



## ENUMERATION AND PHYTOGEOGRAPHICAL PATTERN OF MOSSES (BRYOPSIDA) IN KALRAYAN HILLS, OF EASTERN GHATS OF TAMILNADU, INDIA

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### ABSTRACT

The present investigation made on the enumeration and phytogeographical distribution of mosses in the Kalrayan hills. The moss distribution is related with different climatic condition, vegetation, habitat, moisture, temperature, light, soil, elevation and monsoon. There are totally 55 species belonging to 36 genera comprise 19 families of 8 orders were enumerated in the study area. Most of the species occurs in terricolous and abundant in the habitat of semi-evergreen forest. The maximum numbers of species were observed in between 650-1000 m altitudinal range. The specimens and phytogeographical details of mosses have been collected from different parts and various localities of this area. Out of the 55 species 32 taxa were common to Himalayas, 54 taxa were common to Western Ghats, 50 taxa were common to Eastern Ghats and 52 taxa were with Tamilnadu.

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### INTRODUCTION

Among the three groups of bryophytes the mosses are specialized and evolved group with second highest assemblage among land plants often flowering plants. They have unique characteristic feature in between lower cryptogams and vascular cryptogams, which possess filamentous protonema similar to lower (non vascular) cryptogams and conducting strand like higher (vascular) cryptogams (Verma et al., 2011). But they are not possess true conductive tissue system in their internal structure. Most of the moss plants are able to evolve their growth with special ecological, morphological and physiological characters through demanding environment condition. Mosses (Bryopsida) are the largest group of leafy forms, it have 14,000 species belonging to 650 genera in 117 families of 21 orders (Buck and Goffinet, 2000). Our present knowledge of bryophytes relies mostly on such early works as the Indian sub-continent of phytogeographical regions with varied ecological conditions. About 2,489 taxa of bryophytes have been reported in India by Dandotiya et al., (2011).

The floristic studies on the bryophytes in Eastern Ghats by Murty et al., (2011); Rao and Rao (2013); Sahaya Sathish (2013); Mishra et al., (2016); Rawat et al., (2017). In earlier the Kalrayan hills have been explored on the Angiosperms in Ethnomedicinal plants and their uses among the triples (Nirmala & Britto 2008) and Ethnobotanical survey of medicinal plants in Kalrayan hills, Eastern Ghats, Tamilnadu (Manikandan & Lakshmanan 2014). The present study is the first ever attempt made on the phytogeographical pattern in mosses of Kalrayan hills.

#### Study Area

The Kalrayan hills situated at Southern Eastern Ghats in Villupuram, Salem and Dharmapuri Districts runs through the top of the Kalrayan hill range. It spread over an area of 1145.87 km<sup>2</sup>. Geographically it lies between North latitude 11°35' 00" - 12°05' 00" N and 78°25' 00" - 79°00' 00" E longitude. The height of hills ranges from 760 m to 1370 m above sea level. Mainly the Kalrayan hills consist of two divisions, the Northern portion called 'Chinna Kalrayan' with an average height of 823 m and the Southern portion 'Periya Kalrayan' with an altitude of about 1298 m.

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## MATERIALS AND METHODS

The moss collection was undertaken throughout the study area from July 2013 to December 2016, covering different seasons, especially during and after monsoon suitable for the collections of reproductive parts. The sample collection was made in different localities, vegetations and also differing on the altitude. Simple methodology was adopted to collect specimens in the field. A knife was used to peel of the specimens from the substratum like bark, rock and other substrata. Specimens were dried at room temperature on blotting paper and placed carefully in brown paper envelopes of dimension 15 × 10 cm. Collection details were noted including locality, date of collection, habitat type, altitude etc. Identifications were made with the help of Gangulee's 'Mosses of Eastern India and Adjacent Regions' (1969-1980), Manju *et al.*, 'Bryophytes of Wayanad in Western Ghats' (2005) and other related works and protologues. All moss taxa included in the list were checked against the database (www.tropicos.org and www.theplantlist.org) and concerning on the current acceptable nomenclature.

## RESULTS AND DISCUSSION

A total of 55 species belonging to 36 genera comprise 19 families of 8 orders were identified from the study area. Among which the order Hypnales with 6 families 9 genera and 15 species and Eubryales represented by 12 taxa in 4 genera in 2 families. The family Bryaceae represented by 11 species belonging to 3 genera, which is the dominated family of this area (Table 1, Figure - 1).

