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Diversity and Ecological Status of Bryophytes in Mt. Kitanglad, Bukidnon

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Abstract **-** The study inventoried and assessed the diversity and ecological status of bryophytes in Mt. Kitanglad Natural Park. Results of the study revealed 428 species of bryophytes. Of these, 70 genera and 29 families are for mosses, while 98 species, 16 genera and 11 families for liverworts. There are 4 species, 2 genera and 1 family for hornworts. The lower montane forest exhibited high diversity and species richness followed by mossy and upper montane forest. However, the mossy forest exhibited the highest bryophyte cover. The species were confined in specific habitats either as epiphytic on tree trunks, soils, thick litters and on rock surfaces. Local assessment revealed 9 endemic species, 8 for mosses and 1 for liverworts; 2 species, *Ectropothecium ferrugenium* (C. Mull.) Jaeg. and *Thuidium benguetense* Broth ex. Bartr. were found

endemic to the Philippines. Some 46 species might be possibly new. Of these, 43 are for mosses and 3 for liverworts; and 4 possibly endangered belonging to the genus of *Dawsonia sp.* and *Breutelia sp*., 141 species were found to be rare and others are widespread. Some 11 medicinal species for mosses and 6 species for the liverworts were recorded. Field guides, checklist and IEC materials were produced as a result of the research investigation. The bryophyte status showed that the variation in structural forms and the niche preferences attributed to their specific and extreme micro habitats such as those dominated by mosses as epiphytic on trunks, decayed logs, and various substrates indicate high in terms of species richness, as such, has provided a taxonomic, ecological and economic importance.

Keywords - diversity, ecological, bryophytes, Mt. Kitanglad, hornworts, liverworts, mosses

INTRODUCTION

Bryophytes are nonvascular plants, small, green, simple, spore-bearing and unique among land plants in having relatively large, perennial, photosynthetic, and free-living, haploid gametophytes, unbranched diploid sporophytes that remain attached to the maternal gametophyte throughout their life span, thus it is heteromorphic in their life cycle (Shaw and Beer, 1999). Recently, they include approximately 24, 000 species worldwide, and was divided into three separate divisions, namely: Bryophyta (mosses) with 15,000 species, the Hepatophyta (liverworts) with 8,500 species and Anthocerophyta the (hornworts) with approximately 100 species. These groups are all moisture- loving plants and grow on a wide variety of substrates but differ in their anatomical features. Most importantly, the bryophytes play significant role in the ecosystem in a variety of ways such as biological indicator of air pollution since they are vulnerable to environmental change thus are excellent indicators of climate change; and as model system for research; some species are used in herbal medicine; invaluable in the construction of moss gardens;

few species plays a 'keystone' role in mineral cycling and regulation of microclimate in the forests canopy; they provide food and habitat for a host of invertebrates, (Russell, 1979; Shevock, 2001). They play important role in the dynamics of understory vegetation as well as soil structure, soil stability and interception and retention of water (Bates, 2000).

Mt. Kitanglad is known as one of the natural Parks in Bukidnon, with an elevation up to 2, 938 meters above sea level. The vegetation around its range exhibit richness reflecting the diversity of the montane and mossy forests. However, the said forests were found nearly devastated and tremendous pressures is placed on the mossy forests due to some environmental factors.

Presently, the current state of knowledge of the bryophyte taxa in the Philippines needs to be cryptogamically explored. This should include the identification of its unique and micro-environmental niches that are very limited in extent and threatened by various factors. Philippine forests are ecologically disturbed for some are converted into agricultural landscape. Thus, it is seen that most bryophyte life-forms show emphasis of their distribution in a limited number of classes of land use intensity (Zechmeister, 2001). More so, the continued forest denudation activities and the alarming natural calamities affecting bryophyte flora need immediate attention before they are lost in the biosphere. Taxonomic data on mosses and its allies could hardly be obtained. Thus, there is an urgent need to look into the systematics and ecological status of bryophyte flora in the Mt. Kitanglad Natural park in Bukidnon. Specifically, the study aimed to: identify, classify and describe the bryophyte species in the mountain sites of Mt. Kitanglad; determine the species richness and ecological status of bryophytes; recognize the species with a) medicinal properties; and b) species identified as rare, widespread, endemic and endangered; and produce an instructional handbook and field guide/ checklist of the bryophyte flora in Bukidnon.

MATERIALS AND METHODS

Gratuitous Permit and Entry Protocol

A clearance from the Protected Area Management Board (PAMB), Department of Environment and Natural Resources was secured before the conduct of the study, A series of meetings and representations was organized at the PENRO (Provincial Environment and Natural Resources Office) with the National Commission on Indigenous Peoples (NCIP) Coordinator based at the City of Malaybalay. This was followed by an entry protocol with the village officials at Intavas, La Fortuna, Impasug-ong, Bukidnon. Likewise, meetings with the local guides and researchers were conducted with the information for a two year study in Mt. Kitanglad forest. The researchers observed research ethics particularly the entry protocols of indigenous communities. Informed consent was obtained prior to the interview of respondents.

