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Structure of Fish Community in The Alas River of Aceh Tenggara District

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Abstract. Research on the Community Structure of Fish on the Alas River in Babul Makmur sub-district Aceh Tenggara district was conducted from April to October 2018. The aim of this research was to analyze the structure of fish communities and to analyze physical-chemical factors related to fish community structures in the water of the Alas River in Babul Makmur sub-district Aceh Tenggara district. This research using "Purposive Sampling" method on the location based on human activities i.e the tributary of the Lawe Pakam (household waste disposal), the meeting of 2 rivers (sand dredging), the river parent (tourism), the mountain stream (free of activity). Sampling using nets. Seven species of fish obtained from the study sites were classified into 3 ordo (Cypriniformes, Perciformes, Siluriformes). The result showed that station 1 had the highest fish density at 0.3 ind / m2 for species Tor tambroides. Station 3 had the highest fish diversity index at 1.6213. Temperature, phosphate, light intensity, light penetration, dissolved oxygen and oxygen saturation had strongly correlated with fish diversity in the waters of the Alas River.

Keyword: Alas River, Community structure, Diversity, Tor tambroides

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1 Introduction

Southeast Aceh is one of the districts that is part of Aceh Province, its territory is surrounded by mountains and has very potential natural resources. According to [1] Southeast Aceh Regency is geographically located between 30 55' 23" - 40 16' 37" LU and 960 43' 23"- 980 10' 32" BT. Southeast Aceh regency is administratively divided into 16 sub-districts, 51 mukim and 385 villages, where this southeast Aceh region has a population of about 184,150 people in 2012.

The southeast Aceh region has a high biota diversity, one of which is Gunung Leuser National Park (TNGL), and stretches a very long river that surrounds the southeastern Aceh region called The Alas River or commonly called Kali Alas, and many tributaries empties or flows into

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the body of the Alas River. According to [2] In Southeast Aceh Regency there are two large rivers and several small rivers, namely the Lawe Alas river, which is ± 200 km long with an average depth of 3 meters and an average width of 30 meters, and the Lawe Bulan river. In addition to these two large rivers, the entire southeast Aceh region is crossed by many small rivers. These rivers play a major role in meeting people's water needs, both as a source of clean water (for household needs, such as for bathing, washing, and drinking water), watering rice fields and other agricultural land, as well as for fish farming.

River as one type of living media of aquatic organisms, often becomes a household garbage dump both solid and liquid waste, both organic and inorganic waste by the community around the river that can pollute the river, so that the river often does not escape the problem of declining water quality [3].

The condition of the Alas River is currently experiencing a decrease in quality. According to [4] The Alas River is disrupted due to logging in upstream areas and along watersheds, characterized by yellowish water colors due to the abundance of mud due to erosion and frequent flash floods. The decrease in the water quality of the Alas River will have an impact on fish biota. Therefore research on the Structure of Fish Communities in the Alas River is very necessary.

Alas River is a river that is needed by the local community to carry out various activities such as tourist areas, for daily purposes, even as fishermen's livelihoods. But people who are less concerned actually indirectly damage the aquatic ecosystem such as, fishing by electrocution, dredging river sand for building needs, and garbage disposal into the river, so that it will affect the quality of river water. The decrease in water quality will interfere with the biota activity contained in it, one of which is fish organisms, therefore research is needed on the relationship of fish community structure which includes the diversity of fish species and physical-chemical factors in the water of the Alas River as needed.never been studied so it is necessary to study data on fish diversity as a source of information.

2. Research Methods

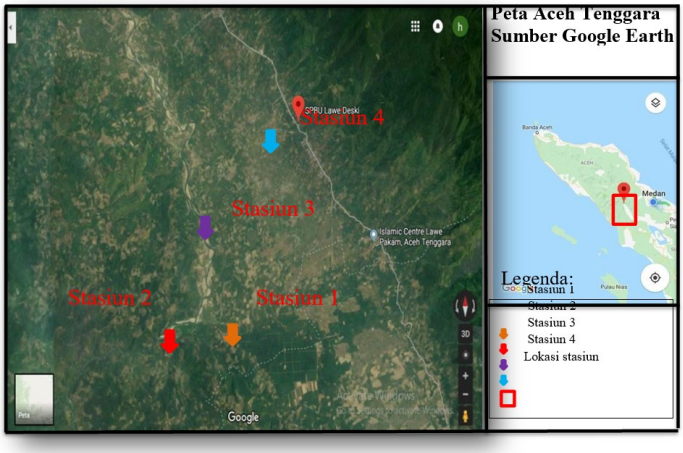
2.1. Time and Location of Research

This research was conducted from April to October 2018 in Sungai Alas, Babul Makmur Subdistrict, Southeast Aceh Regency, Aceh Province. Then the sample was identified in the Laboratory of Natural Resources and Environment Management, Department of Biology, Faculty of Mathematics and Natural Sciences, University of North Sumatra Medan.

2.2 Area Description

2.2.1 Station 1 research location

This station is a tributary originating from Lau Pakam Village that flows into the Alas River in Muara Situlen Village. Activities in this area are household waste disposal and are geographically located at coordinate points 30 33' 40" LU and 980 39' 16" BT



Information:
Sation 1= Sungaianak Station (household waste disposal activity), Station 2 = Meeting 2 rivers (sand dredging activity). Station 3 = Sungai Induk (tourism activities). Station 4 = Tributaries (activity-free)

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

2.2.2 Station 2 research location

This station is a river that is a meeting river and the main river in Muara Situlen Village. The activity on this river is dredging. Sand and geography are located at coordinate points 30 15' 51" LU and 970 54' 48"BT

2.2.3 Station research location 3

This station is the main of Alas River located in Salim Pipit Village. The activities contained in this river are tourist attractions and geographically located at coordinate points 30 17' LU 43' and 970 54' 40" BT

2.2.4 Station research location 4

The station is one of the alas tributaries originating from the mountains in the village of Karo and is an activity-free station and is geographically located at 30 19' 17" LU and 970 57' 57" BT which can be seen in Figure 1

