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Checklist of microlichens in Bolampatti II Forest Range (Siruvani Hills), Western Ghats, Tamil Nadu, India

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A checklist of 137 microlichen species is provided based on the identification of specimens collected from three different vegetation types within the Bolampatti II Forest range (Siruvani Hills), Western Ghats. The dominant family is *Porinaceae* with 23 species. The dominant genus is *Porina* with 21 species. The diversity (87) and number of specific species (31) are highest at the Moist Mixed Deciduous Forest (MMDF) type, while there are about 30 lichen species common to all three different forest types studied. A total of 58 lichen species are new to this area. Study on habitat preferences of the lichens showed that most lichens grow on bark (75 %), followed by rock and leaf substrata. Concerning photobiont distribution, most *Trebouxia* containing lichens were found in the Dry Mixed Deciduous Forest (DMDF), while *Trentepohlia* is most frequent in MMDF. The presented number and types of lichens, and their ecological preferences will be a basis for conducting their future conservation and biomonitoring studies in various habitats of India.

Key words: microlichen diversity, substratum, forest types, photobiont, conservation, Western Ghats.

Balaji P., Hariharan G.N. (2013): Checklist korovitých lišejníků pohoří Siruvani Hills (Bolampatti II Forest Range) v Západním Ghátu, stát Tamil Nadu, Indie. – Czech Mycol. 65(2): 219–232.

Článek předkládá checklist 137 druhů korovitých lišejníků, sebraných ve třech odlišných vegetačních typech v oblasti Bolampatti II Forest range (Siruvani Hills). Nejpočetnější čeledí je zde *Porinaceae* (23 druhy), nejpočetnějším rodem je právě *Porina* s 21 druhy. Vlhký listnatý les (MMDF) je nejbohatším biotopem z hlediska celkové diverzity (87 druhů) i počtu druhů jedinečných pro tento lesní typ (31). Naproti tomu 30 druhů lišejníků se běžně vyskytuje ve všech třech lesních typech, kde probíhal výzkum. Celkem 58 druhů lišejníků je nových pro toto území. Studium substrátových preferencí ukázalo, že nejvíce lišejníků roste na kůře dřevin (75 %), méně pak na skalách nebo listech. Zajímavé srovnání ukazuje rozšíření fotobiontů – nejvíce druhů obsahujících řasy z rodu *Trebouxia* bylo nalezeno v suchém listnatém lese (DMDF), zatímco *Trentepohlia* je nejčastějším fotobiontem ve vlhkém lese (MMDF). Prezentovaný počet druhů a zastoupení různých typů lišejníků spolu s jejich ekologickými preferencemi bude základem pro budoucí ochranu těchto organismů, stejně jako pro biomonitoring v různých biotopech Indie.

INTRODUCTION

Lichens are important components of terrestrial ecosystems, yet they remain largely understudied. Tropical forests, because of their complexity and variety of microhabitats, usually harbour a rich diversity of lichens. Even though they are often small and inconspicuous, especially in lowland forests, they may play a significant role in the forest ecosystem (Gradstein 1992). Lichens are an outstandingly successful group of symbiotic organisms exploiting a wide range of habitats throughout the world**.** It is estimated there are about 20,000 species of lichen in the world (Sipman & Aptroot 2001, Nayaka et al. 2003), while a total of approximately 2305 species in 305 genera and 74 families occur on various substrata in tropical, subtropical, temperate and alpine regions of India (Singh & Sinha 2010, Nayaka & Upreti 2011).

India is endowed with a rich lichen flora on account of its varied climatic and topographic conditions. The Himalayas in the North (Kumar et al. 2012, Negi & Upreti 2000), the Western and Eastern Ghats (Nayaka et al. 2013, Hariharan et al. 2004) in coastal regions, tropical humid rain forests in the East, the Andaman and Nicobar Islands in the Bay of Bengal, and the Sal forests in Central India offer congenial habitats for the growth of a variety of lichens (Singh & Sinha 2010). Most of them are neoendemics from the group of crustose lichens, described mostly from the Western Ghats and the Andaman and Nicobar Islands.

Although most of the lichenological explorations were undertaken in lichen-rich regions such as the Himalayas and Western Ghats (Nilgiri and Palni Hills) (Singh & Sinha 2010, Nayaka & Upreti 2011, Nayaka et al. 2013), they merely resulted in a checklist of lichens of these regions and not much work was done on community ecology, ecological preferences of lichen species, forest types and distribution patterns of lichens. While systematic studies on lichens have been carried out for several decades, investigations into their community ecology have only recently begun (Negi & Gadgil 1996, Negi 2000, Negi & Upreti 2000, Balaji & Hariharan 2004, Balaji & Hariharan 2005, Balaji & Hariharan 2013, Awasthi & Ahti 2007, Pinokiyo et al. 2008). Recently, the macrolichen diversity of the Siruvani Hills was studied with reference to its distribution pattern in different forest types. The study resulted in a total number of 103 macro lichen species in 27 genera in 9 families in 3 fungal orders recorded for the Siruvani Hills. The largest genus was *Usnea* with 15 species, followed by *Heterodermia* and *Parmotrema* with 13 species each (Balaji & Hariharan 2013). Even though large-scale ecological studies of lichen communities provide us with a good indication of ecological preferences of lichen species, there is still a large space for identifying a functional group of sensitive lichens which can be used as indicators of ecosystem functioning in Indian habitats (Rai et al. 2012). Hence we report the microlichen diversity of Bolampatti II Forest Range (Siruvani Hills), Western Ghats. The primary objective of this paper is to enumerate the microlichens and their distribution in different types of forest in the Bolampatti II Forest Range.

