

Distributional Pattern of Genus *Hypnum* Hedw. (Bryophyta) in Relation to Habitat and Altitude at Darjeeling hills (Eastern Himalaya)

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Abstract

Hypnum Hedw. is a moss genus of family Hypnaceae which mostly occurs in temperate and sub tropical regions having ample moisture regime. The present study explicates the distribution and diversity of eight taxa of *Hypnum* viz. *H. aduncooides* (Brid.) Müll. Hal., *H. cupressiforme* Hedw., *H. cupressiforme* ssp. *imponens*, *H. macrogynum* Besch., *H. sikkimense* Ando, *H. subimponens* Lesq., *H. subimponens* ssp. *ulophyllum* (Müll. Hal.) Ando and *H. submolluscum* Besch. occurring in Darjeeling hill region of eastern Himalaya. The distribution of all the eight species of genus *Hypnum* in eastern Himalaya at Darjeeling hills along the altitudinal gradient and at five different habitats has been provided.

1. Introduction

Darjeeling is a well known destination of the east Himalayan region which takes its name from a Tibetan word 'Dorje-ling' meaning the land of the thunderbolt, a name given probably considering the heavy rains and climatic characteristics of this area. It is the northern most district of West Bengal. The Darjeeling hills have altitudes ranging from 303-3636 m above sea level (Malley, 1907). This region represents a combination of temperate and sub-tropical areas of the state of West Bengal encompassing the tea gardens and some agricultural land.

Darjeeling hills represent one of the richest floristic regions in the world, being a part of the east Himalayan mega diversity hot spot. The diversity of life forms at Darjeeling can be attributed to different kinds of physiographic, climatic and edaphic conditions, often aided by biotic factors. More than 7000 species of flowering plants along with plentiful cryptogams including algae, fungi, bryophytes and pteridophytes are known to occur here. The cryptogam diversity of any region holds utmost importance as it is a major component of the biodiversity of any given area. The present contribution deals with the genus *Hypnum* Hedw. which is an important pleurocarpous moss genus of bryophytes.

The bryophytes of Darjeeling have been previously dealt with by several workers but it is

appropriate to mention that consolidated and updated accounts of bryophytes of the Darjeeling region is rather scanty and lacking. Workers have previously provided substantial accounts of mosses along with new additions to the bryophyte diversity of this region (Gangulee, 1969-1972; Chopra, 1975; Srivastava *et al.*, 1994; Asthana *et al.*, 2005, 2012; Lal, 2005; Asthana and Sahu, 2010; Dandotiya *et al.*, 2011). Some researchers have recently taken up assessments on chemical aspects of bryophytes of the region (Chhetri *et al.*, 2009; Dey *et al.*, 2013; Mukhiya *et al.*, 2014). A detailed assessment of the recent status of important bryophyte genera and families is being undertaken considering the void prevailing in current knowledge of this aspect. This work is a small part of the detailed assessment and provides the current scenario of the genus *Hypnum* Hedw. across various habitats and altitudes at Darjeeling hills.

Genus *Hypnum* Hedw. is an important member of family Hypnaceae and represented in India by 11 taxa (Lal, 2005). Gangulee (1980) had initially reported nine species from India, whereas most recently (Dandotiya *et al.*, 2011) have included only six species from India in their checklist of bryophytes. *Hypnum* is a large genus with nearly 95 species worldwide (<http://www.theplantlist.org/> and exhibits a complex taxonomic scenario. A number of workers in the past have revised and elucidated the genus and provided systematic accounts (Ando, 1972a, 1973, 1985, 1989,

1997; Horikawa and Ando, 1957; Nishimura, 1999). Eight taxa of the genus have been reported from the entire east Himalayan region viz. *H. aduncoides* (Brid.) Müll. Hal., *H. cupressiforme* Hedw., *H. cupressiforme* ssp. *imponens*, *H. macrogynum* Besch., *H. sikkimense* Ando, *H. subimponens* Lesq, *H. subimponens* ssp. *ulophyllum* (Müll. Hal.) Ando and *H. submolluscum* Besch. (Lal, 2005). *H. flaccens* Besch. reported earlier from the area has now been treated as a synonym of *H. macrogynum* Besch. (Ando, 1972b). Interestingly, all these species known from eastern Himalaya have been found occurring in the Darjeeling hill region. An attempt has been made in the present work to discuss the distributional patterns and diversity of *Hypnum* in the Darjeeling hill region at the major habitats and across the altitudinal gradient.

2. Materials and Methods

Plant collections, made in different years from 13 sites of Darjeeling hills covering an altitudinal range of approx. 1500 to 3500 meters above sea level were segregated for assessing the distribution. The moss diversity has been assessed on five selected habitats at each site viz. soil, rocks, soil covered rocks, stony walls/brick walls (terricolous habitats) and epiphytic habitat. The collections have been deposited in the Bryophyte Herbarium, National Botanical Research Institute, Lucknow, India (LWG).

3. Results and Discussion

During the assessment, maximum number of species of *Hypnum* were found between 2000 to 2500 meters and substantial distribution was seen over 2000 meters, with all the eight species of *Hypnum* being distributed over this altitude (Fig. 1). *H. cupressiforme* ssp. *imponense*, *H. subimponense* and *H. submolluscum* were restricted to single area of collection viz. on way to Rimbhik, Sandakphu and Llyod Botanical Garden respectively (Table 1). The overall distributional scenario indicates that *Hypnum* is a reasonably distributed genus at Darjeeling hills with presence at 13 sites of collection. Rocks and bark provide the most amicable habitat for this genus with maximum distribution on these two habitats (Fig. 2). Soil also furnishes a favourable habitat for some species (Table 1, Fig. 2). As the genus has a pleurocarpous creeping habit and it therefore colonizes rock and bark fairly well as the rough nature of the surface provides required anchorage to these plants. Further, *H. cupressiforme* ssp. *imponense* was present at maximum (6) sites of collection, whereas *H. sikkimense* was encountered at 5 sites hence, both can be identified as widely distributed species of *Hypnum* at the studied area (Fig. 3).

