Fish Diversity in the Middle Part of Klawing River, Purbalingga Regency, Central Java Province

Keanekaragaman Ikan di Bagian Tengah Sungai Klawing, Kabupaten Purbalingga, Jawa Tengah

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ABSTRACT

Research on the diversity of fish species in the middle part of the Klawing River, Purbalingga Regency, Central Java Province, dealt with exploring the diversity of fish species in the middle part of the Klawing River. A survey method was applied to collect primary data from April-June 2022. Direct fish sampling was carried out at 3 stations in the middle part of the Klawing River. The stations were chosen based on fish farming activities, domestic areas and accessibility. Stations 1, 2, and 3 were located in Onje Village of Mrebet District, in Slinga and in Lamongan Villages of Kaligondang District, respectively. The results showed that a total of 707 individuals were sampled, consisting of 23 species and 12 Familia. Cyprinids dominated the total samples. Diversity indexes were 1.94 and 1.99 in stations 2 and 3, respectively. The diversity index in station 1 was 1.61. Dominance indexes were 0.26, 0.18, and 0.198 in stations 1, 2, and 3, respectively. Evenness indexes comprised 0.73 and 0.76 in stations 1 and 2, respectively. However, the evenness index in station 3 was 0.68.

Keywords: diversity, dominance, evenness, indexes, Klawing River, Purbalingga Regency.
**Introduction**

Klawing River is part of Serayu watersheds (DAS), located in Purbalingga Regency, Central Java Province, running along 55.5 km (Pramono et al., 2018). Klawing River crosses the districts of Bobotsari, Mrebet, Bojongsari, Purbalingga, Kaligondang, and Kemangkon in Purbalingga Regency. Large tributaries include the rivers of Pelus, Berem, Ponggawa, Peguling, Lebak, Kajar, Rumbiling, Lemberang, Gintung, Paingen, Soso, Laban, and Tungtung. As an ecosystem, river ecosystem becomes a habitat for aquatic organisms strongly influenced by the surrounding environment (Sari et al. 2020).

Rivers were furthermore source of water for the community, being for various purposes and daily activities, such as household, agriculture, industry, mineral mining, and other uses (Suryaningsih et al. 2012), and tourism (Emmanuel and Modupe, 2010; Hossain et al., 2012; Zuliyanti and Cahyaningrum, 2022). Water pollution frequently occurs due to anthropogenic impacts such as industrial waste, urbanization, global warming, and agricultural intensification (Altaj et al. 2015). Community activities in the middle part of the Klawing River included sand mining, plants, agriculture, and fisheries. A dam, called Slinga dam, in Slinga Village, Kaligondang District, Purbalingga Regency, was constructed on Klawing River and used for irrigation and tourism. Dam construction affected the diversity of fish species (Limbu et al., 2020). Kartamihardja (2019) stated that the existence of a dam changed the water ecosystem, from previously flowing into stagnant water and subsequently affecting aquatic biota structure, including fish community. However, the use of unfriendly environmentally fishing gear (Britton et al. 2022), habitat degradation (Arantes et al. 2018), and diluted oxygen, current velocity, and pH (Adhikari et al. 2021) would affect fish diversity.

Several studies on the diversity of fish species in the Klawing River were carried out and collected 7 Familia, 13 genera, and 13 species. One of them was an introduced species, namely gourami (Oshpronemus gouramy), and an invasive species, namely broomstick fish (Hypostomus plecostomus), and the rest were native fish species of the Klawing River, Purbalingga Regency (Pramono et al. 2018). Gunara and Rukayah (2019) discovered 23 species in the Klawing River. Meanwhile, Suryaningsih et al. (2012) found 18 species. Fish diversity was one of the aquatic resources, and it was required to know the economic value to increase community income around the riverbanks (Mardani and Yusurum Jagau, 2013). Aquatic resources should be managed sustainably (Chessman, 2013). Shrestha (2017), parallelly stated that endangered fish should be conserved. Information on fish species diversity in Klawing River remained restricted. There was necessary research on fish species diversity in the Klawing River as additional data. Therefore, the purpose of this study was to provide information on fish species diversity in the middle part of the Klawing River. Moreover, all data would be required to maintain and support the sustainability of fish resources in the Klawing River.

