Biodiversity of Ichthyofauna in The Pabelan River, Magelang Regency

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Abstract

Pabelan River is one of the most important rivers in Magelang Regency. This research aims to determine the diversity and composition of the ichthyofauna in the Pabelan River, Magelang Regency. The research was conducted from August to October 2025 at three observation stations selected through purposive sampling. Fish were caught using nets with a mesh size of ¾ inch and a diameter of 4 meters. Sampling was conducted over eight weeks, twice a week, from 08.00-14.00 WIB, for two hours at each research station. Data analysis was conducted using the Shannon-Wiener diversity index (H'), Evenness uniformity index (E), and Simpson dominance index (C). The results show that there are 13 fish species classified into 8 families and 4 orders, with the order Cypriniformes being the most dominant. *Ancistrus multispinis* is recorded as the overall dominant species (RA 43.6%), but it was only found at the settlement station. The average length distribution of the fish was dominated by small fish (<10 cm), accounting for more than 50%. Meanwhile, the average weight percentage of fish sized <10 gs was more than 38%. The diversity index value (H') obtained ranged from 0.81 to 1.73, the evenness index (E) from 0.35 to 0.83, and the dominance index (C) from 0.20 to 0.65. Environmental parameters indicate temperatures of 25.9–26.7 °C and a pH of 7.25–7.49, within the range that supports freshwater fish life. Meanwhile, the physical conditions of the water show a current speed of 0.31–0.73 m/s, a brightness of 8.8–11.6 cm, a depth of 43–59 cm, and a width of 17.3–29.2 m. Overall, the diversity of ichthyofauna in the Pabelan River is classified as moderate, with environmental conditions that still support freshwater fish.

Keywords: composition, diversity, ichthyofauna, Pabelan River.

Introduction

The Pabelan River originates on the slopes of Mount Merapi in Magelang Regency, Central Java, and flows into the Progo River. This river is 31.7 kilometers long and has three tributaries: the Trising River, the Apu River, and the Senowo River *(Aprilian et al*., 2023). It also carries volcanic material from Mount Merapi following the 2010 eruption (Fauziyah *et al*., 2018). As a waterway influenced by volcanic activity, it has a substrate dominated by sand and volcanic rock from upstream to downstream, with moderate to strong currents. The specific geomorphological conditions of this tropical river theoretically provide ecological niches for various native Indonesian fish species, particularly those from the families Cyprinidae, Gobiidae, and Balitoridae, which possess morphological adaptations to strong currents. However, these conditions also trigger human activities such as sand mining and the construction of sabo dams along the

river course, which may alter aquatic habitat characteristics and affect fish diversity (Fauziyah *et al*., 2018; Gob *et al*., 2016).

Despite the pressures of human activities, rivers-as freshwater ecosystems-play a vital role in supporting biodiversity, including fish communities that can reflect the condition of aquatic ecosystems through the variety of habitats they possess. According to Dudgeon (2019), diverse river conditions and varied habitats drive the high number of species and freshwater biodiversity worldwide. Previous research conducted on river sections with varied substrate habitats (sand and rock) and anthropogenic disturbances includes a study on the Progo River. The study by Jailani & Mujtahidah (2021) revealed that the Progo River hosts fish fauna comprising 23 species across 5 orders and 11 families, with the Cyprinidae family as the dominant group. The highest relative abundance was found in the balar fish (*Barbonymus balleroides*), while the lowest relative abundance was observed in the kekhel fish (*Glyptothorax platypogon*). The Pabelan River, located in the same province and flowing into the Progo River, is also of research interest and has the potential for high biodiversity, similar to the Progo River but with different structures and compositions due to variations in the local hydrology of its waters.

Despite this ecological potential, research on the composition and diversity of ichthyofa-na in the Pabelan River remains relatively limited compared to that of the Progo River. Therefore, this study was conducted to determine the diversity and composition of the ichthyofauna in the Pabelan River, Magelang Regency, to provide baseline information on the condition of the local aquatic ecosystem. This study is expected to serve as baseline data to guide the sustainable management of aquatic resources. Additio-nally, the results of this study can support efforts to conserve ichthyofaunal biodiversity, inform policy development, and empower communities living along the Pabelan River to use natural resources responsibly.

