



## OCCURRENCE AND DISTRIBUTION OF MOSS PLANTS IN RELATION TO SUBSTRATE TYPES IN SELECTED PARTS OF NORTHWESTERN NIGERIA



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**Abstract:** This study was carried out to determine the distribution of Moss plants in some parts of northwestern Nigeria which include Zaria, Kamuku (Birnin gwari), Kano and Ringim. Samples were collected from different substrates (bark of trees, uncompleted buildings, wall of buildings, gutter walls, rock surfaces and forest floor/soil/sand) and a total of 144 samples of moss plants were collected throughout, representing eight (8) different species. The percentage occurrences of moss species in all locations, on all the substrates and on each substrate were calculated. More species were found in Zaria and Kamuku and the least found in Kano and Ringim. *Hyophila crenulata* had the highest percentage of occurrence (58.33%) while the least percentage of occurrences was recorded for *Fissidens grandifolius* (1.39%). *Hyophila crenulata* were found growing on all substrates with majority on sandcrete materials; *Barbula lambarenensis*, *Bryum coronatum* and *Splachnobryum subjulaceum* were found only on sandcrete materials (100% occurrence each); *Erpodium pobeguinii* majorly on bark of trees with some on sandcrete materials; *Fabronia pilifera* completely on bark of trees (100% occurrence) and *Fissidens grandifolius* found growing only on sand/soil/forest floor (100%). This indicates that mosses require specific substrates for occurrence or growth. Moss species were distributed among different substrates including bark of trees, sandcrete materials (plastered and un-plastered walls, blocks, rock surface) and sand/soil/forest floor.

**Keywords:** Distribution, moss plants, Northwestern, Nigeria, substrates

### Introduction

Bryophyte is a traditional name used to refer to a paraphyletic/polyphyletic group of embryophytes (land plants) that do not have true stems, leaves, roots and vascular tissues. The name is conveniently used as a collective term for mosses, liverworts and hornworts, although each of the three extant (living) groups is monophyletic (Konrat *et al.*, 2010). The three lineages are [Marchantiophyta](#) (liverworts), [Bryophyta](#) (mosses) and [Anthocerotophyta](#) (hornworts). Most bryophytes are either liverworts or mosses. Liverworts grow horizontally, and are flattened or leafy, whereas mosses have an upright stalk with spirally arranged leaf-like structures (Saxena and Harinder, 2004). The pleurocarpous mosses (carpet-forming) are characterized by extensive branching and lateral sporophyte placement, compared to the terminal sporophytes in acrocarpous (erect) mosses (Saxena and Harinder, 2004).

Among the world of plants, the bryophytes are the second largest group, exceeded only by the Magnoliophyta – the flowering plants (350,000 species). Comprised of 15,000 (Gradstein *et al.*, 2001) – 25,000 species (Crum, 2001), they occur on every continent and in every location habitable by photosynthetic plants. This group of plants which many plant scientists refer to as the “amphibians” of the plant kingdom, live on land and in damp places but breed only in the presence of water. The life history of bryophytes involves an alternation between sporophytic and gametophytic generations that differ in form and function. The actual plant is represented by the gametophytic generation, which is the most evolved haploid generation in the whole plant kingdom (Zechmeister *et al.*, 2003).

Most of the bryophytes are ectohydric species, that receive water as well as mineral nutrients predominantly by atmospheric depositions (Zechmeister *et al.*, 2003). They are well adapted to this strategy since they have no or only very small vacuoles, and beside some surface wax structures (e.g. papillae) there is no continuous water-repellent cuticle.