**Materials and Methods**

**Research Sites**

This research was conducted during April-June 2022 in the middle part of Klawing River, Purbalingga Regency, Central Java Province. Samples were collected from 3 stations, i.e., station 1 was located in Onje Village of Mrebet District; station 2 was located in Slinga Village of Kaligondang District; and station 3 was in Lamongan Village of Kaligondang District. Distribution of the 3 stations along Klawing River was...
plotted in a map as seen in Figure 1. Maps of the 3 Sampling Stations (i.e Onje, Slinga, and Lamongan Villages) in the Middle Part of Klawing River, Purbalingga Regency, Central Java Province. Figure 1.

Each sampling site/station, as described in Table 1, showed some land characteristics and water qualities. These stations were chosen based on fish farming activities, domestic areas, and accessibility. Domestic areas featured areas where people inhabited. Accessibility included a footpath to facilitate collecting fish from fisherman boats.

Data Collection

A research method operated a survey method in collecting fish samples (Notoadmodjo, 2002). Fish were sampled twice a month, during the day and the night, in given stations by pole and line fishing, trapping, and gill nets of mesh sizes of ¾” inner wall and 2” outer wall, with the assistance of local fishermen. Fish from each station were separately stored alive in an ice box, then transported to the laboratory for further analysis. Laboratory analysis consisted of weighing (mg), measuring total and standard lengths (mm), identifying species level, dissecting, and weighing gonads, livers, and visceral.

Fish Identification

Fish identification was based on morphological characteristics and was subsequently compared with identification books of Kottelat et al. (1993), fishbase.org, fish inventory research hitherto in Klawing River, e.g., by Suryaningsih et al. (2012), and Suryaningsih et al. (2018).

Water Quality

In parallel with fish sampling, water qualities were measured, i.e., dissolved oxygen (DO-meter), depth and transparency (Secchi disk), pH (pH-meter), water temperature (thermometer), and current velocity (floating plastic bottle). These water quality parameters were checked in situ.

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**Figure 1.** Maps of the 3 Sampling Stations (i.e Onje, Slinga, and Lamongan Villages) in the Middle Part of Klawing River, Purbalingga Regency, Central Java Province.
Data Analysis

Diversity Index

The Shannon-Wiener diversity index was used to determine the diversity of a species of a taxon in a formula as follows:

\[ H = -\sum p_i \times \ln(p_i) \]

where: \( \Sigma \) is a greek symbol of "sum"

\( \ln \) is natural log;
\( p_i \) is the proportion of the entire community made up of species \( i \)

The higher the value of \( H \), the higher the diversity of species in a particular community. The lower the value of \( H \), the lower the diversity. A value of \( H = 0 \) indicates a community that only has one species (Zach, 2021)

Table 1. Description of Sampling Stations in the Middle Part of Klawing River, Purbalingga Regency, Central Java Province.

<table>
<thead>
<tr>
<th>Sampling Stations</th>
<th>Coordinates</th>
<th>Characteristics</th>
<th>Water Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onje</td>
<td>7°20'9&quot; S, 109°22'16&quot; E</td>
<td>Small fast-growing mimosaid, coconut, bamboo, and bushes trees populated river periphery; Some fish ponds irrigated from Klawing River; Waters used for daily activity, such washing, bath; Substrate: sand and small gravel.</td>
<td>DO: 7.6-7.9 mg/L Transparency: 30-42 cm Depth: 1.43-1.8 m pH: 7.81-7.90 Temperature: 27-28 °C Current velocity: 8-12 m/s</td>
</tr>
<tr>
<td>Slinga</td>
<td>7°21' 35&quot; S, 109°23'6&quot; E</td>
<td>Small fast-growing mimosaid, coconut, bamboo, and bushes trees populated river periphery; Some fish ponds irrigated from Klawing River; Waters used for daily activity, such washing, bath; River tour, rafting, fishing games; Dam and sand mining; Substrate: sand and small gravel.</td>
<td>DO: 8.2-8.4 mg/L Transparency: 28-40 cm Depth: 2.2-3.11 m pH: 7.9-8.39 Temperature: 28-30 °C Current velocity: 3-8 m/s</td>
</tr>
<tr>
<td>Lamongan</td>
<td>7°24'23&quot; S, 109°24'7&quot; E</td>
<td>Small fast-growing mimosaid, coconut, bamboo, and bushes trees populated river periphery; Some fish ponds irrigated from Klawing River; Waters used for daily activity, such washing, bath, and sand mining; Substrate: sandy and muddy.</td>
<td>DO: 8.3-8.5 mg/L Transparency: 30-40 cm Depth: 2.8-3.2 m pH: 7.94-8.22 Temperature: 29-30 °C Current velocity: 5-7 m/s</td>
</tr>
</tbody>
</table>
**Evenness Index**

Shannon Equitability Index was to measure the evenness of species in a community. The term “evenness” referred to how similar the abundances of different species were in the community. Denoted as EH, this index was calculated as:

\[ \text{EH} = \frac{H}{\ln(S)} \]

where:
- \(H\): The Shannon Diversity Index
- \(S\): The total number of unique species

EH value ranges from 0 to 1 where 1 indicates complete evenness (Zach, 2021).

