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Abundance and Diversity of Fish in Bengawan Madiun River, Madiun City, East Java

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Abstract
Fish play an important role in maintaining the balance of river ecosystems. The Bengawan Madiun River, which flows through Madiun City, is not only a vital natural resource but also supports the lives of the surrounding community. This study aims to identify and analyze the diversity of fish species in the Bengawan Madiun River, Madiun City, East Java. Sampling was conducted purposively at three observation stations, namely the Patihan Bridge Area, the Madiun City Bantaran Park Area, and the Sambirejo Bridge Area. The sampling method used included ¾ inch and 2.5 inch nets and fish traps. The results showed that 17 fish species belonging to 5 orders and 12 families, comprising a total of 495 individuals, were found, with the Cyprinidae family being the most dominant. The Shannon-Wiener Diversity Index (H') value was in the moderate category (2.31-2.54), the Evenness Index (E) was high (0.8894-0.9202), and the Species Richness Index (R) was moderate (2.74-2.95). Meanwhile, the Sorensen Species Similarity Index (IS) showed a high value (0.90-0.96), indicating homogeneity of fish communities across stations with similar habitat characteristics. Overall, the Bengawan Madiun River in Madiun City still supports a diverse and relatively stable fish community. However, further research is needed on aquatic environmental conditions and potential anthropogenic pressures to support sustainable fish management and conservation.

Keywords: Bengawan Madiun River, Diversity, Fish, Madiun City.

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1. Introduction

Rivers are ecosystems that are open to the environment and have both living and nonliving parts that interact with each other in a dynamic way. Among abiotic factors, water flow plays a crucial role in shaping habitat structure, regulating energy transfer, and maintaining the productivity and stability of riverine fish communities. Fishes, as an integral part of the biotic component, contribute significantly to the ecological balance of river ecosystems. Fish diversity, which is reflected in species composition, abundance, and relative proportion among species, serves as an important indicator of ecosystem health and carrying capacity. Variations in these attributes can directly

influence community structure and overall ecosystem resilience (Allan *et al.,* 2021; Pariyanto *et al.,* 2021).

Bengawan Madiun River, also known as Kali Madiun, starts in Ponorogo Regency and goes through Madiun Regency, which includes the Madiun City (Hanif, 2023; Wahyudi *et al.,* 2020). People in the area use the river for many activities, such as washing, swimming, fishing, netting, watering crops, and even as a place to collect sand and a tourist attraction. These diverse things hurt fish habitats, which makes it harder for fish to live and lowers the amount of different types of fish (Liu, 2023; Prakash & Verma, 2022; Putro *et al.,* 2022; Su *et al.,* 2021).

Studies on fish diversity in Indonesia continue to receive attention. A study on fish diversity in the Namang River, Bangka Belitung, successfully identified 15 fish species (Helmizuryani *et al.,* 2024). Another study on the structure of fish communities in the Batang Bungo River, Jambi Province, showed important diversity, evenness, and dominance index values as benchmarks for ecosystem condition (Hertati & Eriza, 2023). In East Java, research at Oxbow Lake in Lamongan and Gresik Regencies recorded 12 fish species from 7 families, with diversity index values showing a moderate category of 1,99 to 2,71, and dominance values showing a low category of 0,08 to 0,26 (Zamzami *et al.,* 2023).

Although numerous studies have examined fish diversity, there is currently no public scientific publication documenting the fish species, abundance, and overall diversity of the Bengawan Madiun River in Madiun City. Therefore the aims of the study were to identify and analyze the diversity of species. This data is essential as a basis for conservation efforts, fish resource management, and policies that support the sustainability of the river ecosystem.

2. Methods

2.1 Study Area and Time of Research

This research was conducted from June to August 2025 in the Bengawan Madiun River, Madiun City, East Java. The location was determined using a purposive sampling method at three stations selected based on their representativeness of the surrounding utilization activities.

