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Research Article

Species Richness and Endemism of Zingiberaceae in Cinchona Forest Reserve, Lantapan, Bukidnon, Philippines

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ABSTRACT

This study was carried out to provide information on species richness and endemism of Zingiberaceae in Cinchona Forest Reserve, Kaatuan, Lantapan, Bukidnon, Philippines. Transect walks, opportunistic sampling and collection within the sampling quadrats were conducted along established forest trails to collect ginger species. A total of 11 species of Zingiberaceae were documented belonging to two subfamilies (Alpinioideae and Zingiberoideae) and three tribes (Alpinieae, Hedychieae, and Zingibereae). The species recorded include *Adelmeria alpina* Elmer, *Alpinia haenkei* C.Presl, *A. rufa* C.Presl, *Etlingera fimbriobracteata* (K.Schum.) R.M.Sm., *E. pubimarginata* (Elmer) A.D.Poulsen, *Hedychium philippinense* K.Schum., *Hornstedtia conoidea* Ridl., *H. lophophora* Ridl., *Meistera muricarpa* (Elmer) Škorničk. & M.F.Newman, *Zingiber banahaoense* Mood & Theilade, and *Zingiber* sp. Of these, *H. philippinense* is the only threatened species recorded. All species are endemic to the Philippines except for *E. fimbriobracteata* which is native to Borneo and *Zingiber* sp. which is unidentified to the species level. These species represent 41% of the total genera and 9% of the total species of Zingiberaceae in the Philippines. The high endemicity (82%) in the total collected species in this study and the presence of a threatened species in this area calls for protection and conservation by the stakeholders.

Keywords: Etlingera pubimarginata, Gingers, Key Biodiversity Area, Hedychium philippinense, Philippine endemic

Introduction

Zingiberaceae is a monocot family and the largest among the 8 families in order Zingiberales. This family consists of at least 1,500 species which are distributed in 53 genera [1]. In the Philippines, Zingiberaceae has 17 genera and more than 100 species [2]. Members of this family serve as a significant natural resource that offers useful products, such as for food, spices and condiments, medicines, dyes, perfumes, and aesthetics to man [3]. Recently, several new species of Zingiberaceae [4, 5, 6, 7] and species which are new records to the Philippines and holds new locality records in the country [7, 8, 9, 10] have been described and reported.

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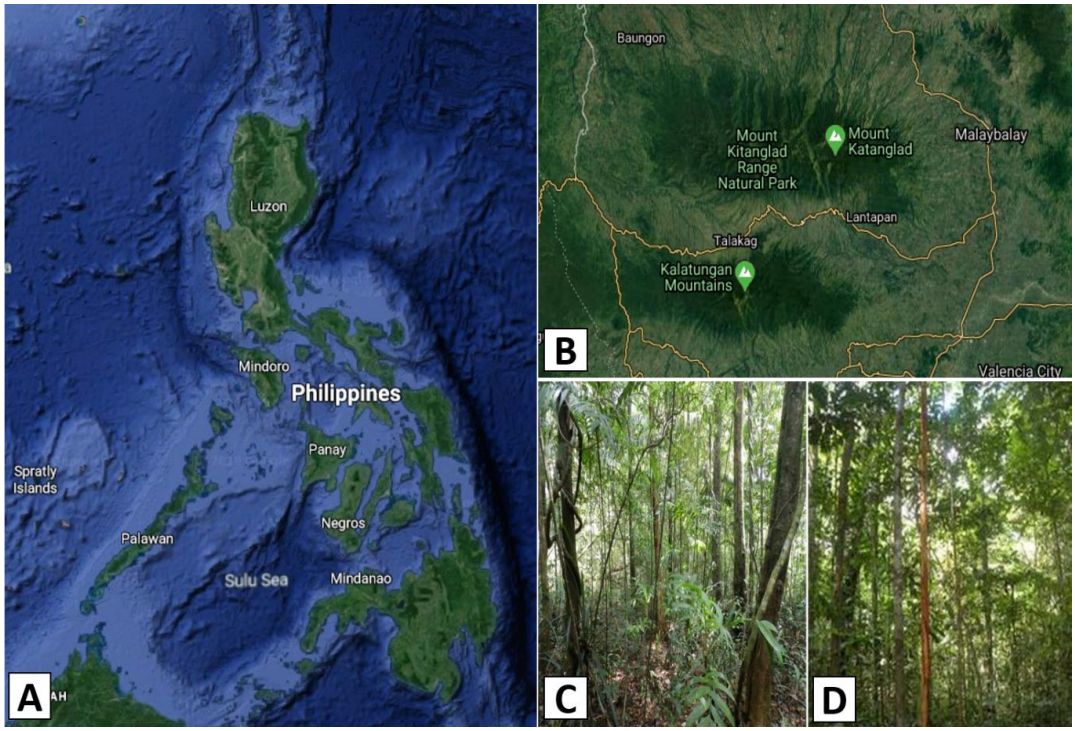