**Dominance Index**

This index was determined as Simpson's dominance index (Magurran, 1988; Thukral et al. 2019),

\[ D = \sum p_i^2 \]

where: \(p_i\) = species proportion, \(p_i = \frac{x_i}{N}\); \(N\) = number total of fish

**Results and Discussion**

Fish identification during sampling in this study, in the middle part of the Klawing River, 707 individuals were collected, consisting of 23 species belonging to 12 Familia. The fish covered *Oxyeleotris marmorata*, *Anguilla bicolor*, *Aplocheilus panchax*, *Hemibagrus nemurus*, *Colossoma macropomum*, *Oreochromis niloticus*, *Amphiliophus trimaculatus*, *A. labiatus*, *Parachromis managuensis*, *Pangio kuhlii*, *Barbodes binotatus*, *Osteochilus vittatus*, *Systomus rubripinnis*, *Rasbora argyrotaenia*, *Barbonymus balleroides*, *B. gonionotus*, *Labiobarbus leptochelius*, *Hampala macrolepidota*, *Hyphostomus plecostomus*, *Mastacembelus armatus*, *Nemacheilus pleiiferae*, *Trichoptodus trichopterus*, and *Osphronemus gourami* (see Table 2). The biggest number of individuals was lifted from station 3 (Lamongan Village), i.e., 287 individuals. From station 1, only 191 individuals were sampled. This was due to the width and depth of the river. Table 2 presented *Oreochromis niloticus*, *Barbonymus balleroides*, and *Hypostomus plecostomus* that were abundantly caught, i.e., 145, 203, and 119 individuals, respectively. Nevertheless, *Anguilla bicolor*, *Amphiliophus trimaculatus*, *Trichoptodus trichopterus*, and *Osphronemus gourami* were rarely sampled, 1 individual in each station. Based on Familia, Eleotrid represented 0.58%, Anguillid 0.14%, Aplochilid 0.28%, Bagrid 1.27%, Characid 0.28%, Cichlid 21.67%, Cobitid 0.42%, Locariid 16.86%, Mastacembelid 0.14%, Nemacheilid 7.93%, Osphromenid 0.14%. The most abundant family was Cyprinid 50.28% (Figure 2).

The high number of individuals in *O. niloticus*, *B. balleroides*, and *H. plecostomus*, should be considered. These species represented Invasive Alien Species (IAS) that developed in the middle of Klawing River. As Ricciardi (2013) described, in general, the more species introduced to an area, the more that become established. Such species have the potential to spread over long distances. Kour et al (2014), additionally, revealed that *O. niloticus* with its wide environmental tolerance, high reproductive rate, rapid population growth and ease of cultivation, rendered it highly invasive, with considerable potential for becoming a pest in aquatic environments where it was introduced. The risks of *O. niloticus* introduction should therefore be rigorously evaluated and weighed against the potential socio-economic benefits. The fish diversity index at station 3 (Lamongan Village) was the highest (1.991), followed then with station 2 (Slinga Village) being 1.940 and station 1 (1.609), as presented in Table 3. According to Zach (2021), the three stations were categorized as medium based on the results of the Shannon-Wiener diversity indexes. These indicated that the
Ecosystem in the middle part of the Klawing River did not experience any stress. Special attention should be paid to station 3, where the highest index was found. This was presumably due to the confluence of river flows, resulting in more available sources of food and nutrients. This condition is the beneficial offers of the middle part of Klawing River as a comfortable habitat for potential IAS, for example, *Oreochromis niloticus, Hypostomus plecostomus, Amphilophus trimaculatus, Amphilophus labiatus, Parachromis managuensis*, and *Colossoma macropomum*. The presence of IAS posed a serious threat to the diversity of native and endemic fish species (Sentosa and Hedianto, 2019). According to Kottelat et al. (1993), a wider area would present a greater variety of habitats than a smaller one, meaning that the longer and wider the river size, the more fish would inhabit. In a previous study, Suryaningsih et al. (2018) stated that the diversity index in the upstream Klawing Purbalingga River was 1.051, the middle part was 1.691 and the downstream part was 1.97. They reported moreover that Cyprinid dominated at each research station, principally *Barbonymus balleroides*. Cyprinid was known as fast and free-swimming fish and usually preferred areas with rocky and flowing waters (Maharudin et al., 2021), adaptable to swim against the current (Dwirastina and Atminarso, 2021). This condition was conformable with the middle part of Klawing River. Muhammad et al. (2020) reported that high diversity of fish species in the Tembesi River, Bathin VIII