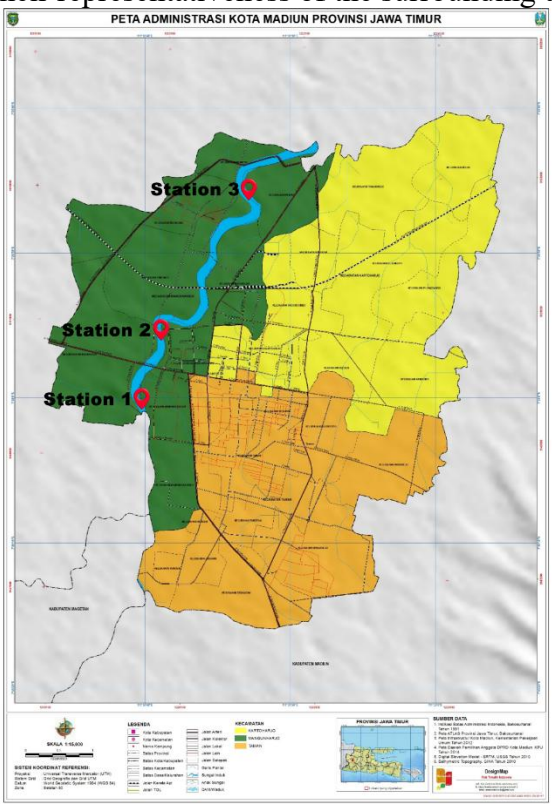

Figure 1. Fish observation station point in the Bengawan Madiun River, Madiun City (Station 1 S 7°38’39.8” and E 111°30’44.2”; Station 2 S 7°37’37.4” and E 111°30’49.9”; Station 3 S 7°36’24.8” and E 111°31’31.5”)

Human activity is considered to influence the number and diversity of fish. Station 1 is located in the Sambirejo Bridge area, an area not far from the river dam. Station 2 is located in the Bantaran Park area of Madiun City with a high intensity of human activity. This area is used as a tourist destination, for sand mining, and for various daily community activities. Station 3 is located in the Patihan Bridge area, an area with a relatively low level of human activity, generally only anglers are active in this location (Figure 1).

2.2 Data Collection and Sampling

Fish sampling in this study was conducted using several types of fishing gear adapted to obtain a variety of fish sizes and species. The fishing gear used included gill nets (mesh sizes of ¾ inch and 2,5 inch) and fish traps that had been previously baited with fish food. Sampling at each observation station was carried out in two replicate sampling efforts to improve data reliability and representativeness of the fish community. Each gill net size was deployed during each sampling event using the same fishing effort across all stations.

The fish traps were set up at each station for eight hours and reviewed every two hours to keep track of the people who were caught and make sure the traps were still working. The use of gill nets with different mesh sizes allowed the capture of fish with varying body sizes, while baited trap nets facilitated the collection of species that are less susceptible to gill nets. This combined approach enabled a more comprehensive representation of fish community composition.

Samples were then identified at the Bioentrepreneurship Laboratory of Muhammadiyah University of Madiun for the identification process. Fish identification was conducted through morphological observation, focusing on external characteristics such as body shape, coloration patterns, fin structure, scale arrangement, and meristic characters. Species determination primarily followed the taxonomic keys provided in *Freshwater Fishes of Western Indonesia and Sulawesi* (Kottelat *et al.,* 1993). To ensure identification accuracy, the observed morphological characteristics were further compared with descriptions and illustrations reported in relevant peer-reviewed studies on freshwater fish diversity in Indonesian rivers (Haqqi *et al.,* 2024; Hasan *et al.,* 2023; Widiansyah *et al.,* 2025; Zamzami *et al.,* 2023).

