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Identification of Diversity Bonorowo Aquatic Fish Species in Kalitengah Subregency, Lamongan Regency

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Abstract

Lamongan regency is one of the areas in the Bengawan Solo watershed always overflow during rainy period and around 50.17 percent of the area was a flood-stricken area called bonorowo. This study aims to identify the composition, species diversity, and potential of fish resources found in the waters of Bonorowo, Kalitengah, Lamongan for 3 months from July to September 2022. The research method is purposive random sampling method. Fish samples were taken using five types of fishing gear, namely gill nets, nets, fishing rods, bubu, and strums. Data was analysed by using relative abundance of each type of fish, frequency of occurrence, the diversity index, evennes index. Also, water quality measurements was done in situ include pH, transparency, temperature, and DO. The results of research showed that there were 16 species which belong to 10 families (*Cyprinidae*, *Channidae*, *Cichlidae*, *Claridae*, *Loricariidae*, *Belontiidae*, *Anabantidae*, *Bagridae*, *Synbranchidae* and *Macrobrachium).* The structure of the fish community is as follows: the composition of the fish species with the highest percentage of relative abundance is the family *Cichlidae* represented by species *Oreochrosmis mossambicus* (18,45%), while catfish (*Clarias sp*) has the lowest percentage at 1.39%. The diversity index range from 2,493 – 2,540 in the medium category, the evennes index ranges from 0.395 – 0.414 in the medium category, so it is quite uniform, and the all-round dominance index is in the low category for all stations because it ranges from 0.093 to 0.104. For potential analysis, there are two types of fish that have the potential to become ornamental fish, namely *Channa striata* and *Trichogaster trichopterus*. As well as the results of measuring water quality parameters prove that the condition of bonorowo waters in Kalitengah sub-regency is good for fish life.

Keywords: Bonorowo aquatic, Diversity, Fish, Lamongan.

1. Introduction

Lamongan Regency, East Java, is one of the areas in the Bengawan Solo watershed that always overflows during rainy period. Because the area is lower than the surrounding area and the Bengawan Solo River, this area is always flooded every time it rains. Around 50.17 percent of the area of Lamongan Regency is a flood-stricken area called bonorowo (Ika, 2016).

The abundance of water in Lamongan Regency is dominated by abundant runoff water from Bengawan Solo River during rainy times, causing flooding, but the opposite decreases during dry times in most areas of Lamongan Regency. Judging from its position, the Kalitengah area is the Bonorowo area with a fairly good fertility level and an even slope of the area (Muta' ali, 2012).

The Bonorowo area in Kalitengah sub regency comes from the flow of the Bengawan Solo River and its tributaries that flow throughout the year. One of the areas in Kalitengah sub regency, the Blawi area is an area that is prone to flooding during the rainy season due to an increase in water discharge (Bappeda Kabupaten Lamongan, 2021).

The Bengawan Solo River is hydrologically a floodplain zone. A floodplain is a vast plain located on the left and right of a river formed by sediment due to the flood runoff of the river and will be flooded during flooding. In 2008, the breaking of the Widang embankment in Tuban Regency caused problems that caused floods in 8 (eight) sub-regencys in Lamongan Regency, including Laren, Maduran, Sekaran, Turi, Kalitengah, Karangbinangun, Glagah and Karanggeneng sub-regencys (Yusqi, 2010).

The availability of runoff water partially accommodated in reservoirs, swamps, and dews providing abundant fish resources is considered necessary for research, especially in flooded aquatic ecosystems that receive a lot of ecological pressure from various human activities and seasons. And knowledge about the diversity of fish in water is very necessary because from time to time it undergoes changes (Bappeda Kabupaten Lamongan, 2021).