MATERIAL AND METHODS

S t u d y a r e a. Bolampatti II Forest Range (Siruvani Hills), Coimbatore District, Tamil Nadu, Western Ghats (76°33' to 76°46' E and 10°54' to 11°02' N), is a part of the Nilgiri Biosphere Reserve, and Western Ghats is considered to be one of the biodiversity hotspots of the world (Fig. 1). The study site is located west of the town of Coimbatore and north of the Walayar valley. It has the shape of a horse-shoe opening eastwards, and covers an area of 197.66 sq km. The Bolampatti valley consists of vegetation types at lower to higher altitudes, such as Southern Dry Mixed Deciduous Forest (DMDF – abbreviation for the forest type; 5A/C3 – type number according to Champion & Seth 1968), Southern Moist Mixed Deciduous Forest (MMDF; 3B/C2), and Southern Hilltop Tropical Evergreen Forest (HTEF; 1A/C3). This valley drains eastwards into the Noyilar and its tributaries. The elevation ranges from 458 m (Noyilar Base) to 1,986 m on Periyakunjiramalai in the south-western corner, and 1,800 m on Vellingiri peak in the northwest. This hill receives a rainfall of 750–2000 mm from the North East Monsoon during September to November, with a dry period of six months (December–May). The temperature ranges from 10 to 22 °C during December to January and 35 to 43 °C during March

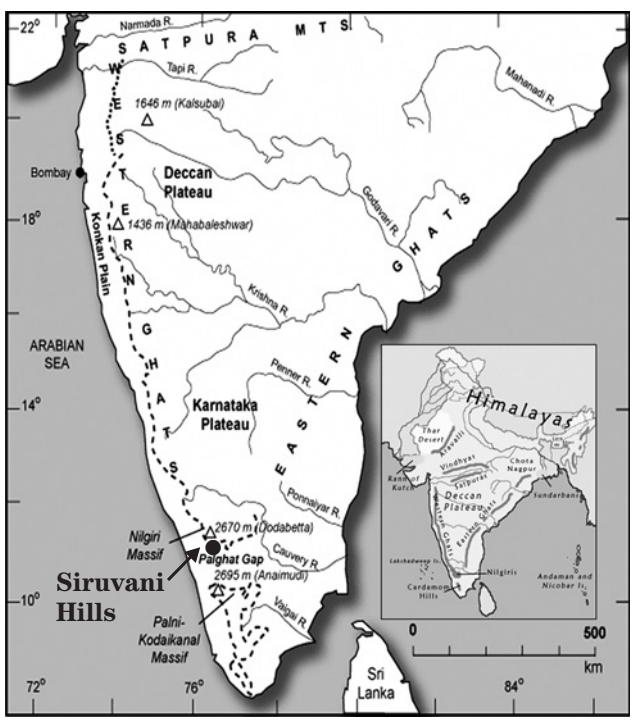

Fig. 1. Map of Bolampatti II Forest Range (Siruvani Hills), Western Ghats showing surveyed area.

to May. The older rock is Precambrian in origin with formation of mainly Charnokite and Nilgiri gneiss. The soil is mainly of the red type in the hills. The foothills generally have sandy loamy soils. The Vellingiri peak is barren and rocky (Wilson 1967).

Specimen collection and identification. Lichen samples (approximately 2000 specimens) were collected from various vegetation types, viz. DMDF, MMDF and HTEF, during 2000–2005 by the authors, based on ocular survey, on all possible lichen-substrates such as tree bark, rocks, leaves and soil. Lichens on fallen twigs were collected since they represent the species that occur in the canopy. Each sample was given a field number. The specimens were dried and incorporated into a reference collection preserved in the Lichen Ecology and Bioprospecting Laboratory, M.S. Swaminathan Research Foundation (MSSRF), Chennai. The specimens were identified based on internal and external morphological, reproductive and chemical features following recent literature (Awasthi 1991, Upreti 1991, 1992, Harris 1995, Huneck & Yoshimura 1996, Aptroot 2002, 2003, Ertz et al. 2009, Lumbsch & Huhndorf 2010, Lücking 2000). Lichen taxa are arranged according to the systematic arrangement provided in Index Fungorum (www.indexfungorum.org). For each lichen species treated its distribution with respect to altitude range, forest type and substratum preferences (presence of species indicated by a symbol +) were provided.

RESULTS AND DISCUSSION

Lichen diversity in Siruvani Hills

A total of 137 species of microlichens in 49 genera in 33 families were recorded in the Siruvani Hills (Tab. 1). Out of 33 families of lichens, *Porinaceae* (23 species) is the largest family followed by *Thelotremataceae* and *Lecanoraceae* with 12 species each and 13 families are represented by a single species. The largest genus was *Porina* with 21 species, followed by *Lecanora* and *Pertusaria* with 11 species each and *Myriotrema* with 10 species. Thirty genera had just one. We have compared our lichen diversity investigation with the lichens of Sahyadri (Nayaka & Upreti on-line) for species new to this area. The results show that about 58 lichen species were found to be records new to this area (marked by an asterisk in Tab. 1). Among the forest types studied, MMDF contained 87 lichen species, followed by DMDF with 76, and HTEF with 71 species, in which 22 lichen species were specific to DMDF, while 30 to MMDF and 18 to HTEF. Thirty lichen species were common to all the forest types. Fourteen species were shared by DMDF and MMDF, while 10 species by DMDF and HTEF, and 13 species by MMDF and HTEF.

Most lichens (75 %) recorded were colonised bark (corticolous), followed by rock (saxicolous, 17 %) and leaf substrates (foliicolous, 8 %). Bark-colonising lichen species were most frequent in MMDF (39.5 %), followed by HTEF (30.5 %) and DMDF (30 %). Rock colonising lichens were most frequent in DMDF (49 %), followed by MMDF (31 %) and HTEF (20 %). Leaf-colonising lichens were most frequent in HTEF (45.4 %) followed by both MMDF and DMDF with 27.3 % each.

