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First report of tree species of Minalungao National Park, Nueva Ecija, Philippines

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Abstract

Minalungao National Park in Nueva Ecija, Central Luzon, Philippines is a protected Key Biodiversity Area and a priority for conservation studies. With its high level of biodiversity, sthis area offers vast opportunities in research especially in species identification and composition. Quadrats measuring 20 × 20 meters were laid out along ten (10) transect lines measuring 100 meters each with a total sampling area of 1200 m². Identification was done using morphological characters. A total of 55 species of trees were recorded from the study area belonging to 25 families and 46 genera, 22% of which are endemic. Four (4) species were listed in the updated 2017 list of threatened plants issued by the Department of Environment and Natural Resources (DENR)-Philippines. All members of the family Dipterocarpaceae, Lamiaceae and Burseraceae recorded from the area were listed in IUCN Red List. This paper presents an initial inventory of tree species that presents prospects for formulation of actions for its conservation.

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Introduction

The composition of isolated islands in the Philippines, the tropical location of the country, and the once extensive areas of rainforest have resulted in high species diversity and an exceptionally high level of endemism. Albeit a mega diverse country, it is also considered a biodiversity hotspottriggered by the destruction of the ecosystems with species becoming endangered at an alarming rate without being named. Given the situation of having a unique, though threatened, biodiversity, it is now one of top priority hotspots for global conservation (Allen, 2008). Hence, with the purpose of conservation of its biodiversity and natural resources, the government established protected areas such as national parks. One of such parks is the Minalungao National Park located at General Tinio in the province of Nueva Ecija, island of Luzon. This protected area covers more than 2000 hectares of lush greenery that gives shelter to a high level of diversity that remains unexplored wherein many inhabitant species are yet to be identified. Only a few groups of organisms inhabiting the national park were reported such as chiropterans (Judan Cruz and Pader, 2018), pteridophytes (Alfonso *et al*., 2018), gobiidae (Judan Cruz *et al*., in press) and macro fungi (Paraguas *et al*., 2014). This area offers vast opportunities in research especially in species identification and composition. With its obvious high level of biodiversity and given the imminent consequences of human activities, it is a priority area for conservation studies. Identification of inhabiting species presents prospects for formulation of actions for its conservation. This study generally assessed and offers the first report of tree species existing in the area. Despite its known distinctive biodiversity and efforts against deforestation, it is ironic that the Philippine tree species is considered the least known among the countries in southeast Asia (Soerianegara and Lemmens, 1994) and the country's vegetation is poorly represented in research with minimal progress (Langenberger, 2004). As a primarily threatened habitat, forests are seldom at the center of researches (Langenberger, 2004). Being a national park and a protected area, the vegetation of Minalungao Park is still intact. In spite of this, signs of forest cover destruction are apparent. Hence, an immediate analysis of its vegetation is of utmost importance.

Materials and methods

Collection of samples

Quadrats measuring 20 × 20 meters were laid out along the starting, middle and end point of each of the ten (10) transect lines measuring 100 meters each with a total sampling area of 1200 m^2. Samples for identification were collected inside every quadrat in each transect line. After the construction of the transect lines, the Global Positioning System (GPS) readings were taken.

Specimen preservation and identification

Collected specimens were tagged and labeled by the number of transect. After collection, the specimens were soaked in 70% ethanol for 5-10 mins to prevent bacterial contamination and to maintain the original size and form of the plant. After soaking, the plant samples were air dried for 5- 10 minutes and properly pressed using a field presser. Finally, it was mounted in a standard size bristol board and labeled accordingly. Identification was done using morphological characters at the Department of Biological Sciences, Central Luzon State University, Science City of Munoz, Nueva Ecija, Philippines.

Results and discussion

A total of 55 species of trees were recorded from the study area (Table 1) belonging to twenty-five (25) families and 46 genera. Scientific names and distribution records were based on Pelser *et al.* (2011). Local names were provided by the locals and from Salvosa (1963) but were not used for the identification.

Family Fabaceae recorded the highest number of species with 7 representative species followed by family Moraceae and Euphorbiaceae with 6 and 5 representative species, respectively. Ten (10) families were represented by a single species.

