Analysis of vegetation diversity at urban forest Balai Wilayah Sungai (BWS) II Medan

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Abstract. The urban forest is part of the public green open space (RTH) formed from tree vegetation that affects temperature and humidity and reduces wind speed to provide comfort for residents in the vicinity. One of the urban forests in Medan is the Balai Wilayah Sungai (BWS) II Medan. Therefore, vegetation density has an influence on temperature and which affects the quality of urban forests. This study aimed to identify the structure and composition of the BWS II Medan urban forest vegetation. The vegetation analysis method used in this study is a combination method between the path method and the plotline method. The vegetation data that has been obtained is then processed to obtain the Important Value Index (IVI) and the Plant Species Diversity Index (H'). The results showed that the woody plants found in the urban forest of BWS II Medan were 20 species with the composition of seedlings of four species (26 individuals), saplings of twelve species (49 individuals), poles of eleven species (39 individuals) and trees of ten species (141 individuals). The species that dominates at the tree level is Trembesi (Samanea saman), with an IVI value of 118.16%. Meanwhile, the dominant plant species at the seedling, sapling, and pole levels were Mahoni (Swietenia mahagoni), with IVI values of 78.67%, 55.73%, and 103.62, respectively. Therefore, the level of diversity in the BWS II Medan Urban Forest for saplings is classified as moderate, while seedlings, poles, and trees are classified as low.

1. Introduction

The urban forest is part of the public green open space (RTH) formed from the association of tree vegetation that affects temperature and humidity and reduces wind speed to provide comfort for the surrounding population [1]. Based on PP No. 63 of 2002 concerning urban forest Article 1 paragraph 2, the urban forest is a stretch of land that grows compact and dense trees in urban areas, both on state land and private land, designated as urban forest authorized official.

One of the urban forests in Medan is the Balai Wilayah Sungai (BWS) II Medan. The BWS II Medan urban forest is located at 3'31' North Latitude and 98’40’ East Longitude with geographical boundaries, namely in the north bordering the river and SMA Negeri 13 Medan, in the south bordering the BWS II Workshop, in the east bordering densely populated houses on Jl. Eka Sama, Medan Johor, and the west are bordered by the river and the Ta'dib Asy-Syakirin Modern Islamic Boarding School. The BWS II Medan urban forest is located right at the end of the Medan Marindal Canal. This urban forest BWS II Medan can be reached within ± 25 minutes from the center of Medan City. The community usually uses
the BWS II Medan urban forest to take residents’ animal feed, such as cows and goats. At the end of the road on the outskirts of the urban forest, there is also a recreation location that can be used to relax and gather with family or community to form environmental education facilities such as waste management, tree planting, and spreading fish seeds in the canal that surrounds the forest area. The selection of the types of urban forest constituents considers factors such as growth speed, tree size, stem strength, roots, density, beauty of the canopy, ease of leaf decomposition, leaf thickness, flower fragrance, and fauna food sources [2]. In addition, the suitability of the place to grow is also an essential criterion in the selection of urban forest tree species [3]. Immaculata et al. [1] stated that there is an effect of vegetation density on temperature, affecting the comfort level of urban forests. Therefore, it is necessary to research the BWS II Medan urban forest to determine the structure and composition of the vegetation. This study aimed to identify the structure and composition of the BWS II Medan urban forest vegetation.

2. Materials and methods
The vegetation analysis method used in this study is a combination method between the path method and the plotline method, which refers to Hartini and Slitonga [4] research. The number of observation lines is 20 plots. Subplots were measuring 2 m x 2 m for the growth rate of seedlings (regeneration is less than 1.5 m high), 5 m x 5 m sub-plots for sapling growth rate (regeneration of tillers starting from 1.5 m in height and having a diameter of less than 10 cm), 10 m x 10 m plots for pole growth level (young trees with trunk diameters ranging from 10-19.9 cm), and 20 m x 20 m sub-plots for tree-level (woody plants with a trunk diameter 20 cm). Parameters measured in the vegetation analysis were the name of the tree species, the number of individuals in each sub-plot, total height, branch-free height, and trunk diameter. The vegetation data that has been obtained is then processed to obtain the Important Value Index (IVI) and the Plant Species Diversity Index (H') [5,6].

3. Results and discussion
Based on the results of the study, 20 species of woody plants were found in the urban forest of BWS II Medan with a composition of four species of seedlings (26 individuals), twelve species of saplings (49 individuals), eleven species of poles (39 individuals) and ten species of trees (141 individuals). These species are Glodokan (Plyalthia longifolia), Jambu (Calophyllum brasiliense), Kapuk (Ceiba petandra), Ketapang (Terminalia catappa), Kuini (Mangifera indica), Mahoni (Swietenia mahagoni), Mangga (Mangifera indica), Mengkudu (Morinda citrifolia), Nangka (Artocarpus heterophyllus), Petai Cina (Leucaena leucocephala), Pulai (Alstonia Scholaris), Rimbang (Solanum torvum), Saga (Adenanthera pavonina), Sengon (Falcataria mollucana), Tanjung (Mimusops elengi), Trembesi (Samanea saman), and Willow (Salix petiolaris).

