

Mosses of Govind Wild Life Sanctuary, Uttarakhand, Western Himalaya, India

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ABSTRACT

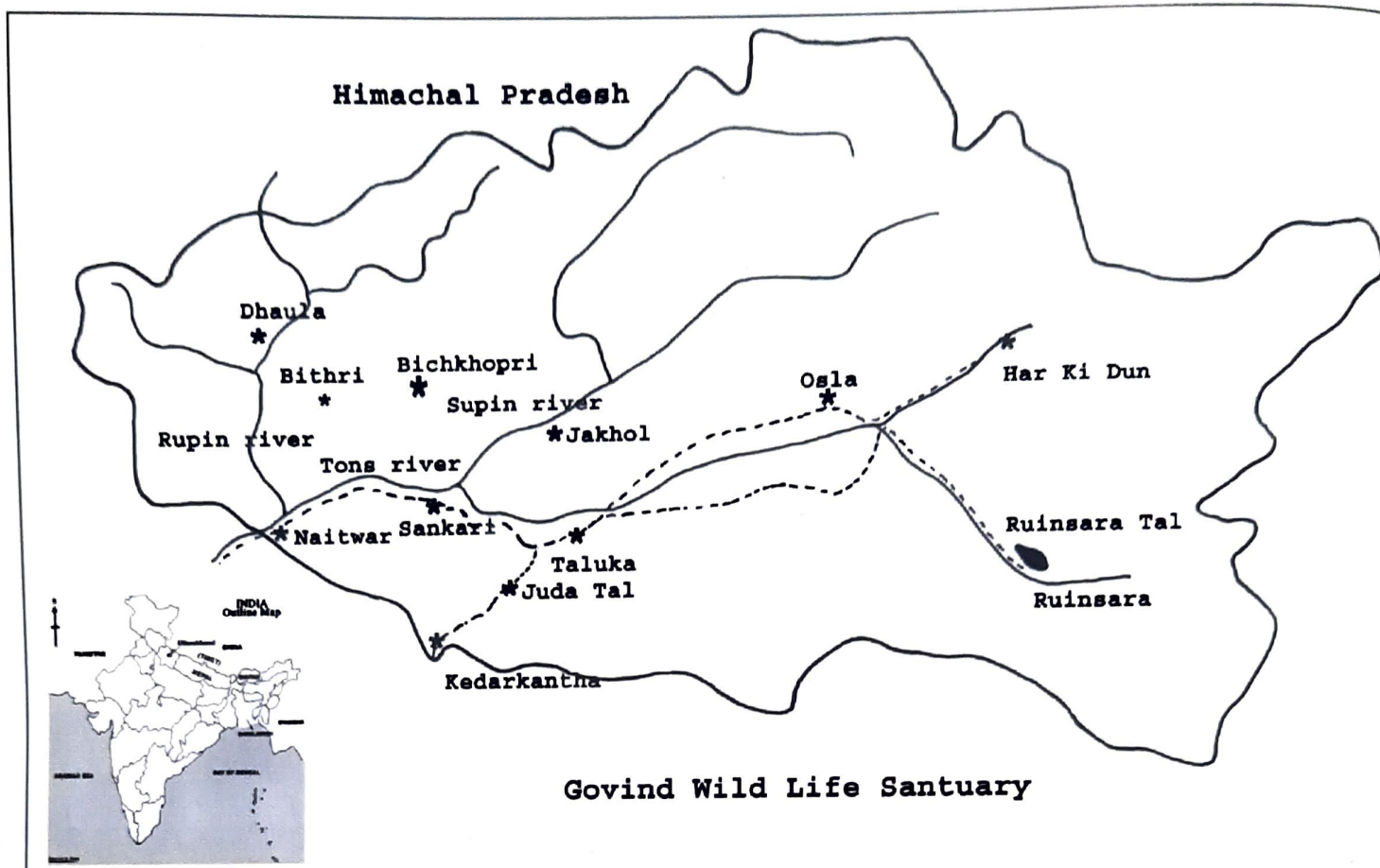
The present study deals with the investigation of moss flora of Govind Wild Life Sanctuary (GWLS), Uttarkashi, Uttarakhand. It includes an account of 216 species of mosses belonging to 103 genera of 32 families. Families Pottiaceae and Bryaceae seem to be more dominant in the region with 32 species, followed by Brachytheciaceae and Thuidiaceae. Both the genera *Brachythecium* and *Bryum* are represented by maximum number of species (9 species each). The taxa *Grimmia nepalensis* Mitt., *Pohlia prolifera* (Lindb. ex Breidl.) Lindb. ex Arn and *Brynia nepalensis* Takaki have been identified as new records to India. Some species viz., *Aulacopilum glaucum* Wilson, *Fissidens griffithii* Gangulee, *Macroma tenuis* subsp. *sullivantii* (Müll. Hal.) Vitt. and *Ptychomitrium indicum* (Schrad.) A. Jaeger are new to western Himalaya. Apart from that *Tayloria hornschurchii* (Grev. & Arn.) Broth. *Lindbergia koelzii* Williams and *Brachythecium falcatulum* (Broth.) Par. are new to Uttarakhand.

Key-words: Mosses, Govind Wild Life Sanctuary, Uttarakhand, Western Himalaya, India.

