

# A PRELIMINARY STUDY ON THE MOSS FLORA OF KISHTWAR, J&K (NORTH-WEST HIMALAYA)

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**Abstract:** This paper is the first attempt to enlist the moss flora of Kishtwar (North-West Himalaya). A total of 17 mosses belonging to 8 orders, 12 families and 17 genera have been collected from diverse habitat, altitude and substrate pH.

**Keywords:** Hypnobryales, North-West Himalaya, Jammu & Kashmir state, Kishtwar, Moss flora.

## INTRODUCTION

Being one of the 17 mega diversity centers of the world (Mittermeier *et al.*, 1997), India exhibits tremendous climatic, altitudinal and habitat diversity. The ecological habitats vary from humid tropical Western Ghats to hot deserts of Rajasthan and from cold deserts of Ladakh to warm coasts of Peninsular India and moist Eastern Himalayas to moderate climatic zones of central India.

Bryophytes constitute one of the richest groups of plants in India and inhabit a wide range of habitats. A recent checklist of bryophytes compiled for India comprised of 2489 taxa representing 1786 species in 355 genera of mosses, 675 species in 121 genera of liverworts and 25 species in 6 genera of hornworts (Dandotiya *et al.*, 2011). Eastern Himalayas harbor richest bryoflora, followed by South India and Western Himalaya (Singh, 1997; Srivastava, 1998; Vashistha, 1998).

The state of Jammu and Kashmir which forms a part of North-West Himalaya offers suitable climatic conditions for bryodiversity. Despite its richness, most of the areas are totally un/under explored for its bryoflora. Only 20 hepatic taxa have so far been reported from Ladakh division of the state (Kashyap, 1929; Tanwir *et al.*, 2006; Dolma and Langer, 2012; Dolma and Langer, 2013) and 48 from Kashmir region (Kashyap, 1929; Robinson, 1965; Kaul and Dhar, 1968; Srivastava, 1979; Banday *et al.*, 1998). Preliminary exploration of a few areas of Jammu region by Langer and her associates (Langer and Tanwir, 2002; Langer *et al.*, 2003; Tanwir and Langer, 2004; Tanwir, 2005; Tanwir *et al.*, 2008) has revealed their richness in bryodiversity. The region comprises 10 districts, of which two (Jammu and Samba) are totally plain, seven (Udhampur, Rajouri, Reasi, Poonch, Doda, Kishtwar and Ramban) totally hilly and one (Kathua) partially hilly and partially plain. Although systematic studies on the hepatic flora of several districts (Jammu, Udhampur, Poonch and Rajouri) have been undertaken in the past, data

available for moss flora of the region is almost negligible except moss diversity of Patnitop (Udhampur district) (Bhandari *et al.*, 2008). As far as district Kishtwar is concerned, it has not attracted the attention of bryologists, part of this district was previously explored for its tracheophyte diversity (Kumar *et al.*, 2009) and thalloid hepatics (Sharma and Langer, 2012; Vanderpoorten and Goffinet, 2009). An attempt was, therefore, made to study the bryoflora of this area covering an altitudinal range of 1005 m to 2316 m. The exploration yielded a total of 27 taxa including 10 liverworts and 17 mosses. Present paper includes the information regarding various ecological aspects of the mosses only. Data collected for the hepatic taxa will be communicated separately.

## MATERIAL AND METHOD

Diverse habitats such as epilithic, non-epilithic, epiphytic and aquatic lying between 1005 m to 2316 m in Kishtwar district of Jammu region (J & K) were thoroughly scanned for their bryodiversity through periodic field trips (Table 1). Data on various ecological parameters (habitat, altitude, soil pH, etc) were collected in the field notebook. The collected taxa were identified on the basis of morphology and anatomy of various gametophytic (branching pattern, habit and habitat, whole mount of leaf, V.S of axis, arrangement of leaves etc) and sporophytic (position and shape of sporophyte, peristome etc) characters.

