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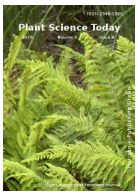

Research Article

Diversity and Distribution of Tropical Macrolichens in Shettihalli Wildlife Sanctuary, Western Ghats, Southern India

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Abstract

A total of 58 species of lichens were documented from the present study area, which is located between 13°40′ and 14°05′ N to 75°10′ and 75°35′ E longitude with wide range of ecosystem diversity at Shettihalli Wildlife Sanctuary, Shimoga district of Karnataka, India. We have surveyed a total area of 396 sq km which supports for 111 species of lichens belongs to 41 genera from 22 families. Some important lichen genera of the areas are *Ramalina*, *Usnea*, *Heteroderma* and *Parmotrema*. Corticolous lichens were found to be dominated in the area (86%). Crustose lichens were represented by 54 species followed by foliose (43) and fruticose (14) species. The present investigations showed that the deciduous forests support a good macrolichen community's diversity then the semi-evergreen forests in nearby area. An interesting observation made in the area is that fruticose lichens were restricted to branches of the tree and main trunk was dominated by foliose lichens. Important host trees which support the growth and distribution of lichens in the area are *Tectona grandis,Terminalia* spp., *Adina cordifolia, Hopea* spp., and *Xylia xylocarpa.*

Keywords
Macrolichens; Tropical lichens; Shettihali; *Parmotrema*

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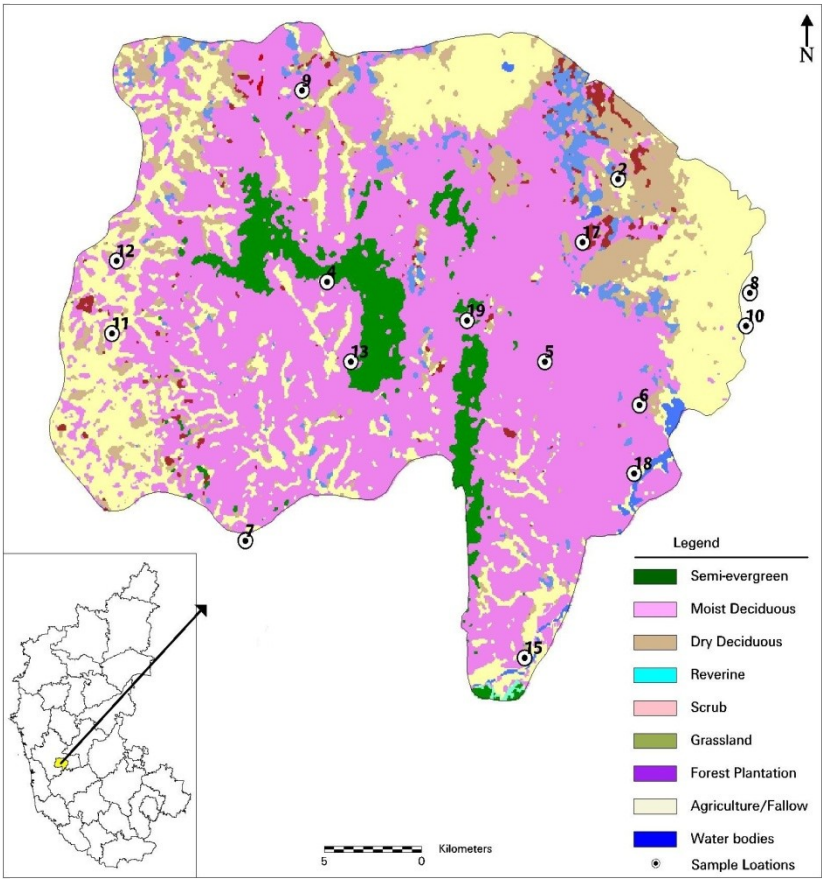
Introduction

Lichens are the complex organisms involve a symbiotic relationship between phycobionts and a mycobiont and have attracted considerable attention because they perceived position in the ladder of evolution to land plants (Hale, 1967). They are often observed as the most significant bioindicators. Lichens form an important floral community playing a major role in ecological indication and succession. They are utilized commercially for enzymes, acids and pigments. The Western Ghats of Karnataka harbour valuable plant resource including lichens, microbes, mosses and other lower plants. The species richness is a fundamental measure of biodiversity and current trends of declining species richness in many regions of the world are major ecological, economic and cultural problem. Understanding the pattern of diversity and distribution of organisms is a key aspect in conservation and management, Ecologists are often concerned with patterns of species diversity, which for any large may be governed by multiple environment (Sequiera and Kumar, 2008). Lichens are often abundant in habitats with an alternation of humid and xeric phases or in extreme environments of high altitude or latitude (Kappen, 1973). They produce characteristic secondary metabolites that



Site Number	Location	Altitude (in Meters)
1	Arasalu	667
2	Anupinakatte	642
3	Ayanur	675
4	Belur	816
5	Chitrashettihalli	679
6	Gajanur	612
7	Hanagere	648
8	Harakere	585
9	Harohitalu	713
10	Hosahalli	589
11	Kaggudi	715
12	Kammachi	688
13	Karakunji	880
14	Mallur	665
15	Mandagadee	614
16	Mandaghatta	703
17	Puradal	705
18	Sakkarebylu	609
19	Shettihalli	781
20	Tavarekoppa	695

Fig. 1 GIS Map of the study area with study sites

are unique with respect to those of higher plants (Lawrey, 1986). Lichen metabolites exert a wide variety of biological actions including antibiotic, antimycobacterial, antiviral, anti-inflammatory, analgesic, antipyretic, antiproliferative and cytotoxic effects (Muller, 2002).In the present study we have carry out the diversity and distribution pattern in various forest types of the sanctuary.