Location of the Study Site

The research sites were located in Mt. Kitanglad Natural Park situated in Sitio Intavas, La Fortuna, Impasug-ong, Bukidnon.

Field site survey of bryophytes was conducted within the potential areas. Site validation was done to determine the occurrence of vegetation and associated habitats and established sample plots according to type of vegetation(Fig. 1 p. 68).

Establishments of Sample Plots

The sample plots were established according to vegetation types. The conduct of inventory and assessment of the bryophytes was done by a transect walk (Alpha Taxonomy) for each vegetation type. This was done by listing all the bryophytes seen or collected along the trail. The choice of the plots within the sites was executed according to the subjective sampling method. The sampling sites were set-up on the northern and eastern part of the forests for reasons of sunlight intensity

which is considered an important factor for assessing the populations of species of bryophytes.

The number of sample plots per vegetation sites was three making it a total of nine plots, with a dimension of 20x20 m quadrat (square), using a calibrated plastic cord. Inside the quadrat, a visual estimates of bryophyte cover was recorded (Fig. 3 p. 69).

Preparation of Herbarium Specimens

The collected specimens of bryophytes (mosses, liverworts and hornworts) were placed in a plastic bag with a field label data: altitude, collection number, date of collection and their ecology and associated habitats. This was then air dried and placed in packets (envelope) and were properly labeled for herbarium vouchers.The herbaria were deposited at the Museum Botanical Section of Central Mindanao University.

Identification, Classification and Description of Bryophyte Species

The specimens collected were identified, classified and described morphologically by their diagnostic characters such as habit, habitat, leaf arrangement, stem structure, sporophyte characters and rhizoids (Yamaguchi, 1993). Identification was made using the existing herbaria and keys from books and scientific articles and journals. Further examinations was done through microscopy examinations. The species identification were confirmed by Tan (2007), a Bryologist based at the Singapore Botanic Gardens.

Assessment of Conservation Status of Bryophyte Species

Assessment of conservation status of bryophyte species maybe rare, widespread, endemic, threatened or endangered based on International Union for Conservation of Nature (IUCN) and from scientific journals and websites search. Also, the new Annotated Philippine Moss Checklist by Tan and Iwatsuki (1991) was used. Local assessment in this study include the rarity and distribution pattern (widespread) of the species. Along with this assessment, bryophyte

species that have medicinal properties were given preference. The data were taken from a secondary source obtained from science reviews and interviews.

Data Analysis

The general level of index diversity among vegetation types was done with the help of BioPro ver.2 (Biodiversity Professional). This statistical tool is helpful in determining the different parameters for measuring the bryofloral species diversity such as: species density, relative abundance, and species similarity composition. The similarity indices and the correlation analysis are shown through a cladogram data and were evaluated between vegetation types (Fig. 5 p. 70).

Photographs and Documentation

Photographs were made from actual observations in the field as to the species natural habitat (Figs. 6-14 p. 70).

Checklist of the bryophytes and Information, Education and Communication (IEC) materials were prepared in support for easy accessibility of profile of records. The checklist is done to document some collected species and to provide pictorial data for comparison from the voucher specimens.

RESULTS AND DISCUSSION

A. Mt. Kitanglad Range and Its Vegetation Types

Mt. Kitanglad is a volcanic Lanao- Bukidnon Highland and covers most of the northern half of Central Mindanao with an area of 31,297 hectares and is composed of more than a dozen mountain peaks, with an elevation of 2,938 meters above sea level. It is a Natural Park, hence a protected area since November 9, 2000. It displays a unique ecological diversity characterized by a combination and interplay of human communities and connected landscapes, and immense natural diversity of its flora and fauna. Diversity of vascular and nonvascular

plants exists in different microhabitats of Mt. Kitanglad range.

Mossy forest is usually found at altitudes ranging from 2, 315 m asl. to 2, 990 m asl. is also known as the cloud belt, due to the persistence of clouds. The forest trees are almost covered by mosses from the tree base to the uppermost top of the trunk. The relative moisture and rainfall are highest compared to the montane forest.

Upper Montane Forest is usually found at altitudes ranging from 1, 800 m asl. - 2,300 m asl. The forest was characterized by trees with big trunks, taller than those observed in the mossy forest. The moss layer appeared less conspicuous than the mossy forest. The relative moisture and rainfall were also noted high in these regions. The slopes were considerably less steep than mossy forest.

Lower Montane Forest is usually found at altitudes ranging from 1, 400 m asl. to 1, 700 m asl. The forest trees had buttresses and produced prop roots for support. Likewise, some pioneering trees are characterized by tall trees which also occurr in the upper montane forest.

