



G- Journal of Environmental Science and Technology

(An International Peer Reviewed Research Journal)
Available online at <http://www.gjestenv.com>

RESEARCH ARTICLE

Lichen Diversity Assessment of Darma Valley, Pithoragarh, Uttarakhand

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ARTICLE INFO

Received: 25 May 2018

Revised: 25 Jun 2018

Accepted: 28 Jun 2018

Key words:

Alpine - sub temperate,
Darma valley, Diversity,
Lichens, Uttarakhand

ABSTRACT

The Himalaya recognized for its biodiversity owing varied landscape and vegetation, provides luxuriant growth of lichens. Various geographical regions were explored for lichens study but till date, many alpine meadows are unexplored condition in this regard. The present study focused on lichen diversity of an alpine / sub temperate regions of Darma valley, Pithoragarh district and providing an inventory of 90 species of lichens belonging 54 genera and 21 families. The *Rhizocarpon distinctum* is being reported for the first time as new to Uttarakhand, previously this species was reported from Maharashtra.

1) INTRODUCTION

India, a country known for its huge geographical region and climatic variations, having a rich diversity of lichens represented by more than 2714 species contributes nearly 13.57% of the total 20,000 species of lichens so far recorded across the globe [1]. Among the various lichen-geographical regions of India, western Himalaya, central Himalaya and eastern Himalaya comprises 1200 species showing luxuriant growth of lichens due to favorable climatic conditions and availability of various phorophytes [2]. Uttarakhand being a part of central Himalaya comprises of Kumaun and Garhwal regions with its diverse geography and vegetation nourishing more than 658 lichens species [1, 3].

Having such a huge diversity, although significant work has been done by many workers time to time on various aspects of lichens from districts of Uttarakhand but till date many alpine meadows are still unexplored. Investigation of lichens for instance in Pithoragarh district of Kumaun Himalaya has been conducted by various researchers [4, 5, 6, 7] and enumeration of 391 species of lichens belonging to 96 genera and 44 families from Pithoragarh district [8] but recently some new species [9] and new records from this region were discovered and increases to 433 (Unpublished). Hence various unexplored alpine areas of this district increase the possibility of enhancing the number of lichen species. Considering this in mind present study is focused on the lichen investigation for the first time from Darma Valley of Pithoragarh, Uttarakhand.

2) MATERIALS AND METHODS

Darma valley is located at the North of the Panchachuli Mountain in Pithoragarh District, a part of Kumaon Himalayan region of Uttarakhand (Fig. 1a). The whole valley

extends to about 100 km [10], comprises of a total of 12 villages in which 07 villages namely Nagling, Baling, Dugtu, Dagar, Tidang, Marcha, and Sipu were surveyed for lichen collection, extending altitude 2870 to 3478 m sal (Table 1) and covers approx 21 km.



Figure 1a: a part of valley, **b-d:** various substrates for lichen growth.

Lichens were collected from fallen twigs, bark of trees, soil

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and rocks (Fig. 1 b-d). The samples were packed in paper bags and brought to the laboratory. The collected samples were air dried and identified on the basis of morphological characters of thallus, reproductive structures, colour, size and shape under stereo-zoom dissecting microscope (SZ2 - ILST OLYMPUS). Anatomy of thallus and fruiting bodies was studied by cutting thin sections and examining under compound microscope (B - 150 DB OPTIKA). Spot tests were performed with the help of reagents K (Potassium Hydroxide), C (Calcium Hypochlorite) and Pd (*para*-Phenylene diamine). Lichen samples were identified with the help of published literature [11, 12, 13] while secondary chemistry of samples was also carried out following standard protocols [14].

Table 1: Geographical distribution of various villages in Darma valley

Villages	Altitude (m)	Latitude	Longitude
Nagling	2870	30°10'48.57	80°34'33.70
Baling	3025	30°11'46.34	80°33'28.78
Dugtu	3224	30°12'56.94	80°32'27.84
Dagar	3294	30°16'33.94	80°31'46.21
Tidang	3305	30°17'00.19	80°31'30.27
Marcha	3376	30°18'17.30	80°30'28.17
Sipu	3478	30°18'36.48	80°29'33.93

3) RESULTS AND DISCUSSION

The present inventory of lichens flora from seven villages of Darma valley revealed a total of 90 species, belonging to 54 genera and 21 families (Table 2), growing on different substrate. Among 21 families, maximum number of species belongs to Parmeliaceae (15) which was followed by Physciaceae and Lecanoraceae (09). Most of lichens collected from this valley were saxicolous in nature and having crustose growth form. Besides of these lichens were found growing on major forest type such as *Abies pindrow*, *Pinus wallichiana*, *Juniperus indica* and alpine scrub and few species were also recorded from *Betula utilis* forest as well.