The highest diversity of corticolous (bark-colonising) lichens found in the MMDF type can be attributed to the availability of different kind of bark substrate and a greater number of microhabitats at middle elevations (Negi & Upreti 2000) than the other forest types studied. Apart from the substrate, naturally other factors such as altitude range (Negi & Upreti 2000) and humidity (moisture level) also contribute to the high number of corticolous lichen diversity in MMDF. A similar trend was observed by Pinokiyo et al. (2008), who reported to have found 133 species of corticolous lichens at mid-elevation range in forest types of Mehao Wildlife Sanctuary in Arunachal Pradesh, India. Altitude and humidity were the putative key factors controlling the diversity and distribution of lichens within the Sanctuary. Balaji & Hariharan (2013) reported that among the macrolichen species recorded in the Siruvani Hills, 92.2 % of lichens had colonised bark (corticolous) and it was highest at middle elevations. It is classified as a moist deciduous forest. Upreti & Negi (1998) also reported that the lichen communities in the temperate-alpine zones of the Garhwal Himalaya contain more than 60 % of lichens colonising bark substrates. Contrary to this, low corticolous lichen diversity can be observed in the Rumbak catchment of the Hemis National Park in Ladakh. In this locality, not even single lichen species grew on the trunks and branches of tree species belonging to genera *Salix* and *Myricaria*. High wind speed causing rapid peeling of tree trunk bark appears to be an important limiting factor for the establishment of lichen-forming fungal spores of Ascomycota (Negi & Upreti 2000). The low diversity of corticolous lichens in HTEF is due to selective cutting of phorophytes, which is a major disturbance affecting the distribution of lichens (Edman et al. 2008).

Among the forest types studied, DMDF contains the maximum number of saxicolous (rock-colonising) lichens, which is due to the presence of barren rocks at lower altitudes of the Siruvani Hills (Balaji 2005). Rai et al. (2011) reported that the crustose growth form and saxicolous (on rock, stones and moraines) habitat were the most preferred at both study sites of Schirmacher Oasis (Queen Maud Land Area) and McLeod Island (Larsemann Hills) of East Antarctica. In the Rumbak catchment of Hemis National Park, the rock habitat supported various lichen assemblages throughout the sampling gradient (Negi & Upreti 2000). A similar pattern was observed in the Dry Mixed Deciduous Forest type (DMDF) of the Siruvani Hills, containing the highest number of saxicolous lichens supported by huge barren rocks at low elevations.

Tab. 1. List of lichen species occurring in the Bolampatti II Forest Range (Siruvani Hills), Western Ghats. Abbreviations: DMDF – Southern Dry Mixed Deciduous Forest, MMDF – Southern Moist Mixed Deciduous Forest, HTEF – Southern Hilltop Tropical Evergreen Forest.

Species (* new record to this area)	**Occurrence in forest types**			**Substrates**			**Altitude** (a.s.l.)	**Herbarium specimen** (all specimens collected by the authors, last number indicates year of collection)
	DM DF	**MM DF**	**HT EF**	**Bark**	**Rock**	**Leaf**		
Arthoniaceae								
Arthonia pellaea Leight.	+	+	+	+			450–1100 m	MSSRF/Herb/ARTHp/558/2000, 2634/2002, 3013/2003
Stirtonia alboverruca Makhija & Patw. *		+		+			900 m	MSSRF/Herb/STIR/1021/2000, 1330/2001
Brigantiaeaceae								
Brigantiaea leucoxantha (Spreng.) R. Sant. & Hafellner		+	+	+			820–1030 m	MSSRF/Herb/BRIl/650/2000
Brigantiaea nigra D.D. Awasthi	+	+	+	+			450–1100 m	MSSRF/Herb/BRIn/660/2000, 1367/2001, 3018/2003
Chrysothricaceae								
Chrysothrix candelaris (L.) J.R. Laundon	+			+			750 m	MSSRF/Herb/CHRYc/700/2000
Coenogoniaceae								
Coenogonium implexum Nyl. *		+	+	+			900–1100 m	MSSRF/Herb/COEi/1315/2001, 3120/2003
Ectolechiaceae								
Tapellaria sp.	+	+	+			+	450–1010 m	MSSRF/Herb/TAP/1355/2001, 3045/2003, 3701/2004
Gomphillaceae								
Calenia leptocarpa Vain. *			+			+	1010 m	MSSRF/Herb/CALEl/2734/2002, 3511/2004
Tricharia vainioi R. Sant. *	+	+	+			+	450–1100 m	MSSRF/Herb/TRIv/2250/2001, 3061/2003, 3550/2004
Graphidaceae								
Glyphis cicatricosa Ach.	+			+			450 m	MSSRF/Herb/GLYc/2810/2002
Graphina flexilis Makhija, Adaw. & Patw. *	+			+			450 m	MSSRF/Herb/GRAf/1503/2001
Graphina obtecta (Nyl.) Müll. Arg.		+		+			850 m	MSSRF/Herb/GRAob/2821/2002
Graphis anfractuosa (Eschw.) Eschw.	+		+	+			450–1010 m	MSSRF/Herb/GRAPa/710/2000, 1380/2001, 3083/2003
Graphis homichlodes Redinger		+		+			820 m	MSSRF/Herb/GRAPh/3150/2003
Graphis nigroglauca Leight.		+		+			820 m	MSSRF/Herb/GRAPn/1600/2001
Graphis scripta (L.) Ach.	+	+	+	+			460–1100 m	MSSRF/Herb/GRAPsc/2834/2002, 3110/2003, 3565/2004
Graphis supertecta Müll. Arg. *	+		+	+			450–1130 m	MSSRF/Herb/GRAPs/691/2000, 1380/2001, 3200/2003
Thecaria quassiicola Fée *	+		+	+			460–1030 m	MSSRF/Herb/THECq/715/2000, 3266/2003
Gyalectaceae								
Cryptolechia carneolutea (Turner) A. Massal. *	+	+	+	+			450–1010 m	MSSRF/Herb/CRYPc/1420/2001, 2612/2002, 3580/2004

