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Research Article

Inventory and Assessment of Lycophytes in the Selected Forest Patches of Kalabugao, Impasug-ong, Bukidnon

Adah Ylisha M. ADAJAR[1], Fulgent P. CORITICO[1,2], Joevina C. NOBLEZA[1,2] and Noe P. MENDEZ[1,2]*

[1]*Plant Biology Division, Institute of Biological Sciences, College of Arts and Sciences, Central Mindanao University, University Town, Maramag, 8714, Bukidnon, Philippines.*
[2]*Center for Biodiversity Research and Extension in Mindanao (CEBREM), Central Mindanao University, University Town, Maramag, 8714, Bukidnon, Philippines.*

*Corresponding author email address: npolomendez@gmail.com

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ABSTRACT

Lycophytes, a group of ancient vascular plants, represent a fascinating evolutionary lineage with significant ecological and evolutionary importance. This study was carried out to determine species composition, describe the diagnostic characteristics, and assess the conservation status and endemism of lycophyte species in Kalabugao, Impasug-ong, Bukidnon. A total of nine lycophyte species were recorded in Kalabugao, namely *Phlegmariurus banayanicus* Herter, *Huperzia* sp., *Phlegmariurus salvinioides* (Herter) Ching, *Palhinhaea cernua* (L.) Vasc. & Franco, *Selaginella alligans* Hieron., *S. involvens* (Sw.) Spring, *S. llanosii* Hieron, *S. negrosensis* Hieron., and *Selaginella* sp. Assessment of conservation status and endemism revealed that two species are endangered (EN) and two species are of least concern (LC). This study contributes to the broader understanding of lycophyte biology and ecology, emphasizing their role in terrestrial ecosystems and their evolutionary significance.

Keywords: Club moss; spike moss; quillworts; vascular plants; Mindanao.

INTRODUCTION

The Philippines comprises *ca.* 1,079 species of ferns and lycophytes that are distributed to 180 genera and 40 families (Pelser et al., 2011 onwards). In Mindanao, a total of 163 species have been recorded, encompassing 73 genera and 26 families. Of these, 144 species are ferns and 19 species are lycophytes (Silverio et al., 2021). These species account for about 15% of fern diversity and 29% of lycophyte diversity in the Philippines and Mindanao Island, respectively (Coritico & Amoroso, 2020).

Lycophytes are seedless vascular plants that have existed for thousands of years and belong to the most fundamental group of vascular plants (Pryer et al., 2001). They are widely distributed across various habitats in subtropical, tropical, temperate, and boreal climates, demonstrating their remarkable adaptability (Moran & Smith, 2001). The living members of lycophytes are divided into three families: Lycopodiaceae, Isoetaceae, and Selaginellaceae (Kenrick & Crane, 1997). Lycophytes are characterized by several distinctive features, including small, scale-like leaves called microphylls (Schneider & Smith, 2001). Additionally, lycophytes do not produce seeds but reproduce through the production of spores (Cranfill, 2001). While lycophytes have limited direct economic importance, they are valued for their ornamental uses in landscaping, potential pharmacological applications, and their role in scientific research and education, indirectly enhancing our understanding of plant diversity and ecosystem health (Brummitt et al., 2015).

Selaginellaceae species are often small and delicate, and thrive predominantly in tropical zones worldwide and have practical uses as sources of natural medicines, vegetables, and ornamental plants (Setyawan, 2011). Lycopodiaceae or clubmosses are ecologically significant, serving as habitats and food sources to animals, contributing significantly to biodiversity. In the Philippines, their roles are influenced by local context and species diversity (Amoroso et al., 2016). The Isoetaceae family, on the other hand, includes the single genus *Isoetes*, with around 250 living species globally (Brunton & Troia, 2018). In the Philippines, *Isoetes philippinensis* Merr. and L.M. Perry is the sole representative and was recently recollected by Amoroso et al. (2022) after a lapse of 52 years.

Kalabugao Mountain is home to the Talaandig tribe, an indigenous community that has lived in this area for generations. The Talaandig people have a deep connection with the land, practicing sustainable living and fostering a harmonious relationship with the diverse wildlife that share this pristine environment. However, there are no published reports on the lycophyte flora in the area. In particular, *Selaginella*, commonly known as spikemosses, is essential to the lycophyte diversity of the Philippines, especially in the mountain ecosystems of Mindanao. Despite their abundance, the morpho-taxonomy of these plants in the region is poorly documented (Bautista et al., 2018). Therefore, this study was conducted to inventory and assess the conservation status and endemism of the lycophyte species found in the selected forest patches of Kalabugao, Impasug-ong, Bukidnon.