2.3 Data Analysis

Data were analyzed using ecological parameters in biodiversity studies (Febrian *et al.,* 2022; Gamito, 2010; Odum, 1993; Pielou, 1966). Biodiversity analysis includes:

a. The Simpson Dominance Index

The Simpson Dominance Index / (D) to determine the species that dominate the community (Febrian *et al.,* 2022; Latuconsina *et al.,* 2022; Odum, 1993).

$$D = \sum_{i=1}^{S} (ni/N)^2$$

Information:
D = The Simpson Dominance Index
ni = number of individuals of i-species
N = number of individuals of all species
S = number of fish species

b. The Shannon-Wiener Species Diversity Index

The Shannon-Wiener Species Diversity Index / (H') to describe the level of diversity (Latuconsina, 2021; Odum, 1993).

$$H' = -\sum_{i=1}^{S} \text{Pi } ln\text{Pi}$$

Information:
H' = Shanon-Wiener Species Diversity Index
Pi = ni/N (proportion of the entire community made up of i-species)

S = number of fish species
N = total number of individual fish
ni = number of individuals of i-species
ln = natural log

c. The Pielou Species Evenness Index
The Pielou Species Evenness Index / (E) to see the distribution of individuals between species (Pielou, 1966; Smith & Wilson, 1996).

$$E = \frac{H'}{ln\ (S)}$$

Information:
E = Species Evenness Index
H' = Shannon-Wiener Species Diversity Index
S = Number of fish species. Index values range from 0-1.

d. The Margalef Species Richness Index
The Margalef Species Richness Index / (R) to assess the number of species relative to the number of individuals (Kunakh *et al.,* 2023; Margalef, 1958).

$$R = \frac{S-1}{ln(N)}$$

Information:
R = Species Richness Index
N = total number of individuals
S = number of species
In = natural log

e. The Sorensen Species Similarity Index
The Sorensen Species Similarity Index / (IS) which was used to compare the similarity of species composition between research stations (Odum, 1993; I. U. Rahman *et al.,* 2019; Surhone *et al.,* 2010).

$$IS = \frac{2C}{A+B} x100\%$$

Information:
IS = The Sorensen Species Similarity Index
A = number of species in area 1
B = number of species in area 2
C = same number of species in both areas

3. Results and Discussion

3.1 Results

3.1.1 Characteristics and Composition of Fish Species

Three sites were selected to represent the various conditions in the aquatic ecology of the Bengawan Madiun River in Madiun City for observation. This study found 17 fish species belonged to 5 orders and 9 families, with a total of 495 individuals recorded at the three sample stations (Table 1).

Table 1. Fish composition in Bengawan Madiun River, Madiun City

Order	Famili	Species	Sampling Stations		
			1	2	3
Cichliformes	Cichlidae	*Oreochromis niloticus*	6	11	10
Cypriniformes	Cyprinidae	*Barbodes binotatus*	9	2	7
Cypriniformes	Cyprinidae	*Barbonymus balleroides*	21	11	12

Order	Famili	Species	Sampling Stations		
			1	2	3
Cypriniformes	Cyprinidae	*Barbonymus gonionotus*	27	8	30
Cypriniformes	Cyprinidae	*Labiobarbus leptocheilus*	15		
Cypriniformes	Cyprinidae	*Mystacoleucus marginatus*	10	8	5
Cypriniformes	Cyprinidae	*Osteochilus vittatus*	15	9	12
Cypriniformes	Cyprinidae	*Rasbora argyrotaenia*	21	8	15
Cypriniformes	Nemacheilidae	*Nemacheilus masyai*	3	7	10
Gobiiformes	Butidae	*Oxyeleotris marmorata*	4	1	2
Siluriformes	Bagridae	*Hemibagrus nemurus*	15	18	11
Siluriformes	Bagridae	*Mystus nigriceps*	40		7
Siluriformes	Bagridae	*Mystus singaringan*	7	6	10
Siluriformes	Clariidae	*Clarias gariepinus*	3		1
Siluriformes	Loricariidae	*Pterygoplichthys pardalis*	26	19	23
Siluriformes	Pangasiidae	*Pangasius djambal*	2	4	1
Synbranchiformes	Mastacembelidae	*Macrognathus aculeatus*	1	2	
		Total	**225**	**114**	**156**

