

Occurrence of Threatened, Endemic, and Economic Seed Plants in Selected Mountains in Mindanao, Philippines

*Hannah P. Lumista^{1,2,3}, Reggie Y. Dela Cruz^{1,2,3}, Florfe M. Acma,^{1,2,3}
& Victor B. Amoroso^{1,2,3}*

¹Department of Environmental Science, College of Forestry and Environmental Science,
Central Mindanao University

²University Museum, Central Mindanao University, Musuan, Bukidnon

³Center for Biodiversity Research and Extension in Mindanao (CEBREM), CMU,
Musuan, Bukidnon, Philippines

ABSTRACT

Philippines is one of the biodiversity hotspots of the world, being home to most of the endangered species. It is important to give utmost attention to these plant taxa considered threatened, endemic, and economically important. The primary concern of this study to provide data on the occurrence and distribution of the threatened seed plants in Mindanao. Determination of these seed plants was based mainly on existing literature. Likewise, field observations were done in selected mountains in Mindanao to validate the occurrence and conservation status of these plants listed in the Philippine database. A total of 190 species of threatened seed plants were reported from Mindanao comprising 180 angiosperm species and ten gymnosperm species. More than half (133 species) of these threatened plants are endemic to the Philippines; 46 are placed in the critically endangered category, 69 endangered and 67 vulnerable. The families Orchidaceae and Dipterocarpaceae contained the highest number of threatened species. The family Melastomataceae is distinctly noted to have species which are all endangered and endemic to the country. The highest occurrence of threatened seed plants was observed in Mt. Malindang, Misamis Occidental. It is concluded that Mindanao houses some threatened, endemic, and economic seed plants.

Keywords: *seed plants, endemic, endangered, vulnerable*

ARTICLE HISTORY

Received for Review: July 10, 2016

Accepted for Publication: November 4, 2016

INTRODUCTION

The Philippines is known for its high endemism for plants and other life forms due to its geographical location, archipelagic formation abundant rainforests, long geologic history, long period of isolation, and varied landforms. Its flora is unique with species-level endemism exceeding 60 percent (Delos Angeles & Buot, 2012). Considering a total 16, 223 species of wild flora in the Philippines (Philippine Clearing House Mechanism for Biodiversity, 2009), the number of endemic species is indeed great. Among these floras are the vascular seed plants composed of angiosperms and gymnosperms.

These plant groups dominate in plant kingdom consisting of various habits such as herbs, vines, shrubs, and trees. Madulid (1991) reported that of the 8,000 species of flowering plants, about 3,500 species and 26 genera are endemic to the country. An assessment of the conservation status of threatened plants of the Philippines by Fernando et al. (2008) includes 472 angiosperms, ten gymnosperms, 202 pteridophytes and two bryophytes (mosses). Up to 75.5% of all the taxa listed are endemic to the Philippines

On the contrary, the country is also one of the biodiversity hotspots worldwide (Myers et al., 2000). It is among the most seriously depleted tropical countries with only 3% of the land area still covered by primary forest. It has the most endangered species and habitats due to threats like deforestation, agricultural intensification, unwise exploitation of floral resources and climate change. This scenario will effect to biodiversity crisis which consequently leads to the loss of endemic species before they are even recorded, studied and conserved. It is, therefore, the primary concern of this study to provide data on the occurrence and distribution of the threatened vascular seed plants in Mindanao for the conservation of these floral resources.

METHODOLOGY

Assessment of the status of plants was based on secondary data. The articles of Fernando et al. (2008) entitled "Threatened Plants of the Philippines" and Department of Environment and Natural Resources-Protected Areas and Wildlife Bureau (2006) entitled "Framework for Philippine Plant Conservation Strategy and Action Plan" were used as the main references for assessment of threatened plants specifically to the status critically endangered, endangered, or vulnerable. Further, reports from Madulid (1991); Cootes (2001); Rojo (1999) and Tan et al. (1986) serve as bases to classify the endemic and economically important plant. Further, field observations were done to validate the occurrence, and conservation status of these plants.

Entry protocol was secured in the different forests in Mindanao from June 2010 to May 2013 compliance with R. A. 9147 otherwise known as the "Philippine Wildlife Conservation and Protection Act", to conduct field sampling at Mt Hamiguitan in Davao Oriental, Mt, Apo in North Cotabato, Mt. Kitanglad in Bukidnon, Mt. Malindang in Misamis Occidental, Mt Salumay in Davao, Mt. Kiamo in Bukidnon and Bislig Experimental Forest in Surigao del Sur (Fig. 1).

