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COMPOSITION AND COMMUNITY STRUCTURE OF PLANT SPECIES IN A SECONDARY GROWTH FOREST IN THE CENTRAL PHILIPPINES

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Abstract

Mt. Bandila-an Forest Reserve (MBFR) is among the remaining areas with patches of closed forests in Siquijor. This forest reserve is one of the potential key biodiversity areas in Central Visayas, yet the vegetation is not fully documented. This study was conducted to determine the species composition and diversity of plant species. Eight randomly distributed nested plots, each with a dimension of 20m×100m and subdivided to 5 equal segments of 20m×20m, were established. A total of 188 plant species was recorded from the plots, representing 131 tree species, 23 shrub, 14 vine, 11 herb, and 9 fern species. Common plant families with more than 6 representative species were Moraceae, Rubiaceae, Fabaceae, Araceae, Euphorbiaceae, Meliaceae and Myrtaceae. There were 19 threatened (vulnerable to critically endangered) and 33 endemic species recorded in the forest reserve highlighting the importance to further conserve the area. The cluster analysis and species accumulation curve suggest that plant species are not homogeneously distributed which implies that different management and conservation strategies should be implemented across MBFR. These results not only indicate the importance of MBFR, but also highlight areas with higher diversity and concentration of threatened and endemic species as a special area of concern.

***Key words*:** Central Visayas; Plant assessment; Mt. Bandila-an; Siquijor Island; Species diversity.

INTRODUCTION

The Philippines is one of the 17 mega diverse countries, with more than 52,117 described species (Mittermeier *et al.* 1997). It is highly regarded as one of the world's top biodiversity "hot spot" areas supporting 1.9 percent of the word's endemic plants and vertebrate species (Myers *et al.* 2000) and over 57 percent of the major faunal and floral groups occur nowhere else in the world (Oliver and Heaney 1996).

Central Visayas is known to have the most important karst and non-karst landscapes in the Visayas. This makes some of its ecologically important flora and fauna remarkably unique from one island to another within the region. Biodiversity in this part of the country is extraordinarily rich and diverse (Fernando *et al.* 2008). It has 13 identified key biodiversity areas (KBA) and is home to an abundance of flora and fauna found in different ecosystems. However, natural and man-made threats limit the occurrence and distribution of these precious creatures in less disturbed ecosystems. These areas, being habitats of ecologically important and highly threatened flora and fauna, be assessed for adequate conservation and proper management.

On the other hand, Siquijor lies off the southern coasts of Cebu, Negros and Bohol. It is part of the geopolitical West Visayas group of islands but it is not considered as part of the Negros-Panay faunal region as it is oceanic in origin (Pedregosa *et al.* 2006, Jakosalem *et al.* 2005). It is located 19 km east of the southern tip of Negros, 30 km southeast of Bohol and 45 km north of Zamboanga peninsula at 9°11' N and 123°35' E. Only four significant blocks of forest remain on the island, covering a total of 781 ha (Mallari *et al.* 2001). All forest blocks are declared nature reserves and controlled by the Department of Environment and Natural Resources (DENR). Mt. Bandila-an Natural Park is the highest point of Siquijor at 557 m elevation. It is surrounded by farm lots and abandoned agricultural fields. The area contains some remnant primary lowland forests in most places where the forest is fragmented, thick undergrowth with saplings of large trees, shrubs and grasses (Jakosalem *et al.* 2005). Several anthropological studies conducted in Siquijor, e.g. Mascuñana *et al.* (1999), described folk-healing practices utilizing certain plants in the preparation of decoction (Mascuñana and Mascuñan 2008). Most of these investigators and writers emphasized the mysticism and religious aspects only.

Apparently, no extensive exploration has been done in smaller limestone islands in the Visayas like Siquijor. The results of this study will not only provide updated information on the species composition and diversity of flora in the island but will also serve as a guide for further investigation, as well as a basis for formulating and implementing policies for forest resources management.

MATERIAL AND METHODS

Study site

The province of Siquijor is generally a hilly, coralline island, covering 344 km^2 and reaching 628 m elevation. Mt. Bandila-an Forest Reserve (MBFR) is among the remaining areas with patches of forest in Siquijor (Fig. 1). It contains some remnant primary lowland forest, but is characterized by highly disturbed secondary growth dominated by fig (*Ficus* spp.) tree species. In most places, the canopy is fragmented and the thick undergrowth saplings of large trees, shrubs and coarse grasses. The forests are composed into secondary area, and probably support the most important surviving population of endemic birds. The extant mammal fauna is largely composed of bats, including four Philippine endemic bat species. Spotted deer and Visayan warty pig are reported to have occurred in Siquijor in the past, but are almost certainly now extinct in the wild (Mallari *et al.* 2001).

