Journal of Threatened Taxa

Building evidence for conservation globally

10.11609/jott.2021.13.14.20143-20310
www.threatenedtaxa.org

26 December 2021 (Online & Print)
Vol. 13 | No. 14 | Pages: 20143–20310

ISSN 0974-7907 (Online)
ISSN 0974-7893 (Print)

Open Access

ISSN 0974-7907 (Online); ISSN 0974-7893 (Print)

Publisher
Wildlife Information Liaison Development Society
www.wild.zooreach.org

Host
Zoo Outreach Organization
www.zooreach.org

No. 12, Thiruvannamalai Nagar, Saravanampatti - Kalapatti Road, Saravanampatti,
Coimbatore, Tamil Nadu 641035, India
Ph: +91 9385339863 | www.threatenedtaxa.org
Email: sanjay@threatenedtaxa.org

For Focus, Scope, Aims, and Policies, visit https://threatenedtaxa.org/index.php/JoTT/aims_scope
For Article Submission Guidelines, visit https://threatenedtaxa.org/index.php/JoTT/about/submissions
For Policies against Scientific Misconduct, visit https://threatenedtaxa.org/index.php/JoTT/policies_various

continued on the back inside cover

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

Journal of Threatened Taxa | www.threatenedtaxa.org | 26 December 2021 | 13(14): 20253–20257
ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)
https://doi.org/10.11609/jott.6706.13.14.20253-20257
#6706 | Received 13 September 2020 | Final received 14 November 2020 | Finally accepted 12 December 2021

SHORT COMMUNICATION

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

Greeshma Balu [1], A.R. Rasmi [2], Stephen Sequeira [3] & Biju Haridas [4]

[1,2] Post Graduate and Research Department of Botany, Govt. Victoria College, Palakkad, Kerala 678001, India.
[3] Lichenology Lab, Post Graduate and Research Department of Botany,, Maharajas College, Ernakulum, Kerala 682011, India.
[4] Microbiology Division, Jawaharlal Nehru Tropical Botanical garden and Research Institute, Palode, Thiruvananthapuram, Kerala 695562, India.
[1] kichugreeshma2@gmail.com, [2] rasmibotany@gmail.com (corresponding author), [3] step@rediffmail.com, [4] drbijutbgri@gmail.com

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), Sequiera (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 km^2 of the district is under forest. Kumar & Sequiera (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^{0}N, 76.132^{0}E (Figure 1). The Wayanad plateau is one of the hotspot regions in the Western Ghats, and is part of the Nilgiri

Editor: Anonymity requested.

Date of publication: 26 December 2021 (online & print)

Citation: Balu,, G., A.R. Rasmi, S. Sequeira & B. Haridas (2021). Diversity and distribution of macro lichens from Kalpetta Municipality of Wayanad District, Kerala, India. *Journal of Threatened Taxa* 13(14): 20253–20257. https://doi.org/10.11609/jott.6706.13.14.20253-20257

Funding: This work was funded by the Student project scheme of Kerala State Council for Science, Technology and Environment (File No: 01196 /SPS 64/2019/KSCSTE)

Competing interests: The authors declare no competing interests.

Acknowledgements: The authors are thankful to principals and heads of the Department of Botany, Maharaja's College, Ernakulam and Government Victoria College, Palakkad for providing necessary facilities. Thanks are also due to Arun Christy Sebastian, Aswathi Anilkumar, and Arsha S Mohan, research scholars, Lichenology Laboratory, Department of Botany, Maharaja's College, Ernakulam for the help rendered during the study. The first and third authors acknowledges Kerala State Council for Science, Technology and Environment (KSCSTE), Govt. of Kerala for the financial support. A special thanks to Aswin Sai who accompanied throughout the collection.

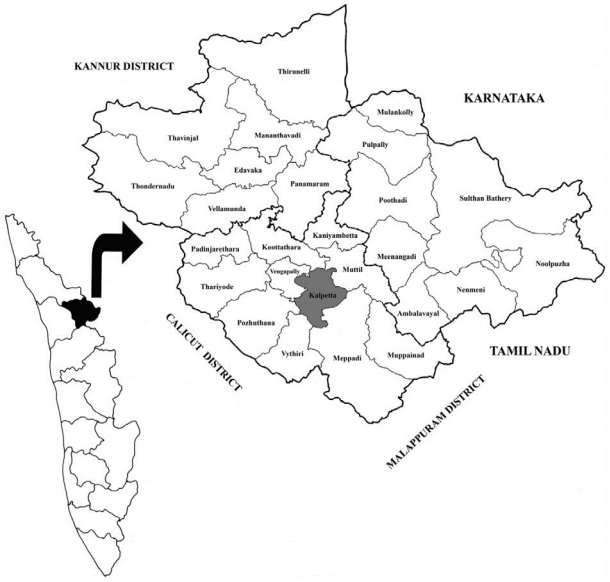

Figure 1. Location map of Wayanad district.

