ISSN NO. 2320-5407

Journal homepage: http://www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH

RESEARCH ARTICLE

DIVERSITY AND DISTRIBUTION OF MACRO-LICHEN IN KUMAUN HIMALAYA, UTTARAKHAND.

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Manuscript Info

Manuscript History:

Received: 14 December 2015
Final Accepted: 19 January 2016
Published Online: February 2016

Key words:
Lichens,Biodiversity, Taxonomy,Kumaun Himalaya, Uttarakhand.

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Abstract

The paper enumerates 246 species of lichens belonging to 45 genera and 13 families from the Kumaun Himalaya Uttarakhand. The study is based on the collection recently made during different field trips in the region. Out of the different districts, Pithoragarh and Bagehswar districts comprised of most of the localities falls under temperate and alpine regions and bears the maximum diversity of foliose lichens. Lichen family Parmeliaceae and Physciaceae are the dominant families in the region.

Introduction:-

Lichens are widely distributed in all the geographical region of the world. The word 'Lichen' has a Greek origin, which denotes that superficial growth on the bark of olive trees 'Theophrastus' the father of botany, introduced the term Lichen. Lichen is a symbiotic association between two different organisms; one is the alga (Photobiont) another is fungus (Mycobiont). De-Berry (1879) the term 'Symbiosis' to first time explain. The relationship of these two symbionts where in the components benefited through not necessarily to an equal degree. The dual nature of lichens first time discover by the Schwender (1869).

Morphologically lichens are three major growth forms, crustose (crust like and closely attached to the substratum), foliose (leaf like and loosely attached to the substratum) and fruticose (shrubs like hanging or erect growing on substratum). Awasthi (1988; 1991; 2007) lichens are categories in to two groups, one is microlichens (crustose and squamulose) and macrolichens (Dimorphic, foliose and fruticose) growth forms of lichens. Based on the substratum lichens divided in corticolous (growing on bark), saxicolous (growing on rock and boulders), terricolous when growing on soil, musicolous (on mosses), ramicolous (on twigs), foliicolous gows on leaves, lingnicolous (on dead wood), humicolous (on humus) and calcicolous (on lime or cement plaster).

A total 20,000 lichen species are reported from the world, while India is a very rich diversity of plants species with a total 3039 million hectare, lichens represented by more than 2305 species (Singh and Sinha 2010) from India. This is total 12% of 20,000 lichen species known from the world. The lichens are luxuriantly grows on moist and humid areas, for macrolichens, suitable temperature for lichen growth is 20-25^{o}C. In India maximum richness and diversity of lichens occurred in Himalayan region.

Himalayas (Sanskrit for 'Abode of Snow') is an intercontinental and the world`s highest mountainous chain covering part of Bhutan, China, India, Pakistan and the whole of Nepal. Indian Himalayas 27^{o}51'-30^{o}06' N latitude and 72^{o}30'-97^{o}25' E longitudes (Rodgers and Ranwar 1988). Stretching from Jammu and Kashmir in the North West to Arunachal Pradesh in the East includes parts of Trans, North West, Central, and East Himalayas (Rodgers and Ranwar 1988). It is covers approximately an area of 4, 19,873 sq km. The Indian Himalayas extends from the

eastern border of Afghanistan in the West and forms the northern part of the country. In India two mightiest rivers of is one of Ganga and other is Yamuna take birth in the Glaciers of Uttarakhand.
Uttarakhand has a total geographical area is 51, 125 sq km, out of which 93% is mountainous and 64% is covered by forest (Map 1). The Uttarakhand region represented a very significant part of the India sub-continent. The state exhibits much variation in its altitudes and topography. The state is bounded in the north Tibet, Nepal on the east and South of the Uttar Pradesh, Haryana to western Himachal Pradesh to North West. The state a large altitudinal range (300-8000 m) with a rich diversity of species, population, communities and ecosystems. Uttarakhand consist of two main regions, they Garhwal and Kumaun region.

Kumaun (lying between $28^{o}44'$-$31^{o}25'$ N latitude and $78^{o}45'$-$81^{o}01'$ E longitudes), It is in the northern side of Uttarakhand (Map 1). The temperate zone has a large number of lakes. The Kumaun region, lying between the Kali River in the east and Sutlej in the West. The total area covered is approximately 31, 035 sq km, and altitudes various greatly between 300 and 7436 m subtropical to alpine region. The three rocks type i.e. Sedimentary, Meta-sedimentary and igneous occur in the Kumaun region and three major tectonic plates or thrust are observed: (A) main boundary thrust, (B) South Almora thrust and (C) Ramagarh thrust.

The Kumaun Himalaya vegetation ranges from subtropical dry deciduous forest to alpine. According to Saxena and Singh (1982) the forest Basel cover and density reported for the forest occurring in Kumaun Himalaya ranged from 3042.2 to 8377.6 cm^2/ $100m^2$ and from 4.2 to 13.0 trees/100 m respectively. In the higher altitude en route to Pindari Glacier in Kumaun the forest cover ranged from 2597 to 18012 $cm^2/100m^2$ and density 5.0 to 10.6 trees/100 m reported by Kalakoti et al. (1986). Inner hill range of Kumaun, the forest basal cover ranged between 1790 to 12250 $cm^2/100m^2$ and density between 2.7 to 6.1 trees/100 m reported by Bankoti et al. (1992). Osmaston (1926) broughout his 'A forest flora for Kumaun'.

Earlier Upreti (1997; 2001) explored the lichens from Indian Himalayas. In higher altitudes area of the region Pindari and Milam Glacier region explored of lichens carried out by Joshi (2010). In Kumaun Himalaya the major localities were exhaustively explored for lichen collections. Based on the altitudinal variations, Kumaun Himalaya lichens can be divided into subtropical, temperate and alpine region.

The temperate and alpine regions exhibit luxuriance and rich diversity of foliose lichens. The temperate region shows diversity of different phorophytes which provides suitable condition for a large number lichens genera to grow colonize epiphytically on them. The trees provide varied niches for the lichens to grow as at the base which is laden with soil and mosses, upper trunk with rough bark higher trunk with smooth bark branches and twigs with varied p^H and texture. The alpine region exhibit luxuriance of lichens grows on soil and rock. Both moist habitats along the rivers and dry exposed areas provided varied climatic conditions for foliose and other lichen taxa on rock and soil. Earlier Upreti and Chatterjee (1999a,b) studied the distribution of epiphytic lichen in Kumaun Himalaya and reported 64 lichen species of lichen on Quercus trees. Similarly in the year 1975 Awasthi studied Pindari Glacier lichen flora and recorded 122 species belonging to 38 genera and 18 families. Furthermore in the Kumaun region floristic and revisionary studies of lichen from India carried out by various workers (Divarkar & Upreti 2005, Nayaka 2005, Joshi 2010, Kumar et al. 2011, Mishra et al. 2010, Kholia et al. 2012, Mishra et al. 2011 & Mishra 2012). But so far not a single foliose floristic account of Kumaun Himalayas is available. Thus the present study is carried out with an aim to list the foliose lichen from Kumaun Himalaya together with their distribution pattern in different district.

