DIVERSITY OF TREES AND SHRUBS ALONG DIFFERENT VEGETATION TYPES IN MT. HAMIGUITAN RANGE, DAVAO ORIENTAL, MINDANAO ISLAND, PHILIPPINES

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Abstract

Mt. Hamiguitan Range in Davao Oriental, Mindanao Island, Philippines is the only protected area with pygmy forest and a priority site for protection and conservation. This range harbors different vegetation types such as agroecosystem, dipterocarp, montane and mossy forests . This study was conducted to determine the diversity of trees and shrubs along vegetation types. Transect walk and 16 sampling plots of 20 x 20 m were established in the different vegetation types. Specimens collected were classified and identified using the Flora Malesiana and type images. Assessment of the status was determined based on International Union for the Conservation of Nature (IUCN). Findings of the study revealed, 223 species of trees with 141 genera and 71 families, while 46 species of shrubs with 26 genera and 21 families. Respective to the vegetation types, the pygmy forest obtained a comparatively high diversity value for trees and shrubs followed by montane forest. The high species importance value (SIV) of Diospyros philippinensis for trees and Medinilla apoensis for shrubs indicates that these species have an important role in regulating the stability of the ecosystem. Species similarities of trees and shrubs were highest between the montane and pygmy forests. The tree profile of this vegetation type is different due to the ultramafic substrate causing the dwarfism of trees in the pygmy forest, thus, given higher priority for protection and conservation.

Keywords: *diversity, Mt. Hamiguitan, vegetation, trees, shrubs, beneficiaries*

1.0 Introduction

Philippines is considered as one of the few countries in the world that is considered as mega diverse and a diversity hotspot (Brooks, 2004). Indeed, it has been designated as one of the world's top 19 biodiversity hotspot and were in the top 5 in this elite group with exceptionally diverse biota (Mittermeier, 1988). As of 2004, it had lost more than 75% of its original habitat (Ong, 2004) that means that the Philippines has a tiny fraction of the original forest only s left. Philippine natural forests have been argued as the most degraded of all the Asian tropical rain forests (Koopowitz et al., 1998) that is considered as an impending disaster. Forest and wildlife are so intertwined and complex, unfortunately, as forests disappear large numbers of plant species and all kinds of organism associated with it are also disappearing (Hawksworth, 1998).

Extinction is caused by destruction through man's exploitative activities (Madulid, 2002). These could create pressure on the native and endemic flora to the extent that endemic species could be possibly regarded as only occasional to completely extinct. With the discovery of the richness of Philippine biodiversity, it has come to the realization that the country may

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have the most seriously threatened flora on earth (Heaney, 1998) with the higher rate of endemism (Koopowitx et al., 1998). Philippine flora is exceedingly rich of about 10,000 species of flowering plants (Quisumbing, 1978). There are about 8,000 species (Madulid, 1997) of which 9,000 are flowering plants and at least 3,200 of these are unique to the Philippines (DENR, 2002), 60% or 23 genera are endemic to the country (Madulid, 1991) there are 72 species which are listed officially as endangered (Gruezo, 1990). In the island of Mindanao, it is noteworthy that five species of trees are endemic as *Kibatalia oblongifolia, Canarium asperum, Canarium reticulatum, Sterculia glabrifolia,* and *Flacourtia euphlabia* (Amoroso et al., 2002). Endemic and rare species are potentially at the highest risk of endangerment when not adequately represented in protected areas (Wong, 1998) thus, diversity assessments are important to address the need of conservation.

Mindanao is considered a Centre of Plant Diversity (WWF, 2005) and all the islands in Mindanao were once completely forested (Morrison, 2001). Habitat destruction is the main threat to biodiversity in the Philippines. Logging and shifting cultivation (*kaingin*) are the primary forces of habitat conversion that changed the forests of Mindanao (Diaz, 2004). Mt. Hamiguitan Range in Davao Oriental is under the jurisdiction of the Municipalities of San Isidro, Mati and Governor Generoso in Mindanao. It is located at the southeastern portion of the Philippine archipelago and the only mountain in the island with fascinating and unique pygmy and ultramafic forest (Mt. Hamiguitan, 2005). The bonsai field or pygmy forest is located southeast from Mt. Hamiguitan. It has the presence of many endemic, endangered, rare and economically important species of plants (Mt. Hamiguitan, 2005). It is identified by Conservation International as one of the hotspots and included by the Philippine Eagle Alliance as one of the priority sites for conservation and protection (Mt. Hamiguitan, 2005). Hamiguitan Range is also identified as one of the best eco-tourism destination in the country (Mt. Hamiguitan, 2005).

