

## Checklist and Conservation Status of Ferns and Lycophytes of Mt. Sinaka, Arakan, North Cotabato, Southern Philippines

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### ABSTRACT

An inventory of ferns and lycophytes was conducted in Mt. Sinaka, North Cotabato through repeated transect walks across vegetation types to determine species richness, species similarity, conservation and ecological status. Results revealed 163 species belonging to 26 families and 73 genera. Of these, 144 species are ferns and 19 are lycophytes. The species richness constitutes about 15% and 29% of the total number of ferns and lycophytes in the Philippines and Mindanao Island, respectively. The majority of the growth forms are terrestrial having 73 species, followed by epiphytes with 64 species, tree ferns 9, hemi-epiphytes 2 and lithophytes with only 1 species and 14 other species were observed to have more than one growth form. Of the 19 threatened species recorded, 7 species are endangered, 9 are vulnerable and 3 as Other Threatened Species. Eleven species are broadly Philippine endemic while two are Mindanao endemic species, viz., *Lindsaea hamiguitanensis* and *Tectaria weberi*. This checklist will serve as a supporting document to formulate a science-based policy for the conservation and protection of the biological resources in Mt. Sinaka.

**Keywords:** flagship species, sampling plot, transect walk, pteridophytes.

### INTRODUCTION

Philippine archipelago recorded a total of 1037 pteridophyte species belonging to 40 families and 172 genera (Pelser *et al.*, 2011 onwards). Moreover, 202 species are noted to be threatened (Fernando *et al.*, 2008) and 266 species are endemic (Pelser *et al.*, 2011 onwards). In Mindanao island, 632 (60%) species are documented (Amoroso *et al.*, 2012). Additionally, 130 species (20%) distributed to 24 families and 66 genera are found in the four long term ecological research sites in Mindanao namely Mt. Apo (North Cotabato), Mt. Hamiguitan (Davao Oriental), Mt. Kitanglad (Bukidnon) and Mt. Malindang (Misamis Occidental) (Amoroso *et al.*, 2015). From this, 45 species are classified as threatened belonging to 16 families and 25 genera (Coritico and Amoroso, 2020).

Mount Sinaka is home of different flora and fauna including the Philippine flagship species, the Philippine

Eagle. It is also one of the remaining forest fragments in Arakan Valley within Greater Mindanao and it has been rated as “Extremely High Critical” in conservation importance according to the Philippine Biodiversity Conservation Priority-setting Program. Mt. Sinaka is a Key Biodiversity Area (KBA) candidate, being home to a highly diverse endemic flora and fauna species (FPE, 2020). It has a highest elevation of 1,690 m asl and with a land area of approximately 3,000 hectares. It is located at 7° 29' 22" N and 125° 15' 22" E, east of Marilog District of Davao City, San Miguel and west of barangays Tumanding, Salasang, Lanao Kuran, and Datu Ladayon of Arakan, North Cotabato (Mallari *et al.*, 2001; Panal *et al.*, 2015; FPE, 2017).

Each of these barangays created a Bantay Kalikasan (BK) organization as mandated by the municipality of Arakan. This organization was established to protect and monitor the area (Salvador and Ibanez, 2006; FPE, 2017).

Illegal logging is the primary extractive activity that severely affects Arakan Valley's natural resources. Land clearing for agriculture, including slash-and-burn practices, also create immense pressure on the forest cover. Additionally, difficulty in protecting the areas because of increasing population, extreme environmental conditions, and varied cultural traditions among the residents further compound the problem were the major threats that affects its diversity (FPE, 2020). Thus, this inadequacy of information of local biodiversity has affected the drafting of policy-making, and implementation of the conservation of biological resources in Mt. Sinaka, Arakan, North Cotabato. Moreover, there is no published checklist of ferns and lycophytes in Mt. Sinaka. Thus, this paper assessed the conservation and ecological status of pteridophytes in Mt. Sinaka. This paper would also serve as basis for the conservation of the remaining threatened and endemic pteridophytes in Mt. Sinaka.

## METHODS AND MATERIALS

### Species Inventory and Permits

An inventory of ferns and lycophytes was conducted in lower montane rainforest (912– 1170 m asl) and upper montane rainforest (1170– 1609 m asl), through a series of transect walk (5 m both sites) and opportunistic sampling techniques in the established trails of Sitio Bagtok, Barangay Tumanding (1345 m asl), Sitio Libas, Barangay San Miguel (1348 m asl), and Purok 2, Barangay Salasang (1609 m asl) Arakan, North Cotabato (Figure 1).

A Gratuitous Permit was secured from Department of Environment and Natural Resources (DENR) through CENRO Matalam Region 12 before field sampling and collection of specimens in the area.

### Collection, Processing, and Identification of Specimens

Collection of the specimens followed the procedure of Coritico et al. (2020) and used the wet method in the preservation of collected specimens (Hodge, 1947). Specimens were identified using monographs, floras, and other publications such as, Copeland's Fern Flora of the Philippines (1958), the Flora Malesiana Series, and digitized plant specimens available in Global Plants on JSTOR and Co's Digital Flora. Taxonomic identification was verified by Fulgent P. Coritico and Victor B. Amoroso.

### Growth forms

The growth forms of identified pteridophyte species were classified as terrestrial, holoepiphytes, arborescent, hemi-

epiphyte and lithophytic (Madison, 1977; Biedinger and Fischer, 1996).

### Species Similarity

Bray–Curtis Cluster Analysis was used for the multivariate analysis of assemblage data, for sound biological reasons (Kembel, 2012). The data for the above mentioned tests made use of BioDiversity Pro 2.0 software in analyzing the data.

