DISTRIBUTION OF SOME INSECTS OBSERVED IN MOSS CUSHIONS AT CINCHONA FOREST RESERVE,MT. KITANGLAD, LANTAPAN, BUKIDNON, MINDANAO, PHILIPPINES

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Abstract: Insects account for about 80 percent of animal life on Earth. Distribution of some insects observed in moss cushions ecosystem was conducted at Cinchona Forest Reserve, Lantapan, and Bukidnon, Philippines. Insects are arthropods that inhabits in moss cushions with their associated bacteria, and fungi which provide nutrients for most fauna. The study aimed to determine insects associated with moss cushions in Cinchona Forest Reserve, Mt. Kitanglad, Lantapan,Bukidnon. The forest has an average elevation of 1,223 meters above sea level. Field sampling through opportunistic survey was employed by recording all the insects observed in moss cushions. Findings revealed a total of 12 families and 21 genera of insects which include the families of Formicidae, Curculionidae, Gryllidae, Blaberidae, Chrysomelidae, Tenebrionidae, Tetrigidae, Cicadelidae, Drosophilidae, Heteropterygidae, Porcellionidae, and Termitidae. Of these, the associated moss families for which insects were observed indicate a total of 7 families, 11 genera, and 18 species.Further, Bryofauna such as insects include organisms that live and eat almost the moss floral species. In tropical regions, numerous moss plant influenced the abundance and distribution of some insects such as the provision of a water refuge to protect from predators. Data suggests some specificity of bryofauna in Cinchona Forest Reserve.

Keywords: arthropods, bryofauna, moss cushions, mossy

1. INTRODUCTION

Ecologically, bryophytes species are lowly group which include the mosses, liverworts and hornworts which are taxonomically diverse group as nonvascular plants with about 25, 000 worldwide and the second largest group of land plants (Shaw and Renzaglia, 2004). Floral species are important component of tropical montane forests, both in terms of ecosystem functioning, biomass and biodiversity (Holtz et al., 2006). It has been the center for biological research and that moss biodiversity studies have been recently receiving greater attention. With the estimate that 20% of plant diversity has been extinct, there is a need to look at the distributions, ecology and taxonomy status of the so-called dynamics of bryophytes in relation to structure and populations (Kimmerer & Dale Vitt., 1997). The emergence of conservation biology in the global context requires greater concern, hence there is a need to consider the ecology and economic value of bryoflora in forest ecosystem (Gunathilaka, 2019).

Generally, mosses have frequently been investigated from an ecological standpoint. For numerous invertebrate species, they serve as an essential natural environment where they can thrive, look for food or shelter, hunt, and deposit their eggs. Ecologically, mosses may alter the soil's properties and has a unique microclimate that can preserve water which might let some arthropods thrive under extreme environmental condition. Additionally, invertebrates can benefit mosses by spreading the spores of some mosses and have recently been discovered to coexist symbiotically with each other (Božanić, 2011). Although mosses can be used as camouflage by invertebrates for some predatory insects have the ability to seek within them and this kind of camouflage helps them only when they within moss growth.

So far, the relationships between mosses and insects nonetheless, have received little attention from both botanical and zoological ecologists. They frequently disregard mosses as a potential habitat for some arthropods. Studying the

distribution of some insects found in moss cushions ecosystem provides a round-the-year interest for naturalists. The ecological distributions of insects are poorly known compared with those of larger, more conspicuous animals thriving in vascular plants. It is also more rewarding to elucidate these ecological distributions because moss species are neither deliberately controlled nor planted by humankind.Thus, this research examined the distribution of some insects observed in Moss Cushions ecosystem at Cinchona Forest Reserve, Barangay Kaatuan, Lantapan, and Bukidnon.