Table 1. List of identified tree species at Minalungao National Park, Nueva Ecija, Philippines.

Family	Scientific name	Local name	Distribution records
Anacardiaceae	*Buchanania arborescens* (Blume) Blume	Malamangga	Native
	Semecarpus cuneiformis Blanco	Ligas	Native
Apocynaceae	*Wrightia candollei* S.Vidal	Lanite	Endemic
Arecaceae	*Caryota cumingii* Lodd. exC.Mart.	Lulob	Endemic
Bombacaceae	*Bombax ceiba* L.	Malabulak	Native
	Ceiba pentandra (L.) Gaertn.	Malabulak	Native
Burseraceae	*Canarium luzonicum* (Blume) A.Gray	Pagsahingin	Endemic
Dipterocarpaceae	*Anisoptera thurifera* (Blanco) Blume	Palosapis	Endemic
	Dipterocarpus grandiflorus (Blanco) Blanco	Apitong	Native
	Shoreaho peifolia (Heim) Sym.	Yakal	Native
Ebenaceae	*Diospyros* cf. *nitida* Merr.	Katilma	Endemic
Euphorbiaceae	*Acalypha cardiophylla* Merr.	Malasapsap	Native
	Jatropha curcas L.	Tubang-bakod	Introduced
	Macaranga grandifolia (Blanco) Merr.	Takipasin	Endemic
	Macaranga tanarius (L.) Müll.Arg.	Bilunga	Native
	Melanolepis multiglandulosa (Reinw. ex Blume) Rchb. &Zoll.	Alim	Native
Fabaceae	*Albizia saman* (Jacq.) F. Muell.	Acacia	Introduced
	Caesalpinia pulcherrima (L.) Sw.	Caballero	Introduced
	Gliricidia sepium (Jacq.) Kunth ex Steud.	Madre de cacao	Introduced
	Koompassia excelsa (Becc.) Taub.	Manggis	Native
	Parkia timoriana (DC.) Merr.	Kupang	Native
	Piliostigma malabaricum (Roxb.) Benth.	Alibangbang	Native
	Tamarindus indica L.	Sampalok	Introduced
Lamiaceae	*Vitex parviflora* Juss.	Mulawin	Native
Lauraceae	*Dehaasiacairocan* (S.Vidal) C.K.Allen	Malakadios	Endemic
	Litseafulva (Blume) Fern.-Vill.	Malabayabas/ Limbahan	Native
	Litsea glutinosa (Lour.) C.B.Rob.	Puso-puso	Native
Lythraceae	*Lagerstroemia speciosa* (L.) Pers	Banaba	Native
Malvaceae	*Kleinhovia hospita* L.	Tan-ag	Native
	Pterospermum diversifolium Blume	Bayok	Native
Meliaceae	*Aglaia luzoniensis* (S.Vidal) Merr. & Rolfe	Kuling-manok	Native
	Dysoxylum arborescens (Blume) Miq.	Kalimutain	Native
	Dysoxylum excelsum Blume	Malasaresa	Native
	Sandoricum koetjape (Burm.f.) Merr.	Malasantol	Introduced
Moraceae	*Artocarpus blancoi* (Elmer.) Merr.	Antipolo	Endemic
	Broussonetia luzonica (Blanco) Bureau in DC.	Himbabao	Endemic
	Ficus balete Merr.	Balite	Endemic
	Ficus caulocarpa (Miq.) Miq.	Bubulung	Native
	Ficusgul Lauterb. & K. Schum.	Tibegnababae	Native
	Ficus nota (Blanco) Merr.	Tibeg	Endemic
Myrtaceae	*Syzygium cumini* (L.) Skeels	Duhat	Native
	Syzygium lineatum (DC.) Merr. &L.M.Perry	Lubeg	Native
Phyllanthaceae	*Antidesma bunius* (L.) Spreng.	Bignay	Native
	Antidesma montanum Blume	Bignay	Native
Primulaceae	*Ardisia elliptica* Thunb.	---	Native
	Ardisia sp.	---	---
	Discocalyx sp.	---	---
Rhamnaceae	*Colubrina asiatica* (L.) Brongn.	---	Native
	Ziziphus cumingiana Merr.	---	Native
Rubiaceae	*Ixora cumingiana* S.Vidal	---	Endemic
Rutaceae	*Micromelum minutum* (G.Forst.) Wight &Arn.	Aninapla	Native
Simaroubaceae	*Quassia amara L.*	---	Introduced
Solanaceae	*Solanum erianthum* D.Don	Malatalong	Introduced
Urticaceae	*Leucosyke capitellata* Wedd.	Alagasi	Native
Vitaceae	*Leea manillensis* Walp.	Nalite	Native