The two vegetation types showed various elevation gradients across the landscape. Observable species were noted for each indicating higher degree of association on their host trees and their natural substrates (Fig. 1 p. 68).

B. Taxonomy

A field inventory of the bryophyte flora in Mt. Kitanglad showed 326 species of mosses, 98 species of liverworts and 4 species of hornworts. The specimens were collected, classified and identified using the taxonomic keys, existing herbaria, and related literature.

The given data for each species include the description based on the observed morphology and diagnostic characters using field lens and microscopes.

MOSSES

Family Bryaceae

Description. Plants in tufts. Stems erect radiculose below, often

subfloral innovations. Upper leaves usually larger, lower leaves small, lanceolate; costa ending in or near apex; cells linear or rhomboidal, thin-walled, smooth, often narrower in several rows at margins. Seta elongate; capsule inclined or pendulous, rarely erect, clavate or pyriform with a distinct, tapering neck; peristome double. 16 lanceolate teeth at outer, inner rudimentary or composed of 16 keeled segments alternating with teeth from a high basal membrane; lid short, conical.

Genus *Brachymenium* Schwaegr.

Description: Plants small to medium-sized. Stems erect with numerous subfloral branches. Leaves erect-spreading, ovate, acuminate; costa excurrent; cells rhomboidal or linear, smooth. Setas elongate; capsule sub-erect; peristome double, teeth 16, papillose, basal membrane of inner peristome high, segments short and rudimentary.

Brachymenium coarctatum Bosch & Lac.

Description: Plants slender. Yellow green when fresh and brownish yellow green when dry. Leaves spreading/ patent, oblong- lanceolate, involute from base up to apex, plicate. Leaf base decurrent. Leaf apex setaceous. Leaf margin entire. Presence of alar cells. Midcosta. Capsule erect, oblong ovoid, sulcate, rostrate operculum.

Ecology: on tree trunk ; 1, 825 m asl.- 2, 410 m asl

ES/ CS: Widespread

VT: Montane & Mossy Forest

C. Species Richness

Inventory of bryofloral species in all the research sites (sampling plots and transect walk) revealed a total of 428 species. Of these, 88 genera and 41 families.

Among the groups of bryophytes, 326 species were classified

as mosses,with 70 genera and 29 families (Table 1). For the liverworts, there are 98 species, 16 genera and 11 families. For the hornworts, there are 4 species, 2 genera and 1 family. These bryophytes occurred mostly along the transects or along trails and sampling plots from the base (1, 805 m asl.) up to the peak (2, 899 m asl.) As such, the total number of bryophytes has been shown to be strongly associated with moisture and vegetation types (Dynesius 2006). However, several species still remain unidentified.

Bryophyte Species Distribution

Several species of mosses, liverworts and hornworts can be observed as low as 1, 805 m asl. and as high as 2, 900 m asl.

As noted, species of bryophytes are generally epiphytic growing on tree trunks on thick decayed fallen logs and litters on covered wet rocks and soil. This observed pattern of species richness may be attributed to the altitudinal zonations of the vegetation types. Hence, the diversity of bryophytes is not evenly distributed in the landscape (Stieperaere 1997).

Some species of mosses that are found in moderately high altitudes (mossy and montane) occurring invariably as an epiphytic on tree trunks and branches or twigs are those belonging to the family of Orthotrichaceae, Neckeraceae, Pterobryaceae, Bryaceae, Calymperaceae, Dicranaceae, Ditrichaceae, Fissidentaceae, Funariaceae, Hookeriaceae, Hypnaceae, Hypnodendraceae, Leucobryaceae, Mniaceae, Polytrichaceae, Pottiaceae, Racopilaceae, Rhizogoniaceae, Sematophyllaceae, Sphagnaceae, Spiridentaceae, Thuidiaceae, Trachypodiaceae, Meteoriaceae and unidentified species, while other species growing well on moist soil, thick humic-rich subtrates are those belonging to the genus of *Sphagnum, Fissidens, Pogonatum,Breutelia, Dawsonia, Hypnodendron, Rhodobryum, Calymperes, Campylopodium, Campylopus, Erythrodontium, Leucobryum, Leucophanes, Plagiomnium, Racopilum, Acroporium, Radulina* and *Thuidium*. Also, other species that usually grows on rock surfaces and crevices, boulders, on exposed tree roots in moderately shaded places either in lowland or in mid-montane forest such as *Plagiomnium, Fissidens,Ectropothecium, Trismegistia* and *Thuidium* but the species *Campylopus* also grows well

on exposed sunlight and thrives along bare rocks and soil surfaces found exclusively at high elevations and are growing on rock rich with soil substrates.

