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RESEARCH ARTICLE

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Inventory and conservation of endangered, endemic and economically important flora of Hamiguitan Range, southern Philippines

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Key words

assessment
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vegetation types

Abstract This research was conducted to inventory and assess the flora of Mt Hamiguitan. Field reconnaissance and transect walk showed four vegetation types, namely: dipterocarp, montane, typical mossy and mossy-pygmy forests. Inventory of plants showed a total of 878 species, 342 genera and 136 families. Of these, 698 were angiosperms, 25 gymnosperms, 41 ferns and 14 fern allies. Assessment of conservation status revealed 163 endemic, 34 threatened, 33 rare and 204 economically important species. Noteworthy findings include 8 species as new record in Mindanao and one species as new record in the Philippines. Density of threatened species is highest in the dipterocarp forest and decreases at higher elevation. Species richness was highest in the montane forest and lowest in typical mossy forest. Endemism increases from the dipterocarp to the montane forest but is lower in the mossy forest. The results are compared with data from other areas.

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INTRODUCTION

Mount Hamiguitan Range Wildlife Sanctuary in Davao Oriental is a protected area covering 6 834 ha located between 6°46'6°40'01" to 6°46'60" N and 126°09'02" to 126°13'01" E. The mountain is known for its unique characteristics and the largest pygmy 'bonsai forest' in the country. This forest type has a substrate predominated by ultrabasic rocks. The rock weathers leaving the soil with an unusually high concentration of iron and magnesium causing it to be unproductive for agricultural activities. Only a specialized group of plants grow on this type of forest which is often low, heath-like shrubs. *Nepenthes alata* Blanco, a facultative ultrabasic, as well as obligate ultrabasic species of *Nepenthes* (*Nepenthaceae*) were found to be numerous in the area. Other ultrabasic indicator species such as *Scaevola micrantha* (Krause) C.Presl (*Goodeniaceae*), *Scaevola* sp., *Suregada glomerulata* (Blume) Baill. (*Euphorbiaceae*) and *Ochrosia glomerata* (Blume) F.Muell. (*Apocynaceae*) were also found thriving in the vegetation.

The unique biodiversity resources in Mt Hamiguitan Range have not been spared from destruction such as timber poaching, illegal logging and overharvesting of forest products and resources. This will be aggravated because of the forthcoming mining activities. As a result, elements of the important flora and fauna may be lost before they are recorded, studied and conserved.

This research aimed to inventory and assess the flora in Mt Hamiguitan Range Wildlife Sanctuary and its surroundings. Specifically, it aimed to identify and describe the vegetation types; determine the diversity and species importance values (SIV); assess the conservation status of the species whether endemic, endangered, rare and economically important; and, determine the threatened and endemic species distributions and habitats for conservation.

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METHODOLOGY

Vegetation types

Field reconnaissance and transect walks were conducted to identify and describe the vegetation types occurring in Mt Hamiguitan Range. On basis of species composition, altitude and other ecological indicators, we identified four vegetation types as a basis for further analysis. In addition, the term agroecosystem is used to refer to the cultivated areas around the villages.

Diversity indices

To determine species richness, transect walks were undertaken and sampling plots were established with the assistance of *Bantay Gubat*. Per vegetation type a 2-ha transect walk was conducted with a local expert and transect belts were established.

A total of thirty-two 20×20 m sampling plots were established in all vegetation types, each type with 6 sampling plots except for the dipterocarp forest with 14 plots. Within these plots, a 5×5 m subplot was laid out to determine the species richness for shrubs, vines and herbs. We assessed species diversity by using the Shannon index of general diversity (H):

$$H = - \Sigma \, ndbh/Ndbh \log ndbh/Ndbh$$

where

ndbh = total diam at breast height of individual tree species
Ndbh = total diam at breast height of all tree species

The Species Importance Value (SIV) was computed using the formula of Brower & Zar (1977):

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

where

RD = Relative Density
RF = Relative Frequency
Rdom = Relative Dominance

Table 1 Total number of families, genera and species of flora in Mt Hamiguitan Range.

Plant group	Families	Genera	Species
Angiosperms	101	273	698
Gymnosperms	4	6	25
Ferns	28	59	141
Fern allies	3	4	14
Total	136	342	878

Identification of collected specimens

The collected plants were identified using available floras and monographs (Merrill 1926, Ashton 1982, Rödl-Linder 1987, Brummitt 1992, Madulid 1995, Amoroso et al. 1996, Barcelona et al. 1996, Huang 1996, 1997, Hovenkamp et al.1998, Nooteboom 1998, Rojo 1999, De Wilde 2000, Jebb & Cheek 2001, Cootes 2001, Berg & Corner 2005, Middleton 2007). Mr. Leonardo L. Co (Conservation International) and Dr. Paul Keßler (Nationaal Herbarium Nederland, Leiden branch) confirmed the identification of some species.

