



## DIVERSITY AND DISTRIBUTION OF LICHENICOLOUS FUNGI AND LICHENICOLOUS LICHENS IN UTTARAKHAND: FIRST COMPREHENSIVE CHECKLIST

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Based on the study of specimens from quoted institutional herbarium, the author's collections and on analysis of literature records, a total of 104 lichenicolous fungi and lichens belonging to 51 genera hosted by 117 lichen species are reported from 11 districts of Uttarakhand (excluding Haridwar and Udham Singh Nagar) including three unidentified specimens of *Clypeococcum* sp. (on *Dendroscosticta praetextata*), *Pyrenidium* sp. (on *Dimelaena oreina*) and *Sclerococcum* sp. (on *Dendroscosticta platyphyloides*, *D. wrightii* and *Sticta henryana*). Besides this, 1 species viz. *Llimoniella ramalinae* is new to India, 10 species viz. *Abrothallus parmiliarum*, *Abrothallus peyritschii*, *Endococcus rugulosus*, *Lichenocodium usneae*, *Lichenostigma maureri*, *Opegrapha foreau*, *Polycoccum pulvinatum*, *Sclerococcum homoclinellum*, *Spirographa fusisporella* and *Zwackhiomyces coepulonus* are reported new for Uttarakhand, and 26 species (including five from Uttarakhand) are extending their distributional range in India. Within Uttarakhand, maximum 46 species were reported from Chamoli district, followed by Uttarkashi (40), Pithoragarh (30), Bageshwar (22), Nainital (12), Almora and Pauri Garhwal (9 each), Champawat (6), Dehradun and Tehri Garhwal (5 each) and Rudrapur (2). The genera *Sphaerellothecium* and *Opegrapha* were speciose rich with 7 and 6 species, respectively.

**Keywords:** Fungi, Himalaya, Lichens, Lichenicolous index, Mycota

Lichenicolous fungi are a highly specialized and successful group of organisms which live exclusively on lichens, most commonly as parasites, but sometimes as broad-spectrum pathogens, saprotrophs and commensals (Diederich *et al.* 2018) and are assumed to represent an important source of new species in many groups of fungi (Hawksworth & Rossman 1997), but their overall diversity remained unexplored subject. So far 2319 species of lichenicolous fungi belonging to 10 different classes of Fungi (Ascomycota and Basidiomycota), 55 orders, 115 families and 397 genera have been reported till date (Diederich *et al.* 2018), of which 96% (2219) are ascomycetes and 4% (100) basidiomycetes. Of these 2319 taxa, 2000 are obligately lichenicolous species, subspecies or varieties, 257 lichenicolous lichens and 62 facultatively lichenicolous taxa (Diederich *et al.* 2018). These fungi usually studied by lichenologists and often included in lichen floras, have resulted in the publication of uncountable checklists from the world mentioning their occurrence throughout the world.

India being a hot spot of lichen diversity is also a hub for large number of

lichenicolous fungi. Despite this, the lichenicolous fungal diversity has not been studied in detail and very few sporadic publications appeared until 2013 (Moreau 1951a, Poelt 1961, Awasthi & Singh 1975, Rairkar & Patwardhan 1979, Sherwood *et al.* 1981, Hertel 1983, Pant & Awasthi 1989, Triebel 1989, Awasthi 1991, Hariharan *et al.* 1996, Coppins & Kondratyuk 1998, Alstrup & Ahti 2007) when Zhurbenko (2013) for the first time reported 42 species of lichenicolous fungi from Jammu & Kashmir (including Ladakh). However, the first report of lichenicolous fungus from India is that of Moreau (1951a) on the basis of a collection of *Opegrapha foreau* (C. Moreau & M. Moreau) Hafellner & R. Sant. [as *Telimena foreau* C. Moreau & M. Moreau] colonizing thallus of *Heterodermia speciosa* [as *Anaptychia speciosa*]. Later several publications pertaining to lichenicolous fungi come from Joshi *et al.* (2013), Joseph & Sinha (2015), Joshi (2018), Joshi *et al.* (2016abc, 2017abc, 2018), Singh *et al.* (2017) and Singh & Singh (2018), thus raising the tally of these fungi to ca. 200 in India.

In India, the western Himalayan region comprising 2 states and 2 Union Territories viz.

Himachal Pradesh, Jammu & Kashmir, Ladakh and Uttarakhand exhibits a varied geographical and climatic variation which provides a suitable habitat for varied group of organisms to grow and flourish and lichens are no exception. Uttarakhand is well explored for the diversity of lichens since the beginning of lichenological studies in India in 1950s. During this period of time a number of workers explored different regions and carried out an exhaustive survey of the lichen diversity in Uttarakhand. Despite of such exhaustive exploration the studies on lichenicolous fungal diversity were greatly ignored. One of the author (YJ) paid great attention to the search of lichenicolous fungi of India and Uttarakhand and presented the first account of lichenicolous fungi of Uttarakhand with 6 species while compiling the checklist of lichenicolous fungal diversity of India (Joshi *et al.* 2015a). Later, he along with his team identified several species (Joshi 2018, Joshi *et al.* 2015b, 2016abc, 2017abc, 2018, Singh *et al.* 2017) including 07 new species (*Didymocyrtis rhizoplacae* Y. Joshi & K. Bisht, *Endococcus physciae* Y. Joshi, *Epicladonia heterodermiae* Y. Joshi, A. Falswal & R. Joshi, *Opegrapha gyalolechia* Y. Joshi, *Plectocarpon diedertianum* Y. Joshi, Upadhyay & Chandra, *Plectocarpon parmeliarum* Y. Joshi, *Polycoccum ochvarianum* Y. Joshi) from Uttarakhand and the tally of lichenicolous fungi from Uttarakhand thus raised up to 104 (Joshi *et al.* 2015b, 2016a, 2018).

In the present paper we are providing the complete checklist of lichenicolous fungi [including lichenicolous lichens which are defined as those taxa which are juvenile non-lichenized parasites on lichenized fungi which ultimately emerge (morph) out the thallus of the host, forming an independent lichenized thallus (Kocourková *et al.* 2012)] of Uttarakhand. The catalogue includes 105 species (101 lichenicolous fungi + 04 lichenicolous lichens), three unidentified specimens of *Clypeococcum* sp. (on *Dendriscosticta praetextata*), *Pyrenidium* sp. (on *Dimelaena oreina*) and *Sclerococcum* sp.

(on *Dendriscosticta platyphylloides*, *D. wrightii* and *Sticta henryana*), 1 new record for the country and 10 regional records. Amongst these lichenicolous lichens, taxa such as *Carbonea assimilis* and *Diploschistes muscorum* are obligate on specific species or genera. Other taxon, such as *Monerolechia badia* occur on a wide range of hosts, while taxon such as *Verrucula latericola* are apparently not obligatory juvenile parasites, but opportunistic, and rarely are found morphing out of other lichens.

## MATERIALS AND METHODS

**Study Area:** The broad objective of the present study overarches the state of Uttarakhand which is divided into 13 districts and covers a geographical area of 53,483 km<sup>2</sup>. It borders Tibet Autonomous Region of China to the north; the Sudurpashchim Pradesh of Nepal to the east; the Indian states of Uttar Pradesh to the south and Himachal Pradesh to the west and north-west. Most of the area falls under montane region hence provides variations in topography and climate. The altitude of varied landscapes ranges from 200 to 7816 m asl. The variations in forest types (tropical-alpine) provide habitats for numerous biodiversity elements including many rare and endemic faunal and floral species.

**Methodology:** The present study includes all species found by examination of available literature, specimens from the author's own field collections and specimens kindly given to the author by other scientists. Specimens examined were from the institutional herbaria LWG, LWU and from the private herbaria of Dr. D.D. Awasthi (all from CSIR-National Botanical Research Institute). The author's collections are deposited in the herbarium of the Department of Botany, University of Rajasthan, Jaipur (RUBL) and Department of Botany, SSJ Campus, Kumaun University, Almora (ALM).

In the abbreviation of authors' names we follow the style of Brummitt and Powell (1992), and in the nomenclature that of

Diederich *et al.* (2018). Distributional data are not to be considered as complete as there are based only on critical revision of specimens, but it may help in the study of lichenicolous fungi by colleagues interested in this subject.

Samples were studied with routine mycological techniques. Macroscopic features were examined with a stereozoom dissecting microscope (Olympus Sz61). Thin hand-cut sections were made for studying the anatomy of fruiting bodies and examined under Olympus BX53 compound microscope (up to 1000×) fitted with a Olympus differential interference contrast. Microscopical examination was done in water, 10 % KOH (K), lactophenol cotton blue (LCB), Melzer's reagent (MLZ), Lugol's iodine, directly (I) or after a KOH pre-treatment (K/I), Congo red (CR) solution.

## RESULT

### **ABROTHALLUS** De Not.

The genus is represented by 42 species throughout the world (Diederich *et al.* 2018) of which 05 and 03 are reported from India and Uttarakhand, respectively (Joshi *et al.* 2016a, 2018).

#### **1) *Abrothallus microspermus* Tul.**

**Host(s):** *Flavoparmelia caperata*

**Infected part:** thallus

**Lichen habitat:** corticolous

**Distribution in India:** Arunachal Pradesh, Himachal Pradesh, Uttarakhand

**Distribution in various districts of Uttarakhand:** Chamoli, Pithoragarh

**Notes:** Joshi *et al.* (2018) also reported the anamorphic stage of this fungus - *Vouauxiomyces truncatus* (B. de Lesd.) Dyko and D. Hawksw. from above mentioned states.

#### **2) *Abrothallus parmeliarum* (Sommerf.) Arnold**

**Host(s):** *Emodomelanelia masonii*, *Parmelia sulcata*, *P. squarrosa*, *Parmotrema saxatilis*

**Infected part:** thallus

**Lichen habitat:** corticolous

**Distribution in India:** Himachal Pradesh, Sikkim, Uttarakhand

### **Distribution in various districts of Uttarakhand:** Bageshwar, Uttarkashi

**Note:** The species was previously reported from Sikkim (Joshi *et al.* 2016a), and in the present study it is extending its distributional range up to Himachal Pradesh and Uttarakhand.

#### **3) *Abrothallus peyritschii* (Stein) I. Kotte**

**Host(s):** *Vulpicida pinastri*

**Infected part:** thallus

**Lichen habitat:** corticolous

**Distribution in India:** Himachal Pradesh, Uttarakhand

### **Distribution in various districts of Uttarakhand:** Uttarkashi

**Note:** The species was previously reported from Himachal Pradesh (Alstrup & Ahti 2007), and in the present study it is extending its distributional range up to Uttarakhand.

### **ARTHONIA** Ach.

The genus is represented by 139 species of lichenicolous fungi throughout the world (Diederich *et al.* 2018) of which 09 (excluding *Arthonia pantherina*) and 05 are reported from India and Uttarakhand, respectively (Joshi 2018; Joshi *et al.* 2016a).

**Note:** *Arthonia pantherina* Etayo reported from the thallus of *Pertusaria* from Madhya Pradesh (Joshi *et al.* 2017a) was wrongly identified, hence should be excluded from Indian flora.

#### **4) *Arthonia ayseniae* Halici & Candan**

**Host(s):** *Pleopodium oxytonum*

**Infected part:** thallus and apothecial disc

**Lichen habitat:** saxicolous

**Distribution in India:** So far the species is known from Uttarakhand.

**Distribution in various districts of Uttarakhand:** Pithoragarh

#### **5) *Arthonia clemens* (Tul.) Th. Fr.**

**Host(s):** *Omphalodina chrysoleuca*, *Protoparmeliopsis peltata*

**Infected part:** thallus and apothecial disc

**Lichen habitat:** saxicolous

**Distribution in India:** Himachal Pradesh, Jammu & Kashmir, Uttarakhand  
**Distribution in various districts of Uttarakhand:** Chamoli, Pithoragarh, Uttarkashi

**6) *Arthonia coronata* Etayo**

**Host(s):** *Flavoparmelia caperata*

**Infected part:** soredia

**Lichen habitat:** corticolous, saxicolous

**Distribution in India:** Arunachal Pradesh, Himachal Pradesh, Uttarakhand

**Distribution in various districts of Uttarakhand:** Chamoli

**7) *Arthonia epiphyscia* Nyl.**

**Host(s):** *Physcia* sp., *Physcia stellaris*

**Infected part:** thallus

**Lichen habitat:** corticolous, saxicolous

**Distribution in India:** Himachal Pradesh, Ladakh, Uttarakhand

**Distribution in various districts of Uttarakhand:** Chamoli, Uttarkashi

**Notes:** The species was previously reported from Ladakh and Uttarakhand (Joshi *et al.* 2016a), and in the present study it is extending its distributional range up to Himachal Pradesh.

