

Lichen diversity of Padder Valley Kishtwar (J&K), India

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Abstract

Lichens are one of the most successful group of organisms and form an important aspect of biodiversity of any region. But still lichens are under explored in most of regions. The present work has been carried out in Padder Valley, Kishtwar, Jammu and Kashmir (J&K). A thorough survey of the lichen diversity from all the possible habitats was conducted in the study area which indicated the presence of 110 species belonging to 54 genera and 23 families. Parmiliaceae has been recorded as the largest family (16 genera, 27 species) and is followed by Physciaceae (8 genera, 14 species). Four families have been observed to be monotypic. *Lecanora* has been recorded as dominant genera with 7 species followed by *Peltigera* with 5 species. Corticolous was most preferred substratum exhibited by 61 species while foliose was the most dominant type of growth form represented by 52 species. The study has added 94 lichen taxa as new records for district Kishtwar and is first of its kind in Padder Valley, J&K.

Keywords: Corticolous, Foliose, Kishtwar, Lichen diversity, Padder valley, Parmiliaceae

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INTRODUCTION

Lichens, a unique symbiotic association between the algae and fungus (and yeast, Spribille, *et al.*, 2016), are cosmopolitan in their distribution and grow on variety of different substratum which includes trees, rocks, soil and various man-made structures. The growth of lichens on different substrata depend upon the various factors like regional climatic factors (average rainfall and average temperature), microclimatic factors (light availability, moisture, temperature, etc) and substrate characteristics like rock composition, bark type, pH, rough surface and moisture retention ability (Hawksworth and Rose, 1976; James *et al.*, 1977; Hawksworth and Hill, 1984; Wolseley and Aguirre-Hudson, 1997; Mulligan, 2009).

Singh and Sinha (2010) have reported the presence of 2532 lichen species belonging to 324 genera and 78 families in India. However in a megabiodiversity nation like India with varied climatic and topographic features, the reported number of lichen species is not sufficient and hence requires rigorous exploration of newer areas. In the state of Jammu and Kashmir a total of 356 species of lichens belonging to 35 families and 91 genera

have been recorded by different workers (Sheikh *et al.*, 2006, Kumar *et al.*, 2012, Kumar *et al.*, 2014, Rahim *et al.*, 2014, Goni *et al.*, 2015) from few area only and still a vast expanse of the state requires a thorough exploration. Padder valley (33°10' to 33°40' N and 76°10' to 76°50' E) with an altitudinal extent ranging from 1500 m to 3500 m above sea level is such a place where no lichen studies have been carried out before this work. It lies at the confluence of Greater Himalaya and Pir-Panjal ranges in the Kishtwar district of the state, thereby creating unique microclimatic conditions. The rich growth of tree species like *Quercus leucotrichophora*, *Q. semicarpifolia*, *Pinus wallichiana*, *Cedrus deodara*, *Abies pindrow*, *Picea smithiana*, *Juglans regia*, *Betula utilis* etc. provide a suitable substratum for the growth of corticolous lichens. The outcrops of rocks of different types present in the study area also provide rich substratum for saxicolous lichens. The current work has been carried out with the objective to explore the lichen diversity of this unique habitat which has remained virgin as far as lichen studies are concerned and to collect baseline data for lichen diversity.

Table 1. Lichen species collected from the study area, their families, substratum and growth forms.