## RESULT

District Kishtwar, one of the ten districts of Jammu division (J & K) is situated between 33° 10' and 33° 25' latitude and 75° 25' and 76° 10' longitude. Altitude of the district ranges from 914 m to 6600m above sea level. Many high altitude areas of the district experience snowfall during December and January when the temperature dips below 0° C. It is bounded on the North by Kashmir and Zanskar

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valleys, South by Bhaderwah and Doda, East by Himachal Pradesh and West by Anantnag and Ramban. This hilly district has largely remained unexplored with respect to its bryodiversity, although Sharma and Langer (2012), undertook exploration of few areas lying between 1500 m to 3500 m altitude for its liverwort diversity. The present paper is the first attempt to document the moss flora of the district falling between 1005 m to 2316 m.

The moss taxa collected presently represent 8 orders, 12 families and 17 genera (Table 2; Figs. Plate I & II). It is evident from the Table that the largest order with respect to number of families represented in the present collection is Hypnobryales (3 families), then Pottiales and Eubryales with 2 families each and remaining five orders (Fissidentales, Funariales, Grimmiales, Polytrichales and Dicranales) are represented by a single family each. The only study on moss flora of Jammu region is that of Bhandari *et al.* (2008) who studied the moss diversity of Patnitop and its adjoining areas (Udhampur district) and reported 40 taxa belonging to 25 genera, 8 orders and 16 families. Out of the 17 taxa collected presently, only five (*Hymenostylium recurvirostre*, *Bryum cellulare*, *Funaria hygrometrica*, *Ditrichum heteromallum* and *Fissidens bryoides*) were common with those collected from Udhampur district by Bhandari *et al.* (2008). Comparison of the ecological (habitat, pH and altitude) data collected presently and earlier for these taxa has been presented in Table 3.

## DISCUSSION

Mosses are known to inhabit wide range of habitats (soil, rock, rotten wood, animal dung, burnt stumps, stream sides, calcareous soil, acidic soil, aquatic, damp areas, rock crevices etc.), pH and altitudinal range. They have either broad ecological amplitude or specific micro-environmental conditions. They play a significant role in ecosystem dynamics (Kashyap, 1920). It is evident from Table 2 that mosses have been collected presently from only two habitats (epilithic and non-epilithic) and none from epiphytic or aquatic habitat. Besides epilithic and non-epilithic, Bhandari *et al.* (2008) also collected 7 epiphytic mosses. Table 2 also reveals that the non-epilithic (11) taxa outnumbered the epilithic (6) ones. Similar trend was recorded by Bhandari *et al.* (2008) who collected 25 non-epilithic and 6 epilithic taxa.

Altitude is also known to play a vital role in bryophytic distribution (Srivastava, 1998; Kashyap, 1920). In Punjab plains, mosses become luxuriant between 1525-2135 m and number gradually increases from plains to mountains (Dixon and Badhwar, 1938). Chopra (1975) however, identified an altitudinal range of 1800-2400 m as the most suitable for the growth of mosses in Western Himalayas like optimum altitudinal range (1824-2432 m) of hepatic richness observed by Srivastava (1998). At higher elevations, there is again decline in their number. The moss taxa collected presently also reveal correlation with altitude. With increase in altitude there is increase in number of species.

As it is clear from Table 2, only one species (*Hymenostylium recurvirostre*) was collected from the lowest altitude (1010 m) and maximum number (8) from an altitudinal range of 1401-1600 m. Similar observations have been made from Udhampur district. Maximum (25) number of species had been collected between 1901-2100 m and minimum (9) from the lowest (500-1200 m) altitude.

Another ecological factor which influences the bryophytic distribution is substrate pH. Moss taxa studied presently were found inhabited the substrata having pH 6.8-8.1. During this study, they were collected neither from acidic nor highly alkaline soils. On the other hand, Bhandari *et al.* (2008) have collected moss taxa from soils with 4.7 as well as 9.2 pH.