Figure 1. Study site. A) Map of the Philippines, B) Map of Bukidnon showing the location of the municipality of Lantapan, C and D) study areas where the plot sampling method was employed. A and B – © google map.

Zingiberaceae in the Philippines are mostly collected in Luzon Island, with the Visayas and Mindanao Islands ranking second and third, respectively [11]. The classification of Zingiberaceae continues to be refined [12, 13] and new taxa are still being discovered and described. Published reports on floristic studies of Philippine Zingiberaceae were recently conducted by Naive [14] at Mt. Nabukalan, Kalatungan Mountain Range in Bukidnon and Acero *et al*. [15] at the expansion site of Mt. Hamiguitan Range Wildlife Sanctuary (MHRWS) in Davao Oriental.

Cinchona Forest Reserve in Kaatuan, Lantapan, Bukidnon is located at the foot of Mt. Kitanglad Range Natural Park (MKRNP). It is home to the Cinchona Plantation established at Barangay Kaatuan and said to be the only one of its kind left in Asia and the Pacific. This present study was undertaken in Cinchona Forest Reserve to provide information on species richness and endemism of Zingiberaceae species.

Material and Methods

Entry protocol

Prior Informed Consent (PIC) was secured from the local government unit (LGU), tribal leaders, and municipal mayor of the study site. The acquired consent, letter of recommendation, and the approved proposal were submitted to the Department of Environment and Natural Resources (DENR) to secure the Gratuitous Permit (GP) and Transport Permit (TP) as mandated in RA 9147 section 14 and section 15. The GP of ABM was used in this study.

Selection of study site

Floristic inventory of Zingiberaceae was carried out within the Cinchona Forest Reserve (Figure 1). Cinchona Forest Reserve is the area where the established 2-ha permanent plot of the Long Term Ecological Research (LTER) Site in Mt. Kitanglad is located. The sampling station is a rich plot due to its physical features, where sunlight is also humid allowing plants to spread more. The area has sufficient humidity to sustain developing and arboreal plants in its habitat.

Establishment of sampling techniques

Plot sampling was done through establishing three 20 × 20 m plots. Each plot was bordered with lines making it near from each other. Meanwhile, transect walks were done in the established forest

Table 1. Subfamilies, tribes and genera of the collected Zingiberaceae species

No.	Subfamily	Tribe	Genus	No. of Species
1.	Alpinioideae	Alpinieae	*Adelmeria*	1
2.			*Alpinia*	2
3.			*Etlingera*	2
4.			*Hornstedtia*	2
5.			*Meistera*	1
6.	Zingiberoideae	Hedychieae	*Hedychium*	1
7.		Zingibereae	*Zingiber*	2
		Total		11

trails, while opportunistic sampling was done through searching and documenting of Zingiberaceae species outside the plot.