Assessment of conservation status

We assessed conservation status of the species in Mt Hamiguitan Range and their status as endemic, rare or economically important, using the data from Merrill (1923–1926), Zamora & Co (1986), Madulid (1995), Tan et al. (1996), Rojo (1999) and Flora Malesiana Series (1995–2007) and the DENR Administrative Order (2007).

Identification of threatened and endemic species and habitats for conservation

The type of vegetation, altitude, and location of endemic, endangered, rare and economically important species and their habitats were recorded whenever they were encountered. Transect diagrams were prepared to identify the location and distribution of the threatened and endemic species. The result of this method will be the basis for in situ conservation of the threatened habitats and species.

RESULTS

Vegetation types

We identified four vegetation types: dipterocarp forest, montane forest, typical mossy forest and mossy-pygmy forest.

The dipterocarp forest is situated around 6°43'30" N and 126°09'01" E, with altitude ranging from 420–920 m. *Shorea spp.* (*Dipterocarpaceae*) and vines (*Smilax* spp., *Smilacaceae*) dominate the forest. The height of trees ranges from 5–30 m.

The montane forest is situated around 6°44'08" N and 126°20'08" E, with altitude ranging from 920–1160 m. *Agathis philippinensis* Warb.(*Araucariaceae*), various species of *Nepenthes* sp. (*Nepenthaceae*) and epiphytes characterize this type. The height of trees ranges from 5–25 m, decreasing as the altitude increases.

The typical mossy forest is situated around 6°42'16" N and 126°11'52" E, in altitude ranging from 1160–1350 m. Mosses form thick mats covering roots and tree trunks. *Calophyllum blancoi* Planch. & Triana (*Clusiaceae*), *Dacrydium elatum* (Roxb.) Wall. (*Podocarpaceae*), *Calamus* spp. (*Arecaceae*) and *Pinanga* spp. (*Arecaceae*) species are dominant in the area. *Freycinetia* sp. (*Pandanaceae*) are the dominant epiphytic plants, often festooned over large trees. The height of trees ranged from 6–15 m.

The mossy-pygmy forest is situated around 6°43'24" N and 126°11'11" E, ranging in altitude from 1160–1600 m. However, pygmy forest (but not mossy) was also observed as low as 75–275 m in Mati around 6°43'44" N and 126°13'27" E. The mossy-pygmy forest occupies c. 225 ha. The height of trees ranges from 0.5–2.5 m and the average diam is 8 cm. The forest is dominated by *Leptospermum* sp. (*Myrtaceae*), *Weinmannia* sp. (*Cunoniaceae*), *Elaeocarpus* sp. (*Elaeocarpaceae*) and *Dacrydium* sp. (*Podocarpaceae*). Abundant mosses are present on the forest floor.

Table 2 Species richness in the different vegetation types in Mt Hamiguitan Range based on sampling plot and transect walk.

Plant groups	Vegetation types				
	Agro-ecosystem	Dipterocarp	Montane	Mossy	Mossy-Pygmy
Angiosperms	204	326	340	179	272
Gymnosperms	3	12	16	7	13
Ferns	37	71	96	57	50
Fern allies	2	9	10	3	3
Total	246	418	462	246	338

Species richness

Transect walk and sampling plots revealed a total of 878 species, 342 genera and 136 families. Of these, 698 were angiosperms, 25 gymnosperms, 141 ferns and 14 fern allies (Table 1, 2). This number of species in Mt Hamiguitan is 68 % lower than those observed in Mt Malindang which has 1 200 species (Arances et al. 2004), but more species of gymnosperms were observed in Mt Hamiguitan than in Mt Malindang Range.

Among the vegetation types, the montane forest exhibits the highest species richness with 462 species. This is 113 % higher than those observed by Arances et al. (2004) in the montane forest of Mt Malindang Range. The higher species richness in this vegetation type might be due to the intact forest and to the more diverse habitats.

The typical mossy forest with 246 species contains more endemic and rare species. The lower species richness in the dipterocarp forest compared to the montane forest despite the numerous sampling plots (14 plots) may be attributed to the small plot size which is less than the standard set for this type of forest (Fig. 1). It could also be attributed to the exploitation of forest resources as source of livelihood. The presence of tall trees with bigger diam at breast height may also limit the growth of smaller plants.

