The Thailand Natural History Museum Journal 14(2), 95-102, 31 December 2020
©2020 by National Science Museum, Thailand
http:doi.org/10.14456/thnhmj.2020.1

Checklist of Ferns and Lycophytes of Mount Agad-Agad, Lanao del Norte, Southern Philippines

Fulgent P. Coritico[1, 2, *], Maria Melanie M. Guiang[1, 2], Mary Cor S. Salolog[2], Iris R. Pescadero[2] and Victor B. Amoroso[1, 2]

[1]*Department of Biology, College of Arts and Sciences, Central Mindanao University, Musuan, Bukidnon 8710, Philippines.*
[2]*Center for Biodiversity Research and Extension in Mindanao (CEBREM), Central Mindanao University, Musuan, Bukidnon 8710 Philippines*
*Corresponding author: cfulgent@cmu.edu.ph

ABSTRACT

The ferns and lycophytes of Mount. Agad-Agad, Lanao del Norte, southern Philippines are here documented in a checklist. The list is based on a comprehensive field survey conducted by the authors in February 2020. A total of 56 species belonging to 10 families and 27 genera are recorded. Of these species, 49 are ferns and seven are lycophytes. The number of species constitutes 10% of the total number of pteridophyte species in the Mindanao Island. Nine species are endemic to the country and four species are threatened. The threatened species include Platycerium grande (A.Cunn. ex Fée) J.Sm (Critically Endangered), *Sphaeropteris glauca* (Blume) R.M. Tryon, *Phlegmariurus carinatus* (Desv. ex Poir.) Ching (Endangered), and *Aglaomorpha heraclea* (Kunze) Copel. (Vulnerable).

Keywords: conservation, endemic, Mindanao, pteridophytes, threatened.

INTRODUCTION

Mindanao Island is the second largest island in the Philippine archipelago and home to 567 species of ferns and lycophytes (Amoroso *et al.*, 2009). Ferns and lycophytes in different mountain ecosystems in Mindanao were documented as early as 1900's in Mt. Apo, Todaya (Copeland, 1910) and Agusan province in northeastern Mindanao (Copeland, 1913). Explorations were made in Mt. Malindang, Misamis Occidental (Amoroso *et al.*, 2006), Mt. Kitanglad, Bukidnon (Amoroso *et al.*, 2011), Mt. Apo, North Cotabato (Amoroso *et al.*, 2014), and recently in Mt. Hamiguitan, Davao Oriental (Amoroso *et al.*, 2016), Mt. Kiamo, Bukidnon (Coritico & Amoroso, 2017), and in Mt. Limbawon, Tago Range (Coritico *et al.*, 2018). However, there is no existing data of ferns and lycophytes of Mt. Agad-Agad, Lanao del Norte.

Mt. Agad-Agad is located in Iligan City, province of Lanao del Norte, Northern Mindanao. It is a proposed protected area covering four Barangays, viz., Pugaan, Langilanon, Lumbatin and Pindugangan. The highest peak of the mountain is 491 meters above sea level (masl) and it is a famous tourism site for mountain climbers and tourists to see the view of the Iligan City. Moreover, this mountain is home to many unique species of plants and animals like *Halcyon gularis*, *Centropus viridis*, *Phapitreron brevirostris*, *Rhipidura nigritorquis*, *Dicaeum australe* (endemic bird species) and *Diotarus verrucifer*, an endemic pygmy grasshopper (Mohagan *et al.*, 2020). This study is the first inventory to document the ferns and lycophytes in this mountain and will significantly contribute to the flora of Mindanao Island.