METHODOLOGY

Site description

The study was conducted in selected forest patches of Kalabugao in the municipality of Impasug-ong, Bukidnon province, Mindanao, Southern Philippines, from December 2023 to April 2024, utilizing the Wildlife Gratuitous Permit (WGP) obtained by the first author, with

WGP number R10-2024-26 (Fig. 1). Four sampling sites were employed in the selected forest patches in the area. Site 1 was located at the mid-elevation, which is characterized as a mossy forest at Sitio Nasandigan (8.4594967 N, 125.1197441) and has an elevation of 1,230 m a.s.l. This area is comprised of diverse species of understory flowering plants, such as *Alocasia heterophylla* (C.Presl) Merr. (Araceae), *Psychotia* sp. (Rubiaceae), *Etlingera fimbriobracteata* (K.Schum.) R.M.Sm. (Zingiberaceae), and *Zingiber* sp. (Zingiberaceae), and some *Elatostema* spp. that can be found near the stream. Site 2 was located in the lower montane area and is a primary forest that is situated at a higher elevation in Mt. Palusonga, Sitio Nasandigan (8.4721673 N, 125.1072541 E) with an elevation of 1,246 m a.s.l. This area is composed of fern species, such as *Diplazium esculentum* (Retz.) Sw. and *Asplenium* spp., gingers such as *Etlingera philippinensis* (Ridl). R.M.Sm., and *Habenaria* sp. (Orchidaceae). Sites 3 and 4 are in a dipterocarp forest in Sitio Sigayan (8.4328504 N, 125.2255214 E) with an elevation of 1182 m a.s.l. and 1045 m a.s.l., respectively. In Site 3, some parts of its forest lands have been converted to roads, which pose a great threat to the species of lycophytes in the area, while Site 4 is partially open with some forest fragments (Fig. 2).

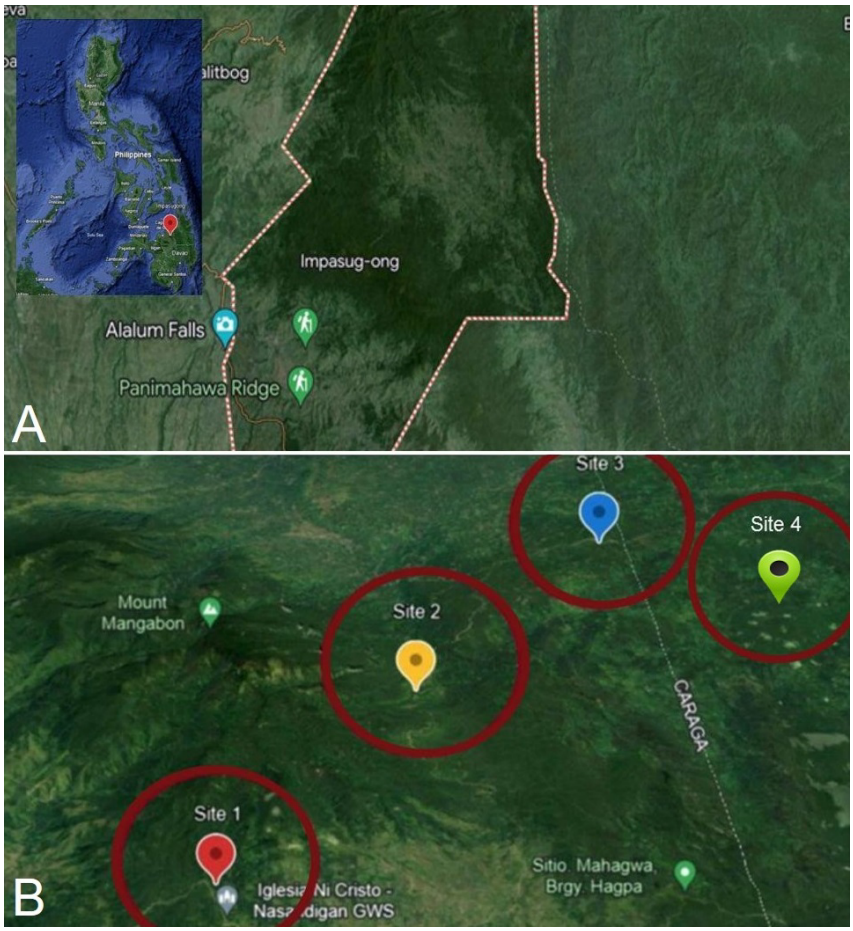

Figure 1: Location of the study site. **A.** Map of Mindanao showing the location of Impasug-ong, Bukidnon (inset: Philippine map). **B.** Map of Kalabugao showing the four sampling sites (Google Earth, 2024).

