Kelompok Bidang: Keanekaragaman Hayati dan Bioprospeksi

Analysis of The Diversity and Important Value Index of Trees in Lowland Forest

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ABSTRACT

This study aims to determine the diversity and the population of plant species based on slope direction and height using plot paths. Data collection at seedling, sapling and pole level was carried out plots in 20 x 20m² sized plots. Plots for observation of seedlings, saplings, and poles measuring size of 2 x 2m², 5 x 5m², and 10 x 10m². Data analysis was performed using vegetation analysis methods by calculating the frequency, density, dominance, relative frequency, relative density, relative dominance, Important Value Index (IVI) and species diversity (H"). The results of the study obtained the highest tree growth strata and individual species were found in the northern slope, while the highest level of seedlings and saplings on the western slope. The dominant plant species on the western and southern slopes, are Murraya paniculata Jack, (IVI 125.42) and Maesopsis eminii Engl (IVI 124.64). The dominant plant species at northern and eastern slopes is Pinus merkusii Jungh (IVI 80.56 and 130.75). The eastern and northern slopes have highest diversity index with an average value > 3, while the western slope direction only has a medium category diversity index with an average value ≤ 2.

INTRODUCTION

Forest is a stretch of land that contains a variety of plants and is dominated by trees that interact with each other. The forests are ecosystems characterized by tree communities and other living natural resources whose management and preservation require ecological knowledge and an ecosystem approach **[1]**. A forest ecosystem will have a close relationship between growing vegetation and its environmental conditions. This relationship is seen by the variation of the structure and vegetation composition in certain ecosystems. The formation of forest diversity patterns is a dynamic process and is closely related to environmental conditions including the height of the location above sea level **[2].** The height of the location will affect several things such as the type, structure, and composition of plant vegetation, temperature, and light intensity **[3]**.

One of the areas that have a high diversity of species with unique forest formations is the Mount Ciremai National Park (MCNP) in Kuningan Regency. Mount Ciremai National Park has a great deal of biodiversity and is one of the nature conservation areas which has a special feature in flora and fauna with lowland mountain forest types classified into several slope directions. The slope directions intended are west, south, east, and northern. Classified into the nature conservation area by separating the slope direction. It is necessary to study the diversity and the structure of the trees vegetation based on the direction of the slopes of Mount Ciremai National Park.

Nature conservancy in MCNP is important in the biodiversity conservation and enhancement in these populations as this will also benefit humans both directly and indirectly **[4]**. One of the factors that greatly influence biodiversity improvement is the role of a number of trees in the population. The tree population serves as a shelter, food, habitat, for other living things in it **[5]**.

The success of the diversity analysis and the forest vegetation structure has been carried out by several researchers such as [6] in Sempu Island Nature Reserve, [7] in Baluran National Forest, and [2] Kalirajut Pemangkuan Forest Resort, [8]

Tree species composition, biodiversity and regeneration in response to catena shape and position in a mountain forest, [9] Species composition, stand structure, and regeneration status of tree species in dry Afromontane forests of Awi Zone, northwestern Ethiopia, [10] Diversity, Composition And Physical Structure Of Tropical Forest Over Limestone In Xishuangbanna, South-West China, [11].

Floristc composition end Structural comparation of leamstone forest at three Different elevation in Bau, serawak Malaysia. Vegetation diversity and structure were analyzed using vegetation analysis which calculates frequency, density, dominance, relative frequency, relative density, relative dominance, Importance Value Index (IVI), and species diversity (H"). Important Value Index (IVI) is used to analyze the dominance of a type in a particular community, while the species diversity index is a value that shows the species diversity discovered at the study site. Each IVI and H' growth analysis were classified into four growth stages, namely seedlings, saplings, poles, and trees. Meanwhile, other research is limited by the forest as a whole.Therefore, this research certainly needs to be carried out to determine the diversity and population of plant species based on the slope and altitude using the plot path at MCNP.

METHODS

The study was conducted from November 2016 to March 2017 in the lowland forests of the Mount Ciremai National Park Area (MCNP) at an altitude of 500-1200 m a.s.l. The MCNP area is classified into climate types of B and C with an average rainfall of 2,000-4,000 mm/year. Monthly temperatures range from 18o C to 22o C. More clearly the location of the study is in Figure 1