MATERIALS AND METHODS

Species Inventory and Permit

An inventory of ferns and lycophytes was conducted by the team in February 2020 through repeated transect walks from the two established sampling sites in Mt. Agad-Agad. Upper Agad-Agad named as Site 1 was established from Sitio Langinlanon, Barangay Pugaan going to the peak with an elevation ranging from 205–491 m a.s.l. while Lower Agad-Agad named as Site 2 is located in the lower part of Mt. Agad-Agad from the Sitio Langinlanon going down the foot of the mountain with an elevation of

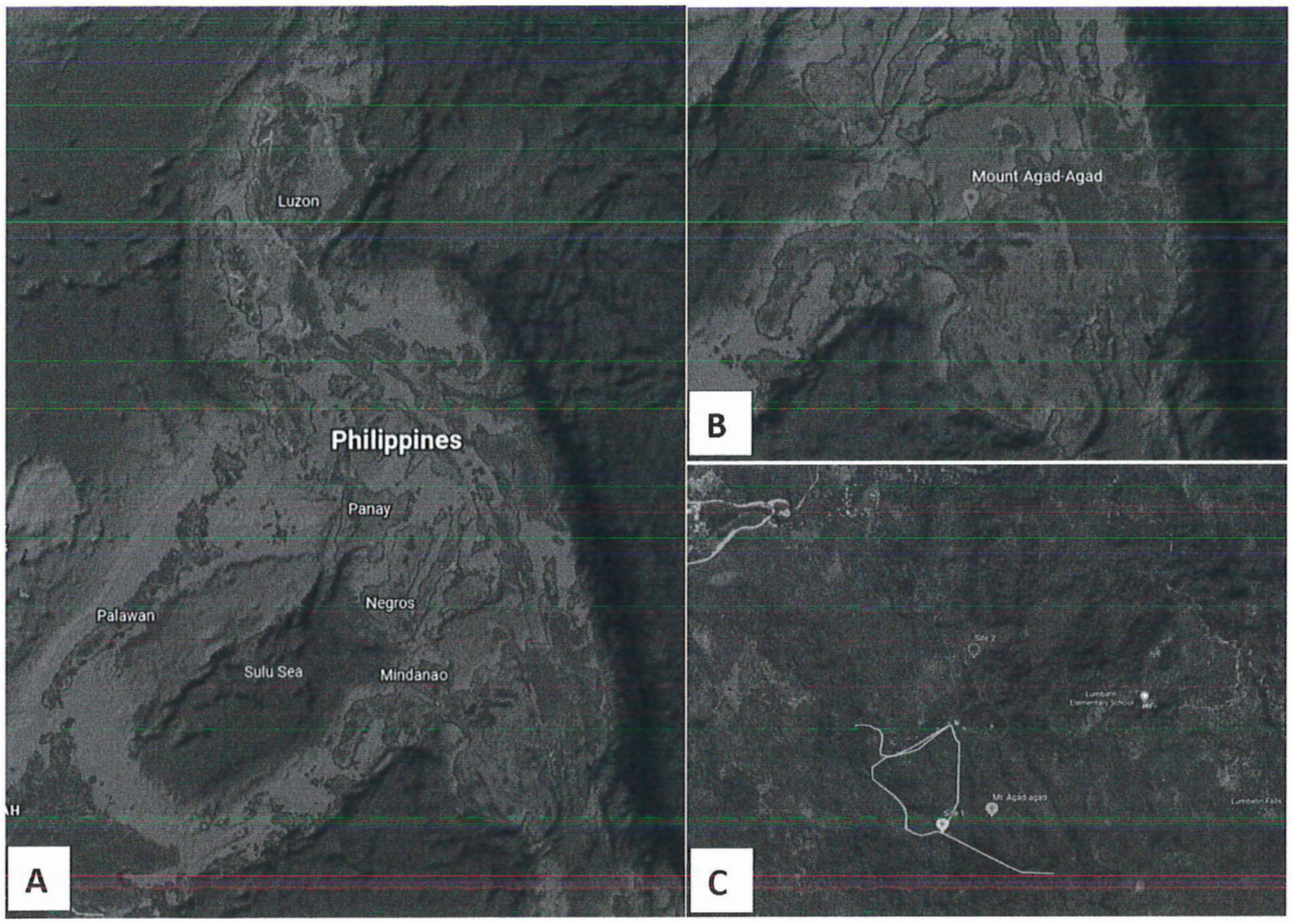


Figure 1. Location map of Mt. Agad-Agad. A. Map of the Philippines, B. Map of Mindanao Island and C. Sampling Sites 1 and 2 in Mt. Agad-Agad.