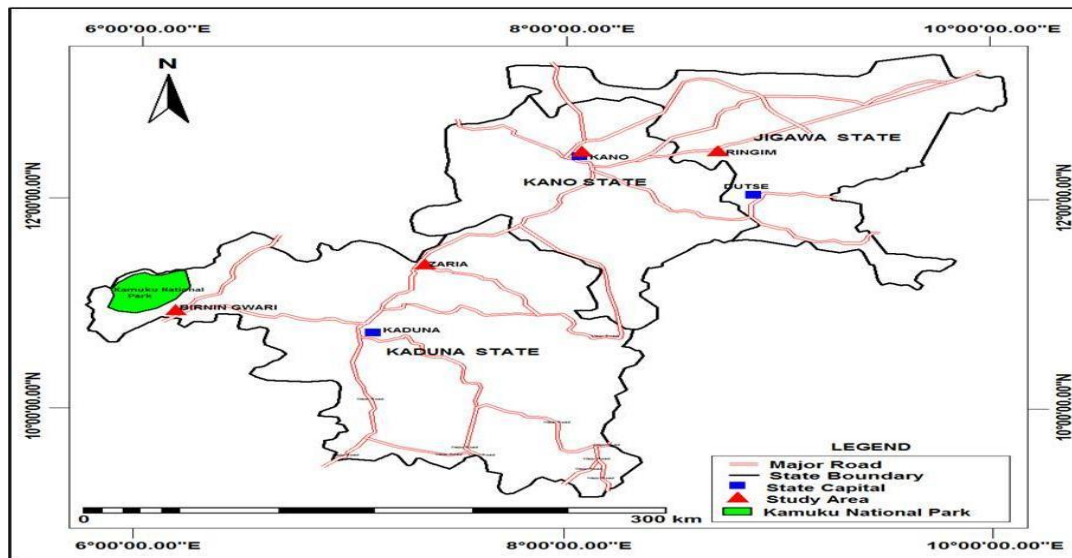
Bryophytes seem all the more elaborate because of their small size. Some bryophytes are only a few millimeters tall and have but few leaves, as in the mosses *Ephemeropsis* and *Viridivellus pulchellum* (Crum, 2001). The more common *Buxbaumia* has a large capsule on a thick stalk, but only a few special leaves protect the archegonia; the plant depends on its protonema (and later the capsule) to provide its photosynthate. At the other end of the scale, the moss *Polytrichum commune* can attain more than half a meter height in the center of a hummock and *Dawsonia superba* can be up to 70 cm tall with leaves of 35 mm length (Crum, 2001) and be self-supporting. *Fontinalis* species, supported by their water habitat, can be 2 m in length.

Bryophytes, especially mosses are found in almost every habitat that supports life and their ecological role as pioneer species during succession is significant (Saxena and Harinder, 2004). The present-day changing environment due to human activities of logging for forest resources and in our traditional African practices of firewood harvesting is a major limitation to the conservation of our natural bryoflora diversity. This study was carried out to document the occurrence and distribution of moss species in relation to their habitat/substrate preferences in parts of northwestern Nigeria during the wet and dry seasons, since little or no information on these existed.

### Materials and Methods

#### Study area

This study was carried out in selected parts of savannah region Northwestern Nigeria which include Kano (12° 00' 00.00" N and 8° 31' 00.00" E), Zaria (11° 04' 54.91" N and 7° 42' 57.44" E), Ringim (12° 08' 50.14" N and 9° 10' 09.27" E) and Birnin Gwari (10° 40' 00.00" N and 6° 32' 00.00" E) (Fig. 1).



Source: Adapted and Modified from Administrative Map of Nigeria (2013)

Fig. 1: Location of the study areas

**Sampling of Moss species**

Moss sampling was carried out randomly during the dry and wet seasons, 2013. Samples were collected during the three months of dry season and also during three months of wet season. For each month, moss samples were collected from six sites in each location selected. The moss species were collected from trees, uncompleted buildings, plastered and unplastered perimeter fences (walls), gutter walls, rock surfaces and forest floor/soil/sand within the sampling area. The samples were placed in small brown envelopes, labeled accordingly with field notes and then taken to the laboratory for identification and other analyses.