INTRODUCTION

The study on the biodiversity of protected areas provides an actual assessment of the diversity of flora and fauna in their natural habitats as they grow in least disturbed niches in such regions. Govind Wild Life Sanctuary is situated in Uttarkashi district of Uttarakhand. It spreads over an area of 953 Km². It is located between 31°17.30'N to 35°55'N and 77°47.30'E to 78°37.30'E. The area comprises of vallies of two rivers viz., Rupin and Supin, the two major tributaries of river Tons which drains into river Yamuna. The average altitude of the region is 1300 to 6230 m. The average annual precipitation varies from 1000 to 1500 m, most of which occur during monsoon. The entire area of the sanctuary is subjected to dry and cold climatic conditions and covered with light to heavy snow. The vegetation of the region includes subtropical coniferous forests through mixed temperate forests, dry

temperate forests to alpine scrubs and meadows. The area is very rich in medicinal plants and home for a large number of endangered animals and plants. The dominant vegetation of this area is occupied by *Abies*, *Quercus*, *Pinus*, *Juglans*, *Rhododendron*, *Cedrus*, *Betula* and *Taxus* species. Various workers from time to time attempted to document the mosses of western Himalaya. Chopra (1975) provided an account of Indian mosses. Subsequently, Chopra and Kumar (1981), Vohra (1983), Tewari and Pant (1994), Nath et al. (2010), Asthana and Sahu (2013a, 2013b), Sahu and Asthana (2015) provided a comprehensive account on mosses of western Himalaya. Very few studies are available on the floristic diversity of Govind Wild Life Sanctuary except the contributions of Kumar and Singh (2002), Singh and Singh (2002), Asthana and Sahu (2014a, 2015a, 2015b, 2016), Asthana and Gupta (2014) and Sahu and Asthana (2014a, 2014b). This



Text Figure 1. Study area showing different localities of Govind Wild Life Sanctuary, Uttarkashi, Uttarakhand (not to scale).

area is less explored for its floristic resources in general and for bryophytes in particular. The present study has been undertaken to exhibit an elaborate account of moss flora through extensive survey and collection of mosses from Govind Wild Life Sanctuary. During the course of investigation in this area the authors came across some interesting findings on mosses. In view of this, an enumeration of mosses of this area is provided with habitat and altitudinal ranges.

MATERIAL AND METHODS

Plant specimens were collected from rock surface, soil covered rocks, twigs and bark of different trees during the year 1989, 2011 to 2015 from different localities (Sankari, Jakhol, Taluka to Osla, Osla, towards Ruinsara and Har Ki Dun, Har Ki Dun, Kedarkantha, Juda Tal, Dhaula, Bichkhopdi, Naitwar, Badang to Bithri) of Govind Wild Life Sanctuary (Text Figure 1, Table 1). The collected specimens were investigated

Table 1. Localities surveyed for collection of Bryophytes

S No.	Localities	Coordinates	Altitude (m)
A	Sankari	N 31°04'34.0", E 78°10'52.5"	2000-2500
B	Jakhol	N 31°06'40.69", E 78°13'50.58"	1800-2500
C	Taluka to Osla	N 31°05'42.41", E 78°17'05.06"	2500-3000
D	Osla to Har Ki Dun	N 31°07'08.23", E 78°20'49.59"	2800-3500
E	Har Ki Dun	N 31°08'22.70", E 78°25'15.20"	3500-4000
F	Kedarkantha	N 31°02'16.283", E 78°10'56.001"	2800-3400
G	Juda Tal	N 31°04'34.0", E 78°10'52.5"	2100-2800
H	Dhaula	N 31°03'08.160", E 78°04'36.6"	1400-1700
I	Bichkhopdi	N 31°08'51.38", E 78°09'00.08"	3000-3500
J	Naitwar	N 31°04'49.82", E 78°11'05.50"	1300-1800
K	Badang to Bithri	N 31°07'27.81", E 78°06'52.70"	2400-3000