90-205 m a.s.l. The vegetation in both sites is largely reforested with a dominance of exotic and invasive species of trees species, viz., *Swietenia macrophylla* King, *Gmelina arborea* Roxb. ex Sm, *Leucaena leucocephala* (Lam.) de Wit, *Acacia mangium* Willd. and other fruit trees. However, there are some remnants of indigenous tree species recorded such as Shorea spp., *Vitex parviflora* Juss., *Pterocarpus indicus* Willd., and *Koordersiodenron pinnatum* (Blanco) Merr. These species are usually found in the steep slopes of the study area.

Prior Informed Consent (PIC) was secured from the Barangay Captain and Mayor of Iligan City regarding the research. A gratuitous permit (GP) was then obtained from the Department of Environment and Natural Resources (DENR) Region 10 with GP number 2020-43.

Collection, Processing and Identification of Specimens

A standard protocol in collecting and preserving of specimens was done following Amoroso *et al.* (2016). Herbarium specimens were deposited at the CMU Herbarium (CMUH) in Central Mindanao University, Musuan, Bukidnon. Specimens were identified by the first and last authors with the use of monographs, floras, and other publications and digitized plant specimens available in Global Plants on JSTOR. The classification system used are Smith *et al.* (2006) and the Pteridophyte Phylogeny Group (PPG 1, 2016).

Assessment of Conservation Status

The assessment of the conservation status follows the updated national list of threatened Philippine plants (Department of Environment and Natural Resources Administrative Order, 2017), which follows the criteria of the International Union for the Conservation of Nature (IUCN) 2016.

RESULTS AND DISCUSSION

A total of 56 species belonging to 15 families and 27 genera were documented. Of these, 49 were ferns and seven were lycophytes (Table 1 and Figure 2A).



Figure 3. Some ferns and lycophytes in Mt. Agad-Agad, Lanao del Norte, Southern Philippines. A. *Asplenium nidus*, B. *A. polyodon*, C. *Lygodium circinnatum*, D. *L. flexuosum*, E. *Tectaria polymorpha*, F. *Adiantum caudatum*, G. *Adiantum caudatum*, H. *Pyrrosia piloselloides*, I. *Pneumatopteris nitidula*, J. *Phlegmariurus carinatus*, K. *Selaginella aristata*, L. *S. gastrophylla.*

Table 1. Checklist of ferns and lycophytes in Mt. Agad-Agad, Lanao del Norte, Southern Philippines

FAMILY	SPECIES NAME	GROWTH FORM	Sampling Sites		Collection No.	CMUH No.
			Upper Agad-Agad	Lower Agad-Agad		
Aspleniaceae	1. *Asplenium nidus* L.	EP	+	+	VBA 17849	00011446
	2. *A. polyodon* G. Forst.	TE/LI	+	–	VBA 17709	00011302
	3. *Asplenium* sp.		+	–	VBA 17820	00011416
Athyriaceae	4. *Diplazium esculentum* (Retz.) Sw.	TE	–	+	VBA 17850	00011447
	5. *Diplazium* sp. (spiny)	TE	+	+	VBA 17701	00011294
Cyatheaceae	6. *Sphaeropteris glauca* (Blume) R.M. Tryon	AR	+	–	VBA 17774	00011369
Davalliaceae	7. *Davallia solida* (G.Forst.) Sw.	EP	+	+	VBA 17851	00011448
Dennstaedtiaceae	8. *Microlepia* sp.	TE	+	+	VBA 17852	00011449

Table 1. (Continued).