### Assessment of Conservation and Ecological Status

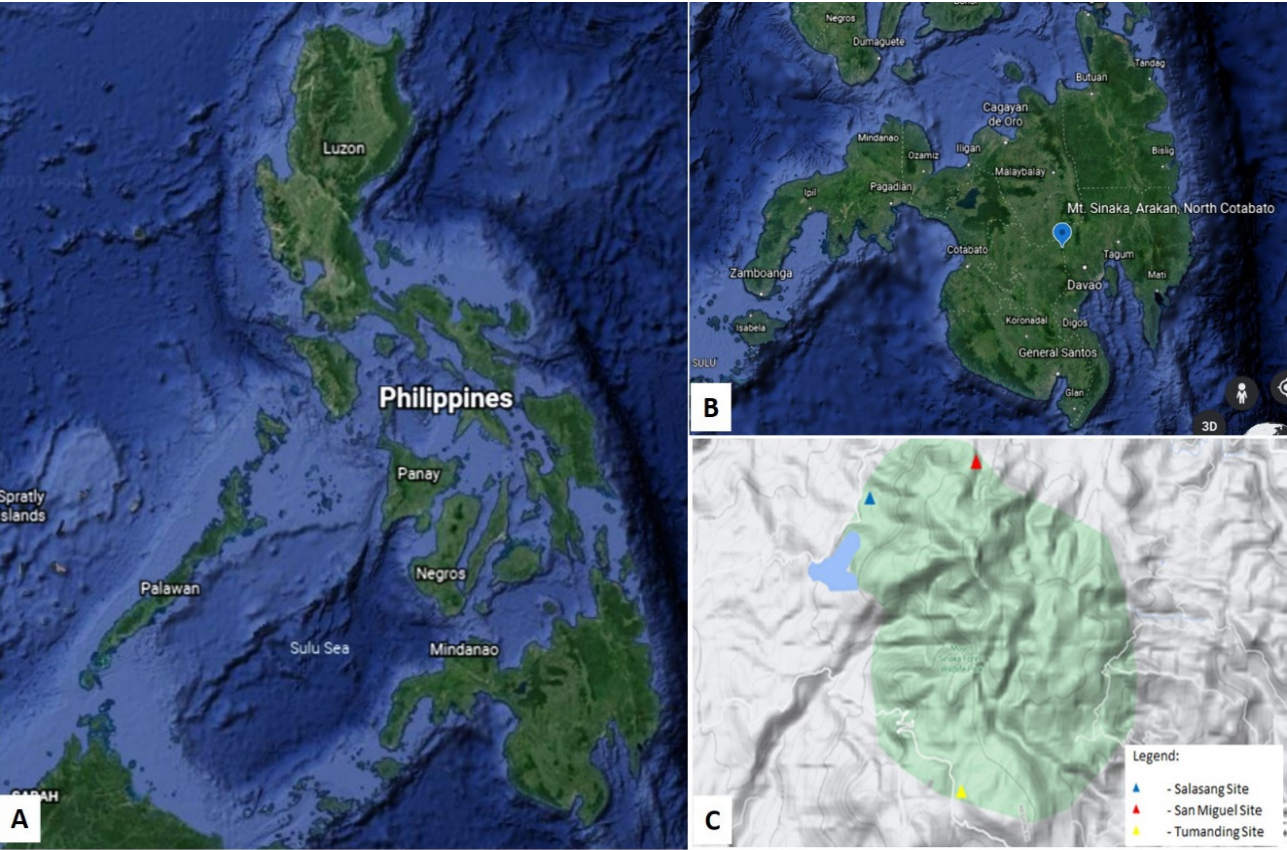
The conservation status of the recorded species was based on the national list of threatened Philippine plants (DENR-DAO, 2017) which follows the standard criteria of the International Union for the Conservation of Nature. Ecological status of identified flora was noted based on Copeland (1958) and Co's Digital Flora of the Philippines (Pelser *et al.*, 2011 onwards). This information serves as a basis for governmental agencies that set environmental policies by the DENR and local government units (LGUs) for monitoring and protecting threatened and endemic species within the mountain range and its vicinity.

## RESULTS AND DISCUSSION

### Species Richness

Inventory of ferns and lycophytes in Mt. Sinaka revealed a total of 163 species belonging to 26 families and 73 genera. These are composed of 144 species are ferns and 19 are lycophytes (Table 1; Figure 2A). Of these families identified, Polypodiaceae has the highest number of species (28) followed by Pteridaceae (14 species), Dryopteridaceae (13 species), Aspleniaceae, Selaginellaceae with 12 species each, Hymenophyllaceae and Thelypteridaceae with 9 species each (Figure 2B). On the other hand, lycophytes are represented by Lycopodiaceae and Selaginellaceae with 7 and 12 species, respectively. The most diverse genera are *Selaginella* P. Beauv., (12 species) *Asplenium* L. (11 species), *Diplazium* Sw. and *Davallia* Sm. (6 species each), *Tectaria*, and *Phlegmariurus* Holub (5 species each), *Sphaeropteris* Bernh., *Alsophila* R.Br., *Elaphoglossum* Schott ex J.Sm., *Tapeinidium* (Presl) C.Chr. and *Selliguea* Bory. (4 species each) (Figure 2C).

The species richness of this study is closely lower than that of Mt. Tago range with 203 species (Coritico *et al.*, 2020), Mt. Kitanglad 275 species (Amoroso *et al.*, 1996), Mt. Malindang in Misamis Occidental with 280 species (Amoroso *et al.*, 2012). However, it is higher than Mt. Hamiguitan Range Wildlife Sanctuary in Davao Oriental with 152 species (Amoroso *et al.*, 2016) and Mt. Agad-Agad, Lanao del Norte (Coritico et al., 2020). The



**Figure 1.** Location map of Mt. Sinaka. A. Map of the Philippines, B. Map of Mindanao Island and C. Sampling routes in Mt. Sinaka.

**Table 1.** Checklist of ferns and lycophytes in Mt. Sinaka, Arakan, North Cotabato, Southern Philippines. (Growth forms: AR – arborescent; HL –holoepiphytic; HE – hemiepiphytic; LI – lithophytic; TE – terrestrial.)

| Species                                                          | Growth forms | Tumanding | San Miguel | Salasang | Collection No.      |
|------------------------------------------------------------------|--------------|-----------|------------|----------|---------------------|
| <b>Lycopodiaceae</b>                                             |              |           |            |          |                     |
| 1. <i>Huperzia miniata</i> (Spring) Trev.                        | TE/LI        |           | /          |          |                     |
| 2. <i>Lycopodiella cernua</i> (L.) Pic. Serm.                    | TE           | /         | /          |          | 0353                |
| 3. <i>Phlegmariurus banayanicus</i> (Herter) A.R.Field & Bostock | HL           |           | /          | /        | 0325/0770/0300/0787 |
| 4. <i>P. pinifolius</i> (Trevis.) Kiew                           | HL           |           | /          |          | 0281                |
| 5. <i>P. salvinoides</i> (Herter) Ching                          | HL           | /         | /          | /        | 0306/0053/0782      |
| 6. <i>P. squarrosus</i> (G.Forst.) Å.Löve & D.Löve               | HL           | /         |            |          |                     |
| 7. <i>P. verticillatus</i> (L.f.) A.R.Field & Testo              | HL           |           | /          |          | 0326                |