2. MATERIALS AND METHODS

A Descriptive survey research was employed involving quadrat plot sampling and active sampling. A permit clearance in the form of real time and Wildlife Gratuitous Permit were then secured from the Protected Area Management Board (PAMB), Department of Environment and Natural Resources (DENR). Also, meetings with the local guides and researchers was conducted to give a total picture of the research investigations. Research ethics particularly the entry protocols was observed before the conduct of the study. The research sites were located in Cinchona Forest Reserved in Barangay Kaatuan, Lantapan, Bukidnon with an elevation of 1,223 meters above sea level. Sample plots were established at the field site. A survey of some insects observed in moss cushion environment was conducted within the sampling areas. This was done by collecting several insect species in a moss cushions environment through active sampling along the established quadrat plots. The collected specimens of several insects were placed in a small plastic or bottled container while the collected specimens of moss where the insects were found were placed in a pre-final packet with field label data: altitude, collection number, date of collection and their ecology. The collected insect species was subjected to curation and long-term storage which includes preservation of the individual specimens. The moss species which serves as the unique habitat that provide shelter against the insects were collected, air dried, and were placed in a final packet envelope and were properly labeled for herbarium vouchers. The voucher specimens and herbaria specimens were deposited at the University Museum, Central Mindanao University. Identification of the collected insects and moss species were subjected for further identification by experts. Other taxonomic body characters and microscopy examinations were made to countercheck its unique characters. Some standard manuals, books, journals, keys, checklist, monographs, internet sources and related literature were used. Photographs were made from the actual observations in the field as to the species distribution and its specific natural moss ecology preference.

3. RESULTS AND DISCUSSION

3.1 Cinchona Forest Reserve and ItsVegetationTypes

Cinchona Forest Reserve located at Kaatuan Lantapan, Bukidnon is considered as a virgin forest and a suitable place for the different flora and fauna especially for the mosses and bryofauna that inhabits it. Moss species are all moisture-loving plants that grow on a wide variety of substrates which offers several advantages for some insects. The insect species in the study area were observed in different moss cushions ecosystems. Ever since, the forest reserve has been maintaining its ecological balance in the surrounding communities and is protecting the watershed of the locality. Lower Montane Forest was characterized by trees with buttresses and produced prop roots for support. The moss cover appeared to be less than the upper montane and mossy forest. Some trees are scattered, tall and are more prone to human-induced destructions. Upper Montane Forest was described by trees with big trunks and were taller than trees found in the lower montane and mossy forest. The moss cover appeared less conspicuous than the mossy forest. The temperature of the area is relatively cool and the relative moisture and rainfall were also noted high in these regions. Mossy Forest was characterized by forest trees covered by mosses from the tree base to the uppermost top of the trunk. The relative moisture and rainfall are extremely high compared with that of the montane forests. These vegetation types revealed variability on the number of insects observed in moss cushion ecosystem. As noted, the insect species present indicates higher degree of association on the moss floral species.

3.2 InsectsFound in Moss Cushion Ecosystem

A total of twelve (12) families and twenty-one (21) genera in Table 1 arranged in their order with the most numbered of insects observed, are Formicidae, Curculionidae, Blaberidae, Gryllidae, Chrysomelidae, Tenebrionidae, Tetrigidae, Cicadelidae, Drosophilidae, Heteropterygidae, Porcellionidae, and Termitidae. Of these, a total of seven

(7) families, eleven (11) genera, and eighteen (18) species of moss flora for which insects were notably observed are Dicranaceae, Leucobryaceae, Calymperaceae, Thuidiaceae, Rhizogoniaceae, Sematophyllaceae, and Neckeraceae.

As noted, the family Formicidae obtain the species-rich in number. A total of nine (9) insects belonging to the genera Camponotus, Lasius, Melophorus, Polyrachis and Temnothorax. About four (4) insect species belonging to the genus Metapocyrtus of the family Curculionidae was also observed in the study area. There were four (4) insect species under the genera namely, Blaberus and Pseudophoraspis of the family Blaberidae were present. Gryllidae such as species of Grylloides, and Nemobius account for three (3) insect species. Two (2) insect species under the genera Hyphasis and Polyclada of the family Chrysomelidae were also observed. Tenebrionidae which include two (2) species belonging to the genera Alphitobius and Menephilus were also present in the study area. The species of the Formosatettix and Paratettix of the family Tetrigidae were also observed. The remaining five (5) insect species of the genera namely, Abana, Stegana, Phasmatodea, Porcellionides, and Sinocapritermes were also observed belonging to the family of Cicadelidae, Drosophilidae, Heteropterygidae, Porcellionidae, and Termitidae respectively.