2.3. Fish Sampling

The research method is determined by the Purpossive Sampling Method. Sampling is done using a net that has a length of 5 m x 1 m with a net eye size of 2 cm x 2 cm. The necessary nets are installed simultaneously conditioned with the width of the river, and the installation is carried out in consecutive zigzags from the left, center and right banks of the river. The installation of nets

twice in 24 hours is done in At 07.00 WIB and the results were taken at 16.00 WIB to get fish sample data, and reassembled at 17.00 WIB and the results were taken at 06.00 WIB to get fish sample data. At the time of installation of the net is carried out measurement of the physical factors of the river chemistry. At the top of the net is installed buoys every meter, while at the bottom of the net is installed ballast on each meter and fishing nets are tied to the support pole. Then the results of the fish obtained are calculated the amount is then measured in length using a ruler and weight using digital scales and dissected using surgical tools to observe the gonads. Upon completion the sample is then put in clear plastic and preserved with 70% alcohol. It was then taken to a laboratory to be identified using freshwater fish books in Nanggroe Aceh Darussalam and Leuser Ecosystem Area (Classification and Decryption).

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 Disolved oxygen (DO)

The measurement of dissolved oxygen is done with the DO meter, which is a sample of water inserted into the DO meter cup, then looks at the values listed on the DO meter screen, then records the results.

2.4.5 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.

2.4.6 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.

2.4.7. 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.

2.4.8 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 λ = 410 nm. Then the values listed on the spectrophotometer.

2.4.9 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.

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 [5,6].:

2.5.1. Population Density (D)

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

2.5.2. Relative Density (RD)

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

2.5.3. 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]

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)

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

E = Equitability Index

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

2.5.6. Simirilaty Index

$$IS = \frac{2C}{a+b} x\ 100\ \% \quad (7)$$

IS = Sinirilaty Index

a = total species for location a

b = total species for location b

c = total species for location a and b

2.5.7 Sex Ratio

To find out the sex of the fish then by observing its morphology and surgically performed to see the male gonad and the female gonad.

The sex ratio can be searched using the following formula**:**

$$RK = \frac{M}{W} x100\ \% \quad (8)$$

Where:

RK: Gender Ratio

A: Men

B: Women[7].

2.5.8 Domination Index

To find out which species or genus dominates other groups [8]

$$\boldsymbol{C} = \sum_{\boldsymbol{i=1}}^{\boldsymbol{s}} \left[\frac{\boldsymbol{ni}}{\boldsymbol{N}}\right]^{\boldsymbol{2}} \quad (9)$$

Information:

D: Dominance index

Ni: Number of individuals of the 1th genus

N: Total number of individuals

The criteria for the dominance index are:

$0 < C \leq 0.5$ = no genus dominates

$0.5 < C < 1$ = dominating genus

2.5.9 Gonad Maturity Index (IKG)

First the fish is dissected and then the gonad is taken and then the gonad is weighed [7].

$$RK = \frac{Wg}{Wt} x100\ \% \quad (10)$$

Description:

Wg: Gonad weight

Wt: Final weight

2.5.10 Fish Length

The total length of the fish is measured from the tip of the snout to the tip of the fish tail using a ruler with a precision of 0.1 mm, then records the results.

2.5.11 Fish Weight

The weight of the fish was weighed using digital scales with an accuracy of 0.1 grams, then recorded the results.

2.5.12 Long Weight Relationship

Long fish relationships can be performed to see the growth patterns of fish in nature, which is determined by the following formula [7]:

$$\boldsymbol{W = aL^b} \quad (11)$$

a: Growth coefficient

A linear regression approach is performed to look at the relationship of the two parameters. Value b is used to estimate the growth rate of both parameters analyzed. The hypotheses used are:

1. If b = 3 then it is called isometric (long growth pattern equals weight growth pattern).
2. If b≠3 is called allometric, it is:

a. If b>3 is called allometric positive (more dominant weight growth).

b. If b<3 is called allometrically negative (long growth is more dominant).

2.5.13 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 Alas River, obtained 7 types of fish as seen in Table 1 below.

Table 1.Types of Fish obtained at a research station on the Alas River

No.	Ordo	Family	Species	Station			
				1	2	3	4
1.	*Cypriniformes*	*Cyprinidae*	*Mystacoleucus marginatus*	+	+	-	-
		Cichlidae	*Tor tambroides*	+	+	+	+
2.	*Perciformes*	*Channidae*	*Oreochromis mossambicus*	-	-	+	+
		Claridae	*Ophiocephalus striatus*	+	-	+	+
3.	*Siluriformes*	*Loricariidae*	*Clarias batrachus*	+	+	+	-
		Bagridae	*Lyposarcus pardalis*	+	+	+	-
			Mystus nemurus	+	-	+	-
		Total		6	4	6	3

Information:
Station 1 = Lawe Pakam Tributary (Household Waste Disposal)
Station 2 = Meeting of 2 rivers (sand dredging)
Station 3 = Mother River (Tourism)
Station 4 = Mountain stream flow (Activity-free)

Table 1 shows that the acquired fish consists of 3 orders, 6 families, and 7 species. At station 1 obtains 6 species of fish, station 2 obtains 4 species of fish, station 3 obtains 6 species of fish, while at station 4 obtains 3 species of fish. However from every station there are some species that cannot be found, this is because the number of individuals and species found is only small. The types of fish obtained each have different characteristics, especially in terms of morphology can be seen as follows:

a. **Cencen Fish (*Mystacoleucus marginatus*)**

Figure 1 shows the shape of the fish's body that is somewhat elongated and the middle is somewhat prominent, as well as scales that are silver gold, the whole body covered in scales. Total length 12 cm-13 cm; standard length 9.3 cm-10.5 cm; head length 1.7 cm-2 cm; tail length 3 cm-3.5 cm; height of 3.5 cm; Weight 24.9 g-26 g. Fish of this group are distinguished from other groups from small horizontal spines in front of dorsal fins. The first thorn of the toothed dorsal fin. Four short sunguts, namely 2 sunguts in the muzzle of the upper jaw and 1 sungut in each corner of the mouth. 26-29 scale along the side of the gurat and 6-7 scale [9].

