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Bryophyte Flora of Kalikasan Park, Albay, Philippines

Daile Meek Salvador-Membreve*, Erwin N. Baňares, Jonathan Jaime G. Guerrero

Biology Department, College of Science, Bicol University, Rizal Street, Legazpi City, Albay, Philippines

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Abstract

Bryophytes are nonvascular plants that have ecological and medicinal value. The present study assessed the diversity and ecological status of bryophytes flora in Kalikasan Park, Albay. Sampling plots were established based on the dominant vegetation types in the Park. Collections were made in 20 x 20m in the sampling plots. A total of eight species (8) with five (5) mosses and three (3) species of liverworts were collected in all sampling areas. Microhabitats observed in the study were decayed woods, tree trunks, wet rocks and moist soils. A high index value (2.29) with evenness index of 0.996 was observed in the study area with trees having a much higher index compared to bryophytes found in fern plots. From the species, two (2) species were found to be possibly endangered with one (1) possibly near threatened of IUCN status. Also, three bryophytes found in the area were known to have medicinal value. To date, this is the first record of bryophyte flora in Kalikasan Park.

***Corresponding Author:** Daile Meek Salvador-Membreve ✉ dmsmembreve@bicol-u.edu.ph

Introduction

Bryophytes are small, photosynthetic, nonvascular and spore-bearing plants. They encompass the terrestrial plants which include mosses, liverworts and hornworts. They occupy various environments from polar to arid conditions but are at their greatest abundance and diversity in tropical rainforests (Valente, Porto and Bastos, 2017). They thrive in trees, rocks, soil, logs and even surfaces of the leaf (Vanderpoorten, Papp and Gradstein, 2010). Bryophytes are known to be indicators of environmental conditions. They are indicator species for air and water quality, heavy metal contamination and climate change (Azuela *et al*., 2016, Carreon, 2016). Also, they provide habitat and food for arthropods and amphibians (Azuela *et al*., 2016). Bryophytes are therefore significant for ecological balance. Hence, assessment of bryophytes is thus important.

Kalikasan Park is a man-made forest situated at the back of the Bicol University main campus. It has a total area of ten hectares and the border lies on the Sagumayon River. It is characterized by shrubs, ferns and endemic and non-timber forest trees such as bamboo and rattan. Border areas of the Park are lined with human settlements and agricultural lands.

Infrastructure developments are occurring in the area which might pose a threat to population of bryophytes. Hence, this study aimed to document and determine ecological status of the bryophytes in the Park. This is the first account of bryophytes in the said area.

Materials and methods

Study Area

The study area was located at the Kalikasan Park, EMs Barrio, South, Legazpi City, Albay (Fig. 1). Preliminary field site visit was conducted to choose sampling sites. Sampling areas were selected according to vegetation types. For this study, tree and fern were chosen as the vegetation type.

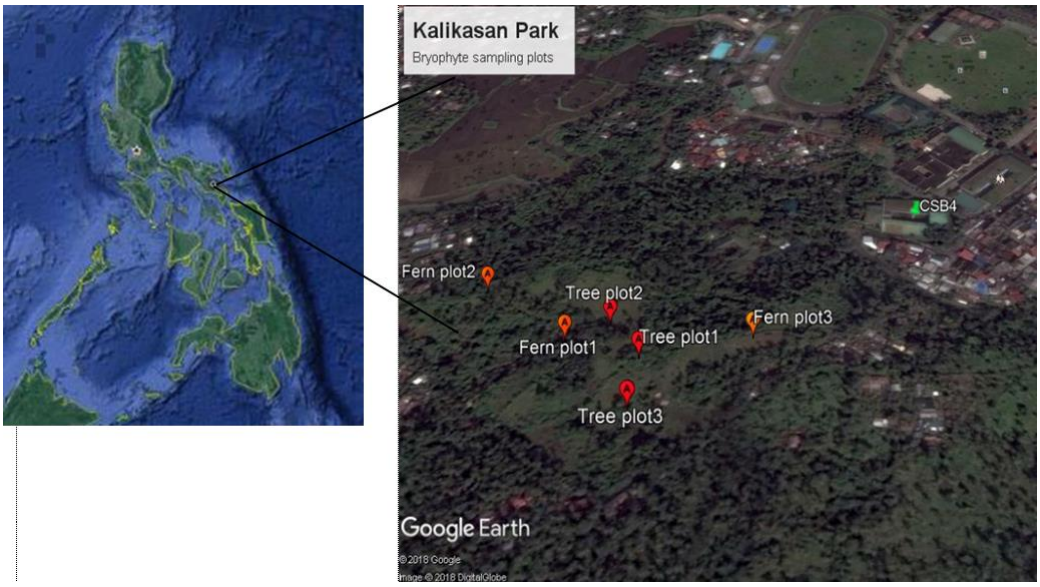

Fig. 1. Map showing the location of sampling sites in Kalikasan Park, Legazpi City.