Table 1 and Figure 2 show that the Cichliformes order is represented by a single species, *Oreochromis niloticus* (family Cichlidae), with 27 individuals. The Cypriniformes order is the most dominant group, consisting of seven species from the Cyprinidae family and one species from the Nemacheilidae family, namely *Barbodes binotatus* (18 individuals), *Barbonymus balleroides* (44 individuals), *Barbonymus gonionotus* (65 individuals), *Labiobarbus leptocheilus* (15 individuals), *Mystacoleucus marginatus* (23 individuals), *Osteochilus vittatus* (36 individuals), *Rasbora argyrotaenia* (44 individuals), and *Nemacheilus masyai* (20 individuals). The Gobiiformes order is represented by *Oxyeleotris marmorata* (family Butidae) with 7 individuals. The Siluriformes order includes 6 species from 4 families, namely *Hemibagrus nemurus* (44 individuals), *Mystus nigriceps* (47 individuals), *Mystus singaringan* (23 individuals) from the Bagridae family; *Clarias gariepinus* (4 individuals) from the Clariidae family; *Pterygoplichthys pardalis* (68 individuals) from the Loricariidae family; and *Pangasius djambal* (7 individuals) from the Pangasiidae family. The Synbranchiformes order is represented by *Macrognathus aculeatus* (family Mastacembelidae) with a total of 3 individuals.

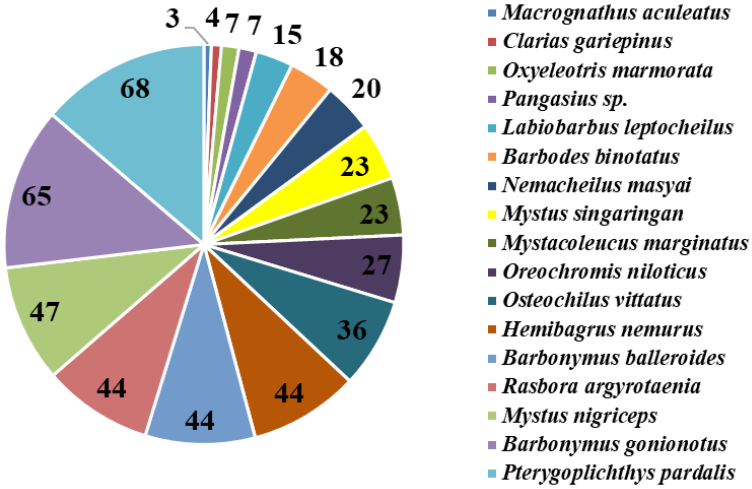

Figure 2. Composition and abundance of fish species in the Bengawan Madiun River, Madiun City

Figure 3 illustrates the number of fish species recorded at each observation station in the

Bengawan Madiun River. Station 1 showed the highest species richness with 17 species, followed by Station 3 with 15 species, while Station 2 had the lowest number of species, totaling 14 species.

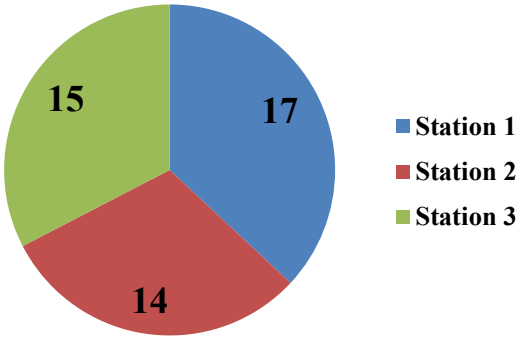

Figure 3. Diagram of the number of fish species at three observation stations in the Bengawan Madiun River, Madiun City

3.1.2 Native and Non-Native Fish Groups

The fish species recorded in the Bengawan Madiun River can be classified into two groups based on their origin, namely native (indigenous) species and non-native (introduced) species (Table 2). A total of 14 species were identified as native freshwater fishes, which commonly occur in Indonesian river ecosystems, while three species were categorized as non-native, indicating the presence of introduced fishes within the study area. The occurrence of non-native species suggests potential anthropogenic influence on the river ecosystem and highlights the importance of monitoring their distribution to prevent possible impacts on native fish communities.