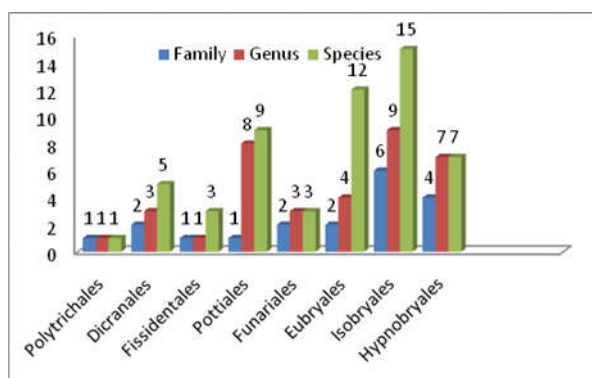


Figure 1. Moss species represent in different orders from Kalrayan hills

The largest genus is *Bryum* with 6 taxa and the widely distributed species is *Semibarbula ranuii*. A broad comparative study was carried out for these moss species based on the clear literature survey and several moss floras, which is estimated that 16 species were common to Shervaroys hills enumerated by Kumar (2002) Next to that 28 species represent in Kolli Hills, where 57 moss species were reported by Sahaya Sathish (2009). Palani *et al.*, (2017) provided a list of 52 moss species from Bodamalai, out of these 17 taxa common to the present report of Kalrayan Hills. Among the 112 species of mosses of South-Western Ghats (Daniel, 2003), 25 were common to the Kalrayan Hills. Alam *et al.*, (2011) provide a list for the 54 moss species from Palni Hills, out of these 22 taxa common to Kalrayan Hills. Verma *et al.*, (2011) & Sonu Yadav (2015) reported above 150 moss species from Nilgiri Hills, among these 28 taxa common to Kalrayan Hills. Compare with Wayanad Hills of Western Ghats in Kerala (Manju and Madhusoodhanan, 2005), among the 113 moss species, 33

species were common to the Kalrayan Hills. 32 species were common to Himalayas (Negi & Gadgil 1997; Dolma & Langer, 2012; Alam, 2013).

The following data providing the various habitats of the mosses such as soil, rock, stone, bark, wood log, old wall, etc. On the basis of the substratum 32 species were terricolous, 30 species were rupicolous, 23 were corticolous, 14 were lignicolous and 17 species found as terricolous and rupicolous habitats. *Hyophila involuta* is found in a wider range of terricolous, rupicolous and corticolous habitats of this region (Table 1, Figure - 2). According to the vegetation types, 23 taxa present in evergreen forest and 35 taxa occurred in semi-evergreen forest followed by 26 species in deciduous, 18 in degraded/scrub forest and minimum number of 7 were collected in plantation. Most species were distributed in semi-evergreen forest (Table 1, Figure - 3). Based on the elevation, highest number of species occurred in between the range of 650-1000 m from this region.

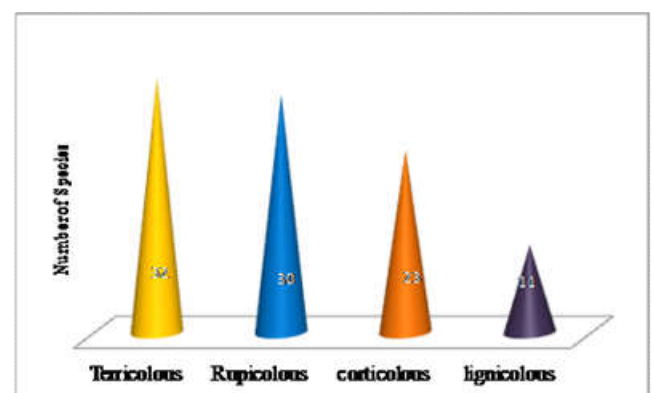
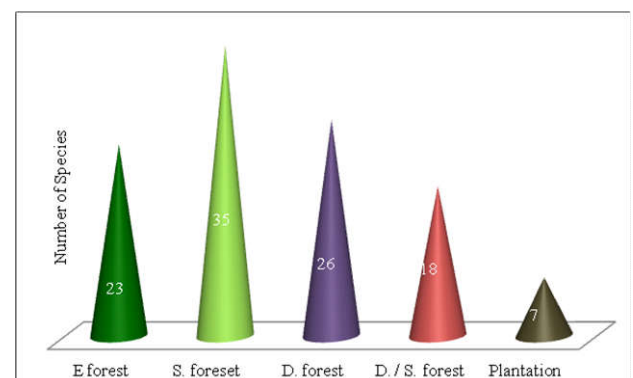


