

## PTERIDOPHYTE AND GYMNOSPERM DIVERSITY IN MUSUAN, BUKIDNON

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### ABSTRACT

Inventory of pteridophytes and gymnosperms in Musuan, Bukidnon revealed 102 species, 52 genera and 24 families of pteridophytes and 8 species and 6 genera of gymnosperms. Of these, 10 species of pteridophytes are endemic, 8 species rare, 8 are depleted, 4 species are new records in terms of locality and 59 are economically important species. Likewise, the gymnosperms have 8 economically important species, 2 rare, and 7 introduced species. Three species of pteridophytes are locally threatened in the wild.

*Keywords: inventory, species richness, non-flowering, vascular plants, Mindanao*

### INTRODUCTION

The pteridophytes include the fern and fern allies which are none seed-bearing plants. The ferns are characterized by the presence of sporangia borne in sori on the lower or abaxial surface of the frond, curling of young fronds forming "fiddle heads" called as circinnate veneration and by the highly developed megaphyllous fronds. On the other hand, fern allies have sporangia associated with sporophylls, young fronds do not coil and the leaves are microphyllous. The gymnosperms, however, are seed plants with ovules freely exposed and mostly in cones.

Copeland (1958-1961) reported 943 species, 150 genera and 17 families of ferns while Co's manuscript (1972) listed 919 species, 143 genera and 29 families. Recently, Salgado (1990) reported 958 species, 151 genera and 31 families. On the other hand, 79 species of fern allies have been identified by Amoroso (1997) and Zamora (1988), viz., 2 species of *Psilotum*, 1 species of *Tmesipteris*, 25 species of *Lycopodium*, 49 species of *Selaginella*, 1 species each for *Isoetes* and *Equisetum*. Thirty-three species of gymnosperms were reported in the Philippines by Zamora and Co (1986).

Musuan, Bukidnon in Northern Mindanao has rich biological resources. It has a variety of habitats such as its forests, grassland and freshwater ecosystems. These ecosystems allow the growth of pteridophytes and gymnosperms as well as other plants which may provide the basic necessities of life such as food, clothing, medicines, shelter and other building materials.

The area covered in the collection of specimens is approximately 3,080 hectares with the Central Mindanao University campus, Musuan, Bukidnon as the nucleus. With an average annual rainfall of 2,195 mm, the elevation ranges from 303 m asl in Pulangui area and reaches as high as 600 m asl in Musuan peak. There is a wide variety of habitats and topography which include flat lowland areas, gentle slopes, rocky crevices, exposed dry ridges, and moist shaded gullies.

Some species of pteridophytes and gymnosperms may be endemic, economic, rare or endangered and may be lost or depleted because of deforestation, land conversion and farming practices. Thus, there is a need to conduct inventory studies to assess the status of pteridophytes and gymnosperms in Musuan, Bukidnon.

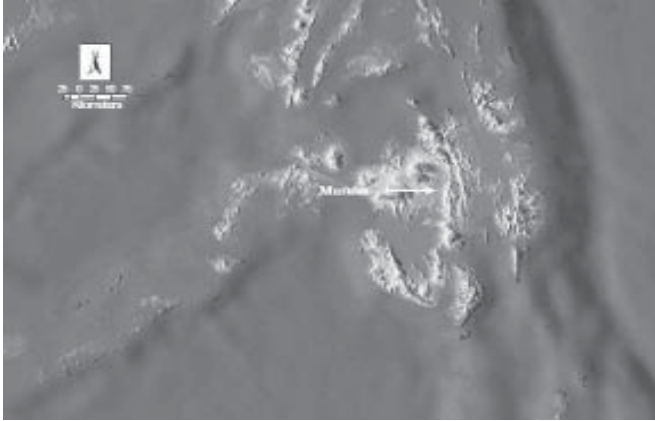
## **METHODOLOGY**

Inventory of pteridophytes and gymnosperms was conducted throughout the 5 zones of Musuan, Bukidnon (Figs. 1 & 2). Species richness was determined by noting the number and kinds of species. The distribution of each species in 5 zones was also noted. Four or five specimens per species were collected and placed in plastic bags with the date of collection, collection number, altitude, habitat and other relevant data. All plants collected from the field were placed in a big plastic bag and brought to the laboratory for pressing and some for planting in the fernery for ex-situ conservation.