Figure 2 *Mystacoelucus marginatus*

b. White man/fish (*Tor tambroides*)

Figure 2 shows the body shape of a slender and flattened fish, a body covered in silver scales as well as yellowish fins and tails. Total length 11.5 cm-31.3 cm; standard length 9.1 cm-22 cm; head length 2.4 cm-4 cm; tail length 2.3 cm-7.5 cm; height 3.5 cm-4 cm; Weight 20.4 g-131.2 g. This fish has a flesh protrusion or caping under a large lip (the caping length is 17-26% and the width is 16 cm-28 cm from the length of the head) and the caping almost reaches the corner of the mouth. The initial dorsal fin was in the middle of the body and was essentially parallel to the abdominal fin. It has 2 sumblings in the upper jaw and 1 srum each at the corner of the mouth[9].

Figure 3 *Tor tambroides*

c. **Mujahideen Fish (*Oreochromis mossambicus*)**

Figure 4 shows the body shape of a flat fish, the body covered in brownish scales and black fins and tail and tail fins, as well as the shape of the taper mouth, a total length of 16.5 cm-22.7 cm; standard length 18.8 cm-22 cm; head length 4.5 cm-4 cm; tail length 3 cm-45 cm; height 5-9 cm; heavy body 73.20 g-258.3 g. On the body there are 7-8 dark color bands. The side gurat is severed on the 19th scale, down 2 1/2 scales and backwards 3 scales (on the 16th scale) then continues again. Male fish are brighter in color especially during spawning times [9].

Figure 4 *Oreochromis mossambicus*

d. **Ikan Gabus (*Ophiocephalus striatus*)**

Figure 5 shows the shape of the fish's rather round body elongated at the front and somewhat flat at the back, the shape of a round mouth and a body covered in slimy and black dark scales. Total length 10.5 cm-20.5 cm; standard length 8.5 cm-17.5 cm; head length 2 cm-4.5 cm; tail length 2 cm-3.5 cm; height 1.5 cm-2.5 cm; Weight 10.8 g-71.33 g. The body of cork fish is generally

brown to black at the top and light brown discharge in the stomach. The head is rather flat with large scales above the head. The upper side of the body of the cork fish from head to tail is dark brown, black or greenish. The lower side of the white body starts the chin backwards. The sides are crossed thick (striata, doodling) and somewhat opaque. The mouth of the cork fish is large, with sharp teeth. The dorsal fin is elongated with the rotation of the tail fin at the end. [10].

Figure 5 *Ophiocephalus striatus*

e. **Catfish (*Clarias batrachus*)**

Figure 6 shows the body shape of the slippery fish has no scales, the whole body is dark black and this fish has 3 pairs of sunguts in the mouth. Total length 14 cm-17.5 cm; standard length 12 cm-14.5 cm; head length 2.2cm-3.5cm; tail length 1.5 cm-2 cm; height 2.5 cm-3.2 cm; Weight 23.52 g-31.5 g. Like the other genus Clarias, this fish also has two basins at the head (ubun-ubun), the first basin is larger and its position only begins between the eyes (interorbital) and ends in the middle of the head. This is 3.4 times shorter than SL. Striated body color is white-greenish like marble. The spines of the pectoral fins are blunt and the ends are enveloped by non-toxic membranes and spines, rarely reported stinging [9]

According to [11] the clariidae family has a combination body shape, cylindrical body, flat and hard head, has a wide mouth with four pairs of long sunguts around the mouth, has long and non-prickly dorsal fins and has additional respiratory organs, which allow for living in low oxygen waters.

Figure 6 *Clarias batrachus*

f. Glass Broom Fish (*Lyposarcus pardalis*)

Figure 7 shows the fish's body has hard scales and fins totaling 3 pairs, the entire body is black and has a white dotted line pattern. The mouth is located on the surface under the body and the eyes are located on the upper surface of the body. Total length 21.7 cm-29.5 cm; standard length 16.5 cm-22 cm; head length 3.5 cm-4.5 cm; tail length 5.4 cm-8 cm; height 5.5 cm-4 cm; Weight 143.1 g-182 g. The body of this fish is covered by thick petals whose ends are thorny. The fingers of the pectoral fins are spiked at the end. Fin fingers dorsal, abdominal fins and pectoral fins are finely spiked in the trunk. The mouth is lower and has one sumbling two branches located at each corner of the mouth, and a flat stomach. The second dorsal fin is very short in the form of only one blunt spine that is behind its membrane. The tip or lobe of the lower tail is longer than the top [9].

Figure 7 *Lyposarcus pardalis*

g. Bahung Fish (*Mystus nemurus*)

Figure 8. shows the body of the fish has no scales and the entire surface is slippery and slimy, the whole body is yellowish and has a sling in the mouth. Total length 15 cm-33 cm; standard length 13 cm-26 cm; head length 3.5 cm-5 cm; tail length 3 cm-7 cm; Height 2.8 cm-5.5 cm; Weight 36.8 g-309.5 g. The body of this fish is covered by thick petals whose fat fins are longer than the dorsal fins but not connected to the dorsal fins. The length of the upper jaw does not reach the fins. This species is one of the Mystus groups that has been widely researched and has been cultivated in ponds and cages [9].