Species diversity index

The highest diversity value for trees could be observed in the montane forest with H = 1.70, followed by the dipterocarp forest (H = 1.63). The mossy-pygmy forest is less diverse, with H = 1.32 and the lowest diversity value was observed in the mossy forest with H = 1.27.

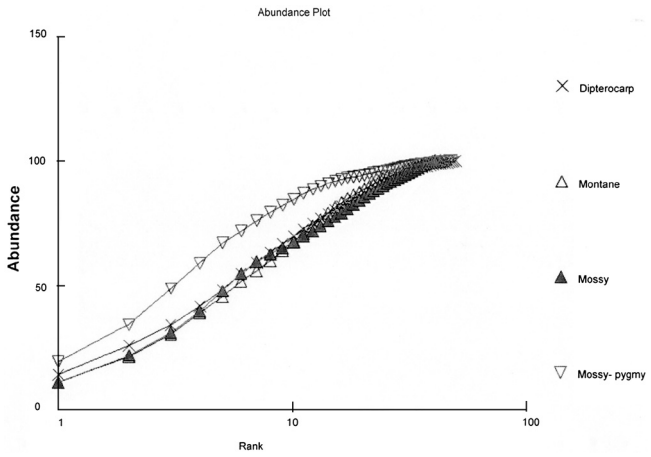

Fig. 1 Species accumulation curve in four vegetation types.

Table 3 Species composition of trees in the different vegetation types of Mt Hamiguitan Wildlife Sanctuary.
* trees with less than 10 cm dbh were also counted.

Vegetation type	Average number of trees				
	Species	Individuals	Density	Dominance	Frequency
Dipterocarp	12.71	63.71	0.14	0.027	6.06
Montane	27.17	84.17	0.21	0.041	9.278
Typical mossy	14.50	53.57	0.13	0.035	7.38
Mossy – Pygmy*	24.00	1560.50	0.39	0.26	13.61

Species Importance Value (SIV)

Inventory of trees within the thirty-two 20 × 20 m sampling plots revealed a total of 184 species of trees and 1 762 individuals with an average of 20 species and 67 individuals. Average numbers per plot are given in Table 3, and the most important species are listed in Table 4.

In the dipterocarp forest, an average of 64 individuals of trees was observed in all sampling plots. *Lithocarpus llanosii* Rehder has the highest species importance value, followed by *Shorea astylosa* Foxw. and *Zanthoxylum diabolicum* Elmer (*Rutaceae*). These tree species with the highest species importance values differ from those recorded in Mt Malindang where *Cyathea brevipes* Copel. (*Cyatheaceae*) ranked first with 79 %, followed by *Lithocarpus philippinense* (A.DC.) Rehder (Arances et al. 2004). *Lithocarpus* and *Shorea* are also dominant in the dipterocarp forest of Mt Apo (Heaney & Regalado 1998).

Table 4 Summary of top five species of trees in the different vegetation types with their species importance value (SIV) and ranks.

Vegetation types / species of trees	Local name	SIV (%)
Dipterocarp forest		
Lithocarpus llanosii (A.DC.) Rehder	Ulayan	50
Shorea astylosa Foxw.	Yakal	46
Zanthoxylum diabolicum Elmer	Badbad	43
Xanthostemon sp.	Magkuno	40
Calophyllum blancoi Planch. & Triana	Bitanghol	33
Montane forest		
Falcatifolium gruezoi de Laub.		37
Shorea polysperma (Blanco) Merr.	Tanguile	30
Agathis philippinensis Warb.	Almaciga	28
Syzygium sp.	Lumboy-lumboy	28
Calophyllum blancoi Planch. & Triana	Bitanghol	26
Typical mossy forest		
Gordonia subclavata Burkill		27
Unidentfied sp.	Tagokan	17
Agathis philippinensis Warb.	Almaciga	5
Osmoxylon simplicifolium (Elmer) Philipson		5
Aralia sp.		5
Mossy – Pygmy forest		
Tristaniopsis micrantha (Merr.) Peter G.Wilson & J.T.Waterh.		46
Leptospermum flavescens J.Sm.		44
Calophyllum blancoi Planch. & Triana	Bitanghol	37
Dacrydium elatum (Roxb.) Wall.	Cedar	32
Falcatifolium gruezoi de Laub.		29

Table 5 Endemism in the Philippines compared to Mt Hamiguitan Range. Based on specimens identified to species only.