Material and methods:-

Based on the published literature and preserved lichen specimens in National Botanical Research Institute (LWG), and recent collections made from the subtropical, temperate and alpine regions of Kumaun Himalaya (Plate 1). The dried samples were packed on hard card sheets inside a lichen herbarium packet (17cm X 13 cm) with details of the locality, date of collection, substratum and are preserved at the lichen herbarium of National Botanical Research Institute, Lucknow (LWG). The study is based on the lichen material collected from the region and the specimens collected earlier and preserved in the lichen herbarium of National Botanical Research Institute, Lucknow (LWG), lichen herbarium of Lucknow University, Lucknow (LWU) and personal herbarium of Dr. D.D. Awasthi (AWAS).

The specimens were identified by studying their morphology, anatomy and chemistry. The morphology of the taxa was studied under stereo-zoom binocular microscope. The details of thallus anatomy and fruiting bodies were

studied by compound microscope. The colour test were carried out on cortex and medulla with usual chemical regents such as aqueous potassium hydroxide (K), Steiner`s stable paraphenylene diamine (PD) and aqueous calcium hypochlorite (C).Thin layer chromatography was performed for identification of the lichen substances in solvent system A (Toluene 180: 1-4 Dioxane 60: Acetic acid 8) following the techniques of Walker & James (1980) and Orange et al., (2001).

For authentic identification of different lichen taxa literature of Awasthi (1988, 1991, 2000 and 2007), Divakar and Upreti (2005), Nayaka (2004) and Joshi (2008) were consulted for the identification of specimens up to species level.

Result and Discussion:-

According to recent classification, a total of 246 species of lichen belonging to 45 genera and 13 families reported form different district of Kumaun Himalaya (Map 1 & Table 1). The member of lichen family Parmeliaceae 23 genera and 92 species followed by Physciaceae with 6 genera and 60 species exhibit dominance in the region. Among the different lichen genera, Heterodermia with 27 species and Leptogium, Collema with 19 species each showed the maximum diversity in the Kumaun. Various habitats of lichens the Crticolus dominates 186 species followed by 92 species of saxicolous and 56 species of terricolous lichens. Based on the altitude forest vegetation the foliose lichen flora of districts clearly shows three major types (Fig. 1 & 2).

1. Subtropical region districts lichens:- The tropical area of Kumaun Himalaya is started from Udham Singh Nagar district in region. The district is being situated in terai region of Kumaun and less forest area in the district. Due to fast pace of urbanization, industrialization and removed forest area for agriculture cultivation resulted in few scattered deciduous forest in the district. Among the different phorophytes Ficus bengalensis, Dalbergia sisso and Shorea robusta trees are dominted in the area. A total of 10 foliose lichens are reported from the district, foliose lichen genera Pyxine and Parmotrema are dominated with 3 species in each genus. Shorea robusta tree is excellent substrate for foliose lichen diversity and 7 species are reported on them. The foothill area of the Kumaun has a tropical Climate not conducive for higher diversity and luxuriant grows of foliose lichens. Further, fast pace of urbanization, deforestation and anthropogenic activities causes of less lichen diversity in Udham Singh Nagar and some part of the Champawat and Nianital districts.

(B). Temperate region districts lichens:- The foliose lichen flora exhibit great diversity in the temperate region due to diverse climatic conditions and diversity of phorophytes. All the districts within the temperate region have more or less similar tree vegetation and climatic condition and show more or less similar lichen flora. The different district exhibit slight variation in their lichen flora due to variation in microclimate and topography of the area as following.

(I). Almora district: - The district shows occurrence of 60 species of foliose lichens. The lichen family Parmeliaceae dominates the district represented by 11 genera and 36 species followed by Physciaceae with 6 genera and 25 species. Heterodermia and Parmotrema are the dominant genera of the district with 13 and 10 species in each genus respectively.

(II). Bageshwar district: - A total of 150 species of foliose lichens reported form the district. The family Parmeliaceae with 22 genera and 78 species and Physciaceae with 8 genera and 39 species are the dominant in the area. The rich diversity of phorophytes and different altitudinal gradients support luxuriant growth of corticolous lichens represented by 235 species followed by 114 and 65 saxicolous and terricolous lichens respectively. The lichen genera Collema and Leptogium grow on boulders on rock species. The Song and Kapkote show poor lichen diversity with 5 and 14 species respectively. The reasons for poor lichen diversity in the localities may be due to the high anthropogenic activities in the area as the localities are situated near the villages.

(III). Champawat district: - The district is represented by the occurrence of 60 foliose species reported from the district. The member of lichen family Parmeliaceae dominates with 35 species followed by 18 and 15 species of Physciaceae respectively. The lichen genera Heterodermia, Caloplaca and Parmotrema are the dominant genera of the district. The corticolous lichen genera with 129 species exhibit their dominance over saxicolous and terricolous lichens represented by 19 and 12 species respectively.

(IV). Nainital district:-A total of 47 species from the district are reported. The members of lichen family Parmeliaceae with 26 species under 11 genera followed by Physciaceae with 8 genera and 20 species exhibit their dominance in the area. Among the different lichen genera, Heterodermia with 8 species showed the maximum diversity. The Kilbury, Snow View and Thirty six Sheeri localities showed the maximum diversity of lichens, while D.S.B. campus and Ayarpatta showed poor to scarce growth of lichen species. The scare growth of lichens in the sites near city centre may be probably due to the fact that both these localities experience heavy tourist pressure throughout the year. The tourist trekking and other human activities lead to the destruction of lichens growing on soil and rocks, resulted loss of lichen diversity in such localities.

(V). Pithoragarh district:- The district shows occurrences of 173 species reported from the region. The lichen family Parmeliaceae dominates the district with 19 genera followed by Physciaceae with 11 genera. Heterodermia with 18 species are dominant genera in the district.

The localities in and around Munsyari and Gori-Ganga are the 'lichen rich sites' of the district. The Askot and Sandev Botanical Hot Spot also exhibit rich diversity of lichens represented by 203 species belonging to 67 genera and 32 families Pant (2002).

(C). Alpine lichens:- The Pindari glacier in Bageshwar district and the localities of Milam glacier area of Pithoragarh district falls under the alpine zone of the Kumaun Himalaya. The alpine zone usually devoid of trees and only shrubs such as Rhododendron, Juniperus and Berberis grow in open grasslands and provide excellent substrate to many lichens species. The boulders, rock and soil in moist shady area are excellent substrate for saxicolous and terricolous lichen genera such as Rhzoplaca, Xanthoria, Dermatocarpon and Umbilicaria species. Both the alpine regions of Milam and Pindari shows occurrence of 394 species belonging to 94 genera and 41 families (S. Joshi,2010).The Zero Point area and Milam village near the glacier snout exhibit poor growth of lichens due to the heavy tourist activities in these area.