MATERIAL AND METHODS

Study site

This study was conducted from August to October 2025 along the Pabelan River in Magelang Regency, Central Java Province. Sampling was conducted at three main stations across two subdistricts: Sawangan Subdistrict (Station 1 in Krogowanan Village and Station 3 in Gondowangi Village) and Dukun Subdistrict (Station 2 in Banyudono Village). Sampling locations were determined using purposive sampling, which involves selecting sites based on specific criteria. In, sampling is done intentionally based on certain criteria that allow researchers to focus on the groups or individuals most relevant to the research objectives The primary criteria used for site selection in this study were the distribution along the Pabelan River, which encompasses

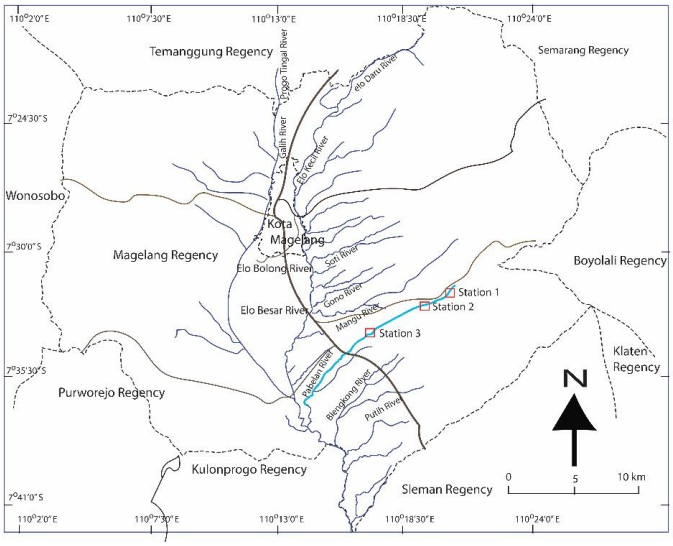

Figure 1. Map of the study area along the Pabelan River (red box). The brown lines indicate national and provincial roads. The broken line marks district boundaries.

habitat variations (separated by dams, sand mining intensity, and surrounding environmental conditions); administrative differences between villages to ensure regional representation; and locations actively used by the community for fishing. A map of the study locations is shown in Figure 1. Details on the location and specific environmental characteristics of each research station are provided in Table 1.

Research Procedures

The study was conducted in several stages, including fish sampling, measurement of water parameters, and data analysis. Fish sampling was carried out over eight weeks, with samples collected twice weekly and assistance from local fishermen. Sampling took place in the morning and afternoon from 8:00 AM to 2:00 PM local time, with two hours allocated at each location.

Table 1. Coordinates and conditions of research stations

Station	Coordinates	Notes
1	7.538104º32' LS, 110.333065º19' BT	Garden/forest area, Krogowanan, Sawangan District, Magelang Regency, Central Java. Elevation: 605 meters above sea level. There is a tomato farm; the vegetation is sparse. Large-scale mining operations (heavy machinery).
2	7.539208º21' LS, 110.328791º19' BT	Karang, Banyudono, Dukun District, Magelang Regency, Central Java. Elevation: 579 meters above sea level. Surrounded by dense vegetation. Moderate sand mining activity (with a significant amount of manual labor).
3	7.557051º33' LS, 110.287797º17' BT	Gijayan, Gondowangi, Sawangan District, Magelang Regency, Central Java Elevation: 439 meters above sea level. Near residential areas, with fairly dense vegetation. Small-scale sand mining activity (visible to a limited extent).

Fish were caught using a net with a mesh size of ¾ inch (1.905 cm) and a diameter of 4 m. A net was chosen because it can catch fish of relatively diverse sizes and species compared to other gear commonly used at the study site. Each caught fish was then identified, counted, placed in a sample bag, and stored in a cold box filled with ice to maintain freshness before being transferred to a freezer for unidentified samples. Taxonomic identification was performed visually, referencing identification guides and the FishBase database. Physical characteristics of the fish, such as total length, were measured with a ruler to 0.5 mm precision, while body weight was measured with a digital scale to 0.1 g precision and recorded with a smartphone camera.