FAMILY	SPECIES NAME	GROWTH FORM	Sampling Sites		Collection No.	CMUH No.
			Upper Agad-Agad	Lower Agad-Agad		
Dryopteridaceae	9. *Bolbitis heteroclita* (C.Presl) Ching	TE/LI	–	+	VBA 17819	00011815
Lomariopsidaceae	10. *Cyclopeltis crenata* (Fée) C.Chr.	TE	–	+	VBA 17775	00011370
Lygodiaceae	11. *Lygodium circinnatum* (Burm.f.) Sw	HE	+	+	VBA 17853	00011450
	12. *L. japonicum* (Thunb.) Sw.	HE	+	+	VBA 17748	00011343
	13. *L. flexuosum* (L.) Sw.	HE	+	–	VBA 17746	00011341
Marattiaceae	14. *Angiopteris palmiformis* (Cav.) C.Chr.	TE	–	+	VBA 17854	00011451
Nephrolepidaceae	15. *Nephrolepis bisserrata* (Sw.) Schott.	TE	+	+	VBA 17855	00011452
	16. *N. hirsutula* (G Forst.) C. Presl	TE/EP	+	–	VBA 17856	00011453
Ophioglossaceae	17. *Ophioglossum petiolatum* Hook.	TE	+	+	VBA 17769	00011364
Polypodiaceae	18. *Aglaomorpha heraclea* (Kunze) Copel.	EP	+	–	VBA 17857	00011454
	19. *A. descensa* (Copel.) Hovenkamp & S.Linds.	EP	+	+	VBA 17858	00011455
	20. *A. quercifolia* (L.) Hovenkamp & S. Linds.	EP	+	+	VBA 17703	00011296
	21. *Microsorum punctatum* (L.) Copel.	EP	+	+	VBA 17710	00011303
	22. *M. samarense* (J.Sm.) Bosman	EP	+	–	VBA 17771	00011366
	23. *Phymatosorus membranifolius* (R.Br.) S.G.Lu	TE/EP	–	+	VBA 17859	00011456
	24. *Platycerium grande* (A.Cunn. ex Fée) J.Sm.	EP	+	–	VBA 17860	00011457
	25. *Pyrrosia lanceolata* (L.) Farw.	EP	+	–	VBA 17861	00011458
	26. *P. longifolia* (Burm.f.) C.V. Morton	EP	+	–	VBA 17862	00011459
	27. *P. piloselloides* (L.) M.G.Price	EP	+	+	VBA 17707/ VBA 17770	00011300/ 00011365
Pteridaceae	28. *Adiantum capillusveneris* L.	TE	+	+	VBA 17708	00011301
	29. *A. caudatum* L.	TE	+	+	VBA 17863	00011460
	30. *Pityrogramma calomelanos* (L.) Link	TE	–	+	VBA 17864	00011461
	31. *Pteris ensiformis* Burm.	TE	+	–	VBA 17865	00011462
	32. *P. vittata* L.	TE	+	+	VBA 17816	00011412

Table 1. (Continued).

FAMILY	SPECIES NAME	GROWTH FORM	Sampling Sites		Collection No.	CMUH No.
			Upper Agad-Agad	Lower Agad-Agad		
	33. *P. oppositipinnata* Fée	TE	+	–	VBA 17706/ VBA 17752	00011299/ 00011347
	34. *Pteris* sp.	TE	+	–	VBA 17818	00011414
Tectariaceae	35. *Pleocnemia irregularis* (C.Presl) Holttum	TE	–	+	VBA 17698	00011291
	36. *P. cumingiana* C.Presl	TE	–	+	VBA 17699/ VBA 17702	00011292/ 00011295
	37. *P. macrodonta* (C.Presl. ex Fée) Holttum	TE	–	+	VBA 17773	00011368
	38. *Pleocnemia* sp.	TE	+	–	VBA 17866	00011463
	39. *Tectaria polymorpha* (Wall. ex Hook.) Copel.	TE	+	+	VBA 17700/ VBA 17749	00011293/ 00011344
	40. *T. athyriosora* M.G.Price	TE	+	–	VBA 17705	00011298
Thelypteridaceae	41. *Christella parasitica* (L.) H.Lév. ex Y.H.Chang	TE	+	+	VBA 17747	00011342
	42. *C. dentata* (Forssk.) Brownsey & Jermy	TE	+	+	VBA 17867	00011464
	43. *Macrothelypteris torresiana* (Gaudich.) Ching	TE	+	+	VBA 17868	00011465
	44. *Metathelypteris gracilescens* (Blume) Ching	TE	+	–	VBA 17869	00011466
	45. *Pneumatopteris laevis* (Mett.) Holttum	TE	–	+	VBA 17750	00011345
	46. *P. nitidula* (C.Presl) Holttum	TE	+	–	VBA 17751/ VBA 17772	00011346/ 00011367
	47. *Pneumatopteris* sp.	TE	+	–	VBA 17704	00011297
	48. *Sphaerostephanos unitus* (L.) Holttum	TE	–	+	VBA 17870	00011467
	49. *Sphaerostephanos* sp.	TE	+	–	VBA 17871	00011468
LYCOPHYTES						
Lycopodiaceae	50. *Phlegmariurus carinatus* (Desv. ex Poir.) Ching	EP	+	–	VBA 17872	00011469
	51. *Selaginella aristata* Spring	TE	+	+	VBA 17768	00011363
	52. *S. cupressina* (Willd.) Spring	TE	–	+	VBA 17815	00011411
	53. *S. ramosii* Hieron.	TE	+	–	VBA 17817	00011413
	54. *S. gastrophylla* Hieron.	TE	+	+	VBA 17711	00011304
	55. *S. willdenovii* (Desv.) Baker	TE	+	–	VBA 17873	00011470
	56. *Selaginella* sp.	TE	+	–	VBA 17874	00011471
	TOTAL		44	33		