The forest of Minalungao National Park is considered as a molave forest (Whit ford, 1911) or a karst forest due the extensive limestone rock in the area. This habitat type is dominated by molave (*Vitex parviflora*) with other dominant vegetation including members of the family Fabaceae, Meliaceae, Malvaceae, Moraceae, Rhamnaceae, Sapindaceae, Sapotaceae, Apocynaceae, Myrtaceae, Lythraceae, Chrysobalanaceae, Ebenaceae and Euphorbiaceae (Whitford, 1911). Several species belonging to family Dipterocarpaceae were also documented to grow on karst habitat (Whit ford, 1911; Co *et al.*, 2006; Fernando *et al.*, 2009). With the exception of family Sapindaceae, Sapotaceae and Chrysobalanaceae, all the families Whit ford (1911) mentioned were represented by the samples collected. The higher number of species of Fabaceae and Moraceae recorded in this study is similar to the pattern observed by Galindon *et al.* (2018) in the karst landscape of quarry sites in Luzon and Mindanao. Species recorded by Galindon *et al.* (2018) which are also present in the study samples include the native species *V. parviflora*, P. *diversifolium* and *B. arborescens*, exotic species *A. saman* and *G. sepium*, and early successional native trees including *M. multiglandulosa* and *B. luzonica*. It should be noted that species belonging to the recorded families were not karst-habitat specialist since they are known to also exist in other habitat types with moister soils, rather their presence is influenced by the presence of the shade-tolerant dipterocarps which can out-compete them. On the other hand, dipterocarps requires a moister soil which limits them from growing in the dry, limestone habitats.

The dominance of family Dipterocarpaceae concerning number of species is well documented (Manokaran and Kochummen 1990; Sist and Saridan 1998; Slik*et al.,* 2003; Wilkie*et al.,* 2004; Langenberger *et al.*, 2006) in primary and secondary forests. On the other hand, the study of Alberto*et al.* (2015) in the Pantabangan-Carranglan Watershed showed that family Moraceae as the most represented tree family. According to Galindon *et al.* (2018), the proliferation of Fabaceae, Rubiaceae, Moraceae and Poaceae in remnant forest indicates that these sites are still in the early stages of vegetation succession, which could be the case in this study site. The differences in the number of representative species are related to proportions of family and result mainly from different inventory approaches (Langenberger *et al.*, 2006).

The proportion of 22% endemic species recorded in this study is lower than the proportion of 39% stated as an average for the Philippines (Davis *et al.*, 1995; Langenberger *et al.*, 2006).

The saline soil properties, dry environment, and shallow soil parent materials allowed for the evolution of limestone-adapted species (Querejeta *et al.* 2007; Fernando *et al.* 2008a; Liu *et al.* 2014). Eight (8) species were introduced-species, commonly harvested as sources of firewood (*A. saman, G. sepium*), fruits (*S. koetjape, T. indica*), traditional medicine (*J. curcas*), ornamentals (*C. pulcherrima*) or had been used in reforestation projects. These species may have been intentionally planted or were introduced in the area by natural dispersal. Small remnant forests are, in general, vulnerable to exotic species invasion because of increased edge-mediated effects (Yates *et al.,* 2004; Ohlemuller *et al.,* 2006; Vila and Ibañez 2011; Galindon *et al.*, 2018) and competition for resources since invasive species are more competitive compared to native species.

Species which are listed in the IUCN Red List (ver. 2018-1) and National List of Threatened Plants (Department of Environment and Natural Resources [DENR] Administrative Order [DAO] 2017-11) is presented in Table 2.