Table 2. Number of Individual Representing Species and Familia Caught in the Middle Part of Klawing River, Purbalingga Regency, Central Java Province, according to Sampling Stations.

<table>
<thead>
<tr>
<th>Familia</th>
<th>Species</th>
<th>Onje</th>
<th>Slinga</th>
<th>Lamongan</th>
<th>Total (ind.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eleotridae</td>
<td><em>Oxyeleotris marmorata</em></td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Anguillidae</td>
<td><em>Anguila bicolor</em></td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Aplocheilidae</td>
<td><em>Aplocheilus panchax</em></td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Bagridae</td>
<td><em>Hemibagrus nemurus</em></td>
<td>2</td>
<td>6</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>Characidae</td>
<td><em>Colossoma macropomum</em></td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Cichlidae</td>
<td><em>Oreochromis niloticus</em></td>
<td>18</td>
<td>32</td>
<td>95</td>
<td>145</td>
</tr>
<tr>
<td></td>
<td><em>Amphilophus trimaculatus</em></td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td><em>Parachromis managuensis</em></td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td><em>Amphilophus labiatus</em></td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Cobitidae</td>
<td><em>Pangio kuhlii</em></td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Cyprinidae</td>
<td><em>Barbodes binotatus</em></td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td><em>Osteochilus vitatus</em></td>
<td>16</td>
<td>32</td>
<td>15</td>
<td>63</td>
</tr>
<tr>
<td></td>
<td><em>Systomus rubripinnis</em></td>
<td>15</td>
<td>3</td>
<td>9</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td><em>Rasbora argyrotaenia</em></td>
<td>0</td>
<td>4</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td><em>Barbonyxus balleroides</em></td>
<td>80</td>
<td>55</td>
<td>68</td>
<td>203</td>
</tr>
<tr>
<td></td>
<td><em>Labiobarbus leptochelius</em></td>
<td>9</td>
<td>4</td>
<td>32</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td><em>Hampala macrolepida</em></td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><em>Barbonyxus gonionotus</em></td>
<td>0</td>
<td>4</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Loricariidae</td>
<td><em>Hypostomus plecostomus</em></td>
<td>48</td>
<td>62</td>
<td>9</td>
<td>119</td>
</tr>
<tr>
<td>Mastacembelida</td>
<td><em>Mastacembelus armatus</em></td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Nemacheilidae</td>
<td><em>Nemacheilus pfeifferae</em></td>
<td>0</td>
<td>22</td>
<td>34</td>
<td>56</td>
</tr>
<tr>
<td>Oshpronemida</td>
<td><em>Trichopodus trichopterus</em></td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td><em>Osphronemus gourami</em></td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>23</td>
<td>191</td>
<td>229</td>
<td>287</td>
</tr>
</tbody>
</table>
District, Sarolangun Regency, Jambi Province, was detected in shallow water with aquatic plants. Odum (1996) conveyed that the evenness index \( (E) \) comprised of three qualifications, i.e., \( E \leq 0.4 \) = low population, \( 0.4 < C \leq 0.6 \) = medium population, and \( E \leq 0.6 \) = high population. The highest \( E \) was found in station 2 (Slinga Village) being 0.756; in station 1 (Onje Village) 0.732, and in station 3 (Lamongan Village) was 0.676. Based on Odum (1996), stations 1 and 2 could be included as having high population evenness. Nonetheless, \( E \) in station 3 was moderate. Stations 1 and 2 were characterized with similar substrates (Table 1), i.e., small and large rocks for the substrates. According to Krebs (1989), the smaller the \( E \), the smaller the \( E \) of a population. The greater the \( E \), the greater the \( E \) of a population. The dominance index \( (D) \) obtained for stations 1, 2, and 3, in the middle part of the Klawing River, were 0.263, 0.181, and 0.198, respectively (Table 3). There was not any dominated in the middle of the Klawing River since \( D \) closed to 0 (zero). The existence of the Slinga dam (around to station 2) possibly caused ecosystem and habitat changes. This would certainly impact biota inhabiting two ecosystems (upstream and downstream segments). \( D \) normally determined the dominant genus in a community with a criterion \( D \) closed 0 (zero). If \( D \) relatively closed to 1, a species could dominate the others (Odum, 1996). Bahiyah et al. (2013) research on Cyprinid, in Serayu River, revealed that \textit{Barbonymus balleroides} was dominant species. This species represented positive rheo-taxis or fast-flowing fish, being able to live in a

