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Pteridophytes and Lycophytes Assessment in the University of Mindanao, Matina Campus, Davao City Philippines

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ABSTRACT

This paper presented the biodiversity assessment of Pteridophytes and Lycophytes in the University of Mindanao, Matina Campus, geographically located in a highly urbanized area between $7^0$6'72.22' N and $125^0$59'5'E from Sept 2016 to June 2017. Opportunistic sampling or visual encounter method and transect walk at two different sites within the campus were conducted. All plant species were initially identified by comparing its morphological characteristics to taxonomic keys and existing herbarium specimen which was confirmed by the experts. A total of twenty-eight (28) species belonging to nine (9) families with fifteen (15) genera of Pteridophytes and lycophytes were recorded. There were 23 (82.1%) ferns and 5 (17.9%) lycophytes. Most of the ferns found in the campus were categorized as least concern and widely distributed in tropical areas. Seven or 25% species of pteridophytes and lycophytes were vulnerable which implicated that the school has catered population of fern species that had declined more than 30-50% in the last ten years. The result of the study served as the baseline data of pteridophytes and lycophytes species in UM Matina Campus. It was recommended to preserve a portion of the school mini forest that hosted the vulnerable species. In addition, it was suggested to propagate and cultivate the vulnerable species identified to help increase their population size. Furthermore, it was also recommended to include biodiversity conservation program to its institutional planning and development as part of the UM development agenda.

Keywords: *Davao Biodiversity, Inventory, Plants, University of Mindanao, Conservation, Pteridophytes, Lycophytes, Philippines.*

INTRODUCTION

University of Mindanao (UM) is one of the largest private non-sectarian schools in Davao City in terms of the student's population which is more than 40,000 and with respect to land area which covers approximately 50 hectares, geographically located in a highly urbanized area between $7^0$6'72.22' N and $125^0$59'5'E . The advocacy of UM is to promote sustainable development and environmental conservation through student and teacher awareness, education and environmental assessment (UM Handbook, 2017). Thus, biodiversity assessment within the school land area and conservation program were conducted in the University of Mindanao Matina Campus. One of the components of the study was to assess the pteridophytes and lycophytes inside UM Matina Campus.

Pteridophytes and lycophytes are group of seedless and flowerless vascular plants that reproduce by releasing spores (Mauseth, 2009). They are among the most economically important yet poorly documented vascular plants (Amoroso et al., 2016). There are estimated 1,100 known species of pteridophytes and lycophytes found in the Philippine archipelago and more than 10% of the mentioned number of species have a definite economic value and potential (Barcelona et al., 2013). Ferns and lycophytes are recognized in their aesthetic qualities (Banaticla and Buot, 2006), as ornaments (Amoroso, 2013), food and dietary fibers (Amoroso et al., 2014), medicinal uses (Yong, 2010), keystone species for forest regeneration (Hamley, 2012), environmental drivers of the biodiversity distributions and community composition (Lang & Murphy, 2011) and were used for medical purposes (Amoroso, 2013; Srivastava, 2007). However, there are still some untapped botanical properties and bioactive components (Amoroso et al.,2014) which are considered important such as its potency in treating prevalent diseases and its potential in bioremediation (Yong, 2010). There are still many areas in the Philippines that have no available data on the said extant plant groups hence, becoming vulnerable and threatened (Amoroso, et al., 2016).

With the enormous quantity of species found in the Philippine island, still, the country is lagging behind in assessing different plant species (Domingo, 2012). Most of the floristic studies on ferns and lycophytes in Mindanao are focused on different mountain ranges (Aya-ay, 2016; Amoroso, et al., 2011) and protected areas such as Mt. Hamiguitan Range Wildlife Sanctuary (Amoroso, et al, 2016) and Mainit Hot Springs Protected Landscape (Pilones, 2012), none so far in urban areas (Adraneda, 2008) like Davao City. Hence, this inadequacy of information of local biodiversity has affected the drafting of policy-making, and implementation of the conservation and management program particularly in response to the expansion of urbanization (Pilones, 2012).