Subplot 10 is located at elevations ranging from 1,352–1,470 masl. The richness is visible to the quantity of plants' penetration which is normal, and is a quality forest. Subplot 20 is located at elevations of 1,476–1,489 masl. It is located just above the subplot 10. Unlike subplot 10, this subplot is dry and shady which results to excessive discrimination of sunlight particularly for the plants on the ground. The area hosts quite a number of plants compared to the other subplots. Meanwhile, subplot 40 which is located at elevations of 1,425–1,402 masl was positioned downhill. Compared to the other two subplots, this subplot is dried and has not enough humid.

Collection and processing of the specimens

Collection of specimens was done during daytime. Other data of the species were recorded in a field notebook. To keep track of the gathered data, labeling and documentation of the areas and collected specimens were done. The specimens were placed in labeled cellophane bags and brought to the camp for further processing. The specimens were prepared following the wet method and were cut to fit in the mounting sheets. The pickled collections of the reproductive parts were placed inside labeled plastic containers.

Identification of the specimens

The specimens were identified using field guides, monographs, and published articles (e.g. 15, 16, 1, 14, 8, 17). The specimens were morphologically described and compared with the specimens within the Philippines and neighboring countries.

Assessment of conservation status and endemism

The assessment of the conservation status was based from DAO 2017-11 [18], while endemism was based from Pelser *et al*. [2].

Results and Discussions

Species richness

This study collected 11 species of Zingiberaceae belonging to two subfamilies (Alpinioideae and Zingiberoideae), three tribes (Alpinieae, Hedychieae, and Zingibereae) and seven genera (Table 1). The species include *Adelmeria alpina* Elmer, *Alpinia haenkei* C.Presl, *A. rufa* C.Presl, *Etlingera fimbriobracteata* (K.Schum.) R.M.Sm., *E. pubimarginata* (Elmer) A.D.Poulsen, *Hedychium philippinense* K.Schum., *Hornstedtia conoidea* Ridl., *H. lophophora* Ridl., *Meistera muricarpa* (Elmer) Škorničk. & M.F.Newman, *Zingiber banahaoense* Mood & Theilade, and *Zingiber* sp. (Figure 2; Table 2). Further, these species represent 41% of the total genera and 9% of the total species of Zingiberaceae in the Philippines.

The *Alpinia*, *Etlingera*, *Hornstedtia* and *Zingiber* obtained two species per genus, while *Adelmeria*, *Meistera* and *Hedychium* with one species per genus. Although plot sampling method was added in addition to transect walk and opportunistic sampling which were done in the previous floristic studies on Philippine Zingiberaceae by Naive [14] and Acero et al. [17], the collected species in this study were still lower compared to the species collected by Naive [14] at Mt. Nabukalan, Kalatungan Mountain Range in Bukidnon and Acero *et al.* [17] at Mt. Hamiguitan in Davao Oriental with 12 species and 14 species, respectively. Phenology and the size of area might be the reasons for the low species richness in Cinchona Forest Reserve.

Table 2. Zingiberaceae species in Cinchona Forest Reserve. **A)** *Adelmeria alpina* Elmer, **B)** *Alpinia haenkei* C.Presl, **C)** *Alpinia rufa* C.Presl, **D)** *Etlingera fimbriobracteata* (K.Schum.) R.M.Sm., **E)** *Etlingera pubimarginata* (Elmer) A.D.Poulsen, **F)** *Hedychium philippinense* K.Schum., **G)** *Hornstedtia conoidea* Ridl., **H)** *Hornstedtia lophophora* Ridl., **I)** *Meistera muricarpa* (Elmer) Škorničk. & M.F.Newman, **J)** *Zingiber banahaoense* Mood & Theilade, and **K)** *Zingiber* sp. (Photos: A, C, I, J – *R.A. Mendez*; B, D, E, F, G, H – *N.P. Mendez*; K – *J.A.L.F. Jayme*)

Recent reports on the occurrence of these collected species include *A. alpina* which has been reported by Naive [14] growing mostly at high elevations between 1,700 to 2,100 masl in deeply shaded localities on upper montane to mossy forests with humid environment at Kalatungan Mountain Range, while *A. haenkei*, *A. rufa*, *H. conoidea* and *M. muricarpa* have been reported by Acero *et al.* [17] at Mt. Hamiguitan in Davao Oriental province. Further, *H. philippinense* was recently reported by Tobias *et al.* [9] from Kasibu, province of Nueva Vizcaya in northern Luzon and Mt. Malambo, Marilog District, Davao City in southern Mindanao and *E. fimbriobracteata* was also reported by Tobias *et al.* [9] at Marilog District in Davao City.