The specimens collected were classified, and identified using taxonomic keys from Copeland's Fern Flora of the Philippines (1958-1960), Holttum's Ferns of Malaya (1968), Jones and Clemesha's Australian Fern and Fern Allies (1980), monographs, floras and books. The local name of each species was recorded. The conservation status and economic uses of the pteridophytes and gymnosperms were assessed through interview and literature citations (DENR AO, 2007) and personal observations. Below are definition of terms as adopted from the International Union for Conservation of Nature (IUCN):

1. Endemic Species – Confined to a certain geographical region or its parts.
2. Rare Species – Not under immediate threat of extinction but occurring in such small numbers or in such localized habitat that it could quickly disappear if the environment worsens; needs watching.
3. Depleted Species - Although sufficiently abundant for survival, the species have been heavily depleted and in decline as a result of natural causes or human activities.
4. Economic Species – Bases on known usefulness.
5. Endangered Species – Actively threatened with extinction and its survival is unlikely without protective measures.

Herbarium vouchers were prepared and deposited at the Herbarium of the University Museum, CMU, Musuan, Bukidnon.



**Figure 1. Map of Mindanao showing Musuan, Bukidnon**



**Figure 2. Map of Musuan, Bukidnon showing the 5 zones**

## **RESULTS AND DISCUSSION**

### **A. SPECIES RICHNESS AND DISTRIBUTION IN 5 ZONES**

#### **PTERIDOPHYTES**

Survey and inventory of pteridophytes in Musuan, Bukidnon revealed 102 species, 52 genera and 24 families as shown in Tables 1 & 2. The families Oleandraceae and Polypodiaceae were represented by the most number of species, each with 10 and 15 species, respectively.

These species were more or less evenly distributed in 5 zones except for Zone II which had 65 species and Zone V with only 26 species. The high species richness in Zone II may be due to the presence of cultivated species of pteridophytes in residential gardens. A lower number of species was observed in Zone V since it is an open area, mainly rice fields and grassland. Zones I and III had 33-36 species

**TABLE 1. NUMBER OF FAMILIES, GENERA AND SPECIES OF PTERIDOPHYTES AND GYMNOSPERMS IN MUSUAN, BUKIDNON**

	FAMILY	NUMBER OF	
		GENERA	SPECIES
<b>A. PTERIDOPHYTES</b>			
1.	ASPIDIACEAE	5	8
2.	ASPLENIACEAE	1	8
3.	ATHYRIACEAE	2	3
4.	BLECHNACEAE	2	2
5.	CYATHEACEAE	1	1
6.	DAVALLIACEAE	2	4
7.	DENNSTAEDIACEAE	2	3
8.	DRYOPTERIDACEAE	1	1
9.	GLEICHENIACEAE	1	1
10.	LINDSAEACEAE	2	2
11.	LOMARIOPSIDACEAE	1	3
12.	MARATTIACEAE	2	2
13.	OLEANDRACEAE	1	9
14.	OPHIOGLOSSACEAE	2	2
15.	OSMUNDACEAE	1	1
16.	POLYPODIACEAE	11	15
17.	PTERIDACEAE	2	6
18.	SALVINIACEAE	1	1
19.	SCHIZAEACEAE	1	3
20.	SINOPTERIDACEAE	3	7
21.	THELYPTERIDACEAE	4	7
22.	SELAGINELLACEAE	1	4
23.	LYCOPODIACEAE	1	7
24.	PSILOTACEAE	2	2
<b>TOTAL</b>		<b>52</b>	<b>102</b>
<b>B. GYMNOSPERMS</b>			
1.	CYCADACEAE	1	3
2.	ZAMIACEAE	1	1
3.	ARAUCARIACEAE	1	1
4.	CUPRESSACEAE	1	1
5.	PINACEAE	1	1
6.	GNETACEAE	1	1
<b>TOTAL</b>		<b>6</b>	<b>8</b>

