

# Lichen flora of Govind Wildlife Sanctuary in Uttarkashi District, Uttarakhand, India

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## ABSTRACT

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The paper enumerates 214 lichen species belonging to 80 genera and 34 families, enroute from Naitwar to Har ki Dun, in Govind Wildlife Sanctuary (GWLS), Uttarkashi District, Uttarakhand. Family Parmeliaceae exhibits its dominance with 45 species followed by Physciaceae, Cladoniaceae, Pyrenulaceae and Lecanoraceae represented with 27, 18, 16 and 13 species respectively. Among the different altitudinal ranges, the altitude range from 3000 to 3500 m exhibits the maximum lichen species in the area. The localities in lower altitudes (up to 1500 m) with, anthropogenic activities, have poor diversity of lichens while, higher altitude localities (beyond 2500 m) exhibit rich diversity of lichens. The alpine regions in and around 3500 m have luxuriance of moss, rock and soil inhabiting lichens while the temperate region having rich tree vegetation exhibit dominance of corticolous lichens.

**Key-words:** Lichens, Govind Wildlife Sanctuary, Uttarkashi District, Uttarakhand, India.

## INTRODUCTION

Lichen taxa collected from a number of localities of Uttarkashi District, Uttarakhand are mentioned in different monographic and revisionary studies of lichens in India. Except for few lichen collections mentioned in these studies from Har ki Dun area, records of systematic collection of lichens from the Govind Wildlife Sanctuary (GWLS) are not available. Thus, in the present study an attempt has been made to collect and enumerate lichens enroute from Naitwar to Har ki Dun area of the sanctuary. The GWLS (alt. 1300 to 6323 m) spreads over an area of 957.969 km<sup>2</sup> between north latitudes 31°17.30' and 35°55' and east longitudes 77°47.30' and 78°37.30'. The average annual precipitation varies from 1000 to 1500 mm, most of which occurs as monsoon

rains (July to September). The entire area of the sanctuary is subjected to light to heavy snowfall. The sanctuary forms the upper catchment of the Tons River, which is the most important tributary of Yamuna River in its upper reaches. Thus, the area has a significant value as a major watershed for Yamuna River. The area is home for a large number of endangered animals and its large area, along with the contiguous forests of the neighboring forest divisions, helps in maintaining genetic diversity. The area is rich in medicinal plants, many of which form the basis for certain lifesaving drugs.

## VEGETATION

The localities enroute from Naitwar to Har ki Dun show great variation in altitude and vegetation. The area between Naitwar and Sankari

(alt. 1500-1900 m) comprises tree vegetation of *Quercus leucotrichophora*, *Pinus roxburghii*, *Acer oblongum* and *Juglans regia*. *Pinus* is a major constituent of the vegetation, although most of the hill slopes have been deforested for apple orchards and potato cultivation. Many trees are badly burnt at their base as the area seems to be prone to fire. The localities, enroute from Sankari to Taluka (alt. 2000-2500 m), comprise rich vegetation of *Abies*, *Acer*, *Juglans*, *Picea*, *Rhododendron*, *Quercus* and *Cedrus* trees. The localities, enroute from Taluka to Osla (alt. 2500-3500 m), show luxuriance of *Acer*, *Juglans*, *Cedrus*, *Pinus* and *Rhododendron*. The forest in and around Osla exhibits dominance of *Quercus semecarpifolia* mixed with conifer and *Juglans regia* and *Acer*. The localities between Osla and Har ki Dun (alt. 3000-3700 m) exhibit luxuriant growth of *Cedrus deodara*, *Picea* and *Abies* tree forest. The area around Har ki Dun shows luxuriant growth of *Betula utilis* and *Taxus*, sometimes mixed with poor patches of coniferous forest. The localities between Har ki Dun and Morinda Lake (alt. 3700-4000 m) have thick shrubby growth of different species of *Rhododendron*. The exposed rocks and boulders and fell fields in and around glacier bear good growth of both mosses and lichen growing in cushion form.

