Diversity of riparian plants of black water ecosystem in the Sebangau River of Central Kalimantan Indonesian

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Abstract. Riparian vegetation that grows on the bank of the Sebangau river plays an important role in supporting the composition of the biota and the quality of river water. This study aims to investigate the condition of riparian vegetation in the Sebangau river. Sampling was carried out in March 2020 using quadrant methods are with various size 1 x 1 m plots for herb and grass habitus, 5 x 5 m for shrub habitus, copses, lianas, and 10 x 10 m plots for tree habitus. The data analyzed were species composition, diversity, and species dominance. The results showed that the plant composition at the study location was characterized by herb and grass habitus where we found 4 families (214 individuals) of grass and herbs, 3 families (135 individuals of shrubs, copses and lianas), and 2 families (282 individuals of tree habitus). The herb and grass habitus were dominated by Hydrilla verticillata species, shrub, copse, and liana habitus were dominated by Pandanus helicopus species, and the dominant species of tree habitus was Shorea balangeran. The low diversity index was found in tree habitus, while for herb and grass habitus and shrubs, shrubs and lianas were classified as moderate diversity.

Keywords: diversity; dominance; number of species; riparian; Sebangau River

1. Introduction
Riparian vegetation is plants that grow on either side of rivers, lakes as habitat providers for wildlife and play a role in maintaining the health of water catchment areas. Riparian has special characteristics on land as a zone that connects terrestrial and aquatic ecosystems that are influenced by the movement of material and water. The topographical position on the riverbank is a source of water or food for plants and the existing structures are habitats for various types of flora and fauna.

Riparian vegetation is important as fish habitat, supporting food chains, habitat for wildlife, maintaining temperature, stabilizing river banks, protecting water quality, and maintaining river morphology and controlling flooding [5]. Disturbance against riparian is the main cause of the reduction of river structure and function [7]. Water quality and fish habitat depend on the ecological sustainability of the existing riparian zone. Therefore, protection against the riparian zone is needed. In order to protect and maintain the ecological function of riparian zones, harvesting or cutting down trees on riparian zones is sometimes prohibited. Riparian vegetation in river morphology has a very large and complex effect. This influence is not limited to vegetation variations but also affects pollutants that enter the water.
bodies, silting, and material composition. Vegetation in the upper reaches of the Sebangau river is dominated by tree species [15].

The Sebangau River is one of the rivers in the province of Central Kalimantan with ± 198.515 km long and 40 m wide, with black watercolor Sebangau River. The river is dominated by peat swamp areas with the dominant vegetation of rasau (*Pandanus helicopus*) and some bakung (*Hanguana malayana*) along the river bank besides that there is some other vegetation in very small amounts. Riparian vegetation has morphological, physiological, and reproductive characteristics that can adapt to wet environments [12].

The vegetation on either side of the river has distinctive characteristic, which often shows the influence and interaction with a dynamic aquatic environment. From an ecological point of view, this phenomenon is important as a mechanism for the flow of energy into aquatic ecosystems, through falling branches, leaves, and especially plant fruit that falls into the water, which will become a food source for aquatic animals. The significant role of riparian vegetation in supplying natural food of fishes has been studied [9]. The presence of riparian vegetation also enriches nutrients due to a large number of dead plants. Aquatic plants as primary producers have an important role in aquatic ecosystems, oxygen provider and shelter for fish and another aquatic biota, a very beneficial attachment (substrate) of periphyton, especially for fish larvae [6]. This study aims to analyze the diversity of riparian plants in the black water f the Sebangau River, Palangka Raya City, Central Kalimantan, Indonesia. This data is used to map the role of riparian vegetation as a food provider for aquatic organisms (fish) and the quality of aquatic environment, particularly in the Perupuk Tunggal area of the Sebangau river. This research is expected to enrich our knowledge on the relationship between riparian vegetation and the structure of the biota community and water quality in the Sebangau River.

2. Materials and methods

The collected of aquatic plant data was done by using the quadrant method, differentiated based on the plant habitus, with the size of the plots 2 x 2 m for herb and grass habitus, 5 x 5 m plots size for shrubs, copses, lianas habitus, and 20 x 20 m plots size for tree habitus. Analysis of riparian plants based on species, vegetation diversity, and dominance. With the research location in the area of Perupuk Tunggal, the Sebangau River.

For the vegetation analysis was carried out for an area that represented the characteristics of the overall community arrangement with 10 plots size of 0.249 ha area. Identification of plant species is carried out directly for common and known species.

Data analysis

Importance Value Index (INP)

Importance value index (INP) is only used for low-level riparians with the formula:

\[
\text{INP} = \text{KR} + \text{FR}
\]

Where:

\[
\begin{align*}
\text{INP} & = \text{Importance Value Index} \\
\text{KR} & = \text{Relative Density} \\
\text{FR} & = \text{Relative Frequency}
\end{align*}
\]

Diversity index is calculated by formula [10], species diversity index (H’) :

\[
H' = \sum S
\]

Where:

\[
\begin{align*}
H' & = \text{Index of species diversity} \\
S & = \text{Many of species} \\
P_i & = \frac{n_i}{N} \\
N & = \text{Total number of individuals}
\end{align*}
\]
3. Results and discussion

3.1. The species composition

The species composition shows the number of species variations at the observation location, the total area of the observation plot is 0.429 ha. The plot area of 0.12 ha is sufficient to describe the composition of the vegetation constituents [11]. The composition of the habitus constituents at the research location was characterized by the herb and grass habitus there were 4 families (214 individuals); in the shrubs, copses, and lianas habitus there are 3 families (135 individuals); and in tree habitus, there are 2 families (282 individuals). The families and the number of individuals that are found at the research location are presented in figure 1.