Sampling procedure

This study was carried out in the selected forest patches of Kalabugao, Impasug-ong, Bukidnon. A total of four transect lines (one transect line per site) were established, and each

of these were 2 km long. Each site contains a single trail, which was inventoried repeatedly to record lycophyte species. Repeated transect walks were carried out to collect lycophyte species present in the transect line, with 5 m on each side of the trail. Opportunistic sampling was also conducted to list and collect other lycophyte species that were found outside the transect line and beyond a 5 m distance on each side.

Collection of specimens and herbarium preparation

Three duplicates of each species were collected and stored at the Central Mindanao University Herbarium (CMUH). The entire plant was completely pulled out to expose its roots. With the use of pruning shears and a pair of scissors, the collected specimens were placed in a plastic sack to lessen dehydration. To avoid damage, specimens were placed in plastic bags and placed in a sack along with their field information. Field data such as the date of collection, name of the collector, and habitat were recorded in the field notebook. Other data, such as description and other measurable characteristics, were also recorded. Small lycophytes were collected by uprooting the whole plant, removing the soil, and pressing the plant intact (Amoroso et al., 2016; Coritico et al., 2020).

Figure 2: Portion of Sampling sites. **A.** Site 1 – mid-elevation at Sitio Nasan-digan. **B.** Site 2 – higher elevation at Mt. Palusonga. **C–D.** Sites 3 and 4 are in lower elevation at Sitio Sigayan in Kalabugao, Impasug-ong, Bukidnon.

The specimens were placed in cellophane bags for transport of specimens. Afterwards, the collected specimens were placed between newspaper sheets with the corresponding collection number and their initial identification. These were cleaned by removing the dew, debris, and other unwanted materials. After pressing, all specimens were soaked with denatured alcohol following the wet method by Hodge (1947). The specimens were then dried and mounted. These specimens were then deposited at the CMUH.

Morphological description, classification, and identification

Morphological description of lycophyte species was done using pictorial keys, published papers, and the online database of the Co's Digital Flora of the Philippines (Pelser et al., 2011 onwards) as bases for initial identification. Image comparisons and protologues from Internet sources were also accessed. Additionally, specimen identification was also referred to in the following monographs, floras, and other publications, such as Smith et al. (2006), Amoroso et al. (2007), Copeland's Fern Flora of the Philippines (1958–1961), Bada et al. (2023), and Pteridophyte Phylogeny Group I (PPG I, 2016). The final verification of the specimens was done at the CMUH by Dr. Fulgent P. Coritico, a taxonomic specialist working on Pteridophytes.

Assessment of conservation status and endemism

The conservation status of lycophytes, whether critically endangered, endangered, or vulnerable, was based on the International Union for Conservation of Nature (IUCN, 2025) and the book of Fernando et al. (2022). The endemism of each species was based on the database of Pelser et al. (2011 onwards).

RESULTS AND DISCUSSION

Species composition

Nine species of Lycophytes belonging to four genera, three subfamilies, and three tribes were recorded in the four sampling sites in the selected forest patches of Kalabugao, Impasug-ong, Bukidnon. The most diverse in terms of species number was Selaginelleae (5 species), followed by Huperzioideae and Lycopodioideae (2 species each). In terms of genus level, *Selaginella* obtained the highest number of species distributed across the four sites.

The species collected in the area were *Huperzia* sp., *Palhinhaea cernua* (L.) Vasc. & Franco, *Phlegmariurus banayanicus* (Herter) A.R.Field & Bostock, *Phlegmariurus salvinioides* (Herter) Ching, *Selaginella alligans* Hieron., *Selaginella llanosii* Hieron., *Selaginella involvens* (Sw.) Spring, *Selaginella negrosensis* Hieron., and *Selaginella* sp. These species belong to Lycopodiaceae and Selaginellaceae (Table 1; Fig. 3).

