

BIOLOGICAL SCIENCES

DIVERSITY, STATUS, AND ECOLOGY OF PTERIDOPHYTES IN THREE FORESTS IN MINDANAO

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ABSTRACT

Field collection trips were conducted in three forests in Mindanao, viz., Mt. Kitanglad and Mt. Apulang in Bukidnon and Marilog Forest in Davao to determine the diversity, status, and ecology of the pteridophytes. Mt. Kitanglad showed the highest species diversity with 275 species, Mt. Apulang with 249 species, and Marilog Forest with only 183 species. Assessment of the status of pteridophytes revealed 1 endangered species, 32 rare species, 7 depleted, 89 endemic, and 81 economically important species. Mt. Kitanglad and Mt. Apulang exhibited high endemism, high percent organic matter, low temperature, and high amount of rainfall. However, the forest tree species, which are the habitat of the pteridophytes, are cut at an alarming rate. Moreover, the foot of the mountain is cultivated as vegetable plantation for potato and cabbage. Lastly, the people practice shifting cultivation, thereby endangering the lives of the pteridophytes.

INTRODUCTION

The Philippines is the habitat of about 930 species of ferns of which more than 50 were reported to have actual or potential economic value and 296 species were so far known to be endemic in the Philippines (Zamora and Co, 1986).

The forests present a very crucial factor in the lives of the pteridophytes since they provide shelter and support. However, with the alarming rate at which our forests are being denuded and destroyed, many species of pteridophytes become rare, endangered, threatened, and depleted. If this condition is allowed to continue without immediate moves to inventory and conserve the pteridophyte flora and their habitat, these ferns are bound to become extinct.

The occurrence of a rich flora in Mindanao is due to the forests in the area and the high elevation of the place. Nevertheless, the rich flora is presently threatened by the illegal loggers and "kaingineros" who have found the area suitable for farming. Forest trees are cut down and burned at an alarming rate. Furthermore, ecosystematic studies on the pteridophyte flora have been meager.

This study was conducted to: (a) collect and identify the pteridophytes found in three forest areas in Mindanao; (b) determine the status of the collected pteridophytes whether they are rare, endangered, depleted, endemic, or economically important species; (c) record the ecological parameters in three selected forest areas; and (d) recommend appropriate protective measures in the conservation of these pteridophytes.

METHODOLOGY

A. Collection, Preparation, and Identification of Specimens

Field collection trips were made to collect pteridophytes in three forest areas, viz., Mt. Kitanglad and Mt. Apulang in Bukidnon and in Marilog Forest in Davao. Some of the collected specimens were transplanted to the fernery for propagation and for *ex-situ* conservation while the others were dried as herbarium specimens and deposited in the Herbarium of the Department of Biology.

The specimens collected were identified using the taxonomic keys from Copeland's Fern Flora of the Philippines (1958-1960), Holttum's Ferns of Malaya (1968), monographs, and other books.

B. Determination of the Status of Pteridophytes

The status of the collected pteridophytes was determined and they were categorized as endangered, endemic, depleted, rare, indeterminate, common, or economically important species. Below are definitions of some terms as adopted from the International Union for Conservation of Nature (IUCN):

1. Endangered Species – Actively threatened with extinction and survival is unlikely without protective measures.
2. Rare Species – Not under immediate threat of extinction but occurring in such small numbers or in such localized or specialized habitats that it could quickly disappear if the environment worsens; needs watching.
3. Depleted Species – Although sufficiently abundant for survival, the species population has decreased heavily in number and has declined as a result of natural causes of human activities.
4. Indeterminate Species – Apparently endangered but insufficient data are currently available for a reliable assessment.

5. Endemic Species – Confined to a certain geographical region or its parts.
6. Economically Important Species – Based on known usefulness.

C. Collection of Ecological Data

For each forest area studied, ecological data such as the temperature, relative humidity, elevation, barometric pressure, soil pH, % soil organic matter, and soil type were recorded. Triplicate readings were gathered from the above parameters. In addition, the surrounding vegetation and monthly rainfall pattern were recorded from each established station.

RESULTS AND DISCUSSION

A. Pteridophyte Diversity

Mt. Kitanglad showed the highest species diversity with 275 species, followed by Mt. Apulang with 249 species and Marilog Forest with only 183 species of pteridophytes as shown in Table 1.