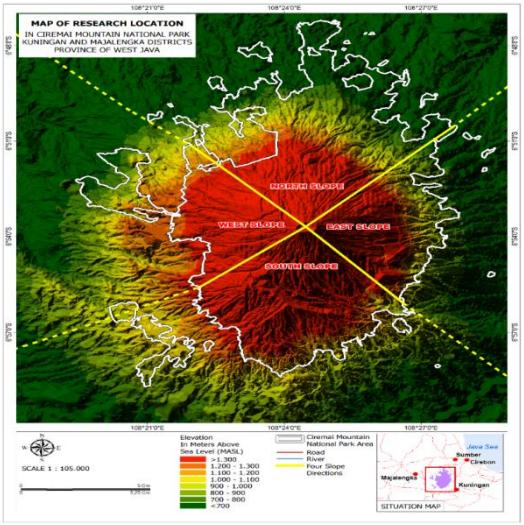

Figure 1. Map of the Research Location

Data collection techniques were done by studying literature and observing directly from the field. The data obtained were then analyzed descriptively. The study was limited from an altitude of 500 - 1200 m a.s.l. Sample plots were made at each height at the size of 20 x 20m² for tree level observations, 10 x 10m² sized plots for pole level, 5 x 5 m² for sapling levels and 2 x 2 cm for seedlings

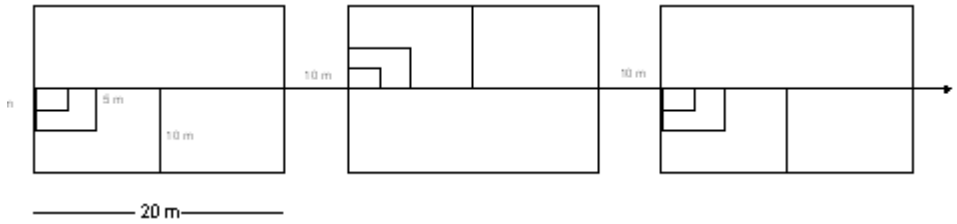

Figure 2. Vegetation Plot

The collection of plant organ specimens was carried out for tree species recognition. Morphological observations of unknown specimens were collected and arranged on newsprint paper inside plastic bags. Next, the specimen was given 70% alcohol until it was wet enough to avoid spoilage. Specimen identification was done by comparing it with the book Flora of Java and with Bogoriense specimens, in Bogor.

Data analysis was performed using vegetation analysis of plot paths at each species growth rate by calculating frequency, dominance. From the observation of vegetation at the tree, pole, sapling, and seedling level, each measurement plot was carried out, density, frequency, and dominance for each type of plant, the calculation used the following formulas [7]

a. Density $= \frac{\sum \text{individual}}{\text{Example area}}$ (1)

b. Relative Density (RD $= \frac{\text{Density of a species}}{\text{Total density of all species}} \times 100\%$ (2)

c. Dominance (D) $= \frac{\sum \text{Basic area}}{\text{Sample plot size}}$ (3)

d. Relative Dominance (RD) $= \frac{\text{Dominance of a species}}{\text{Dominance of all species}} \times 100\%$ (4)

e. Frekuensi (F) $= \frac{\sum \text{Plot of a type discovery}}{\sum \text{Total sample plot}}$ (6)

f. Relative Frecuency (RF) $= \frac{\text{Frecuency value of the species}}{\text{Sum of frecuency of all species studied}} \times 100\%$ (7)

Important Value is used to determine the dominance of plant species in an area by calculating the importance in each study plot. The formula [12;13] is as follows:

$$IV = RD + RF + RD \quad (8)$$

where IV = Important Value; RD= Relative Density; RF = Relative Frecuency and RD= Relative Dominance.

Shanon-Wiener's species diversity values (H') are used to show the stability and complexity of a community, calculated by the formula [13] with the following equation:

$$H' = - \sum [Pi \ .\ln \ . \ Pi] \qquad (9)$$

$$Pi = \frac{ni}{N}$$

where H' = Shannon-Wiener's Diversity Index, *ni* = Number of individuals of species "i", N = Total number of individuals of all species. With grouping classification H' is < 1 very low, 1-2 low; 2-3 medium; 3-4 high; > 4 very high.

RESULT AND DISCUSSION

The number of species and individuals at various growth rates in each study location can be seen in Figure 3. Based on the observations with a total of 672 plots, it was found that the growth stratum of trees had the highest number of species and individual diversity evenly in each direction. The growth strata of the tallest tree was found on the northern slope, reaching 1478 individuals with 87 species diversity. The highest level of seedlings and saplings was found on the western slope, respectively 305 and 385 individuals with lower species than other sample plots. The relatively high diversity of species and individuals of seedlings and saplings on the western slope indicated progress towards restoration of damaged areas. Secondary succession occured on land that was originally fully vegetated but damaged due to disaster or humans and so forth. The high number of growth strata in the undergrowth level to a certain extent in the process of vegetation succession is one of the characteristics of the succession. This condition was increasingly clarified by the high number of the undergrowth in the sample plot of the MCNP's western slope, so it can be said that the MCNP's western slope is currently undergoing a secondary succession process.

