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Tree Stratification in the Permanent Plot of HPPB Andalas University Padang

Jamiatul Hasanah Siregar
Biology Study Program at Postgraduate Program, Universitas Andalas Padang Sumatera Barat
email;msiregar780@gmail.com

ABSTRACT

Stratification is the distribution of vertical indoor plants. All plants in the community are not the same size and are not vertically the same space. The canopy stratification in tropical rainforests can be divided into five strata sequentially from top to bottom, namely stratum A, stratum B, stratum C, stratum D, and stratum E. The research was conducted in May - June 2019 at the HPPB Biology Education Research Forest Permanent Plot. an area of 1 ha which aims to see the stratification of trees in HPPB Andalas University Padang. The method used is stratified sampling by considering the proportion of canopy cover that is in the HPPB Permanent Plot. Then make a sample plot in the form of a path with a contour perpendicular to the size of 20 x 100 m on three observation paths. Stratification of this tree is made by taking data on the diameter and height of tree trunks with a scale of 1: 200 on millimeter paper. Based on the research results found 40 species with 3 strata. namely strata A, B, and C. The absence of strata D because the HPPB Permanent Plot research location is a secondary forest which is only designated as a research site and there is no disturbance by humans that has long experienced growth.

Keywords : Stratification, Tree, Permanent Plot

INTRODUCTION

Indonesia has about 122 million hectares of forest or 62.7% of its total area, most of which is tropical rainforest. The tropical rainforest is the most fertile vegetation type (Sadili & Kartawinata, 2016); (Hofhansl et al., 2020; Juárez-Orozco et al., 2017). In indonesia, tropical rain forests are found in Sumatra, Kalimantan, Sulawesi, Maluku, and Irian Jaya (Arifin et al., 2016; Sartika et al., 2021; WHITTEN, 1987; Sunderline & Resosudarmo, 1996). Zhang et al states the components that exist in the forest structure, namely the vertical structure, and the horizontal structure (Zhang et al., 2020). The structure of plant vegetation such as height, biomass, and vertical and horizontal heterogeneity are important factors affecting the transfer of material and energy flows as well as ecosystem diversity. Stratification or canopy layering is a vertical arrangement of plants in a plant community or forest ecosystem. In tropical rainforest ecosystem types, the stratification is well known and complete. Each layer in the stratification is called a stratum or strata (Orlov & Mirkin, 2014). Stratification is the vertical distribution of plants in a room. All plant species in the community are not the same size and do not occupy the same space vertically. In forest ecosystems, stratification is formed from the arrangement of tree crowns according to the vertical direction and occurs because of the presence of trees that occupy the dominant tree class, codominant tree, middle tree, depressed tree, and down/dead tree (Poorter et al., 2006). Canopy stratification in tropical rain forests can be divided into five strata sequentially from top to bottom, namely stratum a, stratum b, stratum

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c, stratum d, and stratum e (Clark et al., 2021; Silva et al., 2020). Each stratum is described as follows.

Stratum A is the top layer consisting of trees with a total height of more than 30 m. Usually, the crown is discontinuous, the trunk is tall and straight with a tall branch-free trunk. The types of trees from this stratum when they are young, from seedling to weaning level (seedling to sapling), need a little shade, but for further growth, they need a lot of light.

Stratum B consists of trees with a height of 20-30 m, the canopy of trees in stratum B is rounded or elongated and does not widen as in the canopy of stratum A trees, the tree trunk is usually very branched, the trunk free of branches is not too high. The distance between the trees is usually closed, so the tree crowns tend to form a continuous canopy layer. Tree species from this stratum do not require light or are shade tolerant (tolerant).

Stratum C consists of trees with a height of 4--20 m with variable crowns but forming a thick canopy layer. In addition, the trees have many branches that are arranged tightly so that the tree canopy becomes dense. Trees in this stratum are low, small, and many branches. Strata D consists of plants with a height of 1-4 m in that stratum also present and formed by tree species that are still young or in the seedling phase. Examples of this stratum are bushes, ferns, and rattan.

Stratum E, which is the lowest canopy (fifth layer from the top) formed by ground cover plant species that are less than 1 meter high. The diversity in stratum E is less compared to other strata. However, the most common under story species are members of the *Commelinaceae*, *Zingiberaceae*, *Acanthaceae*, *Araceae*, and *Marantaceae* families. In this stratum, ferns and Selaginella are also very dominant, grasses are almost absent but some broadleaf species are present, for example, species *Olyra latifolia*, *Leptaspis cochleata*, *Mapania* spp., and *Hyporlytrum*. spp.