**Determination of Moss distribution/occurrence**

The distribution/occurrence of the plants on the various substrates was calculated using the formulas as follows (Adebisi and Oyeyemi, 2013):

% Occurrence of moss species in all locations

$$= \frac{\text{Total number of each moss species found in all locations}}{\text{Total number of the moss species found in all locations}} \times 100$$

% occurrence of moss species on all the substrates

$$= \frac{\text{Total number of each moss species found on each substrate}}{\text{Total number of the moss species found on all substrates}} \times 100$$

% occurrence of moss species on each substrate

$$= \frac{\text{Total number of each moss species found on each substrate}}{\text{Total number of moss samples collected from each substrate}} \times 100$$

**Results and Discussion**

A total of 144 samples were collected, representing eight (8) different species of moss plants. These were *Hyophila crenulata* C. Mull. ex Dus; *Barbula lambarenensis* C. Mull; *Bryum coronatum* Schwaegr; *Splachnobryum subjulaceum* Card.; *Brachymerium leptophyllum*; *Erpodium pobeguinii* Par & Broth; *Fabronia pilifera* Hornsch and *Fissidens grandifolius* Broth & P. Varde. *Hyophila crenulata* had the highest percentage occurrence (58.33 %), followed by *Erpodium pobeguunii*, *Barbula lambarenensis* and *Bryum coronatum* while the least percentage of occurrences was recorded for *Fissidens grandifolius* (1.39 %). *Hyophila crenulata* and *Bryum coronatum* were found across all the four locations. All the eight species were seen during the wet season, but only *Hyophila crenulata*, *Barbula lambarenensis* and *Erpodium pobeguunii* were observed during both the dry and wet seasons. The percentage occurrence of all the moss species in

all locations were presented in Table 1. More species were found in Zaria and Kamuku especially in wet season and the least found in Kano and Ringim.

**Table 1: Percentage occurrence of moss species in all locations in relation to seasons in North West Nigeria**

Moss species	Location(s)	Season(s)	Freq.	%occurrence
<i>H. crenulata</i>	Zr, Km, Kn, Rn	W, D	84	58.33
<i>B. lambarenensis</i>	Zr	W, D	12	8.33
<i>B. coronatum</i>	Zr, Km, Kn, Rn	W	6	4.17
<i>S. subjulaceum</i>	Zr	W	4	2.78
<i>B. leptophyllum</i>	Zr	W	4	2.78
<i>E. pobeguunii</i>	Zr, Km	W, D	28	19.44
<i>F. pilifera</i>	Km	W	4	2.78
<i>F. grandifolius</i>	Km	W	2	1.39
<b>Total</b>			<b>144</b>	<b>100</b>

Zr=Zaria, Km=Kamuku, Kn=Kano, Rn=Ringim; D=Dry season, W=Wet season

Moss species were distributed among different substrates including bark of trees, sandcrete materials (plastered and unplastered walls, blocks, rock surface) and sand/soil/forest floor. *Hyophila crenulata* was found growing on all substrates with majority on sandcrete materials; *Barbula lambarenensis*, *Bryum coronatum* and *Splachnobryum subjulaceum* were found only on sandcrete materials (100 % occurrence each); *Erpodium pobeguunii* majorly on bark of trees with some on sandcrete materials; *Fabronia pilifera* completely on bark of trees (100 % occurrence) and *Fissidens grandifolius* found growing only on sand/soil/forest floor (100 %). Sandcrete materials recorded the highest number of species, followed by bark of trees and then soil/sand with very few species. The % occurrences of moss species on all substrates and on each substrate were presented in Tables 2 and 3, respectively.

High percentage occurrence of some species over others may be attributed to the fact that they were able to survive in almost all the substrates especially *H. crenulata* which was observed in all the substrates throughout. It could also be due to differences in pH values and nature of the substrates, and many more. The results tend to agree with the work of Adebisi and Oyeyemi (2013) that reveals the occurrence of 8 different moss species in Ekiti State, Nigeria which are distributed among 4 different substrates with *Bryum coronatum*, *Barbula lambarenensis*, *Thuidium gratum* and *Hyophila excurrentinervis* having higher occurrences than others. It is also in agreement with Fatoba (2000) who

collected moss samples from sandcrete materials and was able to reveal the presence of *Hyophila excurrentinervis*, *Bryum coronatum* and *Barbula lambaranensis* only.