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|                                                      |       |   |   |   |                |
|------------------------------------------------------|-------|---|---|---|----------------|
| <b>Selaginellaceae</b>                               |       |   |   |   |                |
| 8. <i>Selaginella biformis</i> A. Braun ex Kuhn      | TE/LI | / | / |   |                |
| 9. <i>S. cupressina</i> (Willd.) Spring              | TE    | / | / | / | 0072/0563      |
| 10. <i>S. denticulata</i> Spring                     | TE    |   |   | / | 0574/0806/0777 |
| 11. <i>S. doederleinii</i> Hieron.                   | TE    | / |   | / | 0560/0182      |
| 12. <i>S. elmeri</i> Hieron.                         | TE    | / |   |   |                |
| 13. <i>S. engleri</i> Hieron.                        | TE    |   |   | / | 0563/0555/0559 |
| 14. <i>S. involvens</i> (Sw.) Spring                 | HL    | / | / | / | 0806 /0328     |
| 15. <i>S. gastrophylla</i> Warb.                     | TE    |   |   | / | 0709/0563      |
| 16. <i>S. negrosensis</i> Hieron.                    | TE    | / | / | / | 0309/0561      |
| 17. <i>S. remotifolia</i> Spring                     | TE    | / |   | / | 0074/0160      |
| 18. <i>S. sp. 1</i>                                  | TE    |   | / |   | 0308           |
| 19. <i>S. sp. 2</i>                                  | TE    |   |   | / |                |
| <b>Aspleniaceae</b>                                  |       |   |   |   |                |
| 20. <i>Asplenium affine</i> Sw.                      | HL    |   | / | / | 0562/0567/0289 |
| 21. <i>A. apoense</i> Copel.                         | HL    | / | / |   | 0067           |
| 22. <i>A. caudatum</i> G. Forst.                     | TE/LI | / | / |   |                |
| 23. <i>A. nidus</i> L.                               | HL    | / | / | / | 0317           |
| 24. <i>A. normale</i> D. Don                         | TE    |   | / | / | 0341/0342/0565 |
| 25. <i>A. persicifolium</i> J.Sm. ex Mett.           | HL    |   |   | / | 0684           |
| 26. <i>A. splendens</i> Kunze                        | HL    | / |   |   |                |
| 27. <i>A. tenerum</i> G. Forst.                      | HL    | / | / |   | 0680           |
| 28. <i>A. thunbergii</i> Kunze                       | HL    | / | / | / | 0679           |
| 29. <i>A. unilaterale</i> Lam.                       | TE/LI | / |   |   | 0166           |
| 30. <i>A. vittaeforme</i> Cav.                       | HL    | / |   |   |                |
| 31. <i>Hymenoasplenium excisum</i> (C.Presl) S.Linds | HL    | / |   | / | 0572           |
| <b>Athyriaceae</b>                                   |       |   |   |   |                |
| 32. <i>Athyrium puncticaule</i> (Blume) T. Moore     | TE    | / | / |   | 0173           |
| 33. <i>Diplazium altum</i> (Copel.) C. Chr.          | TE    | / |   |   | 0183           |
| 34. <i>D. cordifolium</i> Blume                      | TE    |   |   | / | 0774           |
| 35. <i>D. davaoense</i> Copel.                       | TE    | / | / |   | 0283           |

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|                                                         |    |   |   |   |                          |
|---------------------------------------------------------|----|---|---|---|--------------------------|
| 36. <i>D. lomariaceum</i> (Christ) M.G.Price            | TE |   | / | / | 0307                     |
| 37. <i>D. pallidum</i> T. Moore.                        | TE | / | / | / | 0297/0077                |
| 38. <i>D. sorzogonense</i> (C.Presl) C.Presl            | TE | / | / | / | 0069/0349/0776/0661/0768 |
| <b>Blechnaceae</b>                                      |    |   |   |   |                          |
| 39. <i>Blechnum orientale</i> L.                        | TE | / |   |   |                          |
| <b>Cyatheaceae</b>                                      |    |   |   |   |                          |
| 40. <i>Alsophila commutata</i> Mett.                    | AR |   | / |   |                          |
| 41. <i>A. elmeri</i> Copel.                             | AR |   | / |   |                          |
| 42. <i>A. fuliginosa</i> Christ                         | AR | / | / | / | 0164/0554                |
| 43. <i>A. lurida</i> (Blume) Hook.                      | AR |   | / | / |                          |
| 44. <i>Sphaopteris elmeri</i> R.M. Tryon                | AR | / | / | / | 0165                     |
| 45. <i>S. glauca</i> (Blume) R.M. Tryon                 | AR | / |   |   |                          |
| 46. <i>S. polypoda</i> R.M. Tryon                       | AR |   | / |   |                          |
| 47. <i>S. tripinnata</i> R.M. Tryon                     | AR | / | / | / | 0804                     |
| <b>Davalliaceae</b>                                     |    |   |   |   |                          |
| 48. <i>Davallia denticulata</i> (Burm.f.) Mett. ex Kuhn | HL | / | / |   |                          |
| 49. <i>D. heterophylla</i> Sm.                          | HL |   | / |   | 0356                     |
| 50. <i>D. hymenophylloides</i> (Blume) Kuhn             | HL | / |   | / | 0079/0660/0683/0789/0781 |
| 51. <i>D. repens</i> (L. f.) Kuhn                       | HL | / | / |   | 0170/0329                |
| 52. <i>D. solida</i> (G. Forst.) Sw.                    | HL | / | / | / | 0355                     |
| 53. <i>D. trichomanoides</i> Blume                      | HL | / |   | / | 0167                     |
| <b>Dennstaedtiaceae</b>                                 |    |   |   |   |                          |
| 54. <i>Histiopteris incisa</i> (Thunb.) J. Sm.          | HL |   | / |   |                          |
| 55. <i>Microlepia matthewii</i> Christ                  | HL | / | / |   | 0275                     |
| 56. <i>Pteridium aquilinum</i> (L.) Kuhn                | HL | / | / |   |                          |

