International Journal of Agriculture and Forestry 2016, 6(2): 69-73
DOI: 10.5923/j.ijaf.20160602.02

Tree Species Diversity at the Protected Forest of Mountain Masinggi, North Bolaang Mongondow, Indonesia

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Abstract The Protected Forest of Masinggi-Mountains store various species of plants and trees that are characteristic of a tropical protected forest. This study aims to determine the tree species diversity by using the method of calculating the species diversity index of Shannon-Weiner. The research findings showed the presence of 23 species of trees in the protected forest areas.

Keywords Species diversity, Trees, Protected forest

1. Introduction

Biodiversity has three different levels, namely genetic diversity, species diversity and ecosystem diversity. Genetic diversity refers to various kinds of genetic information contained in every living organism. Genetic diversity occurs within and between populations of species. Species diversity refers to the diversity of living species [1] [2]. Ecosystem biodiversity relates to the diversity of habitats and environments, biotic communities, and ecological processes [3], [4].

The protected forest area typically has a high diversity of tree species. The existence of trees in forest vegetation is very beneficial for other living organisms, including preserving endangered species and their habitats [5] The trees vegetation in protected forest areas play an important role in the regulation of groundwater, minimize of flooding, erosion control and maintenance soil fertility [6-11].

Mount Masinggi protected forest in North Bolaang Mongondow has an area of 71.51 ha. The location is in two administrative regions, namely 50 ha in the Huntuk Village and 21.51 ha in the Mome village. At this time Mount Masinggi protected forest are experiencing a variety of disturbances as a result of community activities around the forest, such as the agriculture crop cultivation and harvesting of forest products in excess, thus resulting in fewer species of trees in protected forest areas. In this context, [12] recommends three lines of intervention, namely: (a) protecting native forests and the overall ecological corridors, and carry out enrichment planting along streams and rivers to protect waterways, (b) develop agro forestry practices for biodiversity conservation tree in the buffer zones of protected forest, and (c) the establishment of plantations in severely damaged areas. Specifically in relation to the conservation of tropical forest tree species, [13] proposed a model of timber plantation forest of local species. The purpose of this study was to analyze diversity of tree species and factors affecting species distribution.

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Published online at http://journal.sapub.org/ijaf

2. Research Method

Research was conducted in the protected forest areas of the Gunung Masanggi, by using the Shannon-Weiner methode to calculate the species diversity indexc. Data collection is done by making a lane or transects lines [14]. Each sample rectangular plot with a width of 20 m and a length of 50 m, and tree species are observed in these plots. The sample plots are arranged systematically with distance between sample plots of 2 m in a transect line. The species observed are the trees which are their diameter Ø> 20 cm.

3. Results and Discussion

3.1. Biodversity of Trees Stage

3.1.1. Types and Number of Tree Stage of Plant

According to classification of the Shannon-Wiener index, there are three categories of species diversity, namely (1) Index > 3 is a high diversity, a high number of individual in each species, and its stability is high, (2). Index 1-3 is a moderate diversity, the moderate number of individual in each species, and its stability is moderate, (3) Index < 1 is a low diversity, the low number of individual in each species and its stability is low. These results indicate that there is a diversity of tree species in the protected forest areas of Gunung Masinggi, and is is found as many as 27 species of

trees.

Many of the protected highland forests are currently experiencing strong pressure from habitat losses due to conversion of forests and uncontrolled hunting. If biodiversity in highland protected forests should be conserved, then the protected forest areas must be confirmed by concerning several of local endemic taxa [15]. [16] showed that the conversion of natural forests into cultivated land (home gardens and mixed gardens) that are managed by local people in the highlands of Ethiopia did not result in losses of tree species; changes occurred in terms of species distribution, species density and spatial composition of tree species. [17] Reported that the species diversity index may reflect the role of tropical forests in storing biomass, and may also mixed gardens of multi-strata. Both of these ecosystems can be developed more widely to encourage carbon sequestration from the atmosphere.