## MATERIAL AND METHODS

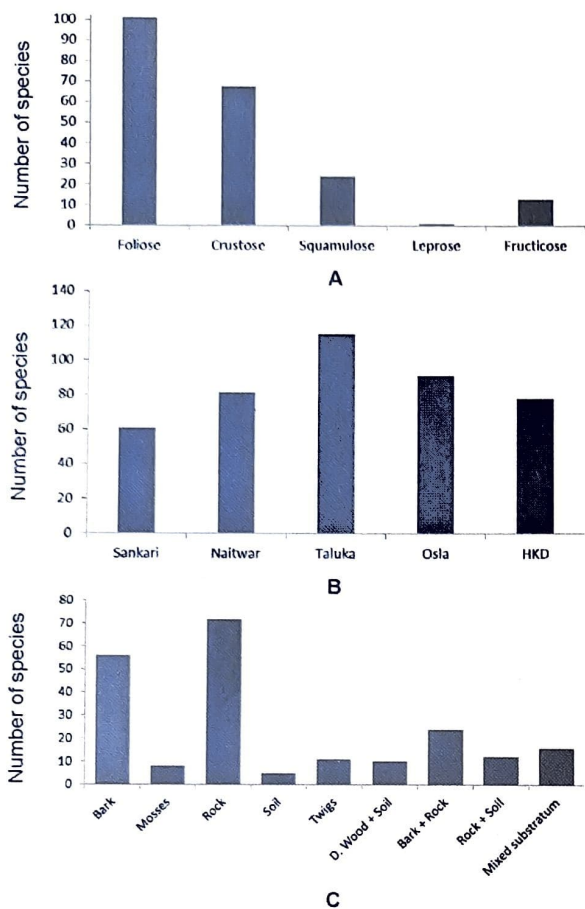
More than 700 lichen specimens were collected from rock, soil, twigs and barks of different trees during May 2011 to March 2012 from five major localities of the Sanctuary en route from Naitwar to Har ki Dun (Table 1). The collected specimens were investigated morphologically, anatomically and chemically. The specimens were identified up to species level following the publications of Coppins and James (1984), Awasthi (1991, 2000, 2007) and Harris (1995). The colour tests were performed with the usual reagents, i.e. K (5% potassium hydroxide), C (aqueous solution of calcium hypochlorite) and P (paraphenylene diamine). Lichen substances were identified with thin layer chromatography (TLC) in solvent system A (toluene: dioxane: acetic acid; 180: 60: 8 ml.) using the technique of Walker and James (1980). The identified specimens are preserved in the herbarium of CSIR-National Botanical Research Institute, Lucknow (LWG).

## RESULTS AND DISCUSSION

The identification of all the specimens collected from the Govind Wildlife Sanctuary reveals occurrence of 214 lichen species belonging to 80 genera and 34 families (Table 2). Family Parmeliaceae, with 45 species, exhibits luxuriant

Table 1. Localities surveyed for collection of lichens

Sr. No.	Localities	Area surveyed	Coordinates	Altitude (m)	Remarks
1	Naitwar	In and around Naitwar	31°04'04.23" N: 78°06'15.30" E	1500-2000	Road side area
2	Sankari	Poorti Khad, Gyan Khad, GMVN and Forest Guest House	31°04'30.83" N: 78°11'08.79" E	2000-2500	Anthropogenic and moderate vehicular area
3	Taluka	In and around Taluka, GMVN and Forest Guest House, Gomi Ghat, Gangar Bridge	31°04'35.45" N: 78°15'03.51" E	2500-3000	Anthropogenic and less vehicular area
4	Osla	In and around Osla, Laturai, near Har ki Dun Bridge	31°07'07.52" N: 78°21'07.17" E	3000-3500	No direct pollution source (Trekking route)
5	Har ki Dun	In and around HKD, Morinda	31°08'33.09" N: 78°25'08.44" E	3500-4000	(Trekking route)