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|                                                                |       |   |   |   |                |
|----------------------------------------------------------------|-------|---|---|---|----------------|
| <b>Dicksoniaceae</b>                                           |       |   |   |   |                |
| 57. <i>Calochlaena javanica</i> (Blume) M.D.Turner & R.A.White | TE    | / | / |   |                |
| 58. <i>Dicksonia mollis</i> Holttum                            | AR    | / | / |   |                |
| <b>Diplaziopsidaceae</b>                                       |       |   |   |   |                |
| 59. <i>Diplaziopsis javanica</i> (Blume) C. Chr.               | TE    | / |   | / | 0303/0576      |
| <b>Dipteridaceae</b>                                           |       |   |   |   |                |
| 60. <i>Dipteris conjugata</i> Reinw.                           | TE    |   | / |   | 0344           |
| <b>Dryopteridaceae</b>                                         |       |   |   |   |                |
| 61. <i>Acrophorus nodosus</i> C.Presl                          | TE    |   | / | / | 0322           |
| 62. <i>Arachniodes caudifolia</i> Ching & Y.T. Hsieh           | TE    |   |   | / | 0579/0564      |
| 63. <i>Bolbitis heteroclita</i> (C.Presl) Ching                | TE/LI | / |   | / | 0553           |
| 64. <i>Ctenitis</i> sp.                                        | TE    |   | / |   | 0286           |
| 65. <i>Dryopteris nodosa</i> (C.Presl)                         | TE    |   |   | / | 0772           |
| 66. <i>D. sparsa</i> (D.Don) Kuntze                            | TE    |   | / | / | 0340/0681/0771 |
| 67. <i>Elaphoglossum blumeianum</i> (Fée) J.Sm.                | HL    |   | / |   |                |
| 68. <i>E. callifolium</i> (Blume) T. Moore                     | HL    |   | / |   | 0313           |
| 69. <i>E. luzonicum</i> (Copel.)                               | HL    |   |   | / | 0710           |
| 70. <i>E. petiolatum</i> (Sw.) Urb.                            | HL    | / | / |   | 0177           |
| 71. <i>Pleocnemia irregularis</i> (C.Presl) Holttum            | HL    |   | / |   |                |
| 72. <i>Polystichum elmeri</i> Copel.                           | HL    | / | / | / | 0337           |
| 73. <i>P. puncticulatum</i> Alderw.                            | TE    |   | / | / | 0338           |
| <b>Gleicheniaceae</b>                                          |       |   |   |   |                |
| 74. <i>Dicranopteris linearis</i> (Burm.) Underw.              | TE    | / | / |   | 0352           |
| 75. <i>Diplopterygium longissimum</i> (Blume) Nakai            | HE    | / |   |   |                |

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|                                                        |    |   |   |   |                     |
|--------------------------------------------------------|----|---|---|---|---------------------|
| 76. <i>Gleichenia curanii</i> Copel.                   | TE |   | / |   | 0304                |
| 77. <i>G. truncata</i> (Willd.) Spreng.                | TE | / |   |   |                     |
| 78. <i>Sticherus hirtus</i> (Blume) Ching              | TE |   | / | / | 0779/0351           |
| 79. <i>S. loheri</i> (Christ) Copel.                   | TE | / | / | / | 0305                |
| <b>Hymenophyllaceae</b>                                |    |   |   |   |                     |
| 80. <i>Abrodictyum cumingii</i> C.Presl                | TE | / | / | / | 0052/0650/0569      |
| 81. <i>A. obscurum</i> (Blume) Ebihara & K. Iwats.     | TE | / | / | / | 0066/0324/0805/0064 |
| 82. <i>Callistopteris apiifolia</i> (C.Presl) Copel.   | TE | / | / | / | 0648/0662/0323/0057 |
| 83. <i>Cephalomanes javanicum</i> (Blume) Bosch        | TE |   |   | / | 0658                |
| 84. <i>Hymenophyllum acanthoides</i> (Bosch) Rosenst.  | HL | / | / |   | 0062/0327           |
| 85. <i>H. inaequale</i> (Poir.) Desv.                  | HL |   |   | / | 0659/0160           |
| 86. <i>H. pallidum</i> (Blume) Ebihara & K.Iwats       | HL |   | / |   | 0347                |
| 87. <i>H. serrulatum</i> C.Chr.                        | HL | / | / | / | 0061/0650/0277      |
| 88. <i>Hymenophyllum</i> sp.                           | HL |   | / | / | 0775/0262           |
| <b>Hypodemiatiaceae</b>                                |    |   |   |   |                     |
| 89. <i>Leucostegia immersa</i> Wall. ex C. Presl       | TE | / | / |   | 0336                |
| <b>Lindsaeaceae</b>                                    |    |   |   |   |                     |
| 90. <i>Lindsaea apoensis</i> Copel.                    | HL | / | / |   | 0063/0330           |
| 91. <i>L. hamiguitanensis</i> D.N.Karger & V.B.Amoroso | TE |   | / |   | 0280                |
| 92. <i>Odontosoria chinensis</i> (L.) J. Sm.           | TE | / |   |   |                     |
| 93. <i>Tapeinidium acuminatum</i> K.U.Kramer           | TE | / |   | / | 0794/0256/0785      |
| 94. <i>T. gracile</i> (Blume) v.A.v.R.                 | TE | / |   |   | 0068                |
| 95. <i>T. luzonicum</i> (Hook.) K.U.Kramer             | TE | / | / | / | 0773/0231           |
| 96. <i>T. pinnatum</i> (Cav.) C. Chr.                  | TE |   | / | / | 0657/0339           |