Table 2. Showing Moss species growing at Govind Wild Life Sanctuary

S. No.	Moss Species	Localities surveyed											Substrate
		A	B	C	D	E	F	G	H	I	J	K	
1	Family Amblystegiaceae												
	<i>Amblystegium saxatile</i> Schimp.	-	-	+	-	+	-	-	-	-	-	-	S, T
	<i>Amblystegium serpens</i> (Hedw.) Schimp.	-	-	-	-	+	-	-	-	-	-	+	T
	<i>Campylium chrysophyllum</i> (Brid.) J. Longe	-	+	-	-	-	-	-	-	-	-	-	S
	<i>Campylium gollanii</i> Müll Hal. ex Vohra	-	-	-	+	-	-	-	-	-	-	-	T
2	Family Bartramiaceae												
	<i>Bartramia halleriana</i> Hedw.	+	-	+	-	-	-	-	-	-	-	-	S, T
	<i>B. ithyphylla</i> Brid.	-	-	+	-	-	-	-	-	-	-	-	S
	<i>B. pomiformis</i> Hedw.	-	+	-	-	-	-	-	-	-	-	-	S
	<i>Philonotis angusta</i> Mitt.	-	-	+	-	-	-	-	-	-	-	-	S
	<i>P. fontana</i> (Hedw.) Brid.	-	-	-	-	+	-	-	-	-	-	-	S
	<i>P. thwaitesii</i> (Mitt.) Broth.	+	+	+	+	-	+	-	-	-	+	-	T, S
3	Family Brachytheciaceae												
	<i>Brachythecium buchanani</i> (Hook.) A. Jaeger	-	-	+	-	-	-	-	-	-	-	-	S
	<i>B. chakratense</i> Vohra	+	-	+	-	-	+	-	-	-	-	-	T
	<i>B. falcatulum</i> (Broth.) Par.	+	-	-	-	-	-	-	-	-	-	+	S, T
	<i>B. garhwalense</i> Vohra	-	-	-	-	+	-	-	-	-	-	-	S
	<i>B. kamounense</i> (Harv.) A. Jaeger	-	-	-	-	-	+	-	-	-	-	-	C, L
	<i>B. plumosum</i> (Hedw.) B. S. G.	+	-	-	+	-	-	-	-	-	-	-	C, T
	<i>B. procumbens</i> (Mitt.) A. Jaeger	+	+	+	+	+	-	-	+	-	-	-	C, S
	<i>B. salebrosum</i> (Hoffm. ex F. Weber & D. Mohr) Schimp.	+	+	-	-	-	-	-	-	-	-	-	S, T
	<i>B. waziriense</i> Dixon.	-	+	-	+	-	-	+	-	-	-	-	S, T
	<i>Bryhnia nepalensis</i> Takaki	+	-	+	-	-	-	-	-	-	-	-	S
	<i>Homalothecium neckeroides</i> (Griff.) Paris	+	-	-	-	-	-	-	-	-	-	-	C
	<i>Rhynchostegiella divaricatifolia</i> (Renauld et Cardot) Broth.	+	+	+	+	+	+	+	-	+	-	-	S
	<i>Rhynchostegium celebicum</i> (Sande Lac.) A. Jaeger	+	+	+	-	-	+	-	-	-	-	-	C, S, T
	<i>R. planiusculum</i> (Mitt.) A. Jaeger	-	-	-	-	-	+	-	-	-	-	+	T
	<i>R. riparioides</i> (Hedw.) Card.	-	-	-	-	-	+	-	-	-	-	-	S
	<i>R. suberectocarpum</i> (Dixon) Vohra	-	-	+	-	-	-	-	-	-	+	-	S
	<i>R. vagans</i> (Harv.) A. Jaeger	-	-	-	+	-	+	-	-	-	-	-	T
4	Family Bryaceae												
	<i>Anomobryum filiforme</i> var. <i>concinatum</i> (Spruce) Amann	+	+	+	+	+	+	-	+	-	+	+	S, T
	<i>A. auratum</i> (Mitt.) A. Jaeger	+	+	+	-	-	+	+	-	-	-	-	S, T
	<i>Brachymenium bryoides</i> Hook. ex Schw? gr.	-	-	-	-	-	-	-	+	-	-	-	S
	<i>B. capitulatum</i> (Mitt.) Paris	+	+	+	+	+	+	+	-	-	-	+	C, T
	<i>B. indicum</i> (Doz. & Molck.) Bosch. & Lac.	-	-	-	-	-	-	-	+	-	-	-	S
	<i>B. sikkimense</i> Renauld et Cardot	-	+	-	+	+	-	+	-	-	-	-	S, T
	<i>Bryum alpinum</i> Huds. ex With.	+	-	+	-	+	-	-	-	-	-	-	L, S
	<i>B. argenteum</i> Hedw.	+	+	+	+	+	+	-	+	-	+	-	S, T
	<i>B. bicolor</i> Dicks	-	+	-	+	-	-	-	-	-	-	-	S
	<i>B. billardieri</i> Schw? gr.	-	-	+	-	-	+	+	-	-	-	-	C, T
	<i>B. capillare</i> Hedw.	+	+	+	-	+	-	-	-	-	-	-	T