**TABLE 2. LIST OF PTERIDOPHYTES, THEIR STATUS AND LOCAL DISTRIBUTION IN MUSUAN CAMPUS AND VICINITY**

FAMILY/SPECIES	STATUS	LOCAL DISTRIBUTION
<b>I. ASPIDIACEAE</b>		
1. <i>Cyclopeltis cumingiana</i> (Fee) Mort.		Zone I and III
2. <i>Hemigramma taccifolia</i> (J. Sm.) Copel.	ECS	Zone III
3. <i>Pleocnemia irregularis</i> (Presl) Copel.		Zone III
4. <i>P. macrodonta</i> (Fee) Holtt.	EIS	Zone III
5. <i>Tectaria crenata</i> Cav.		Zone III
6. <i>T. decurrens</i> (Presl) Copel		Zone III
7. <i>T. dissecta</i> (Forst.) Lellinger		Zone III
8. <i>Pteridys symatica</i> (Willd.) Christen. et Ching		Zone III
<b>II. ASPLENIACEAE</b>		
9. <i>Asplenium colubrinum</i> Christ.	EIS, DS	Zone I and II
10. <i>A. decorum</i> Kunze	EIS	Zone I and II
11. <i>A. longissimum</i> Blume	EIS	Zone II
12. <i>A. militare</i> Copel	ECS, RS, NRL	Zone II
13. <i>A. musifolium</i> L.		Zone II
14. <i>A. nidus</i> L.	EIS, DS	Zone I and II
15. <i>A. polyodon</i> Forst. F.	EIS	Zone I, II & IV
16. <i>A. tenerum</i> Forst	EIS	Zone II
<b>III. ATHYRIACEAE</b>		
17. <i>Diplazium esculentum</i> (Retz.) Holtt.	EIS	Zone I, II & III
18. <i>Diplazium sp.</i>		Zone V
19. <i>Lunathyrium sp.</i>		Zone IV
<b>IV. BLECHNACEAE</b>		
20. <i>Blechnum orientale</i> L.	EIS, DS	Zone V
21. <i>Stenochlaena milnei</i> Underw.	EIS	Zone II
<b>V. CYATHEACEAE</b>		
22. <i>Cyathea contaminans</i> (Hook.) Copel.	EIS, DS	Zone II
<b>VI. DAVALLIACEAE</b>		
23. <i>Davallia robinsonii</i> Copel.	RS, ECS	Zone II
24. <i>D. solida</i> (Forst.) Sw.	EIS	Zone I, IV & V
25. <i>D. trichomanoides</i> Bl.	EIS, NRL	Zone II & IV
26. <i>Davallodes hirsutum</i> (J. Sm.) Copel.	ECS	Zone V
<b>VII. DENNSTAEDIACEAE</b>		
27. <i>Microlepia speluncae</i> (L.) Moore		Zone I, II, III, IV
28. <i>M. trichostichia</i> J. Sm.	ECS	Zone I
29. <i>Pteridium aquilinum</i> (L.) Khun	EIS, CS	Zone III
<b>VIII. DRYOPTERIDACEAE</b>		
30. <i>Acrophorus nodosus</i> Presl.		Zone I, II, III, IV
<b>IX. GLEICHENIACEAE</b>		
31. <i>Dicranopteris linearis</i> (Burm. F.) Underw.	ECS, EIS	Zone V

## X. LINDSAEACEAE

32. *Lindsaea* sp. Zone II  
 33. *Sphenomeris chusana* (Linn.) Copel. Zone II

## XI. LOMARIOPSIDACEAE

34. *Bolbitis diversifolia* (Bl.) Schott. 1 3 Zone III  
 35. *B. heteroclita* (Pr.) Ching NRL Zone III  
 36. *B. rhizophylla* (Kaulff.) Hennip. EIS Zone I

## XII. MARATTIACEAE

37. *Angiopteris palmiformis* (Cav.) Chr. EIS Zone II  
 38. *Marattia sylvatica* Bl. Zone II

## XIII. OLEANDRACEAE

39. *Nephrolepis bisserata* (Sw.) Schott. EIS Zone I, III, IV, V  
 40. *N. bisserata* "furcans" EIS Zone II, III & IV  
 41. *N. cordifolia* (L.) Presl. EIS, CS Zone I, II, IV, V  
 42. *N. cordifolia* (L.) Presl. var. *furcans* EIS Zone II & V  
 43. *N. duffii* Moore Zone II  
 44. *N. exaltata* (L.) Schott. EIS Zone I, II IV & V  
 45. *N. exaltata* (L.) Schott. 'fluffy ruffles' EIS Zone I  
 46. *N. floccigera* (Bl.) Moore DS, EIS Zone V  
 47. *N. hirsutula* (Forst.) Presl. EIS, CS Zone II

## XIV. OPHIOGLOSSACEAE

48. *Ophioglossum pendulum* L. RS, DS Zone II  
 49. *O. reticulatum* L. RS Zone II