Another consequence is the meagerness of information dissemination and education on the significant role of our local ferns and lycophytes species. In our educational system, local textbooks and resource materials often used foreign settings and presented plant species that thrived in different ecosystems, far different from our local condition. Thus, developing a gap in knowing and learning our own local species. Hence, by conducting this study, a preliminary list of pteridophytes and lycophytes of UM will be provided. There will be a venue for improving the stance of the teachers, researchers, students and people in the community on the significant role of the said plants species in biodiversity.

This paper was conducted to assess the extant pteridophytes and lycophytes in the University of Mindanao, Matina Campus. Specifically, the study aimed to present baseline data and to

determine their conservation status. The result will also provide general information and education (IEC) materials that would broaden the awareness of the community on the protection and ecologic significance of ferns and lycophytes. The study also served as a research capacity building for the faculty and students of science programs in the field of plant biodiversity and botany

MATERIALS AND METHODS

Opportunistic sampling or visual encounter method and transect walk were used to collect the specimen inside the University of Mindanao, Matina Campus, Davao City Philippines (Figure 1) between September 2016 to June 2017. This method is ideal since the purpose of the study was to provide the primary list and to determine the conservation status of identified species. This biodiversity assessment focused on the two plants taxonomic group namely: the pteridophytes and lycophytes. Two sampling sites were identified: Area 1 which was near college buildings such as Guillermo E. Torres Building (GET) located between $7^0$4'2.57"N and $125^0$3548.34"E, Dolores P. Torres Building (DPT) positioned amid $7^0$4'6.18"N and $125^0$35'45.44"E and Business and Engineering building (BE) found between $7^0$3'56.45"N and $125^0$35'48.59"E while the university mini forest was considered as the Area 2 located between $7^0$3'57.33"N and $125^0$35'37.05"E. The collection of plant specimen followed the standard protocols of pressing and drying techniques that have been used for many years and are basically same all over the world, which was also described by Amoroso (2013) and Cootes (2011). Proper data labeling such as the name of the collector, date, and location of the collection and habitat were done. Photodocumentation of the specimen was also done for recording purposes.

Identification of the specimen was initially done by the researcher, and final confirmation was done by the experts using taxonomic keys and comparing it with herbarium specimens at Central Mindanao University Museum, Musuan, Bukidnon. The conservation status was determined by the List of Threatened taxa in the Philippines, Department of Environment and Natural Resources – Administrative Order (DENR-DAO, 2017) and International Union for the Conservation of Nature (IUCN, 2015).

