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## Communication

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COMMUNICATION

# Diversity of understory flowering plants in the forest patches of Marilog District, Philippines

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**Abstract:** The forest patches of Marilog District, Davao are the remnants of various anthropogenic activities including logging, conversion of land for agriculture, ecotourism and human settlements. Floristic study was carried out in 2018–2019 from 100 established plots measuring 20 x 20 m, with repeated transect walks and opportunistic sampling along forest trails. One-hundred-and-four species of understory flowering plants were identified from 102 genera and 40 families. Species diversity mean values across study sites using Simpson's (*D*) and Shannon-Wiener index (*H'*) were 0.97 and 3.9, respectively. Species diversity was highest in sites 2 and 4 (*D* = 0.98; *H'* = 4.0 each) and lowest in site 5 (*D* = 0.96; *H'* = 3.7). At family level, the most abundant taxa include Zingiberaceae (26 species) (15%), Orchidaceae (19 species) (11%), Gesneriaceae (14 species) (8%), and Rubiaceae and Arecaceae (13 species each) (7%). Conservation status assessment using International Union for Conservation of Nature (IUCN) revealed 10 threatened species, while listing from the Philippines' administrative order has categorized 13 threatened species. A total of 54 species (ca. 1.14% of the total Philippine endemic vascular flora) of understory flowering plants were Philippine endemics. Findings of this study were used as additional data for the proclamation of Mt. Malambo as Local Conservation Area, which was formalized through a barangay resolution.

**Keywords:** Epiphytes, herbs, lianas, southern Philippines, threatened species, vines.

**Editor:** Anonymity requested. **Date of publication:** 26 April 2021 (online & print)

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**Competing interests:** The authors declare no competing interests.

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**Author contribution:** VBA has conceptualized and proposed the research and is the program leader of the research. FMA is the Research Project Leader who helped the Program Leader in the implementation of the research. FMA, NPM, NEL and VBA collected, processed and identified specimens and likewise analyzed the data. FMA and NPM drafted the manuscript while VBA and NEL improved the manuscript.

**Acknowledgements:** We thank the Commission on Higher Education (CHED) for funding this study under the Discovery-Applied Research and Extension for Trans/Inter-disciplinary Opportunities (DARE-TO) Program. The Department of Environment and Natural Resources (DENR) for the issuance of gratuitous permit; Matigsalug-Manobo Tribal People Council of Elders Davao, Inc. (MAMATRIPCEDI) and Local Government Units (LGUs) of Brgy. Baganihan, Brgy. Datu Salumay, and Marahan Proper for allowing and supporting the researchers to conduct this study; and to our local researchers for accompanying us during the botanical fieldworks.

## INTRODUCTION

The Philippine vascular flora has at least 10,158 species which are distributed to 1,942 genera in 279 families. Of these, 9,038 species are angiosperms (Pelser et al. 2011 onwards), which include understory plants. Understory species contribute to erosion control and nutrient capture (Gilliam 2007). The understory plant communities are considered good ecological indicators of forest health (Tremblay & Larocque 2001; Kerns & Ohmann 2004), biodiversity, habitat potential, umbrella species sustainability, global change impact, and disturbance risk assessment (Suchar & Crookston 2010).

Tropical montane forests are important for the provision of ecosystem services (Martínez et al., 2009). The forest patches of Marilog District, Davao City, Philippines can be classified as tropical lower montane rainforests owing to its elevation and as "Baguio de Mindanao" due to its relatively cool temperature. Twenty-five years ago, Amoroso et al. (1996) reported that Marilog forest has a clay loam soil type with elevations ranging 1,150–1,290 m. It is also home to numerous vascular flora with at least two plant species recently recorded in this country for the first time (see Amoroso et al. 2018a; Acma et al. 2019); however, humans are altering the composition of biological communities through a variety of activities, which endanger some of the plant species in the area. Some of these anthropogenic activities include plant trading and over-collection from the wild, and conversion of the forests into rest houses, restaurants, mountain resorts and farmlands. Hence, these scenarios prompted the authors to conduct an inventory and assessment of understory plants in the forest patches of Marilog District, specifically the understory flowering plants which were not yet documented.

## METHODS

### Permit Statement

This study was conducted from February 2018 to September 2019 after necessary permits were obtained from respective agencies, such as Barangay resolutions from Brgy. Baganihan, Brgy. Datu Salumay, and Marahan Proper; prior informed consents (PIC's); memorandum of agreement (MOA) between Central Mindanao University and the Matigsalug-Manobo Tribal People Council of Elders Davao, Inc. (MAMATRIPCEDI); and wildlife gratuitous permit from the Department of Environment and Natural Resources (DENR) - Region XI.

