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Caption: Large Indian Civet *Viverra zibetha*, Tricoloured Munia *Lonchura malacca* and *Hoya wightii* (Medium—pencil crayon on watercolour paper) © Supriya Samanta.



Diversity and distribution of macro lichens from Kalpetta Municipality of Wayanad District, Kerala, India

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Abstract: Macro lichens of Kalpetta Municipality of Wayanad District of Kerala state were studied. The study revealed about 21 macro lichen species. All the species identified are either foliose or fruticose forms belonging to families Coccocarpiaceae, Caliciaceae, Physciaceae, Parmeliaceae, Collemataceae, Lobariaceae, and Ramalinaceae indicating the dominance of these groups in the study area.

Keywords: Caliciaceae, Coccocarpiaceae, Collemataceae, foliose, fruticose, lichen diversity, Lobariaceae, Parmeliaceae, Physciaceae, Ramalinaceae.

India has a rich lichen diversity, represented by 2,513 species, 64 varieties and eight subspecies distributed in various regions (Nayaka 2014). Sinha et al. (2018) added publications after 2010 and recorded 2,714 species, about 14% of the total global lichen flora. Kerala has a rich lichen diversity, especially of micro forms, and exploration of the Western Ghats (Patwardhan 1983) have identified >400 species. Singh & Sinha (2010) listed 75 references related to lichen studies in Kerala, including reports by Kumar (2000), Easa (2003), Sequeira (2003 & 2007), Singh & Sinha (2010), and Biju et al. (2010).

Later reports include Nayaka & Upreti (2011), Biju et al. (2012), Bhat et al. (2011), Mesta & Kanivebagilu (2015), Sreekumar et al. (2017), and Zachariah et al. (2018, 2019, 2020). Nevertheless, several interesting habitats such as croplands, wetlands, and coastal areas remain unexplored.

Wayanad is a botanically rich area in Kerala, with an altitude ranging from 700 to 2,100 m. About 886 km² of the district is under forest. Kumar & Sequeira (2003) studied lichens from Chembra and Thirunelly hills of Wayanad District, but many gaps remain regarding this region. This study presents the first description of the diversity and distribution of macro lichens of Kalpetta municipality area of Wayanad district, which includes both natural forests and cultivated land.

MATERIALS AND METHODS

Study area

Wayanad is situated at 11.685°N, 76.132°E (Figure 1). The Wayanad plateau is one of the hotspot regions in the Western Ghats, and is part of the Nilgiri

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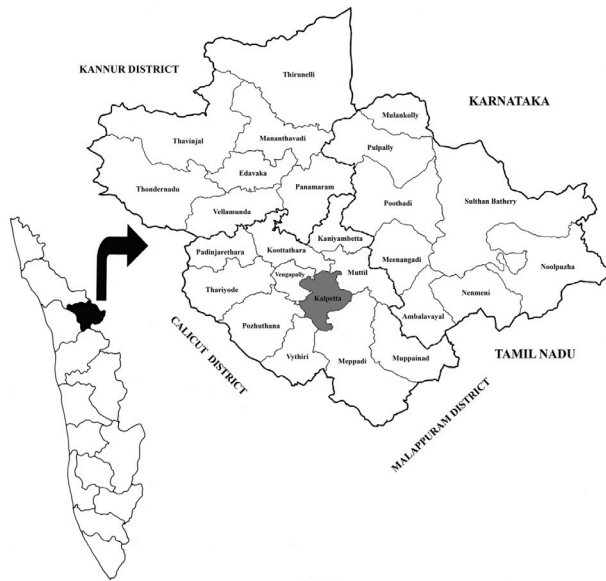


Figure 1. Location map of Wayanad district.

Biosphere Reserve. There are three municipal towns: Kalpetta, Mananthavady, and Sulthan Bathery. Kalpetta municipality comes under Vythiri Taluk and consists of 28 wards (Figure 2). The area is surrounded by coffee and tea plantations, and mountain ranges.

Lichen samples

A total of 112 lichen specimens were collected from 28 wards of Kalpetta Municipality during several field visits (Table 1). Samples were collected in brown acid-free bags of appropriate sizes. Corticolous and saxicolous lichens were collected along with the substratum using sharp chisels. Much care was taken to collect these specimens without any damage to the thallus margins. Fruticose lichens were collected with their holdfasts intact. All specimens were serially numbered in the field according to the date of collection. Characters of lichens which might be lost during drying and preservation—such as the colour of the thallus, reproductive structures, orientation of the specimen, details of associated plants, collection date, locality, and nature of substratum—were noted.