Species (* new record to this area)	Occurrence in forest types			Substrates			Altitude (a.s.l.)	Herbarium specimen (all specimens collected by the authors, last number indicates year of collection)
	DM DF	MM DF	HT EF	Bark	Rock	Leaf		
Hymeneliaceae								
Ionaspis lacustris (With.) Lutzoni & Brodo *			+	+			1130 m	MSSRF/Herb/IONAl/3908/2004
Lecanoraceae								
Lecanora campestris subsp. *gulmargia* Upreti *	+				+		490 m	MSSRF/Herb/LECAca/1670/2001
Lecanora concilians Nyl. *	+		+	+			700–1100 m	MSSRF/Herb/LECAco/2840/2002, 3125/2003
Lecanora coronulans Nyl.			+	+			1100 m	MSSRF/Herb/LECAcor/3221/2003
Lecanora flavidomarginata de Lesd.		+		+			900 m	MSSRF/Herb/LECAf/1682/2001
Lecanora leprosa Fée	+			+			450 m	MSSRF/Herb/LECAl/2855/2002
Lecanora perplexa Brodo	+	+		+			450–900 m	MSSRF/Herb/LECAp/780/2000, 2655/2002, 3149/2003
Lecanora pseudistera Nyl.	+			+			610 m	MSSRF/Herb/LECAps/790/2000
Lecanora pulicaris (Pers.) Ach.		+		+			900 m	MSSRF/Herb/LECApu/788/2000, 1689/2001
Lecanora rugosella Zahlbr. *	+	+	+	+			450–1030 m	MSSRF/Herb/LECAr/1410/2001, 2699/2002, 3229/2003
Lecanora subimmersa (Fée) Vain.	+	+			+		450–800 m	MSSRF/Herb/LECAs/798/2000, 1450/2001
Lecanora xylophila Hue *	+	+	+	+			470–1100 m	MSSRF/Herb/LECAx/1616/2001, 2871/2002, 3160/2003
Lecidella alaiensis (Vain.) Hertel *		+			+		910 m	MSSRF/Herb/LECIDa/1700/2001
Lecideaceae								
Lecidea sp. 1	+	+	+	+			600–1200 m	MSSRF/Herb/LECI1/1695/2001 , 2710/2002, 3190/2003
Lecidea sp. 2	+	+	+	+			700–1030 m	MSSRF/Herb/LECI2/809/2000, 1675/2001, 3250/2003
Lecidea sp. 3	+	+		+			590–850 m	MSSRF/Herb/LECI3/820/2000, 2880/2002
Lecidea sp. 4	+	+		+			510–800 m	MSSRF/Herb/LECI4/802/2000, 1688/2001
Letrouitiaceae								
Letrouitia domingensis (Pers.) Hafellner & Bellem.	+	+	+	+			460–1010 m	MSSRF/Herb/LETRd/789/2000, 1693/2001, 3225/2003
Letrouitia flavocrocea (Nyl.) Hafellner & Bellem.	+		+	+			450–1200 m	MSSRF/Herb/LETRf/1710/2001, 3990/2004
Megalariaceae								
Megalaria laureri (Hepp. ex Th. Fr.) Hafellner *		+		+			820 m	MSSRF/Herb/MEGl/833/2000, 3888/2004
Megalosporaceae								
Megalospora sp.	+	+	+	+			460–1010 m	MSSRF/Herb/MEGA/840/2000, 1735/2001, 3269/2003
Megasporaceae								
Aspicilia dwaliensis Räsänen *		+		+			800 m	MSSRF/Herb/ASPId/2670/2002

Species (* new record to this area)	Occurrence in forest types			Substrates			Altitude (a.s.l.)	Herbarium specimen (all specimens collected by the authors, last number indicates year of collection)
	DM DF	MM DF	HT EF	Bark	Rock	Leaf		
Monoblastiaceae								
Anisomeridium biforme (Borrer) R.C. Harris *		+		+			960 m	MSSRF/Herb/ANISb/2895/2002
Anisomeridium terminatum (Nyl.) R.C. Harris *	+	+		+			460–830 m	MSSRF/Herb/ANISt/551/2000, 1750/2001, 3240/2003
Megalotremis verrucosa (Makhija & Patw.) Aptroot *		+		+			850 m	MSSRF/Herb/MEGAv/815/2000
Mycoblastaceae								
Tephromela atra (Huds.) Hafellner var. *atra*	+				+		500 m	MSSRF/Herb/TEP/3804/2004
Mycosphaerellaceae								
Stigmidium allogenum (Nyl.) D. Hawksw. *		+	+	+			960–1100 m	MSSRF/Herb/STIGa/1851/2001, 3255/2003
Ochrolechiaceae								
Ochrolechia subpallescens Verseghy		+		+			900 m	MSSRF/Herb/OCHs/899/2000, 2910/2002
Peltulaceae								
Peltula obscurans (Nyl.) Gyeln. *	+		+		+		710–1100 m	MSSRF/Herb/PELo/794/2000, 1335/2001, 3028/2003
Peltula tortuosa (Nees) Wetmore *	+	+	+		+		460–1100 m	MSSRF/Herb/PELt/796/2000, 3028/2001, 3608/2004
Pertusariaceae								
Pertusaria albescens (Huds.) M. Choisy & Werner	+			+			460 m	MSSRF/Herb/PERa/630/2000, 3305/2003
Pertusaria concinna Erichsen	+	+		+			470–820 m	MSSRF/Herb/PERc/850/2000, 1366/2001, 2722/2002
Pertusaria cryptocarpa Nyl. *	+			+			460 m	MSSRF/Herb/PERcr/2920/2002, 3075/2003
Pertusaria dehiscens Müll. Arg.		+	+	+			900–1200 m	MSSRF/Herb/PERd/1800/2001, 2675/2002, 3095/2003
Pertusaria kodaikanalensis M. Choisy	+	+			+		460–870 m	MSSRF/Herb/PERk/2931/2002, 3265/2003
Pertusaria leioplaca DC. *		+		+			960 m	MSSRF/Herb/PERl/3323/2003, 3650/2004
Pertusaria leucosora Nyl.			+		+		1200 m	MSSRF/Herb/PERle/1818/2001, 2725/2002
Pertusaria leucostomoides Zahlbr. *		+		+			960 m	MSSRF/Herb/PERl/900/2000, 1370/2001
Pertusaria punctata Nyl.	+	+	+	+			600–1010 m	MSSRF/Herb/PERp/640/2000, 1382/2001, 2940/2002
Pertusaria splendens D.D. Awasthi & Preeti Srivast.			+	+			1010 m	MSSRF/Herb/PERle/3456/2004
Pertusaria thwaitesii Müll. Arg. *		+	+	+			950–1100 m	MSSRF/Herb/PERth/670/2000, 1382/2001, 3330/2003
Physciaceae								
Buellia aethalea (Ach.) Th. Fr.	+	+	+		+		450–1200 m	MSSRF/Herb/BUEa/708/2000, 1550/2001, 2720/2002