### Study area and study sites

Floristic inventory was conducted in the five forest patches of Marilog District, which are geopolitically part of Brgy. Baganihan and Brgy. Datu Salumay situated in the northern part and Marahan Proper in the south (Fig. 1). The established sites were found within the forest patches of Marilog District and the sites are: Purok-5, Sitio New Calinan and Sitio Maharlika, Brgy. Baganihan (site 1); Mt. Malambo, Brgy. Datu Salumay (site 2); Lola Mommy's Rainforest, Sitio Epol, Brgy. Baganihan (site 3); Mt. Ulahingan, Sitio Tagumpay, Brgy. Datu Salumay (site 4); and Sitio Matigsalug, Marahan Proper (site 5).

Sites 1–4 are tropical lower montane rainforests, while site 5 is mixed to agro forest ecosystems with elevations ranging 1,000–1,345 m. Among the sites, site 2 had the highest elevation range (1,197–1,345 m). Soil substrates are clay & limestone (sites 1, 3 & 4) and clay & loam (sites 2 & 5) (Table 1). The explored forest patches in these sites were dominated by *Lithocarpus* spp. (Fagaceae), *Canarium* spp. (Burseraceae), *Palaquium philippense* (Perr.) C.B. Rob. (Sapotaceae), *Ficus* spp. (Moraceae), *Syzygium* spp. (Myrtaceae), *Astronia ferruginea* Elmer (Melastomataceae), and *Cinnamomum* spp. (Lauraceae).

### Establishment of Sampling Plots and Field Sampling

Establishment of the sampling sites was based on Google Earth maps and in consultation with the barangay officials, council of elders, and tribal leaders. The presence of forests or forest patches was the primary consideration in the selection of the sites to capture the naturally growing plants in the area. The understory flowering plants were inventoried and assessed through repeated transect walks, opportunistic sampling, and documentation from the 100 established 20 x 20 m quadrats in the five sampling sites.

### Collection and Processing of Specimens

The collection of plants was done by uprooting the whole plant or by cutting branches preferably with reproductive parts. The specimens were pressed in newspapers, labeled with collection number, collectors, field identification (with local names if available), site of collection, coordinates and elevations. Cardboards were placed in between sheets and tied using a twine. The herbarium specimens were then placed inside the transparent cellophane bags, processed following the wet method, and dried using a mechanical dryer. The dried herbarium specimens were deposited at the