Water quality and river hydrological parameters were measured directly in triplicate at each station, including temperature, pH, turbidity, current velocity, depth, width, and the types of substrate and surrounding vegetation. Station coordinates were determined using GPS on mobile devices and the Timemark app. Water temperature was measured with a digital thermometer, and pH with a pH meter calibrated with a buffer solution. Water turbidity was measured using a Secchi disk lowered into the water column until the black and white marks were no longer visible (d1), then slowly raised until they reappeared (d2), and calculated using the formula: $Transperency = \frac{(d1+d2)}{2}$. Current velocity is measured manually by releasing a ping-pong ball 10 m downstream and recording the elapsed time using a stopwatch. River depth is measured using a weighted rope lowered until it touches the riverbed, while river width is measured using a linear measurement tool. The type of substrate and surrounding vegetation is analyzed visually through direct observation at each observation station. All data obtained is then recorded in a notebook as primary data.

Data Analysis

The collected data on fish species will then be presented in tabular form, along with the number of individuals for each species, to facilitate assessment of species abundance, diversity, evenness, and dominance.

The relative abundance (RA) of fish species in a given area can be calculated using the following formula:

$$RA = \left(\frac{ni}{N}\right) x\ 100\%$$

Note: ni = number of individuals of species i; N = total number of individuals of all species

The fish diversity index for an ecosystem or region can be calculated using the following formula:

$$H' = -\sum \left(\frac{ni}{N}\right) \ln \left(\frac{ni}{N}\right)$$

The diversity index value obtained will indicate the level of ichthyofauna diversity in an ecosystem. The higher the diversity index value, the more diverse the ichthyofauna. The scale or range of diversity index values includes H' ≤ 1 (low category), 1 < H' ≤ 3 (moderate category), and H' ≥ 3 (high category).

Table 2. Environmental parameters at the sampling station on the Pabelan River

Parameter	Station 1	Station 2	Station 3
Temperature (°C)	25.90	26.20	26.70
pH	7.25	7.35	7.49
Current Speed (m/s)	0.73	0.31	0.43
Transparency (cm)	11.70	10.30	8.83
Depth (cm)	48.50	59	43
Width (m)	17.30	25.20	29.20
Substrate	Rocks, sand	Rocks, sand	Rocks, sand
Vegetation	Grasses, banana trees, shrubs	Grasses, shrubs	Grasses, banana trees, shrubs

The evenness index of the ichthyofauna in an ecosystem or region can be calculated using the following formula:

$$E = \frac{H'}{ln\, S}$$

Note: H' = diversity index; S = number of species

The resulting evenness index value indicates the degree of evenness of the ichthyofauna in an ecosystem. The higher the evenness index value, the greater the degree of balance. The scale or range of evenness index values includes E < 0.4 (low category), 0.4 < E < 0.6 (moderate category), and E > 0.6 (high category) (relatively uniform).

The species dominance index for an ecosystem or region can be calculated using the following formula:

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

The dominance index value obtained indicates the degree to which one species dominates others within an ecosystem. The dominance index is inversely proportional to the evenness index; thus, the higher the dominance index, the lower the degree of ecosystem balance as species dominantes. The dominance index ranges from 0 to 1; the closer the value is to 1, the more evident the presence of a dominant species in that community, and vice versa.

RESULT

Environmental Conditions

Environmental parameters at each station are presented in Table 2. Environmental conditions were relatively uniform, with variations in the water's physical parameters. Temperature and pH tended to increase from Station 1 to Station 3, but the ranges did not differ significantly. Station 1 has the highest flow velocity, while Stations 2 and 3 have relatively lower flow velocities. Water clarity decreases progressively down-stream, indicating an increase in suspended particles in the water column. From Station 1 to Station 3, the river width increases, while water depth varies between stations without a clear pattern. The bottom substrate at all three stations is dominated by rocks and sand, along with riparian vegetation consisting of grasses, shrubs, and a few banana trees. These conditions indicate that the three stations share a relatively homogeneous habitat type,

