassis micropogon*), Bagrid catfishes (*Leocassis poecilopterus*), (*Leptogobius oxypterus*), Ray finned (*Luciosoma trinema*), Asian Redtail fish (*Mystus nemurus*), Twospot catfish (*Mystus nigriceps*), Fire eel (*Mastacembelus erythrotaenia*), *Ostiochilus kappenii*, *Ompok siluroides*, Two-spot rasbora (*Rasbora elegans*), Mahseerfish (*Tor tambra*, and *Tor tambroides*), and Horse-face Loach (*Acantopsis dialuzona*).

Table 1. Fish Diversity in Tambatan's River.

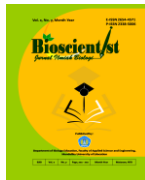
Order	Family	Scientific Name	Local Name	ST 1	ST 2	ST 3
Cypriniformes	Cyprinidae	1. <i>Acantopsis dialuzona</i>	Anculong	-	-	+
		2. <i>Barbonimus goniototus</i>	Lamasi	+	+	+
		3. <i>Barbodes binotatus</i>	Happoras	+	-	+
		4. <i>Barbodes lateristenga</i>	Gappual	+	+	+
		5. <i>Epalzeorhynchus kallopterus</i>	Slining	+	+	+
		6. <i>Hampala macrolepidota</i>	Kebarau	+	+	-
		7. <i>Luciosoma trinema</i>	Juar	-	+	-
		8. <i>Ostiochilus kappenii</i>	Aropadi	+	-	-
		9. <i>Osteochilus waandersi</i>	Lelan Batu	+	+	+
		10. <i>Rasbora elegans</i>	Siluang	+	-	-
		11. <i>Tor tambra</i>	Punguk	+	+	-
		12. <i>Tor tambroides</i>	Garing	-	+	+
Perciformes	Gobiidae	13. <i>Leptogobius oxypterus</i>	Lelan Matua	+	-	-
Siluriformes	Mastacembalidae	14. <i>Mastacembelus erythrotaenia</i>	Tilan Api	-	+	+
	Bagridae	15. <i>Hippichthys spicifer</i>	Gerigi Buaya	+	-	-
		16. <i>Mystus nemurus</i>	Baung	+	-	-
		17. <i>Mystus nigriceps</i>	Kating	+	+	-
	Siluroidae	18. <i>Leiocassis micropogon</i>	Baung Tikus	+	-	-
		19. <i>Leiocassis poecilopterus</i>	Baung Duri	+	-	-
		20. <i>Ompok siluroides</i>	Tapahora	-	-	+

Note: + (Found); - (Not Found).

The result of biodiversity of fish in Tambatan's River describe species dominant were found from Cyprinidae family with 12 species (60% from total species found), this condition suitable to statement of Kottelat *et al.*, (1993) the largest species fish that live in fresh water came from Cyprinidae. The Cyprinidae family dominates life in rivers through out Southeast Asia (Erika *et al.*, 2018; Mutiara & Sahadin, 2017), Sumatera island (Siregar *et al.*, 1993). Same report from around Sumatera island river such as Samitra & Rozi (2018) were report found 46,16% in Selingi river-west Sumatera, found 60% Cyprinidae dominate inf Batang Gadis river-Mandailing Natal (Atifah & Lubis, 2017), found 45,46% in Bah Bolon river-Simalungun district (Sinuhaji, 2017), found 80% in Muara Sipongi-Mandailing Natal district (Anwar *et al.*, 2015), found 64,28% in Belumai river-Deli Serdang district (Siregar *et al.*, 2015), found 46,87% in Ukai river-Riau (Pulungan, 2011), found 43,10% in Kampar Kanan river (Fithra & Siregar, 2010), found 40,70% in Kampar Kiri river (Simanjuntak *et al.*, 2006).

The dominance of family Cyprinidae compared to other on the river around the island of Sumatra likely caused by the condition of the river that has a level of elevation with high slope impact to the movement variations of high current velocity, Anwar *et al.*, (2015) inform that Cyprinidae family were species





are like the habitat with fast flowing the current velocity and has wide area on the bottom of river, the other reason were the availability of nutrients appropriate for Cyprinidae (Gidmark & Simons, 2014) such as little worm (Annelidae). The lesser the number of fish species and the more varied the number of individuals for each species are, the smaller the level of fish diversity in an aquatic ecosystem will be (Sriwidodo *et al.*, 2013). The fish diversity illustrates the abundance of fish in an area (Wahyuni & Zakaria, 2018). An ecosystem that has low species diversity is influenced by a low Evenness index and domination of one or a few species (Sarwono *et al.*, 2012).