Field data collection

The study was conducted from February to March 2019. Eight permanent plots, each with a dimension of 20m x 100m were established randomly in the closed and less disturbed forested areas in Mt. Bandila-an Forest Reserve. Each sampling plot was further divided into five (5) equal segments (20m×20m) to facilitate recording of plants in the canopy layer having diameter at breast height (DBH, cm) of 10 cm and above. Nested subplot of 5m×5m, on the other hand, was laid at the center of each segment for data recording of plants in the intermediate layer having DBH of less than 10 cm. Further, four (4) smallest nested plots (1m×1m) on the inner edges of the 5m×5m plot were also laid to list down species in suppressed ground cover vegetation. Data recorded in the field were: (i) plant names from family down to species level; (ii) bio-measurements on diameter at breast height (cm) and total height (m); (iii) plant habit of observed/recorded plants; and (iv) GPS coordinates of all corners of each segment and nested plots. For low stature plants (understorey and ground vegetation); (i) number of individuals; and (ii) crown cover in percent were estimated.

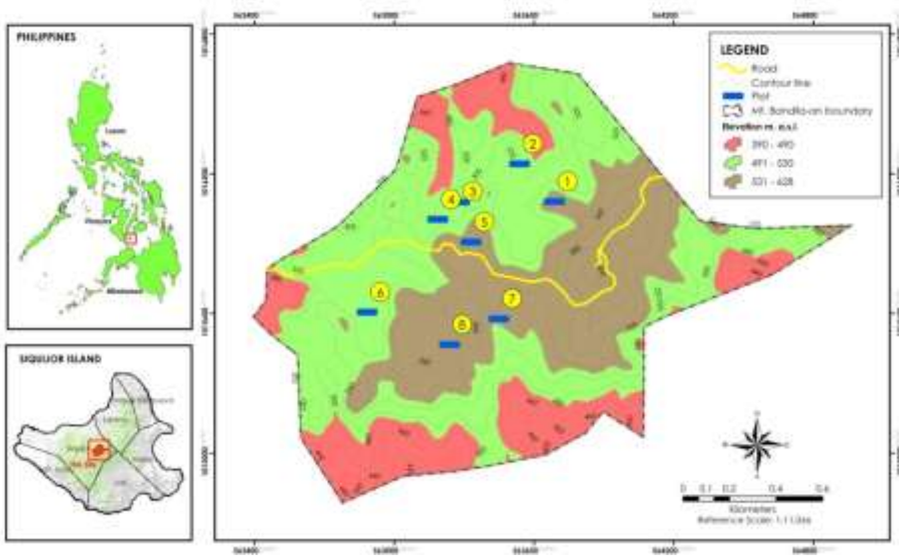

Fig. 1. Topographic map of MBFR showing the locations of the sampling plots.

Plant species identification

Identification and nomenclature were aided using the following strategies: (i) expert determination; (ii) use of flora databases (Co's Digital Flora of the Philippines; International Plant Name Index, IPNI); (iii) lexicons Salvosa (1963), Rojo (1999); (iv) published books (Flora Malesiana, Flora de Manila, Enumeration of Flowering Plant), field guides and other literatures, e.g. de Guzman *et al.* (1986), Rojo and Aragones 1997, Fernando *et al.* (2004), Lapitan *et al.* (2010), Tandang *et al.* (2014) and Malabrigo *et al.* (2016); and finally (v) use of type images.

Data analysis

The relative density, relative frequency and relative dominance for each tree species in all plots were determined to obtain their importance value (IV), a standard measure in ecology that determines the rank relationships of species. High importance value of species indicates a composite score for high relative species dominance, density and frequency and provides a basis on what species can be used for restoration.

To compute for the relative density, relative dominance and relative frequency, the following formula was used (Muller-Dombois and Ellenberg 1974).

$$\text{Density} = \frac{\text{total number of individuals of a species}}{\text{Area sampled}} \qquad \text{(Equation 1)}$$

$$\text{Relative density} = \frac{\text{Density of a species}}{\text{Total densities of all species}} \times 100 \qquad \text{(Equation 2)}$$

$$\text{Dominance} = \frac{\text{Basal area (DBH area) of a species}}{\text{Total area sampled}} = \frac{\text{Crown area of a species}}{\text{Total area sampled}} \qquad \text{(Equation 3)}$$

$$\text{Relative dominance} = \frac{\text{Dominance of a species}}{\text{Total dominances of all species}} \times 100 \qquad \text{(Equation 4)}$$

$$\text{Occurence} = \frac{\text{Number of times a species is encountered}}{\text{Total number of plots established}} \quad \text{(Equation 5)}$$

$$\text{Frequency} = \frac{\text{Number of occurrences}}{\text{Total number of occurrences}} \quad \text{(Equation 6)}$$

$$\text{Relative frequency} = \frac{\text{Frequency of a species}}{\text{Total of frequencies}} \text{ x } 100 \quad \text{(Equation 7)}$$

$$\text{Importance value (IV)} = \text{Relative density} + \text{Relative dominance} + \text{Relative frequency}$$