Table 3. Types of fish fauna caught in the Pabelan River, Magelang Regency

No.	Ordo	Family	Types of ichthyofauna		
			Species	Local Name	Total
1	Anabantiformes	Channidae	*Channa gachua*	Gabus	3
2	Cypriniformes	Balitoridae	*Homaloptera ocellata*	Hiu Mbelan	30
3		Cyprinidae	*Barbodes binotatus*	Wader Cakul	66
4			*Barbonymus gonionotus*	Beles	1
5			*Mystacoleucus obtusirostris*	Kepek	51
6			*Neolissochilus soroides*	Mangur	41
7			*Osteochilus vittatus*	Nilem	1
8			*Rasbora argyrotaenia*	Wader Pari	70
9		Nemacheilidae	*Nemacheilus chrysolaimos*	Uceng	1
10	Perciformes	Cichlidae	*Oreocromis niloticus*	Nila	4
11	Siluriformes	Clariidae	*Clarias batrachus*	Lele	2
12		Loricariidae	*Ancistrus multispinis*	Sapu-sapu	264
13		Sisoridae	*Glyptothorax platypogon*	Kekhel	72

with the primary differences lying in the hydrological characteristics of the water.

Fish Composition

The ichthyofauna collected from the Pabelan River in Magelang Regency comprises 13 species across 8 families and 4 orders. The species are dominated by the order Cypriniformes, which comprises three families: Cyprinidae, Balitoridae, and Nemacheilidae. The family Cyprinidae is the most species-rich, with 6 species. Meanwhile, the orders Perciformes and Anabantiformes have the fewest species, each represented by a single species. In detail, the types of ichthyofauna caught during the study are shown in Table 3.

A total of 606 fish individuals were captured during the study period, dominated by Ancistrus multispinis with a relative abundance of 43.6%, while the species with the lowest abundance were *Barbonymus gonionotus, Osteochilus vittatus*, and *Nemacheilus chrysolaimos,* of which only one

Table 4. Composition of the fish fauna caught in the Pabelan River, Magelang Regency

No	Species	Local Name	Station			Total	RA (%)
			Station 1	Station 2	Station 3		
1	*Ancistrus multispinis*	Sapu-sapu	-	-	264	264	43.6
2	*Barbodes binotatus*	Wader Cakul	21	23	22	66	10.9
3	*Barbonymus gonionotus*	Beles	1	-	-	1	0.2
4	*Channa gachua*	Gabus	1	1	1	3	0.5
5	*Clarias batrachus*	Lele	-	2	-	2	0.3
6	*Glyptothorax platypogon*	Kekhel	40	5	27	72	11.9
7	*Homaloptera ocellata*	Hiu Mbelan	2	20	8	30	5.0
8	*Mystacoleucus obtusirostris*	Kepek	4	45	2	51	8.4
9	*Nemacheilus chrysolaimos*	Uceng	-	-	1	1	0.2
10	*Neolissochilus soroides*	Mangur	19	20	2	41	6.8
11	*Oreocromis niloticus*	Nila	4	-	-	4	0.7
12	*Osteochilus vittatus*	Nilem	-	-	1	1	0.2
13	*Rasbora argyrotaenia*	Wader Pari	47	20	3	70	11,6
Total			139	136	331	606	100

individual each was found (0.2%). Other species had relative Other species had relative abundances ranging from 0.3% to 11.9%. Details of the number of each species at each station are shown in Table 4.

Length and Weight Distribution

The length and weight distribution of the fish collected during the study are shown in Table 5. More than 50% of the average length of the caught fish was <10 cm, and more than 38% of the average weight of the caught fish was <10 g. Clarias batrachus was the largest species compared to others, with an average length of 20.5 cm and an average weight of 74.5 g. The largest Clarias batrachus specimen measured 23.0 cm in length and weighed 80 g. Meanwhile, Glyptothorax platypogon was the smallest fish species, with an average length of 6.55 cm within a length range of 5.0–9.5 cm, while Barbodes binotatus was the lightest species, with an average weight of 3.98 g within a weight range of 2.0–8.0 g.

Community Structure

Community structure can be assessed basedon the diversity, evenness, and dominance indices presented in Table 6. The diversity index (H') values range from 0.81 to 1.73, indicating a low to moderate category. The evenness index (E) ranges from 0.35 to 0.83. An evenness value close to 1 indicates a relatively even distribution of individuals across species, while a lower value indicates an imbalance in the number of individuals among some species. Meanwhile, the dominance index (C) ranges from 0.20 to 0.65, indicating variations in species dominance levels across observation stations.