Assessment on conservation status of flora in Hamiguitan Range Wildlife Sanctuary was conducted at local level (Amoroso and Aspiras, 2011). However, data on trees and shrubs in the different vegetation types are limited and necessary for proper management of the forest resources, and species of great importance have to be studied and conserved before they will be lost. Evaluation on the impact of anthropogenic activities is limited by lack of species richness data on Mt. Hamiguitan Range that is a habitat of the Philippine Eagle. The different vegetation types harbors endemic, critically endangered, endangered species, vulnerable, rare and threatened species but there are species that are locally common with high importance values, thus this study was undertaken to determine the diversity of trees and shrubs along different vegetation types in Mt. Hamiguitan Range, Davao Oriental, Mindanao Island, Philippines.

2.0 Materials & Methods

Mt Hamiguitan is accessible via Purok 8 of Barangay Sergio Osmena, Sr., Governor Generoso traversing the Dumagooc River upstream from Purok 4, the starting point of the hike. Purok 4, being accessible by any land transportation is about 7 kilometers from the town proper of Governor Generoso. Field survey and assessment of trees and shrubs were conducted at the agroecosystem, dipterocarp, montane and pygmy forests. Two sampling plots of 20 x

20 meters were established at the different vegetation types. Within this 20 x 20 meters plot, three 5 x 5 meters were laid out for shrubs (fig. 1).

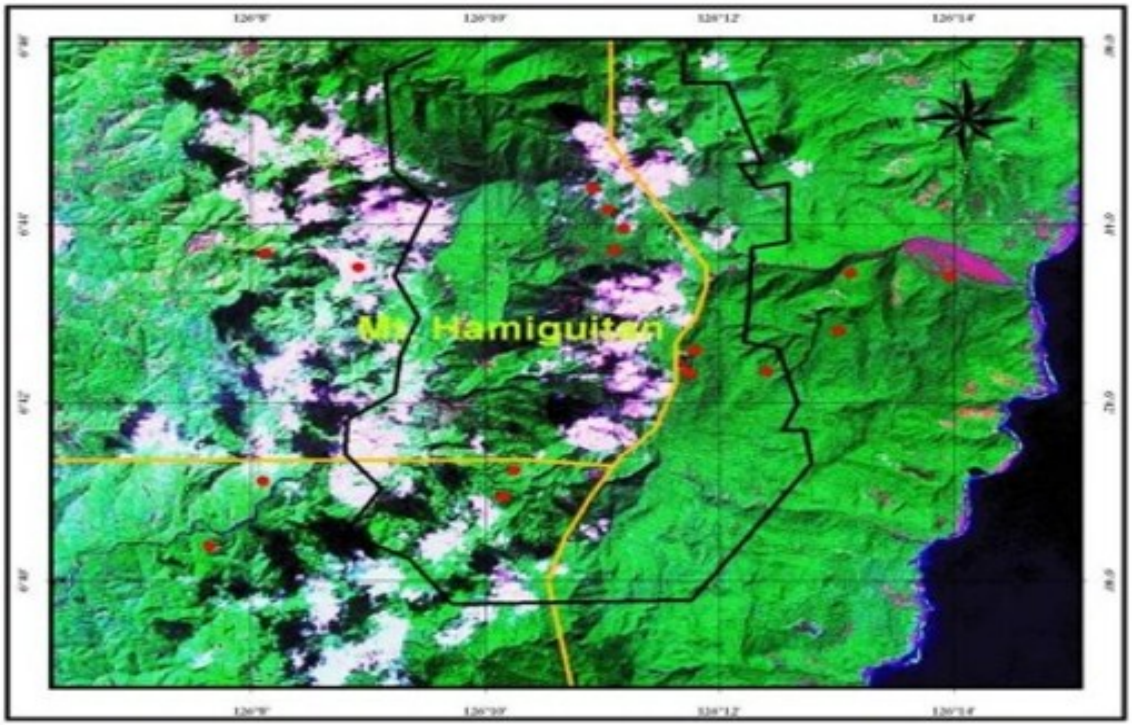

Figure 1. Satellite map of Mt. Hamiguitan showing the sampling sites (red dots)