The diversity of fish species including genetic diversity in them must be maintained because it is the future of evolution and breeding. After all, it is another biological resource. As many as 13,000 freshwater species live in lakes and rivers that cover only 1% of the earth's surface, those living in seawater have 16,000 species, which is 70% of those living in seawater (Mahendra et al., 2018; Saputra et al., 2019). Recently there are about 24,618 different types of fish in the world, with the number of aquatic fish reaching 40% of the total (Haryono, 2009; Saputra et al., 2019). Indonesia around 300 types of them are found in fresh and brackish water (Rozi et al., 2018).

The objectives of the study were to identify the composition, species diversity, potential of fish resources, and potential utilization of freshwater fish species based on the characteristics of dichromatism and dimorphism found in bonorowo waters, Kalitengah sub-regency, Lamongan Regency. It is expected that the study would Identification of Diversity and Potential of Bonorowo Aquatic Freshwater Fish Species in Kalitengah sub-regency, Lamongan Regency.

2. Methods

2.1 Study Site and Time of Research

The research was carried out for three months, July 2022 to September 2022, in the waters of Bonorowo, Kalitengah sub-regency, Lamongan Regency. Sample analysis conducted at Unisla Fisheries Laboratory.

Fish sampling is taken using five types of fishing facilities, namely gill nets, nets, fishing rods, Bubu/traps, and strums. Gill nets which have a length of 30 m, net sizes of 1-1.5 m, mesh sizes of 0.5 inches, 1 inch, and 1.5 inches, nets (cast nets) with a mesh size of 1 centimeter and 1.5 centimeters, Bubu / trap and fishing line/strum, camera, identification book, and 4% formalin to preserve samples

The research methods are survey methods and purposive random sampling methods. The stations at the study site have been able to represent fish populations in bonorowo waters of Kalitengah sub-regency, so as to provide an overview of the diversity of fish species in these waters. The location of this study was determined by as many as four observation stations (Figure 1):

1. Station I is located in Pucangro Village, Kalitengah sub-regency. This location is a swamp that is always flooded, especially during the rainy season and is mostly covered by water hyacinth plants that grow wildly.
2. Station II is in Tiwet Village. This location is a small river that connects with other villages and is the main source of water for aquaculture. In the rainy season, it overflows and there is a wide puddle of water. Part of it is grown with water hyacinth.
3. Station III is located in Dondoman Hamlet, Bojoasri Village, which is near a small river that is used as the main source for aquaculture. flooding at the time of entering the rainy season.
4. Station IV is located in Sugihwaras Village, and is a tributary that is located very close to the Bengawan Solo river. Flowing water is used for agricultural and fishery irrigation.

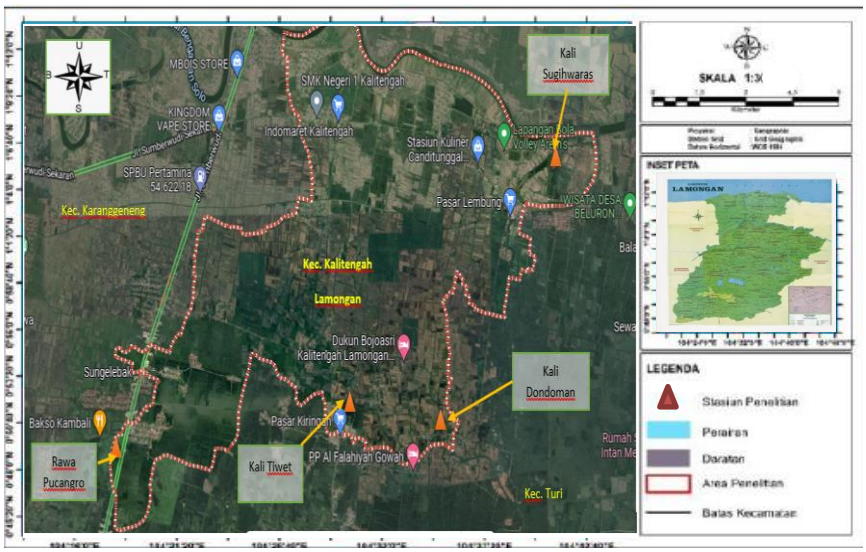

Figure 1. Study Site sampling Kalitengah subregency, Lamongan Regency

Fish samples obtained in the field are taken to the laboratory for identification, referring to the reference books of Saanin (1984); Kottelat *et al*., (1993). Data were analysed by using descriptive method.