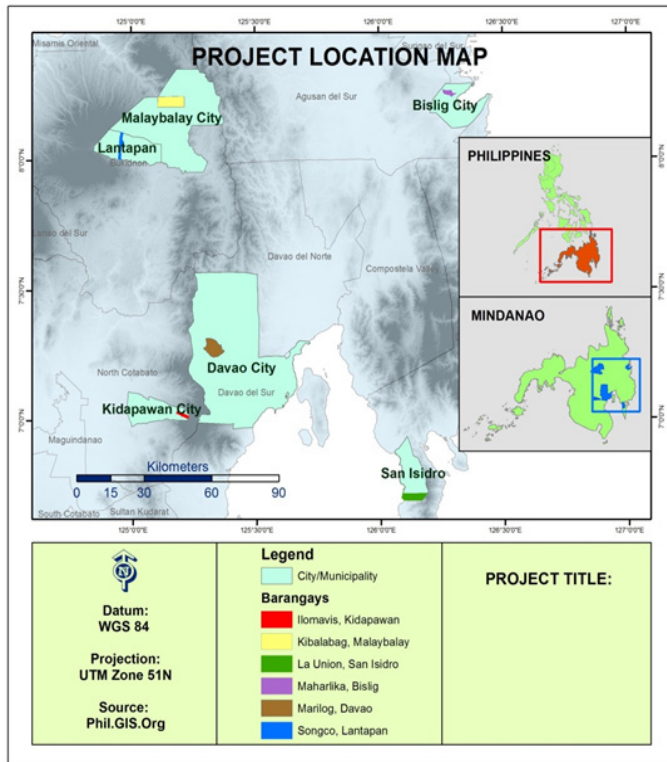


Figure 1. Map of Mindanao, Philippines Showing Study Sites for the Actual Field Sampling

Field sampling was done by transect walk following through established trails of the different mountains with the assistance of local people from respective sites. Representative plant samples of threatened, endemic and economic species were collected and were placed in plastic bags for the classification, identification, and description as well as for herbarium purposes. In each plant collected the following

data were recorded: date and place of collection, collection number, habitat, altitude, coordinates collector(s), and notes on flower color and other reproductive organs.

The collected plants were identified using taxonomic keys from floras and monographs of Merrill (1923-1926); Hsieh et al. (1996); Cheek and Jebb (2001); Cootes (2001); Rojo (1999); Tan, Fernando, & Rojo (1986); Zamora and Co (1986); and Gruezo (1990). Available type images and herbarium specimens deposited at the Philippine National Herbarium (PNH), U.P. Diliman (PUH) and Los Baños (CAHUP) were also used to identify the specimens collected from the field.

The collected and identified specimens were databased using the program BRAHMS (Botanical Resources and Herbarium Management Systems). Data of specimens of threatened, endemic, and economic species deposited at the different herbaria such as those found in the Philippine National Herbarium (PNH), Herbarium of the University of the Philippines Los Baños (CAHUP), Herbarium of the University of the Philippines Diliman (PUH) and the Central Mindanao University Herbarium (CMUH) were also data based. Photographs were taken from suitable materials and natural habitats. Likewise, close up photographs of some plant parts were also done.

RESULTS AND DISCUSSION

Classification and Identification of Mindanao Threatened Plants

A total of 190 species of seed plants in Mindanao is reported to be placed in the threatened category (Table 1). These threatened species are classified in 41 families and two plant groups. The angiosperms or flowering plants had the highest number of threatened species which is 178 and placed in 37 families. There are 0 ten threatened gymnosperms species which are placed in 4 families. The angiosperms contained a higher number of threatened species than the gymnosperms which can be explained because angiosperm species are more numerous than gymnosperms in terms of species.

Table 1.

Number of Families and Species of Mindanao Threatened Seed Plants by Plant Groups

Plant Group	No. of Families	No. of Species
Gymnosperm	4	10
Angiosperm	37	178
Total	41	190

The result of the present study is only 39 % of the 489 species of seed plants reported in the preliminary assessment of threatened plants throughout the Philippines by Fernando et al. (2008). It is almost half (47%) of the 401 species throughout the Philippines in the study done by Amoroso et al. (2012). Aribal and Buot (2009) reported 168 species of threatened species in the Mindanao regions. These plants belong to 97 genera and 47 families. However, the present study has a higher number (190) of threatened species.

More than half (133) of these threatened plants are endemic species (Table 2) which means that these species are confined to the Philippines only and nowhere else. Among the threatened species, sixty-seven (67) are vulnerable which includes 66 angiosperms, and one gymnosperm. Sixty-nine (69) are endangered in status. This includes 61 angiosperms and eight gymnosperms. Forty-six (46) species in Mindanao have recorded to have critically endangered status and all of which are angiosperms.