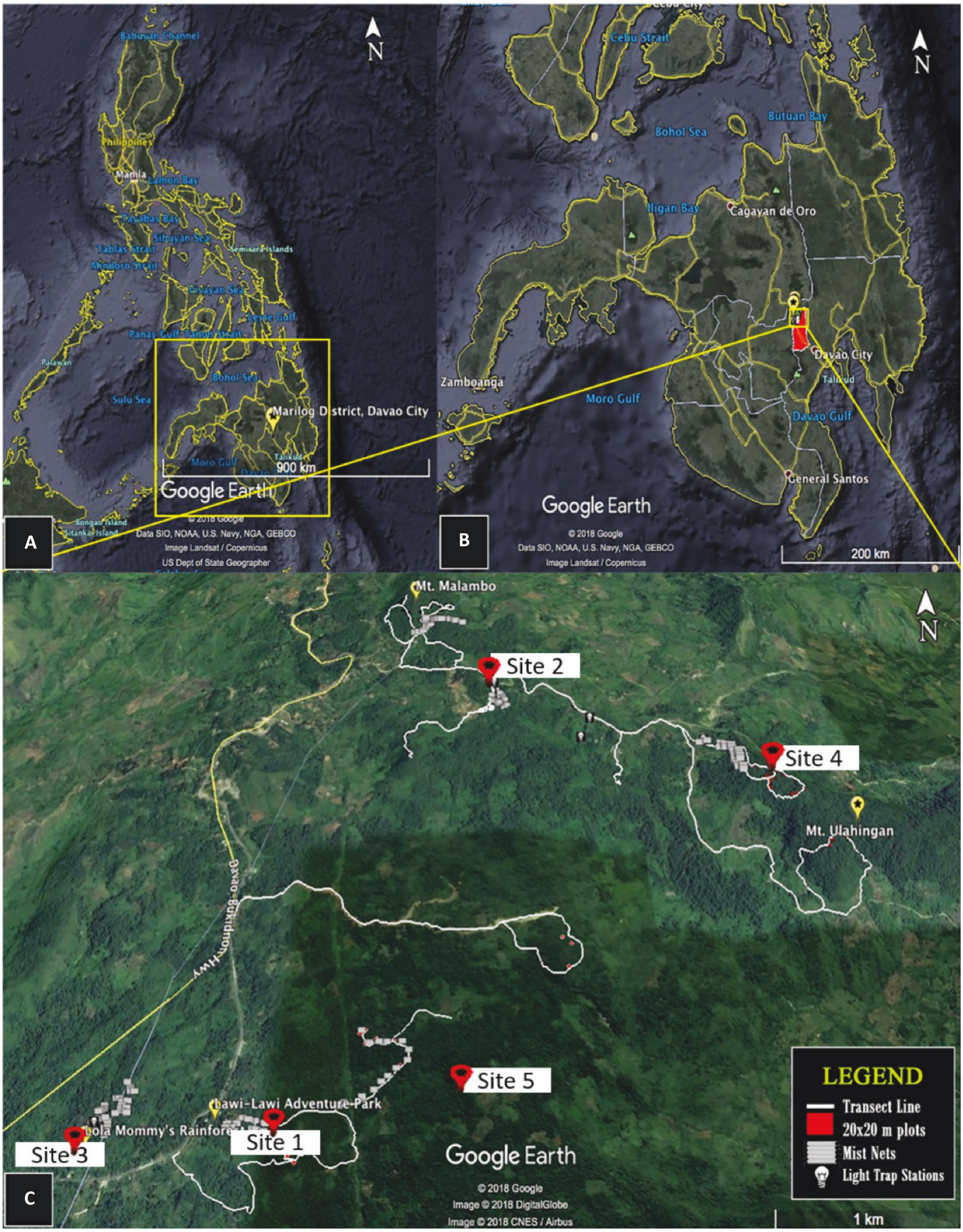


Figure 1. Map of the study site. A—Map of the Philippines | B—Map of the Mindanao Island | C—Marilog forest patches explored by the present study (©2018 Google, image ©2018 CNES/Airbus).

Central Mindanao University Herbarium (CMUH) for accessioning. Herbarium specimens were limited to three individuals of plant or plant parts per species per site as stipulated in the wildlife gratuitous permit.

### Identification of Specimens and Assessment

Field guides, online database (e.g., JSTOR, Co's Digital Flora of the Philippines of Pelser et al. 2011 onwards), and literature (Aribal 2013; Amoroso et al. 2018b) were used to identify the voucher specimens.

Conservation status of the species were determined based on Department of Environment and Natural Resources (DENR) Administrative Order (DAO 2017–11), International Union for Conservation of Nomenclature (IUCN) (IUCN 2020) and publications. The ecological status of plants were assessed using Co's Digital Flora of the Philippines (Pelser et al. 2011 onwards) and DAO (2017–11).

### Data Treatment and Analysis

The biodiversity index values were calculated using Simpson (1948), Shannon and Wiener (1963), and Magurran (2004). The Shannon-Wiener index (*H'*) was applied as measure of both species abundance and richness to quantify diversity of the understory flowering plants, while Simpson's index of diversity gives the probability that any two individuals drawn at random from infinitely large community belonging to the same species. Calculation for frequency, relative frequency, density, relative density and Importance Value Index (IVI) were derived from (Nguyen et al. 2015). The following formulae were used:

$$\text{Shannon-Wiener index (H')} = -\sum_{i=1}^{s} Pi \ln Pi$$

where pi = ni/N, where ni is the number of individuals in species i and N is the total number of individuals in the community and *ln* is the natural logarithm.

$$\text{Simpson's index} = -\sum_{i=1}^{s} \frac{ni\,(ni-1)}{N(N-1)}$$

where ni is the number of individuals in species i and N is the total number of individuals in the community.

$$\text{Species eveness} = \frac{H'}{H'_{max}} = \frac{\sum Pi \ln Pi}{\ln s}$$

where s = number of species; pi = proportion of individuals or abundance of the $i^{th}$ species expressed as a proportion of total cover.

$$\text{Density} = \frac{\text{Number of a species}}{\text{Total area sampled}}$$

$$\text{Frequency} = \frac{\text{Area of plots in which species occurs}}{\text{Total area sampled}}$$

$$\text{Relative density (RD)} = \frac{\text{Density of a species}}{\text{Total density of all species}} \times 100$$

$$\text{Relative frequency (RF)} = \frac{\text{Frequency of a species}}{\text{Total frequency of all species}} \times 100$$

and Species importance value index (IVI) = RD + RF.

## RESULTS AND DISCUSSION

### Species richness and composition across study sites

The study documented a total of 174 species of understory flowering plants, which belong to 102 genera and 40 families. Site 1 had the highest number of species (109 species), followed by site 4 (92 species), site 2 (89 species), site 3 (88 species), and site 5 (83 species) (Fig. 2). These understory flowering plants include herbs, vines, lianas, epiphytes, palms, and rattans. The relatively high species richness in site 1 can be attributed to the environmental and ecological conditions, ample sunlight and a variety of microhabitats present in the area where the understory flowering plants can favorably grow. The species which dominated in site 1 is *Freycinetia* sp. 2 (Pandanaceae) (10%), *Pandanus* sp. (Pandanaceae) (6%) in site 2 (6%), *Curculigo* sp. (Hypoxidaceae) (9%) in site 3, *Dendrochilum* sp. (Orchidaceae) (4%) in site 4, and *Pandanus* sp. 2 (12%) in site 5 (Table 2).