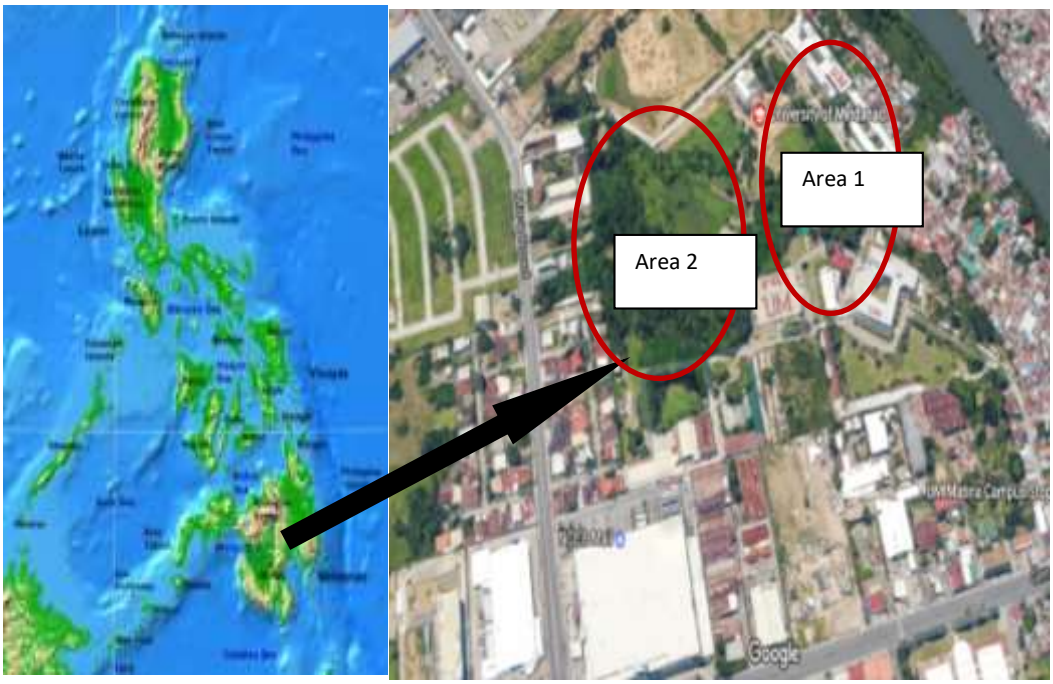

Fig. 1 Map of the Philippines (A) and Aerial view of the University of Mindanao (B) showing Sampling sites.

RESULTS AND DISCUSSION

A total of twenty-eight (28) species belonging to nine (9) families with fifteen (15) genera of Pteridophytes and lycophytes were recorded. There were 23 (82.1%) ferns, and 5 (17.9%) are lycophytes. Among these group of species, seven (7) were found to be vulnerable species which implicated that UM has catered 25% population of fern and lycophyte species that had declined more than 30-50% in the last ten years (DENR-DAO, 2017). This served as the baseline data of pteridophytes and lycophytes species in UM Matina Campus.

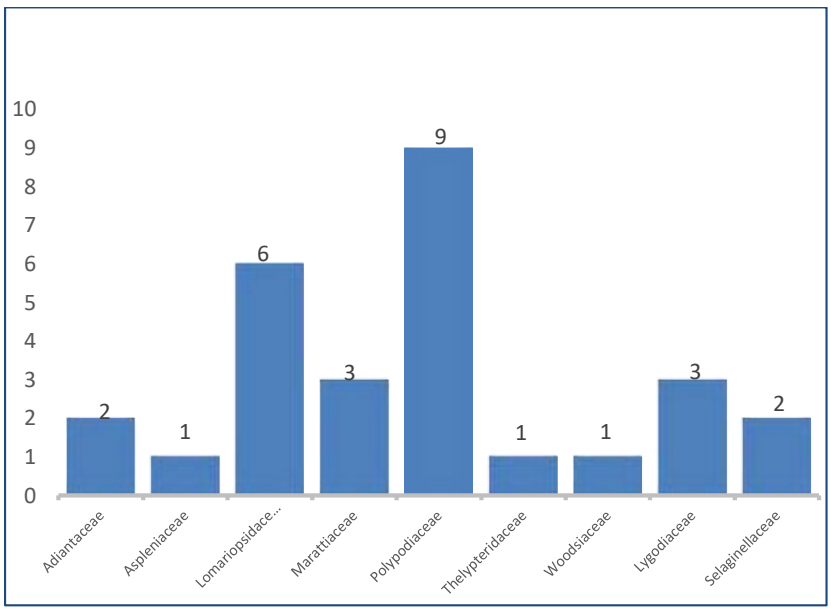

Fig. 2: Ferns and Lycophytes Richness in UM

The conservation status of the 75% of the ferns and lycophytes are least concern and mostly widely distributed. All of the considered vulnerable species were geographically distributed throughout the tropical regions. There were no rare nor threatened fern species found in the school which is realistic since the area is situated in the middle of the highly urbanized business districts. On the other hand, the 25% vulnerable species (Figure 3) found in the campus and the 35% Polypodiaceae which were naturally grown in UM are good indicators that the school is capable of hosting population of fern species despite of the ecological disturbances such as environmental pollution and ecosystem destabilization.

Table 1. Pteridophytes and Lycophytes of the University of Mindanao, Matina Campus.