The tropical zone exhibit luxuriant growth of Pinus, Shora robusta together with cultivated trees of Prunus, Celtis, Grewia and Rubina sp. The Rubina and Populus trees cultivated along road side bear luxuriant growth of Candelaria concolor (Dicks.) Stein together with Physcia dilatata Nyl. foliose lichen. The smooth thick bark of Celtis trees bears excellent growth of Phaeophysia hispidula (Ach.) Moberg., from its base upto the their branches. The species of lichen family Parmeliaceae together with Physciaceae are dominant on both the cultivated and other trees. Bulbothrix meizospora (Nyl.) Hale, Canoparmelia ecaperata (Müll. Arg.) Elix & Hale, Flavoparmelia caperata (L.) Hale and Parmotrema reticulatum (Taylor) Choisy, are the common Parmelioid lichens found growing on Pinus and Shorea robusta trees on its thick rough bark. The member of lichen family Physciaceae also grow luxuriantly on Shorea robusta tree and other substrate in the tropical areas of the district. The common foliose lichens on Shora robusta are Dirinaria applanata (Fée) D. Awasthi, Heterodermia diademata (Taylar) D. Awasthi, Pyxine subcinerea Stirton.

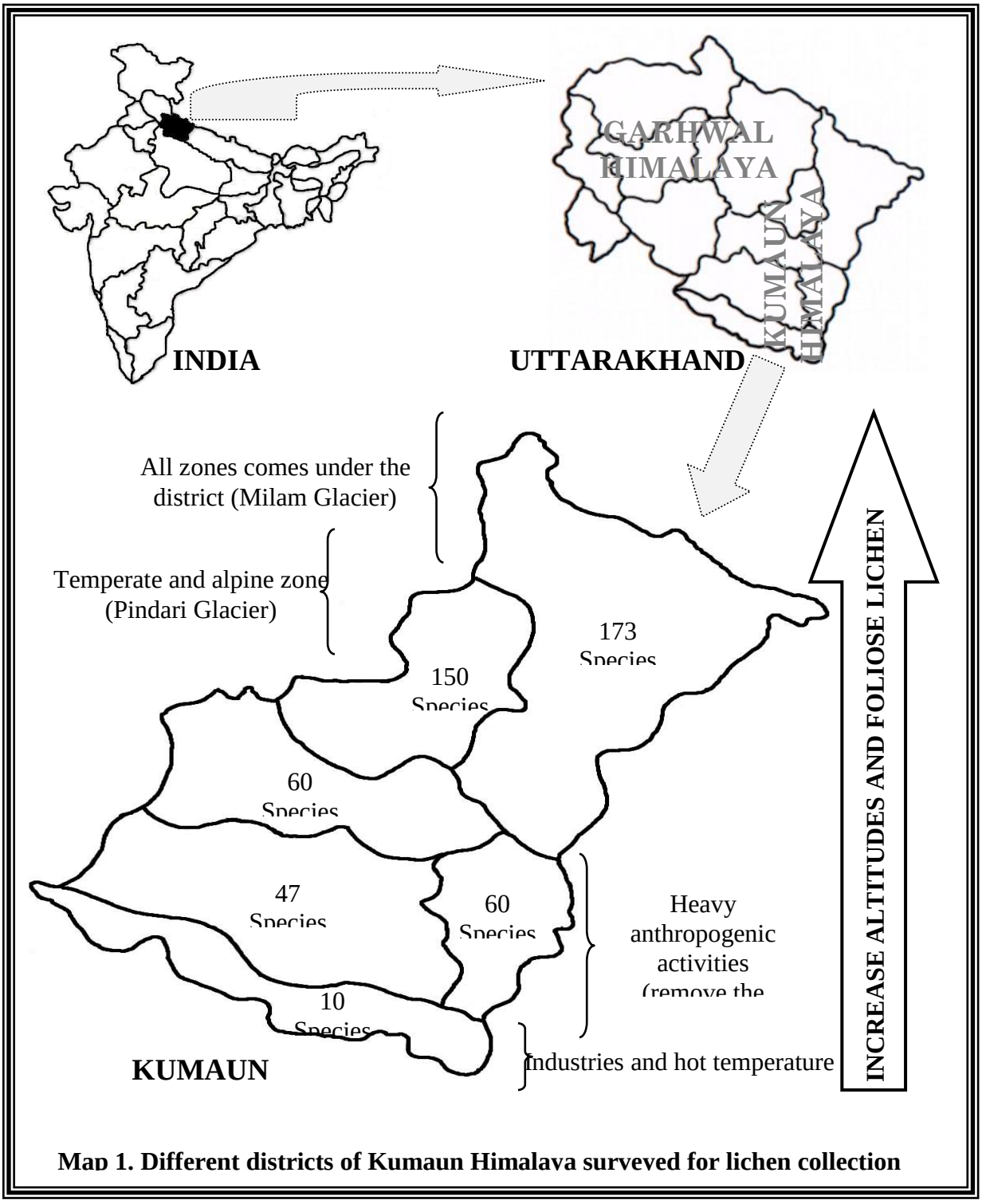
The temperate region of Kumaun Himalaya up to an altitude of 2000 m exhibit luxuriant growth of Quercus leucotricophora together with Rhododendron and Alnus nepalensis trees. The Quercus leucotricophora trees on its trunk and twigs bear luxuriant growth of Parmelioid lichens such as Everniastrum cirrhatum (Fr.) Hale, Parmelaria thomsonii (Stirton) D. Awasthi, and Parmotrema nilgherrense (Nyl.) Hale, together with the Flavoparmelia caperata (L.) Hale and Heterodermia diademata (Taylar) D. Awasthi grow luxuriantly on the bark of Rhododendron trees.

The higher altitude of temperate region up to an altitude of 3000 m of Kumaun region exhibit the luxuriant growth of Quercus semecarpifolia either forming pure patches or mixed together with coniferous trees Cedrus deodar, Pinus wallichiana, Taxus baccata and Abies pindrow. The Quercus semecarpifolia trees provide an excellent habitat for foliose lichen genera to colonize on its trunk, branches and twigs. Bulbothrix meizospora (Nyl.) Hale, Everniastrum cirrhatum (Fr.) Hale, Flavoparmelia caperata (L.) Hale, Heterodermia leucomela (L.) Poelt, Leptogium askotense D. Awasthi in D. Awashti & Akhtar, Lobaria retigera (Bory) Trevisan, Myelochroa xantholepis (Mont. & v.d. Bosh) Elix & Hale, Nephromopsis pallescens (Schaerer in Moritzi) Park., Parmotrema austrosinensise (Zahlbr.) Hale, Parmotrema dilatatum (Vainio) Hale, Umbilicaria indica Frey, are commonly occurring lichen species on Quercus semecarpifolia trees.