**8) *Arthonia phaeophysciae* Grube & Matzer**

**Host(s):** *Phaeophyscia* sp., *P. endococcina*

**Infected part:** thallus

**Lichen habitat:** corticolous

**Distribution in India:** Himachal Pradesh, Uttarakhand

**Distribution in various districts of Uttarakhand:** Almora, Nainital

**Notes:** The species was previously reported from Uttarakhand (Joshi *et al.* 2016a), and in the present study it is extending its distributional range up to Himachal Pradesh.

**BACHMANNIOMYCES D. Hawksw.**

The genus is represented by 06 species of lichenicolous fungi throughout the world (Diederich *et al.* 2018) of which 01 is reported from India and that too from Himachal Pradesh and Uttarakhand (Joshi *et al.* 2018).

**9) *Bachmanniomyces punctum* (A. Massal.) Diederich & Pino-Bodas = *Phaeopyxis punctum* (A. Massal.) Rambold, Triebel & Coppins**

**Host(s):** *Cladonia cartilaginea*, *C. pyxidata*

**Infected part:** thallus

**Lichen habitat:** corticolous, terricolous

**Distribution in India:** Himachal Pradesh, Uttarakhand

**Distribution in various districts of Uttarakhand:** Uttarkashi

**Notes:** The species was previously reported by Joshi *et al.* (2018) under the name *Phaeopyxis punctum* (A. Massal.) Rambold, Triebel & Coppins, which is now synonymised under *B. punctum*.

**BACIDIA De Not.**

The genus is represented by 01 species throughout the world (Diederich *et al.* 2018) which is also reported from Uttarakhand (Joshi *et al.* 2018).

**10) *Bacidia killiasii* (Hepp) D. Hawksw.**

**Host(s):** *Peltigera rufescens*

**Infected part:** thallus

**Lichen habitat:** terricolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of Uttarakhand:** Chamoli

**BELLEMERELLA Hafellner & Cl. Roux**

The genus is represented by 04 species throughout the world (Diederich *et al.* 2018) of which 01 is reported from India and that too from Uttarakhand (Joshi *et al.* 2016a).

**11) *Bellemerella acarosporae* Calat. & Nav.-Ros.**

**Host(s):** *Acarospora* sp., *Silobia rufescens*

**Infected part:** thallus

**Lichen habitat:** saxicolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of**

**Uttarakhand:** Bageshwar, Chamoli, Uttarkashi



**BIATOROPSIS Räsänen**

The genus is represented by 04 species throughout the world (Diederich *et al.* 2018) of which 02 and 01 are reported from India and Uttarakhand, respectively (Joshi *et al.* 2015a; Millanes *et al.* 2016).

**12) *Biatoropsis minuta* Millanes, Diederich, M. Westb. & Wedin**

**Host(s):** *Usnea* sp.

**Infected part:** thallus

**Lichen habitat:** corticolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of Uttarakhand:** Chamoli

**BUELLIELLA Fink**

The genus is represented by 12 species throughout the world (Diederich *et al.* 2018) of which 06 and 04 are reported from India and Uttarakhand, respectively (Joshi *et al.* 2016a, 2018; Singh & Singh 2018).

**13) *Buelliella inops* (Triebe & Rambold) Hafellner**

**Host(s):** *Gyalolechia flavorubescens*

**Infected part:** thallus

**Lichen habitat:** corticolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of Uttarakhand:** Bageshwar

**14) *Buelliella lecanorae* Suija & Alstrup**

**Host(s):** *Lecanora* sp., *L. rugosella*

**Infected part:** thallus and apothecial disc

**Lichen habitat:** corticolous

**Distribution in India:** Odisha, Uttarakhand

**Distribution in various districts of Uttarakhand:** Dehradun, Nainital

**Notes:** The species was previously reported from Uttarakhand (Joshi *et al.* 2016a), and in the present study it is extending its distributional range up to Odisha.

**15) *Buelliella minimula* (Tuck.) Fink**

**Host(s):** *Graphis* sp., *Lepra amara*, *Ochrolechia androgyna*, *O. rosella*, *Pertusaria acuta*, *P. amarkantakana*, *P. concinna*, *P.*

*coronata*, *P. depressa*, *P. himalayensis*, *P. indica*, *P. leioplacella*, *P. melastomella*, *P. pertusa*, *P. pseudococcodes*, *P. quassiae*, *P. rigida*, *P. subochracea*, *P. tuberculifera*, *P. wattiana*

**Infected part:** thallus and/or apothecial disc margin

**Lichen habitat:** corticolous, saxicolous

**Distribution in India:** Bihar, Chhattisgarh, Himachal Pradesh, Kerala, Madhya Pradesh, Uttarakhand, West Bengal

**Distribution in various districts of Uttarakhand:** Bageshwar, Chamoli, Pithoragarh

**Notes:** The species was previously reported from Madhya Pradesh and Uttarakhand (Joshi *et al.* 2016a), and in the present study it is extending its distributional range in different states of India, viz. Bihar, Chhattisgarh, Himachal Pradesh, Kerala, West Bengal. *Graphis* sp. and *Lepra amara* are the new hosts for this fungus.

**16) *Buelliella protoparmeliopsis* Etayo & Pérez-Ort.**

**Host(s):** *Protoparmeliopsis muralis*

**Infected part:** thallus

**Lichen habitat:** saxicolous

**Distribution in India:** Jammu & Kashmir, Uttarakhand

**Distribution in various districts of Uttarakhand:** Chamoli

**CAERULEOCONIDIA Zhurb. & Diederich**

The genus is represented by 02 species lichenicolous throughout the world (Diederich *et al.* 2018) of which 01 is reported from India and that too from Uttarakhand (Joshi *et al.* 2018).

**17) *Caeruleoconidia ochrolechia* Zhurb. & Diederich**

**Host(s):** *Lepra variolosa*, *Ochrolechia rosella*

**Infected part:** thallus and apothecial disc margin

**Lichen habitat:** corticolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of**

**Uttarakhand:** Bageshwar, Chamoli

***CARBONEA* (Hertel) Hertel**

The genus is represented by 11 and 06 species of lichenicolous fungi and lichenicolous lichens, respectively, throughout the world (Diederich *et al.* 2018) of which 04 are reported from India (Hertel 1983, Poelt 1961, Zhurbenko 2013, Joshi *et al.* 2016a, 2018) and 02 from Uttarakhand, one of which is lichenicolous fungus (i.e. *C. aggregantula*) and another lichenicolous lichen (i.e. *C. assimilis*). Recently the genus has been synonymised under *Huea* C.W. Dodge & G.E. Baker (Wijayawardene *et al.* 2020), but till date no new combinations for its species are available and as mentioned earlier we are following Diederich *et al.* (2018) for generic nomenclature, hence we are treating it here as *Carbonea*.

**18) *Carbonea aggregantula* (Müll. Arg.) Diederich & Triebel**

**Host(s):** *Lecanora* sp., *L. impudens*, *L. leproplaca*, *L. subgranulata*, *Protoparmeliopsis muralis*

**Infected part:** thallus and apothecial disc margin

**Lichen habitat:** corticolous

**Distribution in India:** Himachal Pradesh, Jammu & Kashmir, Madhya Pradesh, Uttarakhand

**Distribution in various districts of Uttarakhand:** Pithoragarh

**Notes:** The species was previously reported from Jammu & Kashmir, Madhya Pradesh and Uttarakhand (Joshi *et al.* 2016a), and in the present study it is extending its distributional range in Himachal Pradesh.

**19) *Carbonea assimilis* (Hampe ex Körb.) Hafellner & Hertel**

**Host(s):** *Lecanora* sp., *Lecanora subimmersa*

**Infected part:** thallus and rarely on apothecial disc

**Lichen habitat:** saxicolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of**

**Uttarakhand:** Chamoli, Uttarkashi

***CERCIDOSPORA* Körb.**

The genus is represented by 40 species throughout the world (Diederich *et al.* 2018) of which 07 are reported from India (Zhurbenko 2013, Joshi *et al.* 2016a, 2018) including 04 from Uttarakhand.

**20) *Cercidospora caudata* Kernst.**

**Host(s):** *Amundsenia approximata*, *Calogaya biatorina*, *Caloplaca* sp., *Rusavskia elegans*

**Infected part:** thallus and/or apothecial disc

**Lichen habitat:** saxicolous

**Distribution in India:** Himachal Pradesh, Jammu & Kashmir, Ladakh, Uttarakhand

**Distribution in various districts of Uttarakhand:** Bageshwar, Pithoragarh

**21) *Cercidospora epicarphinea* (Nyl.) Grube & Hafellner**

**Host(s):** *Caloplaca* sect. *Gasparrinia*

**Infected part:** thallus

**Lichen habitat:** saxicolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of Uttarakhand:** Bageshwar

**22) *Cercidospora melanophthalmae* Nav.-Ros., Calat. & Hafellner**

**Host(s):** *Omphalodina chrysoleuca*, *Protoparmeliopsis peltata*, *Rhizoplaca melanophthalma*

**Infected part:** thallus and apothecial disc

**Lichen habitat:** saxicolous, terricolous

**Distribution in India:** Himachal Pradesh, Ladakh, Uttarakhand

**Distribution in various districts of Uttarakhand:** Uttarkashi

**23) *Cercidospora xanthoriae* (Wedd.) R. Sant.**

**Host(s):** *Rusavskia elegans*, *R. sorediata*

**Infected part:** thallus and apothecia

**Lichen habitat:** saxicolous

**Distribution in India:** Himachal Pradesh, Ladakh, Uttarakhand

**Distribution in various districts of**

**Uttarakhand:** Bageshwar

**Notes:** The species was previously reported from Ladakh and Uttarakhand (Zhurbenko 2013, Joshi *et al.* 2016a), and in the present study it is extending its distributional range in Himachal Pradesh.

**CLYPEOCOCCUM D. Hawksw.**

The genus is represented by 13 species of lichenicolous fungus throughout the world (Shivarov 2019, Diederich *et al.* 2018) of which 02 is (including one undescribed specie) also reported from India and that too from Uttarakhand (Joshi *et al.* 2018).

**24) *Clypeococcum grossum* (Körb.) D. Hawksw.**

**Host(s):** *Umbilicaria vellea*

**Infected part:** thallus

**Lichen habitat:** corticolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of Uttarakhand:** Pithoragarh

**25) *Clypeococcum* sp.**

**Diagnostic characters:** Ascomata perithecioid (pseudothecia), black, both on upper and lower side of the thallus. Ascomata 80–90 µm diam. Asci narrowly cylindrical, 65–120 × 7.5–10 µm, 8-spored. Ascospores pale brown to brown, (0–)1-septate, 13–17 × 3.5–4.5 µm, l/b ratio = 3–5. Conidiomata unknown.

**Host(s):** *Dendrocosticta praetextata*

**Infected part:** upper and lower sides of thallus

**Lichen habitat:** corticolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of Uttarakhand:** Chamoli

**26) *Clypeococcum* sp.**

**Host(s):** *Dendrocosticta praetextata*

**Infected part:** upper and lower side of thallus

**Lichen habitat:** corticolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of Uttarakhand:** Chamoli

**CORTICIFRAGAD. Hawksw. & R. Sant.**

The genus is represented by 07 species throughout the world (Diederich *et al.* 2018) of which 01 is also reported from India and that too from Uttarakhand (Zhurbenko 2013, Joshi *et al.* 2016a).