Table 2.
Summary of Threatened Seed Plants in Mindanao

Plant Group	CR*	EN*	VU*	ECS
Gymnosperm	0	8	1	3
Angiosperm	46	61	66	130
Total	46	69	67	133

*based on Fernando et al. (2008)

CR – Critically Endangered
EN – Endangered

VU - Vulnerable
ECS – Endemic species

The threatened plants vary in habit which ranged from being herbaceous plants (e.g. Alocasia, orchids, pitcher plants) to vines (e.g. Agalmyla) to hardwood premium trees like molave (Vitex), and the species of Dipterocarpaceae. The list of the Mindanao threatened seed plants reveal that families Orchidaceae and Dipterocarpaceae contain the highest number of threatened species. The former family is composed of highly-priced beautiful ornamental plants while the latter family is the source of premium hardwood which are attractive targets for loggers. Further, all the threatened species of family Melastomataceae have been noted to be all endangered and all endemic to our country.

Distribution of the Threatened Plants

Based on existing literature, a total of 14 mountains in Mindanao house these threatened plants (Table 3). The majority of the plants are found in Mt. Malindang (21), Mt. Hamiguitan (19) and Mt. Apo (17).

Table 3.

Number and Occurrence of Threatened Seed Plants in Mindanao by Mountains based on Literature

Mountains	Province	Plant Groups		Total
		Angiosperms	Gymnosperms	
Mt. Malindang	Misamis Occidental	19	2	21
Mt. Hamiguitan	Davao	15	4	19
Mt. Apo	Davao	17	0	17
Mt. Kitanglad	Bukidnon	5	3	8
Mt. Bato-Bato	Surigao del Sur	7	0	7
Mt. Urdaneta	Agusan del Norte	6	0	6
Mt. Kiamo	Bukidnon	3	0	3
Mt. Hilong-hilong	Agusan del Norte	3	0	3
Mt. Kampalili	Davao	2	0	2
Mt. McKinley	Davao	1	0	1
Mt. Kabatuan	Surigao	1	0	1
Mt. Hibok-hibok	Camiguin	1	0	1
Mt. Catmon	Misamis	0	1	1
Camp Keithly	Davao	1	0	1

Most of the threatened species of vascular seed plants were distributed in the province of Surigao (33), followed by Agusan (31) and Davao (28) (Table 4). Some of the data on distribution, however, were not specified as to mountains or province (27).

Table 4.
Number and Occurrence of Threatened Seed Plants in Mindanao by Province based on Literature

Island/Province	Plant Groups		Total
	Angiosperms	Gymnosperms	
Surigao	32	1	33
Agusan	30	1	31
Davao	27	1	28
Mindanao (unspecified)	26	1	27
Zamboanga	22	0	22
Basilan	14	1	15
Lanao	14	0	14
Bukidnon	11	0	11
Cotabato	11	0	11
Misamis	10	0	10
Sulu	3	0	3
Camiguin	2	0	2
Jolo	2	0	2
Tawi-Tawi	1	0	1

The following were some plants observed in the field: *Alocasia sanderiana* W. Bull., *Alocasia zebrina* Schott ex Van Houtte, *Shorea polysperma* (Blanco) Merr., *Rhododendron kochii* Stein, *Agalmyla persimilis* Hilliard and B.L. Burt, *Medinilla surigaoensis* Regalado, *Nepenthes copelandii* Merrill ex. Macfarl, *Nepenthes peltata* Sh. Kurata and *Paphiopedilum adductum* Asher (Plate 1).

Table 5 shows the number of threatened species and its occurrence in the different provinces of Mindanao which are validated through actual fieldworks. It revealed that most of the threatened vascular seed plants were observed in the province of Davao (24) with the 22 angiosperm species recorded and two gymnosperm species. This is followed by Bukidnon province having 19 threatened plants recorded having 15 angiosperms and four gymnosperms.

Table 5.

Number and Occurrence of Threatened Seed Plants in Mindanao by Province based on Actual Field Observation

Island/Province	Plant Groups		Total
	Angiosperms	Gymnosperms	
Agusan	0	1	1
Bukidnon	4	15	19
Camiguin	0	2	2
Davao	2	22	24
Misamis Oriental	0	1	1
North Cotabato	1	1	2
Surigao	0	4	4

CONCLUSIONS

A total of 190 species of threatened vascular plants were reported from Mindanao comprising 180 angiosperm species and 0 ten gymnosperm species. More than half (133 species) of these threatened plants are endemic to the Philippines; 46 are placed in the critically endangered category, 69 endangered and 67 vulnerable. The threatened vascular seed plants were observed in the different mountains of Mindanao with Mt. Malindang (Misamis Occidental) having the highest threatened species followed by Mt. Hamiguitan (Davao Oriental) and Mt. Apo (North Cotabato). Economically important families Orchidaceae and Dipterocarpaceae have the highest number of threatened species. Family Orchidaceae has species which are highly-priced ornamentals while family Dipterocarpaceae are composed of premium wood which are attractive targets for loggers. This would imply that man's activities pose a real threat to the status of our floral resources. Further, the family Melastomataceae have been noted to be all endangered and all endemic to our country. Melastomataceae have high aesthetic value, and some species have edible flowers thus prone to overharvesting.