Table 2. Native and non-native fish groups in the Bengawan Madiun River, Madiun City

No	Native	Non-Native
1	*Macrognathus aculeatus*	*Pterygoplichthys pardalis*
2	*Oxyeleotris marmorata*	*Clarias gariepinus*
3	*Hemibagrus nemurus*	*Oreochromis niloticus*
4	*Mystus nigriceps*	
5	*Mystus singaringan*	
6	*Osteochilus vittatus*	
7	*Labiobarbus leptocheilus*	
8	*Barbonymus balleroides*	
9	*Barbonymus gonionotus*	
10	*Mystacoleucus marginatus*	
11	*Barbodes binotatus*	
12	*Rasbora argyrotaenia*	
13	*Nemacheilus masyai*	
14	*Pangasius djambal*	

3.1.3 Index

Table 3 presents the ecological indices of fish communities at the three observation stations in the Bengawan Madiun River. Overall, the dominance index (D) values were low across all stations, indicating the absence of a single dominant species. The Shannon–Wiener diversity index (H') showed moderate diversity levels, while the evenness index (E) values were high, reflecting a relatively even distribution of individuals among species. The species richness index (R) was categorized as moderate at all stations. In addition, the Sorensen similarity index (IS) values were high, indicating a high degree of similarity in species composition among the observation stations.

Table 3. Dominance Index / (D), Species Diversity Index / (H'), Species Evenness Index / (E), Species Richness Index / (R), and Species Similarity Index / (IS)

Station	Dominance Index / (D)	Species Diversity Index / (H')	Species Evenness Index / (E)	Species Richness Index / (R)	Species Similarity Index / (IS)
1	0.0961	2.5197	0.8894	2.9542	0.9032
2	0.1008	2.4283	0.9202	2.7448	0.9375
3	0.1024	2.4438	0.9024	2.7724	0.9655

3.2 Discussion

3.2.1 Overview of Sampling Station

Sustainable fisheries resource management requires a comprehensive understanding of the community structure and diversity of fish in a body of water (Latuconsina, 2021). Information on species diversity, evenness, richness, and similarity of fish communities is an essential basis for assessing aquatic ecosystem stability and levels of environmental stress (Herawati *et al.,* 2020). Fish diversity serves as an ecological indicator that reflects ecosystem balance and aquatic environmental quality (Fitri *et al.,* 2024).

Observations in this study were conducted at three stations selected for their differences in anthropogenic activity and habitat characteristics, ranging from areas close to residential areas to areas with more natural riparian vegetation.

3.2.2 Fish Community Structure

The results showed that fish from the order Cypriniformes, specifically the family Cyprinidae, dominated the waters of the Bengawan Madiun River, Madiun City. Station 2 had the lowest fish abundance and species richness, with 114 individuals (Table 1). Station 2 is located in the Bantaran Park area of Madiun City, close to densely populated settlements, a daily activity for local residents, such as washing clothes, and is also used as a sand mining area. These human activities have an impact on the fish population at Station 2. River ecosystems are a crucial factor in the sustainability of life and diversity of freshwater fish species (Alanda *et al.,* 2025; Budiman *et al.,* 2021; Preniti *et al.,* 2019). The development of economic and demographic activities around rivers has a significant impact on the physical and chemical quality of the water, which can negatively affect fish populations (Bukola *et al.,* 2015).