The area above an altitude of 3000 m belongs to the alpine zone. This zone is devoid of trees and has small bushes and large exposed grassland. Due to the non availability of trees the lichen in the alpine region mostly grows on rocks, soil and branches of small shrubs. The common saxicolous lichen species of alpine region are Dermatocarpon

miniatum (L.) Mann. Umbilicaria indica Frey. And Xanthoria elegans (Links) Th. Fr. grows extensively on the exposed rocks in alpine region. On soil species of Heterodermia grows near the boulders together with Peltigera rufescens (Weis.) Humb.. The small shrubs bear luxuriant growth of Heterodermia incana (Stert.) D. Awasthi species and Parmalioid lichens (Plate 2).

The present diversity of foliose lichens from different districts of the Kumaun Himalaya will act as base line record of the lichens to study the effect of environmental changes and biomonitoring studies in the area in future.



Map 1. Different districts of Kumaun Himalaya surveyed for lichen collection

PLATE 2

Common alpine region macro-lichens in Kumaun Himalaya**:-**

Umbilicaria sp.

Xanthoria sp.

Rhizoplaca sp.

Common temperate region macro-lichens in Kumaun Himalaya**:-**

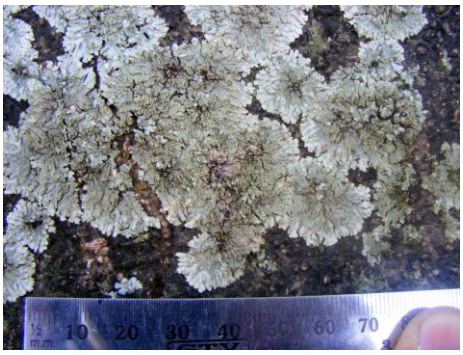
Everniastrum sp.

Parmotrema sp.

Heterodermia sp.

Common tropical region macro-lichens in Kumaun Himalaya**:-**

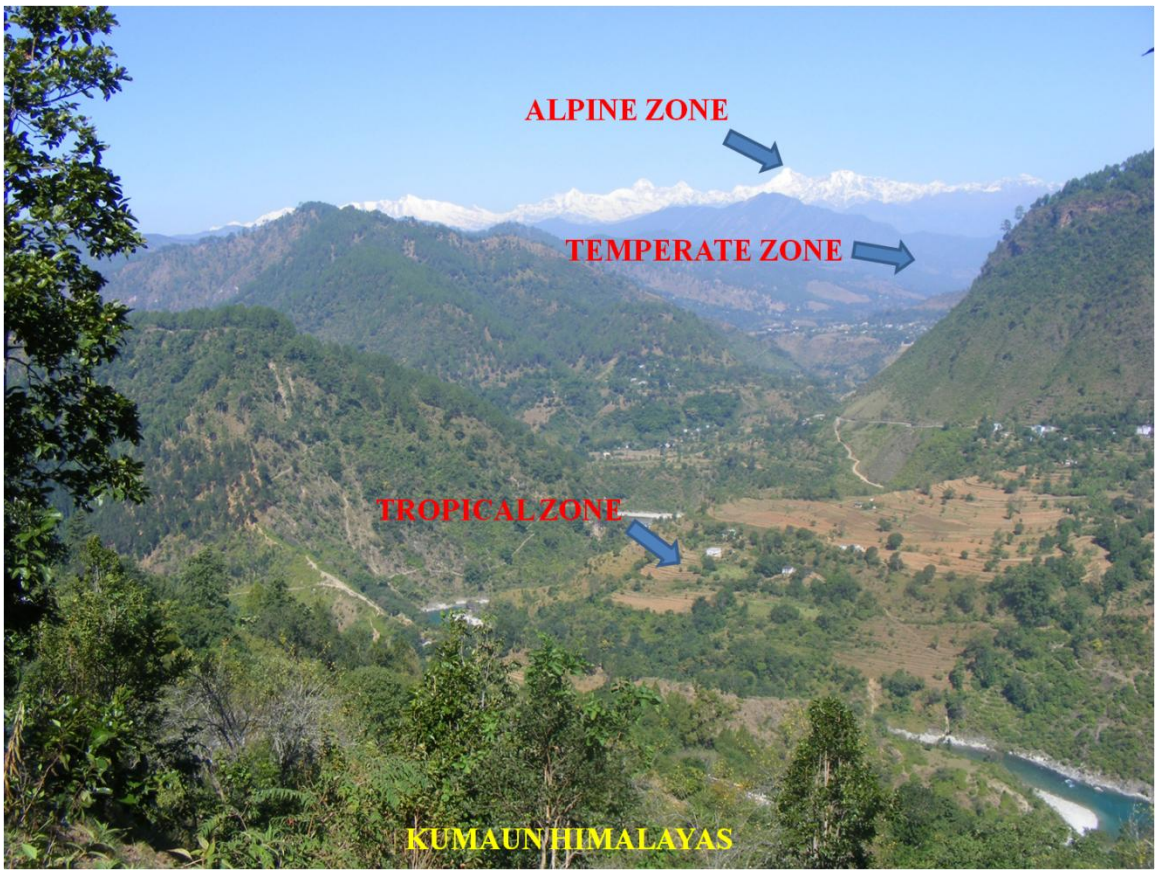
Dirinaria sp.



Pyxine sp.

Hyperphyscia sp.