[18] Reported a negative correlation between the TDC (Tree Diversity Change index) and the distance to the transect lane. This suggests that the species-richness decreased in near-lane and that species richness was maintained only in inner-areas. The negative correlation of the RE index (diameter distribution index) and altitude and a deeper zone indicate that the dynamic replacement of humid-condition species by dry-condition species occur at lower altitudes. A loss in species diversity along with a change towards dry-condition species was observed throughout the forest areas. Zones at lower altitudes or at the forest edges are more sensitive to these dynamics processes. This suggests that changes in any ecosystem functions have been taken place and that a minimum extension of cloud forest is required to maintain the ecological processes necessary for the sustainability of cloud forest [18].

In Table it can be seen that there are as many as 27 species of trees with a total of 62 individual trees. Among these species there are 10 individuals of *Irvingia malayana* Olive. Ii is a tree species with the highest number in the region covering an area of 1.3 ha sample plots. This tree-species is suitable to the environmental conditions of undisturbed mixed dipterocarp forests up to 600 m altitude; usually it grows well on hillsides and ridges with clay soils to sandy soils.

Species of *Pterocarpus indicus* Willd., *Pometia pinnata*, Myristica sp. and Bintangor *Calophylum soulatrii* suggested the four individual trees. *Pterocarpus indicus* Willd is the pioneer species that grow best in open areas. It can grow well on the variety of soil types. Normally it is found up to 600 m altitude, but seems to thrive up to 1300 m altitude. Their populations have declined because of overexploitation, sometimes illegal exploitation of the timber as well as the general habitat losses.

Species *Cananga odorata*, *Threma orientalis* and *Duabanga moluccana* Bl. suggested the three individual trees. Species *Garuga floribunda*, *Homalium foetidum*, and *Ficus sp*. suggested two individual trees. While the 13 other tree species have the least number of individuals, each of them suggested only one individual tree. Presents the species of *Irvingia malayana* Oliv. with a highest of relative density (RD) of 16.11%. Species *Pterocarpus indicus* Willd., *Pometia pinnata*, *Myristica sp*. and *Calophylum soulatrii* is the second highest, each of which has a relative density (RD) of 4.84%. Species *Cananga odorata*, *Threma orientalis*, and *Duabanga mollucana* BI. each having a relative density value (RD) of 3.23%. A total of 13 other tree species suggested a lower relative density (RD) of 1.61%.

3.1.2. Frequency of the Tree-Stage Plant

Frequency is used to present proportion between the numbers of samples that contain a particular species to the total sample. The frequency of tree species is the amount of sample plots where the discovery of a certain species to all of observed sample plots.

In the Table presents the highest level of relative frequency of 16.04 % owned by *Irvingia malayana* Oliv., its frequency is 0.77. Species of *Pterocarpus indicus* Willd., *Pometia pinnata*, *Myristica sp*. and *Calophylum soulatrii* have a high relative-frequency of 6.46%. Species of *Cananga odorata*, *Threma orientalis*, and *Duabanga mollucana BI*, suggested a relative frequency of 4.79%. A total of 13 other tree species have a relatively lower frequency that is 1.67%.

At this observation, frequency suggests the magnitude of discovery of organisms in the community or ecosystem. A more number of sample plots in which a certain species is found, it means the greater frequency of this species in the Forest Protected Areas of Gunung Masinggi.

3.1.3. Dominance of the Tree-Stage Plan

Dominance is a term used to express coverage of the tree species. Expressed "Coverage" by using the canopy coverage or basal area. These parameters are part of parameters used to indicate the dominant plant species in a vegetation community. In the Table presents the dominance index and relative dominance of the tree species.

Table shows some species of trees, in which the top level of dominance among them is the species of *Irvingia malayana* Oliv.) DR=16.05%, species of *Pterocarpus indicus* Willd and *Calophylum soulatrii* suggested the DR of 8.92% and 8.81%, and species of *Myristica sp*.suggested DR of 7.69%.

3.1.4. Important Value Indexes (INP) of the Tree-Stage Plant

Importance Value Index (IVI) is a quantitative parameter that can be used to express the degree of species dominance (level of mastery) in a vegetation community [19]. The dominant species in a vegetation community will have an importance value index is high, so that the most dominant species of course suggests the greatest impostance value index [20].