The specimens were dried, and the morphological details were examined under stereo zoom Leica S8 microscope, while anatomical details were examined with a Leica DM 1000 compound microscope with camera and image analysis software. Chemistry was studied by spot tests using 10% aqueous solution of potassium hydroxide, freshly prepared aqueous solution of calcium hypochlorite, 1–5% solution of para phenylenediamine and iodine solution. Thin layer

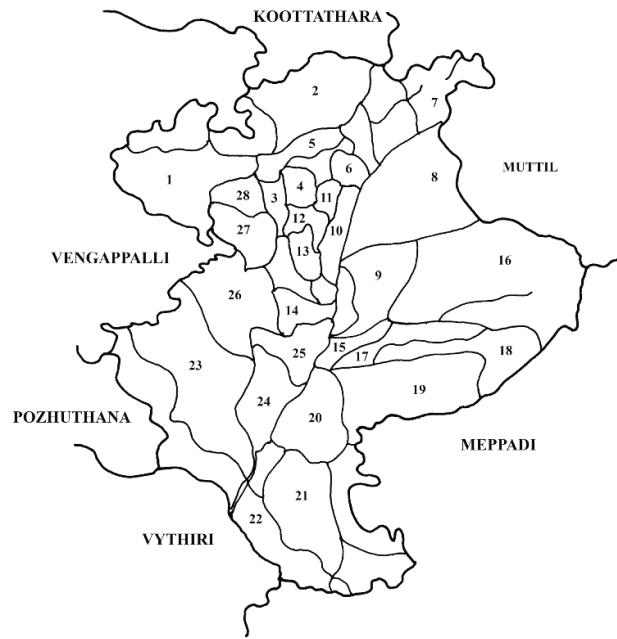


Figure 2. Map of Kalpetta Municipality showing collection localities. 1—Maniangode | 2—Puliyarmal | 3—Govt. High School | 4—Nedungode | 5—Emily | 6—Kanyagurukulam | 7—Kainatty | 8—Civil station | 9—Chathothuvayal | 10—Municipal Office | 11—Emily Thadam | 12—Ambilery | 13—Gramathu vayal | 14—Pallythazhe | 15—Puthiya Bus stand | 16—Pulpara | 17—Rattakolly | 18—Puthoorvayal Quarry | 19—Puthoorvayal | 20—Madiyoorkuni | 21—Perumthatta | 22—Vellaramkundu | 23—Adlayed | 24—Onivayal | 25—Turkey | 26—Edaguni | 27—Munderi | 28—Maravayal.

chromatography was performed in solvent system C following Orange et al. (2001). Recent literature, keys and descriptions (Awasthi 1991, 2007; Divakar & Upreti 2005; Wijayawardene et al. 2020) were followed for identification. Nomenclature was confirmed with the database Index Fungorum (<http://www.IndexFungorum.org>). Lichens were grouped on the basis of collected localities, type of growth forms, type of fungal partner etc. The identified specimens were deposited at the Lichen Herbarium, Department of Botany, Maharaja's College (Autonomous), Ernakulam, Kerala.

RESULTS AND DISCUSSION

Analysis of the collected specimens revealed 21 species belonging to seven families from the study area (Table 2). Of the identified samples, 20 were foliose and the remaining one, *Ramalina* sp. was fruticose. The family Physciaceae dominated with 10 species under three genera, followed by Parmeliaceae (5 species under 3 genera), Collemataceae (2 species under 1 genus), Coccocarpiaceae, Caliciaceae, Lobariaceae, and Ramalinaceae with one species and one genus. The genus *Heterodermia* dominated with seven species



Table 1. Details of localities surveyed.

Name of wards	Latitude	Longitude	Altitude
Munderi	11.620521°N	76.070955°E	728.33 m
Emily	11.626677°N	76.080325°E	760.99 m
Turkey	11.606147°N	76.078668°E	733.91 m
Ambilery	11.621339°N	76.07773°E	669.18 m
Vellaramkunnu	11.586156°N	76.06881°E	840.67 m
Onivayal	11.586156°N	76.06881°E	840.67 m
Gramathuvayal	11.618029°N	76.078388°E	712.88 m
Maravayal	11.620512°N	76.071083°E	723.79 m
Adlayed	11.594902°N	76.06158°E	768.18 m
Pallythazhe	11.614368°N	76.080902°E	721.18 m
Maniangode	11.631595°N	76.065617°E	729.76 m
Puthiya Bus Stand	11.607427°N	76.085316°E	766.97 m
Municipal Office	11.621060°N	76.08349°E	767.97 m
Rattakolly	11.602431°N	76.08917°E	764.76 m
Chathothuvayal	11.618887°N	76.086036°E	754.28 m
Nedungode	11.625475°N	76.080638°E	776.5 m
Govt.High School	11.624791°N	76.072009°E	725.85 m
Kainatty	11.636633°N	76.088925°E	741.82 m
Ambilery	11.625269°N	76.012530°E	670.18 m
Puliyarmala	11.638559°N	76.081451°E	669.04 m
Pulpara	11.605586°N	76.089836°E	774.33 m
Kanyagurukulam	11.638568°N	76.081403°E	602.6 m
Puthoorvayal	11.595779°N	76.092082°E	746.43 m
Puthoorvayal Quarry	11.594441°N	76.094251°E	779.86 m
Emily Thadam	11.622284°N	76.079384°E	743.73 m
Gramathuvayal	11.618329°N	76.078613°E	714.88 m
Madiyorkuni	11.569972°N	76.099636°E	779.69 m
Edaguni	11.697612°N	76.083492°E	745.68 m