DISCUSSION

The dominance of the order Cypriniformes in the study results indicates that the Pabelan River still provides a suitable habitat for freshwater fish. According to Kuchta *et al*. (2020), Cypriniformes is one of

Table 5. Length and weight of the captured fish

No.	Species	Total	Size			
			Leght		Weight	
			Total Length (cm)	Average Length (cm)	Total weight (gr)	Average Weight (g)
1	*Ancistrus multispinis*	264	4.5 – 12.2	9.18	0.5 – 26.0	10.87
2	*Barbodes binotatus*	66	5.0 – 17.0	6.96	2.0 – 8.0	3.98
3	*Barbonymus gonionotus*	1	15.4	15.40	70.0	70.00
4	*Channa gachua*	3	9.5 – 17.5	14.66	6.0 – 41.0	25.00
5	*Clarias batrachus*	2	18.0 – 23.0	20.50	69.0 – 80.0	74.50
6	*Glyptothorax platypogon*	72	5.0 – 9.5	6.55	1.0 – 6.0	10.87
7	*Homaloptera ocellata*	30	6.5 – 14.0	11.03	3.0 – 17.0	9.36
8	*Mystacoleucus obtusirostris*	51	5.0 – 12.0	8.56	2.0 – 19.0	7.23
9	*Nemacheilus chrysolaimos*	1	8.5	8.50	4.0	4.00
10	*Neolissochilus soroides*	41	5.5 – 28.5	13.16	2.0 – 232	35.95
11	*Oreocromis niloticus*	4	5.3 – 10.5	8.85	3.0 – 22.0	15.75
12	*Osteochilus vittatus*	1	18.0	18.00	63.0	63.00
13	*Rasbora argyrotaenia*	70	4.5 – 11.3	7.95	0.5 – 11.0	4.60

Table 6. Diversity, evenness, and dominance indices by sampling station

Note	Station		
	Station 1	Station 2	Station 3
Total	139	136	331
Diversity indeks (H')	1,62	1.73	0.81
Evenness index (E)	0.74	0.83	0.35
Dominance index (C))	0.24	0.20	0.65

the freshwater fish groups with a wide geographic distribution and high species diversity. This dominance is primarily exemplified by the family Cyprinidae, which comprises six species. This family is a highly diverse group of freshwater fish that is widely distributed across regions worldwide and exhibits relatively high environmental tolerance to variations in habitat conditions (Kotellat *et al*., 1993). In addition to the dominance of certain orders and families, the ichthyofauna community in the Pabelan River also exhibits dominance at the species level, specifically *Ancistrus multispinis*.

A total of 13 fish species were identified during the study. This number is relatively small compared to the fish communities typically found in the lower reaches or estuaries of rivers and is likely related to the study location, which is situated in the upper to middle reaches of the river. The upper reaches generally feature stronger currents, narrower habitats, and more selective environmental conditions, thereby limiting the presence of certain fish species. These conditions align with the concept of environmental filtering, in which specific environmental characteristics can support only species with appropriate adaptations (Liu *et al.,* 2025). A similar pattern was also reported in the Opak River system by Djumanto & Probosunu (2011) and by Yudha *et al*. (2020), who demonstrated an increase in species richness with river size toward the lower reaches and the estuary.

In addition to variations in species composition, the study results also indicate differences in length and weight among species. These size variations reflect differences in biological characteristics as well as strategies for utilizing habitats and available resources in the water. Small species such as B. *binotatus*, G. *platypogon*, M. *obtusirostris*, N. *chrysolaimos*, and R. *argyrotaenia* generally utilize small organisms as a food source, whereas larger species such as C. *gachua* and C. *batrachus* occupy higher trophic levels by feeding on small fish, shrimp, and insects.

To gain a more comprehensive understanding of the fish community, catch data were analyzed using the Shannon-Wiener diversity index (H'), the evenness index (E), and the dominance index (C). The diversity index values at all three stations fell into the low-to-moderate range, indicating that the ichthyofauna communities at the study sites have not yet fully stabilized. These

conditions may be influenced by habitat variation and anthropogenic activities in surrounding waters, which affect the distribution of individuals across species. These results are consistent with a study by Aziz *et al*. (2021), which shows that changes in environmental conditions and human activities can affect fish community diversity.