Data suggest that insects were notably find themselves into the moss cushions for the purpose of shelter and for finding food. This explains that mosses not only provide a direct habitat but they also alter the substrates beneath them which could in turn provide food for insects. Further, this could explain the richness of Formicidae since most of the insects belonging to this family seeks on moss capsules as source of food. Drozdová et al., (2009) considered mosses to be unique habitats that could provide safe sites against predators. Additionally, Glime, (2020) reported that the presence of moss can regulate the substrates' temperature and moisture and, in some cases, discourage potential predators such as spiders and centipedes from digging up some insects that inhabits it. In here, predation risk appears to be significantly influenced by the growth form and morphological structures of moss cushions.

Pavel et al., (2020) conducted a study that uses pitfall traps in to compare the insects in forest communities with and without a moss layer to explore the role of mosses. They found that insect species richness is higher in the moss communities. Not surprisingly, moisture was the most important environmental factor affecting habitat preference of some insect species. Similarly, Drozd et al., (2009) found that the species of moss, and its moisture levels are very important determinants of insect's abundance. This could explain that the mosses are considered as ecological place of the observed insects. More so, the distribution of specific insects was noted among the various moss floral species.

Table 1. List of Insect Species Observed in Moss Cushion Ecosystem at CinchonaForest Reserve, Kaatuan, Lantapan, Bukidnon

Insects		**Mosses**	
Family	**Genus/Species**	**Family**	**Genus/Species**
1. FORMICIDAE			
	Camponotus sp.	Calymperaceae	*Syrrophodontristichus*Nees ex Schwaegr.
	Camponotus sp.	Dicranaceae	*Dicranolomaassimile*(Hampe) Par.
	Lasius sp.	Calymperaceae	*Syrrophodontristichus*Nees ex Schwaegr.
	Melophorus sp.	Dicranaceae	*Dicranalomablumii*(Nees) Par.
	Polyrachis sp.	Rhigozoniaceae	*Pyrrobryumspiniforme*(Hedw.) Mitt.
	Polyrachis sp.	Leucobryaceae	*Leucophanes sp.*
	Polyrachis sp.	Leucobryaceae	*Leucobryum sanctum* Hampe.
	Temnothorax sp.	Calymperaceae	*Syrrophodontristichus*Nees ex Schawaegr.
	Temnothorax sp.	Leucobryaceae	*Leucophanesasbescens*C.M Bot. Zeit.
2. CURCULIONIDAE			
	Metapocyrtus sp.	Leucobryaceae	*Leucobryumsanctum* Hampe.
	Metapocyrtus sp.	Dicranaceae	*Dicranodontiumfleischeriamum*Schultze. Motel.
	Metapocyrtus sp.	Neckeraceae	*Neckeropsis crinite* (Griff.) Fleisch.
	Metapocyrtus sp.	Dicranaceae	*Dicranalomabraunii*(c. Mull. Ex Dozy &Mplk) Par.
3. BLABERIDAE			

	Blaberus sp.	Rhigozoniaceae	*Pyrrobryumlatifolium*(Bosch. & Lac.) Mitt
	Blaberus sp.	Dicranaceae	*Dicranalomablumii*(Nees) Par
	Pseudophoraspis sp.	Dicranaceae	*Dicranalomabraunii*(C. Mull. Ex Dozy &Molk) Par.
	Pseudophoraspis sp.	Leucobryaceae	*Leucobryum sp.*
4. GRYLLIDAE			
	Gryllodes sp.	Dicranaceae	*Dicranalomablumii*(C. Mull. Ex Doz. Molk) Par.
	Nemobius sp.	Sematophyllaceae	*Acroporiumstramineum*(Reinw&Hornsch.) Fleisch.
	Nemobius sp.	Leucobryaceae	*Leucobryum sanctum (*Brid) Hampe.
5. CHRYSOMELIDAE			
	Hyphasis sp.	Leucobryaceae	*Leucobryum sanctum* Hampe.
	Polyclada sp.	Calymperaceae	*Syrrophodontristichus*Nees ex Schwaegr.
6. TENEBRIONIDAE			
	Alphitobius sp.	Leucobryaceae	*Leucobryum sanctum* (Brid) Hampe.
	Menephilus sp.	Dicranaceae	*Dicranalomablumii*(Nees) Par.
7. TETRIGIDAE			
	Formosatettix sp.	Thuidiaceae	*Thuidiumbenguetense*(Broth ex Bartr.)
	Paratettix sp.	Dicranaceae	*Dicranalomablumii*(Nees) Par.
8. CICADELLIDAE			
	Abana sp.	Leucobryaceae	*Leucophanes sp.*
9.DROSOPHILIDAE			
	Stegana sp.	Thuidiaceae	*Thuidiumpristocalyx*(C. Mull) Jaeg.
10. HETEROPTERYGIDAE			
	Phasmatodea sp.	Dicranaceae	*Dicranalomareflexifolium*(C.M) Par.
11. PORCELLIONIDAE			
	Porcellionides sp.	Calymperaceae	*Calymperessp.*
12. TERMITIDAE			
	Sinocapritermes sp.	Thuidiaceae	*Thuidiumcymbifolium*(Dozy &Molk.) Dozy &Molk.