**26) *Corticifraga peltigerae* (Fuckel) D. Hawksw. & R. Sant.**

**Host(s):** *Peltigera canina*

**Infected part:** thallus

**Lichen habitat:** terricolous

**Distribution in India:** Jammu & Kashmir, Uttarakhand

**Distribution in various districts of Uttarakhand:** Uttarkashi

**DIDYMOCYRTIS Vain.**

Now most of the lichenicolous *Phoma* species (14) and one *Leptosphaeria* species (*Leptosphaeria protosneae* Etayo) are placed under *Didymocyrtis*, which is represented by 26 species throughout the world (Diederich *et al.* 2018, Joshi *et al.* 2018; Zhurbenko *et al.* 2019) of which 07 (including two species of *Phoma*) and 04 (including one species of *Phoma*) are reported from India and Uttarakhand, respectively (Joshi 2018, Joshi *et al.* 2016a, 2018).

**27) *Didymocyrtis bryonae* (Arnold) Hafellner**

**Host(s):** *Lecanora* sp.

**Infected part:** thallus and apothecial disc

**Lichen habitat:** corticolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of Uttarakhand:** Nainital

**28) *Didymocyrtis consimilis* Vain.**

**Host(s):** *Melanohalea exasperatula*

**Infected part:** thallus

**Lichen habitat:** corticolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of Uttarakhand:** Uttarkashi

**29) *Didymocyrtis rhizoplacae* Y. Joshi & K. Bisht**

**Host(s):** *Omphalodina chrysoleuca*

**Infected part:** thallus and apothecial disc

**Lichen habitat:** saxicolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of Uttarakhand:** Pithoragarh, Uttarkashi

***DIPLOSCHISTES* Norman**

The genus is represented by 04 species of lichenicolous lichens throughout the world (Diederich *et al.* 2018) of which 01 is also reported from India and that too from Uttarakhand.

**30) *Diploschistes muscorum* (Scop.) R. Sant.**

**Host(s):** *Cladonia fimbriata*

**Infected part:** thallus

**Lichen habitat:** terricolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of Uttarakhand:** Uttarkashi

***ECHINOTHECIUM* Zopf**

The genus is represented by 02 species throughout the world (Diederich *et al.* 2018) of which 01 is also reported from India and that too from Uttarakhand (Joshi *et al.* 2016a).

**31) *Echinothecium reticulatum* Zopf**

**Host(s):** *Flavoparmelia caperata*, *Parmotrema reticulatum*

**Infected part:** thallus

**Lichen habitat:** corticolous, saxicolous

**Distribution in India:** Himachal Pradesh, Jammu & Kashmir, Sikkim, Uttarakhand

**Distribution in various districts of Uttarakhand:** Almora, Chamoli, Uttarkashi

**Notes:** The species was previously reported from Uttarakhand under the name *Sphaerellothecium reticulatum* (Zopf) Etayo (Joshi *et al.* 2016a), and in the present study it is extending its distributional range in different states of India viz. Himachal Pradesh, Jammu & Kashmir, Sikkim.

***ENDOCOCCUS* Nyl.**

The genus is represented by 45 species throughout the world (Diederich *et al.* 2018;

Joshi 2018) of which 07 and 03 are reported from India and Uttarakhand, respectively (Zhurbenko 2013, Joshi 2018, Joshi *et al.* 2016a, 2018).

**32) *Endococcus physciae* Y. Joshi**

**Host(s):** *Physcia* sp., *P. adscendens*, *P. gomukhensis*, *P. sinuosa*

**Infected part:** thallus

**Lichen habitat:** saxicolous, terricolous

**Distribution in India:** Jammu & Kashmir, Karnataka, Uttarakhand

**Distribution in various districts of Uttarakhand:** Chamoli, Uttarkashi

**Notes:** Joshi (2018) when described this new species from India reported hymenial gel and asci, I+ orange and ascus and ascospores of  $(22-27.42-35.42.57(-45) \times (5-6.74-11.57-16.39(-17) \mu\text{m}$  and  $(12-12.19-13.14-14.09(-15) \times (4-4.67-5.42-6.18(-7) \mu\text{m}$  dimensions, respectively. Recently one of the author (YJ) encountered some other specimens of this species and found slight variations in characters, which are mentioned here and should be considered whenever identifying this species:

*Ascomata*  $(80-96.81-116.13-135.45(-135) \times (80-90.54-110-129.46(-130) \mu\text{m}$ . Hymenial gel and asci, I+ orange, K/I+ blue. *Asci*  $4-6(-8)$ -spored,  $(20-22.8-30.2-37.6(-45) \times 9-12.4-15.8(-20) \mu\text{m}$ , K/I+ blue. *Ascospores* uni- to bi-seriately arranged in the asci, ellipsoid to somewhat fusiform, hyaline to pale brown when young and golden brown at maturity, K+ intense, simple to 1-septate when mature, not or slightly constricted at the septum, the outermost layer faintly verruculose,  $0.5 \mu\text{m}$  thick, perispore  $0.5 \mu\text{m}$  thick,  $(7-9.88-12.65-15.45(-18) \times (4-4.03-4.63-5.23(-6) \mu\text{m}$ .

**34) *Endococcus propinquus* (Körb.) D. Hawksw.**

**Host(s):** *Aspicilia* sp., *A. almorensis*, *Lecidella alaiensis*, *L. carpathica*, *Porpidia macrocarpa*

**Infected part:** thallus

**Lichen habitat:** saxicolous



**Distribution in India:** Himachal Pradesh, Uttarakhand

**Distribution in various districts of Uttarakhand:** Bageshwar, Chamoli, Uttarkashi

**34) *Endococcus rugulosus* (Borrer ex Leight.) Nyl.**

**Host(s):** *Aspicilia* sp.

**Infected part:** thallus

**Lichen habitat:** saxicolous

**Distribution in India:** Jammu & Kashmir, Uttarakhand

**Distribution in various districts of Uttarakhand:** Chamoli

**Notes:** The species was previously reported from Jammu & Kashmir (Zhurbenko 2013), and in the present study it is extending its distributional range in Uttarakhand.

***EPICLADONIA* D. Hawksw.**

The genus is represented by 03 species throughout the world (Diederich *et al.* 2018) of which 01 is reported from India and that too from Uttarakhand (Joshi *et al.* 2017b).

**35) *Epicladonia heterodermiae* Y. Joshi, A. Falwal & R. Joshi**

**Host(s):** *Heterodermia* sp.

**Infected part:** thallus

**Lichen habitat:** corticolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of Uttarakhand:** Pithoragarh

***HETEROCEPHALACRIA* Berthier**

The genus is represented by 02 species of lichenicolous fungi throughout the world (Diederich *et al.* 2018) of which 01 is also reported from India and that too from Himachal Pradesh, Jammu & Kashmir, Kerala and Uttarakhand (Joshi *et al.* 2018).

**37) *Heterocephalacria physciacearum* (Diederich) Millanes & Wedin**

**Host(s):** *Heterodermia diademata*, *H. dissecta* var. *koyana*, *H. incana*, *Physcia gomukhensis*, *P. grisea*, *P. stellaris* var. *intestiniformis*, *P.*

*stellaris* var. *stellaris*, *Polyblastidium hypocaustum*

**Infected part:** thallus

**Lichen habitat:** corticolous, saxicolous

**Distribution in India:** Himachal Pradesh, Jammu & Kashmir, Kerala, Uttarakhand

**Distribution in various districts of Uttarakhand:** Bageshwar, Uttarkashi

**Notes:** The species was previously reported from Jammu & Kashmir, Kerala and Uttarakhand (Joshi *et al.* 2018), and in the present study it is extending its distributional range in Himachal Pradesh.

***HOMOSTEGIA* Fuckel**

The genus is represented by 02 species of lichenicolous fungi (Diederich *et al.* 2018) throughout the world, and both are also reported from India and that too from Uttarakhand (Alstrup & Ahti 2007, Joshi *et al.* 2016a).

**38) *Homostegia hertelii* D. Hawksw.**

**Host(s):** *Flavoparmelia caperata*, *Punctelia rudecta*

**Infected part:** thallus

**Lichen habitat:** corticolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of Uttarakhand:** Almora

**Notes:** Till date the species is reported from Uttarakhand, and hence can be considered endemic to this region.

**39) *Homostegia piggotii* (Berk. & Broome) P. Karst.**

**Host(s):** *Parmelia* sp.

**Infected part:** thallus

**Lichen habitat:** corticolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of Uttarakhand:** Dehradun

**Notes:** Till date the species is reported from Uttarakhand, and hence can be considered endemic to this region.

***INTRALICHEN* D. Hawksw. & M.S. Cole**

The genus is represented by 04 species of lichenicolous fungi throughout the world (Diederich *et al.* 2018) of which 02 are

reported from India and that too from Jammu & Kashmir and Uttarakhand (Zhurbenko 2013, Joshi *et al.* 2016a).

**40) *Intralichen christiansenii* (D. Hawksw.) D. Hawksw. & M.S. Cole**

**Host(s):** *Amundsenia approximata*, *Caloplaca pachycheila*, *Candelariella aurella*, *Lobothallia alphoplaca*

**Infected part:** apothecial disc

**Lichen habitat:** saxicolous

**Distribution in India:** Jammu & Kashmir, Uttarakhand

**Distribution in various districts of Uttarakhand:** Bageshwar

**41) *Intralichen lichenicola* (M.S. Christ. & D. Hawksw.) D. Hawksw. & M.S. Cole**

**Host(s):** *Candelaria* sp.

**Infected part:** thallus and apothecial disc

**Lichen habitat:** saxicolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of Uttarakhand:** Pithoragarh

**Notes:** Till date the species is reported from Uttarakhand, and hence can be considered endemic to this region.

***LASIOSPHAERIOPSIS* D. Hawksw. & Sivan.**

The genus is represented by 07 species of lichenicolous fungi throughout the world (Diederich *et al.* 2018) of which 01 is also reported from India and that too from Himachal Pradesh and Uttarakhand.

**42) *Lasiosphaeriopsis salisburyi* D. Hawksw. & Sivan.**

**Host(s):** *Peltigera* sp., *P. didactyla*, *P. horizontalis*, *P. rufescens*

**Infected part:** thallus

**Lichen habitat:** saxicolous, terricolous

**Distribution in India:** Himachal Pradesh, Uttarakhand

**Distribution in various districts of Uttarakhand:** Chamoli

**Notes:** The species was previously reported from Uttarakhand (Joshi *et al.* 2018), and in the present study it is extending its distributional

range in Himachal Pradesh.

**LAWALREEA Diederich**

The genus is represented by 01 species of lichenicolous fungus throughout the world (Diederich *et al.* 2018) which is also known from India and that too from Uttarakhand (Joshi *et al.* 2018).

**43) *Lawalreea lecanorae* Diederich**

**Host(s):** *Lecanora* sp.

**Infected part:** thallus and apothecial disc margin but rarely on apothecial disc

**Lichen habitat:** corticolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of Uttarakhand:** Pithoragarh

**Notes:** Till date the species is reported from Uttarakhand, and hence can be considered endemic to this region.

***LICHENOCONIUM* Petr. & Syd.**

The genus is represented by 15 species of lichenicolous fungus throughout the world (Diederich *et al.* 2018) of which 04 and 03 are also reported from India and Uttarakhand, respectively (Joshi *et al.* 2016a, 2018).

**44) *Lichenocodium lecanorae* (Jaap) D. Hawksw.**

**Host(s):** *Omphalodina chrysouleuca*

**Infected part:** apothecial disc

**Lichen habitat:** saxicolous

**Distribution in India:** Himachal Pradesh, Uttarakhand

**Distribution in various districts of Uttarakhand:** Pithoragarh

**45) *Lichenocodium usneae* (Anzi) D. Hawksw.**

**Host(s):** *Flavoparmelia caperata*, *Physcia* sp.

**Infected part:** thallus and apothecial disc

**Lichen habitat:** corticolous

**Distribution in India:** Jammu & Kashmir, Uttarakhand

**Distribution in various districts of Uttarakhand:** Pithoragarh

**Notes:** The species was previously reported from Jammu & Kashmir (Zhurbenko 2013), and in the present study it is extending its

distributional range in Uttarakhand.