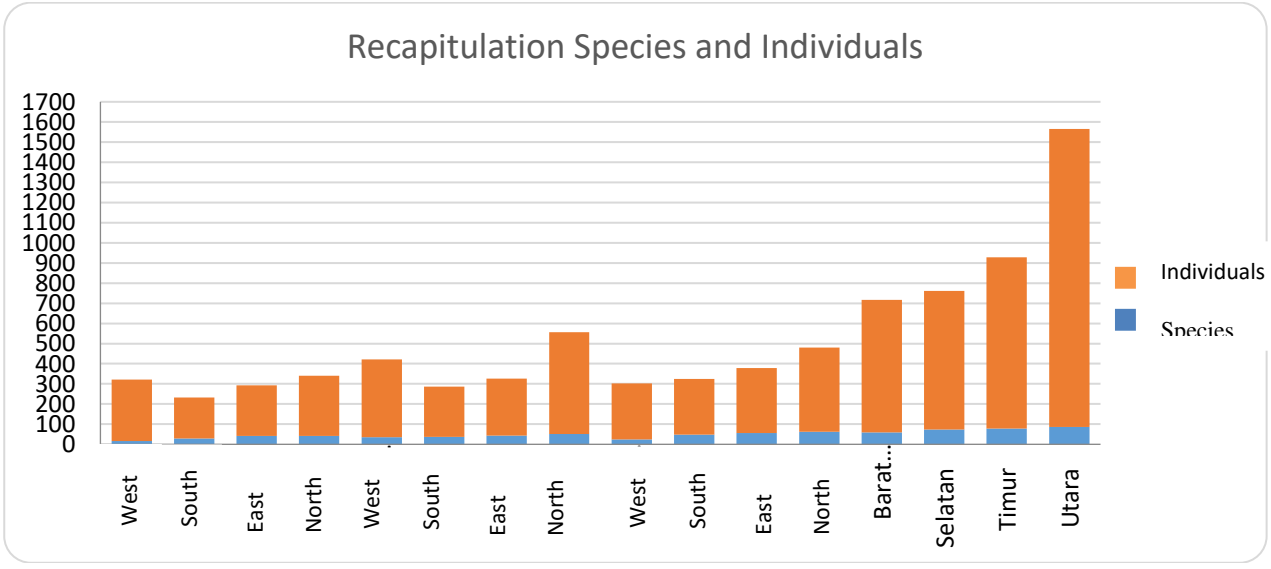

Figure 3. Species Number and Individual Growth Stratums in Each Slope Direction in the Lowland Forest of Mount Ciremai National Park.

In addition, the characteristics of the soil are inseparable from the important things in determining the types of plants that will grow in these populations. The high level of the tree growth rate in the study slope population was due to almost all of the MCNP slopes covered with soil consisting of regosol and lithosol clusters with shallow limestone. Shallow limestone is able to support a relatively high basal area of trees. The high tree species and individuals made it difficult for light to penetrate the canopy of trees resulting in the growth level of both species and individual seedlings and undergrowth were lower.

Based on the results of the data in Table 1, it was obtained that the important value index in the direction of the western and northern slopes that the dominant plant species successively was Murraya paniculata Jack. with a total IVI value of 125.42 and Maesopsis eminii Engl. with a total IVI value of 24,64. On the other hand, the important value index towards the eastern and northern slopes of the dominant plant species is Pinus merkusii Jungh. with total IVI value of 80.56 and 130.75, respectively.

The composition and structure of the growth, the value of which varies in each type was suspected as the result of character differences of each species. Dominant species in a growing community will have a high importance value index. The high of Murraya paniculata Jack's and Maesopsis eminii Eng's IVI in the western and southern slopes are the result of the forests towards the western and southern slopes are known as wetland forests, while the northern and eastern are known as dryland forests. Murraya paniculata Jack and Maesopsis eminii Engl which are plants tolerant of infertile and wet soils were found predominantly in the western and southern slopes, while Pinus merkusii Jungh. as a plant that can grow well in drought stress areas is able to thrive in the direction of the northern and eastern slopes.

Growth strata: in all directions the slope of the stratum is at the highest level, reaching 169.03, while the lowest stratum is at the seedling and sapling levels, reaching only 5.88 and 6.46. This was suspected to be the result of the tall and leafy plant species obstructed fecundity and fertility that resulted the regeneration at the growth stage of each tree species was inhibited.