Plant group	Total number and percentage of endemic species							
	Philippines		Mindanao		Malindang		Hamiguitan	
	Species	Endemism	Species	Endemism	Species	Endemism	Species	Endemism
Angiosperms	8 000+	3 200	No data	No data	450	107 (24 %)	365	153 (42 %)
Gymnosperms	33	6	No data	3	129	53 (41 %)	13	1 (8 %)
Fern and Fern allies	1 027	351	632	183	246	28 (11 %)	99	9 (9 %)
Total	9 060+	3 557	No data	No data	825	188 (23 %)	477	163 (37 %)

The montane forest had the highest average number of species per plot (27) and the highest number of individuals (84). This might be due to the relative absence of human activities and the environmental itself that favours growth of trees. *Calophyllum blancoi* (*Clusiaceae*) was observed in all vegetation types. Merrill (1926) reported that *C. blancoi* could be observed in the primary forest at low and medium altitude and is often abundant there. Two species were observed in both dipterocarp and montane forest, namely *Schefflera sp.* (*Araliaceae*) and *Shorea polysperma* (Blanco) Merr. with 29 % and 21 % SIV, respectively. *Falcatifolium gruezoi* de Laub. (*Podocarpaceae*) was observed both in the montane and mossy forest with 37 % and 29 % SIV. Only five species over 20 % SIV were observed in Mt Malindang, namely *Polyosma philippinensis* Merr. (*Saxifragaceae*), *Clethra lancifolia* Turcz. (*Clethraceae*), *Cyathea brevipes*, *Lithocarpus philippinensis* and *Pometia pinnata* J.R.Forst. & G.Forst. (*Sapindaceae*).

ASSESSMENT ON THE STATUS OF THE FLORA OF MT HAMIGUITAN RANGE

The Philippines is the home of 3 557 endemic species with 26 endemic genera of vascular plants. Of these, 3 200 species are angiosperms, 6 gymnosperms and 351 pteridophytes (ferns and fern allies) (Madulid 1991). In Mt Hamiguitan Range, we were able to identify 477 species to species level. A comparison of endemism is given in Table 5, a breakdown of the status of these species in taxonomic groups is presented in Table 6, and into vegetation types in Table 7. Of the species found in Mt Hamiguitan Range, 163 (37 %) are endemic to the Philippines which is equivalent to 5 % of the total number of endemic plants in the Philippines (Table 5). Thirty-five species (7 %) are threatened, 33 species (7 %) rare and 204 species (43 %) were assessed as economically important (Table 6). Of the 530 threatened species in the Philippines, 35 (7 %) were found in Mt Hamiguitan (Table 8)' The endemism of vascular plants in Mt Hamiguitan Range is higher compared to the Malindang Range where Arances et al. (2004) found only 23 % endemic species.

Table 6 Threatened, rare and economically important plants in Mt Hamiguitan Range. Based on specimens identified to species only, Fern allies not distinguished in all cases. N = Number of species; T = Number of threatened species.

Plant group					Hamiguitan			
	Philippines		Malindang				Rare	Economic
	N	T	N	T	N	T	N	N
Angiosperms	8 000+	440	450	45	365	25	15	161
Gymnosperms	33	5	129	5	13	1	3	9
Ferns	1 027	68	246	4	88	6	13	28
Fern allies		17			11	3	2	6
Total	9 060+	530	825	54	477	35	33	204

Table 7 Assessment of the status of species of Phanerogams per vegetation type. Status of threatened species: CES = Critically endangered species; ES = Endangered species; V = Vulnerable; OTS = Other threatened species.

Conservation status		Vegetation types				
		Agro-ecosystem	Dipterocarp	Montane	Mossy	Mossy-Pygmy
Endemic		44	78	86	49	66
Threatened	CES	2	2	4	1	2
	ES	2	4	6	1	2
	V	9	14	10	8	5
	OTS	2	2			
Rare		3	16	23	23	22
Economically important species		98	114	105	65	75

Assessment of the endemicity of trees per vegetation type, based on the sampling plots, revealed that the mossy-pygmy forest possesses the highest number of endemic species having a value of 32 % (Table 7). This confirms the results of Arances et al. (2004) in Mt Malindang that as elevation increases there is also an increasing number of endemic plants.

The largest numbers of rare species were observed in the montane to the mossy-pygmy forest with 22–23 species in each type, which is equivalent to 67–70 % of the total rare species in Mt Hamiguitan Range. The smallest number of rare species was observed in the agro-ecosystem (Table 7). Economically important species occur in all vegetation types and are not particularly common in the agro-ecosystem.