**Text-figure 1.** Distribution and diversity of lichens. A. Growth forms, B. Localities, C. Substratum

growth in the area followed by Physciaceae, Cladoniaceae, Pyrenulaceae, Lecanoraceae and Teloschistaceae with 27, 18, 16, 13 and 10 species respectively. Thirteen lichen families, mostly belonging to crustose lichens, are represented only by a single species (Table 3). Genus *Cladonia* (18 species) shows dominance in the area as its species can grow on decaying wood, soil, soil over rocks in association and mixed with mosses and forming cushion like growth on exposed boulders in alpine regions. The other genera exhibiting luxuriant growth in the sanctuary are *Pyrenula*, *Heterodermia*, *Lecanora* and *Parmotrema* with 12, 11, 10 and 8 species respectively. *Cladonia corniculata*, *Flavoparmelia caperata*, *Lecanora muralis*, *Phaeophyscia hispidula* and *Pyxine soreliata* are the most common lichen taxa as these are found growing luxuriantly in most of the sub-localities of the five major localities, whereas about 70 species show their occurrence only from a single locality. The foliose form of lichens exhibits

its dominance followed by crustose, squamulose, fruticose and leprose forms (Text-figure 1A).

Among the different localities of the sanctuary enroute from Naitwar to Har ki Dun, the Taluka area exhibits the maximum diversity of lichen species (114 species) followed by Osla with 94 species (Text-figure 1B). The probable reason for rich lichen diversity in Taluka and Osla areas may be their unique topography with deep valleys and wide open slopes which provides suitable habitat for diverse phorophytes to grow and thus bear diverse lichen taxa as epiphytes on them. Sometimes, localities with scattered trees and exposed rocks, both in Osla and Taluka areas provide suitable habitat for light loving lichen taxa to grow. Due to different anthropogenic activities in the localities of Sankari and Naitwar areas, the forests are mostly destroyed for the agricultural and horticultural practices showing poor diversity of lichens. The higher altitudes of Sanctuary exhibit luxuriant growth of lichens in the localities but have poor diversity as the area is devoid of trees and only exposed rocks and boulders provide the substrates for some exclusive (*Cladonia* and *Alloctraria*) lichens to grow. Among the different substrates, the rock bears the maximum lichen species represented by 72 species followed by bark and twigs with 56 and 11 species respectively. Some lichen species (*Heterodermia diademata*, *Phaeophyscia hispidula*) exhibit wide amplitude in colonizing on varied substrates, such as bark, rock and soil, and may also support the luxuriance of lichen species (Text-figure 1C).

## CONCLUSION

The lichen flora of Govind Wildlife Sanctuary, enroute from Naitwar to Har ki Dun within a track of 55 km (alt. 1500-4000 m), represents the occurrence of 214 species which clearly indicates the richness of different lichen species in the area. Intensive survey of lichens in the adjoining areas will definitely contribute more taxa to the lichen flora of this sanctuary. The present enumeration of lichens will act as baseline data which will be