Legend: Growth forms: AR = arborescent; EP = epiphytic; HE = hemi-epiphytic; LI = lithophytic; TE = terrestrial.

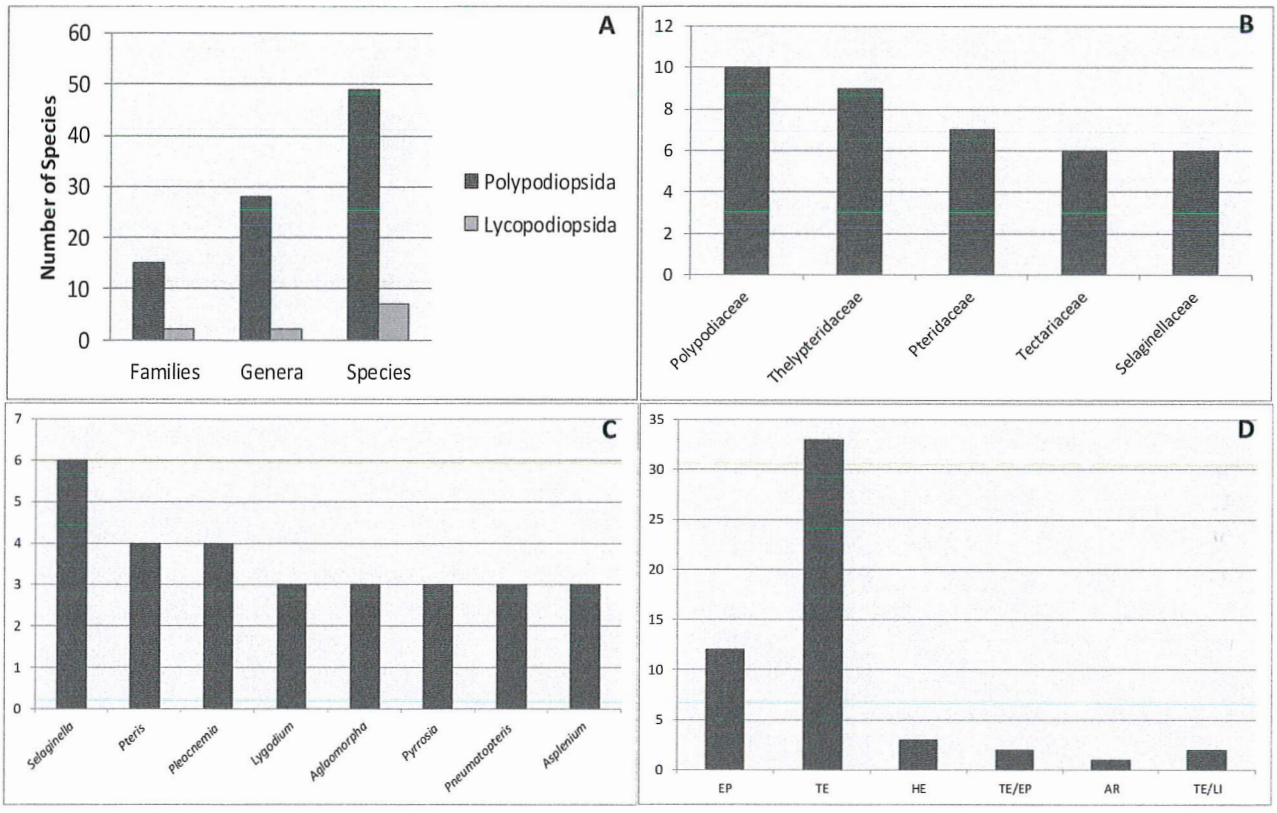


Figure 2. Numbers of ferns and lycophytes in Mt. Agad-Agad by classes, families, genera, and growth forms. A. Proportion of families, genera, and species of Lycopodiopsida and Polypodiopsida. B. Five most diverse families of ferns. C. Eight most diverse genera of ferns and lycophytes. D. Number of species per growth forms, epiphyte (EP), terrestrial (TE), arborescent (AR), hemiepiphyte (HE), lithophyte (LI).

The most speciose families were Polypodiaceae (10 species), Thelypteridaceae (9 species), Pteridaceae (7 species), Tectariaceae, and Selaginellaceae (6 species each) (Figure 2B). These families of ferns and lycophytes were also common in different mountain ecosystems in the Philippines (Barcelona, 2004; Barcelona *et al*., 2006; Amoroso *et al*., 2009; Amoroso *et al*., 2011; Amoroso *et al*., 2016, and Coritico and Amoroso, 2017; delos Angeles and Buot, 2019). The following genera have the greatest number of species, viz., *Selaginella*, *Pteris*, *Pleocnemia, Lygodium*, *Aglaomorpha*, *Pyrrosia*, *Pneumatopteris* and *Asplenium*.

The majority of the ferns are terrestrial (33 species, 58.92%), followed by epiphytes (12 spp., 21.42%), hemi-epiphytic (3 spp., 5.35%) and arborescent (tree ferns) (1 sp., 1.78%) (Figure 2D). However, some other species can be both terrestrial and epiphytes like *Nephrolepis hirsutula* (G Forst.) C. Presl and *Phymatosorus membranifolius* (R.Br.) S.G.Lu, while *Bolbitis