Some of the rare and endemic plants observed are *Calamus merrillii* Becc., *C. ornatus var. philippinensis* Becc., *Nepenthes alata*, *N. argentii* Jebb & Cheek, *N. mira* Jebb & Cheek and *N. copelandii* Merr. The presence of the rare species such as *Gnetum latifolium* Blume (*Gnetaceae*), *Schizaea inopinata* Selling (*Schizaeaceae*), *S. malaccana* Hook., *Platycerium coronarium* (Konig ex Muell.) Desv. (*Polypodiaceae*), *Psilotum nudum* (L.) P.Beauv. (*Psilotaceae*) and *P. complanatum* Sw. are noteworthy (Fig. 2). However, there is a need to protect and conserve the habitat of *Nepenthes copelandii* in the montane, mossy and mossy-pygmy forests in San Isidro since this plant species is critically endangered, endemic and rare (Fig. 3). Mt Hamiguitan mountain range is the habitat of six species of pitcher plants which is 50 % of the total number of *Nepenthes* in the Philippines. It could also be noted that five species of *Shorea* were observed in the dipterocarp forest. While *Shorea*-species are common in other Asian countries (Ashton 1992), these dipterocarps are critically endangered, endemic and vulnerable in the Philippines.

Of the four species of *Schizaea* occurring in the Philippines, three have been found in Mt Hamiguitan Range, viz. *Schizaea dichotoma* (L.) J.Sm., *S. inopinata* and *S. malaccana.* The last two species are of equal botanical importance as these are new records in Mindanao and collected only once or twice in the Philippines (Table 9). *Schizaea inopinnata* was collected only once in Bohol in 1923 while *S. malaccana* was recently collected only in Mindoro and Sibuyan in 1993 (Barcelona et al. 1996).

Another important finding is the number of new records for the Philippines and for Mindanao (Table 10). Eight new records of plant species in Mindanao include *Elaeocarpus argenteus* Merr., *E. verticillatus* Elmer, *Patersonia lowii* Stapf (*Iridaceae*), *Astronia lagunensis* Merr. (*Melastomataceae*), *Nepenthes argentii, N. mira, Schizaea inopinata and S. malaccana. Nepenthes maxima* is a new record for the Philippines, until now being reported from Sulawesi, New Guinea and the Moluccas. Noteworthy is also the discovery of the endemic genus *Greeniopsis*

Table 8 Endangered, endemic and rare species of plants that must be given high priority for protection and conservation. Status: CES = Critically endangered; ES = Endangered; V = Vulnerable; OTS = Other threatened species, E = Endemic; R = rare. Vegetation types: A = Agro-ecosystem; D = Dipterocarp forest; M = Montane forest; Mo = Mossy forest; M-P = Mossy – Pygmy forest. Location: I = San Isidro; G = Gov. Generoso; M = Mati.

	Species	Family	Status	Vegetation types	Altitude (m asl)	Location
1	*Nepenthes copelandii* Merr.	*Nepenthaceae*	CES, E, R	M, Mo, M-P	1180	I
2	*Paphiopedilum adductum* Asher	*Orchidaceae*	CES, E	M, M-P	1146	I
3	*Rhododendron kochii* Stein	*Ericaceae*	CES, E	D, M	540–980	I
4	*Shorea astylosa* Foxw.	*Dipterocarpaceae*	CES, E	A, D, M	120–1060	I, M, G
5	*Shorea polysperma* (Blanco) Merr.	*Dipterocarpaceae*	CES, E	D	320–620	I, M, G
6	*Alocasia zebrina* C.Koch & Veitch	*Araceae*	ES, E	D	685	I
7	*Diospyros philippinensis* A.DC.	*Ebenaceae*	ES, E	A, D	240–820	I
8	*Medinilla magnifica* Lindl.	*Melastomataceae*	ES, E	D, M	420–980	I, M
9	*Nepenthes bellii* K.Kondo	*Nepenthaceae*	ES, S, R	M, M-P	980–1560	I
10	*Paphiopedilum ciliolare* (Rchb.f.) Stein	*Orchidaceae*	ES, E	M, Mo, M-P	905, 965, 1220	I
11	*Agalmyla persimilis* R.Br.	*Gesneriaceae*	V, E	A, D	380–860	I, M
12	*Aeschynanthus miniaceous* R.Br.	*Gesneriaceae*	V, E	A, D	380–740	I
13	*Cinnamomum mercadoi* S.Vidal	*Lauraceae*	V, E	M, Mo	920–1100	I
14	*Dendrobium sanderae* var. *surigaense* Quis.	*Orhidaceae*	V, E	M, Mo, M-P	920–1200	I
15	*Shorea contorta* S.Vidal	*Dipterocarpaceae*	V, E	A, D	360–740	I, M
16	*Shorea guiso* (Blanco) Blume	*Dipterocarpaceae*	V, E	A, D, M	240–820	I, M
17	*Shorea negrosensis* Foxw.	*Dipterocarpaceae*	V, E	A, D		I, M
18	*Mangifera altissima* Blanco	*Anacardiaceae*	V	A, D	120–540	I, M
19	*Myristica philippinensis* Lam.	*Myristicaceae*	OTS, E	A, M	320–640	I, M
20	*Calamus merrilii* Becc.	*Arecaceae*	R, E	D, M, Mo	140–1350	I, M
21	*Calamus ornatus* var. *philippinensis* Becc.	*Arecaceae*	R, E	D, M, Mo, M-P	170–1200	I, M, G
22	*Nepenthes argentii* Jebb & Cheek	*Nepenthaceae*	R, E	M, M-P	920–1145	I
23	*Nepenthes mira* Jebb & Cheek	*Nepenthaceae*	R, E	D, M, M-P	870–1200	I, M, G
24	*Agathis philippinensis* Warb.	*Araucariaceae*	E	D, M, Mo, M-P	905–1235	I, G, M
25	*Buchanania nitida* Engl.	*Anacardiaceae*	E	A, D, M, Mo, M-P	140–1200	I, M, G
26	*Dillenia philippinensis* Rolfe	*Dilleniaceae*	E	A, M	120, 1150–1200	I, M, G
27	*Medinilla cumingii* Vand.	*Melastomataceae*	E	D	540–820	I
28	*Medinilla malindangensis* Merr.	*Melastomataceae*	E	D	380	M
29	*Gnetum latifolium* Blume	*Gnetaceae*	R	M, M-P	920–1145	I, M
30	*Nepenthes maxima* Reinw. ex Nees	*Nepenthaceae*	R	M, Mo, M-P	1165	I
31	*Psilotum nudum* (L.) P.Beauv.	*Psilotaceae*	R	D, M, Mo, M-P	905–1200	I
32	*Schizaea inopinata* Selling	*Schizaeaceae*	R	D, M	280	G
33	*Schizaea malaccana* Hook.	*Schizaeaceae*	Rare	D	1095	I