On the other hand, species of liverworts in the same habitats are those belonging to the family of Lepidoziaceae, Plagiochilaceae, Schistochilaceae and Trichocoleaceae. Some unidentified species also exhibit dominance in the area. Also, the species of hornworts belong to the family of Anthocerotaceae were found to exhibit in the region.

Some species of mosses are indicators of the type of vegetation such as those belonging to the genus of *Dicranoloma, Orthodontium, Rhodobryum, Fissidens, Ectropothecium, Hypnodendron, Leucobryum, Aerobryidium, Aerobryopsis, Meteorium, Neckera, Macromitrium, Dawsonia, Pogonatum, Calyptothecium, Trachyloma, Pyrrhobryum, Acroporium, Clastobryopsis, Trismegistia, Sphagnum, Thuidium* and *Trachypus* dominates both in Montane and Mossy forest.

Data revealed that 130 or 39.87 % of mosses were found growing as epiphytic on trunks and branches, 26 or 26.54 % of the liverworts, while one or 25% of hornworts. Fourty-four (44) or 13.49 % of the mosses are confined at the terrestrial habitats, 15 or 15.31 % of the liverworts and one (1) or 25% of the hornworts. Other species of the mosses and liverworts are confined on rock surfaces and crevices with 11 or 3.38 % of the mosses, eight or 8.16 % of the liverworts and two or 50% of the hornworts; and 141 or 43.25 % of the mosses thriving on decaying litters or rotten logs and 41 or 41.84 % of the liverworts and zero (0) or 0% of the hornworts (Fig. 2 p. 69). The high species population confined at decayed logs served as substrate which provide nutrient- rich to lowly plants like mosses can stimulate the growth of all microscopic plants (Bates, 2000).

Findings of the study revealed that of the moss species collected, the most species –rich is represented by the family of Meteoriaceae, (9 genera, 44 species), followed by the family of Dicranaceae (7 genera, 43 species) and the least species is represented by the families of Bartramiaceae, Ditrichaceae, Entodontaceae, Funariaceae, Hylocomiaceae, Neckeraceae, Fissidentaceae, Rhacocarpaceae, Hookeriaceae, Pottiaceae, Sphagnaceae, Spiridentaceae and Trachypodiaceae with 1- 5 genera and 1-2 species each.

On the other hand, the most species-rich of the liverworts collected

is represented by the family of Plagiochilaceae (1 genus, 26 species) and followed by the family of Lepidoziaceae (2 genera, 20 species) and the least species is represented by the families of Aneuraceae, Jungermanniaceae, Schistochilaceae, Metzgeriaceae, Pallaviciniaceae and Trichocoleaceae with only 1 genus each while in hornworts, the species-rich is represented by the genus *Anthoceros* and the least is the *Folioceros*. However, there are 10 unidentified species of liverworts noted in the study.

As observed, the lowland regions or the low forest belts have limited growth of mosses for it appears that the distribution of a number of mosses were affected by destruction of their habitats. The present floristic study noted that the bryophytes occur in different specific and extreme microhabitats. More importantly, the life-form of any bryophyte species is an ecological description of its characteristics shape and structure. Likewise, the various life forms result from the interactions of the plants' physiological functioning, developmental constraints and environmental relationships (Mishler, 1997).

Several unidentified species of mosses, liverworts and hornworts were noted between vegetation types. These species were identified up to genus level, however, in some cases the families and the genus level cannot be identified for the species displayed uniqueness in their morphology characters.

Bryophyte Diversity Indices

The diversity of the three vegetation types was compared as to species richness. A total of 112 bryophytes species in the lower montane forest were recorded in the plots with a diversity value of 4.71. This was followed by the mossy forest with 108 species and with diversity value of 4.68; while a low species richness and diversity value was noted at the upper montane forest with 87 species and diversity value of 4.46 respectively (Fig. 4 p. 70). The high species value and diversity at the lower montane forest may be due to mixed tall trees which moisture and rainfall are stable with the upper montane forest. There were thick diverse substrates allowing specific microhabitat of mosses and liverworts to withstand environmental change. In fact, endangered species such as *Dawsonia superba* and *Breutelia arundinifolia* which can

be observed at high altitudes were observed while at transect walk at the lateral section of the sampling sites.

Similarity indices showed the increasing values from upper montane (59.34%) to mossy forests (63.88%), however, there was a decrease in values from mossy to upper montane (54.58%). There was a least species similarity when compared to lower montane forests. A cladogram is presented for this purpose (Fig. 5 p. 70). The species similarity among vegetation types showed that the bryophytes species in mossy forests had more similarity to upper montane forest. This might be attributed to the life adaptations of mosses and liverworts, that light intensity, temperature and humidity vary vertically, and both forests displayed equally low temperature and cool environment which allows species of mosses and liverworts in diverse morphological form and structure (del Rosario, 1986). In mossy and upper montane forests, the bryophyte moss cover reaches 90- 95% and 85- 90% growth cover, while lower montane moss cover reaches to 60-70 % (Fig. 3 p. 69).