Table 2. Diversity of lichens enroute to Har ki Dun from Naitwar

Sr. No	Families	Name of lichen	Localities surveyed					Substratum	
			Sankari	Natwar	Taluka	Osla	Har ki Dun		
1	Acarosporaceae	<i>Acarospora</i> sp. 1				+		Rock	
		<i>Acarospora</i> sp. 2					+	Rock	
		<i>Acarospora</i> sp. 3					+	Rock	
		<i>Sarcogyne privigna</i> (Ach.) A. Massal				+	+	Rock	
2	Arthoniales	<i>Arthothelium chiodectoides</i> (Nyl.) Zahlbr.	+					Bark	
3	Bacidiaceae	<i>Bacidia millegrana</i> (Taylor) Zahlbr. in Wawra & Beck		+	+			Bark	
		<i>Bacidia personata</i> Malme				+		Bark	
4	Caliciaceae	<i>Calicium abietinum</i> Pers	+					Rock, bark, twigs	
5	Catillariaceae	<i>Toninia tristis</i> ssp. <i>asiae-centralis</i> (Mangnusson) Timdal				+		Rock	
6	Candelariaceae	<i>Candelaria concolor</i> (Dicks.) Stein.	+					Rock	
		<i>Candelaria indica</i> (Hue) Vain	+			+	+	Rock	
		<i>Candelariella aurella</i> (Hoffm.) Zahlbr.		+					Bark, rock
		<i>Canomaculina subtinctoria</i> (Zahlbr.) Elix	+					+	Rock
7	Chrysothricaceae	<i>Chrysothrix chlorina</i> (Ach.) J. R. Laundon		+	+			Rock	
8	Cladoniaceae	<i>Cladonia awasthiana</i> Ahti & Upreti		+	+			Soil	
		<i>Cladonia cariosa</i> (Ach.) Speng.		+			+	Rock, dead wood	
		<i>Cladonia cartilaginea</i> Müll. Arg.				+	+	+	Rock
		<i>Cladonia chlorophaea</i> (Floerke ex Sommerf) Spreng			+			+	Rock
		<i>Cladonia coniocraea</i> (Flörke) Spreng	+	+	+	+			Rock, soil, wood
		<i>Cladonia corniculata</i> Ahti & Kashiw.	+	+	+	+	+		Rock, mosses, bark
		<i>Cladonia didyma</i> (Fée) Vain.					+		Soil, decayed wood
		<i>Cladonia fenestralis</i> Nuno.			+				Soil
		<i>Cladonia furcata</i> (Huds.) Schard.			+	+	+	+	Bark, rock
		<i>Cladonia fimbriata</i> (L.) Fr.			+			+	Rock, soil, wood
		<i>Cladonia macroceras</i> (Delise) Haw.	+	+		+			Soil
		<i>Cladonia pocillum</i> (Ach.) Grognot	+	+	+	+			Mosses, twigs, bark
		<i>Cladonia pyxidata</i> (L.) Hoffm.	+	+	+	+			Mosses, twigs, bark
		<i>Cladonia rangiferina</i> (L.) F. H. Wigg.					+	+	Rock, twigs, bark
		<i>Cladonia scabriuscula</i> (Delise) Nyl.				+	+		Rock
		<i>Cladonia subradiata</i> (Vain.) Sandst.				+			Rock
<i>Cladonia subulata</i> (L.) F. H. Wigg.				+		+	Rock		
<i>Cladonia ochrochlora</i> Flörke			+			+	Rock, soil, wood		
9	Coccocarpaceae	<i>Coccocarpia erythroxyli</i> (Spreng.) Swinsc. & Krog.				+	+	Rock	
10	Collemaataceae	<i>Collema japonicum</i> (Müll. Arg.) Hue				+	+	Rock	
		<i>Collema subconveniens</i> Nyl.				+	+	Rock	
		<i>Collema nigrescens</i> (Huds.) Dc			+				Soil, bark
		<i>Leptogium askotense</i> D. D. Awasthi				+	+		Rock
		<i>Leptogium burnetiae</i> C. W. Dodge				+		+	Bark, rock
		<i>Leptogium furfuraceum</i> (Harm.) Sierk				+	+		Twigs
<i>Leptogium saturninum</i> (Dicks) Nyl.				+			Bark		
11	Fuscideaceae	<i>Maronea melanocarpa</i> (Müll. Arg.) Zahlbr.		+	+	+	+	Bark	
12	Graphidaceae	<i>Graphis chlorotica</i> Massal & Krempel				+		Rock	
		<i>Graphis intermediella</i> Stirton	+	+	+			Rock	
		<i>Graphis proserpens</i> Vain	+	+	+		+	Bark, rock	
		<i>Graphis scripta</i> (L.) Ach.	+				+	Bark, rock	
		<i>Graphis sikkimensis</i> Nag. & Patw.					+	+	Rock
13	Icmadophilaceae	<i>Thamnolia vermicularis</i> (Sw.) Ach. Ex Schaer.					+	Rock	
14	Lecanoraceae	<i>Lecanora austrointumescens</i> Lumbsch & Elix				+		Wood	
		<i>Lecanora caesiorubella</i> Ach.		+	+			Bark, rock	
		<i>Lecanora cinerofusca</i> var. <i>himalayensis</i> Upreti	+		+			Rock	
		<i>Lecanora concilians</i> Nyl.	+				+	Bark, rock	