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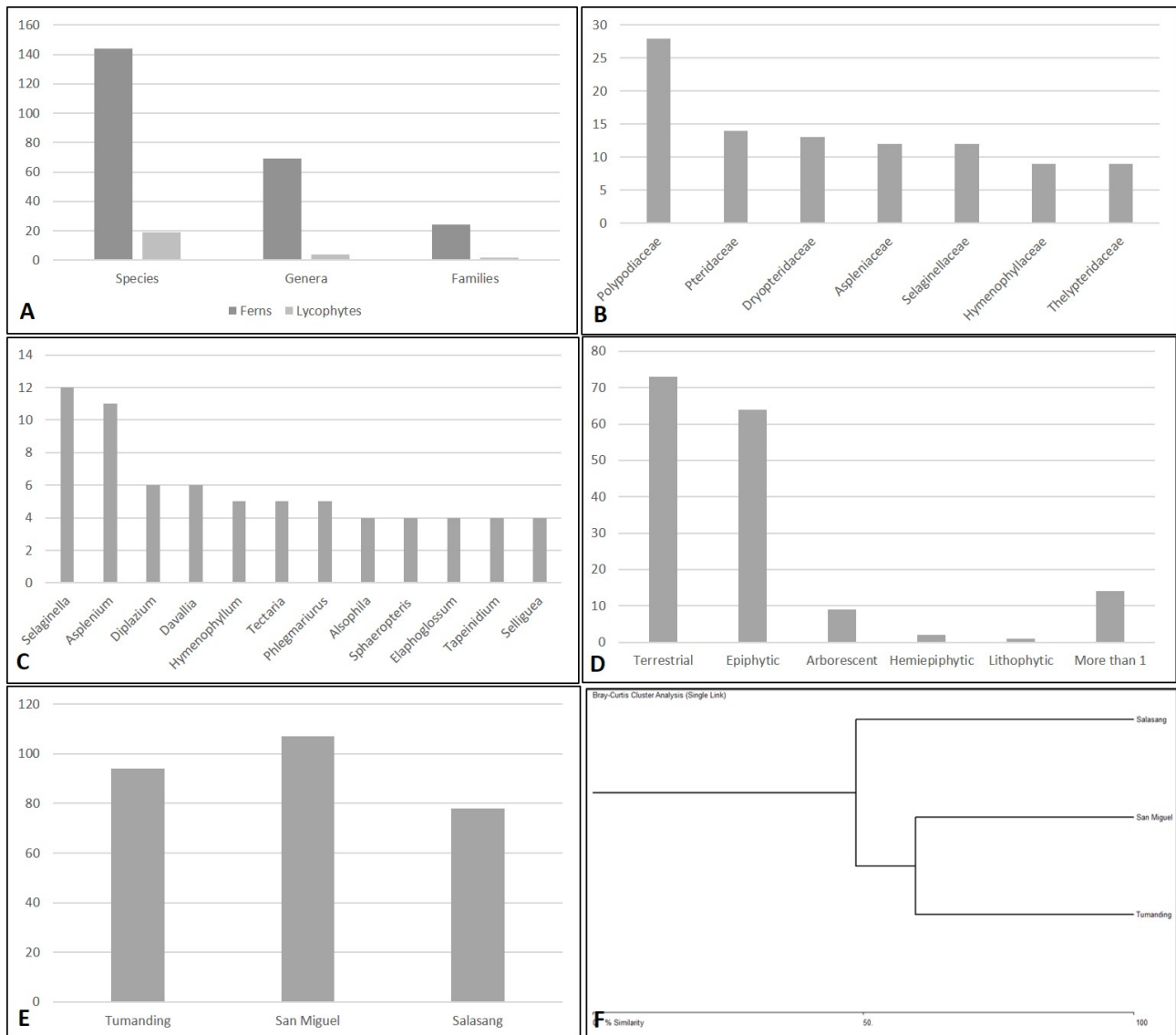
|                                                           |    |   |   |   |                |
|-----------------------------------------------------------|----|---|---|---|----------------|
| <b>Marattiaceae</b>                                       |    |   |   |   |                |
| 97. <i>Angiopteris evecta</i> (G.Forst.) Hoffm.           | TE |   |   | / |                |
| 98. <i>A. palmiformis</i> (Cav.) C. Chr.                  | TE | / | / |   |                |
| <b>Nephrolepidaceae</b>                                   |    |   |   |   |                |
| 99. <i>Nephrolepis biserrata</i> (Sw.) Schott             | HL | / | / |   |                |
| 100. <i>N. cordifolia</i> (L.) C. Presl                   | HL | / | / |   |                |
| 101. <i>N. falcata</i> (Cav.) C. Chr.                     | HL |   |   |   |                |
| <b>Oleandraceae</b>                                       |    |   |   |   |                |
| 102. <i>Oleandra neriiiformis</i> Cav.                    | HE | / | / |   | 0059/0350      |
| <b>Ophioglossaceae</b>                                    |    |   |   |   |                |
| 103. <i>Botrychium daucifolium</i> Wall. ex Hook. & Grev. | TE | / |   |   | 0176/0685      |
| 104. <i>Ophioderma intermedium</i> (Hook.) Nishida        | TE |   | / |   | 0278           |
| 105. <i>O. pendula</i> (L.) C.Presl                       | HL | / | / | / | 0078/0312      |
| <b>Osmundaceae</b>                                        |    |   |   |   |                |
| 106. <i>Plenasium banksiifolium</i> (C.Presl) C.Presl     | TE | / | / |   | 0302/0204      |
| <b>Polypodiaceae</b>                                      |    |   |   |   |                |
| 107. <i>Aglaomorpha cornucopia</i> (Copel.) M.C. Roos     | HL | / | / |   | 0284           |
| 108. <i>A. heraclea</i> (Kunze) Copel.                    | HL | / | / |   | 0310           |
| 109. <i>A. pilosa</i> (J.Sm. ex Kunze) Copel.             | HL |   |   | / |                |
| 110. <i>Calymmodon gracilis</i> (Fée) Copel.              | HL |   | / | / | 0348           |
| 111. <i>Goniophlebium benguetense</i> (Copel.) Copel.     | HE | / |   |   |                |
| 112. <i>G. persicifolium</i> (Desv.) Bedd.                | HL | / | / | / | 0168/0783/0333 |
| 113. <i>G. pseudoconnatum</i> Copel.                      | HE |   |   | / | 0780           |
| 114. <i>Grammitis</i> sp.1                                | TE | / | / | / | 0055           |
| 115. <i>G.</i> sp.2                                       | TE |   | / |   |                |

**Table 1.** Checklist of ferns and lycophytes in Mt. Sinaka, Arakan, North Cotabato, Southern Philippines. (Growth forms: AR – arborescent; HL – holoepiphytic; HE – hemiepiphytic; LI – lithophytic; TE – terrestrial) (continued).