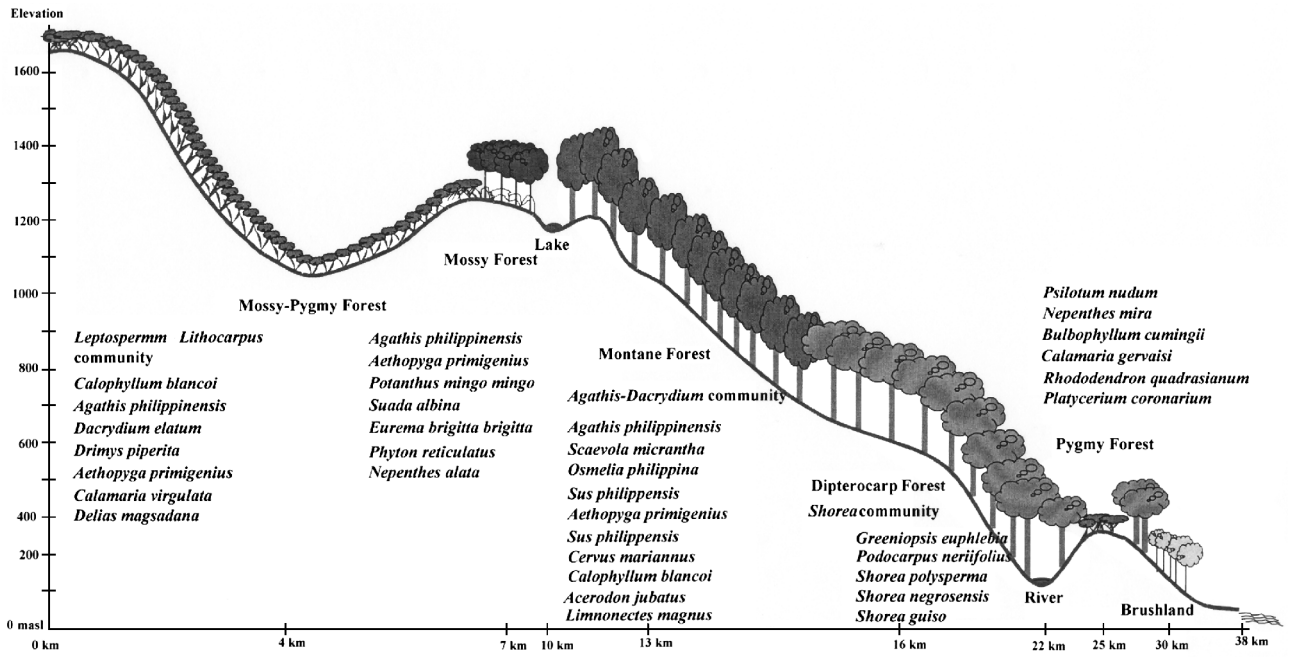

Fig. 2 Transect diagram of Mt Hamiguitan showing the altitudinal distribution of vegetation types, threatened, rare, endemic and economically important species from Hamiguitan Peak to Sitio Magum, Mati.