Table 1: Species Composition and Distribution of Lycophytes in the Selected Forest Patches of Kalabugao, Impasug-ong, Bukidnon.

	Species	Site			
		1	2	3	4
1	*Huperzia* sp.	/			/
2	*Palhinhaea cernua* (L.) Vasc. & Franco	/	/	/	/
3	*Phlegmariurus banayanicus* (Herter) A.R.Field & Bostock				/
4	*Phlegmariurus salvinioides* (Herter) Ching	/			/
5	*Selaginella alligans* Hieron.	/	/	/	/
6	*Selaginella involvens* (Sw.) Spring	/	/		/
7	*Selaginella llanosii* Hieron.	/	/		/
8	*Selaginella negrosensis* Hieron.	/	/		/
9	*Selaginella* sp.		/		/

Figure 3: Lycophytes of Kalabugao, Impasug-ong, Bukidnon. **A.** *Huperzia* sp. **B.** *Palhinhaea cernua* (L.) Vasc. & Franco. **C.** *Phlegmariurus banayanicus* **(**Herter) A.R.Field & Bostock. **D.** *Phlegmariurus salvinioides* (Herter) Ching. **E.** *Selaginella alligans* Hieron. **F.** *Selaginella involvens* (Sw.) Spring. **G.** *Selaginella llanosii* Hieron. **H.** *Selaginella negrosensis* Hieron. **I.** *Selaginella* sp.

The Philippines harbours around 15.47% of the world's lycophyte species, although this estimate is subject to further research. The current study covers only about 1% of the known 1,300 lycophyte species worldwide, underscoring the need for continued exploration and study. Lycophyte species richness observed in the selected forest patches of Kalabugao, Impasug-ong, Bukidnon, is notably lower than that of the Mt. Pantaron Range, Natampod, San Fernando, Bukidnon, which recorded 14 species (Palange, 2023). Similarly, it falls short of the six lycophyte species documented across the four protected areas in Mindanao, which include Mt. Apo Natural Park (Cotabato), Mt. Kitanglad Range Natural Park (Bukidnon), Mt. Malindang Range Natural Park (Misamis Occidental), and Mt. Hamiguitan Range Wildlife Sanctuary (Davao Oriental) (Coritico & Amoroso, 2020). Additionally, the diversity of lycophytes in Kalabugao is relatively low compared to that of Mt. Sinaka, Arakan, North Cotabato, Southern Philippines, with 19 species (Silverio et al., 2021). The low number of lycophyte species in the area could also be attributed to the area covered in this study, as similarly observed by Kessler (2010).

The species of lycophytes observed in the four sites were *Phlegmariurus banayanicus*, *Huperzia* sp., *Palhinhaea cernua*, *Phlegmariurus salvinioides*, *S. alligans*, *S. involvens*, *S. llanosii*, *S. negrosensis*, and *Selaginella* sp. The common species observed in sites 1 and 2 were *Palhinhaea cernua* and *S. alligans*, while the only common species found in sites 1 and 4 was *P. cernua*. Most of the common species were found in sites 1 and 2, while in site 3, only *P. cernua* and *S. alligans* were recorded.

These findings highlight the variations in the adaptations of lycophytes across the four transects in the selected forest patches of Kalabugao. The presence and distribution of these species may be influenced by several factors, including the availability of diverse microhabitats, consistent environmental conditions, humidity levels, and rapid decomposition rates (Coritico & Amoroso, 2020). Kalabugao is a primary forest, and its climate falls under the tropical forest category, meaning that the forest is characterized by a distinct dry season (PAG-ASA, 2023), while most lycophyte species prefer moist environments. Additionally, several factors can affect the species richness of local montane forests in the Philippines, such as anthropogenic disturbances, including conversion of forests to agricultural or industrial lands, and pollution (Amoroso et al., 2016). It has been observed that Site 3 has experienced road construction and widening in the area, which could explain the low numbers of lycophytes recorded at this sampling site. Climate conditions, soil type, and geographic location might also influence the number of lycophyte species in the area (Kessler, 2010).

Description of lycophytes in the selected forest patches of Kalabugao, Impasug-ong, Bukidnon

Among the nine species of lycophytes found in the area, two species were not identified up to species level. The morphological descriptions of these species, as well as their ecology and distribution in the Philippines, are presented below.

