

## Some new records of lichens from the Goodrical Reserve Forest, Pathanamthitta district of Kerala

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### ABSTRACT

The exploration of lichens carried out in the Goodrical Reserve Forest of Pathanamthitta, Kerala resulted in 43 species with dominance of crustose forms. *Graphis japonica*, *Lepraria indica*, *Myelochroa metarevoluta*, *Porina belonospora* and *Pseudocyphellaria junghuhniana* are new records to Kerala. A brief description of the new records is provided.

**Keywords :** Lichenized fungi, Western Ghats, biodiversity, myco-biota, southern India

### INTRODUCTION

The lichens are the most successful symbiotic organisms on earth. It is estimated that approximately 8% of the earth's terrestrial surface has lichens as its most dominant life-form (Ahmadjian, 1995). In the world, approximately 20,000 species of lichens are known to occur (Lücking *et al.*, 2016). India is represented by 2,902 species of lichens under 407 genera and 79 families (Sinha and Jagadeesh Ram, 2020). In India Western Ghats, Himalaya and Andaman Nicobar Islands are considered as hotspots for lichen diversity. The Western Ghats is represented by 1,138 lichen species, among them 266 are endemic to the region (Dudani *et al.*, 2018). Kerala is one of the lichen rich regions in Western Ghats. The lichens earlier collected from the state are included in various inventories or monographs (Vohra *et al.*, 1982; Patwardhan, 1983; Kumar, 2000; Easa, 2003; Sequiera, 2003, 2007; Singh and Sinha, 2010; Biju *et al.*, 2010, 2014 a,b; Pandit and Sharma, 2012; Joshi *et al.*, 2016, 2018; Bajpai *et al.*, 2018). Zachariah *et al.* (2018) reviewed the lichenological exploration carried out in Kerala and reported 25 new lichens to the state. Further, Zachariah *et al.* (2019, 2020) added two new records of *Pyxine* to Kerala and 11 new records of macrolichens, and hence expanding the list of lichens for the state to 793 species. The addition of lichens clearly indicates that forest areas of Kerala has not been fully explored for the lichens although it appears to be immensely rich in lichen diversity, especially the microlichen species.

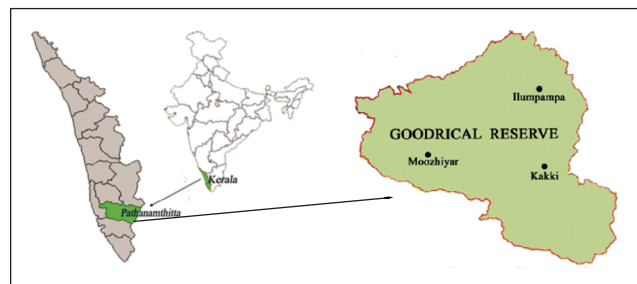
The present study was undertaken to know the lichen diversity in the Goodrical Reserve Forest (RF) of Ranni Forest Division situated in the eastern side of Pathanamthitta district (**Fig.1**). The Goodrical RF has an area of 1,385.27 km<sup>2</sup> and covers about 70 km<sup>2</sup> of evergreen, semi-evergreen forests, shoals and grasslands with altitude ranging between 900 to 1036 m. The temperature of the RF ranges from 17° to 25° C and the mean annual rainfall is about 2086 mm (Kumar, 2003). Literature survey indicates that extensive study on lichens in this reserve forest is lacking.

### MATERIALS AND METHODS

The specimens were collected from different substrates such as barks, twigs and rocks available in Goodrical RF. A total of 120 specimens from different localities of the study area were

collected. Wherever possible, name of the host plant was also noted. The specimens were identified based on the morphology, anatomy, spot tests, and thin layer chromatography (TLC) at CSIR-National Botanical Research Institute, Lucknow. The morphology was studied using a stereozoom Leica S8APO microscope, and the anatomical characters were studied using the DM2500 optical microscope. Spot tests were performed by applying aqueous potassium hydroxide (K), calcium hypochlorite (C), and para-phenylenediamine (P) solutions on the thallus and medulla. TLC was performed in using toluene-acetic acid (170: 30) solvent system for identification of secondary metabolites (Orange *et al.*, 2001). The relevant literature was consulted for the identification (Awasthi, 1991, 2007; Divakar and Upreti, 2005; Orange, 2008; Aptroot *et al.*, 2009; Lücking *et al.*, 2009; Saag *et al.*, 2009; Aptroot, 2012; Breuss and Lücking, 2015; Seavey *et al.*, 2017). The nomenclature of the species is updated following indexfungorum.org and the recent fungal classification provided by Wijayawardene *et al.* (2020) was followed for arranging genera under various families. A set of voucher specimens were preserved in the herbarium of CSIR-National Botanical Research Institute, Lucknow (LWG).