**46) *Lichenoconium xanthoriae* M.S. Christ.**

**Host(s):** *Melanelixia subargentifera*,  
*Rusavskia elegans*

**Infected part:** thallus and apothecial disc

**Lichen habitat:** saxicolous

**Distribution in India:** Jammu & Kashmir,  
Uttarakhand

**Distribution in various districts of  
Uttarakhand:** Chamoli

***LICHENODIPLIS* Dyko & D. Hawksw.**

The genus is represented by 12 species of lichenicolous fungus throughout the world (Diederich *et al.* 2018) of which 02 are also reported from Himachal Pradesh, Jammu & Kashmir, Karnataka, Madhya Pradesh, Sikkim, Uttarakhand states of India (Zhurbenko 2013; Joshi *et al.* 2015a, 2016a, 2017c).

**47) *Lichenodiplis lecanorae* (Vouaux) Dyko & D. Hawksw.**

**Host(s):** *Acarospora*, *Caloplaca* sp., *Lecanora* sp., *L. allophana*, *L. flavidofusca*, *L. somervelli*, *L. tropica*, *Ochrolechia rosella*, *Pertusaria leioplacella*, *Porpidia crustulata*, *P. hydrophila*, *P. macrocarpa*, *Rhizocarpon geographicum*, *Rusavskia elegans*

**Infected part:** thallus and apothecial disc

**Lichen habitat:** corticolous, saxicolous

**Distribution in India:** Himachal Pradesh,  
Jammu & Kashmir, Karnataka, Madhya  
Pradesh, Sikkim, Uttarakhand

**Distribution in various districts of  
Uttarakhand:** Almora, Chamoli, Champawat,  
Nainital, Pauri Garhwal

**Notes:** The species was previously reported from Himachal Pradesh, Jammu & Kashmir, Karnataka, Madhya Pradesh and Uttarakhand (Zhurbenko 2013; Joshi *et al.* 2016a), and in the present study it is extending its distributional range in Sikkim.

**48) *Lichenodiplis lichenicola* Dyko & D. Hawksw.**

**Host(s):** *Rinodina* sp.

**Infected part:** apothecia

**Lichen habitat:** saxicolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of  
Uttarakhand:** Rudraprayag

***LICHENOSTIGMA* Hafellner s. lat.**

The genus is represented by 25 species of lichenicolous fungus throughout the world (Diederich *et al.* 2018) of which 04 and 02 are also reported from India and Uttarakhand, respectively (Zhurbenko 2013, Joshi *et al.* 2016a, 2018).

**49) *Lichenostigma cosmopolites* Hafellner & Calat.**

**Host(s):** *Xanthoparmelia* sp., *X. australasica*, *X. congensis*, *X. conspersa*, *X. coreana*, *X. mexicana*, *X. pseudocongensis*, *X. somloensis*, *X. stenophylla*, *X. taractica*, *X. terricola*

**Infected part:** thallus

**Lichen habitat:** saxicolous, terricolous

**Distribution in India:** Himachal Pradesh,  
Jammu & Kashmir, Rajasthan, Sikkim,  
Uttarakhand

**Distribution in various districts of  
Uttarakhand:** Almora, Chamoli, Pauri  
Garhwal, Pithoragarh, Uttarkashi

**50) *Lichenostigma elongatum* Nav.-Ros. & Hafellner**

**Host(s):** *Lobothallia* sp., *L. alphoplaca*

**Infected part:** thallus

**Lichen habitat:** saxicolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of  
Uttarakhand:** Bageshwar, Chamoli

***LICHENOSTIGMA* Hafellner s. str.**

The genus is represented by 05 species of lichenicolous fungus throughout the world (Diederich *et al.* 2018) of which 02 and 01 are also reported from India and Uttarakhand, respectively (Zhurbenko 2013, Joshi *et al.* 2016a).

**51) *Lichenostigma maureri* Hafellner**

**Host(s):** *Ramalina conduplicans*, *R. confusa*,  
*R. sinensis*, *R. subcomplanata*, *Usnea*

*perplexans*

**Infected part:** thallus and apothecial disc

**Lichen habitat:** corticolous, saxicolous

**Distribution in India:** Himachal Pradesh, Uttarakhand

**Distribution in various districts of Uttarakhand:** Chamoli, Nainital, Pithoragarh, Tehri Garhwal, Uttarkashi

**Notes:** Joshi *et al.* (2016a) misidentified this species colonizing thallus of *Xanthoparmelia stenophylla* from Jammu & Kashmir. In the present study it is reported from Himachal Pradesh and Uttarakhand.

**LICHENOTHELIAD. Hawksw.**

The genus is represented by 03 species of lichenicolous fungus throughout the world (Diederich *et al.* 2018) of which 01 is also reported from Himachal Pradesh and Uttarakhand states of India.

**52) *Lichenothelia convexa* Henssen**

**Host(s):** *Aspicilia almorensis*, *A. dwaliensis*, *Circinaria calcarea*, *Oxneriaria verruculosa*, *Rhizocarpon* sp.

**Infected part:** thallus

**Lichen habitat:** saxicolous

**Distribution in India:** Himachal Pradesh, Uttarakhand

**Distribution in various districts of Uttarakhand:** Tehri Garhwal, Uttarkashi

**Notes:** The species was previously reported from Uttarakhand (Joshi *et al.* 2016a), and in the present study it is extending its distributional range in Himachal Pradesh.

**MELASPILEA Nyl.**

The genus is represented by 10 species of lichenicolous fungus throughout the world (Diederich *et al.* 2018) of which 03 and 01 are also reported from India and Uttarakhand, respectively (Joseph & Sinha 2015, Joshi *et al.* 2016a, Singh *et al.* 2017).

**53) *Melaspilea insitiva* Stirt.**

**Host(s):** *Pertusaria* sp.

**Infected part:** thallus

**Lichen habitat:** corticolous

**Distribution in India:** Uttarakhand, West Bengal

**Distribution in various districts of Uttarakhand:** Almora

**MONEROLECHIA Trevis.**

The genus is represented by 04 species of lichenicolous lichen throughout the world (Diederich *et al.* 2018) of which 01 is also reported from Himachal Pradesh, Sikkim, Tamil Nadu and Uttarakhand states of India (Joshi *et al.* 2016a).

**54) *Monerolechia badia* (Fr.) Kalb**

**Host(s):** *Aspicilia almorensis*, *A. cinerea*, *Circinaria caesiocinerea*, *Myriospora smaragdula*

**Infected part:** thallus

**Lichen habitat:** saxicolous

**Distribution in India:** Himachal Pradesh, Sikkim, Tamil Nadu, Uttarakhand

**Distribution in various districts of Uttarakhand:** Chamoli, Pithoragarh, Uttarkashi

**Notes:** The species was previously reported from Himachal Pradesh, Sikkim and Uttarakhand (Joshi *et al.* 2016a), and in the present study it is extending its distributional range in Tamil Nadu.

**MONODICTYSS. Hughes**

The genus is represented by 05 species of lichenicolous fungi throughout the world (Diederich *et al.* 2018) of which 02 and 01 are also reported from India and Uttarakhand, respectively (Zhurbenko 2013, Joshi *et al.* 2016a).

**55) *Monodictys cellulosa* S. Hughes**

**Host(s):** *Lecanora leprosa*

**Infected part:** thallus and apothecial disc margin but rarely on apothecial disc

**Lichen habitat:** corticolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of Uttarakhand:** Pauri Garhwal

**Notes:** Till date the species is reported from Uttarakhand, and hence can be considered



endemic to this region.

**MUELLERELLA Mull. Arg.**

The genus is represented by 12 species of lichenicolous fungi throughout the world (Diederich *et al.* 2018) of which 04 and 03 are also reported from India and Uttarakhand, respectively (Zhurbneko 2013. Joshi *et al.* 2016a).

**56) *Muellerella erratica* (A. Massal.) Hafellner & Volk. John**

**Host(s):** *Acarospora badiofusca*, *A. bullata*, *A. fuscata*, *A. superans*, *A. veronensis*, *Circinaria caesiocinerea*, *C. maculata*, *Lecidea auriculata*, *Lecidella stigmataea*, *Lobothallia alphoplaca*, *L. praeradiosa*, *Pertusaria* sp., *Pleopsidium oxytonum*, *Protoparmeliopsis garovaglii*, *P. muralis* *Rhizoplaca melanophthalma*, *Rusavskia elegans*

**Infected part:** thallus and apothecial disc

**Lichen habitat:** saxicolous

**Distribution in India:** Himachal Pradesh, Jammu & Kashmir, Kerala, Ladakh, Uttarakhand

**Distribution in various districts of Uttarakhand:** Bageshwar, Chamoli, Pithoragarh, Uttarkashi

**Notes:** The species was previously reported from Himachal Pradesh, Jammu & Kashmir, Ladakh and Uttarakhand (Joshi *et al.* 2016a), and in the present study it is extending its distributional range in Kerala.

**57) *Muellerella lichenicola* (Sommerf.) D. Hawksw.**

**Host(s):** *Calogaya saxicola*, *Caloplaca* sp., *C. lithophila*, *Catilaria* sp., *Golubkovia trachyphylla*, *Gyalolechia flavorubescens*, *G. flavovirescens*, *Lecanora* sp., *L. indica*, *Psora decipiens*, *Pyrenodesmia variabilis*, *Squamulea subsoluta*, *Rusavskia elegans*

**Infected part:** thallus and apothecial disc

**Lichen habitat:** corticolous, saxicolous, terricolous

**Distribution in India:** Himachal Pradesh, Jammu & Kashmir, Ladakh, Tamil Nadu, Uttarakhand

**Distribution in various districts of Uttarakhand:** Chamoli, Dehradun, Nainital, Pithoragarh, Rudraprayag, Tehri Garhwal, Uttarkashi

**Notes:** The species was previously reported from Himachal Pradesh, Jammu & Kashmir, Ladakh and Uttarakhand (Joshi *et al.* 2016a), and in the present study it is extending its distributional range in Tamil Nadu.

**58) *Muellerella ventosicola* (Mudd) D. Hawksw.**

**Host(s):** *Rhizocarpon disporum*, *R. geographicum*

**Infected part:** thallus

**Lichen habitat:** saxicolous

**Distribution in India:** Ladakh, Uttarakhand

**Distribution in various districts of Uttarakhand:** Chamoli

**NESOLECHIA A. Massal.**

The genus is represented by 07 species of lichenicolous fungi throughout the world (Diederich *et al.* 2018) of which 01 is also reported from India and that too from Uttarakhand (Joshi *et al.* 2016a).

**59) *Nesolechia oxyspora* var. *fusca* (Triebel & Rambold) Diederich**

**Host(s):** *Xanthoparmelia* sp., *X. conspersa*, *X. pseudocongensis*, *X. taractica*, *X. terricola*

**Infected part:** thallus

**Lichen habitat:** saxicolous, terricolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of Uttarakhand:** Chamoli, Uttarkashi

**Notes:** The species was reported by Joshi *et al.* (2016a) under the name *Nesolechia fusca* and till date is being reported from Uttarakhand, and hence can be considered endemic to this region.

**OPEGRAPHA Ach.**

The genus is represented by 73 species of lichenicolous fungi throughout the world (Diederich *et al.* 2018, Joshi 2018) of which 06 are reported from India, including Uttarakhand (Moreau 1951; Coppins & Kondratyuk 1998;

Diederich & Ertz 2018; Joshi 2018; Joshi *et al.* 2015ab, 2016a, 2017a).

**60) *Opegrapha anomea* Nyl.**

**Host(s):** *Lepra albescens*, *Pertusaria* sp., *P. amarkantakana*, *P. coronata*

**Infected part:** thallus

**Lichen habitat:** corticolous

**Distribution in India:** Madhya Pradesh, Uttarakhand, West Bengal

**Distribution in various districts of Uttarakhand:** Bageshwar, Pithoragarh

**61) *Opegrapha brigantina* Hafellner**

**Host(s):** *Brigantiaea leucoxantha*

**Infected part:** thallus

**Lichen habitat:** corticolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of Uttarakhand:** Nainital

**Notes:** Till date the species is reported from Uttarakhand, and hence can be considered endemic to this region.

**62) *Opegrapha foreau* (Moreau) Hafellner & R. Sant.**

**Host(s):** *Heterodermia* sp., *H. coronata*, *H. diademata*, *H. incana*, *H. leucomelos*, *H. pseudospeciosa*, *Polyblastidium hypocaesium*, *P. japonicum*, *P. togashii*.