1. *Huperzia* sp. (Fig. 3A)

Epiphytic, pendulous, 20 cm in length, branching, green to reddish-brown. Microphylls small, narrow, and scale-like, arranged densely, lanceolate or ovate, slightly toothed margin, cylindrical or club-shaped. Strobili pendent, elongated, along the axis of sporophylls.

Collection number. AYMA007

Vegetation, locality, and elevation. Mossy forest at Sitio Nasandigan (1,230 m a.s.l.) and dipterocarp forest in Sitio Sigayan (1045 m a.s.l.)

Distribution in the Philippines. The only known distribution in this locality.

2. *Palhinhaea cernua* (L.) Vasc. & Franco (Fig. 3B)
Terrestrial, creeping, ascending, or caulescent, stems dichotomously branching, yellowish. Microphylls light green, linear, small, entire with acute apex, needle-like, dichotomously branched. Strobili pendent, oblong, along the axis of sporophylls.

Collection number. AYMA002

Vegetation, locality, and elevation. Mossy forest at Sitio Nasandigan (1,230 m a.s.l.), lower montane area in Mt. Palusonga, Sitio Nasandigan (1,246 m a.s.l.), dipterocarp forest in Sitio Sigayan (1182 m a.s.l.), and dipterocarp forest in Sitio Sigayan (1045 m a.s.l.).

Distribution in the Philippines. Native and widely distributed in the different islands of the Philippines (Basilan, Batan, Biliran, Bohol, Bucas Grande, Camiguin, Catanduanes, Cebu, Dinagat, Leyte, Luzon, Mindoro, Negros, Palawan, Panay, Polillo, Romblon, Sabtang, Siargao, Siasi, and Sibuyan (Pelser et al., 2011 onwards).

3. *Phlegmariurus banayanicus* (Herter) A.R.Field & Bostock (Fig. 3C)
Epiphytic, pendulous, 19–27 cm. Creeping habit, segmented, green. Stems erect, slender, and branching. Microphylls alternate in whorls, narrow, lanceolate, and toothed margins. Strobili short, oblong.

Collection number. AYMA009

Vegetation, locality, and elevation. Dipterocarp forest in Sitio Sigayan (1045 m a.s.l.)

Distribution in the Philippines. Native and endemic to the Philippines (Camiguin, Luzon, Mindanao, Mindoro, Negros, Palawan, and Panay) (Pelser et al., 2011 onwards).

4. *Phlegmariurus salvinioides* (Herter) Ching (Fig. 3D)
Epiphytic, pendulous, 18 cm. Stem creeping, ascending, greenish brown, longitudinal. Microphylls alternate, linear, leaf apex lanceolate, margin entire. Scale-like leaves are light green, with entire margins. Strobili elongated, terminal.

Collection number. AYMA004

Vegetation, locality, and elevation. Mossy forest at Sitio Nasandigan (1,230 m a.s.l.) and dipterocarp forest in Sitio Sigayan (1045 m a.s.l.).

Distribution in the Philippines. Native to the Philippines (Catanduanes, Leyte, Luzon, Mindanao, Mindoro, Negros, Palawan, Panay, Polillo, and Samar) (Pelser et al., 2011 onwards).

5. *Selaginella alligans* Hieron. (Fig. 3E)
Epiphytic, 16 cm, climbers, usually growing on the trunk. Median microphylls with short arista, serrate with cuspidate leaf apex, lateral microphylls non-ciliated, serrate with acute apex,

axillary microphylls auricled, strobilus tetragonous, decussate leaf arrangement. Scale-like leaf dark green, dichotomously branched, monomorphic sporophyll, unbranched vein. Strobili arranged in a distinct pattern on the sporophylls.

Collection number. AYMA008

Vegetation, locality, and elevation. Mossy forest at Sitio Nasandigan (1,230 m a.s.l.), lower montane area in Mt. Palusonga, Sitio Nasandigan (1,246 m a.s.l.), dipterocarp forest in Sitio Sigayan (1182 m a.s.l.), and dipterocarp forest in Sitio Sigayan (1045 m a.s.l.).

Distribution in the Philippines. Native to the Philippines (Biliran, Catanduanes, Dinagat, Leyte, Luzon, Mindanao, Mindoro, and Negros) (Pelser et al., 2011 onwards).