heteroclita* (C.Presl) Ching and *Asplenium polyodon* G. Forst. can be terrestrial and lithophytic (Figure 6D). The result was expected since two-thirds of the pteridophytes were terrestrial and about one-third are epiphytes (Schuettpelz and Pryer, 2009).

The upper Agad-Agad had 44 species compared to lower Agad-Agad which had 33 species (Table 1). The high species richness in upper Agad-Agad was due to the closed canopy, presence of big trees and less anthropogenic disturbance in the area. The species similarity between two sites was about 54.66%. The common species found in both sites were *Asplenium nidus* L., *Diplazium* sp., *Davallia solida* (*G.Forst.*) Sw., *Microlepia* sp., *Lygodium circinnatum* (Burm.f.) Sw., *Lygodium japonicum* (Thunb.) Sw., *Nephrolepis bisserrata* (Sw.) Schott., *Ophioglossum petiolatum* Hook., *Aglaomorpha descensa* (Copel.) Hovenkamp & S.Linds., *Aglaomorpha quercifolia* (L.) Hovenkamp & S. Linds., *Microsorum punctatum* (L.) Copel., *Pyrrosia piloselloides* (L.) M.G.Price, *Adiantum capillus-veneris* L., *Adiantum caudatum* L., *P. vittata* L., *Tectaria polymorpha* (Wall. ex Hook.) Copel., *Christella parasitica* (L.) H.Lév. ex Y.H.Chang, *Christella dentata* (Forssk.) Brownsey & Jermy, *Macrothelypteris torresiana* (Gaudich.) Ching, *Selaginella aristata* Spring and *S. gastrophylla*

Hieron. The most common species of ferns and lycophytes in the upper Agad-Agad were *A. poyodon*, *T. polymorpha*, *L. circinnatum* and *S. gastrophylla* while in lower Agad-Agad are *Sphaerostephanos unitus*, *N. bisserrata* and *S. gastrophylla*.