Perusal of Table 2 reveals that

- Out of 17 taxa, majority of species (10) grew exclusively on alkaline soil (7.4 and above).
- 5 taxa occurred on the substratum with neutral pH (6.9-7.2).
- 2 taxa grew on slightly acidic pH (6.8).

## Figures

Peristome teeth of *Barbula tortelloides* (Fig. a), *Funaria hygrometrica* (Fig. b)  
Morphology of *Barbula tortelloides* (Fig. c), *Funaria hygrometrica* (Fig. d), *Rhodobryum roseum* (Fig. e), *Fissidens bryoides* (Fig. f), *Encalypta vulgaris* (Fig. g), *Hyophila rosea* (Fig. h), *Ditrichum heteromallum* (Fig. i), *Brachythecium populeum* (Fig. j), *Bryoerythrophyllum wallichii* (Fig. k), *Grimmia ovalis* (Fig. l), *Hymenostylium recurvirostre* (Fig. m), *Hypnum cupressiforme* (Fig. n), *Oxystegus cylindricus* (Fig. o), *Taxithelium kerianum* (Fig. p), *Mnium marginatum* (Fig. q).



**Table 1.** List of the bryophyte taxa collected from various sites.

Locality	Altitude (m)	Taxa collected
Cherhar	1371	<i>Reboulia hemispherica</i> , <i>Marchantia paleacea</i> , <i>Mnium marginatum</i>
Dool	1524	<i>Marchantia paleacea</i> , <i>M. polymorpha</i> , <i>Pellia endivaefolia</i> , <i>Bryum cellulare</i> , <i>Funaria hygrometrica</i> , <i>Atrichum undulatum</i>
Dool dam site	1402	<i>Reboulia hemispherica</i>
Ekhala	1700	<i>Plagiochasma appendiculatum</i> , <i>Pellia endivaefolia</i>
Galhar	1706	<i>Conocephalum conicum</i> , <i>Pellia endivaefolia</i>
Godrashnag	1524-1706	<i>Plagiochasma appendiculatum</i> , <i>Reboulia hemispherica</i> , <i>Dumortiera hirsuta</i> , <i>Bryoerythrophyllum wallichii</i> , <i>Rhodobryum roseum</i> , <i>Fissidens bryoides</i> , <i>Taxithelium kerianum</i>
Hasti	1280	<i>Plagiochasma appendiculatum</i> , <i>Reboulia hemispherica</i>
Hudri	1249	<i>Marchantia paleacea</i>
Hullar	1250	<i>Reboulia hemispherica</i> , <i>Marchantia paleacea</i> , <i>Oxystegus cylindricus</i>
Keru	1706	<i>Conocephalum conicum</i> , <i>Dumortiera hirsuta</i> , <i>Preissia quadrata</i> , <i>Pellia endivaefolia</i> , <i>Brachythecium populeum</i>

Kuadya	1016	<i>Conocephalum conicum, Pellia endivaefolia</i>
Kumran	2316	<i>Reboulia hemispherica</i>
Kwarh	1676	<i>Plagiochasma appendiculatum, Reboulia hemispherica, Marchantia paleacea, M. polymorpha, M. subintegra, Preissia quadrata, Pellia endivaefolia, Hypnum cupressiforme</i>
Mugalmaidan	1005	<i>Conocephalum conicum, Marchantia paleacea, Pellia endivaefolia, Hymenostylium recurvirostre</i>
Nageni	1219	<i>Marchantia paleacea, Pellia endivaefolia, Grimmia ovalis</i>
Parwajan	1492	<i>Plagiochasma appendiculatum, Reboulia hemispherica, Encalypta vulgaris, Hyophila rosea</i>
Poohie	1280	<i>Reboulia hemispherica</i>
Sarthal	1584	<i>Marchantia paleacea, Pellia endivaefolia, Ditrichum heteromallum</i>
Shalimar	1280	<i>Reboulia hemispherica</i>
Wardi	1270	<i>Marchantia paleacea</i>
Waserkund	1584	<i>Reboulia hemispherica, Marchantia paleacea, Pellia endivaefolia, Barbula tortelloides</i>