6. *Selaginella involvens* (Sw.) Spring (Fig. 3F)
Hemi-epiphytic climbers, median microphylls with long arista, serrated with cuspidate apex, lateral. Microphylls non-ciliated, serrated with acute apices, and axillary microphylls are auricled. Strobili tetragonous, scale-like, decussate leaf arrangement, dichotomously branched, light green, monomorphic sporophylls, unbranched vein arrangement.

Collection number. AYMA005

Vegetation, locality, and elevation. Mossy forest at Sitio Nasandigan (1,230 m a.s.l.), lower montane area in Mt. Palusonga, Sitio Nasandigan (1,246 m a.s.l.), and dipterocarp forest in Sitio Sigayan (1045 m a.s.l.)

Distribution in the Philippines. Native and widely distributed to the Philippines (Bohol, Camiguin, Jolo, Leyte, Luzon, Mindanao, Mindoro, Negros, Panay, Samar, and Sulu Archipelago) (Pelser et al., 2011 onwards).

7. *Selaginella llanosii* Hieron. (Fig. 3G)
Epiphytic, erect, rooting at the base, median microphylls with long arista, serrate with cuspidate apex, lateral microphylls are ciliated, serrate with obtuse apex, axillary microphylls are non-auricled, decussate leaf arrangement. Scale-like microphylls dark green, dichotomously branched, monomorphic sporophylls with unbranched veins. Strobilus tetragonous.

Collection number. AYMA001

Vegetation, locality, and elevation. Mossy forest at Sitio Nasandigan (1,230 m a.s.l.), lower montane area in Mt. Palusonga, Sitio Nasandigan (1,246 m a.s.l.), and dipterocarp forest in Sitio Sigayan (1045 m a.s.l.)

Distribution in the Philippines. Native and widely distributed in the Philippines (Bohol, Dinagat, Luzon, Mindoro, Negros, Palawan, Panay, Samar, and Sibuyan) (Pelser et al., 2011 onwards).

8. *Selaginella negrosensis* Hieron. (Fig. 3H)
Terrestrial, creeping, ascending, or caulescent, median microphylls with short arista, serrate, cuspidate apex. Lateral microphylls non-ciliated, margin serrate, apex acute, axillary microphylls non-auricled. Scale-like leaf dark green, dichotomously branched, monomorphic sporophyll, unbranched vein. Strobilus tetragonous, decussate leaf arrangement.

Collection number. AYMA003

Vegetation, locality, and elevation. Mossy forest at Sitio Nasandigan (1,230 m a.s.l.), lower montane area in Mt. Palusonga, Sitio Nasandigan (1,246 m a.s.l.), and dipterocarp forest in Sitio Sigayan (1045 m a.s.l.).

Distribution in the Philippines. Native and endemic to the Philippines (Leyte, Luzon, Mindanao, Negros, Panay, Samar, and Sibuyan (Pelser et al., 2011 onwards).

9. *Selaginella* sp. (Fig. 3I)
Erect, rooting at the base. Stem monostele. Median microphylls with short arista. Strobilus tetragonous, concave sides, broadly rounded corners, greenish yellow.

Collection number. AYMA006

Vegetation, locality, and elevation. Lower montane area in Mt. Palusonga and dipterocarp forest in Sitio Sigayan (1045 m a.s.l.).

Distribution in the Philippines. The only known distribution in this locality.

Conservation status and endemism
Two endangered (EN) species, two least concern (LC) species, and five data deficient (DD) species were recorded in Kalabugao (Table 2). The endangered species are *Phlegmariurus banayanicus* and *Phlegmariurus salvinioides*, which are both pendulous in their habit. *Palhinhaea cernua* and *Selaginella involvens* are the least concern species, meaning that these species are widespread, abundant, have a low risk of extinction, and there are no significant threats observed in their habitats. Three species are Data Deficient, which means that there is not enough scientific information available to assess the species' conservation status, and there are unclear population trends.

Among the recorded species, only *Selaginella negrosensis* is endemic to the Philippines, and six species are native to the Philippines. Two species – *Huperzia* sp. and *Selaginella* sp. – were not identified up to the species level due to lack of adequate distinguishing reproductive features necessary for accurate taxonomic identification. It is also noteworthy that *Selaginellaceae* is one of the least investigated lycophyte families, with several taxa facing extinction (Ebihara et al., 2012).

Table 2: Conservation status and Endemism of Lycophytes in the forest patches of Kalabugao, Impasug-ong, Bukidnon (Fernando et al., 2022; IUCN, 2025).