The diagram in Figure 3 shows that Station 1 exhibited the highest fish species richness, with 17 species, followed by Station 3 with 15 species, while Station 2 had the lowest species richness, with 14 species. In addition to having the highest species richness, Station 1 also recorded the highest fish abundance, as shown in Table 1. This pattern indicates that Station 1 provides more favorable habitat conditions that support both a higher number of species and a greater number of individuals compared to the other stations.

The results of the fish identification in the Bengawan Madiun River, Madiun City, reveal the presence of 14 native fish species and 3 non-native fish species (Table 2). Native species (indigenous species) are species that are naturally found only in a limited geographic area and do not occur naturally outside that area. This means that these species evolve or survive in specific local conditions, with a limited distribution area (Bellwood & Meyer, 2009; Muchlisin *et al.,* 2020). Native species often experience stress when environmental changes or competition with non-native fish occur (Wibowo *et al.,* 2020). Non-native species are often termed non-endemic, alien, exotic, or introduced. Non-native species are species found in a particular area but are not part of the area's native fauna (Hui *et al.,* 2020; Muchlisin *et al.,* 2020). This can be due to being intentionally or accidentally introduced by humans to new habitats outside their natural range. Non-native species can become invasive if they successfully establish themselves, reproduce in large numbers, and affect local communities (native species), through resource competition, predation, or habitat changes (Wibowo *et al.,* 2020).

The *Barbonymus gonionotus* species has the largest number of individuals among the native fish groups (65 individuals). The *Macrognathus aculeatus* species, on the other hand, has the

fewest individuals, with only 3. *Barbonymus gonionotus* is regarded a relatively tolerant cyprinid species that is able to persist in a range of freshwater settings, particularly in waters suffering mild environmental oscillations, such as changes in temperature and increasing turbidity. Although most Cyprinidae are generally sensitive to low dissolved oxygen levels, *Barbonymus gonionotus* is commonly found in disturbed or modified habitats, indicating a certain degree of ecological flexibility compared to other native cyprinid species (Muchlisin *et al.,* 2020; Nisa & Khairunissa, 2023; Wantania *et al.,* 2025). This species thrives in waters affected by human activity, including irrigation, ponds, and expansive, murky rivers (Muchlisin *et al.,* 2020; Nisa & Khairunissa, 2023; Wantania *et al.,* 2025). The *Macrognathus aculeatus* species often inhabits relatively tranquil natural environments characterized by smooth or muddy substrates, riparian or swamp flora, and waters shielded from direct disturbances such as pollution or strong currents (Djumanto, 2023). (FishBase, 2024) states that its habitat includes medium to large rivers, wetlands, and peat areas, characterised by temperatures ranging from 23 to 28 ºC and a pH level between 6.5 and 7.5. The number of these animals tends to decrease in rivers where the ecosystem is deteriorating, pollution is occurring, or people are engaging in activities that harm the substrate and plants. It is not highly stenotolerant, but it is more picky than particular common fish species (Khofiyyah *et al.,* 2024). The presence of non-native fish can also have an impact on the *Macrognathus aculeatus* population.