PLATE 1


ALPINE ZONE
TEMPERATE ZONE
TROPICAL ZONE
KUMAUN HIMALAYAS

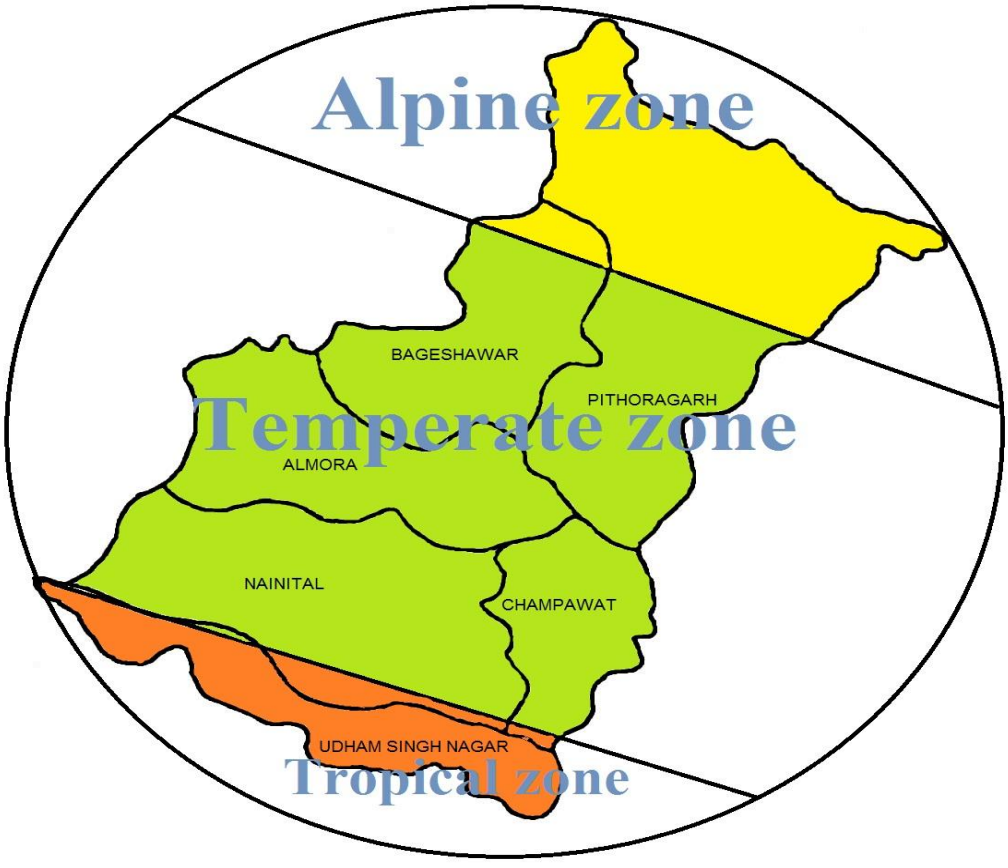

Alpine zone
BAGESHAWAR
PITHORAGARH
Temperate zone
ALMORA
NAINITAL
CHAMPAWAT
UDHAM SINGH NAGAR
Tropical zone

Table 1: Distribution of various macro-lichens in different districts of Kumaun Himalaya and their substratum:-

S.N.	LICHEN TAXA	1	2	3	4	5	6	SUB
	CANDELARIACEAE							
1	Candelaria concolor (Dicks.) Stein	-	+	+	+	+	-	C,S
2	Candelaria indica (Hue) Vain.	-	+	-	+	-	-	C
3	Candelariella aurella (Hoffm.) Zahlbr.	-	-	-	-	+	-	S
4	Candelariella vitellina (Ehrh.) Müll. Arg.	-	+	-	-	+	-	S,T
	COCCOCARPIACEAE							
5	Coccocarpia erythroxyli (Spreng.) Swinscow & Krog	-	+	-	-	+	-	S,T
6	Coccocarpia palmicola (Spreng.) Arv. & D.J. Galloway	-	-	-	-	+	-	C
7	Coccocarpia pellita (Ach.) Müll. Arg. em. R. Sant.	-	+	+	-	-	-	C,T
	COLLEMATACEAE							
8	Collema auriculiforme (With.) Coppins & J.R. Laundon	-	+	-	-	+	-	C,T
9	Collema coccophorum Tuck.	-	+	-	-	-	-	S,T
10	Collema crispum (huds) G.H.Web.	-	+	-	-	+	-	S,T
11	Collema cristatum (L.) Weber ex Wigg:	-	-	-	-	+	-	S,T
12	Collema furfuraceum (Arn.) Du Rietz	-	+	+	-	-	-	C,T
13	Collema fuscovirens (With.) J.R. Laundon	-	-	-	-	+	-	S,T
14	Collema japonicum (Müll. Arg.) Hue	-	-	+	-	+	-	C,S,T
15	Collema kauaiene H. Magn.	-	+	-	-	-	-	C
16	Collema leptaleum var. biliosum (Mont.) Degel.	+	-	-	-	-	-	C
17	Collema leptaleum var. leptaleum Tuck.	-	-	-	-	+	-	C
18	Collema nigrescens (Huds.) DC.	-	-	+	-	-	-	C
19	Collema polycarpon Hoffm.	-	-	-	-	+	-	S,T
20	Collema pulcellum Ach.	-	+	-	-	-	-	C,S,T
21	Collema pulcellum Ach. var. subnigrescens (Müll. Arg.) Degel.	-	-	-	-	+	-	C,S,T
22	Collema shiroumanum Yasuda	-	-	-	-	+	-	C
23	Collema subconveniens Nyl.	-	-	-	+	+	-	C,S,T
24	Collema subflaccidum Degel.	-	+	-	-	-	-	C
25	Collema subnigrescens Degel.	-	+	-	-	-	-	C
26	Collema tenax (Sw.) Ach. Champawat	-	-	+	-	+	-	C,S,T
27	Leptogium arisanense Asahina	-	-	-	-	+	-	C
28	Leptogium asiaticum P.M. Jørg.	-	+	-	-	-	-	C
29	Leptogium askotense D. D. Awasthi	-	+	+	+	+	-	C,S
30	Leptogium austroamericanum (Malme) C.W. Dodge	-	-	-	-	+	-	C,S
31	Leptogium azureum (Sw. ex Ach.) Mont.	-	-	-	-	+	-	C
32	Leptogium burgessii (L.) Mont.	-	+	-	+	-	-	C,S,T
33	Leptogium burnetiae C.W. Dodge	-	-	+	-	+	-	C,S,T
34	Leptogium chloromelum (Sw.) Nyl.	-	-	+	-	+	-	C
35	Leptogium cyanescens (Rabenh.) Körb.	-	+	-	-	-	-	C,S,T
36	Leptogium delavayi Hue	-	+	-	+	+	-	C,S,T
37	Leptogium denticulatum Nyl.	-	-	-	-	+	-	C
38	Leptogium furfuraceum (Harm.) Sierk	-	+	-	-	+	-	C
39	Leptogium javanicum Mont.	-	+	-	-	+	-	C
40	Leptogium pedicellatum P.M. Jørg.	-	+	+	-	+	-	C,S,T
41	Leptogium phyllocarpum (Pers.) Mont.	-	-	+	-	+	-	C,S
42	Leptogium pseudopapillosum P.M. Jørg.	-	-	-	-	+	-	C,T
43	Leptogium resupinans Nyl.	-	-	-	-	+	-	T
44	Leptogium saturninum (Dicks.) Nyl.	-	+	-	-	+	-	C,S,T
45	Leptogium trichophorum Müll. Arg.	-	+	-	-	+	-	C,S,T
46	Rhizoplaca chrysoleuca (Sm.) Zopf	-	+	-	-	+	-	S
	LECANOROMYCETES							
47	Leprocaulon arbuscula (Nyl.) Nyl.	-	-	-	-	+	-	C
48	Leprocaulon pseudoarbuscula (Asah.) Lamb & Ward.	-	-	-	-	+	-	C