Materials and Methods

Study area

Shettihalli Wildlife sanctuary spread over parts of three taluks of Shimoga district viz. Shimoga, Hosanagara and Thirthahalli covering 369.60 sq km.13°40′ and 14°05′ N and longitudes 75°10′ and 75°35′ E Latitude the area comprises the forests of Western Ghats and its fringes (Fig.1). It covers dry deciduous, moist deciduous and semi-evergreen forests of Sahydri hills of Western Ghats. The important tree species were *Tectona*, *Santalum*, *Lagstromia*, *Pteriocarpus* species etc. The average rainfall of the area is 2000mm.Climate is humid and wet with average temperature being about 15°C to 36°C.

Surveying and Sampling

Survey was done regularly in the different habitats and particularly sensitive to timing and location of observation. Survey was carried out by using transect method. Each transects measuring 50x10 m laid in different forest locations of study site. A total of 20 transects were laid in different types of vegetation. In each transect all substrates were thoroughly searched for the occurrence of lichens. All the stems surveyed for lichens on the basis of presence or absence of lichens up to the breast height. The altitude was recorded with a hand-held GPS, (Garmin e-trex, USA) relative humidity (RH) (digital thermo-hygrometer, 288CTH Euro lab), temperature, microhabitat data were recorded in each transect. The pH of the tree bark was estimated (Kricke, 2002) and also recorded the bark texture they grouped as rough, smooth and moderate. The host tree species were identified with the help of published floras (Gamble 2000; Neginhal 2004).

Collection and Identification

The representative lichen specimens were collected along with their substratum irrespectively of their growth form. Only the lichens that were very loosely attached to substratum was scraped out and collected. The corticolous lichens growing on tree trunk at reachable height usually collected and canopy lichens found fallen on ground was collected. Superficial bark was removed with the help of chisel by knife in order to avoid damage to the trees. In case of saxicolous lichens smaller pieces of the rock substrate was collected.

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Table 1: List of Lichens species in the study area with their growth forms (GF), substrate and Importance value Index (IVI)