		<i>Lecanora consilianda</i> Vain			+			Twigs
		<i>Lecanora formosula</i> Lumbsch			+	+	+	Bark, rock, twigs
		<i>Lecanora interjecta</i> Müll. Arg.				+		Bark, rock
		<i>Lecanora japonica</i> Müll. Arg.					+	Rock
		<i>Lecanora muralis</i> (Schr.) Rabenh.			+	+	+	Bark, rock
		<i>Lecanora subimmersa</i> (Fée) Vain				+		Bark
		<i>Lecidea granifera</i> (Ach.) Vain.			+	+	+	Bark, rock
		<i>Lecidella elaechroma</i> (Ach.) M. Choisy			+	+	+	Rock, bark
		<i>Rhizoplaca chrysoleuca</i> (Sm) Zopf					+	Twigs
15	Lobariaceae	<i>Lobaria isidiota</i> (Müll. Arg.) Vain.					+	Bark
		<i>Lobaria kurokawae</i> Yoshim					+	Bark, rock
		<i>Lobaria pindarensis</i> Räsänen			+	+	+	Bark, rock, mosses, wood
		<i>Lobaria retigera</i> (Bory) Trev.					+	Twigs, bark
		<i>Sticta limbata</i> (Sm.) Ach.					+	Rock
		<i>Sticta platyphylloides</i> Nyl.					+	Bark
		<i>Sticta praetextata</i> (Räsänen) D. D. Awasthi			+		+	Bark
		<i>Sticta weigelii</i> (Ach.) Vainio					+	Bark
16	Megasporaceae	<i>Aspicilia almorensis</i> Räsänen					+	Rock
		<i>Aspicilia calcarea</i> (L.) Sommerf.					+	Rock
		<i>Aspicilia dwaliensis</i> Räsänen				+		Rock
17	Nephromataceae	<i>Nephroma helveticum</i> Ach.				+	+	Wood
18	Ochrolechiaceae	<i>Ochrolechia rosella</i> (Müll. Arg.) Vers.					+	Bark
19	Pannariaceae	<i>Pannaria emodi</i> P. M. Jørg					+	Bark
20	Parmeliaceae	<i>Allocetraria strachyei</i> (C. Bab.) Kurok. & M. J. Lai					+	Rock
		<i>Bryoria smithii</i> (Du Rietz) Brodo & D. Hawksw.					+	Bark
		<i>Bulbothrix meizospora</i> (Nyl.) Hale					+	Rock, soil
		<i>Canoparmelia texana</i> (Tuck.) Elix & Hale			+	+	+	Bark, rock
		<i>Cetraria muricata</i> (Ach.) Eckfeldt					+	Bark
		<i>Cetraria nigricans</i> Nyl.					+	Rock, soil
		<i>Cetrelia braunsiana</i> (Müll. Arg.) W. Culb. & C. Culb.			+	+	+	Bark, rock, twigs
		<i>Cetrelia cetrarioides</i> (Del. ex. Dubey) W. Culb. & C. F. Culb.			+	+	+	Rock, wood
		<i>Emodomelanelia massonii</i> (Essl. & Poelt) Divakar & A. Crespo					+	Twigs
		<i>Evernia mesomorpha</i> Nyl.			+			Bark
		<i>Everniastrum nepalense</i> (Taylor) Hale			+	+	+	Bark, twigs
		<i>Everniastrum cirrhatum</i> (Fr.) Hale					+	Bark
		<i>Flavocetraria cucullata</i> (Bell.) Kärnefelt & Thell			+	+	+	Bark, twigs
		<i>Flavoparmelia caperata</i> (L.) Hale			+	+	+	Bark, rock, soil
		<i>Flavopunctelia flaventior</i> (Stirton) Hale					+	Rock, bark
		<i>Flavopunctelia soledica</i> (Nyl.) Hale			+	+	+	Bark, rock
		<i>Hypotrachyna crenata</i> (Kurok.) Hale					+	Bark
		<i>Hypotrachyna immaculata</i> (Kurok.) Hale					+	Rock
		<i>Hypotrachyna infirma</i> (Kurok.) Hale			+	+		Rock
		<i>Hypotrachyna pindarensis</i> (D. D. Awasthi & S. R. Singh) D. D. Awasthi					+	Rock
		<i>Hypotrachyna pluriformis</i> (Nyl.) Hale			+		+	Rock, twigs, bark
		<i>Hypotrachyna scytophylla</i> (Kurok.) Hale					+	Rock
		<i>Menegazzia terebrata</i> (Hoffm.) A. Massal					+	Bark
		<i>Myelochroa aurulenta</i> (Tuck.) Elix & Hale			+			Rock
		<i>Myelochroa denegans</i> (Nyl.) Elix & Hale			+			Twigs, rock, bark, soil, wood
		<i>Mycobilimbia hunana</i> (Zahlbr) D. D. Awasthi			+		+	Bark
		<i>Nephromopsis laii</i> (Thell & Randl) Saag & Thell			+			Wood
		<i>Parmelia meiophora</i> Nyl.					+	Bark
		<i>Parmelia squarrosa</i> Hale					+	Bark
		<i>Parmelinella wallichiana</i> (Taylor) Elix & Hale			+	+	+	Bark
		<i>Parmotrema hababianum</i> (Gyeln.) Hale					+	Bark
		<i>Parmotrema nilgherrense</i> (Nyl.) Hale			+	+	+	Bark