Figure 1. Family and number of individuals that are found at the study site.

Figure 1 shows that the herb and grass habitus are dominated by the *Hydrilla verticillata* family with total individuals are 132; in the habitus of *shrubs, copses and lianas*, is dominated by the *Pandanus helicopus* family with total of 71 individuals, at the tree habitus is dominated by the *Shorea balangeran* family with total 280 individuals. The number of tree species indicates a high level of distribution rate and adaptability to the physical conditions of that forest environment. Trees were more abundant on elevated surfaces, whereas saplings and seedlings were more evenly distributed over all surfaces [12]. The environmental physical conditions such as humidity and wind speed greatly affect the growth and spread of seeds [4]. The following figure 2 shows several types of plants that fulfill several habitus.

![Figure 2](image1.png)

Figure 2. Some vegetations that are found in habitus: a. Herb and Grass; b. Shrubs, copses and Liana; c. Tree.
3.2. Species dominance

The dominance of a species is indicated by the amount of the INP or Importance Value Index. The INP value at the research location is presented in table 1 below. Consists of habitus herb and grass, shrubs, shrubs and lianas and trees.

Table 1. Dominance and species diversity.

| Habitus             | Latin Name                  | K    | KR (%) | F    | FR (%) | INP (%) | H'  |
|---------------------|-----------------------------|------|--------|------|--------|---------|-----|
| Herb & Grass        | *Hydrilla verticillata*     | 33000| 62     | 1500 | 46     | 108     |     |
|                     | *Diplachne sp (Fam. Poaceae)* | 7000 | 13     | 500  | 15     | 28      | 1.16|
|                     | *Leptochloa sp. (Fam. Poaceae)* | 12750| 24     | 750  | 23     | 47      |     |
|                     | *Rumput baru*               | 750  | 1      | 500  | 15     | 17      |     |
| Shrub, Copses, and Lianas | *Timotius salicifolius* (Fam. Rubiaceae) | 2480 | 46     | 280  | 70     | 116     | 0.85|
|                     | *Pandanus helicopus*        | 2840 | 53     | 80   | 20     | 73      |     |
|                     | *Spatholobus Littoralis*    | 80   | 1      | 40   | 10     | 11      |     |
| Trees               | *Shorea balangeran*         | 700  | 99     | 23   | 90     | 189     | 0.21|
|                     | *Barringtonia sp.*          | 5    | 1      | 3    | 10     | 11      |     |

The result analysis of the diversity index (H') for vegetation in the Sebangau River (research location) for the shrubs, copses and lianas habitus, and also tree habitus, shows that the diversity is low and for the herb and grass habitus is classified as moderate, but with the abundant amounts it is seen on family and the number of species found.

The highly stable communities, expanding regionally and homogeneous will have a lower diversity index than mosaic forest forms or regionally disturbed periodically by fire, wind, floods, pests, and human intervention. Each habitus has a certain domination species. The herb and grass habitus are dominated by *Hydrilla verticillata* species; in the habitus of shrubs, copses and lianas is dominated by *Timotius salicifolius* (Fam. Rubiaceae) species; and in tree habitus, the dominant species is *Shorea balangeran*. The *Shorea balangeran* species are endemic in Kalimantan and Sumatra, but due to the threat of fire and wood harvester, that species have decreased in population and is globally considered vulnerable or susceptive. The *Pandanus helicopus* species (on shrubs, copses and lianas habitus) dominates in the plots which are closest to the riverbanks but their presence is reduced or even absent after entering 5 meters into the forest (land). This is because *Pandanus helicopus* has a unique growing place along the banks of the Sebagau river and sometimes in some locations it is able to cover the Sebagau river body itself.

The diversity of a species indicates a high level of distribution and adaptability to the physical conditions of the forest environment. The high abundance of the forest compiler vegetation can be an advantage for aquatic biota. One of the ecological functions of the forest is to provide the space for aquatic biota as a place to spawn, lay eggs and nest such as crabs, shrimp, mollusks and various types of fish, and the fallen leaves will be parsed by microorganisms and become a food source for fish. If the riparian vegetation is reduced or even lost, then the function of the riparian will also be lost, the higher high diversity if the community is composed of many species.

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of fish, and also falling leaves will be parsed by microorganisms and become a food source for various aquatic biota[3].

The composition of tree species based on the landscape of peat swamp forest from the banks of the Sebangau river as many as 47-54 species up to a distance of 10 km from the river does not show a tendency to have fewer or more number of tree species [1]. Hydrilla plants (water grasses) can live in warm and cold waters, with the characteristics of many branching stems near the surface and growing horizontally.

The natural habitat of the Pandanus helicopus plant is in peat swamp areas which have black water characteristics. These plants reproduce through shoots and grow clustered together in deep watery places, such as on the banks of rivers, lakes and swamps, because of the characteristic that easy to grow. It is not uncommon for this plant becomes a nuisance plant because it can grow tightly to cover the flow of water, as also occurs in the Sebangau river. The vegetation of the river catchment of the Sebangau consists of a continuum of forest type from the river to the center of the peatland dome [14].

The composition of the vegetation types in the research location consisted of 4 families of terna and grass habitus (214 individuals); in the habitus of shrubs, shrubs and lianas there are 3 families (135 individuals); and in tree habitus, there are 2 families (282 individuals), with a low to moderate diversity index, the dominant species, namely plants and grasses, are Hydrilla verticillata, shrubs and lianas are dominated by Timothy salicifolius, and in tree habitus species dominant is Shorea balangeran.

4. Conclusions
This study has shown that the habitus diversity index of shrubs and lianas and trees is low, while the habitus terna and grass are moderate. Further study of this research is needed to explain linkage of vegetation to aquatic biota, environment, and fish resources.

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