Parts of vegetative and reproductive organ of trees and shrubs were collected within the established sampling plot. The collected specimens were preserved using denatured alcohol and placed in a plastic bag to prevent dehydration. Diagnostic features and characteristics of the different vegetative and reproductive organs of trees and shrubs were noted, described and identified using the Flora Malesiana and monograph series. Species Importance Value and Species Diversity were determined using the following formulas:

a. Density was used to determine the number of individual trees and shrubs per unit area.

$$D = \frac{\text{no. of individuals}}{\text{area sampled}}$$

b. Relative density (RD) was used to compare the number of trees and shrubs between two areas of equal sizes.

$$RD = \frac{\text{no. of individuals}}{\text{area sampled}} \times 100$$

c. Frequency was used to determine the probability of finding the species in any one quadrat. The plots in which species A occurred were counted and frequency value was computed using the formula:

$$F = \frac{\text{no. of plots in which species A occurs}}{\text{total no. of plot examined}}$$

d. Relative Frequency was used to compare the numerical frequency of one species to the total frequency of one species to the total frequencies of all species.

$$RF = \frac{\textit{freq. value for species}}{\textit{total freq. values for all species}} = 100$$

e. Dominance (Cover) was used to determine the species that exert a major controlling influence on the community by virtue of size or number. The data on the number of individuals per species and the total number of all species were used. Tree basal areas were at breast height level.

$$\textit{Species Dominance} = \frac{\textit{Species Basal Area Coverage Value}}{\textit{area sampled}}$$

f. Relative Dominance (RDom)

$$RDom = \frac{\textit{dominance of Species A}}{\textit{total dominance of all species}}$$

g. Species Importance Value (SIV). Importance value of species A and total importance value were computed to obtain species diversity.

$$S_{IV} \text{ or } ni = RD + RF + Rdom$$

h. Shanon Index of General Diversity (H')

$$H' = (ni/N \log ni/n)$$

i. Percentage of Species Similarity = Jackard Coefficient

$$C_{cj} = C / S_1 + S_2 - C$$

Where: S_1 & S_2 are the numbers of species in communities 1 & 2, respectively, and C is the number of species common to both communities.

3.0 Results and Discussions

A total of 223 species of trees was recorded from sampled plots and transect walk in the selected vegetation types of Mt. Hamiguitan Range, Davao Oriental. Of these, 141 genera and 71 families were identified. The established plots measuring 6,400 m^2 revealed an average of ten species in the agroecosystem, 12 species in the dipterocarp forest, 15 species in the montane forest and 13 species in the pygmy forest. The transect walk measuring 20,000m^2 showed that the highest composition of trees was found in the agroecosystem with 77 species followed by the pygmy forest with 69 species. The dipterocarp forest had 64 species and the montane forest had 55 species. The difference in species composition might be due to the characteristics of the habitat and vegetation type requirements of species for growth and development. As for the shrubs, 45 species, 26 genera and 21 families were recorded from the established plots and transect walk. One species has not been identified. The established plots revealed that, a pygmy forest was the most species rich with an average of ten species followed by the montane forest with 3 species. Moreover, the transect walk showed that pygmy forest had the highest composition with 29 species followed by montane forest with 16 species. The agroecosystem had seven species and the dipterocarp forest had the least with 5 species. Among the vegetation types, Family Rubiaceae had the greatest number of species with 17 species of trees and one species of shrub. The high species richness of shrubs in the pygmy forest could be attributed to the adaptation of a drought environmental and chemical condition of an ultramafic soil.