followed by *Parmotrema* (3 species), *Physcia* (2 species), and *Leptogium* (2 species). Kumar (2000), recorded about 254 macrolichens from Kerala part of Western Ghats among which he recorded 18 species from Thirunelly and 14 species from Pakshipadalam area of Wayanad.

Corticolous species were dominated in both the natural as well as the cultivated ecosystems. Species such as *Leptogium denticulatum*, *Myelochroa perisidians*, and *Phaeophyscia ciliata* were found to be saxicolous in nature, while all others were corticolous inhabiting either on the trunks or branches of arboreal elements in the study area. Trunks of trees and small or medium sized rocks inside the ecosystems are the main microhabitats for most of the macrolichens in the study area. Environmental factors influence the lichen

community to a great extent and these organisms are very much sensitive to environmental changes and microhabitat has significant influence on lichen distribution (Fryday 2000).

Trees near road side like *Bauhinia purpurea*, *Mangifera indica*, *Bixa orellana*, *Roystonea regia*, *Casuarina equisetifolia*, and *Cassia fistula* hold very few lichen species such as *Coccocarpia palmicola*, *Phaeophyscia ciliatea*, and *Pseudocyphellaria aurata*. However, trees which are closer to the natural forests like *Artocarpus hirsutus*, *Dalbergia latifolia*, *Phyllanthus emblica*, *Helicteres isora*, *Ficus sp.*, *Mimusops elengi*, *Alstonia scholaris*, and *Lagerstroemia microcarpa* exhibit more lichens on their trunks and branches. Species like *Heterodermia comosa*, *H. galactophylla*, *H. hypochraea*, *H. speciosa*, *Leptogium denticulatum*, and *Myelochroa perisidians* were found distributed here. Environmental factors such as, light, humidity, rainfall, and stable microclimatic factors govern the distribution of lichen species in such habitats. The result shows strong competitive capability of some lichens and its wide ecological amplitude to survive on the road side trees which has high exposure to vehicular pollution. As per Larsen et al. (2007), transport-related pollution and bark acidity can influence lichen distribution in some areas.

Among cultivated ecosystems, arecanut and coconut plantations had a greater number of lichens than tea and coffee plantations. Macrolichens such as *Dirinaria consimilis*, *Hypotrachyna infirma*, *Parmotrema cristiferum*, *P. praesorediosum*, *P. tinctorum*, and *Physcia tribacoides* were found distributed in the arecanut plantations. Coconut plantations support species like *Dirinaria consimilis*, *Parmotrema tinctorum*, *P. praesorediosum*, *Physcia dilatata*, and *P. tribacoides*. However, tea plantations in the study area inhabit only three species, *Dirinaria consimilis*, *Physcia dilatata*, and *P. tribacoides*; and coffee plantations supports only *Physcia dilatata* and *P. tribacoides*. Since, trees are considered as the major supporting system for the successful growth of lichens in tropical vegetations, the bark character, aspects and height of the tree are of greater importance in the distribution of lichens (John 1992). Nayaka et al. (2006) enumerated the occurrence of 23 lichen species on coconut and arecanut orchard of Goa in which crustose lichens were dominated with 17 species, while foliose and fruticose lichens exhibit scarce growth.

With regard to the altitudinal variation, distribution and occurrence of lichens were highest from 840–860 m. The variation of species occurrence along the different

Table 2. Check list of lichens collected from the study area.