Differences in fish community structure were observed at each observation station. Station 1 exhibits moderate diversity, relatively high evenness, and low dominance. These conditions indicate a fairly even distribution of individuals across species, with no single species conspicuously dominating the community. According to Erika *et al*. (2018), low dominance values generally indicate a more balanced community and relatively good habitat conditions.

Unlike Station 1, Station 3 had the lowest diversity and the highest dominance. This was primarily due to the high abundance of A. multispinis compared to other species. The dominance of a single species causes uneven individual distribution, thereby reducing diversity even when the number of species is relatively high. This phenomenon is consistent with Sofian *et al*. (2024), who state that diversity tends to decrease when most individuals in a community belong to the same species.

Station 2 exhibits the most balanced community structure, with the highest diversity and evenness values and the lowest dominance. Despite anthropogenic disturbance from sand mining, the uneven substrate is believed to create microhabitat variations, including depressions, shallow areas, and differences in current velocity. This habitat heterogeneity can increase the availability of space and resources for species with different ecological preferences, thereby forming a more proportional community (Shi & Czerniawski, 2025).

The distribution patterns of species at each station also provide insight into the fish's ability to adapt to different habitat conditions. Several species, such as G. *platypogon*, R. *argyrotaenia*, C. *gachua*, M. *obtusirostris*, N. *soroides*, B. *binotatus*, and H. *ocellata*, were found at all observation stations. The presence of these species indicates relatively good adaptive capacity to variations in environmental conditions along the Pabelan River. Most are common river fish found in flowing habitats with rocky and sandy substrates and possess a fairly wide tolerance to changes in water physical conditions (Trijoko *et al*., 2016). This is also consistent with the statement by Kusuma et al. (2024), regarding the adaptive capacity of species from the genus Channa across various habitat types, as well as the study by Muhtadi *et al*. (2017), which notes that rocky river habitats with moderate to strong currents provide an environment conducive to the presence of diverse fish communities in the river.

However, some fish species were found only in very low numbers at certain stations. Species such as O. *niloticus* and B.

gonionotus were found only in limited numbers at Station 1. The low abundance of O. *niloticus* is thought to be related to its preference for calmer and warmer waters, although this species is known to have high environmental tolerance (Cahyanti & Awalina, 2022). Meanwhile, the low abundance of B. *gonionotus* is suspected to be related to unfavorable habitat conditions resulting from disturbances to the aquatic substrate. The species C. *batrachus* was also found only at Station 2 in small numbers. According to Wiharti & Hanik (2022), this species possesses additional respiratory organs that allow it to survive in low-oxygen conditions, but generally prefers calm habitats with softer substrates.

The species composition indicates that native freshwater fish still dominate the fish community in the Pabelan River. Of the 13 species recorded, only two were non-native: O. *niloticus* and A. *multispinis*. The low abundance of O. *niloticus* suggests that this species has not yet had a significant impact on the local community structure. In contrast, A. *multispinis* exhibited relatively high abundance, particularly at Station 3. The high abundance of this species is likely related to habitat characteristics, specifically hard substrates that support foraging activities and self-protection. As a benthic fish in the family Loricariidae, A. multispinis possesses morphological adaptations that enable it to effectively use rock surfaces and other hard substrates (Mattos *et al.,* 2018). Additionally, this species exhibits a high degree of adaptability to various environmental conditions (Wahyudewantoro et al., 2024). The high abundance of this species indicates successful adaptation to specific habitats in the Pabelan River and suggests the potential to influence the structure of the local fish community. However, the invasive status of A. *multispinis* cannot yet be definitively determined because this study has not evaluated its distribution patterns or ecological impacts on the local community. According to Bernery *et al*. (2024), a species can be categorized as invasive if it has undergone introduction, successfully established itself, spread widely, and caused impacts on the ecosystem it inhabits. Therefore, further research is needed to evaluate the potential spread and ecological impacts of this species in the Pabelan River.