2.2 Data Analysis

Fish community structure analysis consists of:

a. The Composition
   The composition of fish species describes the total number of fish obtained from the catch or sampling throughout the study

b. Relative Abundance
   The relative abundance of each species of fish was calculated as a percentage (Erika *et al*., 2018):

$$Kr = \frac{ni}{N} X\ 100$$

Information:
Kr = Relative abundance (%)
ni = Number of individuals of the i-th species
N = Total number of individuals of all species

c. Frequency of occurence
   The frequency of catches indicates how widespread the location of a particular type of fish is. The frequency (%) of fish caught is calculated by the equation (Brower *et al*. 1990); (Erika *et al*., 2018):

$$Fi = \frac{ti}{T} X\ 100$$

Information:
Fi = Frequency of caught species i fish (%)
ti = Number of stations where the ith species was caught
T = Sum of all stations

d. Diversity index
   Fish diversity is calculated using the Shanon-Wiener index (Setyobudiandi *et al*., 2009):

$$H' = -\sum_{t=i}^{s} pi \ln pi$$

Information:

H' = Shanon-Wiener Diversity Index
Pi = ni/N
ni = Number of individuals of the i-th species
N = Number of individuals of all species

e. Evennes Index
Fish Evennes is calculated using the Shannon-Wiener index (Setyobudiandi *et al*., 2009), with the formula:

$$E = \frac{H'}{H\ maks}$$

Information:
E : Equityability index
H' : Shannon-Wienner diversity index
Hmax: The maximum diversity index, whose value is similar to Ln S (where S is the number of species). The magnitude of the number E ranges from 0-1

f. Dominance Index
To determine dominance, the Simpson dominance index is used (Gustomi *et al*., 2015), with the following equation:

$$C = \sum_{i} (\frac{ni}{N})^2$$

Information:
C =Simpson dominance index
Ni =the number of individual species i
N =the number of individuals of all these species

3. Results and Discussion

3.1 Results

3.1.1 Characteristic and Composition of Fish Species Caught

The species of fish found in the waters of Kalitengah Bonorowo are listed in Table 1. As follows:

Table 1. CompositiFish was found of Kalitengah

No	Family	Genus	Species	Local Name	
1	Cyprinidae	Rasbora	*Rasbora jacobsoni*	Wader	93
2	Cyprinidae	Rasbora	*Rasbora argyrotaenia*	Wader pari	175
3	Cyprinidae	Barbonymus	*Barbonymus gonionotus*	Tawes	74
4	Cihclidae	Oreochromis	*Oreochromis mossambicus*	Mujair	391
5	Bagridae	Mystus	*Mystus singaring*	Keting	136
6	Claridae	Clarias	*Clarias sp*	Lele	28
7	Channidae	Channa	*Channa striata*	Gabus / Kutuk	87
8	Synbranchidae	Monopterus	*Monopterus albus*	Belut	74
9	Anabantidae	Anabas	*Anabas testudineus*	Betik	261
10	Loricariidae	Hypostosmus	*Hypostosmus Hyposarcus*	Sapu-sapu	130
11	Cihclidae	Oreochromis	*Oreochrosmis niloticus*	Nila	258
12	Cyprinidae	Cyprinus	*Cyprinus carpio*	Mas	66
13	Channidae	Chanos	*Chanos chanos*	Bandeng	47
14	Belontiidae	Trichogastric	*Trichogastric trichopterus*	Sepat	180
15	Claridae	Clarias	*Clarias gariepinus*	Lele Dumbo	40
16	Macrobrachium	Microbrachium	*Micribachium sintangense*	Udang Galah	**53**
			Amount		**2,093**