Sl. No.	Species	Family	GF	Substrate RD	RD	IVI
	MACROLICHENS					
1.	*Bulbothrix isidiza* (Nyl.) Hale	Parmeliaceae	F	Cor	2.0	1.1	3.1
2.	*Coccocarpia palmicla* (Spreng.) Arvidss. & D.J. Galloway	Coccocarpiaceae	F	Cor	0.8	0.9	1.7
3.	*C.erythroxyli* (Spreng.) Swinsc.& Krog	Coccocarpiaceae	F	Cor/Sax	0.7	0.7	1.3
4.	*Dirinaria applanata* (Fée) D.D.Awasthi	Physciaceae	F	Sax	0.8	0.8	1.6
5.	*D. confluens*(Fr.) D.D.Awasthi	Physciaceae	F	Cor	0.8	0.7	1.4
6.	*Heterodermia albidiflava* (Kurok.) D.D. Awasthi	Physciaceae	F	Cor	0.8	0.5	1.4
7.	*H. angustiloba* (Müll. Arg.) D.D. Awasthi	Physciaceae	F	Cor	0.9	0.8	1.7
8.	*H. dendritica* (Pers.)Poelt	Physciaceae	F	Cor	1.3	0.9	2.1
9.	*H. diademata* (Taylor) D.D.Awasthi	Physciaceae	F	Cor/Sax	1.9	1.3	3.2
10.	*H. dissecta*(Kurok.) D.D.Awasthi	Physciaceae	F	Cor	2.3	1.6	4.0
11.	*H. firmula*(Nyl.) Trevis.	Physciaceae	F	Ter/sax	0.7	1.2	1.9
12.	*H. incana* (Stirt.) D.D.Awasthi	Physciaceae	F	Cor	0.6	1.1	1.7
13.	*H. microphylla* (Kurok.) Skorepa	Physciaceae	F	Sax	0.7	0.9	1.6
14.	*H. obscurata*(Nyl.)Trevis.	Physciaceae	F	Cor	0.8	1.3	2.1
15.	*H. pseudospeciosa* (Kurok.) W. L. Culb.	Physciaceae	F	Cor/Sax	0.8	1.2	2.0
16.	*H. speciosa*(Wulf.) Trevis	Physciaceae	F	Cor	0.7	1.0	1.7
17.	*H. tremulans* (Müll. Arg.) W. L. Culb.	Physciaceae	F	Cor	0.8	0.7	1.4
18.	*Hypotrachyna awasthii* Hale &Patwardhan	Parmeliaceae	F	Cor	0.9	0.9	1.8
19.	*H. crenata*(Kurok.) Hale	Parmeliaceae	F	Cor	0.8	0.7	1.5
20.	*Lecanoraindica*Zahlbr.	Lecanoraceae	F	Sax	0.8	0.7	1.4
21.	*Leptogiumburnetiae*C.W. Dodge	Collemataceae	F	Cor/Sax	0.9	1.0	1.9
22.	*L. chloromelum*(Sw.) Nyl.	Collemataceae	F	Cor	0.8	1.2	2.0
23.	*L. denticulatum*Nyl.	Collemataceae	F	Cor	0.8	1.3	2.1
24.	*L. ulvaceum*(Pers.) Vain.	Collemataceae	F	Cor	0.9	0.9	1.8
25.	*Myelochroa xantholepis*(Mont.& Bosch) Elix& Hale	Parmeliaceae	F	Cor/Sax	0.9	0.5	1.4
26.	*Parmelinella wallichiana* (Taylor) Elix and Hale	Parmeliaceae	F	Cor/Sax	1.3	1.3	2.6
27.	*Parmotrema austrosinense* (Zahlbr.) Hale	Parmeliaceae	F	Cor	1.4	1.2	2.6
28.	*P. cristiferum* (Taylor) Hale	Parmeliaceae	F	Cor	1.9	1.5	3.4
29.	*P. hababianum* (Gyeln.) Hale	Parmeliaceae	F	Cor	1.3	1.0	2.3
30.	*P. praesorediosum*(Nyl.) Hale	Parmeliaceae	F	Sax	1.0	0.9	1.9
31.	*P. reticulatum*(Taylor) M. Choisy	Parmeliaceae	F	Cor	2.1	1.4	3.5
32.	*P. stuppeum*(Taylor) Hale	Parmeliaceae	F	Cor/Sax	1.5	1.6	3.1
33.	*P. tinctorum* (Despr.ex Nyl.) Hale	Parmeliaceae	F	Cor/Sax	2.4	1.7	4.2
34.	*P. vartakii*Hale	Parmeliaceae	F	Cor	0.8	0.3	1.2
35.	*Phaeophyscia orbicularis* (Neck.) Moberg	Physciaceae	F	Cor	0.9	0.8	1.6
36.	*Phyllopsora corallina* (Eschw.) Müll. Arg.	Biotoraceae	F	Cor	0.9	1.2	2.1
37.	*Pseudocyphellaria aurata* (Ach.) Vain.	Lobariaceae	F	Cor	0.9	0.8	1.7
38.	*Pyxinecoccifera*(Fée) Nyl.	Physciaceae	F	Cor	1.0	1.1	2.1
39.	*P. cocoes*(Sw.) Nyl.	Physciaceae	F	Cor	0.8	0.9	1.7
40.	*P. minuta*Vain.	Physciaceae	F	Sax	0.9	0.8	1.6
41.	*P. reticulata*(Vain.) Vain.	Physciaceae	F	Cor	0.9	0.8	1.7
42.	*P. sorediata*(Ach.) Mont.	Physciaceae	F	Cor	1.2	0.8	1.9
43.	*Ramalina conduplicans* Vain.	Ramalinaceae	Fr	Cor	1.0	0.5	1.5
44.	*R. hossei* Vain.	Ramalinaceae	Fr	Cor	0.8	0.8	1.5
45.	*R. hossei var.* divaricata H.Magn. & G.Awasthi	Ramalinaceae	Fr	Cor	1.1	1.0	2.0
46.	*R. pacifica* Asahina	Ramalinaceae	Fr	Cor	0.7	0.8	1.4

Table 1 Contd: List of Lichens species in the study area with their growth forms (GF), substrate and Importance value Index (IVI)