Species Diversity, Species Importance Values and Similarities

The highest diversity value for trees (fig. 2a) was obtained in the pygmy forest with H'=1.348 followed by montane forest with

H'=1.284 and agroecosystem with H'=1.164. Dipterocarp forest showed the lowest diversity value of H'=1.161. For shrubs (Fig. 2b), the highest diversity value was noted in the pygmy forest with H'=1.112 followed by montane forest with H'= 0.591. The low diversity could be attributed to the present problems of the area such as timber poaching (Fig. 3a), clearing and conversion into agricultural lands and development of roads for mining activities (Fig. 3b), forest fires, landslides, gathering and collection of forest resources (Fig. 3c). Upland dwellers within Mt. Hamiguitan are dependent on farming and forest resources. Due to poverty and lack of livelihood opportunities, they resort to cutting of trees for firewood, fuel, lumber and agricultural practices. Furthermore, forest destruction brought about by human interventions and geological, climatic edaphic and biological features affect the population growth patterns of trees and shrubs. Forest clearing is a major threat to forest cover that would lead to depletion of forest resources.

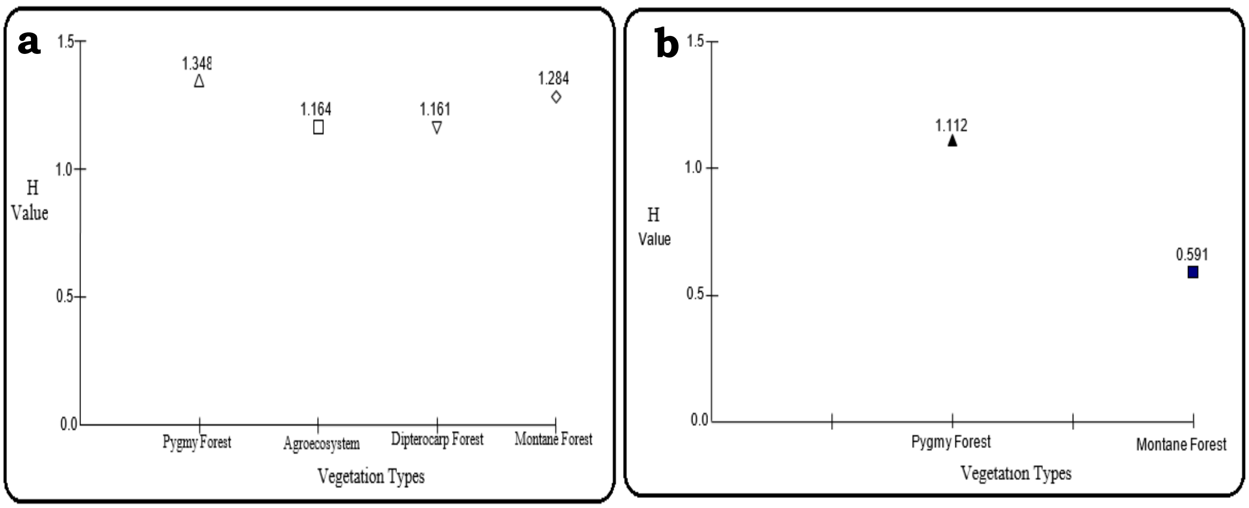

Figure 2. Diversity of (a) trees and (b) shrubs along different vegetation types in Mt. Hamiguitan Range

Figure 3. Photographs of the present problems of the area such as (a) logging, (b) development of roads for mining activities and (c) extraction of almaciga resin for fuel

For Species Importance Value (SIV), among the species of trees, *Diospyros philippinensis* obtained the highest importance value of 81.8% followed by *Ceuthosma* sp. with 66.21% and *Persea americana* (51.94%). For the agroecosystem, *Persea americana* was the most important species with the value 64.00% while *Diospyros philippinensis* had the highest importance value of 81.807% in dipterocarp forest. In the montane forest, *Agathis philippinensis* had the highest SIV of 46.33% while *Ceuthosma* sp. had the highest importance value of 60.40% in the pygmy forest. The variation of species importance value could be due to the differences in response of various species to the same environmental conditions. Elevation provides complex environmental gradients that include temperature, rainfall and relative humidity. Among the species of shrubs, *Medinilla apoensis* (fig. 4) showed the highest species importance value of 126.7% followed by *Drimys piperita* with 83.19% and *Melastoma malabathricum* with 73.91%. For the montane forest, *Melastoma malabathricum* was the most important species with 126.7% and *Vaccinium gitingense* in the pygmy forest with 67.37%. The high species importance values in this vegetation type could be due to the seeds and fruits that are easily carried by animals or some environmental gradients, not easily attacked by fungi and bacteria, and any amount of moisture that is enough for the seeds to grow abundantly. These species have an important role in regulating the stability of the ecosystem.