3.3 Moss Species Present in Cinchona Forest Reserve, Kaatuan, Lantapan, Bukidnon

As shown in table 2, the moss floral species revealed a total of eighteen (18) species belonging to eleven (11) genera and seven (7) families in their order with the most numbered moss species are Calymperaceae, Dicranaceae, Leucobryaceae, Neckeraceae, Sematophyllaceae, Thuidiaceae, and Rhizogoniaceae. The most species-rich among the moss species collected in relation to insects' preference are *Dicranalomablumii* (Nees) Par., *Leucobryum sanctum*Hampe, and *Syrrophodontristichus* Nees ex Schwaegr., and the least preferred moss floral species is represented by Neckeraceae, and Sematophyllaceae (Table 2.). There are moss specimens under study were identified up to genus level, these specimens need further verifications on their distinct morphological characters.

As observed, species of mosses are generally epiphytic growing on different substrates namely: tree trunks, tree base, and decayed logs. These may be closely linked to their habitats on the landscape. Similarly, Tan et al., (2017) attributed the species richness observed to altitudinal zonation of the vegetation types. Meanwhile, Newsmaster et al., (2003) suggested that one should consider the pattern of the species diversity and accessing each to include its potential habitats in ecosystem. The data indicated that the mosses were found in close association with their substrate's similarity (Table 2.). These findings were in consonance with the study of Azuelo et al., (2018) that moss species richness is closely related to microhabitat diversity.

Further, data revealed that the substrate preferences of mosses are on tree trunks which accounts for about 23 or 74%, followed by tree base with 6 or 19% and decayed logs, 2 or 7%. The study of Azuelo et al., (2016) also showed that the most numbered moss species are restricted or confined on tree trunks or corticolous and reported that inasmuch that the trees are the host specificity of the bryofloral species, it is presumed that the substrates contributed to the life strategies among these lowly plants. These assemblages of epiphytic mosses can be related to their microclimatic factors preferences of individual species (Sporn et al., 2010). Furthermore, the findings of the

study support to explain that the habitat preferences among species of bryophytes are influenced by the vegetation structure and their ecological enviro

Table 2. List of Moss Species Present in Cinchona Forest Reserve, Kaatuan, Lantapan, Bukidnon.

Family	Genus/Species	Substrate
1. CALYMPERACEAE		
	*Syrrophodontristichus*Nees ex Schwaegr.	Tree trunk
	*Syrrophodontristichus*Nees ex Schwaegr.	Tree trunk
	*Syrrophodontristichus*Nees ex Schwaegr.	Tree base
	*Syrrophodontristichus*Nees ex Schwaegr.	Tree trunk
	Calymperessp	Tree trunk
2. DICRANACEAE		
	Dicranalomablumii(Nees) Par.	Tree trunk
	Dicranalomablumii(Nees) Par.	Tree trunk
	Dicranalomablumii(Nees) Par.	Tree base
	Dicranalomablumii(Nees) Par.	Tree trunk
	Dicranalomablumii(C. Mull. Ex Doz. Molk) Par.	Tree trunk
	Dicranalomabraunii(C. Mull. Ex Dozy& Molk) Par.	Tree base
	Dicranalomabraunii(C. Mull. Ex Dozy& Molk) Par	Tree base
	Dicranolomaassimile(Hampe) Par.	Tree trunk
	*Dicranodontiumfleischeriamum*Schultze. Motel.	Tree trunk
	Dicranalomareflexifolium(C.M) Par.	Tree trunk
3. LEUCOBRYACEAE		
	*Leucophanesasbescens*C.M Bot. Zeit.	Decayed log
	*Leucobryumsanctum*Hampe.	Tree trunk
	*Leucobryumsanctum*Hampe.	Tree trunk
	*Leucobryumsanctum*Hampe.	Tree trunk
	*Leucobryumsanctum (*Brid) Hampe.	Tree trunk
	*Leucobryumsanctum (*Brid) Hampe.	Tree trunk
	Leucobryumsp.	Tree trunk
	Leucophanessp.	Decayed log
	Leucophanessp.	Tree trunk
4. NECKERACEAE		
	Neckeropsiscrinita(Griff.) Fleisch.	Tree base
5. RHIZOGONIACEAE		
	Pyrrobryumlatifolium(Bosch. & Lac.) Mitt.	Tree trunk
	Pyrrobryumspiniforme(Hedw.) Mitt.	Tree trunk
6. SEMATOPHYLLACEAE		
	Acroporiumstramineum(Reinw& Hornsch.)Fleisch.	Tree trunk
7. THUIDIACEAE		
	Thuidiumbenguetense(Broth ex Bartr.)	Tree trunk
	Thuidiumcymbifolium(Dozy&Molk.)Dozy&Molk.	Tree base
	Thuidiumpristocalyx(C. Mull) Jaeg.	Tree trunk