Family	**Scientific Name**	**Common Name**	**Area**		**Geo-graphic Distri-bution**	**Conser-vation Status**	**Cultiva-tion Status**
			1	**2**			
Adiantaceae	*Adiantum peruvianum (*Klotzsch*)*	Silver dollar fern	+		E/C	Least Concern	I
	Adiantum caudatum G. Forst.	Tailed Maidenhair	+		WD- SEA	Least Concern	N
Aspleniaceae	*Asplenium nidus* L.	Bird's nest	+	+	Tropical Region	Vulnerable	I
Lomariopsidaceae	*Nephrolepis biserrata* (Sw.) Schott.	Giant Sword fern	+	+	WD	Least Concern	I
	Nephrolepis biserrata var. *furcans* (Sw.) Schott .	Fish tail fern	+		Pantropic	Vulnerable	I
	Nephrolepis cordifolia (L.) Presl	Fishbone fern	+	+	Pantropic	Least Concern	I
	Nephrolepis exaltata (L) Schott	Boston fern	+	+	Pantropic	Vulnerable	I
	Nephrolepis falcata (Cav)	Fish tail sword fern	+	+	WD	Least Concern	I
	Nephrolepis hirsutula (G Forst.) C. Presl	Asian sword fern	+	+	WD	Least Concern	I
Marattiaceae	*Angiopteris evecta* Cav	Giant fern	+		Tropical Asia & Africa	Vulnerable	I
	Pityrogramma calomelanos (Linn.) Link	Silver back fern		+	Tropics & Subtropics	Vulnerable	N

	Pteris vittata (Ching)	Chinese brake		+	Tropical Asia	Vulnerable	N
Polypodia-ceae	*Aglaomorpha* sp		+		WD	Least Concern	N
	Drynaria quencifolia	Eagle's wings	+		WD	Least Concern	I
	Microsorum *scolopendria* (Burm) Copel	Basket fern	+		WD	Least Concern	I
	Microsorum grossum. (Langsd. & Fisch) S.B. Andrews	Metuapua'a	+		WD	Least Concern	N
	Polypodium *punctatum* (L.) Sw.	Elkhorn fern	+		Pantropic	Vulnerable	I
	Pyrrosia *adnascens* (Sw.) Ching..		+	+	WD	Least Concern	N
	Pyrrosia *drynaria*	Tongue-fern	+	+	WD	Least Concern	N
	Pyrrosia *piloselloides*	Dragon's scale	+	+	WD	Least Concern	N
	Pyrossia splendens (Prescl.) Ching			+	WD	Least Concern	N
Thelypteri-daceae	Sphaerostephanous unitus (L.) Holttum.		+	+	WD-Tropical region	Least Concern	I
Woodsiaceae	Diplazium *esculentum* (Retz.) Sw.	Vegetable fern		+	Pantropics	Least Concern	N
Lycophytes							
Lygodiaceae	Lygodium *circinnatum* (Burm.) Sw	Red finger fern		+	WD	Least Concern	N
	Lygodium *flexuosum* (Linn) Sw	Maiden hair creeper		+	WD	Least Concern	N
	Lygodium sp			+	WD	Least Concern	N
Selaginella-ceae	Selaginella gastrophylla Warb.	Spike moss		+	Philippines (Mindanao), Malaysia (N. Borneo)	Least Concern	N
	Selaginella plana (Desv.) Hieron	Asian spikemoss	+		E/C	Least Concern	I

Legend: *Area 1 – Near college buildings; Area 2 – University Mini forest; WD – widely distributed; PE – Philippine endemic; R- Rare. E/C- Exotic/ Cultivated; I - Introduce and cultivated; N- Wild, naturally occurring, established for some time.*

A total of 10 (35%) plant species were found to be naturally grown in UM which comprised of 6 ferns and 4 lycophytes. This suggested that by providing conducive ecological condition, these seedless vascular plants would eventually grow and initiate the secondary succession or regeneration of the ecosystem. Meanwhile, the majority of the extant flowerless ferns found in UM grow under the destabilized environmental condition, larger portion of the campus are school buildings and offices. Despite the environmental disturbance, they flourish in diverse conditions and habitat such as in rocky and sandy areas, near buildings, humid, shaded mini forest, and botanical gardens.