Figure 2. Moss species occurring in different Habitat types in Kalrayan hills



E. Evergreen forest; S. Semi-evergreen forest; D. Deciduous forest; D./S. Degraded and Scrub forest; Plantation

Figure 3. Moss species occurring in different Vegetation types in Kalrayan hills

### Soil and topography

The total forest cover area of Kalrayan hills is 64,819.04 Ha. The study area has different types of soil like red-loam to black clay. The soil pH is 6.5-7.5. The soil are reddish brown to dark red, shallow to deep, fine loamy, not-calcareous, excessively drained to made deep soil erosion and the soil are deposited at bottom of the valley.

### Rain fall and climate

Rain fall are received from both the monsoons namely south-west (June - September) and North-East (October - December).

**Table 1. List of the Mosses and its types of Habitat, Vegetation and Altitudinal Zones in Kalrayan hills**

S. No.	Species Name	Habitat	Vegetation	Altitudinal Zone (in m)	
	<b>Bartramiaceae</b>				
1	<i>Philonotis hastata</i>	T	S	650-1070	
	<b>Bryaceae</b>				
2	<i>Brachymenium acuminatum</i>	T, R	S, D	450-1150	
3	<i>B. capitulatum</i>	T	E	650-1000	
4	<i>B. exile</i>	T,R	E, D/S	450-1100	
5	<i>B. leptophyllum</i>	T,R	E,S,D,D/SP	600-1070	
6	<i>Bryum argenteum</i>	T,R	S,P	750-1075	
7	<i>B. coronatum</i>	T,R	E,S,D	750-920	
8	<i>B. kashmirensis</i>	T	E	650	
9	<i>B. paradoxum</i>	T	S,D	600-1100	
10	<i>B. thomsonii</i>	T	D	800	
11	<i>B. wightii</i>	R	E,D	450	
12	<i>Pohlia wahlenbergii</i>	T,R	E,S,D	600-920	
	<b>Racopilaceae</b>				
13	<i>Racopilum cuspidigerum</i>	R,C	E,D	750-1100	
14	<i>R. orthocarpum</i>	R,C,L	S,D	750-1100	
	<b>Dicranaceae</b>				
15	<i>Campylopus flexuosus</i>	T	E	800-1075	
16	<i>C. ericoides</i>	T,R	S,D	1000-1095	
	<b>Leucobryaceae</b>				
17	<i>Leucobryum humillimum</i>	T	D	1100	
18	<i>L. juniperoideum</i>	T,R,C	E,D,D/S	650-1150	
19	<i>Octoblepharum albidum</i>	T,C	S,D	1000-1100	
	<b>Fissidentaceae</b>				
20	<i>Fissidens crispulus</i>	T	D	850	
21	<i>F. kalimpongensis</i>	T,R	S,D/S	450-1075	
22	<i>F. subangustata</i>	T	S	1070	
	<b>Funariaceae</b>				
23	<i>Funaria hygrometrica</i>	T	E	920-1100	
24	<i>Physcomitrium pulchellum</i>	T,R	S,D/S	600-1150	
	<b>Splachnaceae</b>				
25	<i>Splachnobryum assamicum</i>	T	S	750-1100	
	<b>Hypopterygiaceae</b>				
26	<i>Hypopterygium flavolimbatum</i>	R,C	D	450-800	
27	<i>H. tamarisci</i>	C	S	1095	
	<b>Entodontaceae</b>				
28	<i>Entodon flavescens</i>		C	S,D	1150
29	<i>Erythrodonium julaceum</i>		R,C,L	S,D/S	450-1150
	<b>Hypnaceae</b>				
30	<i>Ctenidium lychnites</i>		C,L	S	1075-1095
31	<i>Isopterygium albescens</i>		R,C	S,D/S	1070-1100
32	<i>Vesicularia vesicularis</i>		C	S	450-1095
	<b>Pterobryaceae</b>				
33	<i>Pterobryopsis acuminata</i>		R,C,L	E,S,D/S	600-1150
34	<i>P. orientalis</i>		R,C,L	E,S,D,D/S	650-1100
	<b>Stereophyllaceae</b>				
35	<i>Stereophyllum radiculosum</i>		R,C,L	E,D	650-1150
	<b>Thuidiaceae</b>				
36	<i>Thuidium tamariscellum</i>		C	D	1095
	<b>Meteoriaceae</b>				
37	<i>Aerobryum speciosum</i>		R,C	E,S	750-800
38	<i>Cryptopapillaria fuscescens</i>		C,L	D,D/S	450-1070
39	<i>Floribundaria walkeri</i>		R	S	1150
40	<i>Meteoriopsis ancistrodes</i>		C,L	S,D	800-1100
41	<i>M. reclinata</i>		C	D	600-1100
42	<i>M. squarrosa</i>		R	S	1000
	<b>Neckeraceae</b>				
43	<i>Homaliodendron flabellatum</i>		R,C	E,D/S	1070-1095
	<b>Orthotrichaceae</b>				
44	<i>Macromitrium moorcroftii</i>		C,L	S,D/S	1000-1075
45	<i>M. sulcatum</i>		C	D/S	1095
	<b>Polytrichaceae</b>				
46	<i>Pogonatum aloides</i>		T,R	E,S	650-920
	<b>Pottiaceae</b>				
47	<i>Barbula indica</i>		T,R	E,S,D,D/S,P	600-1100
48	<i>B. javanicum</i>		T,R	E,S,D/S,P	450-1150
49	<i>Bryoerythrophyllum gymnostomum</i>		T	E,D	750-920
50	<i>Gymnostomum aeruginosum</i>		T	D	920
51	<i>Hymenostomum edentulum</i>		T,R	E,S,D,D/S,P	600-1100
52	<i>Hyophila involuta</i>		R,R,C	E,D/S,P	450-1150
53	<i>Semibarbula ranuii</i>		T,R,L	E,S,D,D/S,P	450-1100
54	<i>Tortella torbuosa</i>		T	E	1000-1100
55	<i>Trichostomum tenuirostre</i>		T	S	1100