		<i>Parmotrema pseudonilgherrense</i> (Asahina) Hale							+	Bark
		<i>Parmotrema reticulatum</i> (Taylor) Choisy							+ + + +	Mosses, rock
		<i>Parmotrema tinctorum</i> (Nyl.) Hale							+ +	Bark, rock
		<i>Parmotrema praesorediosum</i> (Nyl.) Hale.							+ +	Rock, soil, bark
		<i>Parmotrema pseudotinctorum</i> (Abbeyes) Hale							+ +	Rock, bark
		<i>Parmotrema sancti-angelii</i> (Lynge) Hale							+ +	Bark, rock
		<i>Punctelia borneri</i> (Sm.) Krog.							+ +	Bark, twigs, rock
		<i>Punctelia rudenta</i> (Ach.) Krog							+ + + +	Dead wood, rock, twigs
		<i>Punctelia subrudecta</i> (Nyl.) Krog							+ +	Rock
		<i>Xanthoparmelia conspersa</i> (Ach.) Hale							+ +	Rock
		<i>Xanthoparmelia stenophylla</i> (Ach.) Ahti & Hawksh.							+ +	Rock
		<i>Xanthoparmelia terricola</i> Hale							+ +	Rock
		<i>Rematotrachyna scytophylla</i> (Kurok.) Divakar & A. Crespo							+ +	Twigs
21	Physciaceae	<i>Heterodermia albidiflava</i> (Kurok.) D. D. Awasthi							+ +	Rock
		<i>Heterodermia boryi</i> (Fée) K. P. Singh & S. R. Singh							+ + + +	Bark, rock
		<i>Heterodermia diademata</i> (Taylor) D. D. Awasthi							+ + + +	Bark, rock
		<i>Heterodermia firmula</i> (Nyl.) Trevis.							+ +	Rock
		<i>Heterodermia incana</i> (Stirton) D. D. Awasthi							+ +	Rock
		<i>Heterodermia japonica</i> (Sato.) Swnsk. & Krog							+ + + +	Bark
		<i>Heterodermia leucomelos</i> (L.) Poelt							+ +	Rock
		<i>Heterodermia pseudospeciosa</i> (Kurok.) W. Culb.							+ +	Rock
		<i>Heterodermia speciosa</i> (Wulfen) Trevis.							+ + + +	Rock
		<i>Heterodermia isidiophora</i> (Nyl.) D. D. Awasthi							+ +	Rock
		<i>Heterodermia obscurata</i> (Nyl.) Trevis							+ +	Rock, bark
		<i>Hyperphyscia adglutinata</i> (Flörke) H. Mayrhofer & Poelt							+ +	Rock, twigs, bark
		<i>Physcia adscendens</i> (Fr.) Olive.							+ +	Bark
		<i>Physcia crispa</i> Nyl.							+ +	Bark
		<i>Physcia dilatata</i> Nyl.							+ +	Bark
		<i>Pyxine berteriana</i> (Fée) Imsh.							+ +	Rock, soil
		<i>Pyxine cocoes</i> (Sw) Nyl.							+ +	Rock, twigs, bark
		<i>Pyxine sorediata</i> (Ach.) Mont.							+ + + + +	Rock
		<i>Pyxine subcinerea</i> Stirt.							+ +	Soil
		<i>Physconia detersa</i> (Nyl.) Poelt							+ +	Bark
		<i>Physconia muscigena</i> (Ach.) Poelt							+ +	Bark
		<i>Phaeophyscia constipata</i> (Norrl. & Nyl.) Moberg							+ +	Rock
		<i>Phaeophyscia hispidula</i> (Ach.) Moberg.							+ + + + +	Rock
		<i>Phaeophyscia nepalensis</i> (Poelt) D. D. Awasthi							+ +	Rock
		<i>Phaeophyscia primaria</i> (Poelt) Trass.							+ + + +	Bark
		<i>Physciella nepalensis</i> (Poelt) Essl.							+ +	Bark
		<i>Rinodina oxydata</i> (Massal.) Massal.							+ +	Rock
22	Pyrenulaceae	<i>Anthracothecium platystomum</i> Müll. Arg.							+ +	Bark
		<i>Anthracothecium subruanum</i> Makhija & Patw.							+ +	Bark
		<i>Anthracothecium thwaitesii</i> (Leight) Müll. Arg.							+ +	Bark
		<i>Lithothelium thiorencens</i> Aptroot & Shipman							+ +	Bark
		<i>Pyrenula bahiana</i> Malme							+ +	Bark
		<i>Pyrenula defosa</i> Mull. Arg.							+ +	Rock
		<i>Pyrenula immissa</i> (Stirton) Zahlbr.							+ + + +	Rock
		<i>Pyrenula introducta</i> (Stirton) Zahlbr.							+ + + +	Rock
		<i>Pyrenula mastophoroides</i> Müll. Arg.							+ +	Rock
		<i>Pyrenula oculata</i> A. Singh & Upreti							+ +	Rock
		<i>Pyrenula pinguis</i> Fée							+ +	Rock, soil
		<i>Pyrenula platystoma</i> (Müll. Arg.) Aptroot							+ +	Rock
		<i>Pyrenula submastophora</i> A. Singh & Upreti							+ +	Rock
		<i>Pyrenula leucostoma</i> Ach.							+ +	Bark, wood
		<i>Pyrenula leucotrypa</i> (Nyl.) Upreti							+ +	Rock
		<i>Pyrenula ochraceoflavens</i> (Nyl.) R. C. Harris.							+ +	Rock, twigs, bark