This first enumeration of lichens from this valley revealed the presence of two endemic species viz *Aspicilia almorensis* Räsänen and *Physcia gomukhensis* D.D. Awasthi & S.R. Singh while *Rhizocarpon distinctum* Th. Fr. is being reported for the first time from Uttarakhand previously this species was reported from Maharashtra.

Although lichen collection and documentation from Uttarakhand has started since long ago and reported more than

Table 2: Lichen species of Darma valley

S. No	Lichens Taxa	Family	GF	Habitat		
				C	T	S
1	<i>Acarospora badiofusca</i> (Nyl.)Th. Fr.	Acarosporaceae	C	-	-	+
2	<i>Acarospora bullata</i> Anzi	Acarosporaceae	C	-	-	+
3	<i>Acarospora strigata</i> (Nyl.) Jatta	Acarosporaceae	Sq	-	-	+
4	<i>Acarospora</i> sp.	Acarosporaceae	C	-	-	+
5	<i>Amandinea submontana</i> Marbach	Caliciaceae	C	-	-	+
6	<i>Aspicilia almorensis</i> Räsänen	Megasporaceae	C	-	-	+
7	<i>Aspicilia maculata</i> (H. Magn.)	Megasporaceae	C	-	-	+
8	<i>Bacidia</i> sp.	Ramalinaceae	C	-	-	+

600 species till 2010 but the extensive lichen survey and floristic investigation within last 07 years showed that the enhancement in lichen flora of Uttarakhand and a total of 55 species were also included in this list. This is the second most explored state after Andaman & Nicobar since 2010 where the highest number of lichens were added the list of state lichen flora.

Since long ago, the main occupation of Darma people had been trading, as per personal communication with villagers, trade of lichens was also in existence of some villagers but this was banned after establishment of Askot Wild-life Sanctuary. Now the trading of lichens from this valley is strictly prohibited. This is a good initiative not only for conservation of lichen but other floral and faunal diversity also. Besides of this the huge number of lichens from this valley suggesting the remoteness and inaccessibility along with less anthropogenic and undisturbed habitat. The valley remains covered with snow for 4-5 months, during this period villagers migrate towards lower altitude along with their cattle and sheep this help to reduce the anthropogenic pressure on valley and flourish of plant diversity.

Although the drastically decrease in sheep population and traditional way of living enhanced the floral diversity in valley [10] which is obviously positive sign for growth of lichen on different phorophytes in this valley but, the construction of road in valley making easier accessibility for people and visitors of Panchchuli mountain which is supportive to tourism point of view but same time these activities encourages landslides and impart threat to lichen diversity of valley which are the highly sensitive entity to disturbance and pollution.

4) CONCLUSION

The present study provides an inventory of lichen from Darma valley would be utilized for future biomonitoring studies in this region. Constructional and developmental work imparts an ecological imbalance due to significant loss of natural heritage which should be taken into consideration while implementing such works in biodiversity rich places.

Acknowledgment

Work has been conducted with the financial support of NMSHE programme. I am grateful to Dr. R.S. Rawal for providing me an opportunity to conduct this study in Darma Valley. I am grateful to Dr. D. K. Upreti for identification of lichen specimens and thanks extend to my team members of NMSHE task force three for their constant support during the field trip.