Furthermore, hierarchical cluster analysis (HCA) and species accumulation curve (SAC) of plots were done using Jaccard's similarity index and diversity curve, respectively from Paleontological Statistics (PAST version 2.17c) (Hammer and Harper 2006). The dendrogram was generated through unweighted pair-group method (UPGMA) and bootstrapping (n=1000). We employed this method of analysis because it is sensitive to small sample sizes and missing observations. Diversity indices (Shannon, Simpson's and Evenness) of the sampling quadrats were computed based on the presence and absence data of all recorded species per quadrat. Index values were interpreted using the descriptions proposed by Fernando (1998) (Table 1).

Table 1. Ordinal classification of species diversity and evenness indices.

Relative value rating	Species diversity (H')	Evenness (E')
Very High	3.50 – above	0.75 – 1.00
High	3.00 – 3.49	0.50 – 0.74
Moderate	2.50 – 2.99	0.25 – 0.49
Low	2.00 – 2.49	0.15 – 0.24
Very Low	0.00 – 1.99	0.05 – 0.14

Conservation status and endemicity

The global and local threatened status of each species was determined from the IUCN Red List of Threatened Species 2019 using the link https://www.iucnredlist.org and from *DENR DAO 2017-11* for the Philippine threatened status. Endemicity was determined through a Philippine archive of plant species *Co's Digital Flora of the Philippines 2011 which* is available online (https://www.philippineplants.org).

RESULTS AND DISCUSSION

General floristic composition

The study revealed that MBFR had recorded a total of 188 plant species belonging to 139 genera under 66 families. The dominant families of Moraceae, Rubiaceae, Fabaceae, Araceae, Euphorbiaceae, Meliaceae and Myrtaceae had more than 6 representative species (Table 2). As shown, tree species dominates with 131 species followed by the shrub (23), vine (14), herb (11) and then the fern species (9). Furthermore, genera with the highest species representation were *Ficus* (12) and *Syzygium* (6). In the addition, the highest number of tree species (58) was observed in plot 6 followed by plot 4 (51) and the lowest was in plots 3 and 8 with value 42 (Fig. 2). This trend was the same with shrub species, with highest number (12) in plot 6, followed by plot 4 (9 species) and lowest in plot 5 with 2 species. Meanwhile, vine, herb and fern had relatively similar number of species across the plots.

Table 2. Composition of flora per plant habit in Mt. Bandila-an Forest Reserve.

Family	Plant habit					Total number of species
	Fern	Shrub	Herb	Vine	Tree	
Acanthaceae			1			1
Anacardiaceae					6	6
Annonaceae		1			5	6
Apocynaceae				1	4	5
Araceae			6	3		9
Araliaceae					3	3
Arecaceae				1	5	6
Asparagaceae		1				1
Bignoniaceae					1	1
Brownlowiaceae					1	1
Burseraceae					4	4
Byttneriaceae		1				1
Calophyllaceae					1	1
Celastraceae					3	3
Clusiaceae					2	2
Combretaceae					1	1
Convolvulaceae				1		1
Cornaceae					1	1
Cunoniaceae					1	1
Dipterocarpaceae					1	1
Dryopteridaceae	1					1
Euphorbiaceae					8	8
Fabaceae				2	8	10
Fagaceae					1	1
Hypericaceae					2	2
Hypoxidaceae			1			1
Lamiaceae		2			3	5
Lauraceae					5	5
Leguminosae					1	1
Lygodiaceae	2					2
Magnoliaceae					1	1
Malvaceae					2	2
Maranthaceae		1				1
Melastomataceae		1		1	1	3
Meliaceae					8	8
Menispermaceae				1		1
Moraceae		3			13	16
Myristicaceae					1	1
Myrtaceae					8	8
Nephrolepidaceae	1					1
Oleaceae					1	1
Orchidaceae			1			1
Pandanaceae		1				1
Phyllanthaceae					2	2
Piperaceae				1		1
Poaceae				2		2
Polypodiaceae	1					1
Primulaceae		2			1	3
Proteaceae		1				1
Rhizophoraceae					1	1
Rosaceae					2	2
Rubiaceae		6	1	1	6	14

Rutaceae					4	4
Sapindaceae					1	1
Sapotaceae					5	5
Selaginellaceae	3					3
Sterculiaceae					2	2
Strombosiaceae					1	1
Symplocaceae					1	1
Thelypteridaceae	1					1
Thymelaeaceae					2	2
Urticaceae		1			1	2
Vitaceae		2				2
Zingiberaceae			1			1
Total	9	23	11	14	131	188