	<i>B. pallescens</i> Schleich. ex Schw? gr.	+	+	+	+	+	+	-	+	-	+	+	L, S, T
	<i>B. paradoxum</i> Schw? gr.	-	-	-	-	-	-	-	-	-	-	+	S
	<i>B. retusifolium</i> Card. et P. de la Varde	-	-	+	-	-	-	-	-	-	-	-	T
	<i>B. uliginosum</i> (Brid.) B. S. G.	+	-	-	-	+	-	-	-	-	-	-	S
	<i>Epiterygium tozeri</i> (Grev.) Lindb.	+	-	-	-	-	+	-	-	-	-	-	T
	<i>Gemmabryum apiculatum</i> (Schwäger.) J.R. Spence & H.P. Ramsay	-	-	-	+	-	-	-	-	-	-	-	S
	<i>Pohlia camptotrachela</i> (Renauld et Cardot) Broth.	-	-	-	-	-	+	-	-	-	-	-	T
	<i>P. elongata</i> Hedw.	-	-	+	+	-	-	-	-	-	-	-	T
	<i>P. flexuosa</i> Hook. var. <i>propagulifera</i> (Renauld et Cardot.) Gangulee	-	-	-	-	-	+	-	-	-	+	-	T
	<i>P. gedeana</i> (Bosch. & Lac.) Gangulee	+	+	-	+	+	+	-	-	-	-	-	S, T
	<i>P. longicolla</i> (Hedw.) Lindb.	-	-	-	-	-	-	-	-	-	-	+	T
	<i>P. minor</i> ssp <i>elongata</i> (Hopp. & Hornsch.) Wijk. & Marg.	-	-	+	+	-	+	-	-	-	-	-	T
	<i>P. proligera</i> (Lindb. ex Breidl.) Lindb. ex Arn.	-	-	-	-	-	-	+	-	-	-	-	S, T
	<i>P. rigescens</i> (Mitt.) Broth.	-	-	-	-	+	-	-	-	-	-	-	S
	<i>Rhodobryum giganteum</i> (Schw? gr) Paris	-	+	+	-	-	-	-	-	-	-	-	T
	<i>R. roseum</i> (Hedw.) Limpr.	+	+	+	+	-	+	-	+	-	-	-	S, T
5	Family Dicranaceae												
	<i>Anisothecium molliculum</i> (Mitt.) Broth.	+	+	-	-	-	+	+	-	-	-	+	T
	<i>Aongstoemia orientalis</i> Mitt.	+	-	-	-	-	-	+	-	-	-	-	T
	<i>Brothera leana</i> (Sull.) Mull. Hal.	-	-	-	-	-	-	-	-	-	-	+	L
	<i>Campylopus ericoides</i> (Griff.) A. Jaeger	-	+	+	-	-	-	-	+	-	-	-	C, S
	<i>C. schimidii</i> (Müll. Hal.) A. Jaeger	-	-	-	+	-	-	-	-	-	-	-	S
	<i>C. schimperi</i> J. Milde	-	-	-	-	+	+	-	-	-	-	-	C, T
	<i>Dicranodontium caespitosum</i> (Mitt.) Paris	-	+	-	-	+	+	+	-	-	-	-	L, S
	<i>D. denudatum</i> (Brid.) E. Britton	-	-	+	-	-	-	-	-	-	-	-	S
	<i>Dicranoweisia indica</i> (Wilson) Paris	-	-	+	-	-	-	-	-	-	-	-	S
	<i>Dicranum lorifolium</i> Mitt.	-	-	-	-	-	+	-	-	-	-	-	C
	<i>Microcampylopus khasianus</i> (Griffiths) Giese & J. P. Frahm	-	-	-	-	-	+	-	-	-	-	-	C
	<i>Symblepharis vaginata</i> (Hook. ex Harv.) Wijk & Margad.	-	-	-	-	-	+	+	-	-	-	-	C, L, T
6	Family Ditrichaceae												
	<i>Ceratodon purpureus</i> (Hedw.) Brid.	-	-	-	+	-	-	-	-	-	-	-	T
	<i>Distichium capillaceum</i> (Hedw.) Bruch. & Schimp.	-	-	-	+	+	-	-	-	-	-	-	T
	<i>Ditrichum pusillum</i> (Hedw.) Hamp.	+	-	-	-	-	-	-	-	-	-	-	T
7	Family Entodontaceae												
	<i>Entodon concinnus</i> (De Not.) Paris	-	-	+	+	-	+	-	-	+	-	+	C,S,T
	<i>E. luridus</i> (Griff.) A. Jaeger	-	-	+	-	+	+	-	-	-	-	-	C, S
	<i>E. luteonitens</i> Renauld et Cardot	+	+	+	+	+	+	+	-	-	-	-	C, S
	<i>E. prorepens</i> (Mitt.) A. Jaeger	-	-	+	+	-	-	-	-	-	-	-	S, T
	<i>E. pulchellus</i> (Griff.) A. Jaeger	+	-	-	-	-	-	-	-	-	-	-	C, T
	<i>E. rubicundus</i> (Mitt.) A. Jaeger	-	+	-	-	-	-	+	-	-	-	-	L, T
8	Family Erpodiaceae												
	<i>Aulacopilum glaucum</i> Wilson	-	-	-	-	-	-	-	+	-	-	-	S