Table 2. Species richness of Zingiberaceae in Cinchona Forest Reserve

Species	Subplot			Transect Walk	Opportunistic Sampling
	10	20	40		
Adelmeria alpina Elmer	-	-	-	-	/
Alpinia haenkei C.Presl	-	-	-	-	/
Alpinia rufa C.Presl	-	-	-	-	/
Etlingera fimbriobracteata (K.Schum.) R.M.Sm.	-	-	-	-	/
Etlingera pubimarginata (Elmer) A.D.Poulsen	-	-	-	-	/
Hornstedtia conoidea Ridl.	-	-	-	/	-
Hornstedtia lophophora Ridl.	-	-	-	/	/
Meistera muricarpa (Elmer) Škorničk. & M.F.Newman	-	/	/	-	-
Hedychium philippinense K.Schum.	-	/	-	-	-
Zingiber banahaoense Mood & Theilade	/	-	-	-	-
Zingiber sp.	-	-	-	-	/

Table 3. Conservation Status and Endemism of Zingiberaceae in Cinchona Forest Reserve.

Species	Conservation Status [18]	Ecological Status
Adelmeria alpina Elmer	-	Philippine Endemic
Alpinia haenkei C.Presl	-	Philippine Endemic
Alpinia rufa C.Presl	-	Philippine Endemic
Etlingera fimbriobracteata (K.Schum.) R.M.Sm.	-	Native to Borneo
Etlingera pubimarginata (Elmer) A.D.Poulsen	-	Philippine Endemic
Hornstedtia conoidea Ridl.	-	Philippine Endemic
Hornstedtia lophophora Ridl.	-	Philippine Endemic
Meistera muricarpa (Elmer) Škorničk. & M.F.Newman	-	Philippine Endemic
Hedychium philippinense K.Schum.	Endangered	Philippine Endemic
Zingiber banahaoense Mood & Theilade	-	Philippine Endemic
Zingiber sp.	-	-

Previously, the Philippine Zingiberaceae has 14 genera until de Boer [19] transferred most of the species of Philippine *Amomum* Roxb. to *Meistera* Giseke and *Wurfbainia* Giseke and Docot et al. [6] reinstated the Philippine endemic genus *Adelmeria* Elmer, making 17 genera in total. This is because Larsen *et al*. [15] reported that Zingiberaceae are still in an active stage of evolution. Also, Te-Lin & Larsen [20] added that the relationships between several newly described species and genera are not yet fully understood. Thus, it is expected that several species of Zingiberaceae will be discovered and described in the Philippines as botanical expedition progresses.

Conservation status and endemism

Hedychium philippinense was the only threatened species collected in this study. The collected Zingiberaceae species revealed nine species (82%) endemic to the Philippines, one non-endemic species (9%) which is native to Borneo, and one species (9%) which is unidentified to the species level (Table 3).

Conclusion

This study revealed 11 species of Zingiberaceae found in Cinchona Forest Reserve. Of these, 9 species are endemic to the Philippines, 1 species is native to Borneo, and 1 species is unidentified to the species level. *H. philippinense* is the only threatened species recorded in this area. The collected species 41% of the total genera and 9% of the total ginger species of Zingiberaceae in the Philippines. Further, the high endemicity (82%) of ginger species in this area in the total collected species is also noteworthy and adds feature to Mt. Kitanglad to be declared as a UNESCO World Heritage Site in addition to being an ASEAN Heri-

tage Park. It is recommended to deeply appreciate the diversity and status of Zingiberaceae in Cinchona Forest Reserve for further investigations. Cinchona Forest Reserve must be preserved and protected, since it is expected that there are still several understudied vascular flora in the area.

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