Assessment of Status

Assessment of status of the bryoflora revealed 8 species considered as endemic for mosses and 1 species for liverworts and none for hornworts. Two (2) endemic species namely: *Ectropothecium ferrugineum* (C. Mull.) Jaeg. and *Thuidium benguetense* Broth ex. Bartr. were reported by Tan and Iwatsuki (1991). The reason for its endemism might be attributed to the length of time during which the locality was available for colonization, environmental diversity and especially on the availability of moisture content in the regional habitat. One endangered species was seen only in the transect walk and inside sampling plots namely *Dawsonia superba.* However, 4 possibly endangered species were noted during the conduct of the study. Also, 141 total species were considered as rare based on local assessment while all other species were noted as widespread (Table 2 p. 67).

Fourteen species were recorded as widespread based from the checklist of Tan and Iwatsuki (1991) as previously studied. The study revealed possibly new species for they displayed unique and distinct morphological character as carefully observed through microscopic examinations. For mosses, 17 families and 20 genera were observed and

noted. These families include Bryaceae, Calymperaceae, Dicranaceae, Fissidentaceae, Hypnodendraceae, Hypopterygiaceae, Leucobryaceae, Meteoriaceae, Mniceae, Orthotrichaceae, Polytrichaceae, Pterobryaceae, Rhacocarpaceae, Racopilaceae, Rhizogoniaceae, Sematophyllaceae and Thuidiaceae. Three families were possibly new for the liverworts with 2 genera. This includes Lepidoziaceae, Metzgeriaceae and Plagiochilaceae. This is very important in looking at individual species of moss flora and other nonvascular plants to include a new assemblage of taxa representative. The structure and composition among bryophytes occupy a special position in the evolutionary pattern, hence, they should be given priority to promote conservation on a worldwide basis (Tan and Iwatsuki, 1991). As reported, there is a need to study local moss flora. Intensive collections should be made before the country's rain forests will disappear (Tan and Iwatsuki, 1991). Studying endemism of plant species is important since some bryophyte endemic species have been reported as threatened. High priority should be given for the protection and conservation of these species.

The Medicinal Value of Bryophytes (Ethnobotanical Uses)

Several species of mosses and liverworts were found extremely useful in the field of medicine. Results of the study identified some bryophyte species with medicinal properties (Table 3 p. 67). Eleven (11) species of mosses were traditionally identified with the genus namely: *Philonotis, Bryum, Rhodobryum, Fissidens, Plagiomnium, Mnium,Dawsonia, Pogonatum, Polytrichum* and *Sphagnum*. There are six (6) species of liverworts known for its potential usefulness for man's healing ailments. These include species under genus *Riccardia, Herbertus, Dumortiera, Marchantia,Pallavicinia* and *Plagiochila* (Asakawa, 2008).

Among the most widely known medicinal uses as exhibited by mosses are: cardiovascular problem, nervous prostration to cure angina, healing wounds such as burns and bruises, fungal infections, diuretics, hair growth stimulation, antibacterial agent (swollen throats), specific treatments such as skin ailments, eye disease, hemorrhoids ailments and colds. Liverworts exhibit treatment on the following: antileukemic activity, antimicrobial activity, antiseptics, specific treatments as

diuretics, liver ailments, insect bites, boils, abscesses and pulmonary tuberculosis (Saxena and Harinder, 2004). The present status of the medicinal bryophytes has not proved for economical use due to slow-growing nature and difficulty of culturing the species. However, their pharmaceutical use is very promising.

CONCLUSIONS

From the findings of the study, the following are the conclusions:

A total of 428 species of bryophytes were collected. Of these, the mosses include 326 species, 70 genera and 29 families, while the liverworts include 98 species, 16 genera and 11 families. 4 species, 2 genera and 1 family for the hornworts.

Diversity exists among the bryophytes since some species of mosses were found at different habitats. At the time of sampling, Lower Montane vegetations exhibited high species richness and diversity values since the forest is characterized by mixed tall trees and enough substrate, and is followed by Mossy Forest and the least is Upper Montane Forest. Some species are epiphytic on tree trunks belonging to the family of Orthotrichaceae, Neckeraceae, Pterobryaceae, and Meteoriaceae; While those species growing on moist soil, thick humic-rich substrates are those belonging to the genus of *Sphagnum, Fissidens, Pogonatum,Breutelia, Dawsonia, Hypnodendron, and Rhodobryum.* Also, other species thriving on rock surfaces and boulders in lowland and montane forest are *Fissidens, Thuidium, Ectropothecium, Campylopus* and *Plagiomnium.* The Liverworts thriving on decayed logs and thick litter are those belonging to the family of Lepidoziaceae, Plagiochilaceae, Schistochilaceae and Trichocoleaceae. Species of *Anthoceros* are confined in varied habitats. Some unidentified species also exhibit dominance in the study site.