	LOBARIACEAE							
49	Lobaria discolor (Bory) Hue	-	+	-	-	-	-	T
50	Lobaria fuscotomentosa Yoshim.	-	-	-	-	+	-	S
51	Lobaria himalayensis Upreti & Divakar	-	-	-	-	+	-	C
52	Lobaria isidiosa (Müll. Arg.) Vain.	-	+	+	-	-	-	C
53	Lobaria japonica (Zahlbr.) Asahina	-	+	-	-	+	-	C,T
54	Lobaria kurokawae Yoshim.	-	+	-	-	+	-	C,T
55	Lobaria meridionalis Vain.	-	+	-	-	+	-	C
56	Lobaria pindarensis Räsänen	-	+	-	-	+	-	C
57	Lobaria pseudopulmonaria Gyeln.	+	+	-	-	-	-	C,S
58	Lobaria quercizans Michx.	-	+	-	-	-	-	T
59	Lobaria retigera (Bory) Trev.	+	+	+	+	+	-	C,S,T
60	Sticta damaecornis (Sw.) Ach.	-	+	-	-	-	-	C,S
61	Sticta henryana Müll. Arg.	+	-	-	-	+	-	C
62	Sticta indica D.D. Awasthi & Upreti	-	+	-	-	+	-	C
63	Sticta limbata (Sm.) Ach.	-	-	-	-	+	-	C,S
64	Sticta nylanderiana Zahlbr.	-	+	-	-	+	-	C
65	Sticta orbicularis (R. Br.) Hue	-	+	-	-	-	-	C,S
66	Sticta platyphylloides Nyl.	-	+	-	-	+	-	C,S
67	Sticta praetextata (Räsänen) D.D. Awasthi	-	+	-	-	-	-	C,S
68	Sticta weigelii (Ach.) Vain	-	-	-	-	+	-	C,S
	NEPHROMATACEAE							
69	Nephroma helveticum Ach.	+	+	-	-	+	-	C,S
70	Nephroma isidiosum (Nyl.) Gyeln.	-	+	-	-	-	-	C
	PARMELIACEAE							
71	Allocetraria oakesiana (Tuck) A. Ahti	-	-	-	-	+	-	C
72	Allocetraria stracheyi (C. Bab.) Kurok. & M.J.Lai	-	-	-	-	+	-	T
73	Bulbothrix bulbochaeta (Hale) Hale	-	-	-	-	+	-	C
74	Bulbothrix isidiza (Nyl.) Hale	-	+	+	-	+	-	C,S
75	Bulbothrix meizospora (Nyl.) Hale	+	+	-	+	+	-	C,S
76	Bulbothrix sensibilis (J. Steiner & Zahlbr.) Hale	-	+	-	-	+	-	C,S
77	Bulbothrix setschwanensis (Zahlbr.) Hale	+	+	+	+	+	-	C,S
78	Canoparmelia aptata (Kremp.) Elix & Hale	+	+	+	+	+	-	C
79	Canoparmelia ecaperata (Müll. Arg.) Elix & Hale	+	-	+	-	+	-	C
80	Canoparmelia eruptens (Kurok.) Elix & Hale	-	-	-	+	-	-	C
81	Canoparmelia texana (Tuck.) Elix & Hale	+	-	+	+	+	-	C
82	Cetraria islandicasubsp. islandica (L.) Ach.	-	+	-	-	-	-	T
83	Cetraria nigricans Nyl.	-	+	-	-	-	-	T
84	Cetrelia braunsiana (Müll. Arg.) W.L. Culb. & C.F. Culb.	-	-	+	+	+	-	C,T
85	Cetrelia cetrarioides (Del. ex Duby) W. Culb. & C. Culb.	-	+	-	-	+	-	C
86	Cetrelia collata (Nyl.) W.L. Culb. & C.F. Culb.	-	+	-	-	-	-	C
87	Cetrelia olivetorum (Nyl.) W.L. Culb. & C.F. Culb.	-	+	-	-	+	-	C
88	Cetrelia pseudolivetorum (Asahina) W.L. Culb. & C.F. Culb.	-	-	+	-	-	-	C
89	Cetreliopsis rhytidocarpa subsp. rhytidocarpa (Mont. & v.d. Bosch) M. J. Lai	-	+	-	-	+	-	C
90	Everniastrum cirrhatum (Fr.) Hale ex Sipman	+	+	+	+	+	-	C
91	Everniastrum nepalense (Taylor) Hale ex Sipman	+	+	-	+	+	-	C
92	Flavocetraria cucullata (Bell.) Kärnefelt & Thell	-	+	-	-	-	-	T

93	Flavocetrariella leucostigma (Lév.) D. D. Awasthi	-	+	-	+	-	-	T
94	Flavocetrariella melaloma (Nyl.) D. D. Awasthi	-	+	-	-	-	-	S,T
95	Flavoparmelia caperata (L.) Hale	-	+	+	+	+	-	C,S
96	Flavopunctelia flaventior (Stirt.) Hale	-	-	-	-	+	-	C,S
97	Hypotrachyna adducta (Nyl.) Hale	-	+	-	-	-	-	C
98	Hypotrachyna awasthii Hale & Patw.	-	+	-	-	-	-	C
99	Hypotrachyna crenata (Kurok.) Hale	-	-	-	-	+	-	C,S
100	Hypotrachyna exsecta (Taylor) Hale	-	-	-	-	+	-	C
101	Hypotrachyna flexilis (Kurok.) Hale	-	-	+	+	+	-	C
102	Hypotrachyna imbricatula (Zahlbr.) Hale	-	-	-	-	+	-	C
103	Hypotrachyna immaculata (Kurok.) Hale	+	-	-	-	-	-	C
104	Hypotrachyna infirma (Kurok.) Hale	-	+	-	-	+	-	C
105	Hypotrachyna osseoalba (Vain.) Y.S. Park and Hale	-	+	-	-	+	-	C
106	Hypotrachyna physcioides (Nyl.) Hale	-	+	-	-	+	-	C
107	Hypotrachyna pindarensis (D.D. Awasthi & S.R. Singh) D.D. Awasthi	-	+	-	-	-	-	S
108	Hypotrachyna pluriformis (Nyl.) Hale	-	+	-	-	+	-	C,S
109	Hypotrachyna radiculata (Kurok.) Elix	-	+	-	-	-	-	C
110	Hypotrachyna scytophylla (Kurok.) Hale	-	+	-	-	+	-	S
111	Melanelia tominii (Oksner) Essl.	-	-	-	-	+	-	S
112	Menegazzia terebrata (Hoffm.) A. Massal	-	+	-	-	-	-	S
113	Myelochroa aurulenta (Tuck.) Elix & Hale	+	+	+	+	+	-	C
114	Myelochroa entotheiochroa (Hue) Elix & Hale	-	+	+	-	-	-	C
115	Myelochroa macrogalbinica Divakar & al	-	+	-	-	+	-	C
116	Myelochroa metarevoluta (Ach.) Elix & Hale	-	+	-	-	+	-	C
117	Myelochroa perisidians (Nyl.) Elix & Hale	-	-	-	+	-	-	C
118	Myelochroa subaurulenta (Nyl.) Elix & Hale	-	+	-	+	+	-	C,S
119	Myelochroa upretii Divakar & Elix	-	+	-	-	+	-	C
120	Myelochroa xantholepis (Mont. & Bosch) Elix & Hale	-	-	+	-	+	-	C,T
121	Nephromopsis ahtii (Randlane & Saag) Randlane & Saag	-	+	-	-	-	-	C
122	Nephromopsis laii (A. Thell & Randlane) Saag & A.Thell	-	-	-	-	+	-	C
123	Nephromopsis nephromoides (Nyl.) Ahti & Randl.	-	+	-	-	+	-	C
124	Nephromopsis pallescens (Schaer.) Park	-	+	-	-	+	-	C
125	Nephromopsis stracheyi (C. Bab.) Müll. Arg.	-	+	-	-	+	-	C
126	Parmelaria subthomsonii D.D. Awasthi	+	+	+	-	+	-	C,S
127	Parmelaria thomsonii (Stirt.) D.D. Awasthi	-	+	+	+	+	-	C
128	Parmelia marmariza Nyl.	-	+	-	-	-	-	C
129	Parmelia masonii Essl. & Poelt	-	+	-	-	-	-	S
130	Parmelia meiophora Nyl.	-	+	-	-	-	-	C
131	Parmelinella simplicior (Hale) Elix & Hale	-	-	-	-	+	-	S
132	Parmelinella wallichiana (Taylor) Elix & Hale	+	+	+	+	+	-	C,S
133	Parmotrema austrosinense (Zahlbr.) Hale	+	-	-	+	+	-	C,S