Based on their Importance Value Index (IVI), the dominant tree species is species of *Irvingia malayana Oliv*. (IVI = 48.2%), *Pterocarpus indicus Willd* and the IVI of 221.83% and 21.72%, respectively. Species of *Myristica sp*. (IVI=20.6%), *Pometia pinnata* (IVI=17.86%). The two trees

species with IVI=13.98% are *Cananga odorata* and *Duabanga moluccana Bl*. While the species of *Threma orientalis* and *Moraceae* suggested IVI values of 13.81% and 13.42, respectively.

3.1.5. Dominance Index (DI)

The Dominance index (DI) reflects the level of species dominance (mastery) in a vegetation community. The dominance in a vegetation community can be centralized on a single species, some species or in many species. The dominance of a species also reflects the tolerance and adaptation to their environment and the growth rate of regeneration in their habitat [21-23].

The Dominance Value Index (DI) of 0.0634 is obtained from the sum of Importance Value Index (IVI) of each species divided by the total IVI of all species found in the certain plot. This ID is included in the "low category". This means that the dominance is centered on a few species [24]. Thus there are several dominant species in Sub-region of Protected Forest of Gunung Masinggi. These species are *Irvingia malayana Olive*. *Pterocarpus indices Wild. Pometia pinnate*, *Myristica sp*., *Calophylum soulatrii*, *Cananga odorata*, *Threma orientalis*, and *Duabanga mollucana BI*.

3.1.6. Species Diversity Base on Shannon-Weiner Index (H')

Results of data analysis obtained in the field by using a plots sample shows the Shannon-Weiner diversity index (H') of 1.1930. Based on the classification of Shannon-Weiner diversity index, this value of diversity index is included in the category "medium", the number of individual tree of each species at the level of "medium" and the stability of the community is "moderate". For this category, the value of Shannon-Weiner index (H ') = 1-3.

The diversity of tree species in Sub-region of the Gunung Masinggi protected areas suggested the "moderate" diversity. This category can be considered "good-enough", the existing density of vegetation at this location is increasingly decreased due to the many illegal logging and illegal cultivation is going on in this sub-region. This can lead to decrease quality of micro-habitats for forest tree species [25], and ultimately degrade composition of tree species in the forest ecosystem [26].

3.2. Factors Affecting the Species Diversity

Various important ecological principles are included in the concept of biodiversity of tree species. The concept of diversity was used by ecologists as a way to look at the possibility of a feedback system, as the more high of biodiversity, the more diverse of food chain and a higher possibility of symbiotic mutualism, commensalism, parasitism and others, as well as increase the possibility to mitigate any negative impacts of climate change [27]. The consequence of this is the more stable of vegetation community with the more stable of weather conditions, usually have higher biodiversity, compared with communities facing a fluctuation of weather conditions or disturbances by human activities [28-30].

Climate changes suggested any serious impacts on the biodiversity of trees community in protected forest areas [31]. Diversity is a reflection of the stability of a community and ecosystem stability [32]. The higher of biodiversity, ecosystems usually also more stable [33].

Biodiversity concerns the diversity and relative abundance of species in the vegetation community, including forest ecosystems [34-36].

4. Conclusions

1. The total of 27 tree species in the protected forest areas of the Mount-Masanggi reflects the moderate species diversity of the vegetation community.The density of 27 species were encountered at 47.73 with a frequency of 4.8 tree, the important value index (IVI) is dominated by *Irvingia malayana* Oliv. (IVI=48.2%), *Pterocarpus indicus* Willd. (IVI = 21.83%), *Calophylum soulatrii* (IVI =21.72%); and the lowest dominance is *Dryobalanops aromaticum* (IVI = 5.91%). The nine species of trees with a level of dominance of 0.0634 are found in the vegetation community of the Mount-Masinggi protected forest. These species are *Irvingia malayana* Oliv., *Pterocarpus indicus* Willd, *Aglaia sp.*, *Myristica sp.*, *Pometia pinnata*, *Cananga odorata*, *Duabanga moluccana* Bl., *Threma orientalis* and *Moraceae* sp. The species diversity of tree phases based on the Shannon-Weiner Index (H') in the protected forests of the Mount-Masinggi is 1.1930. This suggests the level of biodiversity "moderate".
2. The climate is balanced or uniform can affect the diversity of species in a location otherwise unstable climate or human activities vary and will affect the growth of species diversity.