Four families of pteridophytes in Mt. Kitanglad and Mt. Apulang were not represented in Marilog forest. These families include the following: (a) Psilotaceae, (b) Cheiropleuriaceae, (c) Osmundaceae, and (d) Plagiogyriaceae.

B. Pteridophyte Status

The status of the pteridophytes was determined and assessed based on the IUCN definitions. It was found that there was 1 endangered species, 32 rare species, 7 depleted species, 89 endemic species, and 81 economically important species.

Mt. Kitanglad and Mt. Apulang have the endangered pteridophyte, *Tmesipteris lanceolata* Dang. (Fig. 1) and they contain many rare endemic species as compared to Marilog Forest (Table 2).

Of the pteridophytes collected from the three forest areas, 27 species have not been identified. These unidentified species might be considered new to science. Furthermore, 3 species of fern plants, namely: *Asplenium baileyianum* (Domin) Watts; *Asplenium parvum* Watts; and *Goniophlebium manmeiense* (Christ) Rodl. Linder may be new record in the Philippines. Likewise, 34 species were noted to be new record in terms of locality.

Mt. Kitanglad and Mt. Apulang are characterized by higher endemism, 53 and 47 species respectively, than in Marilog Forest with only 34 endemic species (Table 2).

Table 1. Number of families, genera, and species in three forest areas.

<i>Families</i>	<i>Mt. Kitanglad Number of Genera: Species</i>		<i>Mt. Apulang Number of Genera: Species</i>		<i>Marilog Forest Number of Genera: Species</i>	
1. Aspidiaceae	2	6	2	3	2	6
2. Aspleniaceae	1	25	1	27	1	19
3. Athyriaceae	3	16	5	16	4	8
4. Blechnaceae	1	4	1	4	2	3
5. Cheiropleuriaceae	1	1	1	1	0	0
6. Cyatheaceae	4	15	3	9	3	3
7. Davalliaceae	5	9	5	8	4	9
8. Dennstaedtiaceae	6	7	5	12	5	7
9. Dipteridaceae	1	1	1	1	1	1
10. Dryopteridaceae	5	16	4	8	2	2
11. Gleicheniaceae	4	11	4	9	3	5
12. Grammitidaceae	4	26	6	18	2	3
13. Hymenophyllaceae	8	20	8	18	5	7
14. Lindsaeaceae	2	12	3	12	3	13
15. Lomariopsidaceae	2	8	1	4	2	7
16. Marattiaceae	2	3	2	4	2	3
17. Oleandraceae	3	10	2	11	2	10
18. Ophioglossaceae	2	3	2	2	1	2
19. Osmundaceae	1	1	1	1	0	0
20. Plagiogyriaceae	1	3	1	3	0	0
21. Polypodiaceae	12	28	12	28	16	24
22. Pteridaceae	1	4	1	8	1	8
23. Sinopteridaceae	4	7	2	3	5	8
24. Thelypteridaceae	8	15	6	9	10	21
25. Vittariaceae	2	6	2	12	2	9
26. Psilotaceae	2	2	1	1	0	0
27. Lycopodiaceae	1	10	1	9	1	2
28. Selaginellaceae	1	6	1	8	1	3
Total	89	275	85	249	78	183