S.N.	Lichen Species	Family	Substratum	Growth Form
1.	* <i>Acarospora fusca</i> B.de Lesd.	Acarosporaceae	Crustose	Saxicolous
2.	* <i>Acarospora</i> sp	Acarosporaceae	Crustose	Saxicolous
3.	* <i>Allocetraria</i> sp	Parmeliaceae	Foliose	Corticolous
4.	* <i>Anaptychia kaspica</i> Gyel.	Physciaceae	Foliose	Corticolous
5.	<i>Aspicilia calcarea</i> (L.) Mudd.	Megasporaceae	Crustose	Saxicolous
6.	* <i>Aspicilia contorta</i> (Hoffm) Krempelh.	Megasporaceae	Crustose	Saxicolous
7.	* <i>Buellia disciformis</i> (Fr.) Mudd.	Caliciaceae	Crustose	Saxicolous
8.	* <i>Buellia</i> sp	Caliciaceae	Crustose	Saxicolous
9.	* <i>Caloplaca saxicola</i> (Hoffm) Nordin	Teloschistaceae.	Crustose	Saxicolous
10.	* <i>Caloplaca</i> sp	Teloschistaceae.	Crustose	Saxicolous
11.	<i>Caloplaca subsoluta</i> (Nyl.) Zahlbr.	Teloschistaceae.	Crustose	Saxicolous
12.	<i>Candelaria concolor</i> (Dicks.)B Stein	Candelariaceae	Crustose	Corticolous
13.	* <i>Candelariella vittellina</i> (Hoffm.) Mull. Arg.	Candelariaceae	Crustose	Saxicolous
14.	* <i>Cetrelia cetrarioides</i> (Delise ex Duby) Club & Club	Parmeliaceae	Foliose	Corticolous
15.	* <i>Cladonia chlorophaea</i> (Florke) Spring	Cladoniaceae	Fruticose	Lignicolous
16.	* <i>Cladonia corniculata</i> Anti & Kashi.	Cladoniaceae	Fruticose	Lignicolous
17.	* <i>Cladonia fimbriata</i> (L.) Fr.	Cladoniaceae	Fruticose	Corticolous
18.	* <i>Cladonia pyxidata</i> (L.) Hoffm.	Cladoniaceae	Fruticose	Corticolous
19.	* <i>Cryptothecia</i> sp	Arthoniaceae	Crustose	Saxicolous
20.	* <i>Collema</i> sp	Collemataceae	Foliose	Saxicolous
21.	* <i>Dermatocarpon miniatum</i> (L.)Mann.	Verrucariaceae	Foliose	Saxicolous
22.	* <i>Dermatocarpon vellerum</i> Zschacke	Verrucariaceae	Foliose	Saxicolous
23.	* <i>Diploschistes scruposus</i> (Schreb.)Norman	Thelotrema- taceae	Crustose	Saxicolous
24.	* <i>Diploschistes</i> sp	Thelotrema- taceae	Crustose	Saxicolous
25.	* <i>Dirinaria aegialita</i> (Afz. in Ach.) Moore	Caliciaceae	Foliose	Corticolous
26.	* <i>Endocarpon subrosettum</i> A. Singh & Upreti	Verrucariaceae	Crustose	Saxicolous
27.	* <i>Evernia diverticata</i> (L.) Ach	Parmeliaceae	Fruticose	Corticolous
28.	* <i>Evernia prunastri</i> (L.) Ach	Parmeliaceae	Fruticose	Corticolous
29.	* <i>Everniastrum cirrhatum</i> (Fr.) Hale ex Sipman	Parmeliaceae	Fruticose	Corticolous
30.	<i>Flavoparmelia caperata</i> (L.) Hale	Parmeliaceae	Foliose	Corticolous
31.	* <i>Flavopunctalia soledica</i> (Nyl.) Hale	Parmeliaceae	Foliose	Corticolous
32.	<i>Flavopunctelia flaventior</i> (Stirt.) Hale	Parmeliaceae	Foliose	Corticolous
33.	* <i>Heterodermia japonica</i> (Sato) Swinse & Krog.	Physciaceae	Foliose	Corticolous
34.	* <i>Heterodermia</i> sp	Physciaceae	Foliose	Corticolous
35.	* <i>Hyperphyscia adglutinata</i> (Flörke) Mayrhofer & Poelt	Physciaceae	Foliose	Corticolous
36.	* <i>Hypogymnia vittata</i> (Ach.) Nyl.	Parmeliaceae	Foliose	Corticolous
37.	* <i>Lecanora achroa</i> Nyl.	Lecanoraceae	Crustose	Corticolous
38.	* <i>Lecanora campestris</i> (Schaer.) Hue	Lecanoraceae	Crustose	Saxicolous
39.	* <i>Lecanora frustulosa</i> Dicks.) Ach.	Lecanoraceae	Crustose	Saxicolous
40.	* <i>Lecanora indica</i> Zahlbr.	Lecanoraceae	Crustose	Saxicolous
41.	* <i>Lecanora muralis</i> (Schreb.) Rabenh.	Lecanoraceae	Crustose	Saxicolous
42.	* <i>Lecanora perplexa</i> Broda.	Lecanoraceae	Crustose	Corticolous
43.	* <i>Lecanora subrugosa</i> Nyl.	Lecanoraceae	Crustose	Corticolous
44.	* <i>Lecanora</i> sp	Lecanoraceae	Crustose	Saxicolous
45.	* <i>Lecidella euphorea</i> (Florke) Hertel	Lecanoraceae	Crustose	Corticolous
46.	* <i>Lepraria lobificans</i> Nyl.	Lichen imperfecti	Leprose	Terricolous
47.	* <i>Lepraria</i> sp	Lichen imperfecti	Leprose	Terricolous
48.	* <i>Leptogium denticulatum</i> Tuck	Collemataceae	Foliose	Saxicolous
49.	* <i>Leptogium furfuraceum</i> (Harm.)Sierk	Collemataceae	Foliose	Corticolous
50.	* <i>Leptogium saturninum</i> (Dicks)Nyl.	Collemataceae	Foliose	Corticolous
51.	* <i>Lobothallina praesorediosa</i> (Nyl.) Hafellner	Megasporaceae	Crustose	Saxicolous
52.	* <i>Lobothallium</i> sp	Megasporaceae	Crustose	Saxicolous
53.	<i>Melanelia elegntula</i> (Zahlbr.) Essl.	Parmeliaceae	Foliose	Corticolous