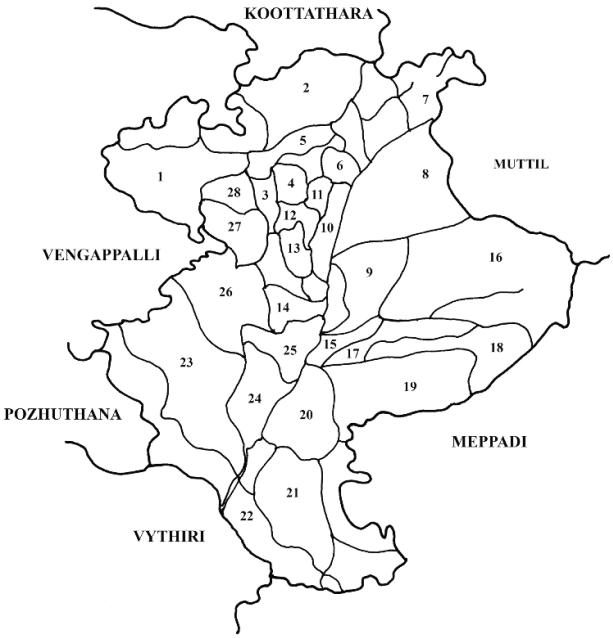

Figure 2. Map of Kalpetta Municipality showing collection localities. 1—Maniangode | 2—Puliyarmal | 3—Govt. High School | 4—Nedungode | 5—Emily | 6—Kanyagurukulam | 7—Kainatty | 8—Civil station | 9—Chathothuvayal 10—Municipal Office | 11—Emily Thadam | 12—Ambilery | 13—Gramathu vayal | 14—Pallythazhe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

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

References

Awasthi, D.D. (1991). A Key to the Microlichens of India, Nepal and Sri Lanka. *Bibliotheca Lichenologica* 40: 1–337.

Awasthi, D.D. (2007). *Compendium of the Macrolichens from India, Nepal and Sri Lanka*. Bishen Singh Mahendra Pal Singh, Dehradun, India, 580 pp.

Bhat, S., S.N. Dudani., M.D.S. Chandran & T.V. Ramachandra (2011). Lichens of Western Ghats. http://wgbis.ces.iisc.ernet.in/biodiversity/sahyadri_enews/newsletter/issue34/lichens_westernghats/index.htm

Biju, H., R.G. Bagool & S. Nayaka (2010). Additions to the lichen flora of Kerala State I: Parmelioid macro-lichens. *Journal of Economic and Taxonomic Botany* 34(4): 890–897.

Biju, H., R. Bagool, S.Nayaka & T. Palode (2012). Additions to the Lichen Flora of Kerala State II: Graphidaceae. *Journal of Economic and Taxonomic Botany* 36(4): 867–873.

Divakar, P.K. & D.K. Upreti (2005). *Parmelioid Lichens in India (A Revisionary study*). Bishen Singh Mahendra Pal Singh, Dehradun.

Easa, P.S. (2003). Biodiversity documentation of Kerala Part 3: Lichens. Kerala Forest Research Institute, Peechi, Kerala, 61 pp.

Fryday, A.M. (2000). The lichen vegetation associated with areas of late snow lie in the Scottish highlands. *Lichenologist* 33: 121–150.

John, E.A. (1992). Distribution patterns and inter thalline interactions of epiphytic foliose lichens. *Canadian Journal of Botany* 70: 818–823.

Kumar, M & S. Sequiera (2003). Notes on a collection of some lichens from Chembra and Thirunelly hills of Wayanad Districts, Kerala State, India. *Journal of Economic and Taxonomic Botany* 27(Suppl.): 1029–1039.