Based on Table 1, fish that the largest species caught found are *Barbonimus gonionotus* and *Osteochillus waandersii*. *Barbonimus gonionotus* or commonly known as the Java barb is freshwater fish living in the lowlands to the highlands with an optimum temperature between 25°C and 33°C. Similar with report Samitra & Rozi (2018), where *Barbonimus gonionotus* were the largest species found in Kelingi's river. Meanwhile, *Osteochillus waandersii* is also freshwater fish found living in clearwater regions with rocky & gravel substrates and having current. Apart from that, fish that are caught the least were *Barbodes binotatus*, *Leioicassis micropogon*, *Leptogobius oxypterus*, *Hippicts spiciter*, *Luciosoma trinema*, *Nystus nemurus*, *Mastacembelus erytronanla*, *Ostiochillus kapenni*, *Rasbora elegans*, *Tor tambra*, and *Tor tambroides*. Wahyuni & Zakaria (2018) stated that a good habitat for fish in the river must have sufficient oxygen content, clear water, slow to moderate current velocity, sand, gravel, rock, and primary forest or shrubs in its riverbank. Samitra & Rozi (2018); Jackson *et al.*, (2001) said that if the water quality is disturbed, environmental problems will arise that are very detrimental to the survival of organisms in the river, including fish.

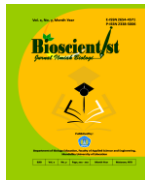
Diversity Index (H')

The value of the diversity index at each station has been almost similar, in which the values of the diversity index for stations 1, 2, and 3 are 1,87; 1,38; and 0,53 respectively. The diversity index at the three stations is classified in a medium category. Djumanto *et al.* (2013) stated that there is an inverse relationship between small fish populations and predatory fish populations. Palomares *et al.* (2020) illustrate when the biomass of predatory fish is very low, the biomass of small fish will be very high. The diversity index is a value to determine the diversity of life, which is closely related to the number of species in a community.

Table 2. Diversity Index, Evenness Index, and Dominance Index.

Stations	Index Analysis		
	Diversity Index	Evenness Index	Dominance Index
Station 1	1.87	0.676	0.062
Station 2	1.38	0.708	0.037
Station 3	0.53	0.292	0.075





Evenness Index (E)

The results of the analysis indicated that the values of the evenness index for stations 1, 2, and 3 were 0,676; 0,708; and 0,292 respectively. According to Nurudin (2013), if the value of the evenness index is higher, the abundance between species is almost similar and the fish is evenly distributed.

Dominance Index (C)

In Table 2, the values of the dominance index (C) at stations 1, 2, and 3 were 0,062; 0,037; and 0,075 respectively. From the three observation stations, it is known that the fish dominance index value in the Tambatan's River is in the low category (based on Simpson's criteria). According to Ulfah *et al.* (2019), the dominance index value usually ranges from 0 to 1. If the value is smaller, it means no dominance from the certain species found. Conversely, if the value is higher, certain species must have dominance. Nurudin (2013) explained that if dominance occurs, there will be competition in the use of potential resources and depressed (unbalanced) aquatic environmental conditions.

Similarity Index (SI)

The results of the similarity index analysis on the Tambatan's River can be seen in Table 3 below. Based on the results of the similarity index (SI) analysis, the level of similarity was 43,48% for stations 1 and 2, 45,45% for stations 2 and 3, and 61,54% for stations 3 and 1 (see Figure 4). This means that the conditions of each research station, in general, have a very high level of similarity. Therefore, it can be concluded that the diversity of species that live in those stations also has an identical level of similarity ($SI \geq 75\%$). Based of observations at the research location found dominate of *Sacharum spontaneum* on the edge of Tambatan's River, this condition presumed to be able to affect the fish biodiversity in the area. According to Binur (2010), one of the factors that may affect the similarity index is the breadth of the ecosystem. Nurudin (2013) added the vegetation and distance layout of habitat that has create the form of microhabitat also being the biodiversity factor.