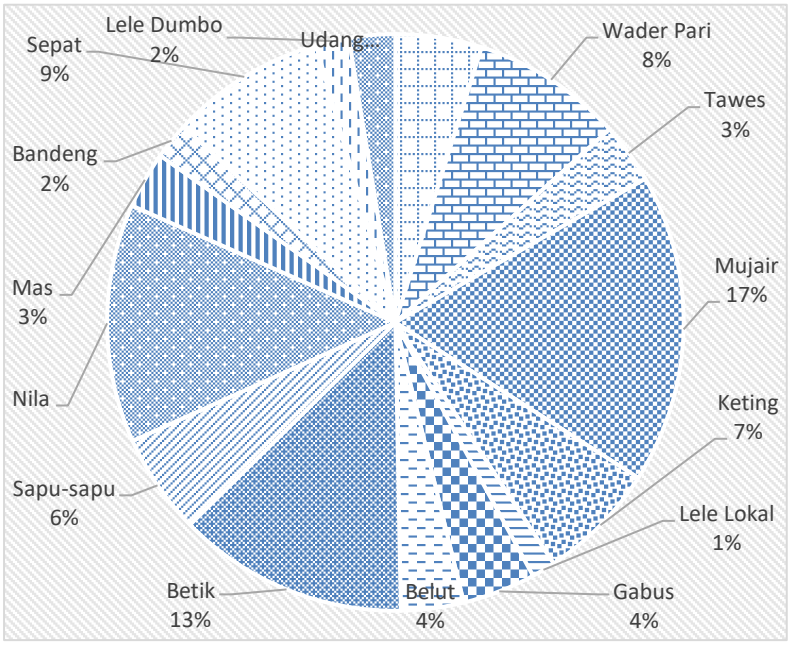

Figure 2. Composition in Bonorowo Waters, Kalitengah sub-regency

3.1.2 Relative Abundance

The relative abundance (Kr) of each type of fish caught in Bonorowo Waters, Kalitengah sub-regency, is presented in Table 2 as follows:

Table 2. Relative abundance (Kr) of each type of fish caught

No	Species	Relative Abundance (%)				Average Kr (%)
		ST. 01	ST. 02	ST.03	ST. 04	
1	*Rasbora jacobsoni*	4.57	3,42	6,24	3.81	4.51
2	*Rasbora argyrotaenia*	8.35	8.05	8,73	8,38	8,38
3	*Barbonymus gonionotus*	3.38	3.94	3,33	3,43	3.52
4	*Oreochromis mossambicus*	19,48	22.09	14,14	18,10	18.45
5	*Mystus singaring*	4.77	5.99	8.52	6,86	6,54
6	*Clarias sp*	1.79	1.37	1.04	1.33	1.38
7	*Channa striata*	3.98	4,28	4,16	4,19	4,15
8	*Monopterus albus*	3.58	3.60	3,33	3,62	3.53
9	*Anabas testudineus*	11.93	11.30	13.72	13,14	12.52
10	*Hypostosmus Hyposarcus*	5,77	7,71	5,61	5,52	6,15
11	*Oreochrosmis niloticus*	16.30	9.59	11.64	12,19	12.43
12	*Cyprinus carpio*	2.98	3.08	3,12	3,43	3,15
13	*Chanos chanos*	2,19	2.74	1.87	2,10	2,22
14	*Trichogastric trichopterus*	6,56	8.39	9.77	9,71	8,61
15	*Clarias gariepinus*	1.79	2.05	1.66	2,10	1.90
16	*Micribachium, sintangense*	2.58	2.40	3,12	2,10	2.55

3.1.3 Species Diversity Index (H'), Evennes Index (E), and Dominance Index (C)

The results of the analysis of the diversity index (H'), uniformity index (E) and fish dominance index (C) at all observation stations are presented in Table 3.