### RESULTS



**Fig. 1:** Map showing the study area Goodrical Forest reserve in Kerala State

The study revealed 43 species of the lichens from the Goodrical RF area of the Pathanamthitta district. Among them, 34 species were of macrolichens belonging to 10 genera and six families while the remaining species were of the microlichens representing seven genera and five families (**Table 1**). During the study lichens were collected from 28 host plants and among them *Callicarpa tomentosa*,

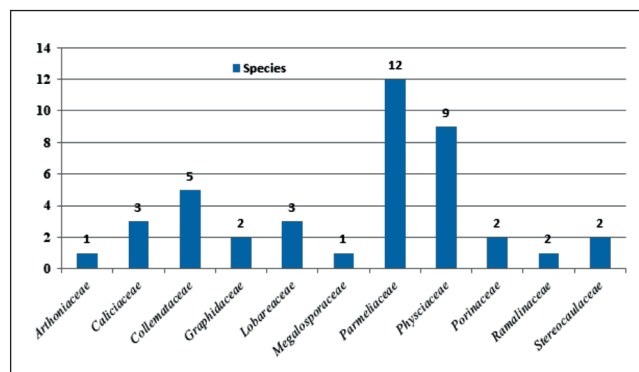
**Table 1:** List of lichens from Goodrical Reserve Forest.