The total understory plants documented in this study is relatively high compared to the studies conducted at the expansion sites of Mt. Hamiguitan Range Wildlife Sanctuary (MHRWS) by Amoroso et al. (2018b) with 30 species (referred as herbs and vines) and Amoroso et al. (2018c) with 29 species (termed as other plants). Since the study area is a tropical lower montane rainforest, current findings support the report of Kessler et al. (2010) that several factors may affect local montane species richness in the Philippines, such as the size of the area sampled, climate conditions, soil type, and geographic location.

Furthermore, it is noteworthy that the species richness reported herein is relatively high compared to the previous studies (Alava 2001; Agduma et al. 2011; Aribal 2013) which included the trees, shrubs, ferns, and lycophytes in their reports. The current study reported only the flowering understory plants excluding the trees, shrubs, pteridophytes and lycophytes, but has higher number of species compared to Alava (2001) who recorded 161 species in Mt. Mayapay; Agduma et al. (2011) with 101 species in Plantinum Rubber Plantation, Makilala, North Cotabato; and Aribal (2013) with 92 species in Caimpugan Peat Swamp Forest.

At family level, the most abundant taxa include Zingiberaceae (26 species) (15%), Orchidaceae (19 species) (11%), Gesneriaceae (14 species) (8%), and Arecaceae and Rubiaceae (13 species) (7%) (Fig. 2). The significant number of Zingiberaceae in the area, especially in Brgy. Baganihan (sites 1 and 3) can be attributed to the presence of water bodies, environmental, and ecological conditions. The number of Zingiberaceae species collected is the highest number in a certain geographical area in the country as of to date (Acma et al. submitted).

In Mt. Malambo (site 2), two species of understory plants were recently reported as new family record and new species record, viz., *Mitrastemon yamamotoi* Makino (Mitrastemonaceae) (Amoroso et al. 2018) and *Plagiostachys albiflora* Ridl. (Zingiberaceae) (Acma et al. 2019), respectively.

Rasingam & Parthasarathy (2009), recorded a total density of understory plants of 851 $ha^{-1}$ (6,812 individuals) and a species richness of 108 species (104 genera and 50 families) in forests of Little Andaman Island, India. In comparison, the present study recorded a greater species richness (174 species); however, the study of Xiao-Tau et al. (2011) reported the presence of 3068 individuals of understory plants belonging to 309 species in 192 genera and 89 families in the tropical seasonal forests of Xishuangbanna, southern China in a 100$m^2$ area. Further, Swamy et al. (2000) reported a total of 244 species (183 genera and 76 families) in their study on the vegetation structure and species composition of tropical ecosystems in reserve forests in the Western Ghats of Tamil Nadu, India. It was also noted that greater diversity was recorded in mid-elevation forests.

## Species Diversity

Species diversity values (mean) across study sites using Simpson's (*D*) and Shannon-Wiener index (H') are 0.97 and 3.9, respectively. Species diversity is highest in site 2 (*D* = 0.98; *H'* = 4.0) and site 4 (*D* = 0.98; *H'* = 4.0), followed by sites 3 (*D* = 97; *H'* = 3.9), site 1 (*D* = 0.96; *H'* = 3.8) and lowest in site 5 (*D* = 0.96; *H'* = 3.7) (Fig. 3). Shannon-Wiener diversity values in the study sites are greater than typical values (1.5 – 3.5) in most ecological studies (Maguran, 1988; Maguran 2004). The results suggest that site 2 (Mt. Malambo) and site 4 (Mt. Ulahingan) are equally the most diverse in understory flowering plants. The low diversity value in Site 5 (Sitio

**Table 1. Elevation, soil substrates and number of established plots in the study sites.**

| Study site | Elevation (masl) | Soil substrate | No. of plots (20x20 m) |
|---|---|---|---|
| Site 1 (Sitio New Calinan and Maharlika) | 1220–1240 | clay & limestone | 20 |
| Site 2 (Mt. Malambo) | 1197–1345 | clay & loam | 20 |
| Site 3 (Sitio Epol) | 1151–1178 | clay & limestone | 20 |
| Site 4 (Mt. Ulahingan) | 1280–1320 | clay & limestone | 20 |
| Site 5 (Sitio Matigsalug) | 1,000–1,200 | clay & loam | 20 |

**Table 2. Dominant species across the study sites.**

| Study site | No. of species | No. of individuals | Dominant species | Dominance (%) |
|---|---|---|---|---|
| Site 1 | 109 | 2523 | *Freycinetia* sp. 2 | 10 |
| Site 2 | 89 | 903 | *Pandanus* sp. | 6 |
| Site 3 | 88 | 1217 | *Curculigo* sp. | 9 |
| Site 4 | 92 | 1184 | *Dendrochilum* sp. | 4 |
| Site 5 | 83 | 947 | *Pandanus* sp. 2 | 12 |