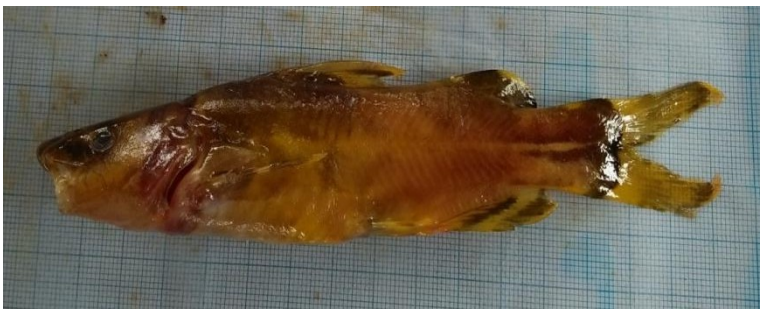


Figure 8 *Mystus nemurus*

Table 2 Data on Density (ind/m^2), Relative Density (%) and Frequency of Presence (%) of Fish at Each Research Station in Sungai Alas.

No	Spesies	Location 1			Location 2			Location 3			Location 4		
		K (ind/ m2)	KR (%)	FK (%)	K (ind/ m2)	KR (%)	FK (%)	K (ind/ m2)	KR (%)	FK (%)	K (ind/ m2)	KR (%)	FK (%)
1	*Mystacoleucus marginatus*	0,033	4,95	16,66	0,033	5,50	16,66	-	-		-	-	-
2	*Tor tambroides*	0,3	45,04	83,33	0,2	33,38	83,33	0,233	35,09	66,66	0,2	50,12	66,66
3	*Oreochromis mossambicus*	-	-	-	-	-	-	0,133	20,03	33,33	0,066	16,54	16,66
4	*Ophiocephalus striatus*	0,033	4,95	16,66	-	-	-	0,133	20,03	50	0,133	33,33	33,33
5	*Clarias batrachus*	0,1	15,01	50	0,166	27,71	50	0,033	4,96	16,66	-	-	-
6	*Lyposarcus pardalis*	0,1	15,01	50	0,2	33,38	66,66	0,066	9,93	33,33	-	-	-
7	*Mystus nemurus*	0,1	15,01	50	-	-	-	0,066	9,93	16,66	-	-	-
	Total	**0,666**			**0,599**			**0,664**			**0,399**		

Information:

Station 1 = Lawe Pakam Tributary (Household Waste Disposal)

Station 2 = Meeting of 2 rivers (sand dredging)

Station 3 = Mother River (Tourism)

Station 4 = Mountain stream flow (Activity-free)

3.1.2 Density, Relative Density, and Frequency of Fish Presence

The values of density (K), relative density (KR), and Frequency of Presence (FK) of fish can be seen in Table 2 above. At station 1, the highest K, KR, and FK values are Tambroida Tor, at station 2 the highest K and KR values are *Tor tambroides* and *Lyposarcus pardalis* and the highest FK values are *Tor tambroides*. At the station

The highest 3 K, KR and FK values are Tambroida Tor and the 4th K station value, KR and FK are the highest is Tambroida Tor. Stations 1, 2, 3 and 4 have the highest density, relative density, and frequency of presence, Tor tambroides. This is because this species has strong survival and is found in heavy or non-heavy habitats. The lowest K, KR and FK values at stations 1 and 2 were *Mystacoleucus marginatus*, but at stations 3 and 4 *Mystacoleucus marginatus* species were not found.

According to [12] tambra fish are able to survive in narrow water, as well as low acid. According to [13] tambra fish tend to favor deeper and medium bodies of water and are heavier and adapt more quickly to their environment. According to [14] the types of fish that have the highest abundance have the ability to adapt and can utilize the potential of existing resources to live.

3.1.3 Diversity Index (Shannon-Wienner), Uniformity Index and Dominance Index Diversity value (H') uniformity index (E) and index The dominance (D) of the fish can be seen in Table 3 below.

Table 3 Diversity Index Values (H') Uniformity Index (E) and Index Fish dominance at every research station on the Alas River.

Indexes	Station 1	Station 2	Station 3	Station 4
H’	1.5122	1.2153	1.6213	0.9956
E	1.1848	0.8767	0.9048	0.9062
D	0.725	0.6977	0.775	0.6112

Information:

Station 1 = Lawe Pakam Tributary (Household Waste Disposal)

Station 2 = Meeting of 2 rivers (sand dredging)

Station 3 = Mother River (Tourism)

Station 4 = Mountain stream flow (Activity-free)

Diversity scores at all four stations ranged from 0.9956-1.6213 which was included in the low diversity score. The highest diversity index of station 3 is 1.6213 there are 6 species, and the lowest is station 4 with a value of 0.9956 as many as 3 species. One factor that influences diversity is the number of species found to be few and a small number of individuals as well.

According to [15] a low diversity index indicates that ecosystems experience stress or declining conditions. According to [16] habitat homogeneity and water quality are also taken into account as the cause of fish diversity in rivers. Ecologically it is assumed that low diversity (a small number of species) indicates a stress system or system that is being damaged, e.g. natural disasters, pollution, etc.

The uniformity index at all four stations is relatively good because it lights up. 0-1 which states the fish are evenly dispersed. According to [17] if the index is close to zero then uniformity will be lower, whereas if it gets closer to one then this species is relatively even or the number of individual species is relatively the same. The better the level of complexity, the more stable society and the higher the diversity. The higher the value of diversity, the lower the value of homogeneity and the higher the value of species productivity [18].

The dominance index at all four stations ranged from 0.6112-0.775. Thus, there are species that dominate at every station. The more dominant and more common species found at each station is tambroida tor. According to [15] the dominance index is used to determine common waters that have been introduced by fish that are classified as invasive. This is indicated by how dominant the organism is. According to [19] dominance occurs because of the results of the process of competition of evicting individuals against each other.

According to [20] the high-scale dominance index shows that the distribution of fish species is evenly distributed, meaning that there is no concentration of individuals in one type, this indicates that relative aquatic ecological conditions still exist. Stable or more natural. Meanwhile, if the low dominance index indicates an uneven population distribution and concentration of individuals in a particular type. According to [18] the dominance index shows the magnitude of the dominance of fish distribution in the water. If the dominance is high then in its habitat there are species that dominate, environmental conditions are unstable, and there is ecological pressure on the fish.