9	<i>Blennothallia crispa</i> (Huds.) Otálora, P.M. Jørg. & Wedin [= <i>Collema crispum</i> (Huds.) Weber ex F.H. Wigg.]	Collemataceae	F	+	-	+
10	<i>Buellia</i> sp.	Caliciaceae	C	-	-	+
11	<i>Bulbothrix isidiza</i> (Nyl.) Hale	Parmeliaceae	F	+	-	
12	<i>Brownliella cinnabarina</i> (Ach.) S.Y. Kondr. <i>et al.</i> [= <i>Caloplaca cinnabarina</i> (Ach.) Zahlbr.]	Teloschistaceae	C	-	-	+
13	<i>Candelaria concolor</i> (Dicks.) Stein	Candelariaceae	F	-	-	+
14	<i>Candelariella vitellina</i> (Ehrh.) Müll. Arg.	Candelariaceae	F	-	-	+
15	<i>Canoparmelia texana</i> (Tuck.) Elix & Hale	Parmeliaceae	F	+	-	-
16	<i>Cetrelia braunsiana</i> (Müll. Arg.) W.L. Culb. & C.F. Culb.	Parmeliaceae	F	-	-	+
17	<i>Cetrelia cetrarioides</i> (Delise ex Duby) W.L. Culb. & C.F. Culb.	Parmeliaceae	F	-	-	+
18	<i>Chrysothrix</i> sp.	Chrysothricaceae	L	-	-	+
19	<i>Circinaria calcarea</i> (L.) A. Nordin, Savić & Tibell [= <i>Aspicilia calcarea</i> (L.) Sommerf.]	Lecanoraceae	C	-	-	+
20	<i>Cladonia fimbriata</i> (L.) Fr.	Cladoniaceae	D	-	+	-
21	<i>Cladonia pyxidata</i> (L.) Hoffm.	Cladoniaceae	D	-	+	-
22	<i>Cladonia</i> sp.	Cladoniaceae	D	-	+	-
23	<i>Collema subflaccidum</i> Degel.	Collemataceae	F	+	-	-
24	<i>Cratiria obscurior</i> (Stirt.) Marbach & Kalb	Caliciaceae	C	-	-	+
25	<i>Dermatocarpon miniatum</i> (L.) W. Mann.	Verrucariaceae	F	-	-	+
26	<i>Dermatocarpon</i> sp.	Verrucariaceae	F	-	-	+
27	<i>D. vellereum</i> Zschacke, Rabenh.	Verrucariaceae	F	-	-	+
28	<i>Dimelaena oreina</i> (Ach.) Norman	Caliciaceae	C	-	-	+
29	<i>Diploschistes scruposus</i> (Schreb.) Norman	Graphidaceae	C	-	-	+
30	<i>Dolichousnea longissima</i> (Ach.) Articus [= <i>Usnea longissima</i> Ach.]	Parmeliaceae	Fr	+	-	-
31	<i>Enchylium polycarpon</i> (Hoffm.) Otálora, P.M. Jørg. & Wedin [= <i>Collema polycarpon</i> Hoffm.]	Collemataceae	F	-	-	+
32	<i>Endocarpon subrosettum</i> Ajay Singh & Upreti	Verrucariaceae	Sq	-	-	+
33	<i>Flavoparmelia caperata</i> (L.) Hale	Parmeliaceae	F	+	-	+
34	<i>Flavopunctelia flaventior</i> (Stirt.) Hale,	Parmeliaceae	F	+	-	+
35	<i>Gyalolechia flavovirescens</i> (Wulfen) Søchting, Frödén & Arup [= <i>Caloplaca flavovirescens</i> (Wulfen) Dalla Torre & Sarnth.]	Teloschistaceae	C	-	-	+
36	<i>Heterodermia boryi</i> (Fée) Kr.P. Singh & S.R. Singh	Physciaceae	F	+	-	-
37	<i>Heterodermia</i> sp.	Physciaceae	F	+	-	-
38	<i>Hypotrachyna cirrhata</i> (Fr.) Divakar, A. Crespo, Sipman, Elix & Lumbsch [= <i>Everniastrum cirrhatum</i> (Fr.) Hale ex Sipman]	Parmeliaceae	F	+	+	-
39	<i>Ioplaca pindarensis</i> (Räsänen) Poelt & Hinter.	Teloschistaceae	C	-	-	+
40	<i>Lecanora frustulosa</i> (Dicks.) Ach.	Lecanoraceae	C	-	-	+
41	<i>Lecanora subimmersa</i> (Fée) Vain.	Lecanoraceae	C	-	-	+
42	<i>Lasallia pustulata</i> (L.) Mérat	Umbilicariaceae	F	-	-	+
43	<i>Lecidea elaeochroma</i> (Ach) Ach.	Lecideaceae	C	-	-	+
44	<i>Lecidella carpathica</i> Körb.	Lecanoraceae	C	-	-	+
45	<i>Lecidella stigmatea</i> (Ach.) Hertel & Leuckert	Lecanoraceae	C	-	-	+
46	<i>Lepraria</i> sp.	Stereocaulaceae	L	-	-	+
47	<i>Leptogium</i> sp.1	Collemataceae	F	+	+	-
48	<i>Leptogium</i> sp.2	Collemataceae	F	+	+	-
49	<i>Lobothallia radiosa</i> (Hoffm.) Hafellner	Megasporaceae	C	-	-	+
50	<i>Lobothallia praeradiosa</i> (Nyl.) Hafellner	Megasporaceae	C	-	-	+
51	<i>Lobothallia</i> sp.	Megasporaceae	C	-	-	+
52	<i>Montanelia panniformis</i> (Nyl.) Divakar, A. Crespo, Wedin & Essl. [= <i>Melanelia panniformis</i> (Nyl.) Essl.]	Parmeliaceae	F	-	-	+
53	<i>Melanelixia villosella</i> (Essl.) O. Blanco & al.	Parmeliaceae	F	+	-	+
54	<i>Mycobilimbia hunana</i> (Zahlbr.) D.D. Awasthi	Porpidiaceae	C	-	-	+
55	<i>Myriolecis dispersa</i> (Pers.) Śliwa, Zhao Xin & Lumbsch [= <i>Lecanora dispersa</i> (Pers.) Sommerf.]	Lecanoraceae	C	-	-	+