RECOMMENDATIONS

It is recommended that nurseries be established for each protected area to raise the wildings of the threatened and endemic species for mass propagation. Likewise, regulation on the collection of the highly-priced ornamentals (Orchidaceae and Melastomataceae) and high-premium wood (Dipterocarpaceae) must strictly be implemented.

REFERENCES

- Amoroso, V.B., Acma, F.M., Lumista, H.P., Amoroso, C.B., Lubos, L.C., Alava, C.G. & Coritico, F.P. (2012). *Threatened and endemic Philippine vascular plants*. Bukidnon, Philippines: Central Mindanao University.
- Aribal, L. & Buot, I. (2009). The threatened plant species in various regions in Mindanao Island, Philippines. *Journal of Nature Studies*, 8 (2), 23-3.
- Cheek, M., & Jebb, M. (2001). *Nepenthaceae*. *Flora Malesiana* 1 (Vol. 15). Leiden, NL: National Herbarium Nederland.
- Cootes, J. (2001). *The orchids of the Philippines*. USA: Timber Press.
- Delos Angeles, M., & Buot, I. (2012). Orders and families of Philippine Pteridophytes. *Journal of Nature Studies*, 11(1 & 2), 19-33.
- Department of Environment and Natural Resources-Protected Areas and Wildlife Bureau (DENR-PAWB). (2006). *Framework for Philippine plant conservation strategy and action plan*. Retrieved from http://www.chm.ph/index.php?option=com_docman&task=doc_details&gid=164&Itemid=74
- Fernando, S. E., Lagunzad, A. D., Gruezo, S. W., Barcelona, F. J., Madulid, A. D., Lapis, & Zamora, M. P. (2008). Threatened plants of the Philippines: A preliminary assessment. *The Asian International Journal of Life Sciences*, 3, 1-52.
- Hsieh, C.H., Huang, T.C., Keng, H., Shieh, W.C., Tsai, J.L., Hu, J.M., & Yang, S.Y. (Eds.). (1996). *Flora of Taiwan* (2nd ed.). *Angiospermae* (2).
- Gruezo, W. (1990). Endangered plants of the Philippines. *Life Today*, 46(8), 16-18.
- Madulid, D.A. (1991). The endemic genera of flowering plants in the Philippines. *Acta Manila*, 39, 47-58.
- Merrill, E.D. (Ed.). (1923- 1926). *An Enumeration of Philippine Flowering Plants*. Manila, Philippines: Bureau of Printing.
- Myers, N., Mittermeier, R.A., Mittermeier, C. G., De Fonseca, G.A.B., & Kent, J. (2000). Biodiversity hotspots for conservation priorities. *Nature*, 403, 853-858. doi: 10.1038/35002501
- Philippine Clearing House Mechanism for Biodiversity (PCHB). (2009). *Philippine plant conservation strategy and action plan*. Retrieved from http://www.chm.ph/index.php?option=com_content&view=article&id=52&Itemid=87
- Rojo, J. P. (1999). *Revised lexicon of Philippine trees*. Laguna, Philippines: Forest Products Research and Development Institute of Science and Technology.
- Tan, B., Fernando, E.A., & Rojo, J. (1986). An updated list of Endangered Philippine Plants. *Yushania*, 3(2), 1-5.
- Zamora, P.M., & Co., L. (1986). *Guide to Philippine flora and fauna*. Philippines: Natural Resources Management Center and University of the Philippines.



Alocasia sandariana W. Bull.

Alocasia zebrina
Schott ex Van Houtte

Shorea polysperma
(Blanco) Merr.



Rhododendron kochii Stein

Agalmyla persimilis
Hilliard & Burtt

Medinilla surigaoensis
Regalado



Nepenthes copelandii Merill ex.
Macfarl

Nepenthes peltata Sh.
Kurata

Paphiopedilum adductum
Asher

Plate 1. Threatened Seed Plants Observed in the Field



Alocasia zebrina Schott ex Van Houtte



Alocasia sandariana W. Bull.



Nepenthes truncata Macfarlane



Paphiopedilum hennisianum (M. W. Wood) Fowlie



Paphiopedilum adductum Asher

Plate 2. Threatened Vascular Plants (angiosperms) Cultivated in the CMU Fernery



Radermachera coriacea Merr.



Shorea almon Foxw.



Shorea polysperma (Blanco) Merr.



Cinnamomum mercadoi Vidal



Medinilla magnifica Lindl.



Xanthostemon speciosus Merr

Plate 3. Threatened Vascular Plants (angiosperms) Cultivated in the MMZBG