Sl. No.	Species	Family	GF	Substrate	RD	RD	IVI
	MACROLICHENS						
47.	*R. pollinaria* (Westr.) Ach.	Ramalinaceae	Fr	Cor	1.0	1.3	2.3
48.	*Roccella montagnei* Bél.	Roccellaceae	Fr	Cor	0.9	1.2	2.1
49.	*Teloschistes flavicans* (Sw.) Norm.	Teloschistaceae	Fr	Cor	0.7	1.0	1.6
50.	*Usnea aciculifera* Vain.	Parmeliaceae	Fr	Cor	0.6	0.5	1.2
51.	*U. eumitrioides* Mot.	Parmeliaceae	Fr	Cor	0.8	0.8	1.5
52.	*U. galbinifera* Asahina	Parmeliaceae	Fr	Cor	0.8	1.0	1.8
53.	*U. pictoides* G. Awasthi	Parmeliaceae	Fr	Cor	0.7	0.7	1.4
54.	*U. stigmatoides* G.Awasthi	Parmeliaceae	Fr	Cor	0.8	0.5	1.4
55.	*U. undulata*Stirt.	Parmeliaceae	Fr	Cor	0.9	1.0	1.9
56.	*U. vegae* Mot.	Parmeliaceae	Fr	Cor	1.2	1.1	2.3
57.	*Xanthoparmelia congensis* (B.Stein) Hale	Parmeliaceae	F	Sax	1.1	1.2	2.3
	MICROLICHENS						
58.	*Arthonia medusula* (Pers.) Nyl.	Arthoniaceae	C	Cor	0.8	0.8	1.6
59.	*A. reniformis* (Pers.) Röhl.	Arthoniaceae	C	Cor	0.7	0.9	1.6
60.	*Brigantiaea leucoxantha* (Sprengel) R.Sant.& Hafellner nigra D.D. Awasthi	Brigantiaceae	C	Sax	0.8	0.7	1.5
61.	*B. nigra* D.D. Awasthi	Brigantiaceae	C	Cor	0.9	0.7	1.5
62.	*Buelliainornata*(Stirt.) Zahlbr.	Physciaceae	C	Cor	0.9	0.9	1.8
63.	*B.punctata* (Hoffm.) A.Massal.	Physciaceae	C	Cor	0.7	1.0	1.7
64.	*Caloplaca flavorubescens* (Huds.) J. R. Laundon	Teloschistaceae	C	Sax	0.7	0.8	1.5
65.	*Cryptothecia culbersonae* Patw. & Makh.	Arthoniaceae	C	Cor	0.7	0.9	1.5
66.	*Diploschistes megalosporus* Lumbsch & H. Mayrhofer	Thelotremataceae	C	Cor	0.6	0.8	1.3
67.	*Graphina fissofurcata* (Leighton) Müll.Arg.	Graphidaceae	C	Cor	0.5	1.0	1.5
68.	*G. junghuhnii* (Mont. & Bosh) Müll. Arg.	Graphidaceae	C	Cor	0.7	0.7	1.3
69.	*G. nylanderi* Patw. & Kulk.	Graphidaceae	C	Cor	0.5	0.7	1.2
70.	*Graphis aphanes* Mont. & Bosch	Graphidaceae	C	Cor	0.6	0.7	1.3
71.	*G .celata* Stirton	Graphidaceae	C	Cor	0.4	0.7	1.1
72.	*G. congesta* (Fée) Müll. Arg.	Graphidaceae	C	Cor	0.9	0.7	1.6
73.	*G. dumastii* (Fée) Sprengel	Graphidaceae	C	Cor	0.8	0.8	1.5
74.	*G. grammitis* Fée	Graphidaceae	C	Cor	1.0	0.9	1.9
75.	*G. longiramea* Müll. Arg.	Graphidaceae	C	Cor	1.2	1.0	2.1
76.	*G. pyrrhocheiloides* Zahlbr.	Graphidaceae	C	Cor	0.8	1.1	1.9
77.	*G. scripta*(L.) Ach.	Graphidaceae	C	Cor	0.7	1.3	2.0
78.	*Laurera aurantiaca* Makhija & Patw.	Trypetheliaceae	C	Cor	0.9	0.9	1.8
79.	*Letrouitia domingensis* (Pers.) Hafellner & Bellem.	Letrouitiaceae	C	Cor	0.9	0.9	1.8
80.	*Megalospora tuberculosa* (Fée) Sipman	Megalosporaceae	C	Cor	0.8	1.0	1.8
81.	*Myriotrema microporum*(Mont.) Hale	Thelotremataceae	C	Cor	0.8	1.0	1.8
82.	*Ocellularia allosporpides* (Nyl.) Patw. & C. R. Kulk.	Thelotremataceae	C	Cor	1.3	1.3	2.6
83.	*O. arecae* (Vain.) Hale	Thelotremataceae	C	Cor	0.9	0.9	1.8
84.	*O. canariana* Patw.& al.	Thelotremataceae	C	Cor	0.9	1.0	1.9
85.	*O. karnatakensis* Hale	Thelotremataceae	C	Cor	0.7	0.9	1.5
86.	*Opegrapha leptoterode s*Nyl.	Opheographeaceae	C	Cor	0.9	0.9	1.8
87.	*O. longula*Nyl.	Opheographeaceae	C	Cor	0.8	1.0	1.8
88.	*Pertusaria albescens* (Huds.) M. Choisy & Werner	Pertusariaceae	C	Cor	0.8	1.1	1.9
89.	*P. concinna* Erichsen	Pertusariaceae	C	Cor	0.7	0.8	1.5
90.	*P. leucosora* Nyl.	Pertusariaceae	C	Cor	0.4	0.5	1.0

Table 1 Contd: List of Lichens species in the study area with their growth forms (GF), substrate and Importance value Index (IVI)