Table 3. Similarity Index (SI) of Fish in The Tambatan's River.

	Station 1	Station 2	Station 3
Station 1			
Station 2	43.48%		
Station 3	45.45%	57.14%	

Table 4. Environment Parameters of Tambatan's River.

Environment Parameters	Unit	Base of Standard	Stations		
			1	2	3
Physics					
Water Temperature	°C	28 – 32	25	27	29
Water Transparency	cm	> 3 m	100	90	93
Current Velocity	m/s	-	2.26	2.16	2.12
Chemistry					
Degree of Acidity (pH)	unit	6 – 9	7.10	6.2	6.6

Note: Information Related to Quality Standards: Indonesia's Government Regulation No. 38/2011.



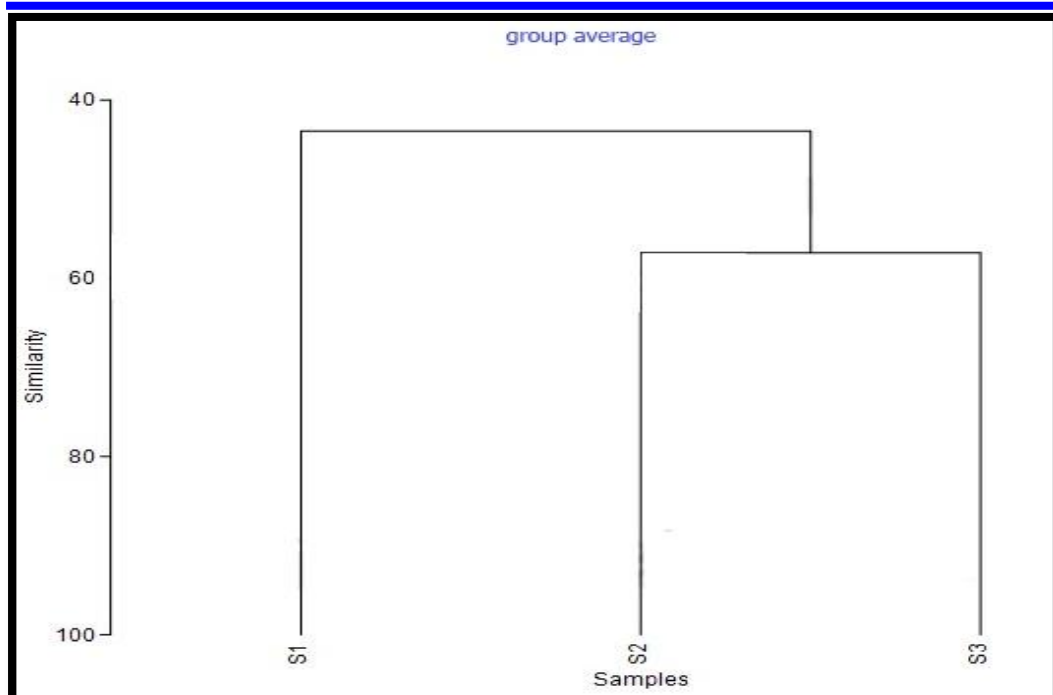


Figure 2. Dendrogram of Similarity Index for 3 Station in Tambatan's River (by Primer Software Analysis).

The pearson correlation results (on table 5) which describe between environmental factors (including pH, water transparency, and current velocity) and biological factors (the fish diversity index) indicated a positive correlation to the parameters of current velocity (0,927), water transparency (0,927), and pH (0,777), and a negative correlation to the parameters of water temperature (-0,988). The obtained correlation values range from 0,777 to 0,927, which are categorized in the very strong category, meaning that the parameters of current velocity, water transparency, and water pH greatly affect the life of fish. The highest values of these parameters are, the broader the fish diversity in the Tambatan's River will be. Sarwono *et al.* (2012) stated that if the correlation value ranges from 0,80 - 1,00, then the level of correlation is in a very strong category.