Collection and Identification

Bryophytes were collected in fallen logs, trunks, trees, soil and rocks. Coordinates and microhabitats were noted during sampling. Photographs were taken in the field to document the natural habitat of the species. The collected specimens were placed in labeled plastic bags. A mobile microscope clip was also used for proper identification of the bryophytes. In the laboratory, the specimens were air dried and placed in packets (brown envelope) and were properly labeled. Microscopic observations were also made using dissecting microscope. Morphological identification was made by consulting taxonomic keys from books and scientific journals (Azuelo *et al*., 2016, Azuelo, Sariana, Pabualan, 2010, Gradstein, 2001, Linis, 2011).

The conservation status of the collected bryophytes was also assessed using the international Union for Conservation of Nature (IUCN) red list and scientific literatures. Economic and medicinal uses of the bryophytes were also identified using secondary sources.

Establishment of Sample Plots

Sampling of bryophytes were made by creating three plots per vegetation type (tree- or fern-associated) with a dimension of 20m x 20m quadrat (Azuela, Sariana, and Pabulaan, 2010). A 5 x 5 m quadrat square was situated inside the plots to estimate cover abundance. A visual calculation of bryophyte abundance was estimated following the Domin-Krajina scale (Jamtsho and Sridith, 2015) (Table 1). GPS were recorded in each area.

Data Analysis

Species diversity was determined using the Shannon index of general diversity. Afterwards, the evenness was calculated using Pielou's evenness index.

Table 1. Estimation of percent cover based on the Domin-Krajina scale.

Class	Range of cover (%)
10	91-100
9	76-90
8	51-75
7	34-50
6	26-33
5	11-25
4	4-10
3	1-4
2	Several individuals, but less than 1% cover
1	1-2 individuals, no measurable cover
+	Single individual, no measurable cover

Results and discussion

Despite the ecological significance of bryophytes, only few attempts were conducted to determine the current ecological state of bryophytes in the Philippines. In the present study, at elevation ranging from 44 to 49 meters, eight (8) species belonging to seven genera and six families (Fig. 2, Table 1) were accounted.

Five species of mosses, three species of liverworts were observed in all six sampling plots (Table 2). The mosses collected are represented by the family Calymperaceae, Entodontaceae, Fissidentaceae, Plagiotheciacea and Brachytheciaceae.

On the other hand, only one family. Lejeuneaceae was identified for liverworts. There was no account of hornworts in the sampling area.

It was shown that, mosses and liverworts observed in this study grow in different microhabitats which includes decayed log, tree trunk (corticolous), wet rocks (petrophytic) and on moist soil (terricolous) (Fig. 3). In both vegetation types, bryophytes were found mostly as corticolous or epiphytic on tree trunk having percentage occurrence of 52.63% on tree sampling plots and 41.67% on fern plots. Low numbers of species were detected on moist rocks and soil as these microhabitats require tolerant species to drought, temperature fluctuations and UV radiation (Arroniz-Crespo *et al.*, 2006, Hespanhol *et al.*, 2011).

In two vegetation types, the species occurring on tree plots are higher (8) in number compared to fern plots (5). Also, in both vegetation types, the cover ranges from class 1-3 which based on Domin-Krajina (Table 1) would indicate about 1-4% growth cover in the sampling area plots (Fig. 4). In this study, low number of species were recorded compared to studies in Mindanao and other parts of Luzon (Alcala, 2019; Azuelo et al., 2016; Carreon et al., 2016) cover could be accounted to the few canopies of trees and moisture content in the area. It is known that the canopy of trees protects moisture loving bryophytes from intense light and dessication (Benitez, Prieto and Aragon, 2015; Hipol *et al.*, 2007). And moisture or water is important for both photosynthesis and growth of bryophytes (He, He and Hyvonen, 2016).

Table 2. Number of families, genera and species of Bryophytes in Kalikasan Park, Albay.

Bryophytes	Genera	Family	Species
Mosses	5	5	5
Liverworts	2	1	3
Total	7	6	8

Fig. 2. Bryophytes flora in Kalikasan Park. Magnification (60x).