Table 1. Recapitulation of Important Value Index (IVI) Based on Slope Direction and Growth Stratum

NO	SLOPE	SPECIES NAME	GROWTH STRATUM				TOTAL
			Seedling	Sapling	Pole	Tree	
1	West	*Ficus benjamina*	*	*	*	31.63	31.63
		Maesopsis eminii Engl.	*4.93*	*7.04*	*16.48*	25.90	54.35
		Cinnamomum sintoc Bl.	*50.86*	*4.14*	*14.37*	25.44	94.81
		Swietenia mahagoni (L.) Jacq.	*2.30*	*9.32*	*38.47*	23.83	73.92
		Murraya paniculata Jack.	*16.45*	*29.33*	*56.54*	23.10	125.42
			74.54	*49.83*	*125.86*	129.9	
2	South	*Pinus merkusii Jungh.*	*	*3.99*	*20.91*	44.87	69.77
		Maesopsis eminii Engl.	*28.58*	*22.12*	*43.25*	30.69	124.64
		Hibiscus macrophyllus Roxb.	*3.13*	*9.05*	*15.78*	26.41	54.37

NO	SLOPE	SPECIES NAME	GROWTH STRATUM				TOTAL
			Seedling	Sapling	Pole	Tree	
		Persea Americana	*	*13.85*	*21.45*	18.99	54.29
		Cinnamomum sintoc Bl.	*41.65*	*6.12*	*11.52*	16.29	75.58
			73.36	*55.13*	*112.91*	137.25	
3	East	*Pinus merkusii Jungh.*	*	*	*4.27*	76.29	80.56
		Swietenia mahagoni (L.) Jacq.	*3.15*	*10.35*	*46.68*	19.05	79.23
		Bischofia javanica	*	*	*	17.18	17.18
		Alstonia scholaris R. Br	*	*	*3.95*	15.16	19.11
		Zyzygium polyanthum	*19.33*	*7.55*	*10.80*	14.50	52.18
			22.48	*17.9*	*65.7*	142.18	
4	North	*Pinus merkusii Jungh.*	*	*	*9.22*	121.53	130.75
		Cinnamomum sintoc Bl.	*5.77*	*0.08*	*23.67*	16.88	46.4
		Gnetum gnemon	*	*1.91*	*31.01*	13.10	46.02
		Schima wallichii	*	*0.03*	*10.51*	9.38	19.92
		Sterculia oblongata R. Br.	*.11*	*4.44*	*4.92*	8.14	17.61
TOTAL			5.88	6.46	79.33	169.03	

The results of Table 2 show that the diversity index on the eastern and northern slopes has a high category index with an average value reaching > 3, while the western and southern slopes only have a medium category index with an average value only reaching ≤ 2. The high value of species diversity on the northern and eastern slopes was suspected to be related to the maintenance of some forest locations that were considered as community customary territory and water catchment areas as community consumption.

The low diversity on the western and southern slopes tends to be caused by the fact that some communities used forest land for vegetable farming activities, based on observations that in the lands of the southern and western blocks used for farming activities from a height of 400-1100 m a.s.l. while for the land of the eastern and north block used by farmers tends to start from an altitude of 400 - 700 m a.s.l.

Table 2. The Recapitulation of Shannon Index Based on Slope Direction and Growth Stratum

No	Slope Direction	Growth Stratum	Temperature (˚C)	Shannon Index	Category H’
1	West	Seedling	25	1,96	Low
		Sapling		2,91	Medium
		Pole		2,55	Medium
		Tree		3,28	High
2	South	Seedling	26	2,42	Medium
		Sapling		3,19	High
		Pole		3,24	High
		Tree		3,12	High
3	East	Seedling	26	3,30	High
		Sapling		3,43	High
		Pole		3,40	High
		Tree		2,81	Medium

No	Slope Direction	Growth Stratum	Temperature (˚C)	Shannon Index	Category H'
4	North	Seedling	27	3,14	High
		Sapling		3,37	High
		Pole		3,43	High
		Tree		2,44	Medium

CONCLUSION

Based on the observations and the results obtained it can be concluded that:

1. The highest tree growth stratum was found on the northern slope, reaching 1478 individuals with 87 species diversity. The highest level of seedlings and saplings were found on the western slope, respectively, 305 and 385 individuals with lower species than other sample plots.
2. The important value index towards the western and northern slopes of the dominant plant species is *Murraya paniculata Jack.* with a total IVI value of 125.42 and *Maesopsis eminii Engl.* with a total IVI value of 124.64, respectively. On the other hand, the important value index towards the eastern and northern slopes of the dominant plant species is *Pinus merkusii Jungh.* with a total IVI value of 80.56 and 130.75, respectively.
3. Diversity index on the eastern and northern slopes has a high category index with an average value reaching > 3, while on the western slope direction only has a medium category index with an average value ≤ 2.

ACKNOWLEDGEMENT

We thank all who assisted this research. Also, Universitas Kuningan were supported to publish our research. Finally, we were grateful thanks to those who review and provide input for this article.

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