Among the non-native fish, the most significant number found was *Pterygoplichthys pardalis*, with 68 individuals. This species was found at all observation stations. *Pterygoplichthys pardalis* originates from the Amazon region of South America, particularly the Amazon River basin in Brazil and Peru (U.S. Fish and Wildlife Service, 2020). This species exhibits high tolerance to diverse environmental conditions, massive reproduction, and minimal predation (including by humans), as well as the ability to burrow and survive in muddy substrates (Patoka *et al.,* 2020; Samat *et al.,* 2016). This is an important note, especially in the Bengawan Madiun River, Madiun City. The lowest number of non-native fish was *Clarias gariepinus*, with 4 individuals. *Clarias gariepinus*, also known as the African catfish, is native to the African continent. Its distribution naturally extends to parts of Southwest Asia, such as Israel, Syria, and southern Turkey (Klimuk *et al.,* 2024; Teugels, 1986). The population of *Clarias gariepinus* tends to decline in waters containing high organic matter and fast-flowing currents, particularly in areas without natural shelter such as riparian vegetation (Haqqi *et al.,* 2024). The abundance of *Pterygoplichthys pardalis* in the Bengawan Madiun, Madiun City, can disturb the waterbed and reduce the availability of detritus or benthic organisms that are also a food source for *Clarias gariepinus*. In addition, the burrowing activity of *Pterygoplichthys pardalis* can change the structure of the substrate and disrupt the habitat where *Clarias gariepinus* hides or lays eggs (Orfinger & Goodding, 2018).

The Dominance Index (D) is a method used to assess the dominance of a species within a community or ecosystem in ecology. This index indicates the likelihood that two individuals randomly selected from a group belong to the same species (Odum, 1993). The dominance index values recorded at the three observation stations along the Bengawan Madiun River were relatively low, nearing 0: Station 1 (0.0961), Station 2 (0.1008), and Station 3 (0.1024) (Table 3). This means that no single species is overrepresented at the three study sites (Table 3). To put it another way, the fish community structure is remarkably balanced, with minimal rivalry between species (Ulfah *et al.,* 2019). Station 3 had a slightly higher dominance value than the other two stations (0.1024), but the difference was not big enough to matter. This figure suggests that some species were more common at Station 3 than others. For example, there were 23 *Pterygoplichthys pardalis* (non-native) and 30 *Barbonymus gonionotus* (native), but this did not diminish the diversity.

The diversity index (H') describes the level of fish species richness in a community, which is determined based on the number of species found and the proportion or relative abundance of each species (Brower *et al.,* 1990). In general, the three observation stations in the Bengawan Madiun River, Madiun City, are included in the moderate category (1<H'<3) with the highest value at station 1 (2.5197) and the lowest value at station 2 (2.4283) (Table 3). These values indicate that

the fish community in the Bengawan Madiun River, Madiun City, still has relatively good diversity. However, anthropogenic pressure or environmental disturbances can reduce this value, thereby threatening ecosystem stability (Morris *et al.,* 2014).

The Evenness Index (E) describes the level of uniformity in the number of individuals between species within a community. This index indicates the extent to which individuals are evenly distributed among the existing species (Chao & Ricotta, 2019; Gregorius & Gillet, 2022). Based on the results of the evenness index calculation, the three stations are categorized as having high evenness, including Station 1 (0.8894), Station 2 (0.9202), and Station 3 (0.9024) (Table 3). This means that the distribution of individuals between species at each station is relatively even, with no species overly dominating. This condition indicates that the fish community structure at the three stations is in a stable and balanced state, reflecting the quality of the aquatic ecosystem that still supports species diversity (Chao & Ricotta, 2019; Luo *et al.,* 2022).

The Fish Species Richness Index (R) indicates the number of fish species found in a body of water, reflecting the ecological conditions and stability of the environment. The higher the value of the species richness index, the greater the variation or diversity of fish in the body of water (Hasan *et al.,* 2023). Species richness is one of the main components of biological diversity, along with species abundance and evenness (Odum, 1993). Based on criteria, the three stations are included in the moderate species richness category, which is Station 1 (2.9542), Station 2 (2.7448), and Station 3 (2.7724) (Table 3). This indicates that the number of fish species at each station is quite diverse, but has not yet reached a high level of species richness. The relatively similar index values at the three locations also indicate that the condition of the aquatic ecosystem between stations has a similar level of stability and productivity. A moderate species richness value indicates that the aquatic environment is still capable of supporting the life of various fish species, although it may be subject to mild to moderate environmental pressures that affect the composition of the fish community at that location (Odum, 1993).