**Infected part:** thallus

**Lichen habitat:** corticolous, terricolous

**Distribution in India:** Himachal Pradesh, Kerala, Tamil Nadu, Uttarakhand

**Distribution in various districts of Uttarakhand:** Pithoragarh

**Notes:** The species was previously reported from Kerala and Tamil Nadu (Moreau 1951; Coppins & Kondratyuk 1998, Joshi *et al.* 2016a), and in the present study it is extending its distributional range in Himachal Pradesh and Uttarakhand.

**63) *Opegrapha gyalolechia* Y. Joshi**

**Host(s):** *Gyalolechia flavorubescens*

**Infected part:** thallus and apothecial disc

**Lichen habitat:** corticolous

**Distribution in India:** Himachal Pradesh,

Uttarakhand

**Distribution in various districts of Uttarakhand:** Bageshwar

**64) *Opegrapha melanospora* Müll. Arg.**

**Host(s):** *Parmotrema* sp., *P. tinctorum*

**Infected part:** thallus

**Lichen habitat:** corticolous

**Distribution in India:** Uttarakhand, West Bengal

**Distribution in various districts of Uttarakhand:** Pithoragarh

**Notes:** The species was previously reported from Uttarakhand (Diederich & Ertz 2018; Joshi 2018), and in the present study it is extending its distributional range in West Bengal.

**65) *Opegrapha phaeophysciae* R. Sant., Diederich, Ertz & Christnach**

**Host(s):** *Phaeophyscia hispidula*, *P. orbicularis*

**Infected part:** thallus

**Lichen habitat:** corticolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of Uttarakhand:** Pithoragarh, Uttarkashi

**Notes:** Till date the species is reported from Uttarakhand, and hence can be considered endemic to this region.

**66) *Phoma peltigerae* (P. Karst.) D. Hawksw.**

**Host(s):** *Peltigera didactyla*

**Infected part:** thallus and in between soredia

**Lichen habitat:** corticolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of Uttarakhand:** Chamoli

**Notes:** Till date the species is reported from Uttarakhand, and hence can be considered endemic to this region (Joshi 2018).

**PLECTOCARPON Fée**

The genus is represented by 41 species of lichenicolous fungi throughout the world (Diederich *et al.* 2018, Joshi 2018) of which 03 and 02 are also reported from India and Uttarakhand, respectively (Joshi *et al.* 2016b;

2018).

**67) *Plectocarpon diedertianum* Y. Joshi,  
Upadhyay & Chandra**

**Host(s):** *Myelochroa aurulenta*

**Infected part:** thallus

**Lichen habitat:** corticolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of  
Uttarakhand:** Pithoragarh

**Notes:** Till date the species is reported from  
Uttarakhand, and hence can be considered  
endemic to this region.

**68) *Plectocarpon parmeliarum* Y. Joshi**

**Host(s):** *Parmelia meiophora*

**Infected part:** thallus

**Lichen habitat:** corticolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of  
Uttarakhand:** Uttarkashi

**Notes:** Till date the species is reported from  
Uttarakhand, and hence can be considered  
endemic to this region.

**POLYCOCCUM Körb.**

The genus is represented by 60 species of  
lichenicolous fungi throughout the world  
(Diederich *et al.* 2018) of which 07 and 05 are  
also reported from India and Uttarakhand,  
respectively (Zhurbenko 2007, 2013,  
Zhurbenko *et al.* 2015, Joshi 2018, Joshi *et al.*  
2016a, 2017a, 2018).

**69) *Polycoccum clauzadei* Nav.-Ros. & Cl. Roux**

**Host(s):** *Rusavskia elegans*

**Infected part:** thallus and apothecial disc

**Lichen habitat:** saxicolous

**Distribution in India:** Ladakh, Uttarakhand

**Distribution in various districts of  
Uttarakhand:** Chamoli, Pithoragarh

**70) *Polycoccum ochvarianum* Y. Joshi**

**Host(s):** *Ochrolechia androgyna*, *Pertusaria  
acuta*, *P. amarkantakana*, *P. coccodes*, *P.  
coronata*, *P. granulata*, *P. himalayensis*, *P.  
melastomella*, *P. neilgherrensis*, *P. pertusa*, *P.  
quassiae*, *P. rigida*, *P. splendens*, *P.  
subdepressa*, *P. subochracea*, *P. tuberculifera*,

*Varicellaria velata*

**Infected part:** thallus

**Lichen habitat:** corticolous

**Distribution in India:** Bihar, Himachal  
Pradesh, Kerala, Madhya Pradesh, Odisha,  
Tamil Nadu, Uttarakhand, Uttar Pradesh

**Distribution in various districts of  
Uttarakhand:** Chamoli, Dehradun, Nainital,  
Pithoragarh

**71) *Polycoccum peltigerae* (Fuckel) Vězda**

**Host(s):** *Peltigera canina*

**Infected part:** thallus

**Lichen habitat:** terricolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of  
Uttarakhand:** Bageshwar

**72) *Polycoccum pulvinatum* (Eitner) R.  
Sant.**

**Host(s):** *Physcia* sp., *P. stellaris*

**Infected part:** thallus and apothecial disc  
margin

**Lichen habitat:** corticolous, saxicolous

**Distribution in India:** Jammu & Kashmir,  
Uttarakhand

**Distribution in various districts of  
Uttarakhand:** Chamoli, Uttarkashi

**Notes:** The species was previously reported  
from Jammu & Kashmir (Zhurbenko 2013),  
and in the present study it is extending its  
distributional range in Uttarakhand.

**73) *Polycoccum tinantii* Diederich**

**Host(s):** *Gyalolechia flavorubescens*

**Infected part:** thallus

**Lichen habitat:** corticolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of  
Uttarakhand:** Nainital, Pauri Garhwal,  
Uttarkashi

**PYRENIDIUM Nyl.**

The genus is represented by 13 species of  
lichenicolous fungi throughout the world  
(Diederich *et al.* 2018, Joshi *et al.* 2018;  
Huanraluek *et al.* 2019) of which 04 and 02 are  
also reported from India and Uttarakhand,

respectively (Zhurbenko 2013, Joshi *et al.* 2016a, 2018).

**74) *Pyrenidium actinellum* Nyl.**

**Host(s):** *Diploschistes* sp., *Peltigera canina*, *P. elisabethae*, *P. praetextata*

**Infected part:** thallus

**Lichen habitat:** corticolous, saxicolous, terricolous

**Distribution in India:** Jammu & Kashmir, Uttarakhand

**Distribution in various districts of Uttarakhand:** Bageshwar, Chamoli

**75) *Pyrenidium* sp.**

**Diagnostic characters:** Vegetative hyphae numerous, brown. Ascomata perithecia, 60–140 × 55–150 µm, sessile to semi-immersed, black, with light greenish-blue tint in ostiolar channel. Peridium 6–15 µm wide. Hymenium hyaline, I-, KI-. Hamathecial filaments numerous, persistent. Asci 60–80 × 10–15 µm, 4(-6)-spored, subcylindrical, I-, KI+ red. Ascospores 15–18 × 5–9 µm, hyaline to brown, oblong to ellipsoidal, 3-septate, with tips or rarely whole end cells subhyaline. Conidiomata not seen.

**Host(s):** *Dimelaena oreina*

**Infected part:** thallus

**Lichen habitat:** saxicolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of Uttarakhand:** Chamoli

**Specimen examined:** India, Uttarakhand, Chamoli district, way to Niti, 10 Km before Niti, alt. 3118 m, on thallus of *Dimelaena oreina* colonizing rocks, 20 Aug. 2007, D.K. Upreti & S. Nayaka 07-010293 (LWG 12335).

**RHIZOCARPONDC.**

The genus is represented by 07 species of lichenicolous fungi throughout the world (Diederich *et al.* 2018) of which 01 is also reported from India and that too from Uttarakhand (Joshi *et al.* 2018).

**76) *Rhizocarpon ochrolechia* (Poelt &**

Nimis) Hafellner

**Host(s):** *Ochrolechia rosella*

**Infected part:** thallus

**Lichen habitat:** corticolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of Uttarakhand:** Uttarakashi

**Notes:** Till date the species is reported from Uttarakhand, and hence can be considered endemic to this region.

**RHYMBOCARPUS Zopf**

The genus is represented by 12 species of lichenicolous fungi throughout the world (Diederich *et al.* 2018) of which 01 is also reported from India and that too from Uttarakhand (Joshi *et al.* 2016a).

**77) *Rhymbocarpus pertusariae* Diederich, Zhurb. & Etayo**

**Host(s):** *Pertusaria leioplacella*

**Infected part:** thallus

**Lichen habitat:** corticolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of Uttarakhand:** Nainital

**Notes:** Till date the species is reported from Uttarakhand, and hence can be considered endemic to this region.

**ROSELLINIOPSIS Matzer & Hafellner**

The genus is represented by 07 species of lichenicolous fungi throughout the world (Diederich *et al.* 2018) of which 01 is also reported from Tamil Nadu and Uttarakhand states of India (Joshi *et al.* 2017a).

**78) *Roselliniopsis tartaricola* (Nyl. ex Leight.) Matzer**

**Host(s):** *Lepra amara*, *L. variolosa*

**Infected part:** thallus

**Lichen habitat:** corticolous

**Distribution in India:** Tamil Nadu, Uttarakhand

**Distribution in various districts of Uttarakhand:** Chamoli

**Notes:** The specimen from Tamil Nadu was wrongly identified as *Weddellomyces*



*periphericus* (Taylor) Alstrup & D. Hawksw. (Joshi *et al.* 2017a), hence, *W. periphericus* should be omitted from Indian checklist.

### **SCLEROCOCCUM Fr.**

The genus is represented by 60 species of lichenicolous fungi throughout the world (Diederich *et al.* 2018) of which 06 (excluding *S. sphaerale*) and 04 are also reported from India and Uttarakhand, respectively (Joshi *et al.* 2016a, 2018). The genera *Dactylospora* and *Sclerococcum* which represent teleomorphic and anamorphic stages, respectively, are monophyletic and the former genus *Dactylospora* in accordance to the results of molecular phylogenetic studies, have now been merged into *Sclerococcum* (Diederich *et al.* 2013, 2018; Pino-Bodas *et al.* 2017). The anamorphic stage (*Sclerococcum*) was given precedence over teleomorphic stage (*Dactylospora*), because *Sclerococcum* (1821) predates *Dactylospora* (1855) and Art. 57.2 was deleted in the new Shenzhen Code (ICN). Hence, previously reported *Dactylospora* species from India are now placed under *Sclerococcum*.

Note: *S. sphaerale* reported earlier from India (Joshi *et al.* 2016a) is being excluded in the present study.

### **79) *Sclerococcum homoclinellum* (Nyl.) Ertz & Diederich**

**Host(s):** *Lecanora fimbriatula*, *L. impudens*, *Protoparmeliopsis muralis*

**Infected part:** thallus

**Lichen habitat:** corticolous, saxicolous

**Distribution in India:** Himachal Pradesh, Madhya Pradesh, Uttarakhand

**Distribution in various districts of Uttarakhand:** Pithoragarh

**Notes:** The species was previously reported from Himachal Pradesh and Madhya Pradesh under the name *Dactylospora homoclinella* (Nyl.) Hafellner (Joshi *et al.* 2016a), and in the present study it is extending its distributional range in Uttarakhand.

### **80) *Sclerococcum saxatile* (Schaer.) Ertz & Diederich**

**Host(s):** *Pertusaria indica*, *P. leioplaca*, *P. pertusa*, *P. quassiae*

**Infected part:** thallus and apothecial disc

**Lichen habitat:** corticolous, saxicolous

**Distribution in India:** Jammu & Kashmir, Madhya Pradesh, Sikkim, Uttarakhand

**Distribution in various districts of Uttarakhand:** Almora

**Notes:** The species was previously reported from Jammu & Kashmir, Madhya Pradesh and Uttarakhand under the name *Dactylospora saxatilis* (Schaer.) Hafellner (Joshi *et al.* 2016a), and in the present study it is extending its distributional range in Sikkim.