9	Family Fabroniaceae													
	<i>Fabronia pusilla</i> Raddi	-	-	-	-	-	+	-	+	-	+	+		C, S
	<i>F. secunda</i> Mont.													
	<i>Schwetschkeopsis fabronia</i> Schw?gr. Broth.	+	-	-	-	-	-	-	+	-	-	-		C, S
10	Family Fissidentaceae													
	<i>Fissidens anomalus</i> Mont.	-	-	+	-	-	-	-	-	-	-	-		C
	<i>F. bryoides</i> Hedw.	-	-	+	+	+	-	+	-	-	-	+		L, S
	<i>F. bryoides</i> var. <i>schmidii</i> (Mull. Hal.) R. S. Chopra and S. S. Kumar	+	-	-	-	-	-	-	+	+	-	-		T
	<i>F. griffithii</i> Gangulee	-	-	-	-	-	+	-	-	-	-	-		T
	<i>F. macrosporoides</i> Dixon & P. de la Varde	-	-	-	-	-	-	+	-	-	-	-		s
	<i>F. robinsonii</i> Broth.	-	-	-	-	-	+	-	-	-	-	-		T
	<i>F. subpalmatus</i> Müll. Hal.	-	-	+	-	-	-	-	-	-	-	-		T
	<i>F. taxifolius</i> Hedw.	-	-	-	-	-	-	+	-	-	-	-		C
11	Family Funariaceae													
	<i>Entosthodon buseanus</i> Dozy & Molk.	-	-	-	-	+	-	-	-	-	-	-		T
	<i>E. wichurae</i> M. Fleisch.	-	-	-	-	-	-	+	-	-	-	-		T
	<i>Funaria hygrometrica</i> Hedw.	+	+	+	+	-	+	-	+	-	+	+		L, S, T
12	Family Grimmiaceae													
	<i>Grimmia donniana</i> Sm.	-	+	+	+	+	-	+	+	-	-	-		S, T
	<i>G. elongata</i> Kaulfuss	-	-	+	+	-	-	-	-	-	-	-		S
	<i>G. khasiana</i> Mitt.	-	-	-	-	-	-	-	+	-	-	-		S
	<i>G. longirostris</i> Hook.	-	-	-	-	+	-	-	-	-	-	-		S
	<i>G. ovalis</i> (Hedw.) Lindb.	-	-	+	+	-	-	-	-	-	-	-		S
	<i>G. nepalensis</i> Mitt.	-	-	-	+	-	-	-	-	-	-	-		S, T
	<i>Niphotrichum canescens</i> (Hedw.) Bednarek-Ochyra & Ochyra	-	-	-	-	+	-	-	-	-	-	-		S
	<i>Racomitrium subsecundum</i> (Hook. & Grev. ex Harv.) Mitt.	-	-	-	+	+	-	-	-	-	-	-		T
	<i>R. rispulum</i> (Hook f. et Wils) Hook f. et Wils	-	-	-	-	-	-	-	-	-	-	+		T
13	Family Hedwigiaceae													
	<i>Hedwigia ciliata</i> (Hedw.) Her. ex P. Beauv. var. <i>ciliate</i>	+	-	+	-	-	-	-	+	-	-	-		C, S, T
14	Family Hylocomiaceae													
	<i>Orontobryum recurvulum</i> Hampe ex Gangulee	-	-	-	-	-	+	-	-	-	-	-		C
15	Family Hypoterygiaceae													
	<i>Cyathophorella burkillii</i> (Dixon) Broth.	-	+	+	-	-	-	-	-	-	-	-		B, C
16	Family Hypnaceae													
	<i>Ectropothecium dealbatum</i> (Reinw. & Hornsch.) A. Jaeger	-	-	-	-	+	-	-	-	-	-	-		C
	<i>Gollania clarescens</i> (Mitt.) Broth.	-	-	-	-	-	+	-	-	-	-	-		S
	<i>G. ruginosa</i> (Mitt.) Broth.	+	-	+	-	-	+	+	-	-	-	-		C, S, T, L
	<i>Hypnum cupressiforme</i> Hedw.	-	-	-	-	-	+	-	-	-	-	-		L
	<i>H. macrogynum</i> Besch.	-	-	-	+	-	-	-	-	-	-	-		C
	<i>Isopterygium serrulatum</i> Fleisch.	-	-	-	-	-	+	-	-	-	-	-		C
	<i>Platygyriella aurea</i> (Schw?gr.) W. R. Buck	-	-	+	-	-	-	-	-	-	-	-		T
	<i>Taxiphyllum giraldii</i> (Müll. Hal.) M. Fleisch.	-	-	+	-	-	-	-	-	-	-	-		S, T
	<i>T. maniae</i> (Ren. & Paris) M. Fleisch.	-	+	+	-	-	-	-	-	-	-	-		S, T
	<i>T. taxirameum</i> (Mitt.) M. Fleisch.	+	+	+	-	-	-	-	+	-	+	-		S, T