**Table 3. Top three species of understory flowering plants with high Importance Value Index (IVI).**

| Study site | Species | IVI |
|---|---|---|
| Site 1 | *Freycinetia* sp. 2 | 13.3 |
| | *Tetrastigma* sp. 1 | 12.3 |
| | *Calamus mollis* Blanco | 11 |
| Site 2 | *Pandanus* sp. 1 | 11 |
| | *Tetrastigma* sp. 1 | 7.4 |
| | *Musa textilis* Nées | 7.1 |
| Site 3 | *Curculigo sp.* | 13 |
| | *Sarcandra glabra* (Thunb.) Nakai | 9 |
| | *Mackinlaya celebica* (Harms) Philipson | 8 |
| Site 4 | *Rubus* sp. | 7 |
| | *Plagiostachys escritorii* Elmer | 7 |
| | *Pandanus* sp. 1 | 6.2 |
| Site 5 | *Pandanus* sp. 2 | 16.4 |
| | *Calamus mollis* Blanco | 14 |
| | *Calamus filispadix* Becc. | 11 |

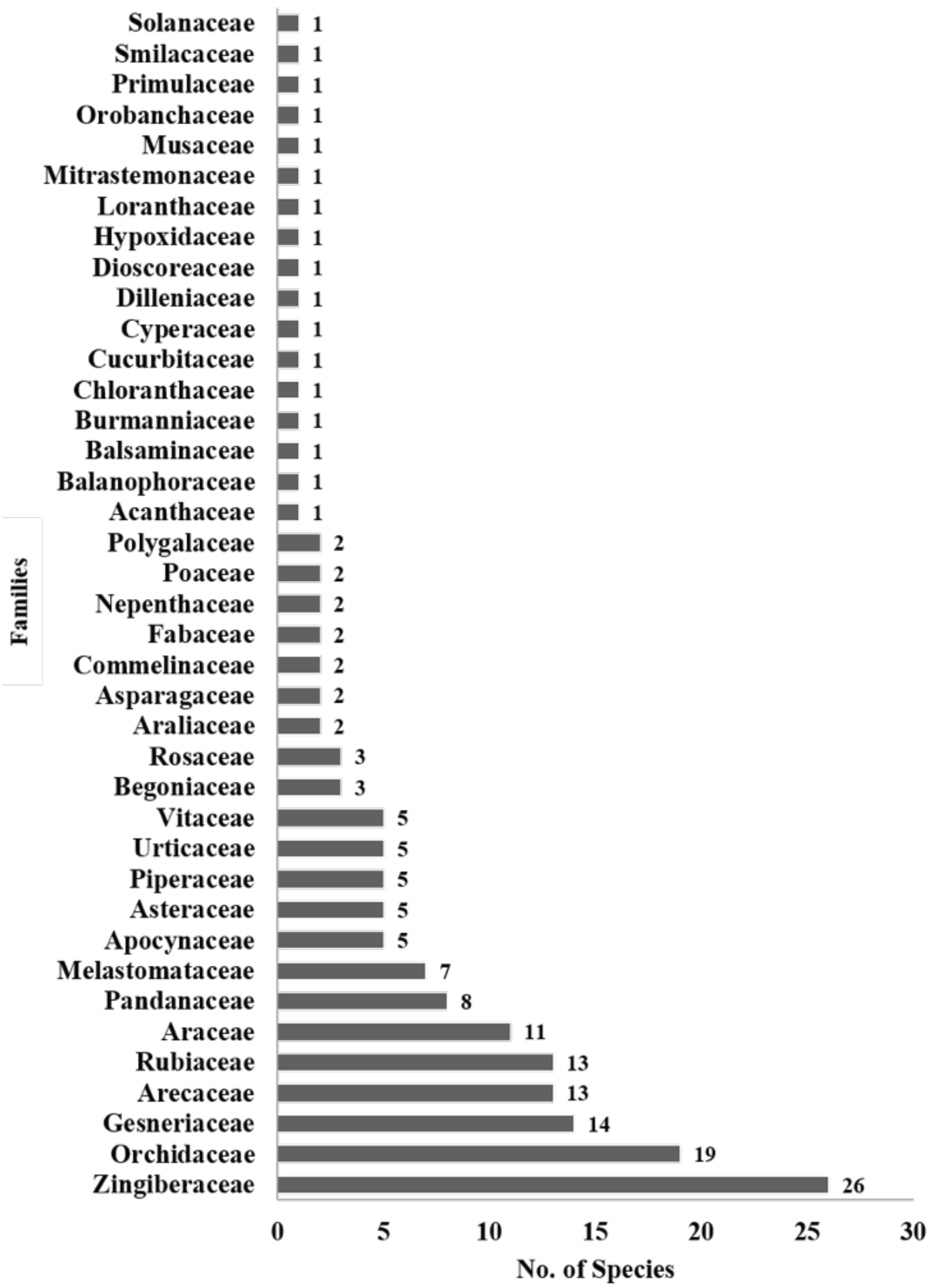


**Figure 2. Species abundance of flowering understory plants in the study area.**

Matigsalug) is attributed to its secondary grown and fragmented forest with dry substrates making the forest not suitable for plants to survive.