## XV. OSMUNDACEAE

50. *Osmunda banksiifolia* (Presl.) Kuhn. EIS Zone II

## XVI. POLYPODIACEAE

51. *Belvisia squamata* (Hieron ex Chr.) Copel. EIS Zone I  
 52. *Colysis bolsteri* Copel. NRL Zone II  
 53. *Crypsinus trilobus* (Holtt.) Copel. Zone I & V  
 54. *Drynaria descensa* Copel. ECS Zone I, II, III, IV V  
 55. *D. quercifolia* (L.) J. EIS Zone I, II, III, IV  
 56. *D. sparsisora* (Desv.) Moore EIS Zone I, II, III, IV, V  
 57. *Drynariopsis heraclea* (Kunze) Ching. EIS, CS Zone II  
 58. *Goniophlebium* sp. Zone I, II & IV  
 59. *Microsorium palmatum* Fee ECS Zone I, II & IV  
 60. *M. punctatum* (Sw.) Ching Zone I, II & IV  
 61. *Photinopteris speciosa* (Bl.) Presl CS Zone II  
 62. *Phymatopteris taeniata* (Sw.) Pic-Ser. ECS, EIS, CS Zone V  
 63. *Platyserium grande* (J. Sm. ex Fee) Presl. EIS Zone II  
 64. *Pyrrosia adnascens* (L.) Price EIS Zone I, II, III, IV, V  
 65. *P. piloselloides* (L.) Price Zone I & V

## XVII. PTERIDACEAE

66. *Acrostichum aureum* L. EIS Zone II  
 67. *Pteris glaucovirens* Golden ECS, EIS Zone II, III & IV

68. <i>P. mutilata</i> Linn. var. <i>mutilata</i>	EIS	Zone I, II & IV
69. <i>P. mutilata</i> Linn. var. <i>victoriae</i> Hort.	EIS	Zone II
70. <i>P. tripartita</i> Sw.	EIS	Zone I, II
71. <i>P. vittata</i> Linn.	EIS	Zone II, IV & V
<b>XVIII. SALVINIACEAE</b>		
72. <i>Salvinia natans</i> Kunth	EIS	Zone II
<b>XIX. SCHIZAEACEAE</b>		
73. <i>Lygodium circinatum</i> (Burm. F.) Sw.	EIS	Zone I, II, III, IV, V
74. <i>L. fexuosum</i> (L.) Sw.	EIS	Zone I, III & IV
75. <i>L. japonicum</i> (Thumb.) Sw.	EIS	Zone I, II, III, IV, V
<b>XX. SINOPTERIDACEAE</b>		
76. <i>Adiantum capillus-veneris</i> Linn.	DS, EIS	Zone I, II & IV
77. <i>A. caudatum</i> Linn.	DS, EIS	Zone III
78. <i>A. philippense</i> Linn.	EIS	Zone I, II, III, IV
79. <i>A. tenerum</i> Swartz.	EIS	Zone I & II
80. <i>A. trapeziforme</i> Linn.	EIS	Zone IV
81. <i>Cheilanthes tenuifolia</i> (Burm.) Sw.	CS	Zone V
82. <i>Pityrogramma calomelanos</i> (L.) Linn.	EIS	Zone II, IV & V
<b>XXI. THELYPTERIDACEAE</b>		
83. <i>Amphineuron terminans</i> (Hook.) Holtt.	RS	Zone V
84. <i>Christella dentata</i> (Forsk.) Brownsey et Jermy	EIS	Zone I, II, III, IV, V
85. <i>C. parasitica</i> (L.) Lev.	EIS	Zone I, III & V
86. <i>C. subpubescens</i> (Bl.) Holtt.		Zone V
87. <i>Macrothelypteris torresiana</i> (Gaud.) Ching		Zone II
88. <i>Sphaerostephanos unitus</i> (L.) Holtt.	EIS	Zone II, III & IV
89. <i>S. unitus</i> (L.) Holtt. var. <i>unitus</i>	EIS	Zone II
<b>XXII. SELAGINELLACEAE</b>		
90. <i>Selaginella bifformes</i> A. br. ex Kuhn	CS	Zone III
91. <i>S. cupressina</i> (Willd.) Spreng.		Zone III
92. <i>S. uncinata</i> (Desv. ex Poir) J. G. Bak.	EIS	Zone II
93. <i>S. usterii</i> Linn.		Zone I & III
<b>XXIII. LYCOPODIACEAE</b>		
94. <i>Lycopodium carinatum</i> Desv.	RS, EIS	Zone III
95. <i>L. nummularifolium</i> Blume		Zone II
96. <i>L. phlegmaria</i> L.	RS	Zone II
97. <i>L. salvinioides</i> (Hert.) Tagawi		Zone II
98. <i>L. serratum</i> Thunb.	EIS, CS	Zone II
99. <i>L. squarrosum</i> Forst.	EIS	Zone II & IV
100. <i>L. verticillatum</i> Linn.	EIS, CS	Zone II
<b>XXIV. PSILOTACEAE</b>		
101. <i>Psilotum complanatum</i> Sw.	RS	Zone II
102. <i>P. nudum</i> (L.) Beauv.	EIS	Zone II