Similarity of plant species in each plot was presented in Fig. 3. Three main clusters were observed. The first cluster had 2 plots (7 and 8) group together and was characterized by extreme incision, dominated by *Litsea fulva.* On the other hand, cluster 2 had 5 plots (2, 3, 4, 5 and 6) grouped together and was characterized by higher plant composition. This cluster was dominated by *Osmoxylon eminens, Aleurites moluccanus*, *Calophyllum blancoi*, *Artocarpus nitidus*, and *Mangifera altissima*. Lastly, plot 1 comprised cluster 3 characterized and dominated by *Streblus macrophyllus.*

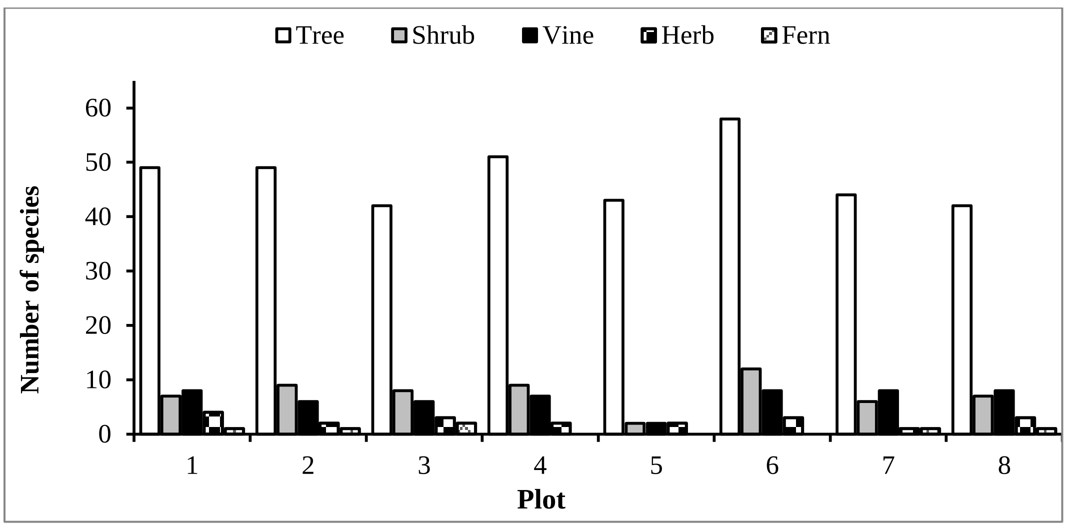

Fig. 2. General plant groups of species observed per plots in MBFR.

Canopy layer

The canopy layer in this study is dominated by trees and other woody plants with DBH of greater than 10 cm recorded in 20m×20m plots. The trees of Mt. Bandila-an forest reserve are composed of 116 species with 1,034 individuals in the sample plots. The relative density, frequency and dominance values for each tree species in all plots were determined to obtain their importance value (IV), a standard measure in ecology that determines the rank relationships of species. The high importance value of species indicates a composite score for high relative species dominance, density and frequency. Based on computed importance value shown in Table 3, kubi (*Artocarpus nitidus*) stood as the most dominant with a value of 23.04%. Large trees of *Artocarpus nitidus* were observed very widespread in the study site. Buhian (*Litsea fulva*) followed with an IV of 18.95% which also commonly observed in the site. Ipil (*Intsia bijuga*) with computed IV of 18.54% which was also commonly found in two of the eight plots established. Banai-banai (*Radermachera quadripinnata)* and balete (*Ficus* sp.) were also dominant in the site with computed IV of 17.12%, 16.98%, respectively.

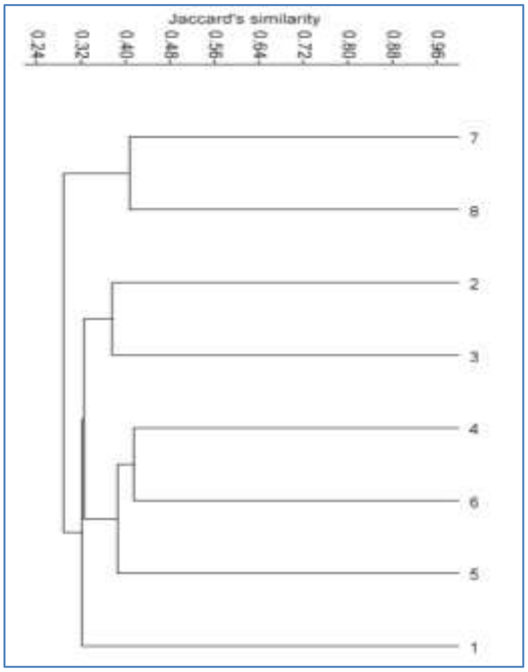

Fig. 3. Dendrogram of eight sampling plots generated through UPGMA using Jaccard's Index. Bootstrapping was done at n= 1000; cophenetic correlation is 0.77