Fig. 3 Vulnerable Species of Pteridophytes and Lycophytes Species in UM

Legend : A - Asplenium *nidus L.; B Nephrolepis exaltata (L) Schott; C. Nephrolepis biserrata (Sw.) Schott var furcans. D. Pteris vittata L.; E . Angiopteris evecta (G. Forst.) Hoffin; F.Pityrogramma calomelanos (L.) LinkG. Polypodium punctatum (L.) SW*

It was found out that the family Polypodiaceae has the highest number of species among all the families, a total of 9 or 32.15%. It was also noted that 6 out of 9 were wild-type and found mostly near the college buildings. Most of them were epiphytic and widely

distributed. Genus *Drynaria* under this family served as food for sucking insects, pest resistance and has antimicrobial potential (Smith, 2006). Lithophytic *Polypodium* were the primary colonizers of exposed rocks and cracked cement. They initiated weathering and formation of soil hence, helped fertilized growing plants. *Polypodium* extracts can also be used to protect skin from sun's UV rays (Baer, 2009).

Most of the ferns in the campus (87%) were found in Area 1 which were near the college buildings. 13 or 56.5% species were introduced and cultivated as ornamental while 10 or 46.5% were naturally occurring and established for some time. Ten species of ferns were found in both areas. There were only 4 or 17.4% wild-type species found in Area 2 that included the Genus *Pyrrosia* from the family Polypodiaceae, Genus *Diplazium* from family Woodsiaceae, Genera *Pityrogramma* and *Pteris* of family Marrattiaceae. *Pyrossia* species were widely distributed and thrived mainly on the barks of old trees. They have medicinal, antiviral, coagulant and laxative properties (Yong et al.,2010). *Diplazium esculentum* (Retz.) Sw was commonly consumed as edible vegetable (Amoroso et al., 2014) and have analgesic as well as insecticidal potentials (Chawa, 2015). All members under family Marrattiaceae were categorized as vulnerable species. Both *Pityrogramma calomelanos* and *Pteris vittata* were documented to phytoremediate soil and water from arsenic contamination, thus cleaning the environment from pollution (Yong et al., 2010). The said characteristics of found ferns in UM can be considered as a potential and venue for students' research and study.

Two families of Lycophytes were documented in the study which were the *Lygodiaceae* having three species and *Selaginellaceae* with two species. Most of the plants under this family thrive naturally in the mini forest (Area 2) and widely distributed except *Selaginella gastrophylla* Warb. which were just documented in the Philippines and North Borneo, Malaysia. The roots of the Genus *Lygodium* can be utilized as a medium for plant's growth (Christenhusz, 2011).

Table 2. Ecological Notes of the Pteridophytes and Lycophytes found in UM.

Pteridophytes			
Family	**Genera**	**Ecological Notes**	**Life forms/ Habits**
Adiantaceae	Adiantum	-Mesophytic -Thrives in high level of humidity and moisture soil but not wet, indirect light and shaded areas	Evergreen with black rachises , rhizome short-creeping
Aspleniaceae	Asplenium	-Epiphytic and terrestrial - Prefers moist soil and moderate water, full sun or semi-shaded	Evergreen with a hard and erect rhizome, leaves at the top.
Lomariopsi-daceae	Nephrolepis	- Mesophytic - Prefers moist, well-drained soil and semi-shaded areas	Evergreen with short, erect rhizome and ascending to sub-erect fronds sometimes having a few leaves drooping.