REFERENCES

[1] Hamilton, A.J. 2005. Species diversity or biodiversity?. Journal of Environmental Management, 75(1): 89-92

[2] Pear man, P.B. and D. Weber. 2007. Common species determine richness patterns in biodiversity indicator tax. Biological Conservation, 138(1–2): 109-119.

[3] Henry. 2007. Leading Practice Sustainable Development Program for the Mining Industry. Department Of Industry Tourist and Resources. Australia.

[4] Lauriat-Pant, M., A. Lehikoinen, L. Uusitalo and R. Venesj ärvi. 2015. How to value biodiversity in environmental management. Ecological Indicators, 55: 1-11.

[5] Houehanou, T.D., A.E. Assogbadjo, R.G. Kauai, T. Kind, M. Houinato and B. Sins in. 2013. How Far a protected area contributes to conserve habitat species composition and population Structure of endangered African tree species (Benin, West Africa). Ecological Complexity, 13: 60-68.

[6] Plamondon, A.P., R.A. Ruiz, C.F. Morales and M.C. Gonzalez. 1991. Influence of protection forest on soil and water conservation (Oxapampa, Peru). Forest Ecology and Management, 38(3–4): 227-238.

[7] Cheng, J.D., L.L. Lin and H.S Lu. 2002. Influences of forests on water flows from headwater watersheds in Taiwan. Forest Ecology and Management, 165(1–3): 11-28.

[8] Bruijnzeel, L.A... 2004. Hydrological functions of tropical forests: not seeing the soil for the trees? Agriculture, Ecosystems & Environment, 104(1): 185-228.

[9] Nunez., L. Nahuelhual and C. Oyaizu. 2006. Forests and water: The value of native temperate forests in supplying water for human consumption. Ecological Economics, 58(3): 606-616.

[10] Human., G. Schuler, C. Muller, R. Schneider, M. Josh and T. Caspar. 2011. Identification of runoff processes – The impact of different forest types and soil properties on runoff formation and floods. Journal of Hydrology, 409(3–4): 637-649.

[11] Ferraz, S.F.B., W.de Palma and C.B. Rodriguez. 2013. Managing forest plantation landscapes for water conservation. Forest Ecology and Management, 301: 58-66.

[12] Apia, M. 2013. Tree population Inventory, diversity and degradation analysis of a tropical dry deciduous forest in Afram Plains, Ghana. Forest Ecology and Management, 295: 145-154.

[13] Pride, E.C., G.J. Holland, S.J. Watson, S. M. Thurston and D.G. Nimmo. 2015. Conservation of tropical forest tree species in a native timber plantation landscape. Forest Ecology and Management, 339: 96-104

[14] Fachrul, M.F. 2007. Method Sampling Biocenology. Bumi aksara, Jakarta.

[15] Berg, R.A., J.F. Oates and R. Fotso. 2007. Distribution and protected area coverage of endemic tax in West Africa's Biafra forests and highlands. `Biological Conservation, 134(2): 195-208.

[16] Tolerate, M., Z. Asfaw, M. Lemenih and E. Karltun. 2008. Woody species diversity in a changing landscape in the south-central highlands of Ethiopia. Agriculture, Ecosystems & Environment, 128(1–2): 52-58.

[17] Con, T.V., N.T. Thank, D.T.T .Ha, C. C. Kim, T.H. Quy, V.T. Lam, T.V. do and T. Sato. 2013. Relationship between aboveground biomass and measures of structure and species diversity in tropical forests of Vietnam. Forest Ecology and Management, 310: 213-218.

[18] Led, A., F. Montes and S. Conies. 2009. Species dynamics in a Montana cloud forest: Identifying factors involved in changes in tree diversity and functional characteristics. Forest Ecology and Management, 258: S75-S84.