Sl. No.	Species	Family	GF	Substrate	RD	RD	IVI
	MICROLICHENS						
91.	*P.leucosorodes* Nyl.	Pertusariaceae	C	Cor	0.8	0.7	1.4
92.	*Phaeographina sp.*	Graphidaceae	C	Cor	0.9	0.8	1.7
93.	*P. limbata* Müll. Arg.	Graphidaceae	C	Cor	0.5	0.4	0.9
94.	*P. wattiana* Müll. Arg.	Graphidaceae	C	Cor	0.6	0.7	1.3
95.	*Phaeographis nilgiriensis* Kr. P. Singh & D. D Awasthi	Graphidaceae	C	Cor	0.8	0.8	1.5
96.	*P.submarcescens*(Leight.) Zahlbr.	Graphidaceae	C	Cor	0.7	0.7	1.3
97.	*Porina americana* Fée	Trichotheliaceae	C	Sax	0.6	0.8	1.3
98.	*P. innata* (Nyl.) Müll. Arg.	Trichotheliaceae	C	Cor	0.7	0.9	1.6
99.	*P. interestes*(Nyl.) Harm.	Trichotheliaceae	C	Cor	0.7	1.0	1.6
100.	*P. subinterestes* (Nyl.) Müll. Arg.	Trichotheliaceae	C	Cor	0.7	0.7	1.3
101.	*Pyrenula cayennensis* Müll. Arg.	Pyrenulaceae	C	Cor	0.8	0.8	1.6
102.	*P. elegans*A.Singh&Upreti	Pyrenulaceae	C	Cor	0.9	1.1	2.0
103.	*P. immersa* Müll. Arg.	Pyrenulaceae	C	Cor	0.7	0.7	1.3
104.	*Strigula elegans*(Fée) Müll. Arg.	Strigulaceae	C	Cor	0.5	0.5	1.0
105.	*Thelotrema canarense Patw. & Kulk.*	Thelotremataceae	C	Cor	1.0	1.3	2.3
106.	*T. confertumNagarkar, Sethy and Patw.*	Thelotremataceae	C	Cor	0.9	1.0	1.9
107.	*T. kamatii* (Patw. & Kulk.) Hale	Thelotremataceae	C	Cor	0.7	0.7	1.3
108.	*T. leprocarpum* (Nyl.) Tuck.	Thelotremataceae	C	Cor	0.9	1.0	1.9
109.	*Trypethelium catervarium* (Fée) Tuck.	Trypetheliaceae	C	Cor	0.8	0.7	1.4
110.	*T. eluteriae* Spreng.	Trypetheliaceae	C	Cor	0.7	0.8	1.4
111.	*T. tropicum* (Ach.) Müll. Arg.	Trypetheliaceae	C	Cor	0.9	1.0	1.9

GF-Growth form, C-Crustose, F-Foliose, Fr- Fruticose, Cor-Corticolous, Ter-Terricolous, Sax-Saxicolous, RD-Relative Density, RF-Relative frequency, IVI- Importance value Index

The collected specimens were made to dry under sun. During winter and rainy season, the material was dried with the help of a hot air oven. The lichen herbarium packets were made with a thick white or brown handmade acid free paper. The process of identification of lichens was done on the basis of the morphology, anatomy and chemical test (Awasthi 2000). All lichen specimens were preserved in the herbarium of the Department of Applied Botany, Kuvempu University, Shimoga, Karnataka.

Results and Discussion

A total of 1809 individuals belongs to 111 species were encountered in all the surveyed localities of Shettihalli Wildlife Sanctuary, Karnataka. These were belongs to 41 genera placed among 22 families. The cortcolious lichens (Fig. 2) were found luxuriantly as they represented by 101species, followed by nine saxicolous and one terricolous lichen species (Table 1).

The lichen flora shows strong correlation with the climatic conditions and arboreal elements of the flora of the regions. Present study also show the same results that the distribution of the lichens are mutually varies with climatic variation in the deciduous forest regions had maximum number of macrolichens and shola forests showed more number of microlichens. Our study results in rich diversity with a total of 111 species from 41 genera (Negi, 2000; Balaji and Hariharan, 2004). Shettihalli Wildlife Sanctuary has different types of forests where, these are also harbouring high species richness of lichens. The forest of Shettihalli Wildlife Sanctuary dominated by moist and dry deciduous forests as these types of vegetation supports the growth of macrolichens. The important macrolichen species growing in these forests such as *Dirinaria, Pyxine, Lecanora, Heterodermia, Parmotrema, Usnea, Ramalina* and several other species (Negi and Gadgil, 1996; Balaji and Hariharan, 2004). Macrolichens were documented in similar habitats of costal Brazil (Marcelli, 1991) and in South Eastearn Australia (Pharo and Beattie, 1997).

The members of families Parmeliaceae (22), Physciaceae (22), Graphidaceae (16) and Thelotremataceae (10) exhibited the maximum diversity in the area (Fig. 3). The families like Roccellaceae, Strigulaceae, Lobariaceae and Biotraceae represented by single species each. The species *Parmotrema tinctorum* (Parmeliaceae) is represented by 44 individuals with IVI of 4.18 with relative density of 2.4 & relative frequency of 1.75 followed by *Heterodermia dissecta, Parmotrema*