No	Species	Conservation Status	Endemism
1	*Huperzia* sp.		
2	*Palhinhaea cernua*	LC	Native
3	*Phlegmariurus banayanicus*	EN	Native
4	*Phlegmariurus salvinioides*	EN	Native
5	*Selaginella alligans*		Native
6	*S. involvens*	LC	Native
7	*S. llanosii*		Native
8	*S. negrosensis*		Endemic
9	*Selaginella* sp.		

CONCLUSIONS AND RECOMMENDATIONS

A total of nine species of lycophytes distributed to four genera, three subfamilies, and three tribes were recorded in Kalabugao, Impasug-ong, Bukidnon. The genus *Selaginella* had the highest number of species distributed across the four sites. This study revealed two endangered (EN) species (*Phlegmariurus banayanicus* and *Phlegmariurus salvinioides*) and two least concern (LC) species (*Palhinhaea cernua* and *Selaginella involvens*). In this study, only *Selaginella negrosensis* is recorded as endemic to the Philippines.

This study recommends the need for further exploration and monitoring in the selected forest patches in Kalabugao, Impasug-ong, Bukidnon, to record other lycophyte species. Policymakers should also develop and implement policies to protect and conserve these lycophyte species for future studies.

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DECLARATIONS

Research permit(s). A Wildlife Gratuitous Permit (WGP) was obtained from the Department of Environment and Natural Resources (DENR) Region X with a holder number R10 2024-26 in compliance to R.A 9147 known as Wildlife Resources Conservation and Protection of Act of 2001.
Ethical approval/statement. Not applicable.
Generative AI use. AI was not used in this study or in the writing of this article.

REFERENCES

Amoroso VB, Zamora PM, Villan R (2007) The Lycopodiaceae of the Philippine Islands. Central Mindanao University. Philippine Journal of Science 145(2): 127–137.

Amoroso VB, Coritico FP, Fritsch PW (2016) Species richness and conservation status of ferns and lycophytes in Mt. Hamiguitan Range Wildlife Sanctuary, Davao Oriental, Philippines. Philippine Journal of Science 145(2): 127–137.

Amoroso VB, Coritico FP, Lagumbay AJD, Chatto NJS, Polizon Manubag JJ (2022) Rediscovery of the presumed extinct Philippine quillwort *Isoetes philippinensis* Merr. & LM Perry (Isoetaceae) and new insights on its morphology and ecology. Philippine Journal of Science 151(6A): 2093–2100.

Bada JAL, Bierneza DJD, Coritico FP, Amoroso VB (2023) Checklist and assessment of pteridophytes in Amai Manabilang, Lanao Del Sur, Philippines. Journal of Tropical Biology & Conservation 20: 111–120.

Bautista MG, Coritico FP, Acma FM, Amoroso VB (2018) Spikemoss flora (*Selaginella*) in Mindanao Island, the Philippines: Species composition and phenetic analysis of morphological variations. Philippine Journal of Systematic Biology 12: 45–53.

Brummitt NA, Bachman SP, Griffiths-Lee J, Lutz M, Moat JF, Farjon A, Donaldson JS, Hilton-Taylor C, Meagher TR, Albuquerque S, Aletrari E, Andrews AK, Atchison G, Baloch E, Barlozzini B, Brunazzi A, Carretero J, Celesti M, Chadburn H, Cianfoni E, Cockel C, Coldwell V, Concetti B, Contu S, Crook V, Dyson P, Gardiner L, Ghanim N, Greene H, Groom A, Harker R, Hopkins D, Khela S, Lakeman-Fraser P, Lindon H, Lockwood H, Loftus C, Lombrici D, Lopez-Poveda L, Lyon J, Malcolm-Tompkins P, McGregor K, Moreno L, Murray L, Nazar K, Power E, Quiton M, Tuijtelaars, Salter R, Segrott R, Thacker H, Thomas LJ, Tingvoll S, Watkinson G, Wojtaszekova K, Nic Lughadha EM (2015) Green plants in the red: A baseline global assessment for the IUCN sampled red list index for plants. PloS ONE 10(8), e0135152. doi: 10.1371/journal.pone.0135152.

Brunton DF, Troia A (2018) Global review of recent taxonomic research into *Isoetes* (Isoetaceae), with implications for biogeography and conservation. Fern Gaz 20: 309–333.