Kumar, M.S.M. (2000). Lichen (Macrolichen) Flora of Kerala Part of Western Ghats, KFRI Research Report 194, Kerala Forest Research Institute, Peechi, Kerala, 186 pp.

Larsen, R.S., J.N. B. Bell., P.W. James., P.J. Chimonides., F.J. Rumsey, A. Tremper & O.W. Purvis (2007). Lichen and bryophyte distribution on oak in London in relation to air pollution and bark acidity. *Environmental pollution* 146(2): 332–340.

Mesta, A.R. & V.S. Kanivebagilu (2015). Distribution Pattern and Ecology of Usneoid lichens in Western Ghats, Southern India. *Journal on New Biological Reports* 4: 247–254.

Mishra, G.K. & D.K. Upreti (2015). Altitudinal distribution of cetrarioid lichens in Govind Wildlife Sanctuary, Garhwal Himalaya, Uttarakhand, India. Geophytology 45(1): 9–19.

Nayaka, S., D.K. Upreti, S. Phatak & C. Samuel (2006). Preliminary observation on lichen flora of coconut and arecanut orchards of Goa, India. *Phytotaxonomy* 6: 23–25.

Nayaka, S. & D.K. Upreti (2011). Lichens diversity in Western Ghats: Need for quantitative assessment and conservation. Report of the Western Ghats Ecology Expert Panel. Ministry of Environment and Forests, Government of India, https://www.researchgate.net/publication/266143899

Nayaka, S. (2014). Methods and techniques in collection, preservation and identification of lichens, pp. 101–128. In: Rana, T.S., K.N. Nair & D.K. Upreti (eds.). Plant Taxonomy and Biosystematics–Classical and Modern Methods. New India Publishing Agency, New Delhi.

Negi, H.R. & D.K. Upreti 2000. Species diversity and relative abundance of lichens in Rumbak catchment of Hemis National Park in Ladhak. *Current Science* 78: 1105–1112.

Orange, A., P.W. James & F.J. White (2001). Microchemical methods for the identification of Lichens. British Lichen Society, Natural History Museum, London, UK.

Patwardhan, P.G. (1983). *Rare and endemic lichens of Western Ghats, South Western India*, pp. 318–322. In: Jain, S.K. & R.R. Rao (eds.). *An assessment of threatened plants of India.* Botanical Survey of India, Howrah.

Singh, K.P. & G.P. Sinha (2010). Indian lichens: an annotated checklist. Botanical Survey of India. Shiva Offset Press, Dehradun, Uttarakhand.

Sinha, G.P., S. Nayaka & S. Joseph (2018). Additions to the checklist of Indian lichens after 2010. *Cryptogam Biodiversity and Assessment* Special Volume (2018): 197–206. https://doi.org/10.21756/cab.esp16.

Sequiera, S. (2003). Taxonomy and Ecology of lichens of Silent Valley National Park, Southern Western Ghats, India. PhD Thesis, FRI, Dehradun.

Sequiera, S. (2007). Lichens of high ranges and their utilization potential. Technical report, KSCSTE, Thiruvananthapuram, 78 pp.

Sreekumar, V.B., K.H. Hussain & C. Renuka (2017). Virtual herbarium of Kerala Forest Research Institute, Peechi, Kerala, India. Current Science 112: 466–470.

Zachariah, S.A., S. Nayaka, S. Joseph, P. Gupta, S. Thomas & S.K. Varghese (2018). New and noteworthy records of lichens from Pathanamthitta district, Kerala. *Studies in Fungi* 3(1): 349–356. https://doi.org/10.5943/sif/3/1/35

Zachariah, S.A., S. Nayaka, P. Gupta & S.K. Varghese (2019). The lichen genus *Pyxine* (Caliciaceae) in Kerala state with *P. dactyloschmidtii* as new to India. *Hattoria* 10: 109–117.