### **81) *Sclerococcum simplex* D. Hawksw.**

**Host(s):** *Lepra albescens*, *L. amara*, *L. multipuncta*, *Ochrolechia subpallescens*, *O. yasudae* var. *corallina*, *Pertusaria coronata*, *P. leioplaca*, *P. melastomella*

**Infected part:** thallus, soredia and apothecial disc

**Lichen habitat:** corticolous

**Distribution in India:** Madhya Pradesh, Sikkim, Uttarakhand

**Distribution in various districts of Uttarakhand:** Bageshwar, Chamoli, Champawat, Dehradun, Pithoragarh, Uttarkashi

**Notes:** The species was previously reported from Sikkim and Uttarakhand (Joshi *et al.* 2016a), and in the present study it is extending its distributional range in Madhya Pradesh.

### **82) *Sclerococcum* sp.**

Diagnostic characters: Ascomata apothecia. 0.1–0.3(–0.4) mm diam., sessile to rarely constricted at base, black. Hymenium hyaline, (25–)35–50(–75) µm high. Epithymenium brown, (6–)10–15(–18) µm. Paraphyses septate, branched to anastomosed, 1–1.5 µm thick. Asci 8-spored, (28–)32.7–44(–50) × (9–)9.7–13.5(–15) µm. Ascospores ellipsoid, brown, 1-septate, 9–11(–12) × (3–)3.8–6.1(–7) × (3–)3.8–6.1(–7) µm.]

**Host(s):** *Dendriscosticta platyphylloides*, *D. wrightii*, *Sticta henryana*

**Infected part:** thallus and apothecial disc

**Lichen habitat:** corticolous, saxicolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of Uttarakhand:** Bageshwar, Tehri Garhwal

### ***SPHAERELLOTHECIUM* Zopf**

The genus is represented by 35 throughout the world (Diederich *et al.* 2018) of which 09 and 07 are also reported from India and Uttarakhand, respectively (Joshi *et al.* 2016a, 2018).

**83) *Sphaerellothecium atryneae* (Arnold) Cl. Roux & Triebel**

**Host(s):** *Protoparmeliopsis muralis*

**Infected part:** thallus

**Lichen habitat:** saxicolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of Uttarakhand:** Chamoli

**84) *Sphaerellothecium cladoniae* (Alstrup & Zhurb.) Hafellner**

**Host(s):** *Cladonia pyxidata*

**Infected part:** thallus

**Lichen habitat:** terricolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of Uttarakhand:** Bageshwar, Uttarkashi

**85) *Sphaerellothecium contextum* Triebel**

**Host(s):** *Omphalodina chrysoleuca*, *Rhizoplaca* sp.

**Infected part:** thallus

**Lichen habitat:** saxicolous

**Distribution in India:** Himachal Pradesh, Jammu & Kashmir, Ladakh, Uttarakhand

**Distribution in various districts of Uttarakhand:** Bageshwar, Chamoli, Uttarkashi

**Notes:** The species was previously reported from Uttarakhand (Joshi *et al.* 2016a), and in the present study it is extending its distributional range in Himachal Pradesh, Jammu & Kashmir and Ladakh.

**86) *Sphaerellothecium gallowayi* Diederich**

**Host(s):** *Heterodermia diademata*, *Polyblastidium hypocaesium*

**Infected part:** thallus

**Lichen habitat:** corticolous, saxicolous, terricolous

**Distribution in India:** Himachal Pradesh, Uttarakhand

**Distribution in various districts of Uttarakhand:** Pithoragarh, Uttarkashi

**87) *Sphaerellothecium parmeliae* Diederich & Etayo**

**Host(s):** *Parmelia meiophora*, *P. sulcata*

**Infected part:** thallus

**Lichen habitat:** corticolous, saxicolous, terricolous

**Distribution in India:** Himachal Pradesh, Uttarakhand

**Distribution in various districts of Uttarakhand:** Chamoli, Uttarkashi

**Notes:** The species was previously reported from Uttarakhand, and in the present study it is extending its distributional range in Himachal Pradesh.

**88) *Sphaerellothecium parmotremae* van den Boom**

**Host(s):** *Parmotrema crinitum*, *P. grayanum*, *P. kamatii*, *P. praesorediosum*, *P. reticulatum*

**Infected part:** thallus

**Lichen habitat:** corticolous, saxicolous, terricolous

**Distribution in India:** Himachal Pradesh, Kerala, Uttarakhand

**Distribution in various districts of Uttarakhand:** Chamoli, Nainital, Pauri Garhwal, Pithoragarh, Uttarkashi

**89) *Sphaerellothecium pumilum* (Lettau) Nav.-Ros., Cl. Roux & Hafellner**

**Host(s):** *Phaeophyscia ciliata*, *P. primaria*, *Physcia* sp., *P. albinea*, *P. caesia*, *P. gomukhensis*

**Infected part:** thallus

**Lichen habitat:** saxicolous, terricolous

**Distribution in India:** Himachal Pradesh,

Jammu & Kashmir, Sikkim, Uttarakhand  
**Distribution in various districts of Uttarakhand:** Bageshwar, Chamoli, Tehri Garhwal, Uttarkashi

**Notes:** The species was reported by Joshi *et al.* (2016a) under the name *Stigmidium pumilum* (Lettau) Matzer & Hafellner from Jammu & Kashmir, Sikkim, Uttarakhand, and is now extending its distribution in Himachal Pradesh.

#### **SPHINCTRINA Fr.**

The genus is represented by 09 throughout the world (Diederich *et al.* 2018) of which 03 are also reported from India including Uttarakhand (Awasthi & Singh 1975, Pant & Awasthi 1989, Joshi *et al.* 2015a, 2016a, 2018).

#### **90) *Sphinctrina anglica* Nyl.**

**Host(s):** *Lecanora interjecta*, *L. leprosa*

**Infected part:** thallus and apothecial disc

**Lichen habitat:** corticolous

**Distribution in India:** Tamil Nadu, Uttarakhand, Uttar Pradesh

**Distribution in various districts of Uttarakhand:** Pauri Garhwal

#### **91) *Sphinctrina leucopoda* Nyl.**

**Host(s):** *Pertusaria* sp.

**Infected part:** thallus

**Lichen habitat:** corticolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of Uttarakhand:** Champawat

#### **92) *Sphinctrina tubaeformis* A. Massal.**

**Host(s):** *Pertusaria* sp., *P. himalayensis*, *P. melastomella*, *P. rigida*

**Infected part:** thallus

**Lichen habitat:** corticolous

**Distribution in India:** Assam, Madhya Pradesh, Manipur, Tamil Nadu, Uttarakhand

**Distribution in various districts of Uttarakhand:** Almora, Chamoli, Champawat, Pauri Garhwal

**Notes:** The species was previously reported from Assam, Manipur, Tamil Nadu, Uttarakhand (Pant & Awasthi 1989, Joshi *et al.* 2015a), and in the present study it is extending

its distributional range in Madhya Pradesh.

#### ***SPIROGRAPHA* Zahlbr.**

The genus is represented by 05 throughout the world (Diederich *et al.* 2018) of which 01 is also known from Madhya Pradesh, Tamil Nadu and Uttarakhand states of India.

#### **93) *Spirographa fusisporella* (Nyl.) Zahlbr.**

**Host(s):** *Lecanora* sp., *Ochrolechia androgyna*

**Infected part:** thallus and apothecial disc

**Lichen habitat:** corticolous, saxicolous

**Distribution in India:** Madhya Pradesh, Tamil Nadu, Uttarakhand

**Distribution in various districts of Uttarakhand:** Champawat, Pauri Garhwal

**Notes:** Joshi *et al.* (2016a). misidentified and reported this species from Jammu & Kashmir colonizing thallus of *Protoparmeliopsis muralis*. However, while examining lichen specimens of *Lecanora* and *Ochrolechia androgyna* collected from Madhya Pradesh, Tamil Nadu, Uttarakhand, the authors encountered this species infecting the thallus and apothecial disc of above mentioned lichens.

#### ***STIGMIDIUM* Trevis.**

The genus is represented by 94 throughout the world (Diederich *et al.* 2018) of which 09 and 01 are also known from India and Uttarakhand, respectively (Joshi *et al.* 2016a, 2018).

#### **94) *Stigmidium cerinae* Cl. Roux & Triebel**

**Host(s):** *Rusavskia elegans*

**Infected part:** thallus and apothecial disc

**Lichen habitat:** saxicolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of Uttarakhand:** Chamoli

#### **TAENIOLELLAS. Hughes**

The genus is represented by 29 throughout the world (Diederich *et al.* 2018) of which 01 is also reported from India and that too from Uttarakhand (Joshi *et al.* 2018).

**95) *Taeniolella delicata* M.S. Christ. & D. Hawksw.**

**Host(s):** *Heterodermia* sp.

**Infected part:** thallus

**Lichen habitat:** corticolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of Uttarakhand:** Pithoragarh.

**TETRAMELAS** Norman

The genus is represented by 02 throughout the world (Diederich *et al.* 2018) of which 01 is also reported from India and that too from Ladakh and Uttarakhand (Joshi *et al.* 2018)

**.96) *Tetramelas pulverulentus* (Anzi) A. Nordin & Tibell**

**Host(s):** *Phycia* sp., *P. dubia*, *P. gomukhensis*, *P. stellaris*

**Infected part:** thallus

**Lichen habitat:** corticolous, saxicolous

**Distribution in India:** Ladakh, Uttarakhand

**Distribution in various districts of Uttarakhand:** Chamoli, Uttarkashi

**TREMELLA** Pers.

The genus is represented by 60 throughout the world (Diederich *et al.* 2018) of which 05 and 04 are also reported from India and Uttarakhand, respectively (Joshi 2018, Joshi *et al.* 2018).

**97) *Tremella cladoniae* Diederich & M.S. Christ.**

**Host(s):** *Cladonia pyxidata*, *C. subradiata*

**Infected part:** thallus

**Lichen habitat:** corticolous, saxicolous

**Distribution in India:** Himachal Pradesh, Uttarakhand

**Distribution in various districts of Uttarakhand:** Uttarkashi

**98) *Tremella everniae* Diederich**

**Host(s):** *Evernia mesomorpha*

**Infected part:** thallus

**Lichen habitat:** corticolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of Uttarakhand:** Uttarkashi

**99) *Tremella parmeliarum* Diederich**

**Host(s):** *Parmotrema* sp., *P. reticulatum*

**Infected part:** thallus

**Lichen habitat:** corticolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of Uttarakhand:** Almora, Champawat

**100) *Tremella phaeophysciae* Diederich & M.S. Christ.**

**Host(s):** *Phaeophyscia* sp.

**Infected part:** thallus

**Lichen habitat:** corticolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of Uttarakhand:** Pauri Garhwal

**Verrucula** J. Steiner

The genus is represented by 22 species throughout the world (Diederich *et al.* 2018) of which 01 is also reported from India and that too from Uttarakhand.

**101) *Verrucula latericola* (Erichsen) Nav.-Ros. & Cl. Roux**

**Host(s):** *Calogaya saxicola*

**Infected part:** thallus

**Lichen habitat:** saxicolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of Uttarakhand:** Chamoli

**Notes:** The species was reported by Joshi *et al.* (2018) from Uttarakhand under the name *Verrucaria latericola* Erichsen

**ZWACKHIOMYCES** Grube & Hafellner

The genus is represented by 35 species throughout the world (Diederich *et al.* 2018) of which 07 and 03 are reported from India and Uttarakhand, respectively (Zhurbenko 2013; Joshi 2018, Joshi *et al.* 2016a, 2018).