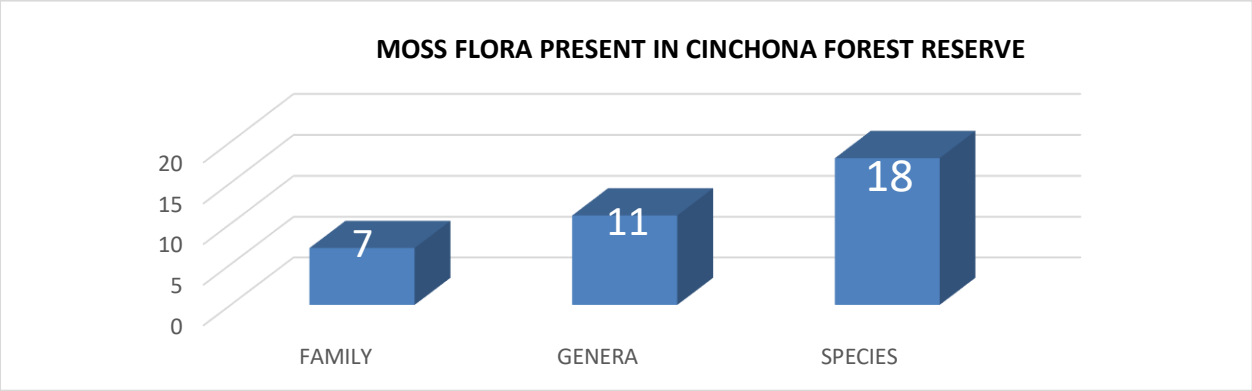

Figure 1. Summary of Families, Genera, and Species of Moss Flora in Cinchona Forest Reserve, Kaatuan, Lantapan, Bukidnon.

As shown in Figure 1, the moss floral species revealed a total of eighteen (18) species belonging to eleven (11) genera and seven (7) families in their order with the most numbered moss species are Calymperaceae, Dicranaceae, Leucobryaceae, Neckeraceae, Sematophyllaceae, Thuidiaceae, and Rhizogoniaceae. The most species-rich among the moss species collected in relation to insects' preference are *Dicranalomablumii*(Nees) Par., *Leucobryum sanctum* Hampe, and *Syrrophodontristichus*Nees ex Schwaegr., and the least preferred moss floral species is represented by Neckeraceae, and Sematophyllaceae (Table 2.). There are moss specimens under study were identified up to genus level, these specimens need further verifications on their distinct morphological characters.

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3.4 Distribution of Some Insects Observed in the Moss Cushions Across Vegetation Types

As shown in Table 3, the vegetation type that harbours the greatest number of insect and moss families is on the mossy forest with 13 insect families and 9 moss families, followed by upper montane with 10 insect families and 6 moss families and lastly on the lower montane forest harbouring 3 families for both insects and mosses. This data seems to be in line with the findings of Banwa (2012) stating that mossy forests harbour diverse flora species. The data table further shows a trend where most of the insect families were found on *Dicranaloma* moss cushions with nine (9) insect families being documented. This was then followed by *Leucobryum* moss cushions with six (6) insect familes, three (3) families of insects were documented in *Leucophanes, Syrrophodon* and *Thuidium* moss cushion while two (2) families of insects found to be inhabiting the moss cushion of *Pyrrhobryum* and only one (1) insect family was documented along the *Calymperes*and *Neckeropsis* moss cushions. This may be due to the fact that the Leucobryaceae family, which was identified at the research location, has clump features. These clumps have an appearance that is packed and dense, which makes them perfect for the protection and habitat of insects.