Zachariah, S.A., S. Nayaka, S. Joseph, P. Gupta & S.K. Varghese (2020). Eleven new records of lichens to the state of Kerala, India. *Journal of Threatened Taxa* 12(10): 16402–16406. https://doi.org/10.11609/jott.5475.12.10.16402-16406

Wijayawardene, N.N., K.D. Hyde, L.K.T. Al-Ani, L. Tedersoo, D. Haelewaters, K.C. Rajeshkumar, R.L. Zhao, A. Aptroot, D. Leontyev, R.K. Saxena, Y.S. Tokarev, D.Q. Dai, P.M. Letcher, S.L. Stephenson, D. Ertz, H.T. Lumbsch, M. Kukwa, I.V. Issi, H. Madrid, A.J.L. Phillips, L. Selbmann, W.P. Pfliegler, E. Horváth, K. Bensch, P.M. Kirk, K. Kolaříková, H.A. Raja, R. Radek, V. Papp, V. Dima, J. Ma, E. Malosso, S. Takamatsu, G. Rambold, P.B. Gannibal, D. Triebel, A.K. Gautam, S. Avasthi, S. Suetrong, E. Timdal, S.C. Fryar, G. Delgado, M. Réblová, M. Doilom, S. Dolatabadi, J. Pawłowska, R. Humber, R. Kodsueb, I. Sánchez-Castro, B.T. Goto, D.K.A. Silva, F.A. de Souza, F.Oehl, G.A. da Silva, I.R. Silva, J. Błaszkowski, K. Jobim, L. Maia, F. Barbosa, P. Fiuza, P. Divakar, B. Shenoy, R.F. Castañeda-Ruiz, S. Somrithipol, A.A. Lateef, S.C. Karunarathna, S. Tibpromma, P.E. Mortimer, D.N. Wanasinghe, R. Phookamsak, J. Xu, Y. Wang, F. Tian, P. Alvarado, D.W. Li, I. Kušan, N. Matočec, A. Mešić, Z. Tkalčec, S. Maharachchikumbura, M. Papizadeh, G. Heredia, F. Wartchow, M. Bakhshi, E. Boehm, N. Youssef, V. Hustad, J. Lawrey, A. Santiago, J. Bezerra, C. Souza-Motta, A. Firmino, Q. Tian, J. Houbraken, S. Hongsanan, K. Tanaka, A. Dissanayake, J. Monteiro, H. Grossart, A. Suija, G. Weerakoon, J. Etayo, A. Tsurykau, V. Vázquez, P. Mungai, U. Damm, Q.R. Li, H. Zhang, S. Boonmee, Y.Z. Lu, A.G. Becerra, B. Kendrick, F.Q. Brearley, J. Motiejūnaitė, B. Sharma, R. Khare, S. Gaikwad, D. Wijesundara, L. Tang, M. He, A. Flakus, P. Rodriguez-Flakus, M. Zhurbenko, E. McKenzie, M. Stadler, D. Bhat, J. Liu, M. Raza, R. Jeewon, E. Nassonova, M. Prieto, R. Jayalal, M. Erdoğdu, A. Yurkov, M. Schnittler, O. Shchepin, Y. Novozhilov, A. Silva-Filho, E. Gentekaki, P. Liu, J. Cavender, Y. Kang, S. Mohammad, L. Zhang, R. Xu, Y. Li, M. Dayarathne, A. Ekanayaka, T. Wen, C. Deng, O. Pereira, S. Navathe, D. Hawksworth, X. Fan, L. Dissanayake, E. Kuhnert, H. Grossart & M. Thines (2020). Outline of Fungi and fungus-like taxa. *Mycosphere* 11(1): 1060–1456. https://doi.org/10.5943/mycosphere/11/1/8

Journal of Threatened Taxa is indexed/abstracted in Bibliography of Systematic Mycology, Biological Abstracts, BIOSIS Previews, CAB Abstracts, EBSCO, Google Scholar, Index Copernicus, Index Fungorum, JournalSeek, National Academy of Agricultural Sciences, NewJour, OCLC WorldCat, SCOPUS, Stanford University Libraries, Virtual Library of Biology, Zoological Records.

NAAS rating (India) 5.64

Print copies of the Journal are available at cost. Write to:
The Managing Editor, JoTT,
c/o Wildlife Information Liaison Development Society,
No. 12, Thiruvannamalai Nagar, Saravanampatti - Kalapatti Road,
Saravanampatti, Coimbatore, Tamil Nadu 641035, India
ravi@threatenedtaxa.org

Journal of Threatened Taxa

www.threatenedtaxa.org

ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)

December 2021 | Vol. 13 | No. 14 | Pages: 20143–20310
Date of Publication: 26 December 2021 (Online & Print)
DOI: 10.11609/jott.2021.13.14.20143-20310

Publisher & Host

WILD ZOOREACH
Threatened Taxa