**Table 2: Percentage occurrence of moss species on all substrates regardless of seasons in some parts of North-Western Nigeria**

Moss species	Bark of trees	Substrates Sandcrete Materials	Soil/Sand
<i>H. crenulata</i>	4 (4.76%)	76 (90.48%)	4 (4.76%)
<i>B. lambaranensis</i>	0	12 (100%)	0
<i>B. coronatum</i>	0	6 (100%)	0
<i>S. subjulaceum</i>	0	4 (100%)	0
<i>B. leptophyllum</i>	4 (100%)	0	0
<i>E. pobeguunii</i>	24 (85.71%)	4 (14.29%)	0
<i>F. pilifera</i>	4 (100%)	0	0
<i>F. grandifolius</i>	0	0	2 (100%)
<b>Total</b>	<b>36</b>	<b>102</b>	<b>6</b>

**Table 3: Relative occurrence (%) of moss species on each substrate regardless of seasons in some parts of North-western Nigeria**

Moss species	Bark of trees	Substrates Sandcrete Materials	Soil/Sand
<i>Hyophila crenulata</i>	11.11	74.51	66.67
<i>Barbula lambaranensis</i>	0	11.76	0
<i>Bryum coronatum</i>	0	5.88	0
<i>Splachnobryum subjulaceum</i>	0	3.92	0
<i>Brachymerium leptophyllum</i>	11.11	0	0
<i>Erpodium pobeguunii</i>	66.67	3.92	0
<i>Fabronia pilifera</i>	11.11	0	0
<i>Fissidens grandifolius</i>	0	0	33.33
<b>Total %</b>	<b>100</b>	<b>100</b>	<b>100</b>

Though, bryophytes occupy a wide range of habitats/substrates with respect to availability of moisture, their occurrence on these habitats/substrates could be attributed to suitable pH (Fatoba, 1983) and availability of propagules at the time of exposure to bare soil or substrate (Banfield, 1976). Abubakar and Abdullahi (2012) carried out a study on Host preference of bryophytes composition from northern Nigeria, where host specificity was shown by the recorded species in which pH value accounted for the marked variation in composition. According to them, *Erpodium coronatum* (Hook f. Wilson) Mitt. was the most abundant epiphyllous moss while *Fissidens glauculus* C.Mfill. was noted to be growing on a particular tank wall substrate. This indicates that mosses require specific substrates for occurrence or growth.

All the eight species were seen during the wet season, but only *Hyophila crenulata*, *Barbula lambaranensis* and *Erpodium pobeguunii* were observed during the dry season. This may probably be due to higher availability of moisture in the wet season. Bryophytes are sensitive to natural fluctuations in humidity. They dry out very quickly, but they can also absorb minute quantities of available moisture from fog, mist, and dew – sources of water that other plants cannot utilize (Hallingback and Hodgetts, 2000). However, during dry days there may be little physiological activity, and during droughts all physiological processes are quickly reduced to a minimum. Reproduction is highly dependable on water availability as the spermatozoids (male gametes) must swim from the antheridia to the archegonia in order to fuse with egg cells, initiating the spore-producing capsule generation, drought hampers this process.

The percentage occurrences of all the moss species in all locations indicate more species in Zaria and Kamuku than

Kano and Ringim. *Hyophila crenulata* and *Bryum coronatum* were the species found across all the four locations, while others were distributed within Zaria and Kamuku. Higher number of species in these two locations could probably be as a result of high levels of atmospheric humidity and low rates of evaporation, which favors the growth and reproduction in the bryobiotina subkingdom. Also, the regions have relatively greater number of trees compared to Kano and Ringim which tend to have very few scattered trees and drier environments, thus favoring the growth of majorly bryophytes that grow only on sandcrete substrates. According to Abubakar and Abdullahi (2012), the present-day changing environment due to human activities of logging for forest resources and in our traditional African practices of firewood harvesting is a major limitation to the conservation of our natural bryoflora diversity.

### Conclusions

This study indicates that mosses require specific substrates for occurrence or growth. Moss species were distributed among different substrates including bark of trees, sandcrete materials (plastered and un-plastered walls, blocks, rock surface) and sand/soil/forest floor. *Hyophila crenulata* were found growing on all substrates with majority on sandcrete materials; *Fabronia pilifera* completely on bark of trees (100% occurrence) and *Fissidens grandifolius* found growing only on sand/soil/forest floor (100%).

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