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54.	* <i>Melanelixia fuliginosa</i> (Fr. Ex Duby) Blanco &al.	Parmeliaceae	Foliose	Corticolous
55.	* <i>Melanelixia glabra</i> (Schaer.)Blanco &al.	Parmeliaceae	Foliose	Corticolous
56.	* <i>Melanelixia subargentifera</i> (Nyl.)Blanco & al.	Parmeliaceae	Foliose	Corticolous
57.	* <i>Mycobilimbia sp</i>	Lecideaceae	Crustose	Saxicolous
58.	* <i>Parmelia maculalis</i> Taylor	Parmeliaceae	Foliose	Corticolous
59.	* <i>Parmelia sulcata</i> Taylor	Parmeliaceae	Foliose	Corticolous
60.	<i>Parmelina pastillifera</i> (Harmand) Hale	Parmeliaceae	Foliose	Corticolous
61.	* <i>Parmelina tiliaceae</i> (Hoffm.) Hale	Parmeliaceae	Foliose	Corticolous
62.	* <i>Parmotrema dilatatum</i> (Vainio)Hale	Parmeliaceae	Foliose	Corticolous
63.	* <i>Parmotrema reticulatum</i> (Taylor) Choisy	Parmeliaceae	Foliose	Corticolous
64.	<i>Parmotrema tinctorum</i> (Nyl)	Parmeliaceae	Foliose	Corticolous
65.	* <i>Peltigera didactyla</i> (With.) J.R. Laundon	Peltigeraceae	Foliose	Saxicolous
66.	* <i>Peltigera elisabethae</i> Gyeln.	Peltigeraceae	Foliose	Saxicolous
67.	* <i>Peltigera horizontalis</i> (Huds) Baumg.	Peltigeraceae	Foliose	Terricolous
68.	* <i>Peltigera polydactylon</i> (Neck) Hoffm	Peltigeraceae	Foliose	Saxicolous
69.	* <i>Peltigera praetextata</i> (Florke)Zopf	Peltigeraceae	Foliose	Saxicolous
70.	* <i>Pertusaria albescens</i> var. albescens (Huds.) M. Choisy & Werner in Werner	Pertusariaceae	Crustose	Corticolous
71.	* <i>Pertusaria leucosora</i> (Nyl.)	Pertusariaceae	Crustose	Saxicolous
72.	* <i>Phaeophyscia hispidula</i> (Ach.) Essl.	Physciaceae	Foliose	Corticolous
73.	<i>Phaeophyscia orbicularis</i> (Neck.) Moberg	Physciaceae	Foliose	Corticolous
74.	<i>Physcia aipolia</i> (Ehrh. Ex Humb.) Furnr	Physciaceae	Foliose	Corticolous
75.	* <i>Physcia dimidata</i> (Arn.)Nyl.	Physciaceae	Foliose	Corticolous
76.	* <i>Physcia dubia</i> (Hoffm.)Lett	Physciaceae	Foliose	Corticolous
77.	* <i>Physcia stellaris</i> (L.) Nyl.	Physciaceae	Foliose	Corticolous
78.	* <i>Physconia distorta</i> (With.) J.R. Laundon	Physciaceae	Foliose	Corticolous
79.	* <i>Physconia perisidiosa</i> (Erichsen)Moberg	Physciaceae	Foliose	Corticolous
80.	* <i>Porpidia crustulata</i> (Ach)Hertal and Knoph in Hertal	Porpidiaceae	Crustose	Saxicolous
81.	* <i>Porpidia hydrophila</i> (Fr.) Hertal and Knoph in Hertal	Porpidiaceae	Crustose	Saxicolous