CONCLUSION

In general, the ichthyofauna diversity in the Pabelan River, Magelang Regency, is classified as moderate, comprising 13 species across 8 families and 4 orders. The Shannon-Wiener diversity index indicates that the ichthyofauna community structure is not yet fully stable and varies across observation stations. Native freshwater species dominate the fish community, although two non-native species were identified that could potentially influence the community structure under certain conditions. The Pabelan River's habitat conditions, which currently support ichthyofauna, must be preserved through sustainable management and conservation

efforts, including the monitoring of activities that could alter the water body's characteristics. Furthermore, the presence of the non-native species *Ancistrus multispinis* warrants attention due to its potential impact on local fish communities. Further research encompassing a wider range of locations, observation periods, and sampling methods is also required to obtain more comprehensive information regarding fish diversity and distribution in the Pabelan River.

References

Aprilian, Z., Harlan, D., Soentoro, E. A., Zahroni, A., Bandung, I. T., Ganesa, J., 10, N., Siliwangi, L., Coblong, K., Bandung, K., & Barat, J. 2023. Analisis Agradasi, Degradasi dan Sedimentasi di Sungai Pabelan Pasca Erupsi Gunung Merapi 2010. *Journal on Education*, *05*(03).

Aziz, Md. S. Bin, Hasan, N. A., Mondol, Md. M. R. Alam, Md. M., & Haque, M. M. 2021. Decline in fish species diversity due to climatic and anthropogenic factors in Hakaluki Haor, an ecologically critical wetland in northeast Bangladesh. *Heliyon*, *7*(1), e05861. https://doi.org-/10.1016/j.heliyon.2020.e05861

Bernery, C., Bellard, C., Courchamp, F., Brosse, S., & Leroy, B. 2024. A global analysis of the introduction pathways and characteristics associated with non-native fish species introduction, establishment, and impacts. *Ecological Processes*, *13*(1), 22. https://doi.org/10.1186/-s13717-024-00495-8

Cahyanti, Y., & Awalina, I. 2022. Studi Literatur : Pengaruh Suhu terhadap Ikan Nila (Oreochromis niloticus). *Panthera : Jurnal Ilmiah Pendidikan Sains Dan Terapan*, *2*(4), 224–235. https://doi.org/-10.36312/pjipst.v2i4.110

Djumanto, & Probosunu, N. 2011. Biodiversitas sumber daya ikan di hulu Sungai Opak. *Jurnal Iktiologi Indonesia*, *11*(1), 1–10.

Dudgeon, D. 2019. Multiple threats imperil freshwater biodiversity in the Anthropocene. *Current Biology*, *29*(19), R960–R967. https://doi.org/10.1016/-j.cub.2019.08.002

Erika, R., Kurniawan, K., & Umroh, U. 2018. Keanekaragaman Ikan Di Perairan Sungai Linggang, Kabupaten Belitung Timur. *Akuatik: Jurnal Sumberdaya Perairan*, *12*(2), 17–25. https://doi.org/10.33019/-akuatik.v12i2.697

Fauziyah, R., Agus Kironoto, B., & Legono, D. 2018. Kajian Angkutan Sedimen Di Sungai Pabelan, Kabupaten Magelang, Jawa Tengah. *Semesta Teknika*, *21*(1). https://doi.org/10.18196/st.211210

Gob, F., Gautier, E., Virmoux, C., Grancher, D., Tamisier, V., Primanda, K. W., Wibowo, S. B., Sarrazin, C., de Belizal, E., Ville, A., & Lavigne, F. 2016. River responses to the 2010 major eruption of the Merapi volcano, central Java, Indonesia. *Geomorphology*, *273*, 244–257. https://doi.org/10.1016/-j.geomorph.2016.08.025

Jailani, A. Q., & Mujtahidah, T. 2021. Study of Iktiofauna Biodiversity Based on Geographical Information Systems (GIS) in the Progo River, Magelang, Central Java. *Journal of Aquaculture Science*, *6*(1), 38–47. https://doi.org/10.31093/-joas.v6i1.136

Kotellat, M., Whitten, A. J., Kaartikasari, S. N., & Wirjoatmodjo, S. 1993. *Freshwater Fishes Of Western Indonesia and Sulawesi.* Pepiplus Edition.