Species (* new record to this area)	Occurrence in forest types			Substrates			Altitude (a.s.l.)	Herbarium specimen (all specimens collected by the authors, last number indicates year of collection)
	DM DF	MM DF	HT EF	Bark	Rock	Leaf		
Buellia indica S.R. Singh & D.D. Awasthi	+		+		+		710–1130 m	MSSRF/Herb/BUEi/669/2000, 1690/2001, 2756/2002
Buellia posthabita (Nyl.) Zahlbr. *	+	+			+		550–860 m	MSSRF/Herb/BUEp/724/2000, 1782/2001, 3029/2003
Buellia stillingiana Stirt. J. Steiner	+	+	+	+			450–1000 m	MSSRF/Herb/BUEs/790/2000, 1377/2001& 3267/2003
Buellia subsororioides S.R. Singh & D.D. Awasthi		+	+		+		800–1010 m	MSSRF/Herb/BUEsu/1795/2001, 3050/2003
Pilocarpaceae								
Byssoloma leucoblepharum (Nyl.) Vain.			+			+	1130 m	MSSRF/Herb/BYSl/698/2000
Porinaceae								
Porina africana Müll. Arg. *	+			+			600 m	MSSRF/Herb/PORaf/2983/2002
Porina andamanica Makhija, Adaw. & Patw. *		+		+			810 m	MSSRF/Herb/PORand/908/2000, 1833/2001
Porina angusta Makhija, Adaw. & Patw.		+		+			850 m	MSSRF/Herb/PORa/3450/2003
Porina aurantiaca Makhija, Adaw. & Patw.	+	+		+			680–850 m	MSSRF/Herb/PORau/911/2000, 1808/2001
Porina belonospora (Nyl.) Müll. Arg. *	+		+	+			600–1010 m	MSSRF/Herb/PORb/2950/2002, 3270/2003
Porina corruscans (Rehm) R. Sant. *			+			+	1100 m	MSSRF/Herb/PORc/934/2000
Porina decamera Vain.		+		+			950 m	MSSRF/Herb/PORde/1840/2001
Porina dolichophora (Nyl.) Müll. Arg.	+		+	+			600–1010 m	MSSRF/Herb/PORd/2955/2002, 3311/2003
Porina epiphylla Fée	+		+			+	560–1010 m	MSSRF/Herb/PORe/945/2000, 1815/2001, 2774/2002
Porina internigrans (Nyl.) Müll. Arg.			+	+			1100 m	MSSRF/Herb/PORint/1851/2001
Porina interstes (Nyl.) Harm.	+	+	+	+			450–1010 m	MSSRF/Herb/PORintn/908/2000, 2778/2002, 3501/2004
Porina microcarpa Makhija, Adaw. & Patw.		+	+	+			810–1030 m	MSSRF/Herb/PORmi/978/2000, 1860/2001
*Porina nitidula*Müll. Arg.		+				+	800 m	MSSRF/Herb/PORni/2971/2002
Porina nonaria Müll. Arg. *	+	+		+			600–820 m	MSSRF/Herb/PORno/996/2000, 2785/2002, 3525/2004
Porina nucula Ach. *	+	+		+			600–900 m	MSSRF/Herb/PORnu/990/2000, 1825/2001, 2805/2002
Porina ochrostoma Makhija, Adaw. & Patw.			+	+			1010 m	MSSRF/Herb/PORoc/2980/2002
Porina pallescens R. Sant.	+	+	+			+	600–1010 m	MSSRF/Herb/PORpa/1011/2000, 1900/2001, 2811/2002
Porina rhodostoma Müll. Arg. *	+	+	+	+			550–1030 m	MSSRF/Herb/PORrh/988/2000
Porina subcutanea Ach.			+	+			1010 m	MSSRF/Herb/PORsub/3567/2004
Porina subinterstes (Nyl.) Müll. Arg.	+	+	+	+			760–1100 m	MSSRF/Herb/PORsubi/999/2000, 1835/2001, 2825/2002
Porina thaxteri R. Sant.			+			+	1010 m	MSSRF/Herb/PORth/2987/2002