82.	* <i>Porpidia macrocarpa</i> (DC.) Hertel and Schwab.	Porpidiaceae	Crustose	Saxicolous
83.	* <i>Pseudoevernina furfuracea</i> (L.) Zopf.	Parmeliaceae	Fruticose	Corticolous
84.	* <i>Psora decipiens</i> (Hedwing) Hoffm.	Psoraceae	Foliose	Terricolous
85.	* <i>Punctalia borreri</i> (Sm.)Krog	Parmeliaceae	Fruticose	Corticolous
86.	* <i>Punctalia rudecta</i> (Ach.) Krog.	Parmeliaceae	Foliose	Corticolous
87.	<i>Punctalia subrudecta</i> (Nyl.) krog	Parmeliaceae	Foliose	Corticolous
88.	* <i>Ramalina hossei</i> var. Hossei Vain.	Ramalinaceae	Fruticose	Corticolous
89.	* <i>Ramalina pollinaria</i> (Westr.) Ach.	Ramalinaceae	Fruticose	Corticolous
90.	<i>Ramalina sinensis</i> Jatta	Ramalinaceae.	Fruticose	Corticolous
91.	<i>Rhizocarpon disporum</i> (Naeg ex Hepp) Müll. Arg.	Rhizocarpaceae	Crustose	Saxicolous
92.	* <i>Rhizocarpon distinctum</i> Th. Fr.	Rhizocarpaceae	Crustose	Saxicolous
93.	* <i>Rhizocarpon geographicum</i> (L.) DC.	Rhizocarpaceae	Crustose	Saxicolous
94.	* <i>Rhizoplaca chrysoleuca</i> (Sm.) Zopf	Lecanoraceae.	Crustose	Saxicolous
95.	* <i>Rinodina badiella</i> (Nyl.) Th. Fr.	Physciaceae	Crustose	Saxicolous
96.	* <i>Rinodina sp</i>	Physciaceae	Crustose	Saxicolous
97.	* <i>Stereocaulon foliolosum</i> Nyl.	Stereocaulaceae	Fruticose	Corticolous
98.	* <i>Usnea aciculifera</i> Vainio	Usneaceae	Fruticose	Corticolous
99.	* <i>Usnea longissima</i> Ach.	Usneaceae	Fruticose	Corticolous
100.	* <i>Usnea subfloridana</i> Stirt.	Usneaceae	Fruticose	Corticolous
101.	* <i>Usnea undulate</i> Stirton	Usneaceae	Fruticose	Corticolous
102.	* <i>Verrucaria aethiobola</i> Wahlb. in Ach.	Verrucariaceae	Crustose	Saxicolous
103.	* <i>Vulpicida pinastris</i> (Scop.) J.E. Mattsson & M. J. Lai	Parmeliaceae	Foliose	Corticolous
104.	* <i>Xanthomendoza fallax</i> (Hepp ex Arn.) Sochting, Kärnefelt & S.Y. Kondr.	Teloschistaceae	Foliose	Corticolous
105.	<i>Xanthomendoza fulva</i> (Hoffm.) Sochting, Karnefelt & S.Y. Kondr.	Teloschistaceae	Foliose	Corticolous
106.	* <i>Xanthoparmelia mexicana</i> (Gyelnik) Hale	Parmeliaceae	Foliose	Saxicolous
107.	* <i>Xanthoparmelia stenophylla</i> (Ach.) Ahti & D. Hawksw.	Parmeliaceae	Foliose	Saxicolous
108.	<i>Xanthoria candelaria</i> (L.) Th. Fr.	Teloschistaceae	Foliose	Corticolous
109.	<i>Xanthoria elegans</i> (Link) Th. Fr.	Teloschistaceae	Foliose	Corticolous
110.	<i>Xanthoria parietina</i> (L.) Th. Fr.	Teloschistaceae	Foliose	Corticolous