Table 3. Average Value of Diversity, Uniformity, and Dominance Index

Station	Diversity Index (H')	Uniformity Index (E)	Dominance Index (C)
1	2,493	0.401	0.104
2	2,531	0.395	0.103
3	2,540	0.414	0.093
4	2,523	0.403	0.097
Average	**2,522**	**0.403**	**0.099**

3.1.4 Water Quality

The measurement of water quality parameters aims to obtain field data that can be used as complementary data in this study. Individually measured parameters are temperature, salinity, pH, dissolved oxygen (DO), and tranparancy. The measurement results can be seen in Table 4.

Table 4. Water Quality Data in Bonorowo Waters, Kalitengah sub-regency

Parameter	Measurement Value				Reference Value
	ST. 01	ST. 02	ST.03	ST. 04	
Temperature (^{O}C)	29.7 - 31.0	31.4 - 31.8	30.6 - 31.5	31.1 - 31.8	25 – 32 ^{O}C (Elangga, 2013)
Transparancy (m)	0.4-0.5	0.4-0.5	0.4-0.5	0.4-0.5	2 m (PP No. 82 of 2001)
pH	7 - 7.7	7,2	7 -7.3	7.5 -7.7	6.8 – 8.0 (Nugroho, 2013)
DO (mg/L)	5 – 7	4 – 7.	5– 7.3	5 – 6.2	> 5mg/L (Nugroho, 2013)

3.2 Discussion

3.2.1 Overview of the Sub-regency of Kalitengah

The position of Kalitengah Subsub-regency is located between 112^{o} 23' 26" east longitude and 6^{o} 59' 56" south latitude, with a sub-regency area of 33.47 km^2. Kalitengah sub-regency consists of 20 villages, which are divided into 2 parts of the region, namely the northern region (consisting of 10 villages) and the southern region (consisting of 10 villages). When viewed from the height of the area above sea level, Kalitengah sub-regency is a lowland with an average height of 5.95 m above sea level. There are 9 villages that have an average height of 7 m above sea level, one village that has an average height of 6 m above sea level, and 10 villages with an average height of 5 m above sea level that have the potential to be affected by floods every year, the area of Kalitengah sub-regency is 43.11 km^2 with land use (BPS Kabupaten Lamongan, 2021).

Bojoasri Village is the village with the largest area in the Kalitengah sub-regency (3.63 km^2). While Lukrejo Village is the village with the second largest area (3.27 km^2), while Sugihwaras Village is the village with the third largest area (2.87 km2). Tiwet Village has the lowest area in Kalitengah sub-regency (0.71 km^2) (BPS Kabupaten Lamongan, 2021).

3.2.2 Fish Community Structure

According to the results of the enumeration of fish caught in bonorowo waters in Kalitengah sub-regency, the total number of fish found in four observation stations was 2,093 individuals, consisting of 16 species from ten families, namely four species of the family *Cyprinidae*, two

species of the family *Channidae*, two species of the family *Cichlidae*, two species of the family *Claridae*, one species of the family *Loricariida* The types of fish in the waters of bonorowo Kalitengah can be seen in table 1. Meanwhile, the total number of individuals caught from all stations was 2,093, the most caught fish were mujair fish (391 individuals) and the least was local catfish (28 individuals) presented in table 2.

From the results of the analysis of type composition (Table 1), the average value of the composition of fish species at the observation site was obtained, with the largest percentage of 3 (three) species, namely the type *Oreochromis mossambicus* from the family Cichlidae (17.36%), followed by *Oreochromis niloticus* 13.39% from the family Cichlidae and the type *Anabas testudineus* (12.92%) of the family *Anabantidae*. The lowest percentage, it is the family *Claridae* species *Clarias sp* (1.39 %).