The types of seedlings found in the BWS II Medan urban forest were relatively few and consisted of Mahoni (11 individuals), Ketapang (5 individuals), Rimbang (1 individual), and Trembesi (9 individuals). The shade conditions of Trembesi caused a low number of seedlings. Trembesi stands have a more closed shade or are classified as significant, namely 85%, so that less sunlight enters the stand floor. Sunlight affects the growth and development of understorey plants [7]. Aniyah et al. [8] stated that one of the most influential environmental conditions on plant growth is sunlight or shade. In addition, soil conditions also affect the growth and development of understorey plants. Hilwan et al. [7] stated that the soil conditions at the location of the trembesi stand were very low (very acidic).

Mahoni seedlings dominated at the seedling level in the urban forest of BWS II Medan with an IVI value of 78.67% and followed by Terembesi seedlings with an IVI of 61.89% (Table 1). The dominance of these two species proves that the species has a high tolerance level to influencing environmental factors, especially shade and soil. Mahoni is one plant that can grow and survive on ex-mining lands around 88% to 95% [9]. In addition, Kurniawan et al. [10] stated that Mahoni plants could adapt to media contaminated with mercury up to 75%.
Table 1. Results of calculation of seedling level vegetation analysis.

| No | Local Name | K   | F   | RK  | RF  | IVI  |
|----|------------|-----|-----|-----|-----|------|
| 1  | Mahoni     | 2750| 0.4 | 42.31| 36.36| 78.67|
| 2  | Trembesi   | 2250| 0.3 | 34.62| 27.27| 61.89|
| 3  | Ketapang   | 1250| 0.3 | 19.23| 27.27| 46.50|
| 4  | Rimbang    | 250 | 0.1 | 3.85 | 9.09 | 12.94|
|    | Total      | 6500| 1.1 | 100.00| 100.00| 200.00|

The dominant plant species at the sapling and pole levels were Mahoni, with IVI values of 55.73% (Table 2) and 103.62% (Table 3). This is following that stated by Sandalayuk et al. [11] that Mahoni plants are often found on roads or as greenery plants. Mahoni plants can absorb pollutants or reduce air pollution produced by industry and transportation. The absorption of heavy metals in Pb in a month in Mahoni plants reached 45.97% in leaves and 37.12% in stems [12]. In addition, the leaves on Mahoni plants are also able to absorb CO₂ relatively well, which is in the range of 2.51 tons/leaf/year [13].

Table 2. Results of the calculation of sapling level vegetation analysis.

| No | Local Name | K   | F   | RK  | RF  | IVI  |
|----|------------|-----|-----|-----|-----|------|
| 1  | Mahoni     | 640 | 0.6 | 32.65| 23.08| 55.73|
| 2  | Ketapang   | 400 | 0.7 | 20.41| 26.92| 47.33|
| 3  | Guanandi   | 160 | 0.2 | 8.16 | 7.69 | 15.86|
| 4  | Tanjung    | 160 | 0.2 | 8.16 | 7.69 | 15.86|
| 5  | Jati       | 200 | 0.1 | 10.20| 3.85 | 14.05|
| 6  | Pulai      | 120 | 0.2 | 6.12 | 7.69 | 13.81|
| 7  | Mengkudu   | 80  | 0.1 | 4.08 | 3.85 | 7.93 |
| 8  | Jambu air  | 40  | 0.1 | 2.04 | 3.85 | 5.89 |
| 9  | Petai cina | 40  | 0.1 | 2.04 | 3.85 | 5.89 |
| 10 | Glodokan   | 40  | 0.1 | 2.04 | 3.85 | 5.89 |
| 11 | Trembesi   | 40  | 0.1 | 2.04 | 3.85 | 5.89 |
| 12 | Jambu Biji | 40  | 0.1 | 2.04 | 3.85 | 5.89 |
|    | Total      | 1960| 2.6 | 100.00| 100.00| 200.00|
Table 3. Results of calculation of pole level vegetation analysis.