Habitat: T: Terricolous, R: Rubicolous, C: Corticolous, L: Lignicolous

Vegetation: E: Evergreen forest, S: Semi-evergreen forest, D: Deciduous forest, D/S: Degraded forest/Scrub forest, P: Plantation.

Altitudinal range: Species occurrence in between the Altitudinal Zones of 450-1150 m.

**Table 2. Mosses of Kalrayan Hills Common to Western Ghats, Eastern Ghats, Himalayas and Tamil Nadu in India**

S. No.	Species Name	W. G	E. G	H	TN
1	<i>Philonotis hastata</i>	++	++	++	++
2	<i>Brachymerium acuminatum</i>	++	++	---	++
3	<i>B. capitulatum</i>	++	++	++	++
4	<i>B. exile</i>	++	++	++	++
5	<i>B. leptophyllum</i>	++	++	---	++
6	<i>Bryum argenteum</i>	++	++	++	++
7	<i>B. coronatum</i>	++	++	++	++
8	<i>B. kashmirensis</i>	++	---	++	---
9	<i>B. paradoxum</i>	++	++	++	++
10	<i>B. thomsonii</i>	++	++	++	++
11	<i>B. wightii</i>	++	++	++	++
12	<i>Pohlia wahlenbergii</i>	++	---	++	++
13	<i>Racopilum cuspidigerum</i>	++	++	---	++
14	<i>R. orthocarpum</i>	++	++	++	++
15	<i>Campylopus ericoides</i>	++	++	---	++
16	<i>C. flexuosus</i>	++	++	---	++
17	<i>Leucobryum humillimum</i>	++	++	++	++
18	<i>L. juniperoides</i>	++	++	---	++
19	<i>Octoblepharum albidum</i>	++	++	++	++
20	<i>Fissidens crispulus</i>	++	++	---	++
21	<i>F. kalimpongensis</i>	++	++	++	++
22	<i>F. subangustata</i>	++	++	---	++
23	<i>Funaria hygrometrica</i>	++	++	++	++
24	<i>Physcomitrium pulchellum</i>	++	---	++	---
25	<i>Splachnobryum assamicum</i>	++	++	++	++
26	<i>Hypopterygium flavolimbatum</i>	++	++	---	++
27	<i>H. tamarisci</i>	++	++	---	++
28	<i>Entodon flavescens</i>	++	++	++	++
29	<i>Erythrodonium julaceum</i>	++	++	++	++
30	<i>Ctenidium lychnites</i>	++	++	---	++
31	<i>Isopterygium albescens</i>	++	++	++	++
31	<i>Isopterygium albescens</i>	++	++	++	++
32	<i>Vesicularia vesicularis</i>	++	++	---	++
33	<i>Pterobryopsis acuminata</i>	++	++	---	++
34	<i>P. orientalis</i>	++	++	++	++
35	<i>Stereophyllum radiculosum</i>	++	++	---	++
36	<i>Thuidium tamariscellum</i>	++	++	++	++
37	<i>Aerobryum speciosum</i>	++	++	---	++
38	<i>Cryptopapillaria fuscescens</i>	++	++	---	++
39	<i>Floribundaria walkeri</i>	++	++	++	++
40	<i>Meteoriopsis ancistrodes</i>	++	++	++	++
41	<i>M. reclinata</i>	++	++	++	++
42	<i>M. squarrosa</i>	++	++	++	++
43	<i>Homaliodendron flabellatum</i>	++	++	---	++
44	<i>M. moorcroftii</i>	++	++	++	++
45	<i>M. sulcatum</i>	++	++	---	++
46	<i>Pogonatum aloides</i>	++	++	++	++
47	<i>Barbula indica</i>	++	++	++	++
48	<i>B. javanicum</i>	++	++	++	++
49	<i>Bryoerythrophyllum gymnostomum</i>	---	---	++	---
50	<i>Gymnostomum aeruginosum</i>	++	++	---	++