*New record for the district Kishtwar, J&K.

Table 2. Comparison of dominant lichen families of the study area with the adjoining areas.

S. N.	Padder Valley (Author)	J&K (Sheikh, 2009)	Ladakh (Kumar <i>et al.</i> , 2012)	J&K (Goni <i>et al.</i> , 2015)	Kumaon Himalayas (Mishra and Upreti, 2016)
1.	Parmeliaceae	Parmeliaceae	Physciaceae	Parmeliaceae	Parmeliaceae
2.	Physciaceae	Physciaceae	Acarosporaceae	Physciaceae	Physciaceae
3.	Lecanoraceae	Teloschistaceae	Lecanoraceae	Lecanoraceae	Collembataceae
4.	Teloschistaceae	Lecanoraceae	Megasporaceae	Teloschistaceae	Lobariaceae
5.	Peltigeraceae	Verrucariaceae	Parmeliaceae	Cladoniaceae	Peltigeraceae

Table 3. Comparison of substrate preferences and growth form of lichens of the study area with the adjoining areas.

S. N.		J&K (Sheikh, 2009)	Ladakh (Kumar <i>et al.</i> , 2012)	Jammu, and (Sheikh <i>et al.</i> , 2013)	Rajouri Kishtwar (Sheikh <i>et al.</i> , 2013)	Kumaon Himalayas (Mishra and Upreti, 2016)	Padder Valley (Author)
1	Substrate	Corticolous	Saxicolous	Corticolous		Corticolous	Corticolous
		Saxicolous	Terricolous	Saxicolous		Saxicolous	Saxicolous
		Terricolous	-	-		Terricolous	Terricolous
2	Growth form	Crustose	Crustose	Crustose		Foliose	Foliose
		Foliose	Foliose	Foliose		-	Crustose
		Fruticose	Fruticose	Fruticose		-	Fruticose

MATERIALS AND METHODS

Lichen samples were collected from different substrates (i.e. rocks, trees and soil) and dried in the folds of bolting paper or newspapers. Dried samples were packed in lichen herbarium packets with details of locality, date of collection, name of collector and other ecological notes. The collected lichen samples were examined and identified at Lichenology Laboratory, National Botanical Research Institute, Lucknow, Uttar Pradesh, India. Morpho-anatomical analysis was carried out using a stereomicroscope and light microscope and chemical analysis with the help of spot tests, UV light and standardized thin-layer chromatography (Elix *et al.*, 1993). Available literature of different workers (Awasthi, 1988, 1991, 2000; Upreti, 1998; Singh and Sinha, 2010; Nayaka and Upreti, 2011; Kumar *et al.*, 2012; Goni *et al.*, 2015) was also consulted for identification of lichen taxa.

RESULTS AND DISCUSSION

The list of lichen species, collected and identified from all the possible substrata of Padder valley, Kishtwar, J&K, India has been presented in table 1 along with their families, growth form and the substratum. A total of 110 lichen species belonging to 23 families and 54 genera have been recorded from the study area of these 94 lichen taxa are new records for district Kishtwar, J&K (Table 1). Parmaliaceae has been recorded as the largest family (27 species) followed by Physciaceae (14 species), Teloschistaceae (8 species) and Peltigeraceae (5 species). Four families (Lecideaceae, Psoraceae, Sterocaulaceae and Arthoniaceae) have been observed to be monotypic (represented by one species each). Comparison of first five dominant families has been carried out with the dominant families of adjoining areas (Table 2) which also revealed Parmaliaceae

and Physciaceae to be the first two dominant families in the J&K (Sheikh, 2009, Goni *et al.*, 2015) and Kumaon Himalayas (Mishra and Upreti, 2016). However, Physciaceae has been recorded as the dominant family in Ladakh region (Kumar *et al.*, 2012)

Substratum preferences of the lichen species in the study area and adjoining regions has been depicted in Table 1 and 3. Perusal of the tables revealed corticolous species (61 species) to be the dominant followed by saxicolous (43 species), terricolous (4 species) and lignicolous (2 species). Corticolous lichens have also been observed as the dominant in different regions of J&K (Sheikh, 2009), Jammu, Rajouri and Kishtwar districts of the state (Sheikh *et al.*, 2013) and Kumaon Himalayas (Mishra and Upreti, 2016).

Lichens in Padder valley also exhibit different growth forms (Table1), of which foliose (52 species) has been observed to be the dominant growth form followed by crustose (39 species), fruticose (17 species) and leprose (2 species) growth forms. Mishra and Upreti (2016) has also reported foliose lichens to be dominant in Kumaon Himalayas. However, crustose lichens have been reported as dominant growth form in J&K (Sheikh, 2009), Ladakh (Kumar *et al.*, 2012) and Jammu, Rajouri and Kishtwar districts of the state (Sheikh *et al.*, 2013).

Conclusion

The present study revealed that the study area i.e. Padder Valley, Kishtwar district of Jammu and Kashmir (J&K) is rich in lichen diversity as it is represented by 110 species belonging to 54 genera and 23 families. Rich lichen diversity is an indicator of ecological health of any ecosystem and recording of 110 lichen species in the study area which accounts for 30.90% of the total lichen diversity of 356 lichen species from J&K state which

indicates the healthy ecosystem of the study area. 94 lichen species are new records for district Kishtwar of J&K. The present study also helps to know the extent of distribution of lichens in the previously unexplored region of the state of J&K.

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