17	Family Leskeaceae												
	<i>Leskeela incrassata</i> (Broth.) Broth.	-	-	-	-	+	-	+	-	-	-	-	T
	<i>Lindbergia duthiei</i> (Broth.) Broth.	-	+	+	-	-	+	-	-	-	-	-	C, L
	<i>L. koelzi</i> Williams	+	+	-	-	-	-	-	+	-	+	-	C, S
	<i>L. longinervis</i> Cardot & Dixon	-	-	-	-	+	-	-	-	-	-	-	C
	<i>Pseudoleskea incurvata</i> (Hedw.) Loesk.	-	-	+	-	-	-	-	-	-	-	-	T
	<i>P. laevifolia</i> (Mitt.) A. Jaeger	-	-	+	+	+	-	-	-	-	-	-	C, S, T
	<i>Pseudoleskeopsis zippeli</i> (Dozy. et Molk.) Broth.	-	-	-	-	-	-	-	+	-	-	-	S
18	Family Leucodontaceae												
	<i>Leucodon secundus</i> (Harv.) Mitt.	+	-	+	+	-	+	+	-	-	-	-	C, S, T
19	Family Meteoriaceae												
	<i>Meteorium buchananii</i> (Brid.) f. <i>polytrichum</i> (Dozy. et Molk.) Gangulee	-	-	+	-	-	+	-	-	-	-	-	C, S
	<i>Meteoropsis reclinata</i> (Müll. Hal.) M. Fleisch.	-	-	-	-	-	+	-	-	-	-	-	C
	<i>Papillaria semitorta</i> (Müll. Hal.) A. Jaeger	-	-	-	-	-	+	+	-	-	-	-	C, L
20	Family Mniaceae												
	<i>Mnium lycopodioides</i> Schw?gr.	-	+	+	+	+	+	-	-	-	-	-	S, T
	<i>M. heteromallum</i> (Hook.) Schw?gr..	-	-	-	-	-	+	-	-	-	-	-	C
	<i>M. thomsonii</i> Schimp.	-	-	+	-	-	-	-	-	-	-	-	S
	<i>Plagiomnium cuspidatum</i> (Hedw.) T. J. Kop.	+	+	+	+	+	+	+	-	-	-	+	C, L, S, T,
	<i>P. integrum</i> (Bosch. & Loc.) T. J. Kop.	-	+	+	-	-	+	+	-	-	-	+	C, S
	<i>P. japonicum</i> (Lindenb.) T. J. Kop.	+	-	+	-	-	+	-	-	-	-	-	C, S, T
	<i>P. rostratum</i> (Schr.) T. J. Kop.	-	+	-	-	+	+	-	-	-	-	-	T
	<i>P. undulatum</i> (Hedw.) T. J. Kop.	-	-	-	-	+	-	-	-	-	-	-	T
21	Family Neckeraceae												
	<i>Cryptolepton flexuosus</i> (Harv.) Renauld et Cardot	+	-	+	-	-	+	-	-	-	-	-	C
	<i>Homalia trichomanoides</i> (Hedw.) Schimp.	-	-	-	-	-	+	-	-	-	-	-	S
	<i>Homali dendron flabellatum</i> (Sm.) M. Fleisch	-	-	+	-	-	-	-	-	-	-	-	S
	<i>H. microdendron</i> (Mont.) M. Fleisch.	-	+	+	-	-	-	-	-	-	-	+	C
	<i>H. rectifolium</i> (Mitt.) M. Fleisch.	-	-	+	-	-	-	-	-	-	-	-	T
	<i>H. sphaeocarpum</i> Nog.	-	+	-	-	-	-	-	-	-	-	-	S
	<i>Thamnobryum subserratum</i> (Hook. ex Harv.) Nog. & Z. Iwats.	-	-	+	-	-	-	-	-	-	-	-	S
22	Family Orthotricaceae												
	<i>Drummondia stricta</i> (Mitt.) Müll. Hal.	-	-	+	+	-	+	-	-	-	-	-	C, T
	<i>Macroma tenuis</i> subsp. <i>sullivantii</i> (Müll. Hal.) Vitt.	-	-	+	+	-	+	-	-	-	-	-	C, S, T
	<i>Macromitrium hymenostomum</i> Mont.	-	-	-	+	-	-	-	-	-	-	-	C
23	Family Plagiotheciaceae												
	<i>Plagiothecium cavifolium</i> (Brid.) Z. Iwats.	-	-	-	-	+	+	-	-	+	-	-	C, T
	<i>P. euryphyllum</i> (Cardot & Thér.) Z. Iwats.	-	-	+	-	-	-	-	-	-	-	-	T
	<i>P. neckeroideum</i> Schimp.	-	-	+	-	-	-	-	-	-	-	-	T
	<i>P. nemorale</i> (Mitt.) A. Jaeger	-	-	-	+	-	-	-	-	-	-	-	T
	<i>Stereophyllum decorum</i> (Mitt.) Wijk & Margad	-	-	-	+	-	-	-	-	-	-	-	C
24	Family Polytrichaceae												
	<i>Atrichum flavisetum</i> Mitt.	-	+	-	+	-	+	-	-	-	-	-	L, T
	<i>A. undulatum</i> (Hedw.) P. Beauv.	+	+	+	+	+	+	-	-	+	-	+	L, S, T
	<i>Oligotrichum semilamellatum</i> (Hook.) Mitt. var. <i>edentatum</i> Gangulee	-	-	-	-	+	+	-	-	-	-	-	T