134	Parmotrema cooperi (J. Steiner & Zahlbr.) Sërus.	-	-	-	-	+	-	C
135	Parmotrema crinitum (Ach.) M. Choisy	-	-	+	-	-	-	C
136	Parmotrema direagens (Hale) Hale	-	+	-	-	-	-	C
137	Parmotrema eunetum (Stirt.) Hale	-	+	-	-	-	-	C
138	Parmotrema grayanum (Hue) Hale	+	+	-	-	+	-	S
139	Parmotrema hababianum (Gyeln.) Hale	+	+	+	-	+	-	C
140	Parmotrema indicum Hale	-	+	-	-	+	-	C
141	Parmotrema mesotropum (Müll. Arg.) Hale	-	-	-	-	+	+	C
142	Parmotrema nilgherrense (Nyl.) Hale	+	+	+	+	+	-	C,S
143	Parmotrema praesorediosum (Nyl.) Hale	+	+	+	+	+	+	C
144	Parmotrema pseudocrinitum (Abbayes) Hale	-	-	-	-	+	-	C,S
145	Parmotrema rampoddense (Nyl.) Hale	+	-	-	-	-	-	C
146	Parmotrema ravum (Krog & Swinscow) Sérus.	-	-	-	-	+	-	C
147	Parmotrema reticulatum (Taylor) M. Choisy	+	+	+	+	+	-	C
148	Parmotrema sancti-angelii (Lynge) Hale	+	+	+	-	+	-	C
149	Parmotrema subtinctorium (Zahlbr.) Hale	+	-	+	-	+	-	C
150	Parmotrema tinctorum (Despr. ex Nyl.) Hale	+	+	+	+	+	+	C
151	Platismatia erosa W.L. Culb.& C.F. Culb.	-	+	-	-	-	-	C
152	Punctelia borreri (Sm.) Krog	+	-	+	-	+	-	C
153	Punctelia neutralis (Hale) Krog	-	-	+	-	-	-	C
154	Punctelia rudecta (Ach.) Krog	+	+	+	+	+	-	C
155	Punctelia subrudecta (Nyl.) Krog	+	-	+	+	+	-	C
156	Xanthoparmelia antleriformis (Elix) Elix & J. Johnst.	-	-	-	-	+	-	S
157	Xanthoparmelia australasica D.J. Galloway	+	-	-	-	-	-	S
158	Xanthoparmelia conspersa (Ach.) Hale	+	-	-	-	-	-	S
159	Xanthoparmelia coreana (Gyeln.) Hale	-	-	-	-	+	-	S
160	Xanthoparmelia mexicana (Gyeln.) Hale	-	-	-	-	+	-	S
161	Xanthoparmelia stenophylla (Ach.) Ahti & D. Hawksw.	-	-	-	-	+	-	S
162	Xanthoparmelia tinctina (Maheu & A. Gillet) Hale	-	-	-	-	+	-	S
	PELTIGERACEAE							
163	Peltigera canina (L.) Willd.	-	+	-	-	+	-	T
164	Peltigera didactyla (With.) J.R. Laundon	-	+	-	-	-	-	T
165	Peltigera dolichorrhiza (Nyl.) Nyl.	+	+	-	-	+	-	T
166	Peltigera elisabethae Gyeln.	-	-	-	-	+	-	T
167	Peltigera horizontalis (Huds.) Baung.	-	-	-	-	+	-	T
168	Peltigera leucophlebia (Nyl.) Gyeln.	-	+	-	-	-	-	T
169	Peltigera membranacea (Ach.) Nyl.	-	+	-	-	+	-	T
170	Peltigera pindarensis D.D. Awasthi & M. Joshi	-	+	-	-	-	-	T
171	Peltigera polydactylon (Neck.) Hoffm.	+	+	+	-	+	-	T
172	Peltigera praetextata (Flörke) Zopf	+	+	-	+	+	-	T
173	Peltigera rufescens (Weiss) Humb.	+	+	-	+	+	-	T

