

Bryoflora of Munsyari and Dharchula Tehsil of Pithoragarh, Uttarakhand, Western Himalayas, India

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Abstract: Uttarakhand state of India comprises unique topographical conditions and hence is rich in bryophytes. In present work two Tehsils-Munsyari and Dharchula of Pithoragarh have been explored extensively to assess the bryophytic wealth of this district. A preliminary checklist has been prepared which revealed the occurrence of 51 taxa of bryophytes from this district.

Keywords: Bryophyta, Western Himalayas, Uttarakhand, Pithoragarh

Introduction

Uttarakhand state of India is naturally landscaped with high Himalayan mountains, snow capped peaks, passes, valleys, alpine meadows, forests, waterfalls, perennial rivers, glaciers and springs. Pithoragarh district is the easternmost Himalayan district in this state. This area is ecologically very rich with diversified flora and fauna. Pithoragarh town, which is located in Soar valley is also its headquarter. The district is the part of Kumaon region of Uttarakhand state and which is also one of its administrative division (Plate 1).

Topography

The geographical area of the district is 7,100 km² (2,700 sq mi). Pithoragarh is located at a height of 1645 metres above sea level. Pithoragarh District lies between 29 degree 4 minutes to 30 degree 3 minutes` north latitude and 80 degree to 81 degree east longitude. Pithoragarh District is located along the eastern and southern part of the central Himalayas with Indo-Tibetan watershed divide in the north and Kali River forming a continuous border with Nepal in the east. The district is administratively divided into five tehsils, namely Munsiyari, Dharchula, Didihat, Gangolihat, and Pithoragarh. Pithoragarh District is surrounded by boundaries of Almora District, Champawat District, Bageshwar District and Chamoli District and extends over an area of around 7,217 sq kms. The northern hilly zone is covered with dense forests, particularly on northern slopes, with an elevation of about 14,000 feet.

Climate

Pithoragarh town, being in the valley, is relatively warm during summer and cool during winters. During the coldest months of December - January, the tropical and temperate mountain ridges and high locations receive snowfall and has an average monthly temperature ranging between 5.5 °C and 8 °C. Pithoragarh district have great variation in temperature due to much altitude gradient. The temperature starts intensifying from mid March until mid June. The areas situated above 3,500 m remain in a permanent snow cover. Regions lying between 3,000 to 3,500 m become snow bound for four to six months. There are extreme points present at the different places like the river gorges at Dharchula, Jhulaghat, Ghat and Sera, where sometimes temperatures rise up to 40 °C. The annual average rainfall is 36.7 cm. After June the district receives Monsoon showers.

Flora

Flora includes many unique sub-tropical, temperate and alpine plants. The flora of the district includes many Bryophytes, Pteridophytes, Gymnosperms and Angiosperms. Rare varieties of Orchids are also present in the high altitude (Champion and Seth, 1968). The prominent forest plants are *Myrica esculenta*, *Saussurea obvallata*, *Zanthoxylum armatum*, *Berberis aristata*, *Saussurea simpsonia*, *Rhododendron campanulatum*, *Rubus rotundifolius*, *Rhododendron barbatum*, *Cypripedium cordigerum*, *Dendrobium normale*, *Vanda cristata*, *Prunus pudum*, *Prunus cornuta*, *Pedicularis punctata*, *Quercus* spp., *Cedrus deodara*, *Taxus wallichiana*, *Abies pindrow*, *Aconitum heterophyllum*, *Betula utilis*, *Nardostachys grandiflora* and *Picrorhiza kurroa* etc.

As evident from the highly diversified geographical, climatic and floristic conditions this district of Uttarakhand state is rich in bryodiversity. However, the area is still underexplored and only few records of bryodiversity from here are available in bits and pieces (Kashyap and Chopra, 1932; Vohra, 1970; Asthana and Srivastava, 1991; Nath and Asthana, 1992; Parihar et al., 1994; Srivastava, 1998; Asthana and Nath, 2002; Nath et al, 2002; Lal, 2005; Saxena and Gangwar, 2005; Saxena et al, 2006; Aziz and Vohra, 2008; Nath et al., 2008; Saxena and Arfeen, 2009; Singh et al., 2010; Saxena et al., 2007; 2010) To fill this lacuna an attempt has been made and in present work only two Tehsil-Munsiyari and Dharchula have been explored extensively in the month of June, 2012. Many plant specimens both terrestrial as well as corticolous bryophytes have been collected from both the localities.