|                                                            |       |   |   |   |                |
|------------------------------------------------------------|-------|---|---|---|----------------|
| 116. <i>Lecanopteris deparioides</i> (Ces.) Baker          | HL    | / | / |   | 0171           |
| 117. <i>Lepisorus accedens</i> (Blume)                     | HL    |   | / |   | 0276           |
| 118. <i>L. spicatus</i> (L.f.) Li Wang                     | HL    |   |   | / | 0682/0712      |
| 119. <i>Leptochilus macrophyllus</i> (Blume) Noot.         | HL    | / | / | / | 0566/0257      |
| 120. <i>Loxogramme avenia</i> (Blume) C.Presl              | HL    | / | / |   | 0296/0184      |
| 121. <i>Microsorium commutatum</i> Copel.                  | HL    | / |   |   |                |
| 122. <i>M. congregatifolium</i> (Alderw.) Holttum          | TE/LI | / |   | / | 0686/0705      |
| 123. <i>M. punctatum</i> (L.) Copel.                       | HL    |   | / |   | 0291           |
| 124. <i>Oreogrammitis</i> sp.                              | HL    |   | / |   | 0279           |
| 125. <i>Prosaptia celebica</i> (Blume) Tagawa & K.Iwats.   | HL    |   |   | / | 0633           |
| 126. <i>P. sp.1</i>                                        | HL    |   | / |   |                |
| 127. <i>Pyrrosia sphaerosticha</i> (Mett.) Ching           | HL    | / |   |   | 0162           |
| 128. <i>Radiogrammitis</i> sp.                             | HL    |   | / | / |                |
| 129. <i>Scleroglossum pusillum</i> (Blume) Alderw.         | HL    | / | / | / | 0169/0315      |
| 130. <i>Selliguea albidosquamata</i> Parris                | HL    | / | / |   | 0179/0298      |
| 131. <i>S. elmeri</i> (Copel.) Ching                       | HL    | / |   |   | 0335/0253      |
| 132. <i>S. triloba</i> (Houtt.) M.G.Price                  | HL    |   |   | / |                |
| 133. <i>S. taeniata</i> (Sw.) Parris                       | HL    | / | / | / | 0332           |
| 134. <i>Tomophyllum subsecundodissectum</i> (Zoll.) Parris | HL    |   |   | / | 0649           |
| <b>Pteridaceae</b>                                         |       |   |   |   |                |
| 135. <i>Antrophyum latifolium</i> Blume                    | HL    | / |   |   | 0073           |
| 136. <i>A. sessilifolium</i> (Cav.) Spreng.                | HL    |   | / |   | 0159/0294/0316 |
| 137. <i>A. callifolium</i> Blume                           | HL    |   |   | / |                |

**Table 1.** Checklist of ferns and lycophytes in Mt. Sinaka, Arakan, North Cotabato, Southern Philippines. (Growth forms: AR – arborescent; HL – holoepiphytic; HE – hemiepiphytic; LI – lithophytic; TE – terrestrial) (continued).

|                                                                |       |           |            |           |                    |
|----------------------------------------------------------------|-------|-----------|------------|-----------|--------------------|
| 138. <i>Dryopteris sparsa</i> (D.Don) Kuntze                   | TE/LI |           | /          | /         | 0340/0681/77<br>1  |
| 139. <i>Haplopteris alternans</i> (Copel.) S.Linds. & C.W.Chen | HL    | /         | /          | /         | 0314/0180          |
| 140. <i>H. ensiformis</i> (Sw.) E.H.Crane                      | HL    | /         | /          | /         | 0314/0791/07<br>88 |
| 141. <i>H. scolopendrina</i> (Bory)C. Presl                    | HL    |           | /          | /         | 0784               |
| 142. <i>Pteris</i> sp.1                                        | TE    |           |            | /         |                    |
| 143. <i>P. mertensioides</i> Willd.                            | TE    |           | /          |           | 0293               |
| 144. <i>P. schlechteri</i> Brause                              | TE    | /         | /          |           |                    |
| 145. <i>P. tripartita</i> Sw.                                  | TE    | /         |            | /         | 0706               |
| 146. <i>Syngamma alismifolia</i> (C. Presl) J. Sm.             | TE    | /         | /          |           | 0070/0334          |
| 147. <i>S. wallichii</i> Bedd.                                 | TE    |           |            | /         | 0793               |
| 148. <i>Taenitis blechnoides</i> (Willd.) Sw.                  | TE    | /         | /          |           | 0181/0295          |
| <b>Saccolomataceae</b>                                         |       |           |            |           |                    |
| 149. <i>Orthiopteris campylura</i> (Kunze) Copel.              | TE    | /         |            |           | 0161               |
| <b>Tectariaceae</b>                                            |       |           |            |           |                    |
| 150. <i>Tectaria angulata</i> (Willd.) Copel.                  | TE    |           | /          |           | 0288               |
| 151. <i>T. athyriorosa</i> M.G.Price                           | TE    |           | /          | /         | 0292               |
| 152. <i>T. decurrens</i> (C.Presl) Copel.                      | TE    |           |            | /         | 0357               |
| 153. <i>T. sulitii</i> Copel.                                  | TE    | /         |            |           |                    |
| 154. <i>T. weberi</i> Copel.                                   | LI    |           | /          |           | 0354/0358          |
| <b>Thelypteridaceae</b>                                        |       |           |            |           |                    |
| 155. <i>Chingia ferox</i> (Blume) Holttum                      | TE    | /         |            |           |                    |
| 156. <i>Christella dentata</i> (Forssk.) Brownsey & Jermy      | TE    | /         |            | /         |                    |
| 157. <i>C. sp.</i>                                             | TE    |           | /          |           | 0318               |
| 158. <i>Pronephrium nitidum</i> Holttum                        | TE    | /         |            |           | 0255               |
| 159. <i>P. sp.</i>                                             | TE    |           | /          |           | 0076               |
| 160. <i>P. xiphioides</i> (Chr.) Holttum                       | TE    |           | /          |           | 0299               |
| 161. <i>Sphaerostephanos</i> cf. <i>semimetralis</i>           | TE    |           | /          |           | 0290               |
| 162. <i>S. unitus</i> (L.) Holttum                             | TE    | /         | /          | /         | 0058               |
| 163. <i>S. sp.</i>                                             | TE    | /         | /          |           | 0285               |
| <b>Total</b>                                                   |       | <b>94</b> | <b>107</b> | <b>78</b> |                    |



**Figure 2.** Numbers of ferns and lycophytes in Mt. Sinaka by classes, families, genera, and growth forms. A. Proportion of families, genera, and species of Lycopodiopsida and Polypodiopsida. B. Seven most diverse families of ferns. C. = D. Number of species per growth forms. E. Total number of species per site. F. Similarity between sites.

species richness constitutes about 15% and 29% of the total number of pteridophyte species in the Philippines and Mindanao island, respectively.

The families of ferns and lycophytes recorded in Mt. Sinaka are also the same families of ferns found in the different mountain ecosystems in Mindanao but differ in species richness (Amoroso *et al.*, 2009, 2012, 2018; Coritico *et al.*, 2020). Kessler *et al.* (2010) stated that species richness is greatly affected on the size of the area sampled, climatic condition, soil type, and geographical location. Even human activities such as the conversion of forests to agricultural lands and pollution (Amoroso *et al.*, 2016) and accessibility of the mountain (Coritico

*et al.*, 2017) could be a factor. The richness of ferns and lycophytes in Mt. Sinaka might be influenced by its neighboring mountain ranges like Mt. Apo in the eastern side and Marilog Forest Reserve in western side. More than 50% of the species recorded in Mt. Sinaka are also found in Mt. Apo Range, Marilog Forest Reserve and other mountain ranges in Mindanao (Amoroso *et al.*, 2016; Coritico *et al.*, 2020).