23	Peltigeraceae	<i>Peltigera collina</i> (Ach.) Scharb.							+	Bark				
		<i>Peltigera polydactylon</i> (Neck) Hoffm.	+	+	+					Bark, soil				
		<i>Peltigera praetextata</i> (Flörke) Zopf	+	+	+	+					Bark			
		<i>Peltigera rufescens</i> (Weiss.) Humb.				+	+	+			Rock, twigs			
24	Pertusariaceae	<i>Pertusaria albescens</i> (Huds.) Choisy & Wern. in. Wern.	+							Bark				
		<i>Pertusaria amara</i> (Ach.) Nyl.				+	+			Bark				
		<i>Pertusaria composita</i> Zahlbr.				+					Bark			
		<i>Pertusaria granulata</i> (Ach.) Müll. Arg.	+							+	Bark			
		<i>Pertusaria leucosora</i> Nyl.				+				+	Mosses, bark			
		<i>Pertusaria multipunctata</i> (Tuckner) Nyl.							+	+	Soil			
25	Porpidiaceae	<i>Porpidia albocoerulescens</i> (Wulfen) Hertel & Knoph in Hertel	+			+				Bark				
		<i>Porpidia crustulata</i> (Ach.) Hertel & Knop in Hertel							+	+	Bark			
26	Ramalinaceae	<i>Phyllopsora furfuracea</i> (Pers.) Zahlbr.						+		Bark				
		<i>Phyllopsora haemophaea</i> (Nyl.) Müll. Arg.	+								Bark			
		<i>Phyllopsora himalayensis</i> G. K. Mishra, Upreti & Nayaka	+								Bark			
		<i>Phyllopsora swinscowii</i> Timdal & Krog							+		Bark			
		<i>Ramalina conduplicans</i> Vain.						+	+	+	+	Rock, soil		
		<i>Ramalina hossei</i> Vain.						+	+	+	+	Rock, bark		
		<i>Ramalina roesleri</i> (Hochst) Hue	+									Rock		
27	Rhizocarpaceae	<i>Ramalina sinensis</i> Jatta						+	+	+	Twigs			
		<i>Rhizocarpon geographicum</i> (L.) DC in Lam. & DC								+	+	Twigs		
28	Streocaulaceae	<i>Lepraria</i> sp.								+	Bark			
		<i>Stereocaulon foliolosum</i> Nyl.						+	+	+	Rock			
		<i>Stereocaulon myriocarpum</i> Th. Fr.								+	+	Rock		
		<i>Stereocaulon pomiferum</i> Duvern.						+	+		+	Bark		
29	Teloschistaceae	<i>Caloplaca cinnabarina</i> (Ach.) Zahlbr.						+		+	Rock, bark			
		<i>Caloplaca flavorubescens</i> (Huds.) J. R. Laundon					+	+			Bark			
		<i>Caloplaca himalayana</i> Y. Joshi & Upreti									+	Bark, rock		
		<i>Caloplaca ochroplaca</i> Poelt & Hinteregger	+				+	+	+			Rock		
		<i>Caloplaca pachycheila</i> Poelt & Hinteregger									+	Rock		
		<i>Caloplaca pindarensis</i> (Räsänen) Poelt & Hinteregger	+									Rock		
		<i>Caloplaca subsoluta</i> (Nyl.) Zahlbr.	+									Bark		