The total richness constituted about 10% of the total number of pteridophyte species in the Mindanao Island. It was comparatively higher compared to Adams, Northern Luzon (Magtoto and Austria, 2017) and Mt. Makiling (delos Angeles and Buot, 2019) with 48 species each. However, it was relatively lower compared to many high mountain ecosystems in the Philippines (Iwatsuki and Price, 1977; Barcelona, 2004; Barcelona *et al.*, 2006; Amoroso *et al.*, 2009; Amoroso *et al.*, 2011; Amoroso *et al.*, 2016; Coritico and Amoroso, 2017).

There were about nine species of ferns noted to have economic value as food, raw materials for handicraft making and ornamental plants. The most common and palatable species of ferns, *Diplazium esculentum* was very common in the lower parts of Mt. Agad-Agad. This species exhibited high quantifiable antioxidant activity (Amoroso *et al.*, 2017). There are three species of *Lygodium commonly* known as "nito" namely *L. circinnatum* (Burm.f.) Sw, *L. japonicum* (Thunb.) Sw., and *L. flexuosum* (L.) Sw. which are used as raw materials for handicraft making such as basket weaving (Amoroso, 2013; Magtoto and Austria, 2017). Other than that, the ornamental ferns include *N. bisserrata* (Sw.) Schott., *N. hirsutula*, *A. nidus*, *A. capillus-veneris* L., *A. caudatum* L., and P. *grande* (Fig. 2C).

Nine species of ferns and lycophyte broadly endemic to the Philippines were recorded in the area, which included: *A. heraclea*, *Microsorum samarense* (J.Sm.) Bosman, *P. grande*, *Pteris oppositipinnata* Fée, *Tectaria athyriosora* M.G.Price, *Pneumatopteris laevis* (Mett.) Holttum, *P. nitidula* (C.Presl) Holttum and *Selaginella ramosii* Hieron. while the threatened species include *P. grande* (Critically Endangered), *S. glauca* and *P. carinatus* (Endangered) and *A. heraclea* (Vulnerable).

CONCLUSION

The field inventory conducted at Mt. Agad-Agad, Lanao del Norte, southern Philippines recorded 56 species, 27 genera and 15 families of ferns and lycophytes. Most of the species were terrestrial and about nine species recorded to have economic values. Nine were endemic and four species were threatened. Of these, one critically endangered, two species are endangered and one vulnerable species. The presence of economic, threatened and endemic species of ferns and lycophytes in Mt. Agad-Agad supports for the nomination of the site as a protected area or local conservation site for the long term protection and conservation of the species.

ACKNOWLEDGEMENTS

Financial support for this research from the National Research Council of the Philippines (NRCP) – Department of Science and Technology (DOST) is gratefully acknowledged. We also thank the Department of Environment and Natural Resources (DENR) Region X for issuing the Gratuitous Permit (GP), Iligan City mayor Hon. Celso G. Regencia and Brgy. Captain Hon. Virgie M. Raman for allowing us to conduct our sampling in Mt. Agad-Agad, the Brgy. Tanods and selected local people for assisting us in the collection of specimens and Central Mindanao University led by Dr. Jesus Antonio G. Derije for the logistic support.

REFERENCES

Amoroso, V.B., J.B. Arances, N.D. Gorne, R.P. Ruba, L.V. Rufila, G.S. Opiso, M.T. Demetillo, K.G. Noval, A. van den Berg, A. Stortelder, P.J.A. Kessler, W. Gruezo, D.A. Lagunzad, B.C. Tan, L.L. Co, E.C. Aranico, B.A. Roscom and C.G. Alava. 2006. *Plant Diversity in the Northern Landscape of Mt. Malindang Range and Environs, Misamis Occidental, Philippines.* College Laguna: SEAMCO SEARCA and Quezon City: PDM Press, Philippines.116 pp.