Kuchta, R., Řehulková, E., Francová, K., Scholz, T., Morand, S., & Šimková, A. 2020. Diversity of monogeneans and tapeworms in cypriniform fishes across

two continents. *International Journal for Parasitology*, *50*(10–11), 771–786. https://doi.org/10.1016/j.ijpara.2020.06.005

Kusuma, W. E., Widyawati, Y., Dailami, M., Kholil, K. N. A., Paricahya, A. F., Sufaichusan, I., & Wiadnya, D. G. R. 2024. Posisi Filogenetik Ikan Kotes (*Channa gachua* (Hamilton, 1822)) dan Ikan Kutuk (*Channa striata* (Bloch, 1793)) dari Jawa Timur Berdasarkan Urutan DNA Mitokondria Cytochrome C Oxidase Subunit I. *Berita Biologi*, *23*(2), 269–283. https://doi.org/-10.55981/-beritabiologi.2024.2733

Liu, Z., Wu, Y., You, W., Li, S., Shi, G., & Zhang, C. 2025. Revealing the Structure and Biodiversity Patterns of Fish Communities in River Networks Based on Environmental DNA. *Fishes*, *10*(4), 175. https://doi.org/10.3390/-fishes10040175

Mattos, T. M., Carvalho, D. R., de Brito, M. S., & Araújo, F. G. 2018. Occurrence of phoresy between Ancistrus multispinis (Actinopterygii: Siluriformes) and Ichthyocladius sp. (Diptera: Chironomidae) in Atlantic forest streams, Southeastern Brazil. *Zoologia*, *35*, 1–6. https://doi.org/-10.3897/zoologia.35.e13255

Muhtadi, A., Dhuha, O. R., Desrita, D., Siregar, T., & Muammar, M. 2017. Kondisi habitat dan keragaman nekton di hulu Daerah Aliran Sungai Wampu, Kabupaten Langkat, Provinsi Sumatera Utara. *Depik*, *6*(2), 90–99. https://doi.org/10.13170/-depik.6.2.5982

Shi, X., & Czerniawski, R. 2025. Habitat Heterogeneity and Channelization of Small Rivers and Streams: Fish Community Responses to Ecological Gradients. *Ecology and Evolution*, *15*(9). https://doi.org/10.1002-/ece3.72092

Sofian, Humairani, & Syaputra, A. 2024. Keanekaragaman jenis ikan di perairan pasang surut Sungai Musi, Kecamatan Muara Telang, Kabupaten Banyuasin. *Jurnal Ilmu-Ilmu Perikanan Dan Budidaya Perairan*, *19*(1), 55–65.

Trijoko, T., Yudha, D. S., Eprilurahman, R., & Pambudi, S. S. 2016. Keanekaragaman Jenis Ikan di Sepanjang Sungai Boyong – Code Propinsi Daerah Istimewa Yogyakarta. *Journal of Tropical Biodiversity and Biotechnology*, *1*(1), 21. https://doi.org/10.22146/jtbb.12930

Wahyudewantoro, G., Dina, R., Larashati, S., Lukman, L., & Akhdiana, I. 2024. New record of bristlenose catfish, Ancistrus chagresi Eigenmann & Eigenmann, 1889 and Ancistrus sp., in Ciliwung Watershed, Indonesia. *BioInvasions Records*, *13*(4), 1021–1032. https://doi.org/10.3391/-bir.2024.13.4.15

Wiharti, T., & Hanik, N. R. 2022. Identification of Types of Fish Captured by Fishermen at TPI Wuryantoro, Wonogiri, that are Consumed by the Community. *Jurnal Biologi Tropis*, *22*(4), 1177–1187. https://doi.org/-10.29303/jbt.v22i4.4137

Yudha, D. S., Trijoko, T., Eprilurahman, R., Nugraha, R., Suranto, R. D. P., Abida, F. U., Tobing, V. F., Fathiya, R. F., & Nopitasari, S. 2020. Keanekaragaman jenis ikan di sepanjang Sungai Opak Provinsi Daerah Istimewa Yogyakarta, Indonesia. *Biota : Jurnal Ilmiah Ilmu-Ilmu Hayati*, 81–91. https://doi.org/-10.24002/biota.v5i2.2939