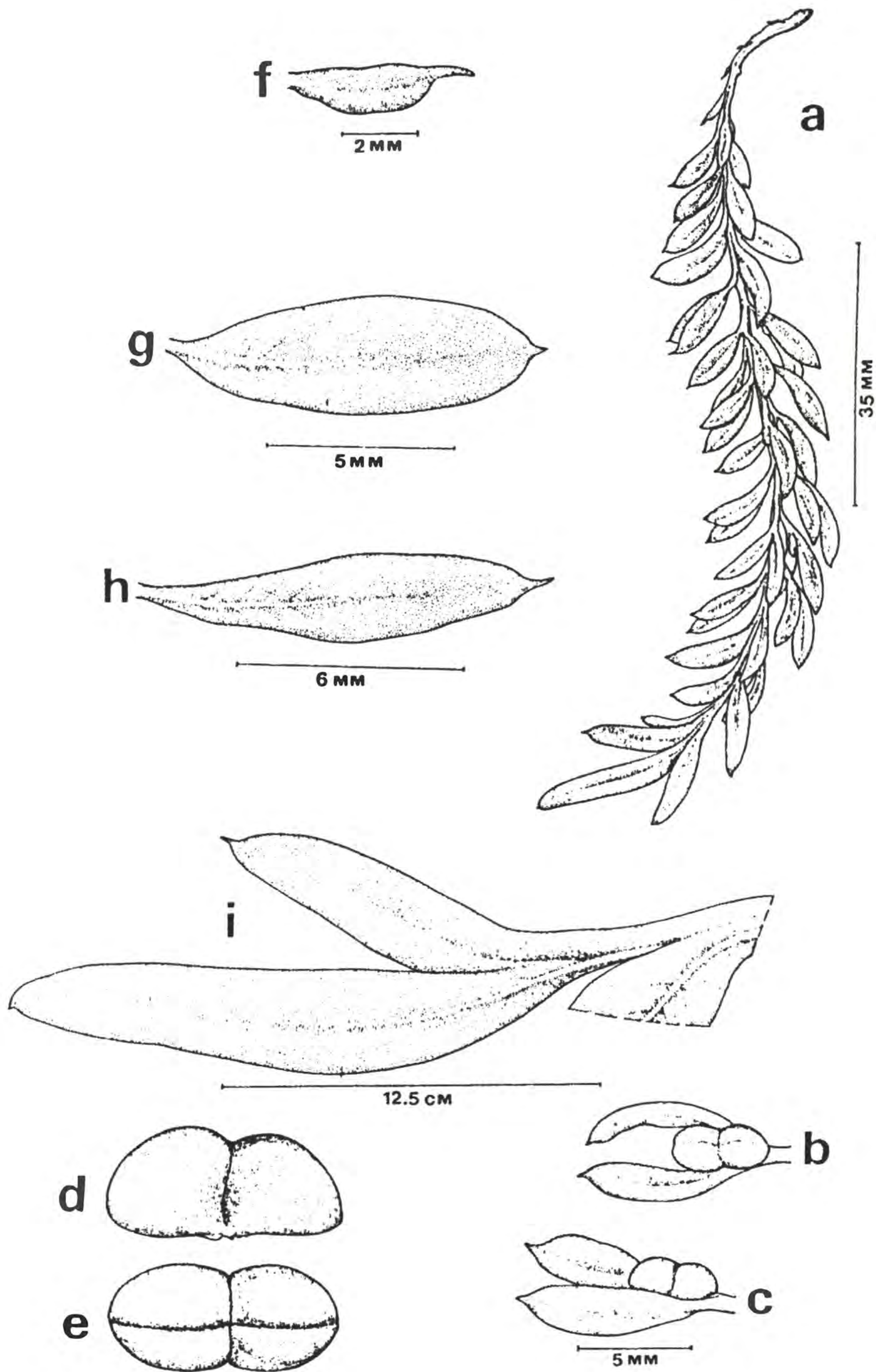


Figure 1. *Tmesipteris lanceolata* Dang. a. Habit showing leaf arrangement; b, c. Proximal and lateral views of sporophylls; d, e. Lateral and proximal views of synangium; f-h. Shapes of basai and middle leaves; i. Shape of terminal leaf.

Table 2. Status of pteridophytes in three forest areas.

<i>Status</i>	<i>No. of Species</i>		
	<i>Mt. Kitanglad</i>	<i>Mt. Apulang</i>	<i>Marilog</i>
Endangered Species (EDS)	1	1	0
Rare Species (RS)	19	17	14
Depleted Species (DS)	7	4	7
Endemic Species (ECS)	53	47	34
Economically Important Species (EIS)	48	39	54

Table 3. Ecological parameters recorded in three forests in Mindanao.

<i>Parameters</i>	<i>BUKIDNON</i>		<i>DAVAO</i>
	<i>Mt. Kitanglad</i>	<i>Mt. Apulang</i>	<i>Marilog Forest</i>
Altitudinal Range (m asl)	1,125-2,700	1,140-2,350	1,150-1,290
Soil pH	3.85 (3.6-4.9)	4.10 (3.9-4.3)	4.85 (4.8-4.9)
Soil Organic Matter (%)	20.10 (15.11-28.90)	16.9 (10.9-22.9)	8.5 (3.8-13.4)
Soil Type	Clay loam	Clay loam	Clay loam

C. Associated Ecological Parameters

1. Soil

Mt. Kitanglad and Mt. Apulang have more acidic soil and high (%) organic matter content than Marilog Forest (Table 3).