Species (* new record to this area)	Occurrence in forest types			Substrates			Altitude (a.s.l.)	Herbarium specimen (all specimens collected by the authors, last number indicates year of collection)
	DM DF	MM DF	HT EF	Bark	Rock	Leaf		
Trichothelium alboatrum Vain.	+	+	+			+	700–1100 m	MSSRF/Herb/TRICa/2998/2002, 3327/2003, 3850/2004
Trichothelium sp. 2			+	+			1100 m	MSSRF/Herb/TRIC2/1200/2000
Pyrenulaceae								
Anthracothecium himalayense (Räsänen) D.D. Awasthi	+			+			600 m	MSSRF/Herb/ANTHh/1320/2001
Anthracothecium indicum Ajay Singh			+	+			1100 m	MSSRF/Herb/ANTHi/553/2000
Anthracothecium megaspermum Patw. & Makhija			+	+			1010 m	MSSRF/Herb/ANTHm/2600/2002
Anthracothecium variolosum (Pers.) Müll. Arg.		+		+			900 m	MSSRF/Herb/ANTHv/1344/2001
Pyrenula brunnea Fée *	+	+	+	+			610–1100 m	MSSRF/Herb/PYRb/1151/2000, 1995/2001, 2838/2002
Pyrenula cayennensis Müll. Arg.		+	+	+			910–1010 m	MSSRF/Herb/PYRc/2990/2002
Pyrenula globifera (Eschw.) Aptroot *			+	+			1010 m	MSSRF/Herb/PYRg/1310/2001
Pyrenula mastophora (Nyl.) Müll. Arg. *	+	+	+	+			450–1010 m	MSSRF/Herb/PYRm/1213/2000, 3332/2003, 3600/2004
Ramalinaceae								
Bacidia arnoldiana Körb. *	+				+		450 m	MSSRF/Herb/BACIa/600/2000
Bacidia convexula (Müll. Arg.) Zahlbr. *	+	+	+	+			680–1100 m	MSSRF/Herb/BACIc/1845/2001, 2843/2002, 3021/2003
Bacidia medialis (Tuck. ex Nyl.) Zahlbr.	+	+	+	+			450–1010 m	MSSRF/Herb/BACIm/1849/2001, 2678/2002, 3338/2003
Bacidia millegrana (Taylor) Zahlbr.		+	+	+			920–1010 m	MSSRF/Herb/BACImi/998/2000, 1350/2001
Bacidia rubella (Hoffm.) A. Massal.	+			+			450 m	MSSRF/Herb/BACIr/2708/2002
Bacidia sp.	+				+		450 m	MSSRF/Herb/BACI/3025/2003
Bacidia submedialis (Nyl.) Zahlbr.			+	+			1000 m	MSSRF/Herb/BACIs/1360/2001
Roccellaceae								
Chiodecton leptosporum Müll. Arg.		+		+			850m	MSSRF/Herb/CHIOl/3100/2003
Opegrapha leptoterodes Nyl.	+	+	+	+			450–1100 m	MSSRF/Herb/OPEl/1232/2000, 1792/2001, 2857/2002
Pulvinodecton kurzii (Kremp. ex Nyl.) Henssen & G. Thor *	+				+		700 m	MSSRF/Herb/PULk/3759/2004
Strigulaceae								
Strigula smaragdula Fr. *	+	+	+			+	450–1010 m	MSSRF/Herb/STRIsm/1863/2001, 2990/2002, 3227/2003
Strigula nemathora Mont.			+	+			1100 m	MSSRF/Herb/STRIn/2221/2001
Teloschistaceae								
Caloplaca bassiae (Willd. ex Ach.) Zahlbr. *	+	+	+	+			460–1010 m	MSSRF/Herb/CALb/1379/2001
Caloplaca cinnabarina (Ach.) Zahlbr. var. *cinnabarina* *		+			+		900 m	MSSRF/Herb/CALci/2770/2002
Caloplaca poliotera (Nyl.) Stein *		+			+		950 m	MSSRF/Herb/CALp/1389/2001
Caloplaca cerina (Ehrh. ex Hedw.) Th. Fr. *		+		+			900 m	MSSRF/Herb/CALc/3070/2003