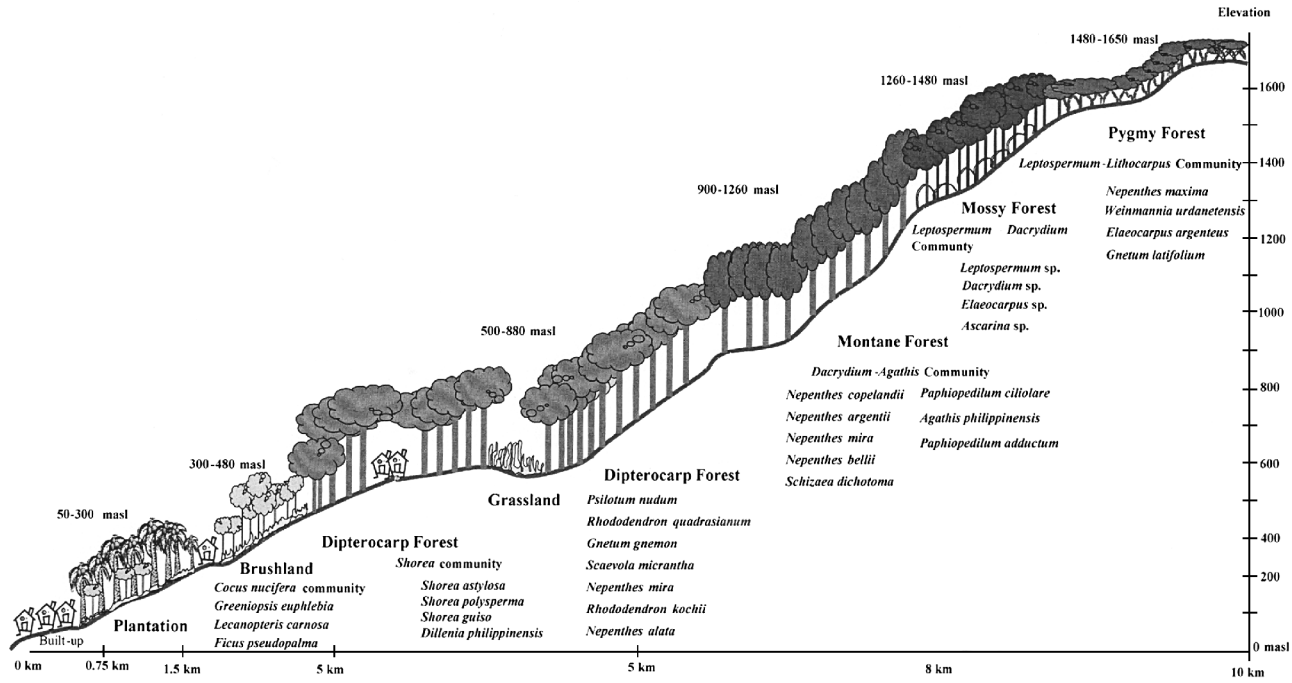

Fig. 3 Transect diagram of Mt. Hamiguitan showing the altitudinal distribution of vegetation types, threatened, rare, endemic and economically important species from Sitio Tumalite to Hamiguitan Peak.

(*Rubiaceae*). Of the six Philippine species of *Greeniopsis*, two species, *Greeniopsis euphlebia* Merr. and *G. megalantha* Merr. were found to be common in the area, from agro-ecosystem to mossy forest.

CONCLUSIONS

Mt Hamiguitan Range is the habitat of one new record in the Philippines and 8 new records for Mindanao and harbours some endemic, threatened, rare and economically important species of plants needing high priority for protection and conservation.

Density of threatened species is highest in the dipterocarp forest and decreases at higher elevation. Species richness was highest in the montane forest and lowest in typical mossy forest. Endemism increases from the dipterocarp to the montane forest but is lower in the mossy forest.

Table 9 Total number and percentage of endemic species of trees, averages of 6 sampling plots per vegetation type.

Vegetation type	Species	Endemic species
Dipterocarp forest	49	7 (14.29 %)
Montane forest	42	7 (16.67 %)
Mossy forest	46	11 (23.91 %)
Mossy – Pygmy forest	47	15 (31.91 %)

Table 10 New records of plants in the Philippines and in Mt Hamiguitan. * = earlier reported in Sulawesi, New Guinea and Moluccas; ** = 2nd collection since 1923.