Four (4) species were listed in the updated list of threatened plants issued by the DENR-DAO (2017) compared to the 10 species recorded in the IUCN database. All members of the family Dipterocarpaceae, Lamiaceae and Burseraceae recorded from the area were listed in IUCN Red List. Aside from the difference in the number of species listed, the data available from IUCN designated higher conservation status for some of the species. Two species of dipterocarps were listed as vulnerable (*A. thurifera)* and critically endangered (*S. hopeifolia*) whereas they are not included in the DAO list while *D. grandiflorus* is listed as endangered with decreasing population in the IUCN but is listed as vulnerable under DAO 2017-11. *C. luzonicum*was evaluated by the IUCN to be vulnerable but is listed as OTS under DAO 2017-11. Species which are listed under OTS (other threatened species) are those which are not listed in the higher categories but are likely to be moved to the vulnerable category in the near future due to adverse factors.

Table 2. Species listed in the IUCN Red List ver. 2018-1 and DAO 2017-11.

Species	DAO 2017-11	IUCN ver. 2018-1
Bombacaceae		
Ceiba pentandra (L.) Gaertn.	Not listed	Least concern (2017)
Burseraceae		
Canarium luzonicum (Blume) A.Gray	Other threatened species (OTS)	Vulnerable A1cd (1998)
Dipterocarpaceae		
Anisoptera thurifera (Blanco) Blume	Not listed	Vulnerable A3cd; population decreasing (2017)
Dipterocarpus grandiflorus (Blanco) Blanco	Vulnerable	Endangered A2cd; population decreasing (2017)
Shoreaho peifolia (Heim) Sym.	Not listed	Critically endangered A1cd (1998)
Euphorbiaceae		
Macaranga grandifolia (Blanco) Merr.	Not listed	Vulnerable A1cd (1998)
Fabaceae		
Koompassia excelsa (Becc.) Taub.	Endangered	Lower risk/conservation dependent (1998)
Tamarindus indica L.	Not listed	Least concern (2017)
Lamiaceae		
Vitex parviflora Juss.	Endangered	Vulnerable A1cd (1998)
Moraceae		
Artocarpus blancoi (Elmer.) Merr.	Not listed	Vulnerable A1d (1998)

On the other hand, two species, *K. excelsa* and *V. parviflora* were listed in the lower threat levels (lower risk/conservation dependent and vulnerable, respectively) in the IUCN but are listed in the higher threat status (endangered) in DAO 2017-11. It should be noted that 6 species evaluated in the IUCN were evaluated 10 years ago and is in need of updating. The list provided by the DENR (2017) as recommended by the Philippine Plant Conservation Committee provides this much needed update. Moreover, the presence of these threatened species should be used as a reminder against prematurely writing off even small remnant forests just because of size, as they are still packed with high levels of biodiversity (Galindon *et al.*, 2008).

The availability of resources suitable for construction, particularly limestone used in the production of cement and the accessibility of these resources made such habitats ideal for quarrying, thus making it one of the most threatened forest formations in the Philippines (Fernando *et al.,* 2008). Clements*et al.* (2006) stated that limestone karst forest as “arks” of biodiversity and often contain high levels of endemism which is under threat by human activities. Unfortunately, only about 29% or 35,000 km^2 of karst landscape in the Philippines are protected mostly by indirect means, in that the karst is located within protected areas established for other purposes (Day and Urich 2000; Restificar *et al.* 2006). Furthermore, the impact of quarrying activities to plant diversity in the forest over limestone is not fully understood (Galindon *et al.*, 2018). It was only in 1994, with the establishment of the Cave Management and Conservation Program (CMCP) that the importance of conservation of karst habitats became recognized (Restificar *et al.*, 2006).

Currently, Minalungao National Park is recognized as a protected area, with no documented large-scale quarrying activities. The area is being developed into an eco-tourism site with on-going construction on selected sites along the river. A comprehensive biodiversity survey is recommended to assess the impact of tourism on this delicate landscape and the numerous species which depends on this habitat.

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