	<i>Pogonatum microstomum</i> (Schw? gr.) Brid.	-	-	+	-	-	-	-	-	-	+	S, T
	<i>P. neesii</i> (Müll. Hal.) Dozy	+	+	-	-	-	+	+	-	-	+	T
	<i>P. patulum</i> (Harv.) Mitt.	-	-	+	-	-	-	-	+	-	-	T
	<i>P. perichaetiale</i> (Mont.) A. Jaeger	-	-	-	-	+	-	-	-	-	-	T
	<i>P. urnigerum</i> (Hedw.) P. Beauv.	+	-	-	+	+	+	+	-	+	-	T
25	Family Pottiaceae											
	<i>Anoetangium stracheyanum</i> Mitt.	+	+	-	-	-	-	-	-	-	-	S, T
	<i>A. thomsonii</i> Mitt.	+	+	+	-	-	-	-	-	-	-	T
	<i>Barbula gregaria</i> (Mitt.) A. Jaeger	-	-	-	-	-	+	-	-	-	-	T
	<i>B. flavicans</i> D. G. Long	-	-	-	-	+	-	-	-	-	-	T
	<i>Bellibarbula kurziana</i> Hampe ex P. C. Chen.	+	-	-	-	-	-	-	-	-	-	S
	<i>Bryoerythrophyllum atrorubens</i> (Besch.) P. C. Chen.	-	-	+	-	+	-	-	-	-	-	C, T
	<i>B. inaequalifolium</i> (Taylor) R. H. Zander	-	-	-	+	-	-	-	-	-	-	S
	<i>B. wallichii</i> (Mitt.) P. C. Chen	+	+	-	+	-	+	+	-	+	-	L, S, T
	<i>B. yunnanense</i> (Herzog) P. C. Chen	-	-	-	-	+	-	-	-	-	-	T
	<i>Desmatodon gemmascens</i> P.C. Chen	-	-	+	-	-	-	-	-	-	-	S
	<i>D. latifolius</i> (Hedw.) Brid.	-	-	-	-	+	-	-	-	-	-	T
	<i>D. kabir-khanii</i> Broth.	-	-	-	-	+	-	-	-	-	-	S
	<i>Didymodon constrictus</i> (Mitt.) K. Saito	-	-	-	+	+	-	-	+	-	-	S
	<i>D. michiganensis</i> (Steere) K. Saito	-	-	+	+	-	-	-	-	+	+	S, T
	<i>D. nigrescens</i> (Mitt.) K. Saito	-	+	-	+	-	+	+	-	-	-	S, T
	<i>D. rigidulus</i> Hedw.	-	-	-	-	-	+	-	-	-	-	T
	<i>Gymnostomum calcareum</i> Nees & Hornsch.	-	-	-	+	-	-	-	-	-	-	S
	<i>Hydrogonium amplexifolium</i> (Mitt.) P. C. Chen.	-	-	+	-	-	-	-	-	-	-	S
	<i>H. arcuatum</i> (Griff.) Wijk. & Marg.	-	-	-	-	-	-	-	-	+	-	S
	<i>H. consanguineum</i> (Thwaites. et Mitt.) Hilp.	-	-	-	-	-	-	-	+	-	-	T
	<i>Hymenostyliella llanosii</i> (Müll. Hal.) H. Rob.	-	-	+	-	-	-	-	-	-	-	S
	<i>Hymenostylium recurvirostrum</i> var. <i>insigne</i> (Dix.) Bartro.	+	+	-	+	-	-	-	-	+	-	C, T
	<i>Hyophila involuta</i> (Hook.) A. Jaeger	+	+	+	-	-	-	+	+	-	+	S, T
	<i>H. nymaniana</i> (M. Fleisch.) M. Menzel	-	-	-	-	-	+	-	-	-	-	T
	<i>Leptodontium flexifolium</i> (Dicks.) Hampe	-	-	-	-	-	-	-	+	-	-	C
	<i>Oxystegus tenuirostre</i> (Hook. et Taylor) A. J. E. Smith	-	+	+	+	+	+	-	-	-	-	C, S
	<i>Syntrichia norvegica</i> Web.	-	-	-	+	-	-	-	-	-	-	T
	<i>Timmiella anomala</i> (Bruch & Schimp.) Limpr.	-	-	+	+	+	+	-	-	-	+	T, S
	<i>T. diminuta</i> (Müll. Hal.) P.C. Chen	-	+	-	+	-	+	-	-	-	+	T
	<i>Tortella fragilis</i> (Hook. & Wilson) Limpr.	-	-	-	-	-	-	+	-	-	-	L
	<i>Tortula inermis</i> (Brid.) Mont.	-	-	-	-	+	-	-	-	-	-	T
	<i>Trichostomum brachydontium</i> Bruch	-	+	-	-	-	-	-	-	-	-	S
26	Family Ptychomitriaceae											
	<i>Ptychomitrium indicum</i> (Schrad.) A. Jaeger	+	-	-	-	-	-	-	-	-	-	S
27	Family Sematophyllaceae											
	<i>Brotherella curvirostris</i> (Schwägr.) M. Fleisch.	-	-	-	-	-	+	-	-	-	-	T
	<i>B. harveyana</i> (Mitt.) Dixon.	-	-	-	-	-	-	-	-	-	+	L
	<i>Pylaisiadelpha tenuirostris</i> (Bruch & Schimp. ex Sull.) W. R. Buck	-	+	-	-	-	+	+	-	-	-	C
	<i>P. drepanioides</i> Cardot & Dixon	-	-	-	-	-	+	-	-	-	-	C
	<i>Wijkia pallida</i> (Renauld & Cardot) Y. Jia & Si He	-	-	-	-	-	+	-	-	-	-	L

28	Family Splachnaceae												
	<i>Tayloria hornschurchii</i> (Grev. & Arn.) Broth.	-	-	-	-	-	-	-	-	+	-	-	T
29	Family Symphyodontaceae												
	<i>Symphyodon erraticus</i> (Mitt.) A. Jaeger	-	-	+	-	-	-	-	-	-	-	-	T
30	Family Theliaceae												
	<i>Myurella sibirica</i> (Müll. Hal.) Reimers	-	-	-	-	-	+	-	-	-	-	-	C
31	Family Thuidiaceae												
	<i>Anomodon minor</i> (Hedw.) Lindb.	+	+	-	+	-	+	-	+	-	-	-	C, S
	<i>A. rugelii</i> (Müll. Hal.) Keissl.	+	-	+	+	+	+	+	+	+	-	+	C, S, T
	<i>Clapodium assurgens</i> (Sull. & Lesq.) Card.	-	-	+	-	-	-	-	-	-	-	-	S
	<i>C. pellucinerve</i> (Mitt.) Best.	-	+	+	+	-	-	-	-	-	-	-	C, S, T
	<i>C. prionophyllum</i> (Müll. Hal.) Broth	-	-	+	-	-	+	-	-	-	-	-	C, T
	<i>Haplocladium schimperi</i> Ther	-	-	+	-	-	-	-	-	-	-	-	S
	<i>H. stratosum</i> (Mitt.) Dixon	-	-	-	-	-	-	-	-	-	-	+	T
	<i>Haplohymenium triste</i> (Les.) Lindb.	+	+	-	-	-	-	-	+	-	-	-	C, S
	<i>Herpetineuron tocoae</i> (Sull. & Lesq.) Card.	+	+	+	-	+	+	-	+	-	-	-	C, S
	<i>Leptopterigynandrum decolor</i> (Mitt.) M. Fleisch.	-	-	+	+	-	-	-	-	-	-	-	C, S
	<i>L. subintegrum</i> (Mitt.) Broth.	-	-	-	-	+	-	-	-	-	-	-	S
	<i>Thuidium cymbifolium</i> (Dozy et Molk.) Dozy et Molk.	+	+	+	+	+	+	-	+	-	-	+	C, S, T
32	Family Trachypodaceae												
	<i>Duthiella declinata</i> (Mitt.) Zanten	-	-	+	+	-	-	-	-	-	-	-	S
	<i>Trachypodopsis auriculata</i> (Mitt.) M. Fleisch.	-	+	+	-	-	-	-	-	-	-	-	C, S
	<i>T. serrulata</i> (P. Beauv.) M. Fleisch.	-	-	+	-	-	+	-	-	-	-	-	C, L, S