51	<i>Hymenostomum edentulum</i>	++	++	---	++
52	<i>Hyophila involuta</i>	++	++	++	++
53	<i>Semibarbula ranuii</i>	++	++	++	++
54	<i>Tortella torbuosa</i>	++	++	++	++
55	<i>Trichostomum tenuirostre</i>	++	++	++	++
Total		54	50	32	52

W. G.; Western Ghats, E. G.; Eastern Ghats, H.; Himalayas, TN.; Tamil Nadu

The annual rainfall recorded at 971 mm from Kallakurichi and the total mean annual rainfall in Kalrayan hills is 1318 mm. It has mild tropical climate and can be shortly classified into three seasons viz., summer season (March - May), Rainy season (June - December) and winter season (January - February). The maximum rainfall obtained during north east monsoon period especially in between October and November. The minimum temperature in winter season is between November-January is 11 °C and maximum temperature in summer seasons is April - June in 35 - 40 °C.

### Vegetation types

The different types of forest present in the study area such as sholas, evergreen, semi-green, deciduous and scrub jungle. Sholas occupied most of the forest cover area of the study area. The altitudinal ranges of Sholas are 1200-1600 m (Sheltered pockets on the plateau), evergreen and semi-green forests occupied the top of plateau (altitude range 800-1,300 m.), deciduous forests (altitude range 300-900 m.) The scrub jungle forest is in the altitude of 400 m.

## Conclusion

A total of 55 species belonging to 36 genera comprise 19 families of 8 orders were identified from the study area. Among which 16 species were common to Shervaroys hills, 28 species to Kolli Hills, 17 taxa were common to Bodamalai, 25 taxa in South-Western Ghats, 22 species common to Palni Hills, 28 taxa to Nilgiri Hills, 33 species were common to the Wayanad Hills of Western Ghats in Kerala and 32 species were common to Himalayas. This study was carried out on the basis of the phytogeographical representation of moss species in the study area. In the present scenario the taxonomical survey on mosses by the research communities is very meager. Therefore very few scientists are familiar for the taxonomical identification of mosses. The present study revealed that, the moss species were distributed in different type of habitat, vegetation and also elevation of Kalrayan hills. In addition to that some taxa were adapted to soil, water sources of this regions. The major issue of the study area is the loss of nutrient value to the soil present here due to rapid erosion.

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