Species (* new record to this area)	**Occurrence in forest types**			**Substrates**			**Altitude** (a.s.l.)	**Herbarium specimen** (all specimens collected by the authors, last number indicates year of collection)
	DM DF	**MM DF**	**HT EF**	**Bark**	**Rock**	**Leaf**		
Caloplaca cupulifera (Vain.) Zahlbr. *	+				+		450 m	MSSRF/Herb/CALcu/1910/2001, 3078/2003
Caloplaca ferruginea (Huds.) Th. Fr.	+			+			550 m	MSSRF/Herb/CALf/1925/2001, 2755/2002
Caloplaca nigrocinctella (Nyl.) Zahlbr. *			+		+		1100 m	MSSRF/Herb/CALn/3090/2003
Caloplaca sp.		+		+			950 m	MSSRF/Herb/CAL/699/2000
Caloplaca subdolosa (Nyl.) Zahlbr. *	+	+			+		480–890 m	MSSRF/Herb/CALsu/2210/2001, 2780/2002
Thelotremataceae								
Diploschistes candidissimus (Kremp.) Zahlbr.	+			+			550 m	MSSRF/Herb/DIPLc/3135/2003
Myriotrema anamalaiense (Patw. & C.R. Kulk.) Hale	+			+			460 m	MSSRF/Herb/MYRa/2888/2002
Myriotrema clandestinum (Fée) Hale		+		+			810 m	MSSRF/Herb/MYRt/2901/2002
Myriotrema decorticatum Hale *		+	+	+			830–1010 m	MSSRF/Herb/MYRd/2225/2001, 2890/2002
Myriotrema desquamans (Müll. Arg.) Hale *		+	+	+			850–1010 m	MSSRF/Herb/MYRde/830/2000
Myriotrema granulosum (Leight.) Hale *	+	+	+	+			700–1100 m	MSSRF/Herb/MYRg/2240/2001, 3275/2003, 3995/2004
Myriotrema hartii (Müll. Arg.) Hale *	+	+		+			460–850 m	MSSRF/Herb/MYRh/1745/2001
Myriotrema microporum (Mont.) Hale		+	+	+			850–1100 m	MSSRF/Herb/MYRm/3277/2003
Myriotrema microstomum (Müll. Arg.) Hale *		+		+			910 m	MSSRF/Herb/MYRmi/2899/2002
Myriotrema norstictideum (Patw. & Nagarkar) D.D. Awasthi	+	+	+	+			460–1100 m	MSSRF/Herb/MYRn/1780/2001, 2865/2002, 3335/2003
Myriotrema thwaitesii Hale		+		+			890 m	MSSRF/Herb/MYRth/835/2000
Ocellularia andamanica (Nyl.) Tat. Matsumoto & Deguchi *		+		+			820 m	MSSRF/Herb/OCELa/844/2000
Trypetheliaceae								
Astrothelium fallax Müll. Arg. *		+		+			800 m	MSSRF/Herb/ASTRf/1345/2001
Laurera benguelensis (Müll. Arg.) Zahlbr. *		+	+	+			910–1010 m	MSSRF/Herb/LAUb/725/2000, 2875/2002
Trypethelium eluteriae Spreng.	+			+			450 m	MSSRF/Herb/TRYPe/3999/2004
Verrucariaceae								
Staurothele clopima (Wahlenb.) Th. Fr. *	+	+			+		700–860 m	MSSRF/Herb/STAc/2200/2001, 2925/2002
Staurothele fissa (Taylor) Zwackh	+				+		730 m	MSSRF/Herb/STAf/1001/2000
Verrucaria margacea (Wahlenb.) Wahlenb. *	+				+		760 m	MSSRF/Herb/VERm/1229/2000, 2963/2002
***Lecanorales* incertae sedis**								
Heterocyphelium leucampyx (Tuck.) Vain.		+		+			800 m	MSSRF/Herb/HETl/721/2000

Photobionts and environmental conditions

Concerning photobionts, 50.3 % lichens showed to contain *Trentepohlia* photobionts, 46.4 % of lichens *Trebouxia*, and the rest of the lichens (3.3 %) contained both *Nostoc* and *Cephaleuros* spp. as photobionts. *Trebouxia*-containing lichens were most frequent in DMDF (36.5 %), followed by MMDF (34.9 %) and HTEF (28.4 %). *Trentepohlia* lichens were most common in MMDF (39.8 %), followed by HTEF (31.6 %) and DMDF (28.6 %).

Dominance of *Trentepohlia*-containing lichens was found in MMDF and HTEF, while dominance of *Trebouxia*-containing lichens was found in DMDF. This distribution pattern can be attributed to the sensitivity of the lichen photobiont to drought or high temperatures, which determine the survival of a lichen thallus (Wolseley & Aguirre-Hudson 1997). The *Trebouxia*-containing lichens are known to survive better in open and dry (Balaji & Hariharan 2004, 2013) conditions prevailing in DMDF. In the Deciduous Dipterocarp Forest in northern Thailand, the number of lichens with *Trebouxia* as photobiont is the highest due to the very dry and mostly fire-damaged conditions of the forest. The seasonal evergreen and tropical mixed deciduous forests of Thailand (Wolseley & Aguirre-Hudson 1997) were reported to contain a higher number of shade-tolerant *Trentepholia*-containing lichens compared to dry deciduous forests of Thailand. This trend (higher number of shade-tolerant *Trentepholia*-containing lichens) was similar in the MMDF and HTEF types in the Bolampatti II Forest Range.

Wolseley & Aguirre-Hudson (1997) state that crustose lichens (microlichens) are slow growing and long-lived, and are also sensitive to environmental changes, making them good indicators of ecological continuity and in particular old-growth forest. The present study has revealed the occurrence of 137 crustose lichens from 197.66 sq km of forest area, indicating the lichen richness of the study area and their suitability for further ecological monitoring. It is desirable to develop location specific and lichen-centered conservation strategies using this baseline data to protect the valuable and yet poorly studied ecologically important microlichen group.

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REFERENCES

APTROOT A. (2002): *Arthopyrenia*. – In: Nash T.H. III., Ryan B.D., Gries C. and Bungartz F., eds., Lichen Flora of the Greater Sonoran Desert Region. I, Lichens Unlimited, p. 103–106, Tempe.

APTROOT A. (2003): Pyrenocarpous lichens and related non-lichenized ascomycetes from Taiwan. – J. Hatt. Bot. Lab. 93: 155–173.

AWASTHI D.D. (1991): A Key to the Microlichens of India, Nepal and Sri Lanka. – Bibliotheca Lichenologica 40: 1–340.

AWASTHI D.D., AHTI T. (2007): A compendium of the macrolichens from India, Nepal and Sri Lanka. – 580 p. Dehra Dun.

BALAJI P., HARIHARAN G.N. (2004): Lichen diversity and its distribution pattern in Tropical Dry Evergreen Forest of Guindy National Park (GNP), Chennai. – Indian Forester 130: 1155–1168.

BALAJI P. (2005): Assessing the lichen diversity and its distribution pattern for prospecting the ecological and economic potential of lichens within Bolampatti II Forest Range (Siruvani Hills), Western Ghats, India. – Ph.D. Thesis [depon. in: University of Madras, India].

BALAJI P., HARIHARAN G.N. (2005): Annonated checklist of lichens of Chennai, Tamil Nadu, India. – Phytotaxonomy 5: 1–7.

BALAJI P., HARIHARAN G.N. (2013): Diversity of Macrolichens in Bolampatti II Forest Range (Siruvani Hills), Western Ghats, Tamil Nadu, India. – ISRN Biodiversity 2013: 1–7.