The findings of Drozdova et al (2009) are in consistent with the result drawn from this investigation. In addition, they discovered that the dense cushion qualities of bryophytes are a primary factor that contributes to it being a source of shelter and protection for insects. The thick and dense clumps of moss cushion could also be a discouraging factor for the would-be predators of insects from digging inside it as evident in the study of Glime (2017). Variety of insect families found in the moss cushions is also attributed for their bryophage (feeding on moss) characteristics as similarly evident with the study of Stevenson (2013) as cited by Glime (2017).

Table 3. Distribution of Some Insects Observed in the Moss Cushions AcrossVegetation Types.

Vegetation Types	Insect Species	Moss Species
Lower Montane Forest	*Polyclada sp.*	*Leucobryumsanctum* Hampe.
	Metapocyrtussp	*Dicranodontiumfleischeriamum*Schultze. Motel.
	Polyrachis sp.	*Leucophanes sp.*
	Temnothorax sp.	*Syrrophodontristichus*Nees ex Schawaegr.
Upper Montane Forest	*Blaberus sp.*	*Pyrrobryumlatifolium*(Bosch. & Lac.) Mitt
	Blaberus sp.	*Dicranalomablumii*(Nees) Par
	Pseudophoraspis sp.	*Leucobryum sp.*
	Hyphasis sp.	*Leucobryum sanctum* Hampe.
	Stegana sp.	*Thuidiumpristocalyx*(C. Mull) Jaeg.
	Camponotus sp.	*Syrrophodontristichus*Nees ex Schwaegr.
	Temnothorax sp.	*Leucophanesasbescens*C.M Bot. Zeit.
	Nemobius sp.	*Leucobryum sanctum (*Brid) Hampe.
	Phasmatodea sp.	*Dicranalomareflexifolium*(C.M) Par
	Porcellionides sp.	*Calymperessp.*
	Sinocapritermes sp.	*Thuidiumcymbifolium*(Dozy &Molk.) Dozy &Molk.
Mossy Forest	*Pseudophoraspis sp.*	*Dicranalomabraunii*(C. Mull. Ex Dozy &Molk) Par.
	Abana sp.	*Leucophanes sp.*
	Metapocyrtussp.	*Dicranodontiumfleischeriamum*Schultze. Motel.
	Metapocyrtussp.	*Neckeropsis crinite* (Griff.) Fleisch.
	Metapocyrtussp.	*Dicranalomabraunii*(c. Mull. Ex Dozy &Mplk) Par.
	Camponotus sp.	*Dicranolomaassimile*(Hampe) Par.
	Lasius sp.	*Syrrophodontristichus*Nees ex Schwaegr.
	Melophorus sp.	*Dicranalomablumii*(Nees) Par.
	Polyrachis sp.	*Pyrrobryumspiniforme*(Hedw.) Mitt.
	Polyrachis sp.	*Leucobryum sanctum* Hampe.
	Gryllodes sp.	*Dicranalomablumii*(C. Mull. Ex Doz. Molk) Par.
	Nemobius sp.	*Acroporiumstramineum*(Reinw&Hornsch.) Fleisch.
	Alphitobius sp.	*Leucobryum sanctum* (Brid) Hampe.
	Menephilus sp.	*Dicranalomablumii*(Nees) Par.
	Formosatettix sp.	*Thuidiumbenguetense*(Broth ex Bartr.)
	Paratettix sp.	*Dicranalomablumii*(Nees) Par.