Materials and Methods

This study is initially based on recent collection trip to Pithoragarh which was made during the month of 23rd -29th June, 2012 by the authors (Afroz Alam & party). The authors collected several epiphytic and terrestrial populations of liverwort, hornwort and mosses. Simple methodology was adapted to collect specimens in the field. A simple knife was used to peel off specimens from tree barks, moist ground floor and other substratum. The collected materials were dried at room temperature on blotting paper and placed carefully in simple brown paper envelopes. All the essential field data were noted down including locality, date of collection, altitude etc. Various relevant literatures were consulted for identification work. The collected bryophytes were identified carefully and deposited to Banasthali Vidyapith Herbarium (BVH), Banasthali University, Rajasthan.

List of taxa:**CLASS: MARCHANTIOPSIDA Cronquist, Takht. & W. Zimm.****I. Order Marchantiales Limpr. In Cohn****1. Ricciaceae Rchb.****i. Riccia L.***Riccia billardieri* Mont. & Nees ex Gottsche, Lindenb. & Nees

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Dharchula; alt.ca. 900m; 786112 (BVH).

Riccia fluitans L.; Munsyari; alt.ca. 2100m; 786202 (BVH).**2. Aytoniaceae Cavers****ii. Asterella P. Beauv***Asterella blumeana* (Nees) Pandé, K.P. Srivast. & Sultan Khan

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786216 (BVH).

Asterella khasiana (Griff.) Grolle

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786236 (BVH).

iii. Plagiochasma Lehm. & Lindenb.*Plagiochasma appendiculatum* Lehm. Et Lindenb.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786271(BVH); Dharchula; alt. ca. 800m; 786154 (BVH).

Plagiochasma pterospermum

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786243 (BVH).

Plagiochasma rupestre

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Dharchula; alt.ca. 900m; 786145 (BVH).

iv. Reboulia Raddi*Reboulia hemisphaerica* (L.) Radii

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786197(BVH).

3. Marchantiaceae Lindl.**v. Marchantia L.***Marchantia palmata* Nees

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786186 (BVH); Dharchula; alt. ca. 800m; 786142 (BVH).

Marchantia paleacea Bert.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786204 (BVH); Dharchula; alt. ca. 800m; 786177 (BVH).

Marchantia polymorpha L.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786235-47(BVH).

5. Dumortieraceae D. G. Long**vi. Dumortiera Nees***Dumortiera hirsuta* (Sw.) Nees

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786253 (BVH).

7. Lunulariaceae H. Klinggr.,**vii. Lunularia Adans.***Lunularia cruciata* (L.) dum.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786266 (BVH).

8. Conocephalaceae Müll. Frib. ex Grolle

viii. Conocephalum Hill nom. cons.

Conocephalum conicum (L.) Underw.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786193 (BVH).

9. Targioniaceae Dumort.

ix. Targionia L.

Targionia hypophylla L.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786247 (BVH); Dharchula; alt. ca. 800m; 786155 (BVH).

10. Cyathodiaceae Stotler & Crand.-Stotl. in A. J. Shaw & B. Goffinet

x. Cyathodium Kunze

Cyathodium cavernarum Kunze

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Dharchula; alt.ca. 900m; 786133 (BVH).

CLASS: JUNGERMANNIOPSIDA Stotler & Crand.-Stotl.

II. Order Jungermanniales

11. Lejeuneaceae Cavers

xi. Lopholejeunea (Spruce) Schiffn. nom. cons.

Lopholejeunea sikkimensis Steph.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786276 (BVH).

12. Jubulaceae H. Klinggr.

xii. Frullania Raddi

Frullania ericoides (Nees ex Mart.) Mont.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786288 (BVH).

Frullania arecae (Spreng.) Gottsche

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786294 (BVH).

13. Jungermanniaceae Rchb.

xiii. Jungermannia L.