Based on the data presented in Table 4, it is known that the water temperature in the Tambatan's River ranges from 25 - 29°C, indicating that the water temperature in the Tambatan's River is still tolerable for the life of fish. Fish have a certain level of tolerance to water temperature. The optimum temperature for fish growth ranges from 20 - 30°C (Sarwono *et al.*, 2012). According to Kantun (2012), fish diversity has a certain tolerance for temperature, fish species that have a wide tolerance to temperature are called eurythermal, whereas those with a narrow tolerance are categorized as stenothermal. Water temperature may affect the respiration and reproductive activities of fish (Ridho *et al.*, 2019; Mamri, 2014). In addition, it has a role in the speed of the metabolic rate of aquatic biota and the metabolic processes of aquatic ecosystems (Staehr *et al.*, 2012).

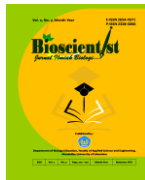


Table 5. The Pearson's Correlation Analyze Result.

Environment Parameter	Diversity Index	Pearson's Correlation Category
Water Temperature	-0.988*	(-) Negative
Current Velocity	0.927**	(+) Positive
Water Transparency	0.927**	(+) Positive
Degree of Acidity (pH)	0.777*	(+) Positive

Symbol * = Correlation is Significant at The 0,05 Level (2-tailed);

** = Correlation is Significant at The 0,01 level (2-tailed).

The pH value obtained from the measurement of physical and chemical parameters in the Tambatan's River ranges from 6 to 7. Those values are still in the water pH category that can be tolerated for freshwater biota. Furthermore, those were still in the range of class II quality standards regulated in Indonesia's Government Regulation Number 82/2001 concerning water quality management and pollution control, which ranged from 6 - 9, with stated that heavily polluted waters have a pH level of < 5 or > 9. Mamri (2014) said that the ideal pH for freshwater fish is between 6,8 and 8,5. Kencono *et al.* (2016) added a high pH level can increase the concentration of ammonia in water which is also toxic to aquatic organisms. Furthermore, to low pH conditions can kill organisms and increase the solubility of heavy metals in water.

The results of the current velocity measurement in the Tambatan's River from November 2020 to January 2021 range from 2,12 to 2,26 m/s. It means that the current in the Tambatan's River is in the very fast current speed category. Mamri (2014) mentioned that there are 4 current speed categories: slow current speed (0 - 0,25 m/s), medium current speed (0,25 - 0,50 m/s), fast current speed (0,5 - 1 m/s), and very fast current speed (above 1 m/s). Hariyadi *et al.* (2019) explained that differences in current velocity in a river are caused by differences in altitude from the surface, slope, depth, substrate of the bottom of the river, and the base width. Sand-Jensen & Staehr (2011) inform regard to longitudinal and lateral transport and exchange processes determining local habitat conditions and the food supply for fish. In addition, variations fishing gear (nets) and influence of the flow velocity also affect the diversity of ichthyofauna species caught. Yustian *et al.* (2016) shifting and movement of nets influenced by flow velocity. Erika *et al.* (2018) added the slow to moderate of velocity enable the availability sources food of fish in a waters, such as particle leave litter that get carried away by the flow from upstream to downstream rivers.

Based on the information presented in Table 4, the average values of water transparency range from 90 to 100 cm. It means that the light intensity that enters the Tambatan's River is classified as a very supportive category for fish diversity. According to Sarwono *et al.* (2012), a good transparency value for fish life is greater than 45 cm. This is reinforced by the statement from Rizal *et al.* (2013), that the depth of the waters is one of the factors that influence the presence of aquatic organisms. To put it simply, the deeper the waters are, the fewer organisms will be found. Sarwono *et al.* (2012) stated that the intensity of light entering the water column decreases with increasing water depth. Therefore, it will indirectly affect the growth of the biota in it. This can be seen in fish diversity in the Tambatan's River, in this research where found 20 species.





CONCLUSION

Based on the results of this study, we can be concluded that from Tambatan's River found 20 species of fish, in which they were dominated by *Barbonimus goniototus*, *Osteochillus waandersii*, and *Tor tambroides*. Current velocity, water transparency, and pH are environmental parameters that have positive correlation to the diversity of fish, where as water temperature is a parameter with a negative correlation to the diversity of fish.

SUGGESTION

Based on the acquisition of information from the results of this study, there are many more data about the biota of Tambatan's River ecosystem on the North Labuhanbatu Regency that need to be revealed, so this requires further research.

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