Local assessment of status of bryoflora revealed 9 endemic species: Eight (8) species for mosses, 1 species for liverworts and none for hornworts. Two species namely *Ectropothecium ferrugineum* (C. Mull.) Jaeg. and *Thuidium benguetense* Broth ex. Bartr. were noted endemic to the Philippines. Forty-six (46) species might be new (43 for mosses and 3 for liverworts) belonging to different families. Four (4) possible

endangered species were noted in mosses belonging to the genus *Dawsonia* and *Breutelia.* A total of 141 species are rare and all others are widespread. On the bryophyte medicinal properties, several species that were collected, identified, and recorded showed potential medicinal value. Some 11 species of the mosses were ethnobotanically recorded. These include *Philonotis, Bryum, Rhodobryum, Fissidens, Plagiomnium, Mnium, Dawsonia, Pogonatum, Poytrichum, Barbula* and *Sphagnum*. And 6 species of liverworts with their representative genera namely: *Riccardia, Herbertus, Dumortiera, Marchantia, Pallavicinia* and *Plagiochila.* Most of these species exhibited antimicrobial activity, antileukemic activity and healing effects.

The overall observations on the diversity and ecological status of bryophyte showed that the variation in structural forms and the niche preferences are attributed to their specific and extreme microhabitats. Most bryophytes live tightly to their moist habitat, and their biology makes use of the substrate to coordinate overall growth. Thus, the various life-forms result from the interactions of the plants' physiology and environmental relationships.

RECOMMENDATIONS

As a result of this research, the following are the recommendations:

Structural diversity and ecology of bryophytes require an in-depth study to carefully explore and describe their morphology and its representation taxa should properly be documented to show evidence of early divergence and probable relationships between the species studied.

Further studies should be conducted with more sampling plots in other parts of Mt. Kitanglad Range in relation to geographic distribution of bryophyte species and correlate this to climatic factors such as climatic change affecting the species diversity.

There is a need to provide an action plan to review the Philippine status of bryophytes and disseminate new information on its potential usefulness as ethnobotanically significant. With this, scientific exploration should be conducted and determine their antimicrobial components through biological activity.

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Table 1. Number of families, genera, and species of Bryophytes in Mt. Kitanglad, Bukidnon

	Family			Genera			Species		
Study site	Mosses	Liverworts	Hornworts	Mosses	Liverworts	Hornworts	Mosses	Liverworts	Hornworts
Mt. Kitanglad	29	11	1	70	16	2	326	98	4
Total		41			88			428	

Table 2. Status of Bryophytes Species in Mt. Kitanglad Natural Park, Bukidnon

Bryophytes	Endemic	Possibly Endangered	Possibly New	Medicinal Properties	Rare	Widespread
Mosses	8	4	43	11	103	211
Liverworts	1	0	3	6	34	63
Hornworts	0	0	0	0	4	0
Total	**9**	**4**	**46**	**17**	**141**	**274**

Table 3. Some Bryophyte Species and their Ethnobotanical Uses

Families	Habitat	Vegetation Type	Medicinal Value/ Uses
MOSSES			
1. Bartramiaceae	on tree trunk	UM	Heal burns
2. *Philonotis* sp. Bryaceae	on decayed log/ litter	UM, Mo	For cardiovascular problem and nervous prostration; cure angina
Rhodobryum giganteum (Schwaegr.) Par.		UM	Healing wounds, burns and bruises; cure fungal infections
Bryum sp.			
3. Fissidentaceae	on soil, decayed rock surface	UM,Mo	Diuretics stimulation and hair growth tonics as antibacterial agent for swollen throats and other symptoms of bacterial infection
Fissidens nobilis Griff.	on rock surface, soil		
4. Mniaceae	on decayed log	LM, UM,Mo	For infections and swellings
Plagiomnium sp.	on soil		Poultice to reduce pain of burns, bruises and wounds
Mnium sp.		LM, UM Mo	
5. Polytricaceae	on soil	UM, Mo	Diuretics and hair growth stimulation; for treating colds
Dawsonia superba Grev.			
Pogonatum macrophyllum Dozy & Molk.	on soil (near creek)	UM	To reduce inflammation and fever, as detergent diuretic, laxative and hemostatic agent