Jungermannia appressifolia Mitt.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786265 (BVH).

Jungermannia truncata Nees

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786272 (BVH).

xiv. Solenostoma Mitt.

Solenostoma tetragonum (Lindenb.) R.M. Schust. ex Váňa & D.G. Long

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786277-79 (BVH).

xv. Leiocolea (Müll. Frib.) H. Buch

Leiocolea alpestris (Schleich.) Isov.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786293 (BVH).

14. Porellaceae Cavers

xvi. Porella L.

Porella chinensis (Steph.) Hatt.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786298-302(BVH).

III. Order Metzgeriales Chalaud

15. Fossombroniaceae Hazsl.

xvii. *Fossombronia*

Fossombronia himalayensis Kash.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786199 (BVH).

16. Metzgeriaceae H. Klinggr.

xviii. *Metzgeria* Raddi

Metzgeria himalayensis Kash.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786298 (BVH).

18. Pelliaceae H. Klinggr.

xix. *Pellia* Raddi

Pellia epiphylla (L.) Corda

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786279 (BVH).

19. Aneuraceae H. Klinggr.

xx. *Riccardia* Gray

Riccardia levieri Schiffn.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786277 (BVH).

ANTHOCEROTOPSIDA Jancz. ex Stotl. & Crand.-Stotl.,

I. Order Anthocerotales

1. Anthocerotaceae Dumort.,

i. *Anthoceros* L.

Anthoceros crispulus (Mont.) Douin

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786222 (BVH); Dharchula; alt. ca. 800m; 786198 (BVH).

ii. *Phaeoceros* Prosk.

Phaeoceros himalayensis Prosk.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786239 (BVH).

PHYLUM (DIVISION) BRYOPHYTA

1. ORDER: HYPNALES

1. *Meteoriaceae* Kindb.

i. *Aerobryopsis* M. Fleisch.

Aerobryopsis longissima (Doz. et Molk.) Fleisch.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786277-82(BVH); Dharchula; alt. ca. 800m; 786185 (BVH).

ii. *Floribundaria* M. Fleisch.

Floribundaria floribunda (Doz. et Molk.) Fleisch.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Dharchula; alt. ca. 800m; 786257 (BVH).

iii. *Ambystegiaceae* G. Roth.

Amblystegium Schimp.

Amblystegium serpens (Hedw.) B. S. G.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786261 (BVH); Dharchula; alt. ca. 800m; 786189 (BVH).

2. Anomodontaceae Kindb.

iv. Anomodon Hook. & Taylor

Anomodon planatus Mitt.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786272 (BVH); Dharchula; alt. ca. 800m; 786200 (BVH).

3. Brachyteciaceae G. Roth.

v. Brachytecium Schimp.,

Brachytecium campestre (C. Muell.) B. S. G.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786232-45(BVH); Dharchula; alt. ca. 800m; 786192-95 (BVH).

4. Trachypodaceae

vi. Diaphanodon Renaud & Cardot

Diaphanodon blandus (Harv.) Ren. et Card.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786244-48 (BVH); Dharchula; alt. ca. 800m; 786176 (BVH).

5. Entodontaceae Kindb.

vii. Entodon Müll. Hal.

Entodon subplicatus Ren. et Card.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786273-75(BVH).

Entodon luteonitens Ren. et Card.

6. Leucodontaceae Schimp.

viii. Leucodon Schäggr.

Leucodon secundus (Harv. in Hook.) Mitt.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786284-89 (BVH).

II. ORDER: DICRANALES

7. Orthotrichaceae Arn.

ix. Amphidium Schimp

Amphidium lapponicum (Hedw.) Schimp.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786249-52 (BVH).

8. Dicranaceae Schimp.

x. Campylopus Brid.,

Campylopus gracilis (Mitt.) Jaeg.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786132 (BVH); Dharchula; alt. ca. 800m; 786145 (BVH).

9. Fissidentaceae Schimp.

xi. Fissidens Hedw.

Fissidens bryoides Hedw.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786241 (BVH); Dharchula; alt. ca. 800m; 786129 (BVH).

Fissidens taxifolius Hedw.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786279-83 (BVH); Dharchula; alt. ca. 800m; 786124-26 (BVH).