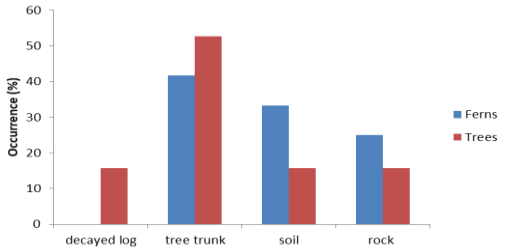

Fig. 3. Habitat preference of Bryophytes in Kalikasan Park.

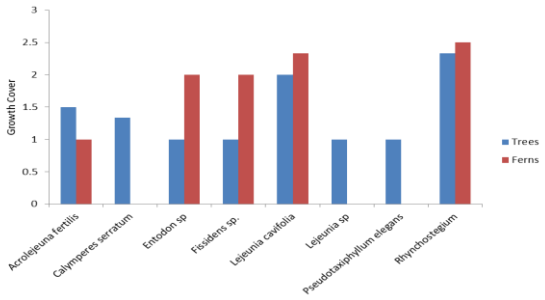

Fig. 4. Abundance cover of Bryophytes in two types of vegetation.

Although minimal number of species were recorded, the diversity value of 2.267 with 0.984 evenness index were measured in tree sampling plots indicating high diversity and equal distribution with no apparent dominant species in the sampling areas (Table 3).

While a low diversity and evenness index were generated in fern sampling plots. The absence of enough shade might be the possible reason for low index value in fern plots. It was mentioned that the composition of the bryophytes are influenced by the type of vegetation and ecological environment (Azuelo *et al.,* 2016). Data shown that fern flora might be inhospitable to some bryophytes.

It was shown that bryophytes in fern plots most bryophytes were occurring as epiphytic or corticolously on tree trunk (Fig. 3). However, a high diversity value was still generated when considering all sampling plots into two vegetation types.

Table 3. Index of diversity in vegetation types.

Vegetation	Shannon's Index of Diversity (H')	Shannon's Index of Abundance (H_{max})	Pielou's Index of Evenness (E)
Tree	2.267	2.302	0.984
Ferns	1.560	2.302	0.677
Combined	2.294	2.302	0.997

Assessment of status of the eight species of bryophytes revealed two (2) species which includes *Calymperes serratum* and *Entodon sp* as widespread (Linis, 2011) (Table 4). While *Lejeunia sp* observed in this study is considered as possibly endangered and *Fissidens sp* as possibly endangered or possibly near threatened based from IUCN status. Several species are not yet assessed for their status.

Also, as can be seen, three species were known to have medicinal value (Table 4). Related species such as *Fissiden nobilis* is known to have antibacterial activity, stimulate diuretics and hair growth (Azuelo, Sariana, Pabualan, 2011), while *Rhynchostegium pallidifolium* is known to have allelopathic or growth inhibitory activity on *Lepidium sativum* (Kato-Noguchi and Seki, 2010).

Table 4. Status and Medicinal Uses of Bryophytes in Kalikasan Park, Albay.

Species	Family	Status	Medicinal Uses (Source)
Mosses			
Calymperes serratum	Calymperaceae	Widespread	NAA
Entodon sp	Entodontaceae	Widespread	Antibacterial activity (Kumar and Chaudhary, 2010)
Fissidens sp	Fissidentaceae	PE/PNE	Antibacterial activity (Azuelo *et al.*, 2016)
Pseudotaxiphyllum elegans	Plagiotheciaceae	NAA	NAA
Rhynchostegium sp.	Brachytheciaceae	NAA	Antibacterial activity, Growth inhibitor or allelopathic activity (Kato-Noguchi and Seki, 2010) antioxidant activity (Yayintas *et al.*, 2017)
Liverworts			
Acrolejeuna fertilis	Lejeuneaceae	NAA	NAA
Lejeunia cavifolia	Lejeuneaceae	NAA	NAA
Lejeunia sp	Lejeuneaceae	PR/PE	NAA

NAA-no available assessment, PE-Possibly endangered, PR-possibly rare, PNE-near threatened.

Conclusions and recommendation

A total of eight species of bryophytes were collected at Kalikasan Park. Higher number of species were observed in mosses (5) compared to liverworts (3). From the eight species, two species were categorized as possibly endangered by IUCN, two species as widespread by local assessment and the rest as no available assessment. Three species of bryophytes collected are known to have medicinal potential. Also, the bryophytes collected were distributed in different microhabitats which include decayed log, tree trunks, rocks and soil. Diversity of species was depicted in all sampling areas with a much high diversity in tree sampling plots compared to fern plots. The present list could be enhanced when more collections to other areas in the Park will be conducted. Also, identification should be up to species level for proper assessment of the IUCN status and medicinal value.

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