The Sorensen Species Similarity Index (IS) is a tool that scientists use to see how similar the species make-up of two or more study sites or stations is. This index is very helpful in community ecology for figuring out if two ecosystems contain fish communities that are the same or different (Rahman *et al.,* 2020). Table 3 shows that the IS values ranged from 0.76 to 1.00 which is Station 1 (0.9032), Station 2 (0.9375), and Station 3 (0.9655). This indicates a very high level of similarity between stations. Thus, these results indicate that the fish species composition at the three observation stations is very similar. The high value of this similarity index indicates that the three stations have relatively similar aquatic environmental conditions, both in terms of physical and chemical factors of the water, thus supporting the presence of almost identical fish species. Furthermore, the high similarity may also reflect relatively balanced ecological disturbances or anthropogenic pressures at the three locations, thus not causing significant differences in fish community structure. This finding aligns with Tony *et al.,* (2021) that high similarity values indicate homogeneity of fish communities between stations, which generally occurs in waters with similar habitat characteristics and not experiencing extreme environmental changes.

The findings of this study can provide a fundamental idea for the management and preservation of fish resources in the Bengawan Madiun River, Madiun City. The variety of fish found in these waters indicates that they still support a wide range of species, despite human activities such as sand mining, littering, indiscriminate fishing, and changes in land use along the riverbanks, putting pressure on them. If these conditions are not adequately managed, they could harm the habitat and lead to a decline in fish populations in the area. So, when managing the fisheries in the Bengawan Madiun River, Madiun City, you need to think about how to keep the environment healthy, how to make sure the people who live nearby are doing well, and how well the river management institutions work (Bukola *et al.,* 2015; Candolin & Rahman, 2023; Prakash & Verma, 2022).

The fish community structure observed in the Bengawan Madiun River shows similarities with findings reported from other sections of the Bengawan Solo watershed and several freshwater ecosystems in Indonesia. Previous studies conducted in rivers within the Bengawan Solo Basin generally reported moderate fish diversity levels, particularly in areas influenced by urban

activities, agriculture, and riverbank modification (Damayanti *et al.*, 2024; Zamzami *et al.*, 2023). Comparable conditions have also been documented in other Indonesian river systems, such as the Musi River, Batang Bungo River, and Namang River, where moderate diversity and relatively high evenness were associated with heterogeneous habitats and varying degrees of anthropogenic pressure (Anggraini *et al.*, 2019; Helmizuryani *et al.*, 2024; Hertati & Eriza, 2023). These similarities suggest that the fish assemblage in the Bengawan Madiun River reflects a common ecological pattern of tropical rivers experiencing moderate environmental disturbance, while still maintaining a relatively balanced community structure.

4. Conclusion

This study identified 17 fish species from 5 orders and 12 families in the Bengawan Madiun River, Madiun City, with a total of 495 individuals. The Cyprinidae family dominated the fish community at all observation stations. The diversity index (H') value showed a moderate category ($1 < H' < 3$), indicating a stable and diverse fish community. The evenness index (E) belonged to the high category, indicating a relatively balanced distribution of individuals between species. The species richness index (R) was classified as moderate, while the species similarity index (IS) had a high value, indicating community homogeneity between stations due to similar habitat conditions and minimal extreme environmental changes. A total of 14 native species and 3 non-native species were recorded in the Bengawan Madiun River. The occurrence of introduced species, particularly *Pterygoplichthys pardalis*, indicates the presence of non-native elements within the fish community that may influence the structure of native assemblages. Despite the presence of these non-native species, the overall fish community across the observation stations remained relatively well represented in terms of species composition and abundance.

This research provides an important information for further studies on the relationship between fish diversity and aquatic environmental conditions in the Bengawan Madiun River, Madiun City. Long-term monitoring is necessary to detect changes in biodiversity, particularly those caused by human activities and climate change, so that conservation efforts can be directed appropriately and sustainably.

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