**Table 2.** Habitat diversity of various moss taxa collected

Order/ Family	Taxa	Site of collection	Altitude (m)	Habitat	pH
<b>A.POTTIALES</b>					
a)Pottiaceae	<i>Barbula tortelloides</i> C. Muell.	Waserkund	1280	Cemented wall fully/partially exposed to sunlight	7.6
	<i>Hyophila rosea</i> Williams	Parwajan	1490	Moist soil partially exposed to sunlight	7.9
	<i>Bryoerythrophyllum wallichii</i> (Mitt.) Chen	Godrashnag	1706	Rock surface fully exposed to sunlight	7.1
	<i>Hymenostylium recurvirostre</i> (Hedw.) Dix.	Mughal maidan	1010	Moist soil partially exposed	7.8
	<i>Oxystegus cylindricus</i> (Brid.) Hilp.	Hullar	1250	Soil partially exposed	7.8
b)Encalyptaceae	<i>Encalypta vulgaris</i> Hedw.	Parwajan	1493	Soil fully exposed to sunlight	8.1
<b>B.EUBRYALES</b>					
a)Bryaceae	<i>Bryum cellulare</i> Hook.	Dool	1524	Moist soil fully exposed to sunlight	7.4
	<i>Rhodobryum roseum</i> (Hedw.) Limpr.	Godrashnag	1706	Soil partially exposed to sunlight	6.8
b)Mniaceae	<i>Mnium marginatum</i> (With.) P.Beauv.	Cherhar	1371	Soil partially exposed	7.6
<b>C.FUNARIALES</b>					
Funariaceae	<i>Funaria hygrometrica</i> Hedw.	Dool	1524	Soil partially exposed to sunlight	6.8
<b>D.FISSIDENTALES</b>					
Fissidentaceae	<i>Fissidens bryoides</i> Hedw.	Godrashnag	1524	Wet rock surface	7.1
<b>E.HYPNOBRYALES</b>					
a)Brachytheciaceae	<i>Brachythecium populeum</i> (Hedw.) Schimp.	Keru	1700	Rock surface fully exposed	7.2
b)Hypnaceae	<i>Hypnum cupressiforme</i> Hedw.	Kwarh	1676	Wet rock surface	6.9
c)Sematophyllaceae	<i>Taxithelium kerianum</i> (Broth.) Broth.	Godrashnag	1524	Cemented wall fully exposed	7.1
<b>F.GRIMMIALES</b>					
Grimmiaceae	<i>Grimmia ovalis</i> (Hedw.) Lindb.	Nageni	1219	Soil partially exposed to sunlight	7.6

<b>G.DICRANALES</b>					
Ditrichaceae	<i>Ditrichum heteromallum</i> (Hedw.) Britt.	Sarthal	1584	Soil partially exposed	7.6
<b>H.POLYTRICHALES</b>					
Polytrichaceae	<i>Atrichum undulatum</i> (Hedw.) P. Beauv.	Dool	1524	Moist soil fully exposed to sunlight	7.8

**Table 3.** Comparison of common moss taxa of Kishtwar with Patnitop and its adjoining areas.

Taxa	Habitat		Altitude (m)		pH	
	Present study	Bhandari et al. (2008)	Present study	Bhandari et al. (2008)	Present study	Bhandari et al. (2008)
<i>Hymenostylium recurvirostre</i>	Non-epilithic	Epilithic	1010	1530	7.8	7.8
<i>Funaria hygrometrica</i>	Non-epilithic	Non-epilithic	1524	2000	6.8	7.8
<i>Fissidens bryoides</i>	Epilithic	Non-epilithic	1524	2000	7.1	8.2
<i>Ditrichum heteromallum</i>	Non-epilithic	Non-epilithic	1584	1650	7.6	9.2
<i>Bryum cellulare</i>	Non-epilithic	Non-epilithic	1524	2000	7.4	8.4

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