The cichlidae family is a species of fish that is very easy to breed so that the percentage of its composition is highest in bonorowo waters. Mujair fish are omnivorous fish (predators of all, animals and aquatic plants) such as aquatic plants, diatoms, Chlorophyceae, Dinophyceae, Cyanophyceae, and Crustaceae renic) and belong to voracious fish. When they were young, mujair fish consumed plankton and zooplankton (Syahrir *et al*., 2016).

Also, the results indicated that the mujair fish species (*Oreochrosmis mossambicus*) has the highest relative abundance of 22.09% at Station 02 (Table 2) in Bonorowo waters of Kalitengah sub-regency. This is because the area of inundation of Bonorowo waters is quite large, and the water is relatively calm and deep. This is the main habitat of this species for foraging and shelter. In addition, mujair fish (*Oreochrosmis mossambicus*) is also a type of fish at stations 01, 02, and 04 with a relatively high abundance of 18.45% on average. Mujair fish (*Oreochrosmis mossambicus*) is one of the fish species found in freshwater waters in East Java. While the lowest relative abundance is local catfish (*Clarias sp*) at 1.38%.

From the results of the diversity index calculation presented in table 6, it is obtained that the diversity index (H') of each station is station 01 of 2.493; station 02 of 2,531; station 03 of 2,540; and station 04 of 2,523. Based on the results of the diversity index, the diversity of fish at all stations averages 2,522, which is included in the category of moderate diversity, meaning that it has many and diverse species. Kreb (1989) explains that the range of the diversity index for Shannon-Wiener is that if it is 1<H<3 then diversity is moderate.

Diversity is occurring at the research site by the state of the bonorowo waters alone, where until now there has been a decline in air quality, as well as the use of pollutants resulting from various activities, including those related to agriculture and society, as well as those related to the bonorowo waters themselves, but we are still in the process of tolerance. Jukri *et al.*, (2013) also asserts that the diversity and abundance of fish is also determined by the characteristic aquatic habitat. It is also influenced by environmental conditions and the area of swampy areas and extensive waterlogging as a good habitat for freshwater fish (Ulimaz 2020). Kartamihardja (2017) said that the environment, especially water quality, has an effect on fish life, and for the area of the territory, it affects the population and the formation of fish communities affects fish life. The diversity index is useful in pursuing environmental constraints (abiotic) to a community or to recognize the succession or stability of a community (Jukri *et al.*, 2013).

The evennes index in each of the research stations are as follows: station 01 of 0.401, station 02 of 0.395, station 03 of 0.414, and station 04 of 0.403. For the evennes index of all stations averaging 0.403, it can be concluded that the evennes index indicates a low category because 0 < E < 0.4; species evenness is low if the evenness of individuals belonging to each species is less evenly distributed (Jukri *et al*., 2013).

For the dominance index at all research stations, namely station 01 of 0.104; station 02 by 0.103; station 03 of 0.093; and station 04 of 0.097. Its dominance index value at all stations averaged 0.099 indicating the dominance of fish in the bonorowo waters of Kalitengah sub-regency in the low category, because there is 1 species of fish that is most commonly caught at stations 1, 2, 3, and 4 dominated by mujair fish (*Oreochromis mosambicus*). Mujair fish has become a valuable commodity due to its high tolerance to environmental conditions and rapid

growth rate (Nakkina, 2016); Yustysi *et al*., 2016). Mujair fish is abundant in bonorowo waters and is favored by the community as a source of animal protein at low prices and abundant in nature. The mujair fish (*Oreochromis mossambicus*) has long been known as one of the unsalted types of fish of great importance in religious ceremonies (Gunadi et al., 2021).