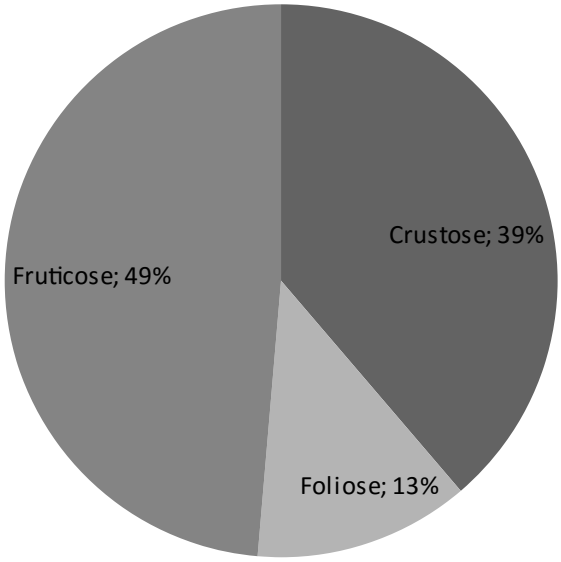

Fig. 2 Growth forms of lichens recorded in Shettihalli Wildlife Sanctuary

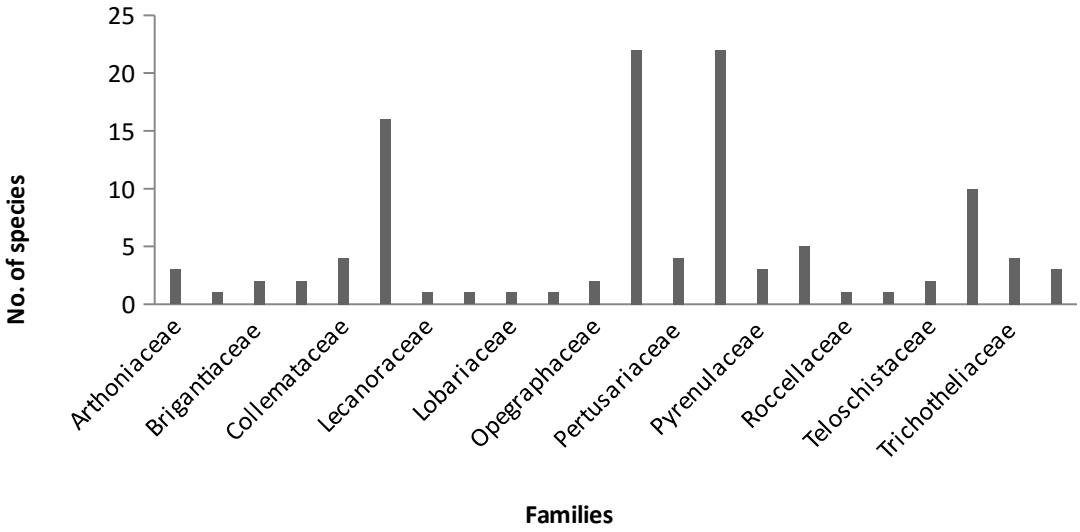

Fig. 3 Family Importance value recorded in Shettihali Wildlife Sanctuary

reticulatum, Parmotrema cristiferum with IVI of 3.96, 3.52, 3.41 respectively. The *Pertusaria limbata* and *Pertusaria leucosora* showing lower IVI of 0.93 and 0.99 respectively (Table 1).

Saxicolous lichens were representing by *Dirinaria applanata, Lecanora indica, Parmotrema grayanum, Leptogium chloromelum*. Some macrolichen species showed specificity to a particular host tree which could be attributed to various ecological conditions. *Roccella montagnei* were specific to host *Mangifera indica*. *Usnea stigmatoides* were corticolous species reported from deciduous forests only. *Coccocarpiaerythroxyli* and *Heterodermia speciosa* hosted by *Litsea floribunda* and some *Usnea* species were supported by branches of *Tectona grandis* and *Syzygium* species. *Pyxine coccifera* and *Dirinaria applanata* were resistant to pollutions and they grow in almost open areas and scrubby forests and dry regions of study area. *Parmotrema tinctorum, P. cristiferum, Parmelinella wallichiana, Haterodermia diademata, H. dissecta* and *Leptogium burnetiae* were commonly distributed in deciduous and semi-evergreen forests. *Parmotrema tinctorum* and *Leptogium burnetiae* were most common genera growing both in deciduous and semi-evergreen forests. *Parmotrema reticulatum and Ramalina pacifica, R.conduplicans and Usnea galbinifera* were rich in deciduous forests and semi-evergreen forests were dominated by Thelotrematacеae and Graphidaceaeous members.

In the present study found that over 64% species of lichens occurred on woody component and highest diversity in evergreen forests is associated with an increase in crustose species and decrease in foliose species. In the dry deciduous forests, diversity in crustose species varies with fire and forest history, but foliose diversity is

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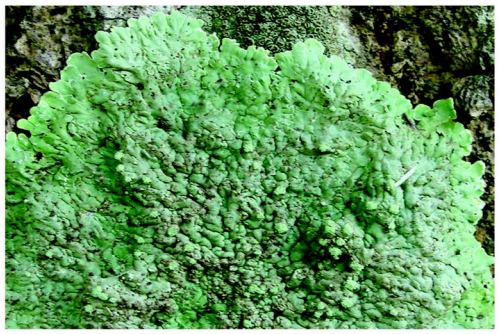


Dirinaria confluens (Fr.) D.D. Awasthi

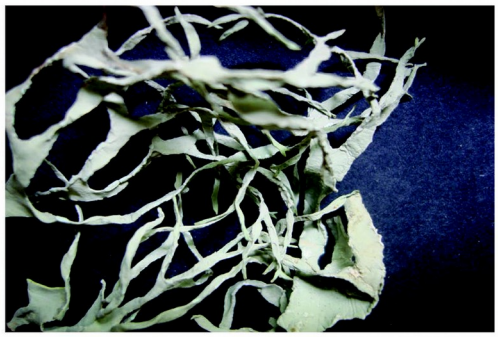
Heterodermia dissecta (Kurok.) D.D.Awasthi

Parmotrema cristiferum (Taylor) Hale

Leptogium chloromelum (Sw.) Nyl.