3.1.4 Fish Equality Index (IS)

The equality index (IS) values at each station can be seen in the table 4 below.

Table 4 Fish Equality Index (IS) data at each research station on the River Basis

Stations	Station 1	Station 2	Station 3	Station 4
Station 1	-	80%	83,33%	44,44%
Station 2	-	-	60%	28,57%
Station 3	-	-	-	66,66%
Station 4	-	-	-	-

Information:
Station 1 = Lawe Pakam Tributary (Household Waste Disposal)
Station 2 = Meeting of 2 rivers (sand dredging)
Station 3 = Mother River (Tourism)
Station 4 = Mountain stream flow (Activity-free)

The highest equivalence index at stations 1 and 3 was 83.33% categorized as similar, but not much different from stations 1 and 2. One of the factors that affect species similarity at stations 1, 2, and 3 is the physical factor of murky brown water, substrate in the form of sand, small rocks and winding and medium river currents. At stations 2 and 4,

The similarity of 28.57% is relatively low because it is caused by the difference in water conditions that are very striking, namely station 4 clear and clear colored water, substrate in the form of sand, boulders and gravel, and heavy and moderate river currents. According to [21]the

smaller the equivalence index, the fewer fish species are similar between the two locations, and are strongly influenced by environmental factors contained in the area.According to [18] the types of river habitats with substrates are generally divided into pond groups (quiet habitat, mud substrate), riffle (sand substrate) and fast (stone substrate). This river is widely used by the surrounding community to meet daily needs.

3.1.5 Fish Sex Ratio

The sex ratio of fish in the Alas River can be seen in the table 5 below.

Table 5 Sex ratio of each fish species obtained at the station research on the Alas River.

No.	Species	Station 1	Station 2	Station 3	Station 4
1.	*Mystacoleucus marginatus*	-	-	-	-
2.	*Tor tambroides*	2:1	1:1	2,5:1	2:1
3.	*Oreochromis mossambicus*	-	-	1:1	1:1
4.	*Ophiocephalus striatus*	-	-	3:1	1:1
5.	*Clarias batrachus*	2:1	1,5:1	-	-
6.	*Lyposarcus pardalis*	1:2	1:1	1:1	-
7.	*Mystus nemurus*	2:1	-	1:1	-

Description J: Male; B: Female

The sex ratio of each fish obtained ranges from 1:1 to 2.5:1 and is a relatively different and more dominant male sex ratio than females between stations 1, 2, 3 and 4. At station 1 the ratio of males is more dominant than females there are 3 species and 1 species the ratio of females is more dominant. At station 2 the number of males and females is almost balanced and only 1 species of male ratio is more dominant. At station 3 the ratio of males and females 2 species is predominantly male, while the other 3 species are balanced. At station 4 there is 1 species with a larger male ratio and 2 other species are balanced. However, the comparison of male and female fish both in nature and cultivation is categorized as balanced, namely 3 females into 1 male.

According to [22] the ratio of male and female sex to female 1:1, which is 50% each, is the ideal number for sustaining fish populations. However, this is not absolute because distribution patterns are influenced by food chain balance factors, and population density. Fish eating habits are influenced by living habitat, fondness for certain types of food, seasons, size and age of fish [7].

According to [23] differences in the number and size of fish in the population in the waters can be caused by new patterns of growth, migration, and changes in fish species in existing populations, causing competition in these habitats that affects the number of fish populations. One of the factors that affect fish growth patterns is food that can also trigger migration.

3.1.6 Gonad Maturity Index

Gonad Maturity Index of fish in Alas River can be seen in Table 6.

Table 6 Gonad maturity index of each acquired fish species length, weight, gonad weight and gonad maturity index of gonad fish obtained at a research station on the Alas River.

No.	Species	Length (cm)	Weight (g)	Weigth of Gonad (g)	IKG (%)
1.	*Tor tambroides*	11.8-23.5	18.5-164.8	1.1-4.4	0.66-8.10
2.	*Mystacoleucus marginatus*	12-13	24.9-26	2.1-2.3	8.07-9.23
3.	*Mystus nemurus*	15.5-33	31.5-309.5	3.9-5.6	-
	Mean	17.21	74.63	2.57	6.17

Gonad maturity index, where gonads are found from 3 species namely *Tor tambroides* from 28 tails only 8 tails found gonads with the characteristics of small granules covered in membranes and pale yellow; *Mystus nemurus* of 5 tails only 2 have gonads with small granules typical of egg yolks covered by reddish membranes and blood vessels; *Mystacoleucus marginatus* 2 tails have gonads with distinctive greenish yellow granules in the form of small clumps. Other fish species not found by gonads are *Oreochromis mossambicus, Ophiocephalus striatus, Clarias batrachus*, and *Lyposarcus pardalis*, because they have not undergone fertilization and gonads have not yet developed and some are males. From the maturing index gonad 3 spsies range from 0.66-12.22% it can be concluded that only a few manage to lay eggs, causing a decrease in the number of species and individuals of fish in unfortunately.

According to [23] the initial size of gonad maturity is one of the important parameters in determining the smallest size of fish caught or caught. The recovery of the size of the first mature gonad is one way to find out the development of the population in water. Future declines in fish populations can occur because fish caught are fish that will colonize or fish that have not had time to colonize. The level of gonad maturity is the level of sexual maturity in fish. Most metabolic results are used during the gonad development phase [22]. At the stage of gonad maturity, the development of eggs becomes larger, contains egg yolks and will ovulate in medium fish. It's an adult [24]. According to [25] in an un fertilized egg, the outside is coated by a membrane called a capsule membrane or khorion. Under the chorion is a second membrane, the vitelin membrane.