Intermediate layer

Intermediate layer is composed of plants (trees, shrubs, herbs, lianas) having a diameter at breast height of less than 10 cm, but not more than 1 cm recorded in 5m × 5m plots. A total of 79 plant species with 762 individuals was recorded in the intermediate layer of the forest in Mt Bandila-an forest reserve. The five most abundant recorded species in terms of IV were tagnos (*Goniothalamus elmeri*) 39.17%, buhian (*Litsea fulva*) 35.09%, malakapaya (*Osmoxylon eminens*) 31.77%, os (*Streblus macrophyllus*) 18.24% and ligas (*Semecarpus cuneiformis*) 13.64%.

Ground cover

There are 114 ground cover species recorded from the sampled 1m × 1m plots. It must be noted that the ground cover species referred in this survey are all species (crawling or erect) inside the plot with the height of less than 1 meter. Hence, the seedlings of different tree species are included as ground cover. This treatment gives us better understanding of the stand structure of the forest from the ground to the canopy. The five most dominant species that occupy the highest relative cover were bitanghol (*Calophyllum blancoi*) 48.14%, buhian (*Litsea fulva*) 32.56, tagnos (*Goniothalamus elmeri*) 19.51%, takipan (*Caryota rumphiana*) 12.77% and puso-puso (*Neolitsea villosa*) 10.75%. (Table 3).

Table 3. Top 10 species with the highest importance value (IV %) in all vegetation layers.

Species	Family	IV(%)
Canopy layer		
Artocarpus nitidus Trécul	Moraceae	23.04
Litsea fulva (Blume) Fern.-Vill.	Lauraceae	18.95
Intsia bijuga (Colebr.) O. Kuntze	Fabaceae	18.54
Radermachera quadripinnata (Blanco) Seem.	Bignonaceae	17.12
Ficus balete Merr.	Moraceae	16.98
Alstonia macrophylla Wall. ex. DC.	Apocynaceae	13.59
Calophyllum blancoi Planch. & Triana	Calophyllaceae	11.47
Osmoxylon eminens (W. Bull.) Philipson	Araliaceae	11.39
Aleurites moluccanus (L.) Willd.	Euphorbiaceae	10.11
Pterocarpus indicus Willd.	Fabaceae	9.93
Intermediate		
Goniothalamus elmeri Merr.	Annonaceae	39.17
Litsea fulva (Blume) Fern.-Vill.	Lauraceae	35.09
Osmoxylon eminens (W.Bull.) Philipson	Araliaceae	31.77
Streblus macrophyllus Blume	Moraceae	18.24
Semecarpus cuneiformis Blanco	Anacardiaceae	13.64
Medinilla sp.	Melastomataceae	12.38
Calophyllum blancoi Planch. & Triana	Calophyllaceae	11.38
Palaquium luzoniense (Fern.-Vill.) S.Vidal	Sapotaceae	10.45
Mangifera altissima Blanco	Anacardiaceae	8.80
Artocarpus nitidus Trécul	Moraceae	7.91
Ground cover		
Calophyllum blancoi Planch. & Triana	Calophyllaceae	48.14
Litsea fulva (Blume) Fern.-Vill.	Lauraceae	32.56
Goniothalamus elmeri Merr.	Annonaceae	19.51
Caryota rumphiana C.Mart.	Arecaceae	12.77
Neolitsea villosa (Blume) Merr.	Lauraceae	10.75
Streblus macrophyllus Blume	Moraceae	10.75
Calamus merrillii Becc.	Arecaceae	9.40
Litsea cordata (Jack) Hook.f.	Lauraceae	8.93
Aglaonema philippinense Engl.	Araceae	8.66
Anaxagorea luzonensis A.Gray	Annonaceae	7.82

Tree structure and density

Tree structure and density (Fig. 4) were described and gave insight on vertical stratification of the recorded trees in the area. In this study, tree dominates among the plots of 5, 7 and 8 (Table 4). Moreover, the diameter of trees lies within 10-20 cm contributed about 56% and mostly recorded in plots 5 and 7. Diameter 21-30 cm mostly recorded on the plots 5 and 8. The diameter class 31-40 and > 40 cm has equally distributed 11% in all plots. Results revealed that large diameter trees were recorded mostly in the plots 6 and 8, wherein these areas are located in steep slopes and are usually difficult to access, thus less disturbance.

Table 4. Diameter classes and frequency of tree species per plot in Mt. Bandila-an forest reserve.