| No | Local Name | K  | F  | D  | RK | RF | RD | IVI  |
|----|------------|----|----|----|----|----|----|------|
| 1  | Mahoni     | 140| 0.8| 2.57| 35.90| 30.77| 36.95| 103.62|
| 2  | Trembesi   | 60 | 0.3| 1.23| 15.38| 11.54| 17.63| 44.55|
| 3  | Saga       | 50 | 0.2| 0.96| 12.82| 7.69 | 13.74| 34.25|
| 4  | Sengon     | 30 | 0.3| 0.50| 7.69 | 11.54| 7.25 | 26.48|
| 5  | Ketapang   | 30 | 0.2| 0.51| 7.69 | 7.69 | 7.36 | 22.74|
| 6  | Nangka     | 20 | 0.2| 0.36| 5.13 | 7.69 | 5.20 | 18.02|
| 7  | Guanandi   | 20 | 0.2| 0.19| 5.13 | 7.69 | 2.70 | 15.52|
| 8  | Kuini      | 10 | 0.1| 0.20| 2.56 | 3.85 | 2.85 | 9.26 |
| 9  | Mangga     | 10 | 0.1| 0.17| 2.56 | 3.85 | 2.42 | 8.83 |
| 10 | Pulai      | 10 | 0.1| 0.15| 2.56 | 3.85 | 2.17 | 8.58 |
| 11 | Jati       | 10 | 0.1| 0.12| 2.56 | 3.85 | 1.74 | 8.15 |
|    | Total      | 390| 2.6| 6.95| 100.00| 100.00| 100.00| 300.00|

At the tree level, the dominant plant species was Trembesi, with an IVI value of 118.16% (Table 4). This indicates that Trembesi is suitable for use as a city greenery/protective plant in the urban forest of BWS II Medan. Ow & Ghosh [14] stated that Trembesi is commonly planted on roadsides and in urban areas. Trembesi can provide shade for humans and other organisms [15]. In addition, Trembesi can reduce the temperature in the surrounding environment [16]. Sofyan et al. [17] stated that Trembesi is a type of tree with a considerable ability to absorb carbon dioxide from the air. This tree can absorb CO₂ reaching 314.28 tons/ha [18].

Table 4. Results of tree-level vegetation analysis calculations.

| No | Local Name | K  | F  | D  | RK | RF | RD | IVI  |
|----|------------|----|----|----|----|----|----|------|
| 1  | Trembesi   | 147.5| 1 | 18.24| 41.84| 27.78| 48.53| 118.16|
| 2  | Sengon     | 92.5 | 0.5| 11.66| 26.24| 13.89| 31.04| 71.17 |
| 3  | Mahoni     | 45 | 0.6| 2.73 | 12.77| 16.67| 7.27 | 36.70|
| 4  | Ketapang   | 17.5 | 0.4| 1.63 | 4.96 | 11.11| 4.32 | 20.40|
| 5  | Saga       | 25 | 0.3| 1.52 | 7.09 | 8.33 | 4.06 | 19.48|
| 6  | Jati       | 12.5 | 0.3| 0.87 | 3.55 | 8.33 | 2.30 | 14.18|
| 7  | Pulai      | 5 | 0.2 | 0.40 | 1.42 | 5.56 | 1.06 | 8.03 |
| 8  | Kapuk      | 2.5 | 0.1| 0.35 | 0.71 | 2.78 | 0.94 | 4.43 |
| 9  | Willow     | 2.5 | 0.1| 0.09 | 0.71 | 2.78 | 0.25 | 3.73 |
| 10 | Guanandi   | 2.5 | 0.1| 0.09 | 0.71 | 2.78 | 0.23 | 3.72 |
|    | Total      | 352.5| 3.6| 37.58| 100.00| 100.00| 100.00| 300.00|

Species diversity in the urban forest of BWS II Medan for the tree level had an index value of 1.60, pole level 1.99, sapling 2.03, and seedling 1.17 (Figure 1). The value of the species diversity index, according to Magurran [19], can be classified in several levels H' < 2 then the value of H' is low, if the value of H' = 2-3 then it is moderate, and if the value of H'> 3 is high. Therefore, based on the classification, species diversity in the BWS II Medan urban forest for saplings is classified as medium, while seedlings, poles, and trees are classified as low. According to Indriyanto [20], the species diversity of a community is high if the community is composed of many species. Otherwise, a community is said to have low species diversity if the community is composed of a few species and only a few dominant species.
4. Conclusion

The woody plants found in the urban forest of BWS II Medan were 20 species with the composition of four species of seedlings (26 individuals), twelve species of saplings (49 individuals), eleven species of poles (39 individuals), and ten species of trees (141 individuals). The species that dominates at the tree level is *Samanea saman*, with an IVI value of 118.16%. Meanwhile, the dominant plant species at the seedling, sapling, and pole levels were *Swietenia mahagoni*, with IVI values of 78.67%, 55.73%, and 103.62%. Therefore, the level of species diversity in the BWS II Medan City Forest for saplings is classified as moderate, while seedlings, poles, and trees are classified as low.

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