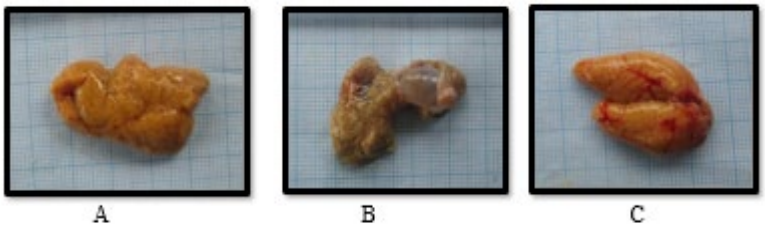


Figure 9 Gonad *Tor tambroides* (A), *Mystacoleucus marginatus* (B), *Mystus nemurus* (C).

Based on Figure 9 gonad Tor tambroides and Mystus nemurus are categorized in group IV as adult gonads, while Mystacoleucus marginatus gonads is categorized in group III because it still develops gonads.

According to [26] the grouping of ovarian development levels consists of several stages, namely:
Stage I (young): small, transparent, yellowish white, slightly asymmetrical, somewhat cylindrical, transparent ovum and without egg yolk deposits, long and thin oed ducts.
Stage II (young, developing): clear ovaries, small, transparent, slightly asymmetrical, slightly reduced o'ansl.
Stage III (developing): the o'a duct is greatly reduced, the appearance of the granular ovary, clearly, can be seen with the naked eye.
Stage IV (adult): the ovaries are yellow, oel ducts are reduced, occupying almost 2/3 of the body cavity, eggs in the follicles.
Stage V (adult): the ovaries are yellow, occupying 2/3 to 3/4 of the body cavity, blood vessels collect on the surface.
Stage VI (memijah): Occupies almost the entire body cavity, dark yellow or beige, asymmetrical, reduced o'aqueducts, larger eggs and extruded after pressure on the abdomen.
Stage VII (childbirth): the ovaries shrink, begin to empty, in the ovaries only slightly in the form of eggs.

3.1.7 Long Weight Fish Relationship

The long relationship of fish can be seen in Table 7 below.

Table 7 Data on the long relationship of fish obtained from the Alas River.

No.	Spesies	B	Growth pattern
1.	*Mystacoleucus marginatus*	0,540071	Allometrik (-)
2.	*Tor tambroides*	3,02394	Allometrik (+)
3.	*Oreochromis mossambicus*	4,11127	Allometrik (+)
4.	*Ophiocephalus striatus*	2,803752	Allometrik (-)
5.	*Clarias batrachus*	2,347683	Allometrik (-)
6.	*Lyposarcus pardalis*	0,843839	Allometrik (-)
7.	*Mystus nemurus*	2,849606	Allometrik (-)

Information:

Negative allometric sign (-)

Positive allometric sign (+)

Fish growth patterns obtained in the Alas River are different, namely Mystacoleucus marginatus, Ophiocephalus striatus, Clarias batrachus, Lyposarcus pardalis, and Mystus nemurus which have negative allometric b values whose growth is more dominant, while Tor tambroides and Oreochromis mossambicus have values of b = 3.02394 and 4.11127 which are all positive.

According to [27] the small value of b is strongly influenced by fish, where fish that swim more actively show a lower value of b when compared to passive fish.

Growth is the relationship between length and weight[28] . According to [23] differences in the number and size of fish in a population in the waters can be caused by new fish species growth, migration, and changes in existing populations. One of the factors that influence fish growth patterns is food that can also trigger migration in some fish species.

According to [29] male and female fish have longer growths faster than heavy growth. The average condition factor value of male and female fish is almost the same, which means the obesity of male and female fish can be said to be balanced. The value of the condition factor of the female fish cannot be said whether it increases or decreases with an increased length size. In male fish the longer the fish, the condition factor increases.

The long and weight relationship of fish species can be seen in figure 10 below.