Species evenness is highest in site 4 (0.89), followed by site 2 (0.88), site 3 (0.86), site 5 (0.83) and was lowest in site 1 (0.80) (Fig. 3). The species evenness implies how equal the community is numerically.

**Species Importance Value Index (IVI)**

The inventory of flowering understory plants revealed that *Freycinetia* sp. 2 (IVI =13.3) obtained the highest importance value index (IVI) in site 1, *Pandanus* sp. (IVI = 11) in site 2, *Curculigo* sp. (IVI = 13) in site 3, *Rubus* sp. (IVI = 7) in site 4, and *Pandanus* sp. 2 (IVI = 16.4) in site 5 (Table 3).

Marilog District is home to five species of *Tetrastigma*, with *Tetrastigma* sp. 1 as the most observed in all sampling sites; however, identification up to the species level was not possible, since flowering and fruiting materials of the species were not available at the time

**Table 4. Conservation status of understory flowering plants in Marilog Forest Reserve.**

| Family | Taxon | Conservation status | | |
|---|---|---|---|---|
| | | IUCN (2020) | DENR (2017) | Endemicity Pelser et al. (2011 onwards) |
| Apocynaceae | *Hoya apoensis* Kloppenb. & Siar. | | | PE |
| Araceae | *Alocasia heterophylla* (C.Presl) Merr. | | | PE |
| | *Alocasia sanderiana* W.Bull | CR | EN | PE |
| Araliaceae | *Schefflera simplicifolia* Merr. | | | PE |
| Arecaceae | *Calamus bicolor* Becc. | | | PE |
| | *C. cumingianus* Becc. | | | PE |
| | *C. filispadix* Becc. | | | PE |
| | *C. microcarpus* Becc. | | | PE |
| | *C. mollis* Blanco | | OTS | PE |
| | *C. spinifolius* C.Mart. | | | PE |
| | *Heterospathe philippinensis* (Becc.) Becc. | | | PE |
| | *Pinanga copelandii* Becc. | | | PE |
| | *P. philippinensis* Becc. | | | PE |
| | *P. speciosa* Becc. | | | PE |
| | *P. woodiana Becc.* | | | PE |
| Begoniaceae | *Begonia mindanaensis* Warb. | | | PE |
| | *B. pseudolateralis* Warb. | LC | | |
| Fabaceae | *Strongylodon pulcher* C.B.Rob. | | | PE |
| Gesneriaceae | *Aeschynanthus asclepioides* (Elmer) B.L.Burtt & P.Woods | | | PE |
| | *A. cardinalis* (Copel. ex Merr.) Schltr. | | | PE |
| | *Agalmyla chorisepala* (C.B.Clarke) Hilliard & Burtt | | | PE |
| | *A. clarkei* (Elmer) B.L.Burtt | | | PE |
| | *A. persimilis* Hilliard & B.L.Burtt | | VU | PE |
| | *Cyrtandra tagaleurium* Kraenzl. | | | PE |
| | *Monophyllaea merilliana* Kraenzl. | | OTS | |
| Melastomataceae | *Medinilla clementis* Merr. | | OTS | PE |
| | *M. copelandii* Merr. | | | PE |
| Mitrastemonaceae | *Mitrastemon yamamotoi* Makino | | CR | |
| Nepenthaceae | *Nepenthes mindanaoensis* Sh.Kurata | LC | VU | PE |
| | *N. truncata* Macfarl. | EN | EN | PE |
| Orchidaceae | *Ceratostylis retisquama* Rchb.f. | | | PE |
| | *Coelogyne candoonensis* Ames | | | PE |
| | *C. cloroptera* Rchb.f. | | | PE |
| | *Phaius philippinensis* N.E.Br. | | | PE |
| | *Trichotosia odorifera* (Leav.) Kraenzl | | | PE |
| Pandanaceae | *Freycinetia jagorii* Warb. | | | PE |
| | *F. negrosensis* Merr. | | | PE |
| | *F. sphaerocephala* Gaudich. | | | PE |
| Piperaceae | *Piper ensifolium* Quisumb. | | | PE |
| Rubiaceae | *Oldenlandia apoensis* Elmer | | | PE |
| | *Psychotria cuernosensis* Elmer | | | PE |