Administratively, the Biology Research and Education Forest (HPPB) of Andalas University is located in Koto Panjang Village, Pauh District, Padang City. To the north, it is bordered by Batu Busuk Village, to the south by the Air Sekajan River, to the east by the people's cultivation, and to the west by the Bukit Rimbu Kamulau range. In HPPB there is a Permanent Measurement Plot covering an area of 1 ha which is designated as a research site. And this research plot is located at an altitude of 315 m above sea level with a position of 000054' South Latitude and 1000028' East Longitude and no one has conducted research on tree stratification in the Hppb Permanent Plot. Based on the above, the researcher is interested in conducting a study "Tree Stratification in the Permanent Plot of HPPB University of Padang.

MATERIALS AND METHODS

The research was carried out in May - June 2019 in the HPPB Biology Education Research Forest Permanent Plot covering an area of 1 ha. Prior to direct research, a site review was conducted to determine the state of the vegetation from the permanent plot that would be used as a research site. Determination of the location of the sample research using the stratified sampling method by considering the percentage of canopy cover in the HPPB Permanent Plot. Then make a sample plot in the form of a path with a direction perpendicular to the contour

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with a size of 20 x 100 m on three observation lines. Take the width of the lane (20 m) as the Y-axis and the length of the path (100 m) as the X-axis. Number all the poles/trees > 10 cm in diameter in the sample plot. Then record the name of the tree species and measure the position of each tree with respect to the X and Y coordinates. Measure the diameter of the tree trunk at breast height, total height, and free height of branches, as well as draw the shape of the branching and the shape of the crown. After that measure, the projection (closure) of the canopy to the ground surface from the right, left front, and back of the tree. Drawing of vertical and horizontal profiles (canopy closure) on millimeter paper with an adequate scale. Observations will be carried out in the form of recording the transect stretch that has been made, vertically in the form of making tree pictures along with species names, measuring trunk diameters, and measuring tree heights using a bow and meter stick. Measurement of tree canopy and grouping trees based on height, trunk diameter, and tree canopy length.

All data is processed into diagrams and depicted on millimeter paper, based on the height and length of the tree canopy to be observed with a scale of 1:200 m. Based on the tree stratification, it will be grouped into several strata, namely stratum A which has a height of 30-45 m, stratum B which has a height of 20-30 m, stratum C which has a height of 4-20 m, stratum D with a height of 1-4 m and stratum E. with a height of 0-1 m. How to calculate the height of trees

Tree heigth = Y + Z

$Y = X \tan \alpha$

Information :

Y = The height of tree from the eye of the top observer

X= Observer distance from tree

Z= Observer height (from toe to eye)

Tan α= The angle formed at eye level with the direction of the shot to the top of the tree

How to calculate header area

$$L = \frac{(D1+D2)}{4} X \pi$$

Mean:

L= Header area

D1 = First header diameter

D2 = Second header diameter

Π= Circle coefficient (3.14)

RESULTS AND DISCUSSION

Stratification or canopy layering is a vertical arrangement of plants in a forest community or ecosystem. Where stratification at the tree level can be done from the measurement of height in the field. From the results of observations of stratification and canopy cover, it can be seen that the pattern of canopy layering in the HPPB permanent plot can be grouped into three strata, namely stratum A (tree height above 30 meters), stratum B (tree height between 20 – 30 meters),

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and stratum C. (tree height between 4 – 20 meters) and the dominant stratum is stratum B and C because they have changing shapes and canopy layers and form unreal vegetation structures. This can be caused by several factors, including the competition factor from plants to get sunlight, so that plants will make adjustments to the shape of the plant body or morphological adjustments (in this case the formation of the shape and canopy layer towards the vertical) so that the need for sunlight can be met even in a small intensity, and many overlapping headers. The overlapping canopy layers are caused by different tree heights. In addition, it is also caused by the trees growing on the slopes, so that trees of the same height but growing on the slopes cause some of the crowns to stick together.

The tree species, tree height, and tree strata in the HPPB permanent plot can be seen in table 1.

Table 1. Types, Heights and strata of trees in HPPB Andalas University Padang

No.	Species Name	Tree height (m)	Level
1	*Arthocarpus sp*	19.83	C
2	*Arthocarpus borneensis*	35.19	A
3	*Arthocarpus maingayi*	18.43	C
4	*Adinandra dumosa*	21.18	B
5	*Aporusa praineana*	21.18	B
6	*Aglaia trichostemon*	12.67	C
7	*Alstonica scholaris*	16.54	C
8	*Acronychia larifolia*	13.45	C
9	*Adenanthera pavonian*	13.36	C
10	*Baccaurea wellichii*	27.80	B
11	*Cyathocalyx ridley*	22.65	B
12	*Castanopsis ramnifolia*	24.90	B
13	*Canarium sp*	14.13	C
14	*Clorodendron deflexum*	15.30	C
15	*Dilenia indica*	10.29	C
16	*Durio zibethinus*	40.29	A
17	*Elaeocarpus porfivolius*	22.60	B
18	*Endiandra sp*	23.19	B
19	*Gironiera nervosa*	10.30	C
20	*Grewia umbellata*	12.23	C
21	*Knema kunstteri*	16.90	C
22	*Lasianthus oblongus*	21.63	B
23	*Litsea sp*	15.33	C