CHAMPION H.G., SETH S.K. (1968): A Revised Survey of the Forest Types of India. – 404 p. New Delhi.

EDMAN M., ERIKSON A., VILLARD M. (2008): Effect of selection cutting on the abundance and fertility of indicator lichens *Lobaria pulmonaria* and *Lobaria quercizans*. – J. Appl. Ecol. 45: 26–33.

ERTZ D., MIADLIKOWSKA J., LUTZONI F., DESSEIN S., RASPÉ O.,VIGNERON N., HOFSTETTER V., DIEDERICH P. (2009): Towards a new classification of the *Arthoniales* (Ascomycota) based on a three-gene phylogeny focusing on the genus *Opegrapha*. – Mycol. Res. 113: 141–152.

GRADSTEIN S.R. (1992): The vanishing tropical rain forest as an environment for bryophytes and lichens. – In: Bates J.W. & Andrew M.F., eds., Bryophytes and Lichens in a changing Environment, p. 235–258, Oxford.

HARIHARAN G.N., KRISHNAMOORTHY K.V., UPRETI D.K. (2004): Lichens of Shervaroy Hills of Eastern Ghats, India. – Phytotaxonomy 3: 1–23.

HARRIS R.C. (1995): More Florida Lichens. Including the 10 cent Tour of the Pyrenolichens. – 192 p. New York.

HUNECK S., YOSHIMURA I. (1996): Identification of Lichen Substances. – 493 p. Tokyo.

KUMAR J., KHARE R., RAI H., UPRETI D.K., TAYADE A., HOTA S., CHAURASIA O.P., SRIVASTAVA R.B. (2012): Diversity of lichens along altitudinal and land use gradients in the Trans Himalayan cold desert of Ladakh. – Nat. Sci. 10(4): 1–9.

LUMBSCH H.T., HUHNDORFS H. (2010): Myconet Outline of Ascomycota. Myconet vol. 14. – Fieldiana, Life and Earth Sciences 1: 1–64.

LÜCKING R. (2000): Key to the foliicolous lichens and their lichenicolous fungi Part 1, Foliicolous lichens. – http://www.bio.uni-bayreuth.de/planta2/ass/robert/lichens/key_genera.html. [accessed 19 March 2013]

NAYAKA S., REDDY A.M, PONMURUGAN P., DEVI A., AYYAPPADASAN G., UPRETI D.K. (2013): Eastern Ghats' biodiversity reserves with unexplored lichen wealth. – Curr. Sci. 104(7): 821–825.

NAYAKA S., UPRETI D. K. (2011): An Inventory of Lichens in Uttar Pradesh through Bibliographic Compilation. – In: National Conference on Forest Biodiversity: Earth's Living Treasure, p. 24–35, Uttar Pradesh.

NAYAKA S., UPRETI D. K. (on-line): Status of Lichen Diversity in Western Ghats, India. – http://wgbis.ces.iisc.ernet.in/biodiversity/sahyadri_enews/newsletter/issue16/main_index.htm. [accessed 19 March 2013]

NAYAKA S., UPRETI D.K., GADGIL M., VIVEK P. (2003): Distribution pattern and heavy metal accumulation in lichens of Bangalore city with special reference to Lalbagh garden. – Curr. Sci. 84: 674–680.

NEGI H.R., UPRETI D.K. (2000): Species diversity and relative abundance of lichens in Rumbak catchment of Hemis National Park in Ladakh. – Curr. Sci.78: 1105–1112.

NEGI H.R. (2000): On the patterns of abundance and diversity of macrolichens of Chopta-Tunganath in the Garhwal Himalaya. – J. Biosci. 25: 367–378.

NEGI H.R., GADGIL M. (1996): Patterns of distribution of Macrolichens in western parts of Nanda Devi Biosphere Reserve. – Curr. Sci. 71: 568–575.

PINOKIYO A., SINGH K.P., SINGH J.S. (2008): Diversity and distribution of lichens in relation to altitude within a protected biodiversity hot spot, north-east India. – The Lichenologist 40(1): 47–62.

RAI H., KHARE R., NAYAKA S., UPRETI D.K., GUPTA R.K. (2011) Lichen synusiae in East Antarctica (Schirmacher Oasis and Larsemann Hills): substratum and morphological preferences. – Czech Polar Reports 1(2): 65–77.

RAI H., GUPTA R.K., UPRETI D.K., NEGI P. (2012): Distribution pattern of terricolous lichens in Garhwal Himalayas (Chopta-Tungnath tract) with reference to morphological and environmental variables. – In: Gupta R.K., Kumar M., Paliwal G.S., eds., Diversity of lower plants, p. 265–278, New Delhi.

SINGH K.P., SINHA G.P. (2010): Indian Lichens: An annotated Checklist. – 572 p. Kolkata.

SIPMAN H.J.M., APTROOT A. (2001): Where are the missing lichens? – Mycol. Res. 105(12): 1433–1439.

UPRETI D.K. (1991): Lichen genus *Pyrenula* from India. V. *Pyrenula approximans* spore type. – Feddes Repertorium 102(5-6): 425–430.

UPRETI D.K. (1992): Lichen genus *Pyrenula* from India VII. *Pyrenula mastophora* spore type. – Feddes Repertorium 103(3-4): 279–296.

UPRETI D.K., NEGI H.R. (1998): Lichen flora of Chopta-Tunganath, Garhwal Himalayas, India. – Journal of Economic and Taxonomic Botany 22(2): 273–286.

WILSON J. (1967): Working plan for the Bolampatti Range of Coimbatore Central Forest Division. – 155 p. Madras.

WOLSELEY P.A., AGUIRRE-HUDSON B. (1997): The ecology and distribution of lichens in tropical deciduous and evergreen forests of northern Thailand. – J. Biogeo. 24: 327–343.