	Name	Family	Growth form	Substratum	Localities
1.	<i>Coccocarpia palmicola</i> (Spreng.) Arvidss. & D.J. Galloway	Coccocarpiaceae	Foliose	Corticolous	Munderi, Emily, Turkey, Ambilery, Vellaramkunnu Onivayal, Gramathuvayal
2.	<i>Dirinaria consimilis</i> (Stirton) D.D. Awasthi	Caliciaceae	Foliose	Corticolous	Maravayal, Adlayed, Pallythazhe
3.	<i>Heterodermia comosa</i> (Eschw.) Follmann & Redon	Physciaceae	Foliose	Corticolous	Maniangode, Emily, Puthiya Bus Stand, Municipal Office, Rattakolly, Vellaramkunnu
4.	<i>Heterodermia galactophylla</i> (Tuck.) W.L. Culb.	Physciaceae	Foliose	Corticolous	Civil Station, Onivayal, Chathothuvayal, Nedungode Adlayed, Govt.High School
5.	<i>Heterodermia hypocaesia</i> (Yasuda ex Rasanen) D.D. Awasthi	Physciaceae	Foliose	Corticolous	Civil Station, Kainatty, Rattakolly Perumthatta, Turkey, Edaguni Onivayal
6.	<i>Heterodermia hypochraea</i> (Vain.) Swinsc. & Krog	Physciaceae	Foliose	Corticolous	Civil Station
7.	<i>Heterodermia japonica</i> (M.Sato) Swinsc. & Krog	Physciaceae	Foliose	Corticolous	Maravayal, Nedungode, Perumthatta, Govt. High School, Puthoorvayal, Madiyoorkuni Edaguni
8.	<i>Heterodermia obscurata</i> (Nyl.) Trevis.	Physciaceae	Foliose	Corticolous	Civil Station, Nedungode, Puthoorvayal, Madiyoorkuni, Emily
9.	<i>Heterodermia speciosa</i> (Wulf.) Trevis.	Physciaceae	Foliose	Corticolous	Civil Station, Onivayal, Govt. High School, Edaguni, Maniangode, Adlayed
10.	<i>Hypotrachyna infirma</i> (Kurok.) Hale	Parmeliaceae	Foliose	Corticolous	Civil station, Edaguni, Madiyoorkuni, Ambilery Pallythazhe, Kainatty
11.	<i>Leptogium denticulatum</i> Nyl.	Collembataceae	Foliose	Saxicolous	Civil Station, Puliarmala, Ambilery, Pulpara, Rattakolly Vellaramkunnu
12.	<i>Leptogium</i> sp.	Collembataceae	Foliose	Saxicolous	Civil Station, Onivayal, Kanyagurukulam, Adlayed, Perumthatta
13.	<i>Myelochroa perisidians</i> (Nyl.) Elix & Hale	Parmeliaceae	Foliose	Saxicolous	Munderi, Turkey, Kanyagurukulam, Puthoorvayal Quarry
14.	<i>Parmotrema cristiferum</i> (Taylor) Hale	Parmeliaceae	Foliose	Corticolous	Emily, Pulpara, Turkey, Puliarmala, Perumthatta Puthoorvayal Quarry
15.	<i>Parmotrema praesorediosum</i> (Nyl.) Hale	Parmeliaceae	Foliose	Corticolous	Civil Station, Pulpara, Puthoorvayal, Emily, Thadam, Kanyagurukulam
16.	<i>Parmotrema tinctorum</i> (Despr. ex Nyl.) Hale	Parmeliaceae	Foliose	Corticolous	Rattakolly, Kainatty, Gramathuvayal, Turkey, Puthiya Bus Stand Municipal Office, Munderi
17.	<i>Phaeophyscia ciliata</i> (Hoffm.) Moberg	Physciaceae	Foliose	Saxicolous	Civil Station, Adlayed, Maniangode, Edaguni Perumthatta, Kainatty, Chathothuvayal
18.	<i>Physcia dilatata</i> Nyl.	Physciaceae	Foliose	Corticolous	Maravayal, Emily, Puthiya Bus Stand, Maravayal, Puliarmala
19.	<i>Physcia tribacoides</i> Nyl.	Physciaceae	Foliose	Corticolous	Puthoorvayal Quarry, Emily, Thadam, Maravayal
20.	<i>Pseudocyphellaria aurata</i> (Ach.) Vain.	Lobariaceae	Foliose	Corticolous	Civil Station, Edaguni, Chathothuvayal, Munderi Gramathuvayal, Municipal Office Maravayal, Puliarmala
21.	<i>Ramalina</i> sp.	Ramalinaceae	Fruticose	Corticolous	Munderi

altitudinal gradients shows that the distribution and occurrence of lichens vary with altitude. Negi & Upreti (2000) observed that species richness of lichens was low at lower altitude gradually rises to a peak at middle altitudes and then fall significantly at higher altitudes while working along the altitudinal gradients in the rock microhabitat of Hemis National Park, in Ladakh. Mishra & Upreti (2015) also observed that diversity of lichens changed with altitude in Govind Wildlife

Sanctuary, Uttarakhand. The most probable reason for poor diversity in different localities situated in lower altitudes may be due to environmental conditions, heavy anthropogenic pressure as the inhabitants of the villages largely depend for their fuel and fodder needs on the nearby forest area which resulted into destruction of forests.



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