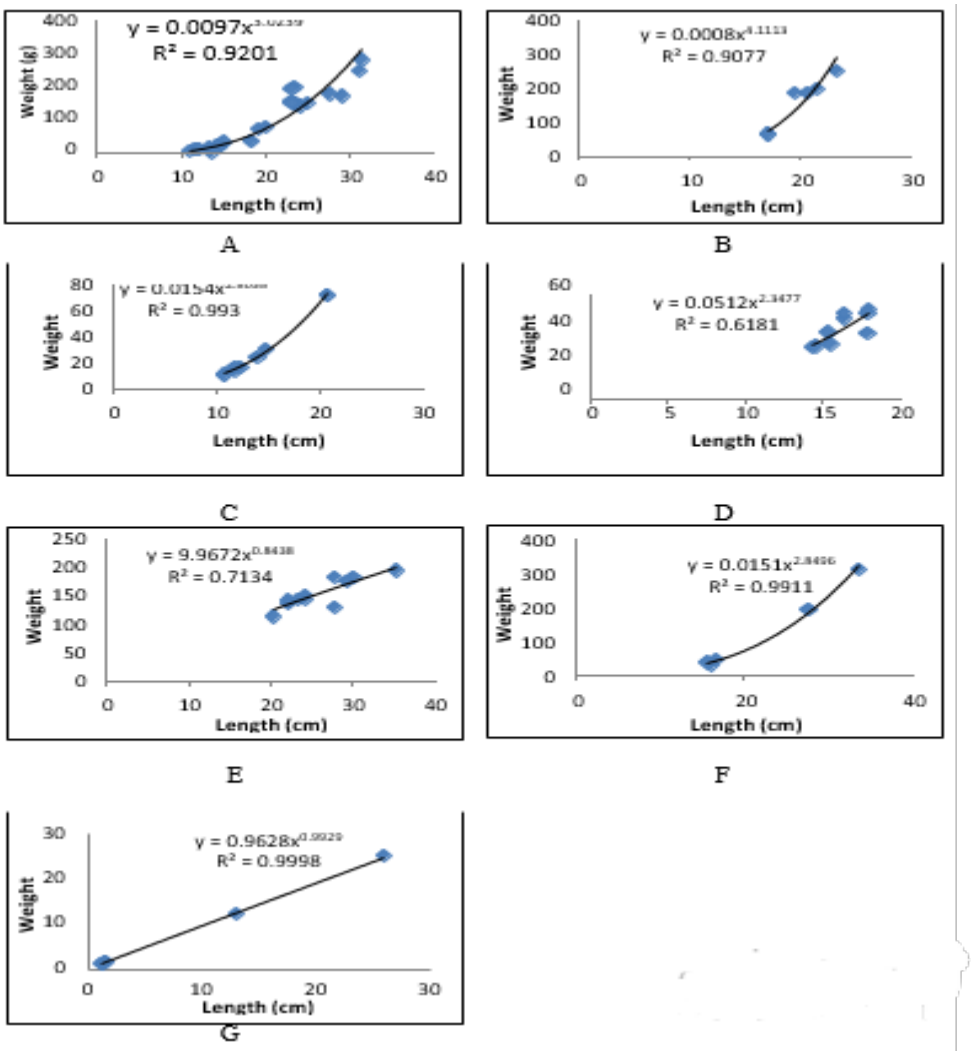


Figure 10 Fish growth patterns obtained at all four stations: *Tor tambroides* (A), *Oreochromis mossambicus* (B), *Ophiocephalus striatus* (C), *Clarias batrachus* (D), *Lyposarcus pardalis* (E), *Mystus nemurus* (F), *Mystacoleucus marginatus* (G).

3.2 Abiotic factors of aquatic environment

The physical-chemical factors of the waters in the Alas River can be seen in Table 8.

Table 8 Aquatic physics-chemistry parameters at each research station on the River Alas.

No.	Parameters	Units	Station 1	Station 2	Station 3	Station 4
1.	Temperature	°C	25.75	24.25	24.5	22.75
2.	Intensity of light	Candela	427.75	387.5	390	368.5
3.	Light penetration	Cm	67.5	59.5	30.5	75.5
4.	pH	-	9.02	6.18	5.97	7.17
5.	DO	mg/L	6.9	7.1	7.5	8.1
6.	BOD5	mg/L	3.3	2.9	4	5
7.	Oxygen sturation	%	86.03	86.37	91.68	96.08
8.	Nitrat (NO3)	mg/L	11.9	12.9	0.6	2.66
9.	Fosfat (PO4)	mg/L	0.02	0.02	<0.001	0.05

Information:

Station 1 = Lawe Pakam Tributary (Household Waste Disposal)

Station 2 = Meeting of 2 rivers (sand dredging)

Station 3 = Mother of the River (Tourism)

Station 4 = Mountain stream flow (Activity-free)

Table 9 Pearson appreciates the correlation between fish diversity and the physical-chemical properties of the Alas river.

No.	Parameter	Nilai Korelasi
1.	Temperature	+ 0,805
2.	Intensity of light	+ 0,674
3.	Light penetration	- 0,735
4.	pH	+ 0,087
5.	DO	- 0,717
6.	BOD5	- 0,421
7.	Oxygen saturation	- 0,720
8.	Nitrat (NO3)	- 0,037

Description: + = Positive correlation (unidirectional) and - = Negative correlation (opposite)

3.2.1 Physical-Chemical Parameters

3.2.1.1 Temperature

The average value of physics-chemical parameters throughout stations 1, 2, 3 and 4 is that the temperature ranges from 22.75 °C-25.75 ° C and the highest temperature is at station 1 because and the lowest temperature is at station 4. This is because the current of station 1 river is medium and the river surface is wider so that the absorption of solar heat is greater while station 4 river currents are heavy and the river surface is smaller so that the absorption of solar heat is less. However, the temperature of the four stations is a good temperature for fish, because it is still classified as optimal water temperature.

According to [22] the optimal temperature range for organisms living in tropical waters is 20°C-30°C. According to [30]temperature is a direct factor that affects the growth rate, survival

and increases the metabolic rate of the organism. The increase in water temperature will directly or indirectly affect the life of aquatic organisms.

3.2.1.2 Light Intensity

The intensity of light is one of the factors that influence the spread of fish. The intensity of light measured was in the range of 368.5-427.75 candela. The highest value is at station 1 while the lowest at station 4. This is because at station 1 the tree is only slight, while station 4 there are many trees around the station and cooler environmental conditions so that the intensity of light is lower.

According to [31] the limited light that enters the body of water interferes with the process of photosynthesis which has an impact on the decrease in dissolved oxygen content. According to [6] the intensity of light greatly affects phytoplankton and perifitons in water, the magnitude of light intensity has a major effect on the process of photosynthesis.

3.2.1.3 Light Penetration

The penetration value of light obtained at each station ranges from 30.5 cm-75.5cm. The highest value is at station 4 and the lowest is at station 3, this is because at station 4 the color of water is relatively clear and clean so that it facilitates light through water, while at station 3 water conditions are brownish and murky so as to inhibit the entry of light into the river.

According to [8] turbidity can affect the habitat of aquatic organisms. High levels of turbidity can cause stress and even death in fish. High turbidity can result in disruption of the osmoregulation system, for example, the power of breathing and viewing aquatic organisms, and can inhibit the penetration of water depth light.[31] such high levels of turbidity can disrupt the lives of fish in search of food, vision, and breathing. The higher the level of turbidity, the light that enters the body of water will also be reduced, consequently disrupting the process of vision of prey / food.

3.2.1.4 Degrees of Acidity (pH)

The acidity (pH) level at each station ranges from 5.97 to 9.02. The highest acidity is at station 1 and the lowest is in Station 3, where station 1 pH is alkaline, at stations 2 and 3 pH is acidic, while at station 4 pH is neutral.

According to [32] very acidic or alkaline water conditions can cause metabolic and respiration disorders that can indirectly affect the diversity of fish species in the river. Highly acidic or alkaline water conditions will endanger the survival of the organism, as it will result in metabolic and respiration disorders. The tolerance limit of organisms to pH varies and most aquatic organisms are sensitive to changes in pH [30].