		<i>Ioplaca pindarensis</i> (Räsänen) Poelt & Hinter.								+	+	+	Rock	
		<i>Xanthoria candelaria</i> (L.) Th. Fries								+	+		Bark	
30	Thelotremataceae	<i>Xanthoria elegans</i> (Link.) Th. Fries								+		Rock		
		<i>Diploschistes muscorum</i> (Scop.) R. Sant.								+	+	Twig, bark, rock		
		<i>Tephromela khatiensis</i> (Räsänen) Lumbsch							+			Bark		
32	Umbilicariaceae	<i>Umbilicaria indica</i> Frey								+		Rock		
		<i>Umbilicaria vellea</i> (L.) Ach.								+	+	Rock		
33	Usneaceae	<i>Usnea aciculifera</i> Vain	+									Rock		
		<i>Usnea longissima</i> Ach.								+	+	Twigs		
		<i>Usnea orientalis</i> Mot.	+	+	+	+						Twigs		
		<i>Usnea perplexans</i> Stirt.									+	Twigs		
		<i>Usnea subfloridana</i> Stirt.									+	+	Twigs	
34	Verrucariaceae	<i>Dermatocarpon miniatum</i> (L.) Mann								+	+	+	Rock	
		<i>Dermatocarpon miniatum</i> var. <i>compactum</i> (Lamy) Zahlbr.									+	+	+	Bark
		<i>Dermatocarpon vellereum</i> Zschacke	+								+	+		Bark, rock, soil
		<i>Dermatocarpon meiophyllizum</i> Vain.									+	+	+	Twig, bark, rock
		<i>Endocarpon rosetum</i> A. Singh & Upreti								+				Rock, soil
		<i>Normandia pulchella</i> (Borrer) Nyl.								+	+	+	+	Rock, bark, twigs
		<i>Placidium squamulosum</i> (Ach.) Breuss.											+	Twigs
		<i>Verrucaria margacea</i> (Wahlenb.) Wahlenb.										+		Rock

Table 3. Dominance of lichen families with respect to species in the GWLS.

Sr. No.	Families	Number of genera	Number of species
1	Parmeliaceae	23	45
2	Physciaceae	8	27
3	Cladoniaceae	1	18
4	Pyrenulaceae	3	16
5	Lecanoraceae	4	13
6	Teloschistaceae	3	10
7	Lobariaceae and Ramalinaceae	2	8
8	Verrucariaceae	5	8
9	Collembataceae	2	7
10	Pertusariaceae	1	6
11	Graphidaceae and Usneaceae	1	5
12	Candelariaceae	3	4
13	Peltigeraceae	1	4
14	Acarosporaceae and Stereocaulaceae	2	4
15	Megasporaceae	1	3
16	Bacidiaceae, Porpidiaceae and Umbilicariaceae	1	2
17	Arthoniales, Caliciaceae, Catillariaceae, Chrysothricaceae, Coccocarpaceae, Fuscideaceae, Icmadophilaceae, Nephromataceae, Ochrolechiaceae, Pannariaceae, Rhizocarpaceae, Thelotremaaceae and Tephromelataceae	1	1
	Number of families: 34	80	214

helpful in carrying out future biomonitoring and bioprospectional studies in the area.

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