Legend:

STATUS	ZONES
CS - Common Species	I – Faculty Hill
RS - Rare Species	II – Kibalagon Creek A. Main Campus B. Forestal Area
DS - Depleted Species	III – Pleasantville, Pasture, Water Source, Coconut Plantation
EIS - Economically Important Species	IV – High School, National Food Authority (NFA), Lowland (Rice Paddies), Fishponds
ECS – Endemic Species	V – Pulangui Area, Philippine Carabao Center (PCC), Foot of Mt. Musuan
NRL – New record in terms of locality	

which was more or less 50% less than observed in Zone II. Although these zones had lower species richness, the species density was higher due to the presence of forests in these zones (Table 3).

#### GYMNOSPERMS

A total of 8 species of gymnosperms were identified in 5 Zones (Table 3). These are *Cycas circinalis* L., *C. revoluta* Thumb., *C. rumphii* Miq., *Zamia pumila* L., *Araucaria heterophylla* (Salisb.) Franco, *Thuja occidentalis* L., *Pinus kesiya* Royle ex Gorden and *Gnetum gnemon* L.

Of this number, 7 species were found in Zone II while Zones I and IV had 1 and 2 species, respectively. The high number of species in Zone II was due to the presence of residential homes and buildings with gardens and landscaped by species of gymnosperms like *Cycas revoluta*, *C. circinalis*, *C. rumphii*, *Pinus kesiya*, *Thuja occidentalis*, *Araucaria heterophylla* and *Zamia pumila*. Majority of these gymnosperm species are introduced and cultivated as ornamental plants in residential gardens.

#### B. CONSERVATION STATUS

##### PTERIDOPHYTES

Of the 102 species of pteridophytes identified in 5 zones, 10 species are endemic, 8 species rare, 8 species depleted, 59 species have economic uses and 4 species are new record in terms of locality (Tables 2 & 4). It should be noted that 5 species have not been identified to the species level. These species may be new to science or possibly new record in the Philippines. Many species of pteridophytes are becoming rare, depleted or absent in CMU due to land conversion (Table 5).



**TABLE 3. SPECIES RICHNESS OF PTERIDOPHYTES AND GYMNO-SPERMS IN 5 ZONES**

Zones	Total No. of Species	
	Pteridophytes	Gymnosperms
I	36	1
II	65	7
III	33	-
IV	29	2
V	26	-

**TABLE 4. CONSERVATION STATUS OF PTERIDOPHYTES AND GYMNO-SPERMS**

Conservation Status	Total No. of Species	
	Pteridophytes	Gymnosperms
Common	10	2
Rare	8	2
Depleted	8	-
Economic	59	8
Endemic	10	-
Extinct/Threatened	3	-
New Record/Introduced	4	7

**TABLE 5. PTERIDOPHYTES PRESENT IN 1979 BUT NO LONGER OBSERVED IN PRESENT SURVEY**

Species / Family	Available Local Names
1. <i>Asplenium pellucidum</i> Lam. (Aspleniaceae)	
2. <i>Gleichenia longissima</i> Bl. (Gleicheniaceae)	
3. <i>Marsilea crenata</i> Presl. (Marsileaceae)	Apat-apat
4. <i>Ceratopteris thalictroides</i> (Linn.) Brongn. (Parkeriaceae)	Pakong-sungai
5. <i>Drynaria rigidula</i> (Sw.) Bedd. (Polypodiaceae)	
6. <i>Platyserium bifurcatum</i> (Cav.) C. Chr. (Polypodiaceae)	Staghorn Fern
7. <i>Lygodium auriculatum</i> (Willd.) Alston (Schizaeaceae)	Nito
8. <i>L. microphyllum</i> (Cav.) R. Br. (Schizaeaceae)	Nitong-parang
9. <i>Cyclosorus interruptus</i> (Willd.) H. Ito (Thelypteridaceae)	
10. <i>Pronephrium xiphioides</i> (Christ.) Holtt. (Thelypteridaceae)	
11. <i>Lycopodium cernuum</i> Linn. (Lycopodiaceae)	Club moss