**102) *Zwackhiomyces coepulonus* (Norman) Grube & R. Sant.**

**Host(s):** *Caloplaca* sp., *Variospora flavescens*

**Infected part:** thallus and apothecial disc

**Lichen habitat:** saxicolous

**Distribution in India:** Himachal Pradesh, Ladakh, Uttarakhand

**Distribution in various districts of Uttarakhand:** Chamoli



*Rhizocarpon ochrolechia*, *Sclerococcum simplex*, *Spirographa fusisporella*

**Omphalodina species:** *Arthonia clemens*, *Cercidospora melanophthalmae*, *Didymocyrtis rhizoplacae*, *Lichenocodium lecanorae*, *Sphaerellothecium contextum*

**Oxneriaria species:** *Lichenothelia convexa*

**Parmelia species:** *Abrothallus parmeliarum*, *Homostegia piggotii*, *Plectocarpon parmeliarum*, *Sphaerellothecium parmeliae*

**Parmotrema species:** *Echinothecium reticulatum*, *Opegrapha melanospila*, *Sphaerellothecium parmotremae*, *Tremella parmeliarum*

**Peltigera species:** *Bacidia killiasii*, *Corticifraga peltigerae*, *Lasiosphaeriopsis salisburyi*, *Phoma peltigerae*, *Polycoccum peltigerae*, *Pyrenidium actinellum*

**Pertusaria species:** *Buelliella minimula*, *Lichenodiplis lecanorae*, *Melaspilea insitiva*, *Muellerella erratica*, *Opegrapha anomea*, *Polycoccum ochvarianum*, *Rhymbocarpus pertusariae*, *Sclerococcum saxatile*, *Sclerococcum simplex*, *Spirographa fusisporella*, *Sphinctrina leucopoda*, *Sphinctrina tubaeformis*

**Phaeophyscia species:** *Arthonia phaeophysciae*, *Opegrapha phaeophysciae*, *Sphaerellothecium pumilum*, *Tremella phaeophysciae*

**Physcia species:** *Arthonia epiphyscia*, *Endococcus physciae*, *Heterocephalacria physciacearum*, *Lichenocodium usneae*, *Polycoccum pulvinatum*, *Sphaerellothecium pumilum*, *Tetramelas pulverulentus*, *Zwackhiomyces physciicola*

**Pleospidium species:** *Arthonia ayseniae*, *Muellerella erratica*

**Polyblastidium species:** *Heterocephalacria physciacearum*, *Opegrapha foreaui*, *Sphaerellothecium gallowayi*

**Porpidia species:** *Endococcus propinquus*, *Lichenodiplis lecanorae*

**Protoparmeliopsis species:** *Buelliella protoparmeliopsis*, *Carbonea aggregantula*, *Muellerella erratica*, *Sclerococcum homoclinellum*, *Sphaerellothecium atryneae*

**Psora species:** *Muellerella lichenicola*

**Punctelia species:** *Homostegia hertelii*

**Ramalina species:** *Lichenostigma maureri*, *Llimoniella ramalinae*

**Rhizocarpon species:** *Lichenodiplis lecanorae*, *Muellerella ventosicola*

**Rhizoplaca species:** *Cercidospora melanophthalmae*, *Muellerella erratica*, *Sphaerellothecium contextum*

**Rinodina species:** *Lichenodiplis lichenicola*

**Rusavskia species:** *Cercidospora caudata*, *Cercidospora xanthoriae*, *Lichenocodium xanthoriae*, *Lichenodiplis lecanorae*, *Muellerella erratica*, *Muellerella lichenicola*, *Polycoccum clauzadei*, *Stigmidium cerinae*

**Silobia species:** *Bellemerella acarosporae*

**Sticta species:** *Sclerococcum* sp.

**Umbilicaria species:** *Clypeococcum grossum*

**Usnea species:** *Biatoropsis minuta*, *Lichenostigma maureri*

**Variospora species:** *Zwackhiomyces coepulonus*

**Vulpicida species:** *Abrothallus peyritschii*

**Xanthoparmelia species:** *Lichenostigma cosmopolites*, *Nesolechia oxyspora* var. *fusca*

## DISCUSSION

Based on the revised herbarium specimens, fresh field collections and reliable literature records, a total of 100 lichenicolous fungi (the anamorph with its teleomorph are counted as one taxon) and 04 lichenicolous lichens belonging to 51 genera hosted by 117 different lichen species from 11 districts of Uttarakhand (excluding Haridwar and Udham Singh Nagar) (Fig 1), three unidentified specimens of *Clypeococcum* sp. (on *Dendriscosticta praetextata*), *Pyrenidium* sp. (on *Dimelaena oreina*) and *Sclerococcum* sp. (on *Dendriscosticta platyphylloides*, *D. wrightii* and *Sticta henryana*), 1 new record for the country viz. *Llimoniella ramalinae* and 10 regional records viz. *Abrothallus parmeliarum*, *Abrothallus peyritschii*, *Endococcus rugulosus*, *Lichenocodium usneae*, *Lichenostigma maureri*, *Opegrapha foreaui*, *Polycoccum pulvinatum*, *Sclerococcum homoclinellum*, *Spirographa fusisporella* and

**Notes:** The species was previously reported from Ladakh (Zhurbenko 2013), and in the present study it is extending its distributional range in Himachal Pradesh and Uttarakhand.

**103) *Zwackhiomyces physciicola* Alstrup**

**Host(s):** *Physcia gomukhensis*

**Infected part:** thallus

**Lichen habitat:** saxicolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of Uttarakhand:** Uttarkashi

**104) *Zwackhiomyces sphinctrinoides* (Zwackh) Grube & Hafellner**

**Host(s):** *Lecanora* sp.

**Infected part:** thallus

**Lichen habitat:** corticolous

**Distribution in India:** Uttarakhand

**Distribution in various districts of Uttarakhand:** Nainital

**HOST INDEX**

Notes: It should always be kept in mind that any lichenicolous fungus listed under a genus could possibly occur on many species in the genus and should be eliminated when making a determination. Hence, herewith we are providing the list of host genera occurring in Uttarakhand which are infected by various lichenicolous fungi.

***Acarospora* species:** *Bellemerella acarosporae*, *Lichenodiplis lecanorae*, *Muellerella erratica*

***Amundsenia* species:** *Cercidospora caudata*, *Intralichen christiansenii*

***Aspicilia* species:** *Endococcus propinquus*, *Lichenothelia convexa*, *Monerolechia badia*

***Brigantiaea* species:** *Opegrapha briganteae*

***Calogaya* species:** *Muellerella lichenicola*, *Verrucula latericola*

***Caloplaca* species:** *Cercidospora caudata*, *Cercidospora epicarphinea*, *Lichenodiplis lecanorae*, *Muellerella lichenicola*, *Zwackhiomyces coepulonus*

***Candelaria* species:** *Intralichen lichenicola*

***Catilaria* species:** *Muellerella lichenicola*

***Circinaria* species:** *Lichenothelia convexa*, *Monerolechia badia*

***Cladonia* species:** *Bachmanniomyces punctum*, *Diploschistes muscorum*, *Sphaerellothecium cladoniae*, *Tremella cladoniae*

***Dendriscosticta* species:** *Clypeococcum* sp., *Sclerococcum* sp.

***Dimelaena* species:** *Pyrenidium* sp.

***Diploschistes* species:** *Pyrenidium actinellum*

***Emodomelanelia* species:** *Abrothallus parmiliarum*

***Evernia* species:** *Tremella everniae*

***Flavoparmelia* species:** *Abrothallus microspermus*, *Arthonia coronata*, *Echinothecium reticulatum*, *Homostegia hertelii*, *Lichenocodium usneae*

***Graphis* species:** *Buelliella minimula*

***Gyalolechia* species:** *Buelliella inops*, *Muellerella lichenicola*, *Opegrapha gyalolechia*, *Polycoccum tinantii*

***Heterodermia* species:** *Epicladonia heterodermiae*, *Heterocephalacria physciacearum*, *Opegrapha foreau*, *Sphaerellothecium gallowayi*, *Taeniolella delicata*

***Lecanora* species:** *Buelliella lecanorae*, *Carbonea aggregantula*, *Carbonea assimilis*, *Didymocyrtis bryonanthae*, *Lawalreea lecanorae*, *Lichenodiplis lecanorae*, *Monodictys cellulosa*, *Muellerella lichenicola*, *Sclerococcum homoclinellum*, *Sphinctrina anglica*, *Spirographa fusisporella*, *Zwackhiomyces sphinctrinoides*

***Lecidella* species:** *Endococcus propinquus*

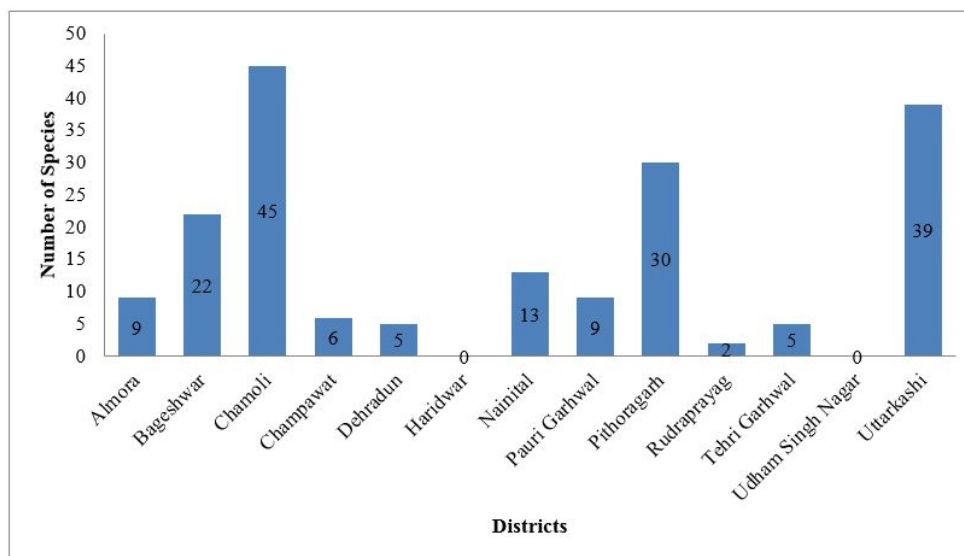
***Lepora* species:** *Buelliella minimula*, *Caeruleoconidia ochrolechia*, *Opegrapha anomea*, *Roselliniopsis tartaricola*, *Sclerococcum simplex*

***Lobothallia* species:** *Intralichen christiansenii*, *Lichenostigma elongatum*

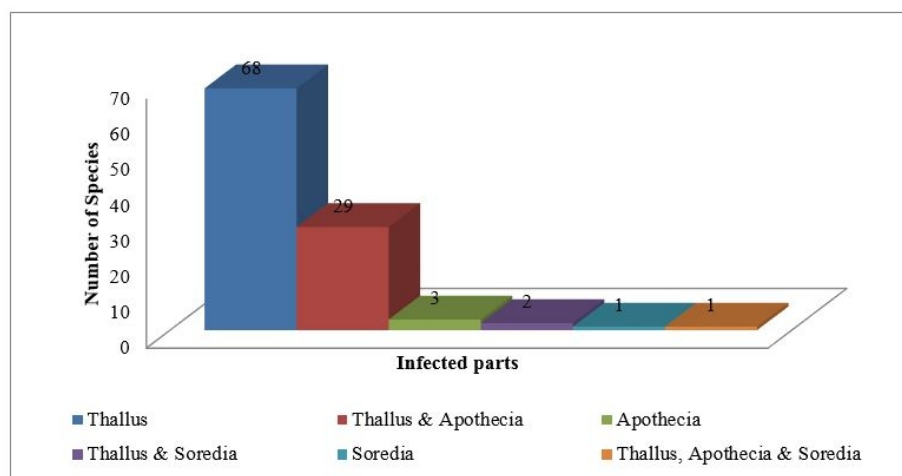
***Melanohalea* species:** *Didymocyrtis consimilis*