Lichen Species	Family	Host
<i>Bulbothrix isidica</i> (Nyl.) Hale	Parmeliaceae	<i>Cinnamomum malabratrum</i>
<i>B. setschwanensis</i> (Zahlbr.) Hale	Parmeliaceae	<i>Cinnamomum sulphuratum</i>
<i>Crocynia gossypina</i> (Sw.) A. Massal.	Ramalinaceae	<i>Ficus benghalensis</i>
<i>Diorygma junghuhnii</i> (Mont. & Bosch) Kalb, Staiger & Elix	Graphidaceae	<i>Cinnamomum verum</i>
<i>Graphis japonica</i> (Müll. Arg.) A.W. Archer & Lücking	Graphidaceae	<i>Palaquium ellipticum</i>
<i>Heterodermia diademata</i> (Taylor) D.D. Awasthi	Physciaceae	<i>Bridelia scandens</i>
<i>H. flabellata</i> (Fée) D. D Awasthi	Physciaceae	<i>Gordonia obtusa</i>
<i>H. hypochraea</i> (Vain.) Swinsc. & Krog	Physciaceae	<i>Macaranga indica</i>
<i>H. incana</i> (Stirton) D.D. Awasthi	Physciaceae	<i>Callicarpa tomentosa</i>
<i>H. isidiophora</i> (Vain.) D.D. Awasthi	Physciaceae	<i>Syzygium cumini</i>
<i>H. japonica</i> (Sato) Swinsc. & Krog	Physciaceae	<i>Syzygium cumini</i>
<i>H. microphylla</i> (Kurok.) Skorepa	Physciaceae	<i>Syzygium malabaricum</i>
<i>H. speciosa</i> (Wulf.) Trevis.	Physciaceae	<i>Ligustrum robustum</i>
<i>H. togashii</i> (Kurok.) D.D. Awasthi	Physciaceae	<i>Pittosporum tetraspermum</i>
<i>Herpothallon philippinum</i> (Vain.) Aptroot & Lücking	Arthoniaceae	<i>Sterculia guttata</i>
<i>Hypotrachyna costaricensis</i> (Nyl.) Hale	Parmeliaceae	<i>Phyllanthus rheedii</i>
<i>H. infirma</i> (Kurok.) Hale	Parmeliaceae	<i>Bridelia stipularis</i>
<i>H. rigidula</i> (Kurok.) Hale	Parmeliaceae	<i>Mimusops elengi</i>
<i>H. sublaevigata</i> (Nyl.) Hale	Parmeliaceae	<i>Aporosa acuminata</i>
<i>Lepraria caesiocalba</i> (B. de Lesd.) J.R. Laundon	Stereocaulaceae	<i>Cinnamomum verum</i>
<i>L. indica</i> R. Bajpai & Upreti	Stereocaulaceae	<i>Syzygium caryophyllatum</i>
<i>Leptogium cyanescens</i> (Rabenth.) Körb.	Collemataceae	<i>Hevea brasiliensis</i>
<i>L. denticulatum</i> Nyl.	Collemataceae	<i>Syzygium caryophyllatum</i>
<i>L. gelatinosum</i> (With.) J.R. Laundon	Collemataceae	<i>Callicarpa tomentosa</i>
<i>L. moluccanum</i> (Pers.) Vain.	Collemataceae	<i>Mallotus tetracoccus</i>
<i>L. ulvaceum</i> (Pers.) Vain	Collemataceae	<i>Aporosa cardiosperma</i>
<i>Megalospora sulphurata</i> Meyen	Megalosporaceae	<i>Wendlandia thyrsoidea</i>
<i>Myelochroa metarevoluta</i> (Asahina) Elix & Hale	Parmeliaceae	<i>Macaranga indica</i>
<i>Parmotrema crinitoides</i> J.C. Wei	Parmeliaceae	<i>Macaranga indica</i>
<i>P. hababianum</i> (Gyeln.) Hale	Parmeliaceae	<i>Callicarpa tomentosa</i>
<i>P. nilgherrense</i> (Nyl.) Hale	Parmeliaceae	<i>Diospyros ebenum</i>
<i>P. praesorodiosum</i> (Nyl.) Hale	Parmeliaceae	<i>Palaquium ellipticum</i>
<i>P. tsavoense</i> (Krog & Swinsc.) Krog & Swinsc.	Parmeliaceae	<i>Elaeocarpus serratus</i>
<i>P. reticulatum</i> (Taylor) M. Choisy	Parmeliaceae	<i>Bridelia stipularis</i>
<i>Parmelinella wallichiana</i> (Taylor) Elix & Hale	Parmeliaceae	<i>Cinnamomum sulphuratum</i>
<i>Porina belonospora</i> (Nyl.) Müll. Arg.	Porinaceae	<i>Elaeocarpus serratus</i>
<i>P. interests</i> (Nyl.) Harm.	Porinaceae	<i>Glochidion ellipticum</i>
<i>Pseudocyphellaria junghuhniana</i> (Müll. Arg.) D.D. Awasthi	Lobariaceae	<i>Sterculia guttata</i>
<i>Pyxine cocei</i> (Sw.) Nyl.	Caliciaceae	<i>Lagerstroemia speciosa</i>
<i>P. cylindrica</i> Kashiv.	Caliciaceae	On a Rock
<i>P. dactyloschmidtii</i> Kalb & Mongkols.	Caliciaceae	<i>Mimusops elengi</i>
<i>Sticta cyphellulata</i> (Müll. Arg.) Hue	Lobariaceae	<i>Elaeocarpus serratus</i>
<i>S. weigelii</i> (Ach.) Vain.	Lobariaceae	<i>Cinnamomum verum</i>

*Elaeocarpus serratus*, and *Syzygium cumini* harboured the highest number of lichen species.

The study area was found dominated by *Heterodermia* (nine species) and *Parmotrema* (six species) followed by *Leptogium* (five species), *Hypotrachyna* (four species), and *Pyxine* (three species). *Bulbothrix*, *Porina*, and *Sticta* were represented by two species each and *Crocynia*, *Diorygma*, *Herpothallon*, *Parmelinella*, *Pseudocyphellaria*, and *Graphis* were represented by one species each. *Graphis japonica*, *Lepraria indica*, *Porina belonospora*, *Pseudocyphellaria junghuhniana* and *Myelochroa metarevoluta* are reported as new records to Kerala. With the addition of five more species from the present study, the total number of lichens of Kerala has gone up to 798 species.

*Pyxine cylindrica* is found to be the only rock-inhabiting species. *Parmeliaceae* and *Physciaceae* were the dominant families with twelve and nine species respectively (Fig.2). This is the first study of lichens from Goodrical RF which indicates the rich diversity of lichens in this area and further extensive study is needed in the area for assessing the complete status of lichens.

**Fig. 2:** Graph showing the number of lichen species in each lichen family

### Description of new records

*Graphis japonica* (Müll. Arg.) A.W. Archer & Lücking, in Lücking, Archer & Aptroot, *Lichenologist* **41** (4): 437 (2009).