Water quality

The *temperature* in bonorowo waters is one of the indicators of the speed of biochemical reactions found in the waters. Based on the results of in-situ measurements, it was found that the water temperature ranged from 29.7 to 31.8 oC. Compared to the reference figures in Erlangga (2013) in Table 10 shows that it is safe and ideal for life/living media for freshwater fish. From the sampling results of each sampling, it is known that the temperature does not fluctuate but tends to be stable. Temperature stability in Bonorowo Waters is influenced by the metabolic rate of fish living in bonorowo waters and other biotas in them (Erlangga, 2013). Khairuman & Amri (2012) added that for growth and breeding, the optimum temperature for freshwater fish such as tilapia is around 25°C-30^{0}C according to Kottel *et al*. (1993), the family Cyprinidae prefers water temperatures of 22^{O}C-27^{o}C. From the observations, the bonorowo water area of Kalitengah sub-regency is an area with large and open waterlogging and is not protected by the presence of high-level trees. Temperatures at all stations fall into the ideal category as habitats where they live and breed to maintain the fish's population. In addition, plants that live near swamps have another purpose: to help stabilize the air, preventing it from getting too hot or too cold (Ulimaz, 2020).

Transparancy is a physical parameter that is closely related to photosynthesis in aquatic ecosystems. High transparancy indicates the ability of sunlight to penetrate deep into the water and vice versa (Effendi, 2003). The transparancy results showed that the average transparancy level at each observation station varied between 45cm and 50cm, implying that the transparancy was better for fish life because the photosynthesis process took longer, so the amount of phytoplankton available for fish consumption was less. The transparancy value varies, the high transparancy is 50 cm to the low transparancy is 45 cm. And this transparancy value is influenced by different conditions of the bottom surface of the swamp. Bonorowo waters are calm waters, the water currents are weak because they are quite wide puddles. Nybakken (1992) explained that the transparancy of water is influenced by the concentration of suspended solids, solutes, and particles and the color of water, due to the large amount of mud carried by the movement of water in bengawan can cause the transparancy to be low, the result is that water productivity decreases.

The value of the acidity (pH) of water is 7.4 – 7.7 when compared to the table of water quality parameters, which is in the range of 6.8 – 8.0, so the water conditions are categorized safe for aquatic biota life. In field observations, the fluctuation of pH changes is only 0.1 units so it is still in safe and ideal conditions. According to Barus (2004), each species has a different pH tolerance. The ideal pH range for living freshwater biota is 6.5-7.5.

Oxygen in the water is a factor that affects the way of life of an organization. The effect of oxygen levels on the body can last a long time, resulting in organ damage. Its long-term effect is to increase the toxicity of pollutants, which will eventually lead to the failure of the organism. Since oxygen is used in metabolic and reproductive processes in the body (Barus, 2004). DO in the study was 5.90 - 7.33 mg/L (Table 10). When compared with the water quality data table which is at the level of > 5 mg/L, the water conditions in the swamp are categorized as DO which is safe for fish and ideal for breeding various types of freshwater fish (Zaman & Syarifudin, 2012); (Erlangga, 2013); (Ulimaz 2020). Some species of aquatic biota, for example, can live in waters with oxygen concentrations as low as 2-3 ppm. The minimum concentration of fish proven effective in promoting healthy living is 5 ppm (Barus, 2004); (Muntarasiroh, 2018)

4. Conclusion

The conclusion of research was found 16 species from 10 families (*Cyprinidae*, *Channidae*, *Cichlidae*, *Claridae*, *Loricariidae*, *Belontiidae*, *Anabantidae*, *Bagridae*, *Synbranchidae* and *Macrobrachium).* The structure of the fish community is as follows: the composition of the fish species with the highest percentage is the family *Cichlidae* species *Oreochrosmis mossambicus* (17.30 %), catfish (*Clarias sp*) has the lowest percentage at 1.39%, relative abundance (Kr) *Oreochrosmis mossambicus* has the highest at 18.45%. The diversity index (H') is between 2,493 – 2,540 in the medium category, the evennes index (E) ranges from 0.395 – 0.414 in the medium category, so it is quite uniform, and the all-round dominance index is in the low category for all stations because it ranges from 0.093 to 0.104.

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