| Family | Taxon | Conservation status | | |
|---|---|---|---|---|
| | | IUCN (2020) | DENR (2017) | Endemicity Pelser et al. (2011 onwards) |
| Urticaceae | *Procris brunnea* Merr. | | | PE |
| | *P. urdanetensis* Elmer | | | PE |
| Zingiberaceae | *Adelmeria alpina* Elmer | LC | | PE |
| | *Alpinia haenkei* C.Presl | LC | | PE |
| | *A. rufa* C.Presl | | | PE |
| | *Amomum dealbatum* Roxb. | DD | | |
| | *Etlingera elatior* (Jack.) R.M.Sm. | DD | | |
| | *E. fimbriobracteata* (K.Schum.) R.M.Sm. | DD | | |
| | *E. philippinensis* (Ridl.) R.M.Sm. | | | PE |
| | *E. pubimarginata* (Elmer) A.D.Poulsen | | | PE |
| | *Globba campsophylla* K.Schum. | LC | | PE |
| | *Hedychium philippinense* K.Schum. | | EN | PE |
| | *Hornstedtia conoidea* Ridl. | | | PE |
| | *H. lophophora* Ridl. | | | PE |
| | *Meistera muricarpa* (Elmer) Škorničk. & M.F.Newman | | | PE |
| | *Plagiostachys albiflora* Ridl. | LC | | |
| | *P. escritorii* Elmer | | | PE |
| | *Wurfbainia hedyosma* (I.M.Turner) Škorničk. & A.D.Poulsen | | | PE |
| | *W. mindanaensis* (Elmer) Škorničk. & A.D.Poulsen | | | PE |
| | *Zingiber banahaoense* Mood & Theilade | | | PE |

Legends: CR—Critically Endangered | EN—Endangered | VU—Vulnerable | OTS—Other Threatened Species | LC—Least Concern | DD—Data Deficient | PE—Philippine endemic

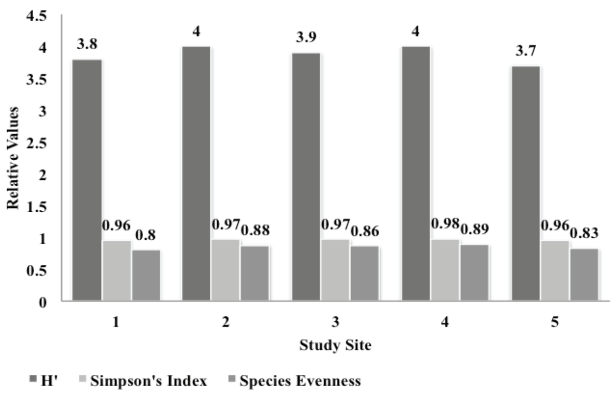


**Figure 3. Species diversity and evenness across study sites.**

of sampling. *Calamus mollis* Blanco*, C. filispadix* Becc., *Pandanus* sp. 1, and *Pandanus* sp. 2 were the most common rattans and pandans in the area. This implies that these species play important roles in the ecosystem and elimination of these species would result to changes in plant community structure.

### Conservation Status and Endemism

Conservation status assessment revealed one Critically Endangered (CR), one Endangered (EN), seven Least Concern (LC), and two Data Deficient (DD) species following the IUCN (2020). The DAO (2017–11) listed three EN species, two Vulnerable (VU), and eight other threatened species (OTS). *Mitrastemon yamamotoi* Makino proposed as CR by Amoroso et al. (2018) was only observed in site 2 (Table 4; Image 1). Among these species, *Monophyllaea merilliana* Kraenzl. (OTS) was observed in sites 1–4 in limestone karst habitat. On the other hand, a total of 54 species of understory flowering plants were Philippine endemics. This number constitutes ca. 1.14% of the total Philippine endemic vascular flora.