III. ORDER: POTTIAES

10. Pottiaceae Schimp.

xii. Anoetangium Schwägr.

Anoetangium clarum Mitt.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786233-39 (BVH); Dharchula; alt. ca. 800m; 786121-25(BVH).

xiii. *Barbula Hedw.*

Barbula funalis Dix. et Badhw.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786255-57.(BVH).

Barbula obscura Mitt.

xiv. *Hyophila Brid.*

Hyophila involuta (Hook.) Jaeg.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786288-89 (BVH).

IV. ORDER: BRYALES

11. Bartramiaceae Schwägr.

xv. *Bartramia Hedw.*

Bartramia subulata B. S. G.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786259 (BVH)

12. Bryaceae Schwägr.

xvi. *Brachymerium Schwägr.*

Brachymerium bryoides Hook. ex Schwaegr.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786277-78 (BVH); Dharchula; alt. ca. 800m; 786185 (BVH).

xvii. *Bryum Hedw.*

Bryum alpinum Huds. ex With.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786261 (BVH).

Bryum argenteum Hedw.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786258-59 (BVH); Dharchula; alt. ca. 800m; 786177 (BVH).

xviii. *Rhodobryum (Schimp.) Limpr.*

Rhodobryum giganteum (Schwaegr.) Par.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786263-64 (BVH).

xix. *Pohlia Hedw.*

Pohlia flexuosa Hook.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786279-80 (BVH); Dharchula; alt. ca. 800m; 786219 (BVH).

13. Mniaceae Schwägr.

xx. *Mnium Hedw.*

Mnium rostratum Schrad.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786278-79 (BVH).

V. ORDER: POLYTRICHALES

14. Polytichaceae Schwägr

xxi. *Pogonatum P. Beauv*

Pogonatum aloides (Hedw.) P. Beauv.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786273 (BVH); Dharchula; alt. ca. 800m; 786152 (BVH).

xxii. *Atrichum Card.*

Atrichum undulatum (Hedw.) P. Beauv

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786284 (BVH); Dharchula; alt. ca. 800m; 786179 (BVH).

VI. ORDER: ENCALYPTALES

15. Encalyptaceae Schimp.

xxiii. *Encalypta* Hedw.

Encalypta vulgaris Hedw.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786288 (BVH).

VII. ORDER: FUNARILES

16. Funariaceae Schwägr.

xxiv. *Funaria* Hedw.

Funaria hygrometrica Hedw.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786244-52 (BVH); Dharchula; alt. ca. 800m; 786135 (BVH).

xxv. *Physcomitrium* (Brid.) Brid.,

Physcomitrium cyathicarpum Mitt.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Dharchula; alt. ca. 800m; 786267 (BVH).

VII. ORDER: GRIMMIALES

17. Grimmiaceae Arn.

xxvi. *Grimmia* Hedw.

Grimmia ovalis (Hedw.) Lindb.

Specimen examined: Western Himalayas: Uttarakhand-Pithoragarh: Munsyari; alt.ca. 2100m; 786276 (BVH).

Result and Discussion

The present study of Munsyari and Dharchula tehsils of Pithoragarh revealed the occurrence of 16 species of Marchantiopsida, 12 species of Jungermanniopsida, 2 species of Anthocerotopsida and 31 species of phylum Bryophyta belonging to overall 47 genera; 37 families; 11 orders and 4 classes. It proves the potential of this region of Himalayas in terms of bryodiversity. However this work is a preliminary effort to assess the bryofloristic wealth of the region and many more explorations were needed to these lesser known remote areas of this district in future to compile the bryo-diversity.

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Plate 1: Location of Munsyari and Dharchula and a bird eye view of Dharchula



Plate 2: Figs. 1-2: Scenic beauty of Munsyari, Fig. 3: Growth of bryophytes near water source, Fig. 4: Moss population as corticolous form, Fig. 5: Terrestrial growth of *Marchantia*, Fig. 6: Mixed population of thalloid forms and mosses, Fig. 7: Growth of *Dumortiera* near dripping water, Fig. 8: Moss population at the base of tree trunk.

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