174	Solorina simensis Hochst. in Flot.	-	+	-	-	-	-	T
	PHYSCIACEAE							
175	Dirinaria aegialita (Afzel.) Moore	-	-	+	-	+	-	C
176	Dirinaria applanata (Fée) D. Awasthi & M.R. Agarwal,	-	-	+	+	+	+	C
177	Dirinaria confluens (Fr.) D.D. Awasthi	-	+	+	-	-	+	C
178	Dirinaria consimilis (Stirt.) D.D. Awasthi & M.R. Agarwal	-	-	+	-	+	-	C
179	Dirinaria picta (Sw.) Clem. & Shaer	+	-	-	-	-	-	C
180	Heterodermia albidiflava (Kuork.) D. D. Awasthi	-	+	-	-	+	-	C,S
181	Heterodermia angustiloba (Müll. Arg.) D.D. Awasthi	-	+	-	-	+	-	C,S
182	Heterodermia boryi (Fée) Kr.P. Singh & S.R. Singh	-	+	-	+	+	-	C
183	Heterodermia comosa (Eschw.) Follmann & Redón	+	-	+	-	+	-	C,S
184	Heterodermia dactyliza (Nyl.) Swinsc. & Krog	-	+	-	-	+	-	C,S
185	Heterodermia diademata (Taylar) D. D. Awasthi	+	+	+	+	+	-	C,S
186	Heterodermia dissecta (Kurok.) D.D. Awasthi	+	+	-	+	+	-	C,S
187	Heterodermia dissecta var. koyana (Kurok.) J.C. Wei	-	+	-	-	+	-	C,S
188	Heterodermia firmula (Nyl.) Trevis.	+	+	-	+	+	-	C,S
189	Heterodermia flabellata (Fée) D.D. Awasthi	-	-	-	-	+	-	C
190	Heterodermia himalayensis (D.D. Awasthi) D.D. Awasthi	+	-	+	-	+	-	C,S
191	Heterodermia hypocaesia (Yasuda) D.D. Awasthi	+	+	-	-	+	-	C,S
192	Heterodermia incana (Stirt.) D. D. Awasthi	+	+	+	+	+	-	C,S
193	Heterodermia indica (H. Magn.) D.D. Awasthi	-	-	-	+	-	-	C
194	Heterodermia isidiophora (Nyl.) D.D. Awasthi	+	-	-	-	-	-	C
195	Heterodermia japonica (M. Satô) Swinscow & Krog	+	+	-	+	+	-	C,S
196	Heterodermia leucomelos (L.) Poelt	+	+	-	-	+	-	C,T
197	Heterodermia microphylla (Kurok.) Skorepa	-	+	-	+	+	-	C,T
198	Heterodermia obscurata (Nyl.) Trevisan	-	+	+	-	-	-	C
199	Heterodermia pellucida (D.D. Awasthi) D.D. Awasthi	-	-	-	+	-	-	C
200	Heterodermia podocarpa (Bél.) D.D. Awasthi	-	-	+	-	+	-	C
201	Heterodermia pseudospeciosa (Kurok.) W.L. Culb.	-	+	-	-	+	-	C,T
202	Heterodermia punctifera (Kurok.) D.D. Awasthi	+	-	-	-	-	-	C
203	Heterodermia rubescens (Räsänen) D.D. Awasthi	+	+	-	-	+	-	C,S
204	Heterodermia rubricosa (Stirt.) Poelt	-	-	-	-	+	-	T
205	Heterodermia speciosa (Wulf.) Trevis.	+	+	-	+	+	-	C,T
206	Heterodermia tremulans (Müll. Arg.) W. Culb.	-	+	-	-	-	-	S,T
207	Hyperphyscia adglutinata (Flörke) H. Mayrhofer & Poelt	-	-	+	-	+	+	C
208	Hyperphyscia syncolla (Tuck. ex Nyl.) Kalb.	-	+	+	-	+	-	C
209	Phaeophyscia ciliata (Hoffm.) Moberg	-	+	-	-	+	-	C
210	Phaeophyscia constipata (Norrl. & Nyl.) Moberg	-	+	-	-	+	-	C
211	Phaeophyscia endococcina (Körb.) Moberg	-	+	-	+	+	-	C
212	Phaeophyscia hispidula (Ach.) Moberg	+	+	+	+	+	+	C
213	Phaeophyscia nepalensis (Poelt) D.D. Awasthi	-	+	-	-	-	-	C

214	Phaeophyscia orbicularis (Neck.) Moberg	-	+	-	-	-	-	C
215	Phaeophyscia primaria (Poelt) Trass	+	+	-	-	-	-	C
216	Phaeophyscia pyrrhophora (Poelt) D.D. Awasthi & M. Joshi	+	+	-	-	+	-	C
217	Physcia aipolia (Ehrh. ex Humb.) Fürnr.	+	-	-	-	-	-	C
218	Physcia caesia (Hoffm.) Fürnr.	-	+	-	-	-	-	S
219	Physcia dilatata Nyl.	+	+	-	+	+	-	C
220	Physcia dimidiata (Arn.) Nyl.	-	-	-	-	+	-	C
221	Physcia phaea (Tuck.) J.W. Thomson	-	+	-	-	+	-	C
222	Physcia tribacoides Nyl.	+	-	-	-	-	-	C
223	Physconia enteroxantha (Nyl.) Poelt	+	-	-	-	+	-	C,T
224	Pyxine berteriana (Fée) Imshaug	+	-	-	+	+	-	C
225	Pyxine berteriana var. himalaica D.D. Awasthi	+	-	-	+	-	-	C
226	Pyxine cocoes (Sw.) Nyl.	-	-	+	-	+	+	C
227	Pyxine himalayensis D.D. Awasthi	-	+	+	-	+	-	C
228	Pyxine meissnerina Nyl.	-	-	+	-	+	-	C
229	Pyxine minuta Vain.	-	+	-	-	+	-	C,S
230	Pyxine petricola Nyl. in Cromb.	-	-	-	-	+	-	C
231	Pyxine philippina Vain.	-	+	-	-	+	-	C
232	Pyxine reticulata (Vain.) Vain.	-	-	-	-	-	+	C
233	Pyxine sorediata (Ach.) Mont.	+	+	+	-	+	+	C
234	Pyxine subcinerea Stirt.	-	+	-	+	+	-	C
	TELOSCHISTACEAE							
235	Xanthoria elegans (Link) Th. Fr.	-	+	-	-	+	-	S
236	Xanthoria parietina (L.) Th. Fr.	-	-	-	-	+	-	S
237	Xanthoria sorediata (Vain.) Poelt	-	+	-	-	-	-	S
	UMBILICARIACEAE							
238	Umbilicaria badia Frey	-	-	-	-	+	-	S
239	Umbilicaria indica Frey	-	+	-	-	+	-	S
240	Umbilicaria indica var. nana Frey em. Poelt	-	+	-	-	-	-	S
241	Umbilicaria vellea (L.) Ach.	-	+	-	-	-	-	S
242	Umbilicaria virginis Schaer.	-	-	-	-	+	-	S
243	Umbilicaria yunnana (Nyl.) Hue	-	-	-	-	+	-	S
	VERRUCARIACEAE							
244	Dermatocarpon meiophyllizum Vain.	-	+	-	-	-	-	S
245	Dermatocarpon miniatum (L.) W. Mann.	-	+	-	-	+	-	S
246	Dermatocarpon vellereum Zschacke	+	+	+	-	+	-	S

Abbreviations: Sub.- Substrate, **+** Present, **-** Absent, **S**- Saxicolous, **C**- Corticolous, **T**- Terricolous. **1**- Almora, **2**- Bageshwar, **3**- Champawat, **4**- Nainital, **5**- Pithoragarh and **6**- Udham Singh Nagar districts.

Acknowledgment:-

The authors are thankful to the Director of the CSIR-National Botanical Research Institute, Lucknow for providing laboratory facilities. One of the authors (GKM) is grateful to the Department of Science and Technology (DST-SERB), New Delhi (SB/FT/LS-258/2012) for the award of Young Scientist fellowship.

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