2. Temperature and Rainfall

Mt. Kitanglad and Mt. Apulang have lower temperatures at any time of the day and night than in Marilog Forest (Table 4). In Marilog Forest, the temperature is increasing every year due to the cutting of trees and shifting cultivation.

The rainfall data show that Mt. Kitanglad has the highest amount of rainfall followed by Mt. Apulang and the least amount was recorded in Marilog Forest (Table 5).

3. Altitudinal Range

Of the three forests studied, Mt. Kitanglad has the highest altitude which is 2700 m asl at its peak. Mt. Apulang is 2350 m asl while Marilog Forest is 1250 m in altitude.

D. Dominant Tree Species

The dominant tree species in the three forests are as follows:

Mt. Kitanglad:

- a. *Lithocarpus buddii* Soepadmo
- b. *L. sulitii* Camus
- c. *Erythrina subumbrans* (Hasskarl) Merrill

Mt. Apulang:

- a. *Lithocarpus buddii* Soepadmo
- b. *Dacrycarpus cumingii* (Parl.) de Laubenf.

Marilog Forest:

- a. *Agathis dammara* (Lamd.) Rich.
- b. *Lithocarpus buddii* Soepadmo
- c. *Dacrycarpus cumingii* (Parl.) de Laubenf.
- d. *Tristania decorticata* Merrill
- e. *Shorea contorta* Vidal
- f. *S. negrosensis* Foxworthy

Table 4 Annual temperature recorded in three forests in Mindanao.

<i>Parameters</i>	<i>BUKIDNON</i>					<i>DAVAO</i>		
	<i>Mt. Kitanglad</i>			<i>Mt. Apulang</i>		<i>Marilog Forest</i>		
	<i>1991</i>	<i>1992</i>	<i>1993</i>	<i>1992</i>	<i>1993</i>	<i>1991</i>	<i>1992</i>	<i>1993</i>
Temperature (°C)								
T								
I 6:30 A.M.	13 (10-15)	11 (8-15)	14 (10-16)	16.6 (11-23)	15.28 (11-18)	15 (15-17)	18.3 (15.5-18)	18.6 (17-22)
M 3:30 P.M.	17.5 (17-21)	18.7 (17-20)	18 (15-20)	19.1 (16-23.5)	19.64 (16-25)	21 (18-24)	21.3 (18-25)	21.64 (16.5-26)
E 8:30 P.M.	15 (13-17)	15.3 (14-16)	17 (16-20)	16.8 (14-19)	17.19 (15-18)	17 (16-20)	18.4 (17-20.5)	18.77 (17-21.5)

Table 5. Mean monthly rainfall pattern and number of rainy days in three forests in Mindanao.

<i>Month</i>	<i>F o r e s t A r e a s</i>					
	<i>Mean monthly rainfall (mm)</i>			<i>Number of rainy days</i>		
	<i>Mt. Kitanglad</i>	<i>Mt. Apulang</i>	<i>Marilog Forest</i>	<i>Mt. Kitanglad</i>	<i>Mt. Apulang</i>	<i>Marilog Forest</i>
June, 1993	136.10	162.0	179.47	18	20	23
July, 1993	245.00	145.72	243.95	20	21	24
August, 1993	265.00	232.50	205.38	16	20	13
September, 1993	279.6	238.57	281.38	26	28	18
October, 1993	233.85	178.00	238.82	13	15	17
November, 1993	95.63	121.18	97.50	16	17	14
December, 1993	257.33	173.33	145.58	15	18	17
January, 1994	186.67	144.44	130.00	6	9	8
February, 1994	195.00	201.25	82.73	8	8	11
March, 1994	120.00	320.00	105.88	11	13	17
Total	2,014.18	1,916.99	1,710.69	149	169	162
Mean	201.42	191.70	171.07	14.9	16.9	16.2

The classification and local names of these dominant tree species are shown in Table 6.

E Present Ecological Status

Mt. Kitanglad

A portion of the mossy forest, somewhere at the middle portion, approximately 2000 m asl is utilized as resting area or for establishing tents for overnight camping.