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24	*Macaranga triloba*	31.37	A
25	*Myristica sp*	25.80	B
26	*Mangifera sp*	21.23	B
27	*Morace sp*	19.84	C
28	*Microcos florida*	13.26	C
29	*Ptenandra sp*	20.83	B
30	*Ptenandra echinata*	23.66	B
31	*Pterospermum javanicum*	22.13	B
32	*Parkia speciosa*	18.12	C
33	*Pometia pinnata*	11.60	C
34	*Pometia sp*	15.20	C
35	*Querqus ewickii*	44.93	A
36	*Rhizopora sp*	14.22	C
37	*Ptenandra sp*	15.33	C
38	*Shorea sp*	14.22	C
39	*Sterculia oblongata*	25.47	B

From table 1, it can be seen that the tree species found in the study area varied including tree species from the Euphorbiaceae, Fagaceae, Melastomataceae, and several other species. Aiba et al said that lowland tropical rain forests in Borneo generally have a canopy (Aiba et al., 2013). wider trees and the types of trees found in lowland forests are Dipterocarpaceae, Fagaceae, Lauraceae. From table 1 it can also be seen that the types of plants in strata A are Arthocarpus borneonsis, Durio zibethinus, Macaranga triloba, Quercus ewickii with a height of 30-41 m where the families of Dipterocarpaceae, Fagaceae, Lauraceae generally live and are spread in lowland to mountainous areas, and can live in various climates and weathers (Fort, 2015; Caminade et al., 2019). This shows that this species has a better survival ability in the 3 research areas. In general, in plant communities (Mursal et al., 2021), there is competition from the results of the competition, only trees that are strong or more powerful than other species. For tall plants will be the winner and control the low trees (Büntgen et al., 2019).

In strata B, 15 species were found, namely, Adinandra dumosa, Aporusa praineana, Baccaurea wellichii, Cyathocalyx ridley, Castanopsis ramnifolia, Elaeocarpus porfivolius, Endiandra sp, Gironiera Nervosa, Lasianthus oblongus, Myristica sp, Mangifera javanic, Pterospermum sp. oblongata with tree height between 20-26.4 m. and In strata B, the family Lauraceae and Melastomataceae are more dominated (Esa et al., 2016). According to Flavelle that the second canopy is usually controlled by Familia Lauraceae, Myrtaceae, Myristaceae, and Guttiferae, this indicates that the type of lowland rain forest (Flavelle, 1991). This B strata is usually tolerant (shade resistant) or requires less sunlight. Strata B in a plant community requires shade from taller trees or needs companionship with other trees as shade for optimal growth (Soedomo, 2014; Zotz et al., 2001).

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In strata C, the plant species found were species Arthocarpus sp, Arthocarpus maingayi, Aglaia trichostemon, Alstonica scholaris, Arthocarpus meingayii, Acronychia larifolia, Adenanthera pavonian, Canarium sp, Clorodendron deflexum, Dilenia indica, Grewia umbellata, Moracema sp., Microcos florida, Parkia speciosa, Pometia pinnata, Pometia sp, Ptenandra sp, Shorea sp of the family Dipterocarpaceae, Melastomataceae, Myristicaceae, Dilleniaceae, Ulmaceae, Leguminosae, Meliaceae, Tiliaceae, Ixonantheceae, Moraceae, Melaestomaceae, Symploaceae, Picoperaceae Rutaceae, Burseraceae and, Myrtaceae. This is by Salvana et al (2019) stated that the most common families found in lowland tropical forests are the Euphorbiaceae, Anacardiaceae, Dipterocarpaceae, Rubiaceae, Moraceae, Lauraceae, Burseraceae, and Myrtaceae families.

In strata C, namely the canopy layer, in strata C, the third canopy layer from the top of trees with a height of 4-20 m. In the study area, the tree height in this strata ranges from 9 m to 19.8 m. Trees in stratum C have a variable crown shape but form a thick canopy layer. In addition, the trees have many branches that are tightly arranged, so that the canopy becomes tight (Setyawati et al., 2015). The absence of strata D is because the research location of the HPPB Permanent Plot is a secondary forest that is only intended as a research site and there is no disturbance by humans and has also been growing for a long time. At the research location, there are many young plants scattered in the study area which have stem diameters of less than 10 cm. Trees that have a diameter of less than 10 cm are at the sapling level (beta). This tree will later become a sapling and a core tree or future tree if the ecosystem is maintained and can be used for further research.

CONCLUSION

Based on the results and discussions that have been carried out, it can be concluded that at Hppb Andalas University Padang found 39 tree species from 23 families, with 3 strata namely strata A, B, and C It is recommended to Andalas University to be able to monitor plant species which has a diameter of less than 10 cm where this plant will become a future plant and will have a major impact on the forest ecosystem.

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