Figure 4. *Medinilla apoensis* C. B. Rob. MELASTOMATACEAE

Respective to the percentages of species similarities between vegetation types were calculated to provide information on the status of species between two vegetation types. Species similarities of trees between vegetation types showed that the highest species similarity was between montane forest and pygmy forest with 15 common species or 13%. On the other hand, there were 14 common species or 11% found between dipterocarp forest and pygmy forest followed with 13 common species or 10% in agroecosystem (fig 5) and dipterocarp forest (fig 6). Dipterocarp forest and pygmy forest had only seven common species or 6% followed by the agroecosystem and pygmy forest with 5 common species or 3% and the least with 4 common species or 3% in agroecosystem and montane forest (fig 7). Species similarities could be attributed to the distances of vegetation types that facilitate the easier dispersal of seeds by forest interior birds in neighboring sites. Based on the data gathered, the highest shrub species similarity index was obtained between montane forest and pygmy forest (Fig 8) with ten common species or 29% followed by dipterocarp forest and pygmy forest with two common species or 7%. Agroecosystem and pygmy forest showed 2 common species or 6% followed by dipterocarp forest and montane forest with only 1 common species or 5%. Only one common species or 4% also was found in agroecosystem and montane forest. However, agroecosystem and dipterocarp forest showed no common species of shrubs that could be due to the absence of relevant faunal species associated with the species of shrub (Table 1).

Figure 5. Agroecosystem at Governor Generoso, Davao Oriental

Figure 6. Dipterocarp forest at Mati, Davao Oriental

Figure 7. Mossy forest at San Isidro, Davao Oriental

Figure 8. Pygmy forest at San Isidro, Davao Oriental

Table 1. Similarity index of trees and shrubs between vegetation types

Vegetation Types			No. of Common Species	Number of Species		Similarity Index	Percentage of Similarity Index
1		2		1	2		
Trees							
AE	&	DF	13	77	67	0.099	10
AE	&	MF	4	77	55	0.31	3
AE	&	PF	5	77	72	0.035	3
DF	&	MF	7	67	55	0.061	6
DF	&	PF	14	67	72	0.112	11
MF	&	PF	15	55	72	0.0134	13
Shrubs							
AE	&	DF	10	16	28	0.294	29
AE	&	MF	2	4	28	0.067	7
AE	&	PF	2	7	28	0.061	6
DF	&	MF	1	7	16	0.045	4
DF	&	PF	1	4	16	0.053	5
MF	&	PF	0	7	4	0	0

Legend: AE– Agroecosystem; MF– Montane Forest; DF– Dipterocarp Forest; PF– Pgymy Forest

4.0 Conclusion and Recommendations

Mt. Hamiguitan Range harbors different vegetation types such as the agroecosystem, dipterocarp, montane, mossy and pygmy forest. It is a habitat of 223 species of trees and 46 species of shrubs. Species richness, diversity and similarity varied across the different vegetation types; thus species are heterogeneously distributed. The high diversity (H) values and highest species similarity of trees and shrubs in the pygmy forest and montane forest need conservation and protection before they will be lost. *Diospyros philippinensis* locally known as Kamagong and *Medinilla apoensis* had the highest species importance values (SIV). These species are locally common that can easily adapt to the environment. *Diospyros* is economically important as wood for building and *Medinilla* as ornamental plant. The species richness of the different vegetation types could affect the species of fauna in the area, thus the need to preserve the forest. The biodiversity status of Mt. Hamiguitan could be a good basis for policy implementation for protection and conservation of resources. Anthropogenic activities in the area may cause forest disturbance and can interfere with the species richness, composition and abundance that leads to species diversity reduction. Based on this conclusion, it is recommended that other plant groups should be investigated so that complete species richness data using GIS mapping in Hamiguitan will be recorded. An *ex-situ* and in situ conservation be conducted to protect the endemic, rare, endangered, depleted and economically important trees and shrubs.

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