It is noteworthy to mention that 3 species are locally threatened in the wild, namely *Marsilea crenata* (apat-apat), *Ceratopteris thalictroides* (pakong-sungay) and *Lycopodium cernuum* (clubmoss) (Figs. 3-5). These pteridophytes were observed to be abundant in rice fields and canals in the CMU Lowland Area in the 1970's (Amoroso, 1979). However, recent survey indicated the absence of these species in the wild. The elimination of these species is brought about by farming practices like continuous uprooting of these plants as weeds and by the excessive use of pesticides and fertilizers which are detrimental to these delicate plants.

**TABLE 6. LIST OF GYMNOSPERMS AND THEIR CLASSIFICATION, LOCAL NAMES, STATUS AND DISTRIBUTION IN MUSUAN, BUKIDNON**

FAMILY/SPECIES	COMMON NAMES	STATUS/REMARKS
LOCAL DISTRIBUTION AND ZONE NO.		
<b>I. CYCADACEAE</b>		
1. <i>Cycas circinalis</i> L.	Common Pitogo	Economically Important
Front of College of Forestry/ Laurente's residence (Zone II)		
2. <i>C. revoluta</i> Thumb.	Oliva	Economically Important
Ground, Admin. Bldg. (Zone II)		
3. <i>C. rumphii</i> Miq.	Pitogo	Economically Important
Hebron's & Arances' Residence (Zone II)		
<b>II. ZAMIACEAE</b>		
4. <i>Zamia pumila</i> L.	Zamia	Economically Important
College Park, Amoroso's & Austral's Residence (Zones I, II & IV)		
<b>III. ARAUCARIACEAE</b>		
5. <i>Araucaria heterophylla</i> (Salisb.) Franco	Monkey-Puzzle Tree	
Common; Introduced; Propagated by cutting of ends of young shoots		
Lariosa's, Galan's & Cañete's Residence ( Zone II)		
<b>IV. CUPRESSACEAE</b>		

## GYMNOSPERMS

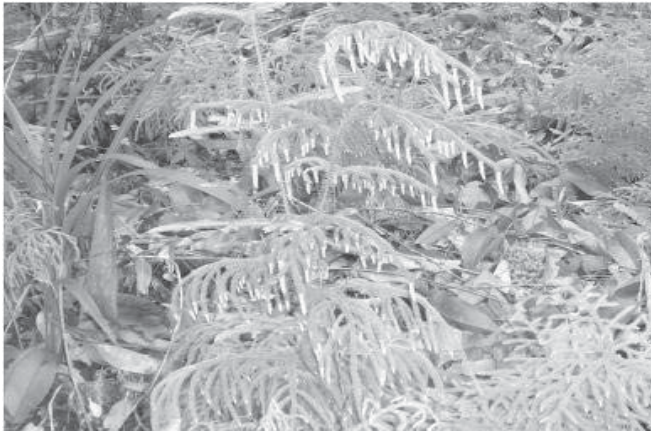
The eight (8) species of gymnosperms are all economically important species. An example is *Cycas circinalis* L. commonly known as “Common Pitogo” in which the seeds of this species are poisonous when fresh but when thoroughly washed and cooked, they furnish a sort of a sago; leaves are also cooked and eaten. Of the 8 species, 2 species are locally rare, viz., *Gnetum gnemon* L. known as “Bago” (Fig. 6) and *Zamia pumila* L. Two species are common, namely, *Thuja*