Table 4 shows the insect genera observed in the moss cushions from the different vegetation types. Twenty-one (21) insect genera were found to be seeking refuge in the moss cushions of the study site. Most insect genera were found to be rich in mossy forest with a total of fourteen (14) genera of insects, this is then followed by the montane forest with ten (10) insect genera and four (4) insect genera found to be thriving at the dipterocarp forest. Further, it has been documented that among the total genera of insects, six (6) genera were documented to be thriving in two (2) vegetation types: *Camponotus, Nemobius* and *Pseudophoraspis*all found both in montane and mossy forest; Metapocyrtus and Polyrachis were found to be inhabiting both in dipterocarp and mossy forest; and Temnothorax was documented to be thriving both in dipterocarp and montane forest. While the rest of the insect genera were just documented in one specific vegetation type. According to the premise of the research, it has been found that there is a plethora of moss cushions and that their distribution is rather even, which provides an accessible shelter,

habitat, and food supply for insects. Curran et al (2022) expressed similar findings where insects were found to be successful in thriving in different elevation as long as there is a supply of food. Likewise, Dangles & Casas (2019) reported that the diverse population of insects in the mossy forest mainly due to wide range of protection, lesser number of predators, and abundance of food.

Table 4. List of Insect Species Observed in the Moss Cushions Across Vegetation Types.

Genera	Lower Montane Forest	Upper Montane Forest	Mossy Forest
Abana			✔
Alphitobius			✔
Blaberus		✔	
Camponotus		✔	✔
Formosatettix			✔
Gryllodes			✔
Hyphasis		✔	
Lasius			✔
Melophorus			✔
Menephilus			✔
Metapocyrtus	✔		✔
Nemobius		✔	✔
Paratettix			✔
Phasmatodea		✔	
Polyclada	✔		
Polyrachis	✔		✔
Porcellionides		✔	
Pseudophoraspis		✔	✔
Sinocapritermes		✔	
Stegana		✔	
Temnothorax	✔	✔	

4. CONCLUSIONS AND RECOMMENDATIONS

There are three (3) vegetation types that were included in the investigation: lower montane, upper montane, and mossy forest. These vegetation types were found to be rich in moss cushions communities.A field inventory of insects in Cinchona Forest Reserve, Kaatuan, Lantapan Bukidnon showed 12 families and 21 genera. Each insect was observed in its preferred moss cushion ecosystems. Families of insects observed were Formicidae, Curculionidae, Gryllidae, Blaberidae, Chrysomelidae, Tenebrionidae, Tetrigidae, Cicadellidae, Drosophilidae, Heteropterygidae, Porcellionidae, and Termitidae. A total of seven (7) families, eleven (11) genera, and eighteen (18) species of moss flora of which insects were notably observed are among Dicranaceae, Leucobryaceae, Calymperaceae, Thuidiaceae, Rhizogoniaceae, Sematophyllaceae, and Neckeraceae family.The specimens collected were subjected to further identification by an expert using taxonomic keys and related literatures. Examination of diagnostic characters through microscopy examinations aid the researchers to countercheck its diagnostic characters for insect classifications.The vegetation type that harbours the most numbered of insects and moss families is on the mossy forest with 12 insect families and 9 moss families, followed by upper montane with 10 insect families and 6 moss families and lastly on the lower montane forest harbouring 3 families for both insects and mosses.The investigation showed a trend where most of the insect families were found on *Dicranaloma* moss cushions with nine (9) insect families being documented. This has then followed by *Leucobryum* moss cushions with six (6) insect

familes, three (3) families of insects were documented in *Leucophanes, Syrrophodon* and *Thuidium* moss cushion while two (2) families of insects found to be inhabiting the moss cushion of *Pyrrhobryum* and only one (1) insect family was documented along the *Calymperes*and *Neckeropsis* moss cushions.

The species diversity of insects observed in moss cushions ecosystem require an in-depth investigation to explore their ecological relationship to moss vegetation.Further research be investigated for the microhabitat preferences of mosses in the study area be investigated. The need to evaluate the moss species present across the vegetation types so as to provide observational data in order to see patterns of its taxonomy and ecological status. Taxonomy of insects should be carefully studied, in order to describe their distinguishing morphological characters and must be identified up to the species level to show evidence of probable taxonomic data between species. Photographs of live insect species should be properly taken to countercheck the species for further species examinations.Moreover; scientific exploratory studies are required to carefully understand the taxonomy and ecological distribution of insects in moss cushion ecosystems across vegetation types. The key species represented by these groups should be carefully be identified and monitored to provide an accurate measure of biodiversity research. There is a need to provide a concrete action plan for continuous conservation of the place under study in order to preserve the quality of the forest and its bryofauna. Disseminate scientific information regarding the potential impacts of bryophytes and its ecological interactions toward faunal species.

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