Diameter class (cm)	Frequency per plot								Total	%
	P1	P2	P3	P4	P5	P6	P7	P8		
10-20	65	57	53	54	103	62	100	89	583	56
21-30	18	11	35	21	42	23	26	45	221	21
31-40	9	10	18	11	18	12	16	19	113	11
40 above	12	15	15	11	8	19	14	23	117	11
Total	**104**	**93**	**121**	**97**	**171**	**116**	**156**	**176**	**1034**	**100**

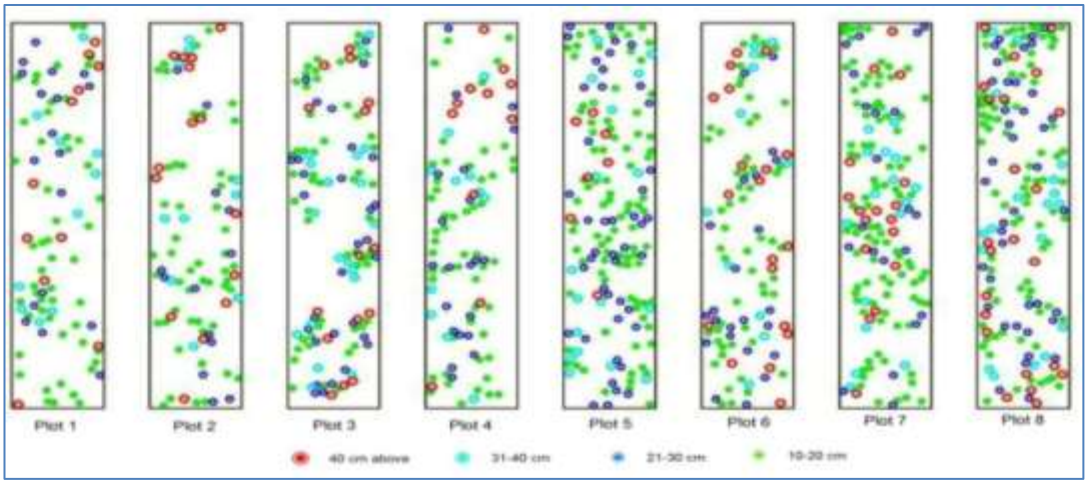

Fig. 4. Structure and density of tree species recorded in each plot of MBFR.

Diversity index

Shannon diversity index (H') gives an estimate of species richness and distribution. The plot 6 had the highest computed Shannon index (H'=3.90), followed by the plot 4 with value 3.64 and lastly the plot 8 with value 3.26 (Fig. 5). Evenness Index tells us how evenly species and/or individuals are distributed inside a plot. The plot 6 had the highest computed evenness with value 0.61, followed by the plot 5 with value 0.58, then lowest is plot 2 with 0.42 Simpson's Index, on the other hand, gives the probability of getting different species when two individuals were drawn (with replacement) inside a plot. Highest computed Simpson index (0.97) was in the plot 6 and lowest was in the plot 2 with value 0.92. Moreover, the overall computed Shannon and Evenness indices for MBFR were 3.63 and 0.37, respectively.

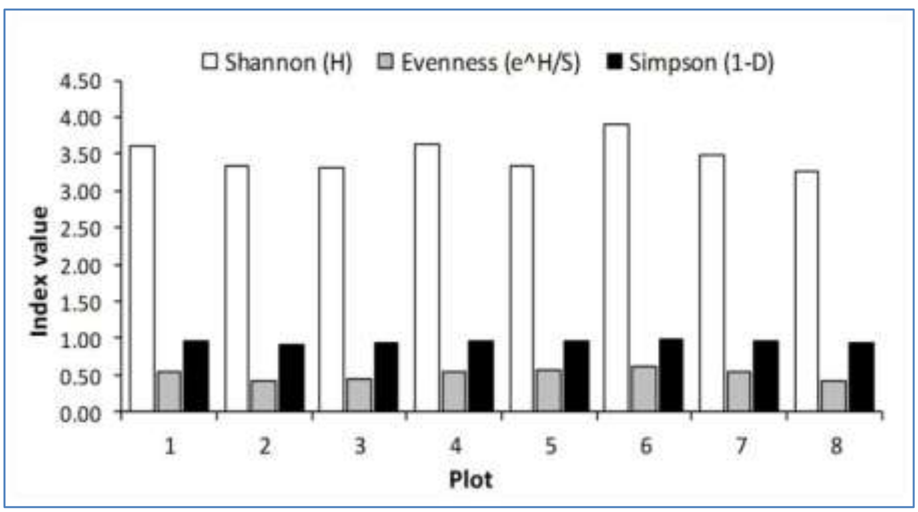

Fig. 5. Plant diversity index in each plot established in MBFR.