Majority of the growth forms were terrestrial having 73 species, (44.78%) – followed by epiphytes (64 spp., 39.26%), arborescent (tree ferns) (9 spp., 5.52%), hemiepiphyte (2 spp., 1.22%) and lithophytic (1 sp., 0.61%) – and other species were observed to have more than

one growth forms (14 spp., 8.58%) (Figure 2D). The growth forms showed that the ferns and lycophytes in the area are mostly terrestrial and epiphytes. Terrestrial species of pteridophytes are important part of the ground vegetation in many forest. As a matter of fact, they composed two-thirds of the ground flora and one-third are epiphytes (Schuettpelez and Pryer, 2009; Dubuisson *et al.*, 2009).

### Species Similarity Between Sites

Barangay Salasang has the highest elevation (1609 masl) among the three sites. An abundance of terrestrial and epiphytic ferns, lycophytes, bryophytes, and other understory plants were observed in this area.

Barangay Tumanding is closely related to Barangay San Miguel with about 60% similarity of the species and it is attributed to the same elevational gradient and forest type present which is the montane rainforest. The low species richness observed in Barangay Tumanding is due to the massive illegal logging activity in the area. Reforestation was also evident, where *Swietenia macrophylla* King, *Pterocarpus indicus* Willd. and other trees are flourishing in the area. On the other hand, Barangay San Miguel has the highest number of species recorded. Part of the area has unique pitcher plant sanctuary where different species of *Nepenthes* are found *viz.*, *Nepenthes truncata* Macfarl., *N. surigaoensis* Elmer, *N. mindanaoensis* Sh.Kurata, *N. alata* Blanco. This barangay also organized Bantay Kalikasan or forest guards to protect and conserve the biological resources in the area. The ultramafic soil resembles that of Mt. Hamiguitan in Davao Oriental. Both terrestrial and lithophytic lycophytes (*Lycopodiella cernua* (L.) Pic. Serm. and *Huperzia miniata* (Spring) Trev. were also recorded in the said sanctuary. However, the lowland forest of these three sites has been converted into agricultural ecosystem such as banana, palm oil, coffee, corn and vegetables like cabbage, but there are still remnants of indigenous tree and other plant species in these areas.

### Endemism and Conservation Status

There are 13 endemic species recorded in Mt. Sinaka. Of these, 11 are broadly Philippine endemics and 2 are Mindanao endemic. This is about 5% of the total endemic species found in the country. The broadly distributed Philippine endemic species are *Asplenium apoense* Copel., *Alsophila fuliginosa* Christ, *Polystichum elmeri* Copel., *Lindsaea apoensis* Copel., *Aglaomorpha cornucopia* (Copel.) M.C.Roos, *Selliguea elmeri* (Copel.) Ching, *Tectaria athyriosora* M.G.Price, *Pronephrium xiphioides* (Chr.) Holttum, *Phlegmariurus banayanicus*

(Herter) A.R.Field & Bostock, *Selaginella negrosensis* Hieron., and *Selaginella elmeri* Hieron. The Mindanao endemic species are *Lindsaea hamiguitanensis* D.N. Karger & V.B. Amoroso and *Tectaria weberi* Copel.. *L. hamiguitanensis* was discovered in Mt. Hamiguitan Range Wildlife Sanctuary in 2012 and has recently been documented in Mt. Tago and Mt. Pantaron Range in Bukidnon, Central Mindanao (Coritico and Amoroso, 2020) while *T. weberi* was previously recorded only in Mt. Hilong-Hilong, Butuan Province (Copeland, 1912) (Table 2).

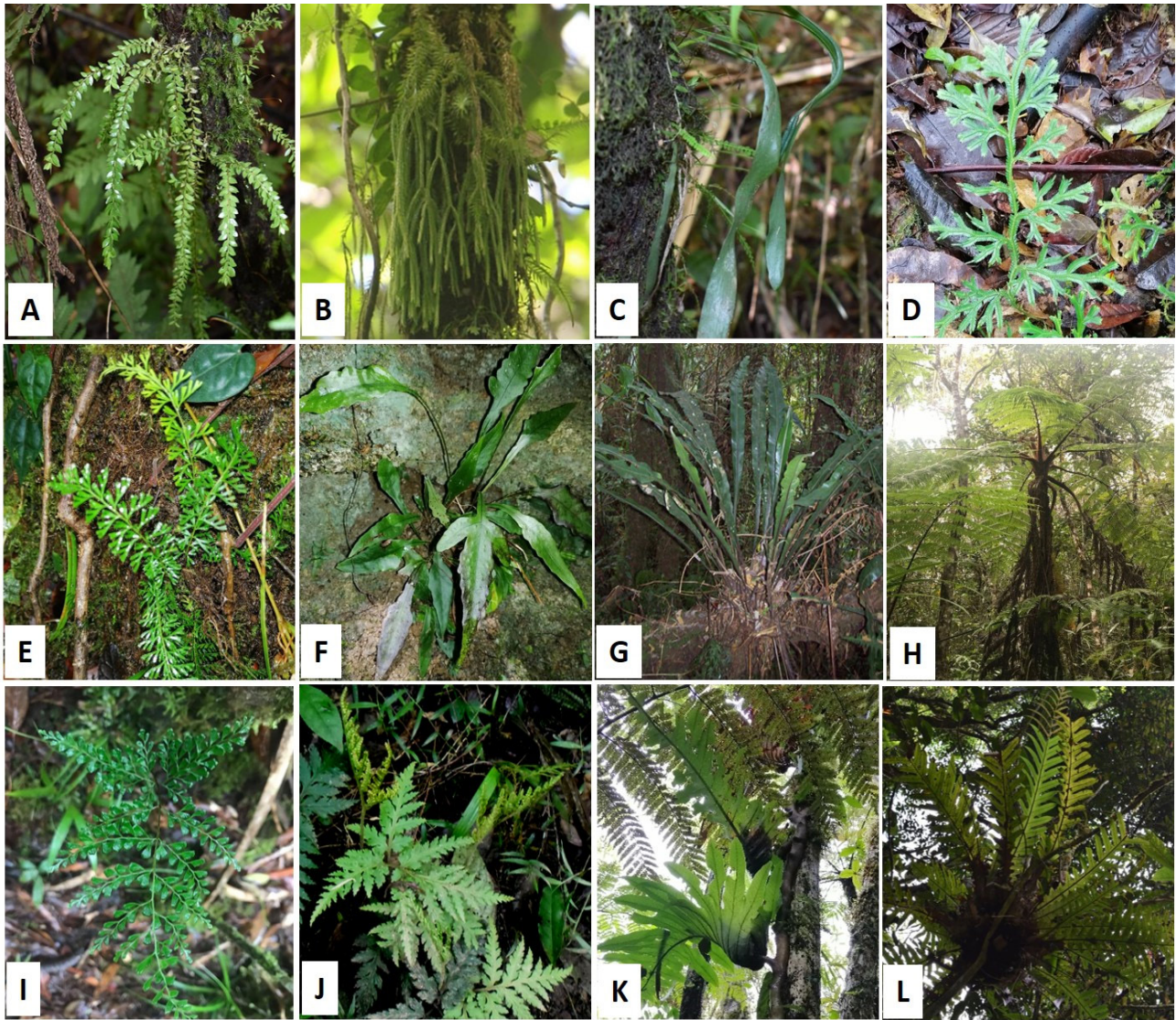
The mountain range is prone to over-collection and exploitation of floral resources, as a source of income of the settlers residing in the foot of the mountain. A total of 19 threatened species recorded, 7 species are endangered, 9 are vulnerable and 3 as other threatened species. The endangered species include *Sphaeropteris glauca* (Blume) R.M. Tryon, *S. lepifera* (J. Sm. ex Hook.) R.M. Tryon, *Dicksonia mollis* Holttum, *Ophioderma pendula* C.Presl, *Lecanopteris deparioides* (Cesati) Baker, *Phlegmariurus salviniioides* (Herter) Ching, *Phlegmariurus squarrosus* (G.Forst.) Á.Löve & D.Löve (Table 2; Figure 3). These ferns and lycophytes particularly the tree ferns are commonly harvested in Mt. Sinaka and sold along the highways going to Davao City for a very minimal price. Habitat destruction through logging, shifting cultivation, land use/land cover change, environmental pollution, invasive species, and over-exploitation of forest resources are considered the major threats to biodiversity (Catibog-Sinha and Heaney, 2006; Monastersky, 2014; Coritico and Amoroso, 2020). Thus, it is strongly recommended that these remaining species will be given a high priority for protection and conservation.