Legend: LM- Lower Montane UM- Upper Montane Mo- Mossy

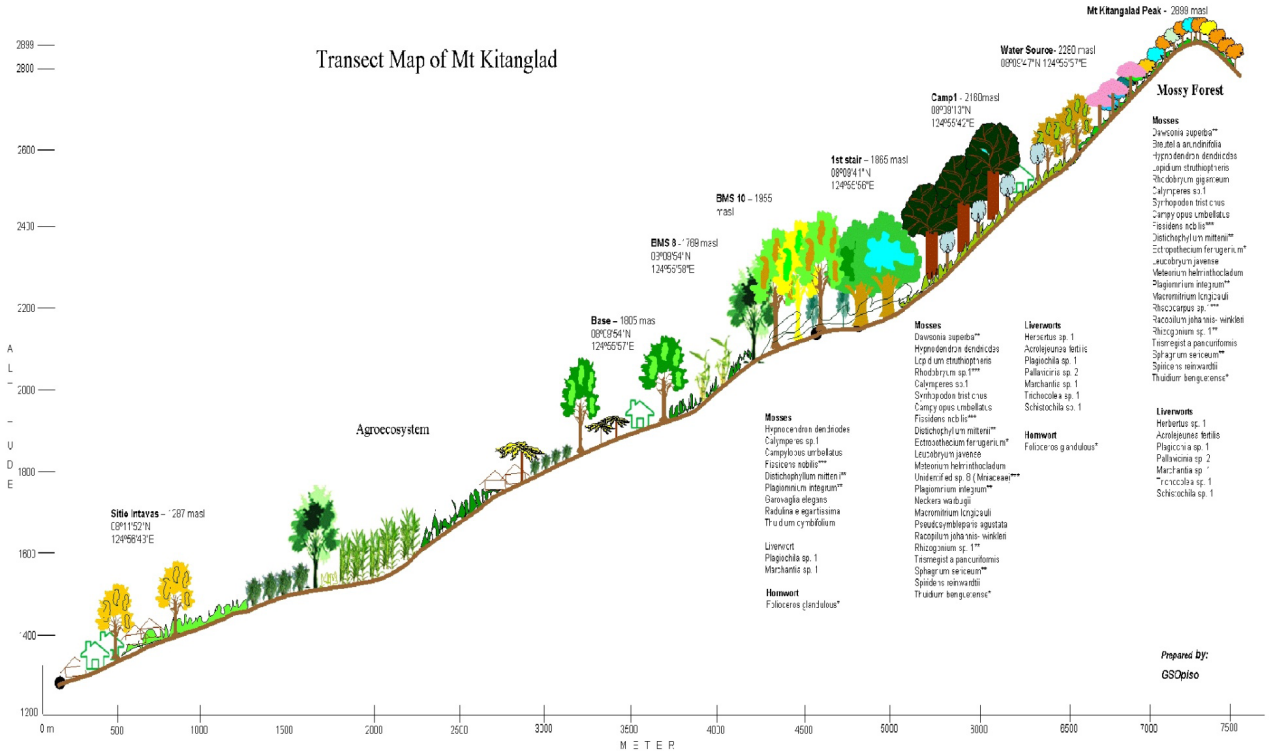

Fig. 1. Transect diagram of different vegetation types

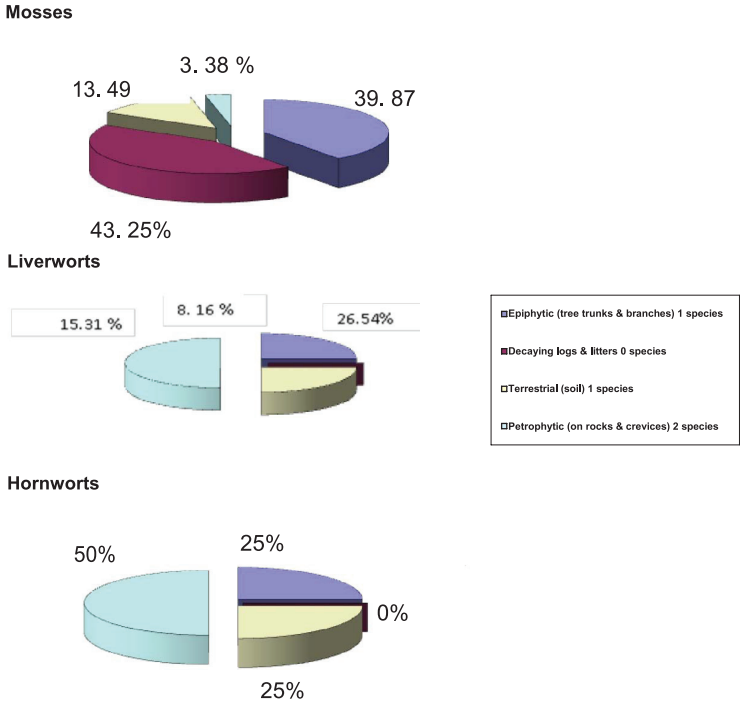

Fig. 2. Percentage of bryophytes confined at their main habitat

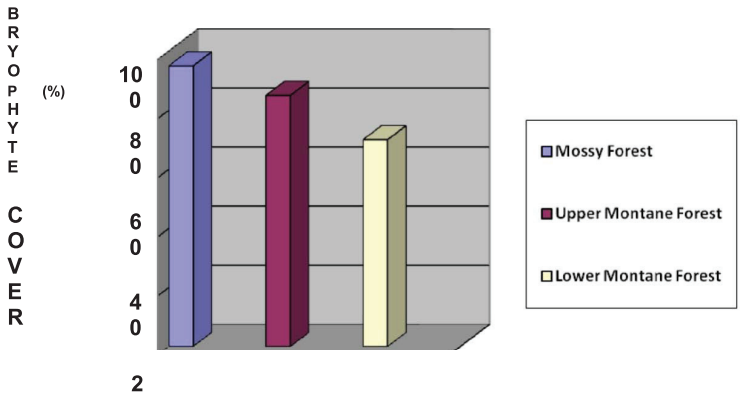

Fig. 3. Bryophyte cover in Mt. Kitanglad Natural Park, Bukidnon

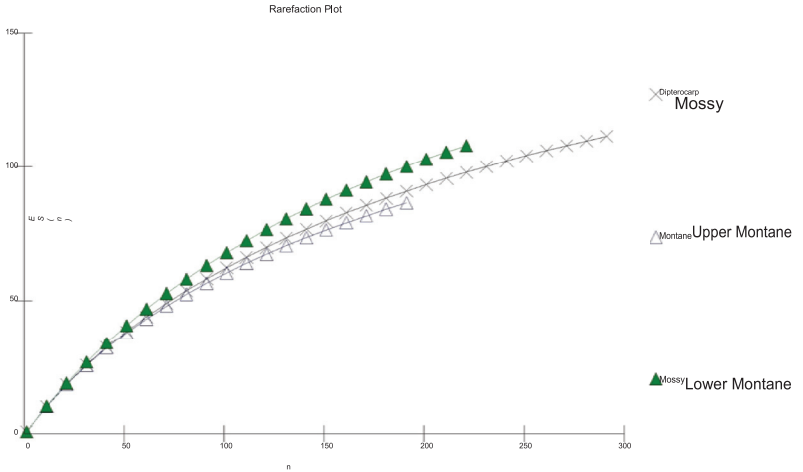

Fig.4. Index of diversity among vegetation types

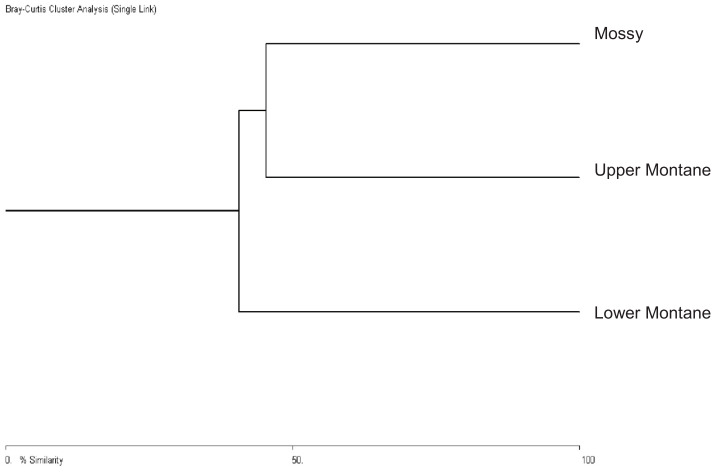

Fig.5. Cladogram showing similarity of species composition

Fig. 6. Family BRYACEAE
Unidentified sp. (Possibly new species)

Fig. 7. Family POLYTRICHACEAE
Dawsonia superva Grev. (Endangered species)

Fig. 8. Family BARTRAMIACEAE
Breutilia arundinifolia (Duby) Fleisch
(Endangered species)

Fig. 9. Family RHIZOGONIACEAE
Unidentified sp. (Possibly new species)

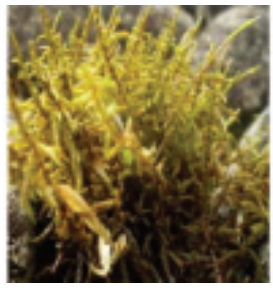

Fig. 10. Family RHACOCARPACEAE
Unidentified sp. (Possibly new species)

Fig. 11. Family BRYACEAE
Rhodobryum sp. (Possibly new species)

Fig. 12. Family MNIACEAE
Unidentified sp. (Possibly new species)

Fig. 13. Unidentified sp. (Possibly new species)

Fig. 14. Family HYPNACEAE
Ectropothecium ferrugineum
(C Mull) Jaeg. (Endemic)