Marattiaceae	Angiopteris	- Mesophytic - Thrives in shaded or moderate sunlighted area. -Preferably grown in acidic, fertile, loamy, moist soils but the well-drained area	Evergreen giant- fern with short rhizome that bears many leaves at the tip.
	Pityrogramma	- Lithophytic - Mesophytic, needs a moderate amount of water and full sun or semi-shaded area	Evergreen short shrub creeper with erect rhizome and upright fronds covered with scales,
	Pteris	- Mesophytic - Prefers in moist old walls or soil and semi-shaded areas	Evergreen low-growing fern that forms small clumps, rhizome short and scaly.
Polypodiaceae	Aglaomorpha	- Epiphytic -xerophyte - Grows on tree truck and semi-shaded area	Evergreen drooping fronds with lobed nest leaves and creepy rhizomes covered with distinctive scale.
	Drynaria	- Epiphytic - Mesophytic to xerophyte - Thrives on moist fertile and loamy soils and easy to grow in the semi-shaded area.	- Evergreen, erect large fronds with lobed nest leaves - Rhizome is creeping, thick and fleshy, with narrow, brown to blackish short-ciliate scales,
	Microsorum	- Epiphytic or lithophytic - Best if grown in semi-shade, but can tolerate in full sun, or in heavily shaded areas - Able to tolerate short periods of drought/ dryness but will thrive in areas with good humidity and moisture levels. - Easy to Grow	- Evergreen, rhizomatous fern with fronds, leathery when matured.
	Polypodium	- Epiphytic or lithophytic - Mesophytic - Thrives in moist, shaded areas. - Grows on boulders and rock debris	- Evergreen -Creeping herb, densely hairy or scaly rhizome bearing fronds.

	Pyrrosia	- Mainly epiphyte -Occurs everywhere on the trunks of old trees and thrives in semi-shaded areas	-Evergreen -Small fern with long creeping rhizome covered with small, almost round or heart-shaped scales and have succulent leaves.
Thelypteri-daceae	Sphaeros-tephanous	- Terrestrial fern - Mesophytic - Prefers moist soil and semi-shaded areas	-Evergreen herb that has long-creeping rhizomes with smooth scales and wide fronds
Woodisiaceae	Diplazium	- Terrestrial - Grows best in moist, fertile soil and semi-shaded areas	Evergreen, vegetable fern with a short and erect rhizome trunk-like or can be creeping, covered with short reddish- brown scales. .
Lycophytes			
Lygodiaceae	Lygodium	- Terrestrial - Thrives in a shady position, allowing the plant to climb up into the sun. - Prefers a neutral to slightly acid soil	- A slender climbing fern with a wide-creeping rhizome and elongated rachis - It twines around other plants for support.
Selaginellaceae	Selaginella	- Requires high humidity and constantly moist soils. -Prefers semi-shady conditions, but able to tolerate full sun if provided with lots of water. - Grows Fertile Loamy and Acidic Soils. - Easy to Grow	- Fern-like plant - Herbaceous, erect shrub. - Creeping rhizomes and scaly fronds - It grows quite low to the ground, with small, bright green leaves that often overlap one another.

CONCLUSION AND RECOMMENDATION

The significant number of vulnerable species of pteridophytes and lycophytes found in the school is a good implication that the university is still considered a conducive environment for hosting threatened plant species. Two of the vulnerable species, naturally occurred in the mini forest, namely; Pityrogramma *calomelanos and* Pteris *vitata* have bioremediation potentials (Yong et al., 2010) which implied that the said species are capable of absorbing pollutants from the soil, water, and air. Species from the genus *Diplazium*, *Selaginella* and *Sphaerostephanous* have insecticidal and larvicidal property (Chawa, 2015) which could help control the mosquito population. Majority of the ferns and lycophytes species are medicinal and antimicrobial in nature. Therefore, it is recommended to preserve particular area in the campus which can host vulnerable species such as the mini forest. In addition, it is suggested to propagate and cultivate the vulnerable species found in UM to help increase their population size. Furthermore, it is also recommended to include biodiversity conservation program to its institutional planning and development as part of the UM development agenda. Conservation program must be conducted by providing Information, Education, and Communication (IEC) materials of biodiversity and hosting Community Education and Public Awareness (CEPA) through biodiversity symposium, biodiversity exhibit and scientific conferences. Lastly, students under Biology and Biological Education Program, Environmental Studies, Forestry, and Health Sciences could conduct further assessment particularly on phytoremediation properties, bioregulatory ecological functions and medicinal potentials of these extant plants.

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