Ramalina hossei Vain.

Usnea stigmatoides G. Awasthi



Roccella montagnei Bél.

Usnea galbinifera Asahina

Plate I: Pictorial representation some important lichens species of the Shettihali Wildlife Sanctuary

lowest in regularly burnt plots variation with tree species (Wolsely & Hudson, 1997b).

The corticolous taxa in the seasonal tropics of Southeast Asia can be used to indicate, areas of long ecological continuity, areas of high biodiversity and areas where degradation of forests is occurring (Wolsely & Hudson, 1997a). Shettihalli Wildlife Sanctuary represents more number of corticolous lichens (90.9%) and also results that the higher altitude contains less percentage of lichens when compare to lower altitudes.

Alpha diversity index, i.e., shannon-winner and simpson index was found to be 4.65 and 0.99

Table 2. Showing bark texture, moisture, pH and number of colonies on different host tree species distribution in Shettihalli Wildlife Sanctuary

Sl. No.	Host tree	Bark texture	Bark moisture	Bark pH	No of colonies	Dominant genera
1	*Anogeissus latifolia* (Roxb. ex DC.) Wall. ex Guill. and Perr.	Smooth	17.4	4.9	2	-
2	*Bauhinia malabarica*Roxb.	Moderate	21.2	5.5	9	*Parmotrema*
3	*Butea monosperma* (Lam.) Taub.	Moderate	12.9	5.5	5	-
4	*Canthium* sp.	Moderate	12	6.8	12	-
5	*Cassia siamea*Lamk.	Rough	11.5	5.5	11	*Heterodermia*
6	*Cassine glauca* (Rotth.) Kuntze	Rough	9.6	4.8	14	*Parmotrema* and *Pyxine*
7	*Dalbergialatifolia*Roxb.	Moderate	21	5.6	9	*Parmotrema*
8	*Delonixregia* (Bojer ex Hook.) Raf.	Moderate	18	5.4	8	*Parmotrema*
9	*Diospyros melanoxylon* Roxb.	Very Rough	14.6	6.4	17	*Pyxine*and *Dirinaria*
10	*Diospyros montana* Roxb.	Rough	11.6	6.5	12	*Pyxine*
11	*Ficus racemosa* L.	Moderate	23.7	5.7	14	*Parmotrema*
12	*Grewia tiliifolia*Vahl.	Rough	9.8	6.1	10	*Pyxine*
13	*Lagerstroemia microcarpa* Wight	Smooth	18.3	4.9	4	-
14	*Maduca latifolia* (Roxb.) Macbride	Moderate	16.4	6.4	9	-
15	*Polyalthia cerasoides* (Roxb.) Bedd.	Rough	13.4	6.3	15	*Parmotrema*
16	*Polyalthia longifolia* (Sonn.) Thw.	Moderate	17.3	6.1	13	*Drineria*
17	*Pterocarpus marsupium* Roxb.	Rough	20.2	6.2	12	-
18	*Radermachera xylocarpa* (Roxb.) K. Schum.	Moderate	15.3	5.7	11	-
19	*Randia dumetorum*(Retz.) Poir.	Moderate	15.4	6.1	19	*Parmotrema*
20	*Santalum album* L.	Moderate	17	5.9	12	*Ramalina*
21	*Schefflera oleosa* (Lour.) Oken.	Rough	12.8	5.6	10	-
22	*Syzygium cumini* (L.) Skeels	Rough	16.2	4.8	7	*Parmotrema*
23	*Tectona grandis* L.	Rough	12.8	4.6	6	*Hetrodremia*
24	*Terminalia bellirica* (Gaertn.) Roxb.	Moderate	14.7	4.8	6	-
25	*Terminalia paniculata* Roth	Rough	13.8	5.6	15	*Parnotrema*
26	*Terminalia tomentosa* (Roxb. ex DC.) Wight and Arn.	Very Rough	15	5.8	8	-
27	*Wrighitia tomentosa* Roem. And Sch.	Moderate	15.3	5.1	12	-
28	*Xylia xylocarpa* (Roxb.) Taub.	Rough	14.3	5.1	10	*Ramalina*
29	*Ziziphus xylopyrus* (Retz.) Willd.	Moderate	9.8	5.8	9	*Bulbothrix*
30	*Ziziphus rugosa* Lam.	Rough	18.5	5.1	11	*Heterodermia*

respectively. The lichen species are varies with altitude in the study area. In lower altitude i.e., 585 m 20 species of lichens were and in higher altitude *i.e.*, 880 m six species of lichens were reported. The higher altitudes contributing more number of fruticose lichens and in lower altitude more number of foliose and crustose lichens were found.