Coritico FP, Amoroso VB (2020) Threatened lycophytes and ferns in four protected areas of Mindanao, Philippines. Nature Conservation Research 5(4): 78–88. https://dx.doi.org/10.24189/ncr.2020.061.

Copeland, E. B. (1958–1960). Fern Flora of the Philippines (Vols. 1–3). Manila: Bureau of Printing. Pp. 555.

Cranfill R (2001) Phylogenetic Studies in the Polypodiales (Pteridophyta) with an Emphasis on the Family Blechnaceae. Ph.D. Dissertation, University of California, Berkeley, California, USA. Pp. 1–650.

Ebihara A, Jenkins CRF, Paris BS, Zhang XC, Yang YH, Chiou WL, Chang HM, Lindsay S, Middleton D, Kato D, Praptosuwiryo TN, Amoroso VB, Barcelona JF, Ranil RHG, Park CH, Murakami N, Hoya A (2012) Rare and threatened pteridophytes of Asia. An enumeration of narrowly distributed taxa. Bulletin of the National Museum of Nature and Science, Series B (Botany) 38: 93–119.

Fernando E, Co L, Lagunzad D, Gruezo WSm, Barcelona JF, Madulid DA, Lapis A, Texon G, Manila A, Zamora P (2022). Threatened plants of the Philippines: A preliminary. DENR-Biodiversity Management Bureau (BMB) Ferns in Four Protected Areas of Mindanao, Philippines. Pp. 1–149.

Google Earth (2024) [Google Maps directions to drive from Colwood City Hall to Royal Roads University]. Version 2024-1. https://earth.google.com/web/. (Accessed 12 April 2024).

Hodge WH (1947) The use of alcohol in plant collecting. Rhodora 49(584): 207–210.

International Union of Conservation of Nomenclature (2025) The IUCN Red List of Threatened Species. Version 2025-1. https://www.iucnredlist.org/. (Accessed 11 February 2025).

Kenrick P, Crane PR (1997) The Origin and Early Diversification of Land Plants: A Cladistic Study. Smithsonian Institution Press. Pp. 1–441.

Kessler M (2010) Biogeography of ferns. In: Fern Ecology. Mehltreter K, Walker LR, Sharpe JM (eds.). Cambridge, United Kingdom: Cambridge University Press. Pp22–60.

Moran RC, Smith AR (2001) Phytogeographic relationships between neotropical and African-Madagascan pteridophytes. Brittonia 53: 304–351.

PAG-ASA (2023) Philippine Atmospheric, Geophysical and Astronomical Services Administration.https://bagong.pagasa.dost.gov.ph/automatedweather-station/. (Accessed 8 March 2024).

Palange AM (2023) Morpho-Taxonomy, Assessment and Distribution of Lycophytes in Mt. Pantaron Range, Natampod, San Fernando, Bukidnon. Central Mindanao University. Unpublished data (Thesis). Pp. 1–75.

Pelser PB, Barcelona JF, Nickrent DL (eds.) (2011 onwards) Co's Digital Flora of the Philippines. www.philippineplants.org. (Accessed 10 February 2025).

Pryer KM, Schneider H, Smith AR, Cranfill R, Wolf PG, Hunt JS, Sipes SD (2001) Horsetails and ferns are a monophyletic group and the closest living relatives to seed plants. Nature 409: 618–622. https://doi.org/10.1038/35054555.

PPG I (2016) A community-derived classification for extant lycophytes and ferns. Journal of Systematics and Evolution 54(6): 563–603.

Schneider AB, Smith JK (2001) Characteristics of Lycophytes: Small and Scale-like Leaves (Microphylls). New York: American Society of Plant Biologists. Pp. 1–320.

Setyawan AD (2011) Review: Natural products from genus *Selaginella* (Selaginellaceae). Nusantara BioScience Journal of Biological Science 3: 44–58.

Silverio F, Cadali JA, Malik BS, Coritico FP, Amoroso VB (2021) Checklist and conservation status of ferns and lycophytes of Mt. Sinaka, Arakan, North Cotabato, Southern Philippines. The Thailand Natural History Museum Journal 15(12): 161–175. http:doi.org/10.14456/thnhmj.2021.12.

Smith AR, Pryer KM, Schuettpelz E, Korall P, Schneider H, Wolf PG (2006) A classification for extant ferns. Taxon 55(3): 705–731.