Threatened and endemic species

Nineteen (19) species (Table 5) recorded from Mt. Bandila-an forest reserve are listed either the Philippine Red List (DAO 2017-11) or the IUCN Red List of Threatened Species (2019). Of the total

188 taxa identified to species level, 33 species (17.55%) were found to be Philippine endemics or have natural habitat confined only in the country.

Table 5. List of threatened species recorded in MBFR.

Species	Family	IUCN Red List	DENR DAO 11-17
Artocarpus blancoi (Elmer) Merr	Moraceae	VU	
Madhuca betis (Blanco) MacBride	Sapotaceae	VU	EN
Dracontomelon dao (Blanco) Merr. & Rolfe	Anacardiaceae		VU
Intsia bijuga (Colebr.) O. Kuntze	Fabaceae	VU	VU
Ficus ulmifolia Lam.	Moraceae	VU	
Toona calantas Merr. & Rolfe	Meliaceae		VU
Cinnamomum mercadoi S.Vidal	Lauraceae	VU	
Prunus grisea (Blume) Kalkm.	Rosaceae		VU
Meiogyne mindorensis (Merr.) Heusden	Annonaceae		VU
Canthium dicoccum (Gaertn.) Merr.	Rubiaceae	VU	
Vitex parviflora Juss.	Lamiaceae	VU	EN
Pterocarpus indicus Willd.	Fabaceae	EN	VU
Palaquium luzoniense (Fern.-Vill.) S.Vidal	Sapotaceae	VU	EN
Mangifera altissima Blanco	Anacardiaceae	VU	
Canarium luzonicum (Blume) A.Gray	Burseraceae	VU	
*Calamus merrilli*i Becc.	Arecaceae		VU
Ardisia squamulosa Elmer	Primulaceae	VU	VU
Macaranga grandifolia (Blanco) Merr.	Euphorbiaceae	VU	
Shorea contorta S.Vidal	Dipterocarpaceae	CR	VU

CR- Critically Endangered, EN- Endangered, VU- Vulnerable.

The number of species recorded in this study had a cumulative total of 188 plant species in all permanent plots belonging to 139 genera under 66 families. This result was higher compared to the studies conducted in forest over limestone of Dinagat island which accounted in 144 plant species belonging to 50 families and 88 genera (Lillo *et al.* 2018), Mt. Lantoy key biodiversity area (KBA) in the Province of Cebu with 112 species (Lillo *et al.* 2019) but lower compared to Canbantug forest with 192 species, 159 genera belonging to 62 plant families (Replan and Malaki 2017), 351 species from Negros (Aureo *et al*. 2021) and 368 species in Bohol (Aureo *et al*. 2020). One of the factors that could contribute to this finding was the sampling effort and size of the forest areas, which highlights the importance of establishing sufficient number of sampling plots as suggested by the species accumulation curve (Fig. 6). This is important in determining whether the plant species in the area is sufficiently represented or not. Additionally, the result of cluster analysis exhibits heterogeneity of plant species across MBFR. This has implication on the management aspect as different vegetation structure requires specific approach. Moreover, Moraceae or figs species were the most dominant among plant families encountered across the study site followed by coffee (Rubiaceae), legumes (Fabaceae) and herbs (Araceae) and euphorbs (Euphorbiaceae) which is in consonance with the latter studies. Fig species and Rubiaceae are known food source of bats and birds by which can lead to a high rate of seed dispersal and recolonization success (Shanahan *et al.* 2001, Bremer and Farley 2010, Lomascolo *et al.* 2010). Legume species are the majority abundant species and also been identified to play critical roles in forest restoration due to their nitrogen-fixing capability (Wang *et al.* 2010, Chaer *et al.* 2011, Menge *et al.* 2019). Likewise, the species of euphorbs also attract many pollinator species, such as butterflies and birds found in the wild (Simpsons 2005, Smith and Smith 1990). The open forest canopy allows light to penetrate to reach the forest floor in order to proliferate the sun-loving ground herbs and grasses which explains why legumes are found dominant in this study (Durst *et al.* 2009). Furthermore, the dominance of Araceae species indicates that forest canopy in Mt. Bandila-an is still under recovery and is actually way far from completion. Interestingly, Begoniaceae, Gesneriaceae, and other herbaceous species which are often expected on a limestone habitat were not represented in this study. Since our sampling was only done during dry season, these families of herb which are considered short-live because of its rare seeds were not observed (Doorenbos *et al.* 1998, Bernardello 2007).