Thallus corticolous, crustose, green to greyish green. Ascromata lirellate, subserpentina-morph (sensu Lücking *et al.*, 2009), proper exciple apically to laterally carbonized; hymenium 140-160 µm high, not interspersed; ascospores, 4 per ascus, muriform, 1013/24-locular, hyaline, 39-67 × 12.5-20 µm, 1+ blue. TLC- Stictic acid complex.

**Specimen examined:** India, Kerala, Kakki, Goodrical RF, Pathanamthitta, 9°19'31.777"N, 77°8'42.707"E, 1020m, 1 June, 2018, Diana Purushothaman. LWG 35969.

*Lepraria indica* R. Bajpai & Upreti, in Bajpai, Nyaka & Upreti, *Phytotaxa* **356** (2): 106 (2018)

Thallus corticolous, leprose powdery; green to light grey, marginal lobes well developed with weakly raised rim; medulla well developed, usually thick, white; hypothallus rarely present, scarce, pale brown; soredia abundant, loosely packed, variable in size, fine, projecting hyphae present. TLC- Stictic acid complex, salazinic acid, atranorin.

**Specimen examined:** India, Kerala, Moozhiyar, Goodrical RF, Pathanamthitta, 186 m, 1 June 2018, Diana Purushothaman, LWG 35985.

*Myelochroa metarevoluta* (Asahina) Elix & Hale, *Mycotaxon* **29**: 241 (1987)

Thallus corticolous, foliose, adnate 4 cm across; lobes 4 mm wide, ciliate in axils; upper side whitish grey, postulate, sorediate; medulla yellow, pale orange beneath soralia. Apothecia and pycnidia absent. TLC - Galbinic, salazinic, norstictic, secalonic acids and zeorin.

**Specimen examined:** India, Kerala, Upper Moozhiyar, 9.302°N 77.127°E, 882m, Goodrical RF, Pathanamthitta, 181 m, 1 June 2018, Diana Purushothaman, LWG 35992.

*Porina belonospora* (Nyl.) Müll. Arg., *Bot. Jb.* **6**: 400 (1885)

Thallus corticolous, crustose, yellowish-green, smooth, glossy interminate, closely adpressed, epiphloedal,

ecorticate; ascomata concolorous, minute, immersed to slightly emergent, ostioles pale brown, depressed; ostiolar rim light brown to mostly black; involucrellum brown; exciple pale yellowish; ascospores hyaline, transeveresely septate, 13-57.46 µm. TLC - No chemicals.

**Specimen examined:** India, Kerala, Moozhiyar, Goodrical RF, Pathanamthitta, 181m, 1 June 2018, Diana Purushothaman, LWG 36000.

*Pseudocyphellaria junghuhniana* (Müll. Arg.) D.D. Awasthi, *Beih. Nova Hedwigia* **17**: 104 (1965).

Thallus corticolous, foliose, up to 11 cm, pinnately lobate; 8 mm wide; upper side brownish, scrobiculate, lacking isidia and soredia; lower side light brown, pseudocyphellae white; photobiont *Nostoc*. Apothecia marginal to submarginal, 3 mm in diameter; ascospores brown, transversely 1-3 septate, 21-35 × 9-11 µm. TLC - No chemicals.

**Specimen examined:** India, Kerala, Moozhiyar, Goodrical RF, Pathanamthitta, 181m, 1 June 2018, Diana Purushothaman, LWG 36002.

## CONCLUSION

The present study provides baseline data for future studies on lichen in the Goodrical RF area in the Pathanamthitta district of Kerala. The occurrence of 43 species with the diversity of both macro-and microlichens indicates the richness of lichens in the area. The reserve forest represents the typical lichen communities of the Western Ghats with species belonging to *Graphidaceae*, *Parmeliaceae*, *Physciaceae*, and *Porinaceae*. Further, the forest also has a good representation of cyanolichens (lichen with cyanobacteria as photobiont) with species of *Leptogium*, *Pseudocyphellaria*, and *Sticta*. The cyanolichens are actually ecological indicators of old-growth forests and the availability of moisture in a habitat (Rikkinen 2015). From the overall diversity of the lichens, it can be concluded that Goodrical RF is a lesser disturbed area. However, an intensive study is required in the area to assess the health of the forest using lichens as bioindicators.

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