### Threats observed in the sampling sites

Ongoing habitat degradation through land

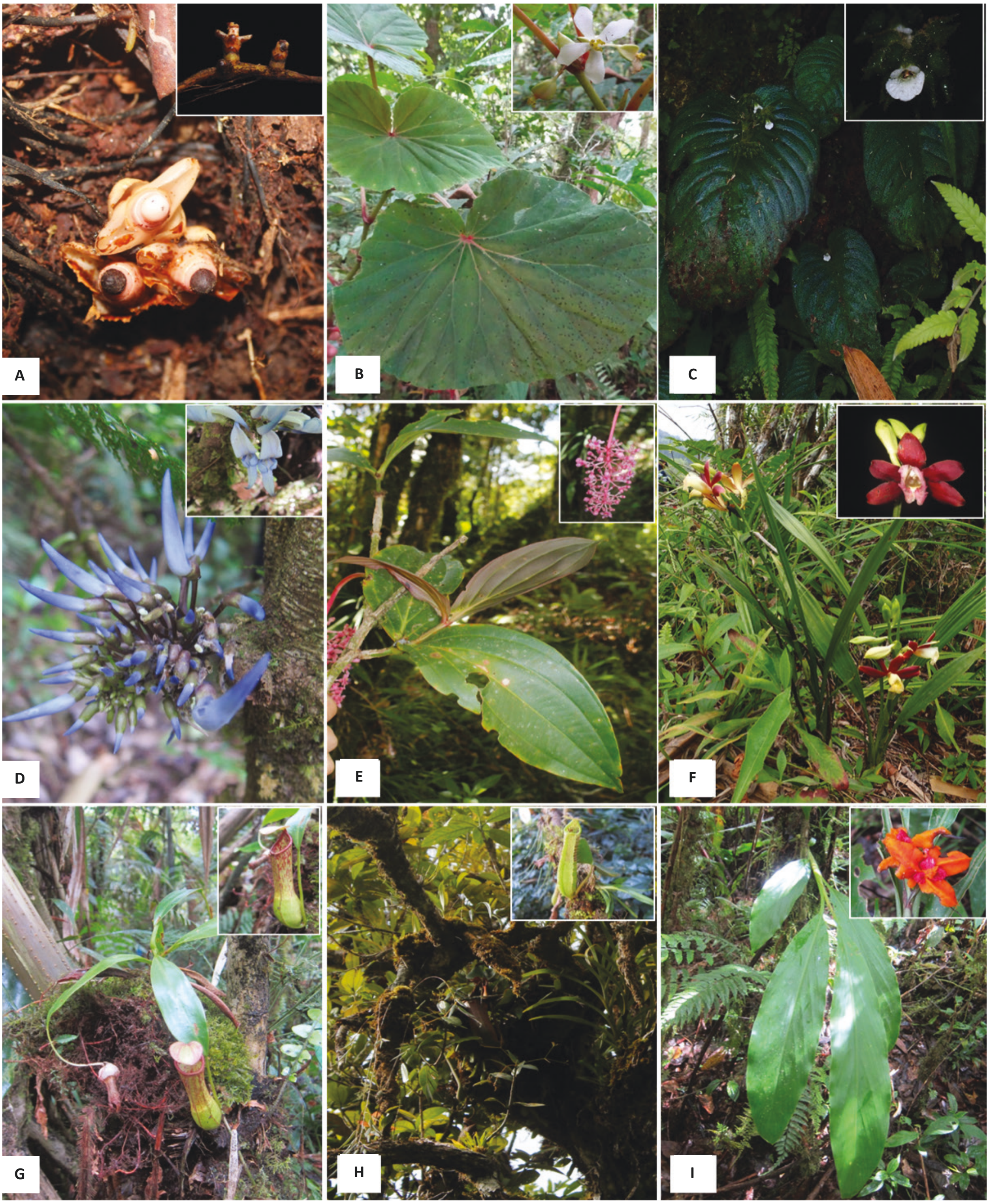


Image 1. Some threatened and endemic understory flowering plants in Marilog Forest Reserve. A—*Mitrastemon yamamotoi* Makino | B—*Begonia pseudolateralis* Warb. | C—*Monophyllaea merilliana* Kraenzl. | D—*Strongylodon caeruleus* Merr. | E—*Medinilla clementis* Merr. | F—*Phaius philippinensis* N.E.Br. | G—*Nepenthes mindanaoensis* Sh. Kurata | H—*Nepenthes truncata* Macfarl. | I—*Hedychium philippinense* K. Schum. © Authors.

conversion for agriculture and human settlements, and rampant small-scale harvesting of wild plants from the forests, are documented biodiversity threats in Marilog District. If these activities are not mitigated, the number of species will likely decline and economically-important species will be depleted in the areas.

## CONCLUSIONS AND RECOMMENDATIONS

This study concludes that the Marilog District forests harbor a rich understory plant community (174 species) which is distributed in 102 genera and 40 families. The sites having high elevation and with intact forest had the highest diversity: Site 2, Mt . Malambo and site 4, Mt. Ulahingan (*D* = 0.98; *H'* = 4.0). Each site is unique as evidenced by the species which obtained the highest importance value index of the site. *Freycinetia* sp. 2 (IVI = 13.3) for site 1, *Pandanus* sp. (IVI = 11) for site 2, *Curculigo* sp. (IVI = 13) for site 3, *Rubus* sp. (IVI = 7) for site 4, and *Pandanus* sp. 2 (IVI = 16.4) for site 5. Conservation efforts should be done since the 13 threatened species recorded and 54 species overall are Philippine endemics, which represent ca. 1.14% of the total Philippine endemic vascular flora.

It is therefore imperative that the results gathered from this study be cascaded to the local government units (LGU's) and stakeholders to create more awareness of the richness of the understory flora in their locality and formulate additional policies and strategies for the protection and conservation of these important biological resources. Ex situ and in situ conservation are also recommended to properly protect and conserve the species and their habitats.

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