The aforementioned portion of the forest has the following features:

- a. It has a rich pteridophyte vegetation;
- b. It is the specific location of the endangered primitive vascular plant scientifically known as *Tmesipteris lanceolata* Dang. (Fig. 1); and
- c. It has the presence of a flowing spring as water source for campers.

If this area is allowed to become the constant resting place for mountaineers, there is a great possibility that the rich pteridophyte flora, endangered pteridophytes, and spring will be disturbed and eventually destroyed due to human activities such as throwing of trash, cutting down of trees, burning of decaying logs, etc.

Mt. Apulang

The forest is characterized by high species diversity, the presence of pristine, crystal-clear waterfalls and springs, and beautiful scenic spots that would equal or surpass other national parks of the Philippines. However, the foot of Mt. Apulang is cultivated as vegetable plantations for potato and cabbage. Furthermore, the people practice shifting cultivation – that is, they move from the periphery of the mountain foot going upwards – which will gradually clear the forest to give way for their crops.

Marilog Forest

The forest has an abundance of dipterocarps which are the habitat of some rare and endemic species of pteridophytes. However, the forest trees are cut down at a very fast rate. Forest tree species which are good for lumber are cut down by the natives and sold to construct the booming resthouses in the area. Furthermore, the forest occupants themselves burn the trees for them to plant cash crops. With these activities, the forest as well as the pteridophytes, are cleared at an alarming rate.

Table 7. Dominant tree species for each forest area.

<i>Mt. Kitanglad</i>	<i>Marilog Forest</i>
1. <i>Lithocarpus buddii</i> Soepadmo FAGACEAE Ulayan, Babaisakan	1. <i>Agathis dammara</i> (Lamb.) Rich. ARAUCARIACEAE Almaciga
2. <i>L.sulitii</i> Camus FAGACEAE Pangnan, Ulayan	2. <i>Lithocarpus buddii</i> Soepadmo FAGACEAE Ulayan, Babaisakan
3. <i>Erythrina subumbrans</i> (Hasskarl) Merrill Anii, Rarang	3. <i>Dacrycarpus cumingii</i> (Parl.) de Laubenf. PODOCARPACEAE Iguem
<i>Mt. Apulang</i>	4. <i>Tristania decorticata</i> Merrill MYRTACEAE Malabayabas
1. <i>Lithocarpus buddii</i> Soepadmo FAGACEAE Ulayan, Babaisakan	5. <i>Shorea contorta</i> Vidal DIPTEROCARPACEAE White Lauan
2. <i>Dacrycarpus cumingii</i> (Parl.) de Laubenf. PODOCARPACEAE Iguem	6. <i>S. negrosensis</i> Foxworthy DIPTEROCARPACEAE Red Lauan

SUMMARY AND CONCLUSIONS

1. Mt. Kitanglad showed the highest species diversity with 275 species, followed by Mt. Apulang with 249 species and Marilog Forest with only 183 species.
2. The status of pteridophytes was evaluated and it revealed 1 endangered species, 32 rare species, 7 depleted species, 89 endemic species, and 81 economically important species.
3. The high pteridophyte species diversity in Mt. Kitanglad and Mt. Apulang may be attributed to certain favorable ecological conditions such as high altitude, high soil organic matter, low temperature, and high amount of rainfall. However, with the expanding camping sites at the middle of Mt. Kitanglad and the on-going shifting cultivation practiced by the people in Mt. Apulang, species diversity will be reduced.

RECOMMENDATIONS

1. Identified sites/habitats of rare, endemic, endangered, and economically important species of pteridophytes should be protected and *in-situ* conservation of these species should also be made;
2. Mt. Apulang be developed and maintained as Natural Botanical Garden due to the richness of the flora, presence of springs and waterfalls, and proximity to Malaybalay;
3. Propagation of the pteridophytes in ferneries or greenhouses for *ex-situ* conservation;
4. Study further the biology of the threatened taxa;
5. The 27 unidentified pteridophytes species be sent to foreign herbaria for identification and the pteridophyte species reported new to the Philippines be described in detail and published in a scientific journal;
6. Strict implementation of the forest laws by concerned government authorities; and
7. Massive education of the people on the importance of the forests in the protection, not only of the pteridophytes, but also of other wildlife.

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