56	<i>Myriospora smaragdula</i> (Wahlenb.) Nägeli ex Uloth [= <i>Acarospora fusca</i> de Lesd.]	Acarosporaceae	Sq	-	-	+
57	<i>Parmotrema grayanum</i> (Hue) Hale	Parmeliaceae	F	+	-	-
58	<i>P. reticulatum</i> (Taylor) M. Choisy	Parmeliaceae	F	+	-	-
59	<i>Peltigera</i> sp.	Peltigeraceae	F	-	+	-
60	<i>Physcia gomukhensis</i> D.D. Awasthi & S.R. Singh	Physciaceae	F	-	-	+
61	<i>Physcia stellaris</i> (L.) Nyl.	Physciaceae	F	-	-	+
62	<i>Phaeophyscia constipata</i> (Nyl.) Moberg	Physciaceae	F	-	+	-
63	<i>Phaeophyscia ciliata</i> (Hoffm.) Moberg	Physciaceae	F	+	-	-
64	<i>P. hispidula</i> (Ach.) Moberg	Physciaceae	F	+	-	+
65	<i>Physconia detersa</i> (Nyl.) Poelt	Physciaceae	F	+	-	-
66	<i>Physconia distorta</i> (With.) J.R. Laundon	Physciaceae	F	+	-	-
67	<i>Pleopsidium flavum</i> (Trevis.) Körb.	Acarosporaceae	C	-	-	+
68	<i>Polycauliona candelaria</i> (L.) Frödén, Arup & Söchting [= <i>Xanthoria candelaria</i> (L.) Th. Fr.]	Teloschistaceae	F	+	-	+
69	<i>Porpidia macrocarpa</i> (DC.) Hertel & A.J. Schwab	Lecideaceae	C	-	-	+
70	<i>Protoparmeliopsis muralis</i> (Schreber) M. Choisy [= <i>Lecanora muralis</i>]	Lecanoraceae	C	-	-	+
71	<i>Pyxine berteriana</i> var. <i>himalaica</i> D.D. Awasthi	Caliciaceae	F	-	-	+
72	<i>Ramalina conduplicans</i> Vain.	Ramalinaceae	F	+	-	-
73	<i>Ramalina sinensis</i> Jatta	Ramalinaceae	Fr	+	-	-
74	<i>Rhizocarpon disporum</i> (Nägeli ex Hepp) Müll. Arg	Rhizocarpaceae	C	-	-	+
75	<i>Rhizocarpon distinctum</i> Th. Fr.	Rhizocarpaceae	C	-	-	+
76	<i>Rhizocarpon geographicum</i> (L.) DC.	Rhizocarpaceae	C	-	-	+
77	<i>Rhizoplaca chrysoleuca</i> (Sm.) Zopf	Lecanoraceae	C	-	-	+
78	<i>Rusavskia elegans</i> (Link) S.Y. Kondr. & Kärnefelt [= <i>Xanthoria elegans</i> (Link) Th. Fr.]	Teloschistaceae	F	-	-	+
79	<i>Sarcogyne privigna</i> (Ach.) A. Massal	Acarosporaceae	C	-	-	+
80	<i>Squamulea subsoluta</i> (Nyl.) Arup, Söchting & Frödén [= <i>Caloplaca subsoluta</i> (Nyl.) Zahlbr.]	Teloschistaceae	C	-	-	+
81	<i>Stereocaulon</i> sp.	Stereocaulaceae	C	-	-	+
82	<i>Staurothele fissa</i> (Taylor) Zwackh	Verrucariaceae	C	-	-	+
83	<i>Toninia</i> sp.	Catillariaceae	C	-	-	+
84	<i>Umbilicaria indica</i> Frey	Umbilicariaceae	F	-	-	+
85	<i>Verrucaria coerulea</i> DC.	Verrucariaceae	C	-	-	+
86	<i>Xanthoparmelia mexicana</i> (Gyeln.) Hale	Parmeliaceae	F	+	-	+
87	<i>Xanthoria parietina</i> (L.) Th. Fr.	Teloschistaceae	F	-	-	+
88	<i>Xanthoria sorediata</i> (Vain.) Poelt	Teloschistaceae	F	-	-	+
89	<i>Usnea himalayana</i> C. Bab.	Parmeliaceae	Fr	+	-	-
90	<i>Usnea</i> sp.	Parmeliaceae	Fr	+	-	-

GF= Growth form, C= Corticolous, T= Terricolous, S= Saxicolous, C= Crustose, D= Dimorphic, F= Foliose, Fr= Fruticose, Sq= Squamulose

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