for their morphology and anatomy. The identified specimens were air dried and deposited in the herbarium of CSIR-NBRI Lucknow (LWG).

RESULTS AND DISCUSSION

During the present study on the moss taxa of Govind Wild Life Sanctuary, 216 species belonging to 103 genera and 32 families have been identified occurring at eleven localities of the sanctuary on variety of habitats. These taxa are documented here in Table 2 with their respective localities and habitat of collection. (Legends of collection sites in Govind Wild Life Sanctuary, Uttarkashi, Uttarakhand; Localities surveyed are: A - Sankari, B - Jakhol, C - Taluka to Osla, D - Osla, toward Ruinsara and Har Ki Dun, E - Har Ki Dun, F - Kedarkantha, G - Juda Tal, H - Dhaula, I - Bichkhopdi, J - Naitwar, K - Badang to Bithri; Substrate: S= Saxicolous, C=Corticolous, L= Lignicolous, T= Terricolous).

A critical investigation on the mosses of Govind Wild Life Sanctuary has revealed that families Bryaceae and Pottiaceae exhibit luxuriant growth with 32 species

in the area followed by Brachytheciaceae (17), Dicranaceae (12) Thuidiaceae (12) and Hypnaceae (10). The genera *Brachythecium* and *Bryum* show dominance of species (9 species each) in the area. The other genera exhibiting luxuriant growth in the area are *Pohlia* (8 species), *Fissidens* (8 species), *Entodon* (6 species) and *Grimmia* (6 species). The dominant species of mosses in this area are *Atrichum undulatum*, *Pogonatum urnigerum*, *Anomodon rugelii*, *Thuidium cymbifolium*, *Oxystegus tenuirostre*, *Mnium lycopodioides*, *Funaria hygrometrica*, *Grimmia donniana*, *Entodon luteonitens*, *Bryum pallescens*, *B. argenteum*, *Brachymenium capitulatum*, *Anomobryum filiforme* var. *concinatum*, *Rhynchostegiella divaricatifolia* and *Brachythecium procumbens*. It is important to be mentioned here that *Philonotis thwaitesii*, *Rhynchostegiella divaricatifolia*, *Rhynchostegium suberectocarpum* and *Brachythecium garhwalense* are endemic to India. Earlier, Asthana and Sahu (2016) reported *Plagiothecium cavifoilum* and *Plagiothecium euryphyllum* new to India from this

area. Asthana and Sahu (2014a, 2014b, 2015a), Asthana and Gupta (2014) and Sahu and Asthana (2014a) also recorded *Bryum retusifolium*, *Campylopus schimidii*, *Cyathophorella burkillii*, *Homalothecium neckeroides*, *Leptopterigynandrum decolor*, *Microcampylopus khasianus*, *Myurella sibirica* and *Symphodon erraticus* as new taxa from western Himalaya. *Didymodon michiganensis* and *Fabronia pusilla* were reported new to this area (Sahu and Asthana 2014b). In the present study *Grimmia nepalensis*, *Pohlia prolifera*, *Bryhnia nepalensis* have been recorded as new to India, while *Aulacopilum glaucum*, *Fissidens griffithie*, *Macroma tenuis* subsp. *sullivantii* and *Ptychomitrium indicum* have been recognized as new to western Himalaya. Moreover, *Tayloria hornschurchii*, *Lindbergia koelzii* and *Brachythecium falciculatum* have been recognised as new to Uttarakhand. The present analysis of moss diversity from Govind Wild Life Sanctuary, Uttarkashi, Uttarakhand has revealed the occurrence of a rich and diverse moss vegetation including some endangered taxa viz., *Hedwigia ciliata* (Hedw.) Her. ex P. Beauv. var. *ciliata* (Asthana and Sahu 2014c). Based on the foregoing account of critical and systematic survey of the study area, it can be concluded that Govind Wild Life Sanctuary hosts a rich diversity of mosses including several potential and endemic taxa as well as some endangered species. Hence, conservation measures (*ex situ* and *in situ*) must be adopted to conserve this rich heritage of biodiversity.

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