3.2.1.5 DO (Dissolved Oxygen)

The dissolved oxygen value at each station is in the range of 6.9 mg/L – 9.3 mg/L, with the highest value at station 4 and the lowest in station 1. This is because the temperature at station 4 is lower and also the heavy flow of the river produces higher air circulation which causes the resulting oxygen to be higher, while at station 1 the temperature is higher and more activity so that the oxygen content is lower. According to [33] water can be said to be good and has a low pollution level if the dissolved oxygen level (DO) is greater than 5 mg / L, while the concentration of dissolved oxygen (DO) in natural waters has a DO value of less than 10 mg / L.

According to [30] dissolved oxygen is a limiting factor for an organism's life because it can cause direct effects resulting in the death of the organism and the indirect effect increases the toxicity of the polluting material which can ultimately harm the organism itself. The content is closely related to pollution levels, the type of waste and the amount of organic matter in the water. In addition, the ability of water to clean up pollution naturally depends on the level of do and the number of decaying organisms. According to [34] the dissolved oxygen content affects the number and type of aquatic organisms. A high DO value is the effect of water mass dissing caused by currents.

3.2.1.6 BOD_5 (Biochemical Oxygen Demand)

The BOD_5 value is one of the indicators for determining water pollution. Bod5 values at each station are in the range of 2.9 mg / L - 5.0 mg / L. According to [33] the greater the concentration of BOD indicates that the peraian has been polluted, the concentration of BOD whose pollution level is still low and can be categorized as good waters have BOD levels ranging from 0 - 10 mg / L, while waters that have BOD concentrations greater than 10 mg / L are considered polluted. According to [31] the high number of dissolved particles will have an impact on the decrease in gill performance so that fish breathing is disrupted.

3.2.1.7 Oxygen Saturation Value

Oxygen saturation values range from 86.03% - 96.08%, where the highest oxygen saturation values are at station 4 and lowest at station 1. This is caused by station 4 lower temperature while oxygen is measured higher, while in station 1 temperature is higher and oxygen is measured lower. The higher the value of oxygen saturation, the smaller the deficit of oxygen contained in the body of water and vice versa.

According to [35] oxygen plays an important role as an indicator of water quality, as dissolved oxygen plays a role in the oxidation and reduction process of organic and inorganic matter. In addition, oxygen also determines the biology carried out by aerobic or anaerobic

organisms. In aerobic conditions, the role of oxygen is to oxidize organic and inorganic matter with the end result being nutrients that can ultimately provide aquatic fertility.

3.2.1.8 Nitrate

Nitrates play an important role in the life of fish. Nitrates measured at each station range from o.6 mg/L- 12.9 mg/L. The highest values are at station 2 and the lowest is at station 3. Factors that affect the waters are around the waters which are community farmland and the waters used to support community activities. According to [22], nitrate-nitrogen levels in natural waters are almost never more than 0.1 mg / liter. According to [30] nitrate is the main form of nitrogen in natural waters. Nitrates are one of the essential compound nutrients in the synthesis of animal and plant proteins. High concentrations of nitrates in the waters can stimulate the growth and development of aquatic organisms when supported by the availability of nutrients.

3.2.1.9 Phosphate

Phosphates measured at each station ranged from <0.001 mg/L- 0.05 mg/L. The highest values were at station 4 and the lowest was at the station 3. Thus phosphate values are well categorized because they meet standard values. According to [30] based on The Minister of Lh Regulation No. 51 of 2004 the standard value of phosphate quality is 0.015 mg / L. Phosphate in water sourced from industrial, domestic and agricultural waste, as well as damage to organic materials. According to [22] the total phosphorus content in natural waters rarely exceeds 1 mg / L. While the level of phosphorus allowed for drinking water is 0.2 mg / L in the form of Phospat (PO_4).

3.3 Pearson Correlation Analysis Values

Pearson Correlation Analysis was obtained by analyzing the relationship of diversity and physical-chemical factors in the Alas River using pearson method. The correlation index value (r) can be seen in the 9 table below.

Table 9 Pearson Values correlation between fish diversity and the physical-chemical properties of the Alas River.

No.	Parameter	Corleation Rate
1.	Temperature	+ 0,805
2.	Intensity of light	+ 0,674
3.	Light penetration	- 0,735
4.	pH	+ 0,087
5.	DO	- 0,717
6.	BOD5	- 0,421
7.	Oxygen saturation	- 0,720
8.	Nitrat (NO3)	- 0,037

Description: + = Positive correlation (unidirectional) and - = Negative correlation (opposite)

The results of the correlation analysis test between the physical-chemical parameters of the waters and the diversity of fish in the Alas River differed in degree of correlation and significance.

Temperature and phosphate values collude very strongly against the diversity of fish. While the values of light intensity, light penetration, DO and oxygen saturation were strong correlations with fish diversity. BOD_5 values are quite correlated. PH and nitrate values are very weak correlations. Nevertheless temperature, light intensity and pH correlated positively with the diversity of the fish.

a. Temperature is one of the factors that affect the condition of fish. If the temperature is not optimal, it will interfere with fish organisms in the water.

b. The intensity of light also greatly affects the condition of the waters, where the light entering the water is needed by phytoplankton to photosynthesize.

c. DO plays a role in water where, DO is the dissolved oxygen needed by fish to carry out the process of respiration.

d. Oxygen saturation is good then the quality of dissolved oxygen is also good.

e. Nitrates and phosphates are nutrients needed by organisms in water.

4. Conclusion

The conclusions of this study are:

a. The fish community in alas river as many as 3 orders from 6 families and 7 types.

b. Tor tambroides are the species with the highest density values and dominate of the four stations. The diversity and uniformity index at stations 1, 2, 3 and 4 is still relatively low. Fish growth patterns are mostly allometrically negative. The sex ratio is relatively nearly balanced, but only a few species experience mature gonads caused by several factors such as gonads that are not fertilized and not fertilized to lay eggs.

c. Temperature, phosphate light intensity values, light penetration, DO and oxygen saturation are strongly correlated with the diversity of fish at each station on the Alas River.

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