### Figure 2. Percentage of families sampled in the middle part of the Klawing River, Purbalingga Regency, Central Java Province

![Percentage of families sampled](image_url)

### Table 3. Dominance, Evenness, and Diversity Indexes of Fish Caught in the Middle Part of Klawing River, Purbalingga Regency, Central Java Province, according to Sampling Stations.

<table>
<thead>
<tr>
<th>Indexes</th>
<th>Sampling Stations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Onje</td>
</tr>
<tr>
<td>Dominance</td>
<td>0.263</td>
</tr>
<tr>
<td>Evenness</td>
<td>0.732</td>
</tr>
<tr>
<td>Diversity</td>
<td>1,609</td>
</tr>
</tbody>
</table>

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Saprudin et al. 2022
temperature range of 25-30°C. The middle part of Klawing River ecosystem was relatively steady. However, the D index related to nutrients and feed.

Water temperature in the middle part of Klawing River, reflected normal range aquatic biota life, since they ranged from 27-30°C. According to water quality standards, from government rules (Peraturan Pemerintah Nomor 82 Tahun 2001, 2001), water temperature criteria for biotic life were 22-28°C. Water temperature, supporting feeding and growth of fish, ranged 21-30°C (Buckel et al., 1995). Water temperature patterns were influenced by anthropogenic factors, e.g., human activities such as heat waste, factory cooling water, and deforestation, causing loss of protection of water bodies (Barus, 2004).

Dissolved oxygen DO in the current study area oscillated between 7.6 to 8.5 mg/L, being remained suitable for aquatic biota growth. DO was an important parameter for all organisms, including fish. The transparency of the middle part of Klawing River is undulated by around 28-40 cm. The difference in transparency made different characteristics of each station and could be influenced by the amount of mud sediment, other particles, and domestic or factory wastes. The current velocity in the Klawing River, Purbalingga Regency, ranges from 3-22 m/s. Current velocity, ranging around 3-12 m/s, tended to be fast to moderate. The difference in current velocity is due to the more intensity of rain. River structure and other factors, such as seasons, correspondingly determined current velocity. The pH, in the middle part of the Klawing River, remained comfortable, ranging from 7.81-8.22, and were in accordance with the finding of Suryaningsih et al. (2018) being 6.9-8. This pH was principally a determinant for water quality, since helping chemical processes of water (Andria and Rahmaningsih, 2018).

Depth in the middle part of the Klawing River, varied from 1.43 to 3.2 m. The lowest depth was in station 1, and the deepest was in station 3. The depth of the water affected the number of organisms, light penetration (transparency), and the distribution of plankton. Water depth represented a necessary factor in activities for organisms requiring low to a sufficient depth, changes in water quality, e.g., changes in physical and chemical parameters. Changes in these parameters could be caused by disposal activities, domestic and industrial waste and agriculture, into a body of water (Koniyo et al., 2017).

**Conclusion**

Based on the results of the study, it could be concluded that the fish caught were 707 individuals, consisting of 23 species, 12 Familia. The diversity index ranges from 1.609-1.991, being categorized as moderate. The ecosystem in the study area did not experience significant pressure. The evenness indexes were between 0.676 and 0.756. The highest dominance index varied from 0.181 to 0.363. Cyprinid dominated in the middle part of the Klawing River. Information about the diversity of fish species was very indispensable as a basic material in order to maintain the diversity of native fish species of the Klawing River, for its sustainability.

**Acknowledgments**

The authors would address the highest gratitude to the Research and Community Service Institute of Jenderal Soedirman University for the allocated research fund (under RISIN Scheme) in 2022. Immense thankfulness should be delivered chiefly to our undergraduate students of Aquatic Resource Management Study Program, Jenderal Soedirman University, i.e., ASNA, ENW, and SA, for assistance in most works of sampling campaigns.

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