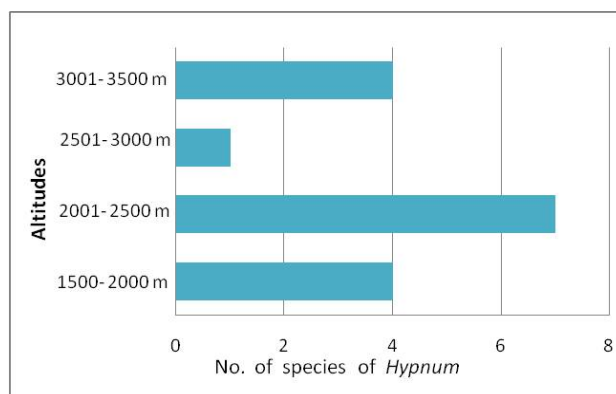


Fig. 1: Distribution of species of *Hypnum* Hedw. at different altitudinal gradients of Darjeeling hills

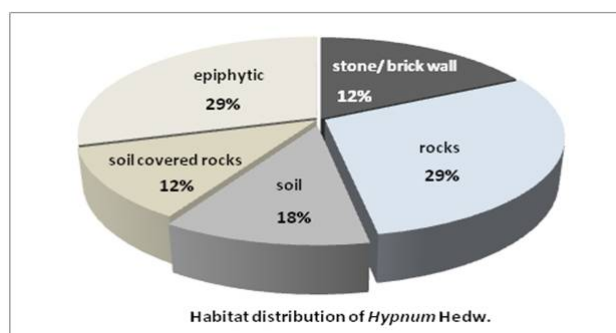


Fig. 2: Distribution of species of *Hypnum* Hedw. at various habitats of Darjeeling hills

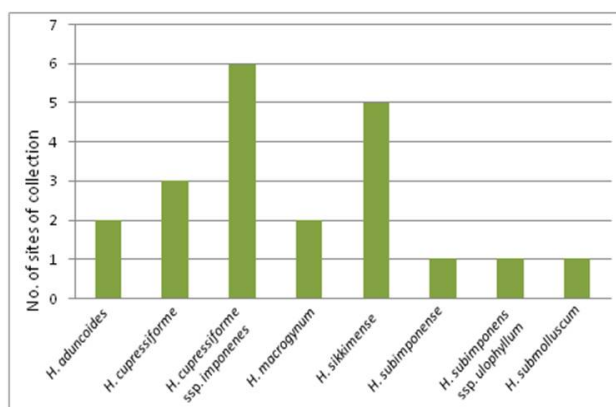


Fig. 3: Distribution of species of *Hypnum* Hedw. at various sites of collection at Darjeeling hills

Interestingly, *H. cupressiforme* is an important moss encountered from the study area, which has trace element and metal accumulation qualities (Sardans and Peñuelas, 2005; Andic *et al.*, 2015). This moss shows different phenotypes and exhibits an interesting taxonomy which has undergone detailed assessment by

Table 1: Habitat and altitudinal distribution of *Hypnum* Hedw. at Darjeeling hills

S. No.	Plant name	Altitude				Habitat				Sites of collection														
		1500-2000 m	2001-2500 m	2501-3000 m	3001-3500 m	SL	RC	SCR	SW/RW	EP	A	B	C	D	E	F	G	H	I	J	K	L	M	
1	<i>H. aduncooides</i>	-	+	-	+	-	-	-		+	+	+	-	-	-	-	-	-	-	-	-	-	-	-
2	<i>H. cupressiforme</i>	+	+	-	-			+	+	-	-	-	+	+	+	-	-	-	-	-	-	-	-	-
3	<i>H. cupressiforme</i> <i>ssp. imponenes</i>	+	+	-	+	+	+	+	+	+	-	+	+	+	-	+	+	+	+	+	+	-	-	-
4	<i>H. macrogynum</i>	-	+	-	+	+	+	-	-	+	-	-	-	-	-	-	-	-	-	+	+	-	-	-
5	<i>H. sikkimense</i>	+	+	-	+	+	+	-	-	+	-	+	-	-	-	-	-	-	-	+	+	+	+	+
6	<i>H. subimponense</i>	-	+	-	-	-	-	+	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-
8	<i>H. subimponens</i> ssp. <i>ulophyllum</i>	-	-	+	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-
7	<i>H. submolluscum</i>	+	+	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-

SL= Soil, RC= Rocks, SRC= Soil covered rocks, SW/RW= Stony wall/ Rock wall, EP= Epiphytic; A= Tanglu, B= Sandakphu, C= Mall road, D= on way to Teesta, E= on way to Rimbick, F= Ranjeet Bridge, G= Jala pahar, H= Llyod Botanical Garden, I= Gurdum Forest, J= on way to Senchal Lake, K= Manebhanjan, L= Tiger Hill, M= on way to Tanglu.

Frahm and Frey (1987) and Frahm (2009). This moss has been encountered at Darjeeling hills from 3 sites of collection between an altitude of 1500- 2500 meters. *Hypnum* is an important pleurocarpous moss genus which needs proper updates and taxonomic revisions regularly considering the complex taxonomy and ecological importance. The present work is an attempt to update and supplement the knowledge about occurrence and distribution of *Hypnum* at the Darjeeling hills.

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