[19] Wahyudi, A., Harianto, S. P., & Darmawan, A. (2014). Trees Diversity in the Tahura wan abdul rachman E educational Forest. *Journal Sylva Lestari*, *2*(3).

[20] Shaven, H., Z. Ulla, S. M. Khan and D. M. Harper. 2012. Species composition and community structure of western Himalayan moist temperate forests in Kashmir. Forest Ecology and Management, 278: 138-145.

[21] Wohlgemuth, T., M. Burgin, C. Scheidegger and M. Schultz. 2002. Dominance reduction of species through disturbance—a proposed management principle for central European forests. Forest Ecology and Management, 166(1–3): 1-15.

[22] Adie, H. and M.J. Lowes. 2009. Explaining conifer dominance in Afro temperate forests: Shade tolerance favors Podocarpus latifolius over angiosperm species. Forest Ecology and Management, 259(2): 176-186.

[23] Baht, J.A., A.K. Nagy and N.P. To Dario. 2015. Regeneration status of woody species in a protected area of Western Himalaya. Act Ecological Seneca, 35(3): 51-58.

[24] Semiarti, E., Indrianto, A., Purwantoro, A., Martiwi, I., Feroniasanti, Y. M. L., Nadifah, F., & Dwiyani, R. (2010). High-frequency genetic transformation of Phalaenopsis ambles orchid using tomato extract-enriched medium for the pre-culture of protectors. *Journal of Horticultural Science & Biotechnology*, *85*(3), 205-210.

[25] Vidor, A., Y. Pail let, F. Archaic and F. Gosselin. 2011. Influence of tree characteristics and forest management on tree microhabitats. Biological Conservation, 144(1): 441-450.

[26] Borah, M., D. Das, J. Kalita, H.P.D. Boruah, B. Phukan and B. Neoga. 2015. Tree species composition, biomass and carbon stocks in two tropical forest of Assam. Biomass and Bio Energy, 78: 25-35.

[27] Belle, M.Y., D.J. Sonya and A.-M. Tiani. 2015. Adapting the Congo Basin forests management to climate change: Linkages among biodiversity, forest loss, and human well-being. Forest Policy and Economics, 50: 1-10.

[28] Singh, P.P. 2008. Exploring biodiversity and climate change benefits of community-based forest management. Global Environmental Change, 18(3): 468-478.

[29] Sassen, M. and D. Shell. 2013. Human impacts on forest structure and species richness on the edges of a protected mountain forest in Uganda. Forest Ecology and Management, 307: 206-218.

[30] Sassen, M., D. Shell, K.E. Griller, C.J.F. tar Brake. 2013. Complex contexts and dynamic drivers: Understanding four decades of forest loss and recovery in an East African protected area. Biological Conservation, 159: 257-268.

[31] Screven, S.A., J.A .Hodgson, C.J. McLean and J.K. Hill. 2015. Protected areas in Borneo may fail to conserve tropical forest biodiversity under climate change**.** Biological Conservation, 184: 414-423.

[32] Aslaksen, I., S. Nebo, E. Farmstead, P.A. Garn åsjordet and O. Skarpaas. 2015. Norway. Ecosystem Services, 12: 108-116.

[33] Harrison, P.A., P.M. Berry, G. Simpson, J.R. Haslett, M. Blicharska, M. Baucus, R. Dun ford, Begot, M. Garcia-Lorentz, N. Geamănă, W. Geertsema, E. Lommelen, L. Meiresonne and F. Turkelboom. 2014. Linkages between biodiversity attributes and ecosystem services: A systematic review. Ecosystem Services, 9: 191-203.

[34] Magurran, A.E. 1988. Ecological Diversity and Its Measurement. London: Croon Helm Ltd.

[35] Lewis, O.T... 2009. Biodiversity change and ecosystem function in tropical forests. Basic and Applied Ecology, 10(2): 97-102.

[36] Nadrowski, K., C. Wirth and M. Scherer-Lorenzen. 2010. Is forest diversity driving ecosystem function and service?. Current Opinion in Environmental Sustainability, 2(1–2): 75-79.