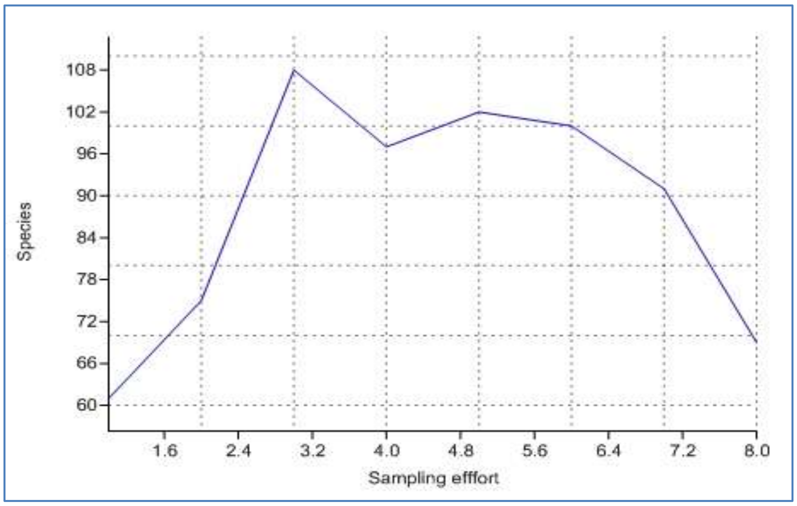

Fig. 6. Species accumulation curve of plant species in each plot.

All plots showed high diversity in both Shannon (H') and Simpson's (D) indices. The high diversity index for the plot is understandable considering the number of species and individuals recorded. The plot 6 had the highest Shannon index with value 3.99 while the lowest was in the plot 8 with value 3.26. This high diversity could be attributed to its location where disturbance is minimal allowing the plants to regenerate faster. It is also important to note that in terms of Shannon diversity index, the ordering of the plots was mostly affected by the topography, dense forest cover and maturity of the forest (Replan and Malaki 2017) where the plots were established. The high percentage value of IV of *Artocarpus nitidus*, *Litsea fulva* and *Calophyllum blancoi* denotes the importance of these species for future rehabilitation programs. Moreover, distribution on diameter class on tree species would demonstrate different patterns on population structure and implying various different population dynamics among species (Tesfaye *et al.* 2013). Thus, MBFR is considered a relatively young secondary forests characterized by smaller sized and stunted trees as evidenced by the high basal area of diameter class (10-20 cm).

In terms of conservation status and endemicity, 33 species were considered as Philippine endemic and 19 were threatened. This value for endemic is higher compared to the 23 recorded by Lillo *et al.* (2018) in Dinagat island and 19 recorded by Replan and Malaki (2017) in Canbantug forest, Cebu. In terms of threatened species, our value was higher compared to the 18 species accounted by Replan and

Malaki (2017) but lower to the 25 species accounted by Lillo *et al*. (2018). Forests over limestone like MBFR have been a home for many endemic and threatened species because of their unique environmental conditions, the saline soil properties, dry environment, and shallow soil parent materials, which allowed for the evolution of limestone-adapted species (Querejeta *et al.* 2007). Presence of listed threatened and endemic species should use as reminder even on small remnant forest because they were still impact on the level of biodiversity (Galidon *et al.* 2017). The forest over limestone was considered as home for many endemic species because of their unique environmental conditions (e.g., saline soil properties, dry environment and shallow soil parent materials), which allowed for the evolution of limestone adapted species (Querejeta *et al.* 2007, Fernando *et al.* 2008, Liu and Slik 2014). Thus, appropriate management and monitoring strategies to ensure the continued survival of its population as well as other threatened species should be developed. Species confined to a particular site should be given particular conservation management strategies, as they are more vulnerable to disturbance due to their narrow range.

Exotic mahogany (*Swietenia macrophylla*) trees were planted and found growing due to seed dispersal against wind in several remnant forests of Mt. Bandila-an. This species most likely was planted due to its economic value and local practices in rehabilitating degraded areas. A total of ten individuals of mahogany with highest diameter of 76 cm was recorded. High number of the seedlings of this species in MBFR indicates a high rate of natural regeneration potential. According to Baguinon *et al.* (2003) mahogany is successful at invading natural forests due to its attributes. The number of seeds from a mahogany mother tree can disperse considerably and the seeds are recalcitrant, i.e. it can germinate in less than a month. The seed also contains food reserves and germinate hypogeal which means that even if the initial light is relatively poor, the young mahogany plant develops even without initial photosynthesis (Baguinon *et al.* 2003). This has implication on the future vegetation structure of MBFR as mahogany starts to invade this remaining forest.

Plant diversity assessment implies that Mt. Bandila-an Forest Reserve has a high to very high diversity value in all vegetation layers and is home to at least 188 plant species. More than 17% of which flora are exclusively found in the country and has a significant number of threatened species. It is recommended that immediate conservation and management activities should be conducted to save the threatened and endemic plant species from extirpation. Future studies should consider plant associations and environment interactions. PAMB and all other concerned stakeholders should by all means exert their best effort to protect and conserve the area, though, the primary reason for this is the obvious scarcity of flora exploration.

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