### CONCLUSIONS

Species inventory revealed a total of 163 species of ferns and lycophytes belonging to 73 genera under 26 families. With these, 144 are ferns and 19 are lycophytes. Nineteen threatened species recorded, 7 species are endangered, 9 are vulnerable and 3 as Other Threatened Species. Eleven species are broadly Philippine endemic while two Mindanao endemic species are recorded. Majority of the growth forms are terrestrial (44.78%) and epiphytic (39.26%). The status of the species found in the area demands an immediate protection and conservation in order to preserve the remaining important species. Continuous comprehensive inventory of the species and policy enactment is recommended in order to realize the LGU's desire in declaring Mt. Sinaka as a critical habitat or a local conservation area.

**Table 2.** Conservation status of ferns and lycophytes in Mt. Sinaka, Arakan, North Cotabato. Conservation status: CR – critically endangered, EN – endangered, VU – vulnerable, OTS – other threatened species. Endemism: PE – Philippine Endemic, ME – Mindanao Endemic

| Family          | Species                             | DENR DAO-2017 | Endemism |
|-----------------|-------------------------------------|---------------|----------|
| Lycopodiaceae   | 1. <i>Phlegmariurus salvinoides</i> | EN            | -        |
|                 | 2. <i>P. squarrosus</i>             | EN            | -        |
|                 | 3. <i>P. banayanicus</i>            | -             | PE       |
| Selaginellaceae | 4. <i>Selaginella negrosensis</i>   | -             | PE       |
|                 | 5. <i>S. elmeri</i>                 | -             | PE       |
| Aspleniaceae    | 6. <i>Asplenium vittaeforme</i>     | VU            | -        |
|                 | 7. <i>A. apoense</i>                | -             | PE       |
| Blechnaceae     | 8. <i>Oceaniopteris egregia</i>     | VU            | -        |
| Cyatheaceae     | 9. <i>Alsophila fuliginosa</i>      | VU            | PE       |
|                 | 10. <i>Sphaeropteris elmeri</i>     | VU            | -        |
|                 | 11. <i>S. glauca</i>                | EN            | -        |
|                 | 12. <i>S. lepifera</i>              | EN            | -        |
| Davalliaceae    | 13. <i>Davallia solida</i>          | OTS           | -        |
| Dicksoniaceae   | 14. <i>Dicksonia mollis</i>         | EN            | -        |
| Dryopteridaceae | 15. <i>Polystichum elmeri</i>       | -             | PE       |
| Lindsaeaceae    | 16. <i>Lindsaea apoensis</i>        | -             | PE       |
|                 | 17. <i>L. hamiguitanensis</i>       | VU            | ME       |
| Marattiaceae    | 18. <i>Angiopteris evecta</i>       | OTS           | -        |
| Ophiglossaceae  | 19. <i>Ophioderma pendula</i>       | EN            | -        |
|                 | 20. <i>Botrychium daucifolium</i>   | VU            | -        |
| Osmundaceae     | 21. <i>Plenasium banksiifolium</i>  | OTS           | -        |
| Polypodiaceae   | 22. <i>Lecanopteris deparioides</i> | EN            | -        |
|                 | 23. <i>Aglaomorpha cornucopia</i>   | VU            | PE       |
|                 | 24. <i>A. heraclea</i>              | VU            | -        |
|                 | 25. <i>Aglaomorpha pilosa</i>       | VU            | -        |
|                 | 26. <i>Selliguea elmeri</i>         | -             | PE       |
| Tectariaceae    | 27. <i>Tectaria athyriosora</i>     | -             | PE       |



**Figure 3.** Some ferns and lycophytes in Mt. Sinaka, Arakan, North Cotabato. A. *Phlegmariurus salviniioides*, B. *Phlegmariurus squarrosus*, C. *Ophioderma pendula*, D. *Selaginella negrosensis*, E. *Lindsaea apoensis*, F. *Tectaria weberi*, G. *Asplenium vittaeforme*, H. *Sphaeropteris elmeri*, I. *Lindsaea hamiguitanensis*, J. *Botrychium daucifolium*, K. *Aglaomorpha cornucopia*, L. *Aglaomorpha heraclea*.

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