***Myelochroa* species:** *Plectocarpon diedertianum*

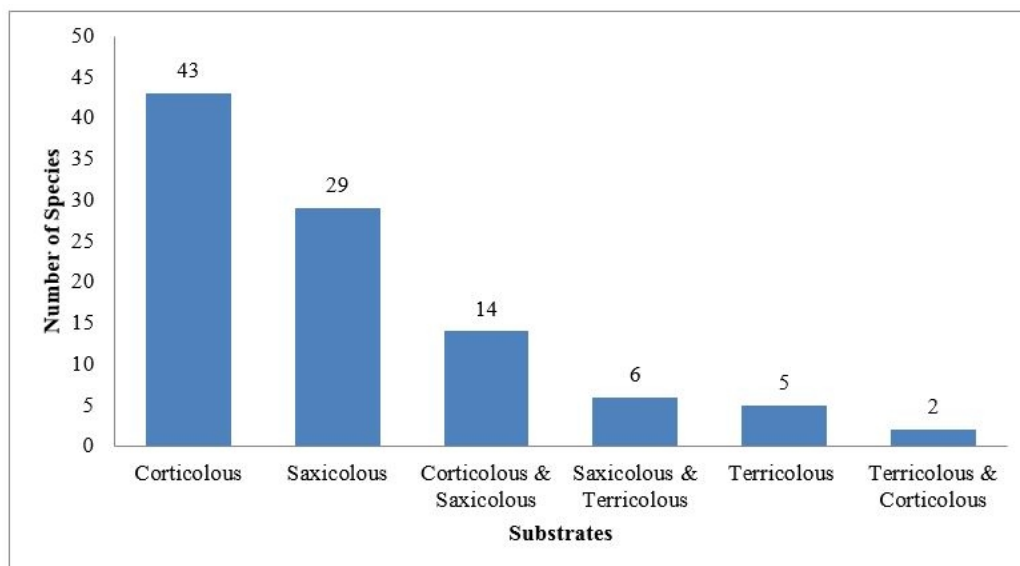
***Ochrolechia* species:** *Buelliella minimula*, *Caeruleoconidia ochrolechia*, *Lichenodiplis lecanorae*, *Polycoccum ochvarianum*,



**Graph 1:** Number of lichenicolous fungi species in different districts of Uttarakhand



**Graph 2:** Infected part of lichens by lichenicolous fungi of Uttarakhand



**Graph 3:** Number of lichenicolous fungi species colonizing various substrates

*Zwackhiomyces coepulonus* are currently accepted in Uttarakhand, making it one of the best studied areas in India regarding lichenicolous mycobiota. Besides this, 26 species (including five species from Uttarakhand) are extending their distributional range in India viz. *Arthonia epiphyscia*, *Arthonia phaeophysciae*, *Buelliella lecanorae*, *Carbonea aggregantula*, *Cercidospora xanthoriae*, *Echinothecium reticulatum*, *Heterocephalacria physciacearum*, *Lasiosphaeriopsis salisburyi*, *Lichenodiplis lecanorae*, *Lichenothelia convexa*, *Monerolechia badia*, *Muellerella erratica*, *Muellerella lichenicola*, *Sclerococcum saxatile*, *Sphaerellothecium parmeliae*, *Sphaerellothecium pumilum*, *Sclerococcum simplex*, *Sphinctrina tubaeformis*, *Spiroa fusisporella* and *Zwackhiomyces coepulonus*.

Lichenicolous fungi *Sphaerellothecium* and *Opegrapha* were speciose rich genera and were represented by 7 and 6 species, respectively in Uttarakhand. As far as best host genera is considered, then it was *Lecanora* and *Pertusaria* which were being infected by 12 lichenicolous fungi, followed by *Rusavskia* and *Physcia* (8 each), *Ochrolechia* (7), *Peltigera* (6), and so on (see host index). Maximum 46 species of lichenicolous fungi were reported from Chamoli district, followed by Uttarkashi (40), Pithoragarh (30), Bageshwar (22), Nainital (12), Almora and Pauri Garhwal (9 each), Champawat (6), Dehradun and Tehri Garhwal (5 each) and Rudraprayag (2) colonizing thallus, apothecia and soredia of various corticolous, saxicolous and terricolous lichens (Fig. 2 & 3).

In addition, *Cladospodium licheniphilum* Heuchert & U. Braun reported colonizing thallus of *Xanthoria candelaria* from Jammu & Kashmir (Zhurbenko 2013) is misidentified by Joshi *et al.* (2016a) colonizing thallus of *Pertusaria* sp. from Uttarakhand, hence is being excluded from Uttarakhand's checklist.

## CONCLUSION

This checklist adds some new records of lichenicolous biota not only to India but also for Uttarakhand and establishes a baseline for further studies on this diverse guild of fungi. Due to the small number of collections and collectors of lichenicolous fungi in India, we have no clear idea of the distribution of these species in Uttarakhand or the country as a whole. This can also be justified by the fact that despite long history of lichenological studies in Uttarakhand, only 07 species of lichenicolous fungi are described as new to science from this region. The finding of such a huge number of lichenicolous fungi, including some taxa possibly unknown to science, shows that the diversity of lichenicolous fungi in the region is still far from being revealed.

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## REFERENCES

- Alstrup V and Ahti T 2007 New reports of lichenicolous fungi, mainly from Finland and Russia. *Karstenia* **47** 1–4.
- Awasthi 1991 *A key to the microdichens of India, Nepal and Sri Lanka* (Bibliotheca Lichenologica, Band 40)
- Awasthi DD and Singh KP 1975 Additions to the lichen flora of India – III. *Geophytology* **5** 110–112.



- Yogesh Joshi, Pradeep Kumar, Arjun Lal Yadav and Niranjan Suda
- Coppins BJ and Kondratyuk SY 1998 *Opegrapha trassii* sp. nov., a new lichenicolous fungus on *Heterodermia*. *Folia Cryptogamica Estonica* **32** 9–14.
- Diederich P and Ertz D 2018 Lectotypification of *Plectocarpon diedertianum* (Arthoniales). *Herzogia* **31** 322–326.
- Diederich P, Ertz D, Lawrey JD, Sikaroodi M and Untereiner WA 2013 Molecular data place the hyphomycetous lichenicolous genus *Sclerococcum* close to *Dactylospora* (Eurotiomycetes) and *S. parmeliae* in *Cladophialophora* (Chaetothyriales). *Fungal Diversity* **58** 61–72.
- Diederich P, Lawrey JD and Ertz D 2018 The 2018 classification and checklist of lichenicolous fungi, with 2000 non lichenized, obligately lichenicolous taxa. *The Bryologist* **121** 340–425.
- Hawksworth D L and Rossman A Y 1997 Where are all the undescribed fungi? phytopathology **87** 888–891
- Hariharan GN, Mibey RK and Hawksworth DL 1996 A new species of *Lichenopeltella* on *Porina* in India. *The Lichenologist* **28** 294–296.
- Hertel H 1983 Über einige aus *Lecidea* und *Melanolecia* (Ascomycetes, Lichenisati) auszuschliessende Arten. *Mitteilungen der Botanischen Staatssammlung München* **19** 441–447.
- Huanraluek N, Ertz D, Phukhamsakda C, Hongsanan S, Jayawardena RS and Hyde KD 2019 The family *Pyrenidiaceae* resurrected. *Mycosphere* **10**(1) 634–654.
- Joseph S and Sinha GP 2015 The lichenicolous species of *Melaspilea* (Melaspileaceae) in India. *Taiwania* **60**(1) 18–22.
- Joshi S, Upreti DK and Nayaka S 2013 A new lichenicolous *Arthonia* species (Arthoniaceae) on *Diorygma* from India. *The Lichenologist* **45** 323–327.
- Joshi Y 2018 Documentation of lichenicolous fungi from India - Some additional reports. *Kavaka* **51** 30–34.
- Joshi Y, Upadhyay S, Shukla S, Nayaka S and Rawal RS 2015a New records and an updated checklist of lichenicolous fungi from India. *Mycosphere* **6**(2) 195–200.
- Joshi Y, Upadhyay S, Tripathi M and Chandra K 2015b First report of a lichenicolous fungus *Opegrapha phaeophysciae* from India. *Kavaka* **44** 50–52.
- Joshi Y, Falswal A, Tripathi M, Upadhyay S, Bisht A, Chandra K, Bajpai R and Upreti DK 2016a One hundred and five species of lichenicolous biota from India: An updated checklist for the country. *Mycosphere* **7**(3) 268–294.
- Joshi Y, Upadhyay S, Chandra K, Bisht K and Falswal A 2016b New species of *Plectocarpon* (Roccellaceae, lichenised ascomycetes) from India. *Acta Botanica Hungarica* **58**(3–4) 257–264.
- Joshi Y, Falswal A, Bajpai R and Upreti DK 2016c A new species of *Didymocyrtis* (*Phaeosphaeriaceae*, *Ascomycetes*) growing on *Thamnolia vermicularis* from India. *Kavaka* **46** 27–29.
- Joshi Y, Falswal A and Halda JP 2017a *Polycoccum ochvarianum* – a new species of Dothideomycetes from India. *Sydowia* **69** 147–151.
- Joshi Y, Falswal A and Joshi R 2017b A new species of lichenicolous fungus *Epicladonia* from India. *Kavaka* **48** 42–43.
- Joshi Y, Falswal A, Tripathi M and Halda JP 2017c *Lichenodiplis ochrolechia*, a new species of lichenicolous fungi from India.

*Sydowia* **69** 19–22.

Joshi Y, Tripathi M, Bisht K, Upadhyay S, Kumar V, Pal N, Gaira A, Pant S, Rawat KS, Bajpai R and Halda JP 2018 Further contributions to the documentation of lichenicolous fungi from India. *Kavaka* **50** 26–33.

Kocourková J, Knudsen K and Tucker S 2012 A checklist of the lichenicolous biota of California. *Opuscula Philolichenum* **11** 64–103.

Millanes AM, Diederich P, Westberg M and Wedin M 2016 Three new species in the *Biatoropsis usnearum* complex. *Herzogia* **29** 337–354.

Moreau F 1951a Sur une Dothidéacée parasite du Lichen *Anaptychia speciosa* (Wulfen) Massalongo. *Bulletin of the Botanical Society France* **98** 7–9.

Moreau F 1951b Un champignon lichenicole cecidogene, *Phyllosticta galligena*, sp. nov. *Bulletin of the Botanical Society France* **98** 100–102.

Pant G and Awasthi DD 1989 Caliciales from India and Nepal. *Biovigyanam* **15** 3–27.

Pino-Bodas R, Zhurbenko MP and Stenroos S 2017 Phylogenetic placement within Lecanoromycetes of lichenicolous fungi associated with *Cladonia* and some other genera. *Persoonia* **39** 91–117.

Poelt J 1961 Flechten aus dem N.W. Karakorum in Rahmen der Duetschen Karakorum expedition 1959, von F. Lobbichler und Dr. Schneider gesammelt. *Mitteilungen der Botanischen Staatssammlung München* **4** 83–94.

Rairkar S and Patwardhan PG 1979 *Didymosphaeria peltigerae* Fuck. - a lichen parasite from south India. *Current Science* **48(23)** 1048

Sherwood MA, Hawksworth DL and Coppins BJ 1981 *Skyttea*, a new genus of odontotremoid lichenicolous fungi. *Transactions of the British Mycological Society* **75** 479–490.

Shivarov VV 2019 *Clypeococcum hemiamyloideum* (Polycoccaceae, Ascomycota), a novel lichenicolous fungus on *Verrucaria latebrosa*. *Herzogia* **32** 438–443.

Singh P and Singh KP 2018 *Buelliella indica* (Dothideomycetes), a new lichenicolous species from India. *Acta Botanica Hungarica* **61(3–4)** 435–439.

Singh P, Singh KP and Joshi Y 2017 A new lichenicolous species of *Melaspilea* Nyl. (Arthoniales: Roccellaceae) from India. *Acta Botanica Hungarica* **59** 439–443

Triebel D 1989 Lecideicole Ascomyceten. Eine Revision der obligat lichenicolen Ascomyceten auflecidoiden Flechten. *Bibliotheca Lichenologica* **35** 1–278.

Zhurbenko MP. 2007– Lichenicolous fungi of Russia: history and first synthesis of exploration. *Mikologiya i Fitopatologiya* **41** 481–486.

Zhurbenko MP 2013 A first list of lichenicolous fungi from India. *Mycobiota* **3** 19–34.

Zhurbenko MP, Enkhtuya O and Javkhlan S 2019 A first synopsis of lichenicolous fungi of Mongolia, with the description of five new species. *Plant and Fungal Systematics* **64(2)** 345–366.

Zhurbenko MP, Frisch A, Ohmura Y and Thor G 2015 Lichenicolous fungi from Japan and Korea: new species, new records and a first synopsis for Japan. *Herzogia* **28** 762–789.