Amoroso, V.B., L.D. Obsioma, J.B. Arlalejo, R.A. Aspiras, D.P. Capili, J.J.A. Polizon and E.B. Sumile. 2009. Inventory and Conservation of Endangered, Endemic and Economically Important Flora of Hamiguitan Range, Southern Philippines. *Blumea* 54(1–3): 71–76.

Amoroso, V.B., S.H. Laraga and B.V. Calzada. 2011. Diversity and assessments of plants in Mt. Kitanglad Range Natural Park, Bukidnon, Southern Philippines. *Garden's Bulletin Singapore* 63(1 & 2): 219–236.

Amoroso, V.B. 2013. *Philippine Medicinal Ferns and Lycopods*. Central Mindanao University, Musuan, Bukidnon, Philippines. 109 pp.

Amoroso, V.B., F.M. Acma, R.Y. Dela Cruz, F.P. Coritico, A.D. Nietes, G.B. Hamo and H.P. Lumista. 2014. Diversity of *Herbaceous* Pteridophytes in Four Mindanao Long Term Ecological Research (LTER)

Sites, Philippines. *Asia Life Sciences* 24(1): 69–85.

Amoroso, V.B., F.P. Coritico and P.W. Fritsch. 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): 17–23.

Amoroso, V.B., R.A. Mendez and A.P. Villalobos. 2017. Bringing back the lost value of Philippine edible ferns: Their Antioxidant, Proteins and Utilization. *International Journal of Advanced Research* 5(4): 757–770.

Barcelona, J. 2004. Collection and conservation status of pteridophytes in Panay Island, Philippines. *Philippine Scientist* 41:57–73.

Barcelona, J., N. Dolotina, G. Madroñero, W. Granert and D. Sopot. 2006. The ferns and fern allies of the karst forests of Bohol Island, Philippines. *American Fern Journal* 96(1): 1–20.

Copeland, E.B. 1910. The ferns of Mount Apo. *Leaflets of Philippine Botany* 3: 791-851.

Copeland, E.B. 1913. Some ferns of north-eastern Mindanao. *Leaflets of Philippine Botany* 5: 1679–1684.

Coritico, F.P. and V.B. Amoroso. 2017. A rapid assessment of vascular plants in Mt. Kiamo, Mindanao, Philippines. *Asian Journal of Biodiversity* 8(1):62-78.

Coritico, F.P. 2018. *Plant Diversity and Forest Structure in Mt. Limbawon, Tago Range, Bukidnon, Philippines.* PhD dissertation. Central Mindanao University, Philippines. 259 pp.

delos Angeles, M.D. and I.E. Buot Jr. 2019. A checklist of fern species in disturbed areas of Mount Makiling, Philippines. *The Thailand Natural History Museum Journal* 13(2): 163–172.

DENR – DAO. 2017. *Updated National List of Threatened Philippine Plants and their Categories.* 30 pp.

Iwatsuki, K. and M. Price. 1977. The pteridophytes of Mt. Burnay and Vicinity, Northern Luzon. *Southeast Asian Studies* 14(4): 540–572.

Magtoto, L.M. and C.M. Austria. 2017. The pteridophytes of adams, northern Luzon, Philippines and their ecosystem services. *Philippine Journal of Systematic Biology* 11(2): 43–51.

Mohagan, A.B., R.R. Patano Jr., E.P. Leaño, M.G. Melencion, F.P. Coritico and V. B. Amoroso. V. B. Amoroso. 2020. Morphology and Morphometrics of *Diotarus verrucifer* (Stål, 1877), a Pygmy Grasshopper Endemic to Mindanao. *Philippine Journal of Science* 149(3): 571–579.

PPG 1. 2016. A community-derived classification for extant lycophytes and ferns. *Journal of systematics and Evolution* 54(6): 563–603.

Schuettpelz, E. and K. Pryer. 2009. Evidence for a Cenozoic radiation of ferns in an angiosperm-dominated canopy. *Proceedings of the National Academy of Sciences* 106(27): 11200–11205.

Received: 27 May 2020
Accepted: 18 July 2020
Published: 31 December 2020