**Figure 3**



**Figure 4**



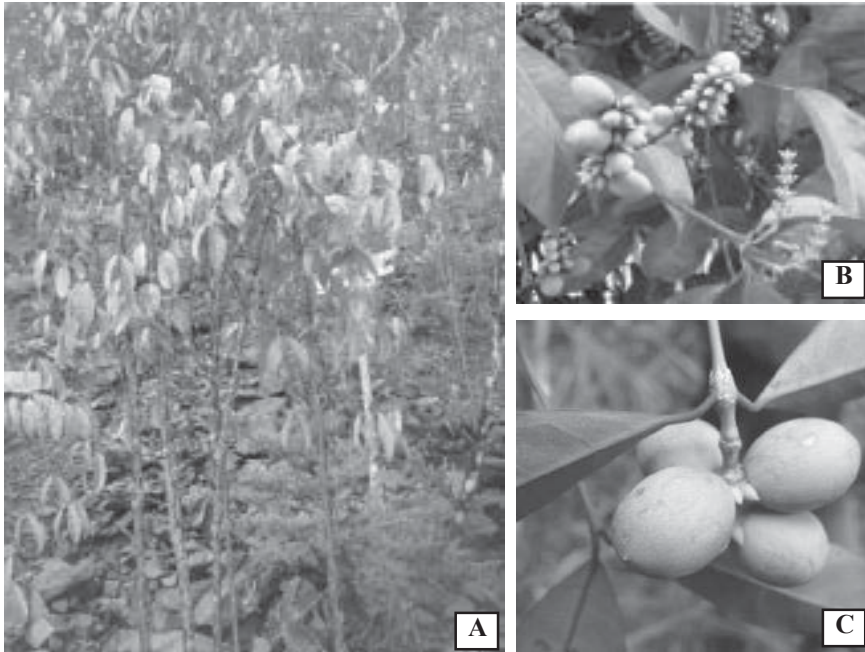
**Figure 5**

## HABIT OF LOCALLY THREATENED PTERIDOPHYTES

Figure 3. *Marsilea crenata* Presl. (Marsileaceae)

Figure 4. *Ceratopteris thalictroides* L. (Brongn.) (Parkeriaceae)

Figure 5. *Lycopodium cernuum* L. (Lycopodiaceae)



**Figure 6. (A) Habit, (B) young and (C) mature seeds of *Gnetum gnemon* L**

*occidentalis* L and *Araucaria heterophylla* (Salisb.) Franco. Most of these gymnosperms are cultivated in garden and introduced in CMU as ornamental plants for landscaping.

### C. *EX SITU* CONSERVATION

One way of conserving rare, endemic and economically important species of pteridophytes is through *ex situ* conservation. This is done by collecting live specimens from the wild and grow them in pots or in hanging baskets in the Fernery for propagation. These pteridophytes in the Fernery will also be the source of spores for spore culture to mass propagate slow growing species of pteridophytes. At present, the Fernery has 83 species of pteridophytes planted in clay pots or hanging baskets. This fernery is now the showcase for the study of pteridophytes and frequently visited by students and teachers.

### SUMMARY AND CONCLUSION

- a. Inventory of pteridophytes in Musuan revealed the presence of 12 species, 52 genera and 24 families. On the other hand, 8 species and 6 genera of gymnosperms were identified. Majority of these species were found in Zone II.
- b. Of the total number of species, 10 species of pteridophytes are endemic, 8 species rare, 8 depleted species, 4 species are new record in terms of local-

ity and 59 are economically important species. Likewise, the gymnosperms have 8 economically important species, 2 rare species, and 7 introduced species.

- c. Three species of pteridophytes, viz., *Marsilea crenata* (Marsileaceae), *Ceratopteris thalictroides* (Parkeriaceae) and *Lycopodium cernuum* (Lycopodiaceae) are locally threatened in the wild.
- d. *Ex situ* conservation in Fernery is one way of conserving rare, endemic and economically important species of pteridophytes.

## RECOMMENDATIONS

1. Identified sites of rare, endemic, depleted and economically important species of pteridophytes and gymnosperms should be protected.
2. Spore culture should be conducted especially the species of pteridophytes which are slow growing and considered to be rare, endemic and economically important species.
3. Gymnosperms considered as edible and have medicinal values should be domesticated for large scale production.
4. Study further the biology of threatened taxa like *Marsilea crenata* and *Ceratopteris thalictroides*.
5. The unidentified species should be sent to an expert for further identification. If these species are found to be new to science then these should be described, given a name, type specimens should be designated and be published in a scientific journal.
6. Encourage housewives and farmers to establish pteridofarms for ferns as cash crops, plantation for medicinal ferns, commercial gardens for ornamental species and cottage industry for ferns with handicraft potentials.

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