		New record	
Family / species		Philippines	Mindanao
I	*Elaeocarpaceae*		
1	*Elaeocarpus argenteus* Merr.		/
2	*Elaeocarpus verticillatus* Elmer		/
II	*Iridaceae*		
3	*Patersonia lowii* Stapf.		/
III	*Melastomataceae*		
4	*Astronia lagunensis* Merr.		/
IV	*Nepenthaceae*		
5	*Nepenthes argentii* Jebb & Cheek		/
6	*Nepenthes maxima* Reinw. ex Nees	/*	
7	*Nepenthes mira* Jebb & Cheek		/
V	*Schizaeaceae*		
8	*Schizaea inopinata* Selling		/**
9	*Schizaea malaccana* Hook.		/
Total		1	8

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REFERENCES

Amoroso VB, Acma FM, Pava H. 1996. Diversity status and ecology of Pteridophytes in three forests in Mindanao. In: Canus JM, Johns RJ (eds), Pteridology in perspective: 53–60. Royal Botanical Garden, Kew.

Arances JB, Amoroso VB, Gruezo WS, Ridsdale CE, Visser L, Tan BC, Rufila LV, Galvezo JB, Opiso GS, Comilap R, Pacut N, Montimar B, Sacul S. 2004. Development of a participatory methodology for inventory and assessment of floral resources and their characterization in the Montane Forest of Mt Malindang. SEAMEO SEARCA. College Laguna. PDM Press, Quezon City, Philippines.

Ashton PS. 1982. Dipterocarpaceae. Flora Malesiana, Ser. I, Vol. 9: 237–552.

Barcelona JF, Hernandez BF, Price MG. 1996. Philippine Schizaea. Asia Life Sciences.

Berg CC, Corner EJH. 2005. Moraceae (Ficus). Flora Malesiana, Ser. I, Vol. 17 / 2.

Brower JE, Zar JH. 1977. Field and laboratory methods for general ecology. Wm. C. Brown, Dubuque, Iowa.

Brummitt RK. 1992. Vascular plant families and genera. Royal Botanic Gardens, Kew.

Cootes J. 2001. The orchids of the Philippines. Times Editions, Singapore.

De Wilde WJJO. 2000. Myristicaceae. Flora Malesiana, Ser. I, Vol. 14.

DENR Administrative Order No. 2007-01. Establishing the national list of threatened Philippine plants and their categories, and the list of other wildlife species. Department of Environment and Natural Resources, Visayas Avenue, Diliman, Quezon City.

Heaney LR, Regalado Jr JC. 1998. Vanishing treasure of the Philippine rainforest. The Field Museum, Chicago, Illinois.

Hovenkamp PH et al. 1998. Polypodiaceae. Flora Malesiana, Ser. II, Vol. 3: 1–234.

Huang TC (ed). 1996. Flora of Taiwan. 2nd ed., Vol. 2. Angiospermae. Editorial Committee of the Flora of Taiwan, Taipei, Taiwan.

Huang TC. 1997. Daphniphyllaceae. Flora Malesiana. Ser. I, Vol. 13: 145–168.

Jebb M, Cheek M. 2001. Nepenthaceae. Flora Malesiana, Ser. I, Vol. 15: 1–157.

Madulid DA. 1991. The endemic genera of flowering plants in the Philippines. Acta Manillana 39: 47–58.

Madulid DA. 1995. A pictorial cyclopedia of Philippine ornamental plants. Bookmark, Inc.

Merrill ED. 1923–1926. An enumeration of Philippine flowering plants. Volumes I–IV. Bureau of Printing, Manila.

Middleton DJ. 2007. Apocynaceae (subfamilies Rauvolfioideae & Apocynaceae). Flora Malesiana, Ser. I, Vol. 18.

Nooteboom HP. 1998. Davalliaceae. Flora Malesiana, Ser. II, Vol. 3: 235–276.

Rödl-Linder G. 1987. Monograph of the fern genus Goniophlebium (Polypodiaceae). Blumea 34: 283–328.

Rojo JP. 1999. Revised lexicon of Philippine trees. Forest Products Research and Development Institute, Department of Science and Technology. College, Laguna 4031, Philippines.

Tan BC, Fernando ES, Rojo JP. 1996. An updated list of endangered Philippine plants. Yushania 3, 2: 1–5.

Zamora PM, Co L. 1986. Guide to Philippine flora and fauna, Vol. IV. Goodwill, Quezon City.