Microhabitat preference of particular lichens is responsible for their differential distribution. However, in spite of their abundance in the vegetation only a small fraction of trees actually harboured lichens on trunk. Many of these trees have somewhat smooth, medium and rough bark textured. We studied the texture, P^H and moisture content of barks of different host trees in different forest types (Table 2). Among the deciduous trees *Canthium* species had highest pH 6.8 followed by *Diospyros montana* (6.5). Whereas *Tectona grandis* showed lower pH level (4.6). Results can be speculated that lichen thalli do not directly depending on bark moisture and pH. Bark moisture and pH are slightly negatively related but it is not significant which is indicated by $p>0.05$

(0.64). But number of colonies and bark pH is positively related and relationship is significant. It was evident that occurrence of lichens on trees with rough bark exists. In case of altitudinal gradient, the higher altitude support for more number of fruticose lichens. The data showed in Ayanur represented by *Usnea* and *Ramalina* species. In low land areas most of foliose species like *Parmotrema*, *Heterodermia*, *Leptogium* and *Pyxine* species were present. Parmeliaceae and Physciaceae were either attach to the upper canopy branches or on rocks with sufficient canopy openings that regions will receives more lights and wind in this region.

Epiphytic lichens change hosts in different climatic regimes, even when the same host trees are present. Hale (1955) also reported similar host specificity pattern of lichens in the upland forests of Wisconsin. Macro and micro climatic conditions and bark characteristics of trees vary depending on the forest types and altitude. Although, light factor is important in the distribution of lichens, the availability of light is low inside evergreen forests when compare to deciduous forests. In addition to precipitation, mist and fog may cause humid condition even where precipitation is low (Hilmo et al. 2009). The factors responsible for loss of lichen diversity in the study area include change in the ecological conditions, forest cover, loss of habitat and increase of the urban and industrial areas. There is an urgent need to protect and manage the fragile ecosystem of the sanctuary. Conservation should be attributing to rock, soil or wood specialist taxa of micro and macrolichens.

Little exploration regarding collection of lichens has been so far carried out in this region, when compare to other parts of Country. In this attempt we have enumerate the lichen diversity in Shettihalli Wildlife Sanctuary and collected 111 species of lichens from 22 families. This enumeration of lichen species will be useful for conservation policy formulation and biomonitoring studies.

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References

Awasthi, D. D. 2000. A Compendium of the Macrolichens from India, Nepal and Sri Lanka. Bishen Singh Mahendra Pal Singh, Dehra Dun, pp 1-580.

Balaji, P. and Hariharan, G. N. 2004. Lichen diversity and its distribution pattern in tropical dry evergreen forests of Gunidy national park (GNP), Chenni. *Indian forester* 130(10): 1155-1168.

Gamble, S. 1935. Flora of presidency of Madras: III. Botanical Survey of India Calicut.

Hale M.E. 1955. Phytosociology of corticolous cryptogams in a virgin forest in Wisconsin. *Ecology* 36: 45-63. doi: 10.2307/1931430

Hale M.E. 1967. *The Biology of Lichens*. Edward Arnold publication, London.

Hilmo O, H. Holien, H. Hytteborn and Ely-aalstrup. 2009. Richness of epiphytic lichens in differently aged *Picea abies* plantations situated in the oceanic region of Central Norway. *The Lichenologist*, 41(1): 97-108. doi: 10.1017/S0024282909007865

Kappen, L. 1973. Response to extreme environments. *The lichens* (ed. By V. Ahmadjian), Academic press, New York. Pp 310-380.

Kricke, R. 2002. Measuring bark pH. In: *Monitoring with Lichens-Monitoring Lichens* (eds. P.L. Nimis, C. Scheidegger and P.A. Woolseley), Academic Publishers, Netherlands, 333-336. doi: 10.1007/978-94-010-0423-7_30

Lawrey, J. D. 1986. Biological role of lichen substances. *Bryologist* 89: 111–122. doi: 10.2307/3242751

Macelli, M. P. 1991. Aspects of foliose lichen flora of southeren Central coast of Sau Paulo state, Brazil, Tropical lichens: their systematic, conservation and ecology. Ed: Galloway D/ J. Clarendon Press, Oxford. p. 151-170.

Muller, K. 2002. Pharmaceutically relevant metabolites from lichens. *Applied Microbiology and Biotechnology* 56: 9-16.

Negi, H. R and Gadgil, M. 1996. Patterns of distribution of macrolichens in western parts of Nanda Devi Biosphere reserve. *Current Science* 71(7): 568-5575.

Negi, H. R. 2000. On the patterns of abundance and diversity of macrolichens of Chopta-Tungnath in the Garhwal Himalaya.*Journal of Bioscience* 80: 571-589.

Neginhal, S. G. 2004. Forest trees of south India. Navbharath Press, Bangalore, p 447.

Pharo, E. J. and Beattie, A. J. 1997. Bryophytes and lichen diversity: A comparative study. Australin*J. Ecol* 22: 151-162. doi: 10.1111/j.1442-9993.1997.tb00654.x

Sequiera, S. and Muktesh, K. 2008.Epiphyte host relationship of macrolichens in the tropical wet evergreen forests of Silent vallyNatonal Park, Western Ghats, India.*Tropical Ecology* 49(2): 211-224.

Wolsely, P. A. and Huadson.B. A. 1997a. The ecology and distribution of lichens in tropical deciduous and evergreen forests of northern Thailand. *J. Biogeography* 24: 327-343. doi: 10.1046/j.1365-2699.1997.00124.x

Wolsely, P. A. and Huadson.B. A. 1997b.Fire in Tropical dry forests: corticolous lichens as indicator of recent ecological changes in Thailand. *J. Biogeography* 24: 345-362. doi: 10.1046/j.1365-2699.1997.00125.x