



AMBIENT APPRAISAL

Lichen Diversity on *Shorea robusta* Gaertn. in the Transitional Zone of Similipal Biosphere Reserve

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Study Area: Mayurbhanj, Odisha, India.
Coordinates: 21°28' N; 86°04' E

Abstract

Shorea robusta Gaertn. (Sal) is one of the important species in most of the deciduous or semi-evergreen forests of India. Similipal Biosphere Reserve (SBR) is situated in the Mayurbhanj district of Odisha, which comprises many plant species including lichens. The distribution of epiphytic lichen on *Shorea robusta* shows that it is one of the most suitable hosts for it. The present study reveals the occurrence of 88 numbers of species belonging to 18 genera and 13 families of lichenized fungi occurring on the bark of *Shorea robusta*, collected from the transitional zone of Similipal Biosphere Reserve. Members of the family Graphidaceae followed by Pyrenulaceae growing luxuriantly on the bark of *Shorea* together with the dominant genera *Pyrenula*. Crustose species are the dominant one followed by foliose taxa represented by 67 and 21 numbers species respectively. The North-West localities of Similipal contains a more diverse group of lichen taxa (52 species) than that of the South-West region represented by 44 species.

Introduction:

Single host plant in terms of lichen diversity is gaining more importance in order to understand the species-host interaction (Sequiera & Kumar, 2008; Shravanakumara *et al.*, 2010; Christopher, 2012; Upreti & Tandon, 2013; Joshi *et al.*, 2016; Liira *et al.*, 2020; Vinayaka, 2021). From the earlier studies, it was clearly indicated that Sal or *Shorea robusta* Gaertn. is the suitable host for the growth of different groups of lichens for its bark properties (Satya *et al.*, 2005). The plant is usually known for its timber with tough, hard and heavy wood. It comprises about 13.3 % of the forest cover in India and is mostly distributed in the tropical region. However, during the last few decades, the density of Sal Forest cover reduced to 42.11 % of the total forest area (Pyasi *et al.*, 2013). The old mature trees of *S. robusta* are usually characterized by thick rough fissured bark at the base of the trunk up to the lower branches. Different bark textures provide space for the lichen propagules to get establish, which is ultimately supported by the six different microclimates within a tree ecosystem of *S. robusta* (Fig.-1). The bark at the bottom is often loaded with soil and root sometimes exposed outside, which is occupied by genera such as *Pertusaria* and *Lecanora*. However, the basal rough part of the tree is occupied by *Pertusaria* and *Caloplaca* species. Above basal portion, genera like *Leptogium*

(Collemboid) and *Bulbothrix* (Parmelioid) along with some crustose genera such as *Graphis*, *Pertusaria* and *Buellia* have luxuriant patches. The species such as *Bacidia*, *Graphis*, *Lecanora* and *Lecidella* usually have their easy foothold on smooth bark. However, lichen-like *Chrysothrix candelaris* and *C. chlorine* along with some Pyrenocarpous species exhibits their presence on the bark of young *Shorea robusta* in moist areas (Satya *et al.*, 2005). Due to the low water content (10.8 %) the bark pH usually remains acidic (4.5-5), that's ultimately providing the substratum for the growth of crustose lichens. The presence of oleanolic acid and triterpene also favours the growth of lichen on the bark of *Shorea robusta* (Karnik *et al.*, 1968).

Similipal Biosphere Reserve, Odisha is enriched with top peaks such as Meghasini, steep like Ganapati and valleys like Devasthali. It has covered almost half of the geographical area of Mayurbhanj and spread over an area of 5569 km², covered with dense forested hills and valleys, which ultimately comprises dry deciduous vegetation. On average, the area receives 1800 mm annual rainfall with a temperature variation of a minimum of 3°C to a maximum of 38°C during winter and summer respectively. *Shorea robusta* stands as major vegetation in the Biosphere region. The present study aims to predict the occurrence of different groups of lichens on Sal trees in SBR, which can be

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correlated with the previous studies about lichen distribution on the particular plant.

Methodology:

Similipal Biosphere Reserve divided into four major zones such as North-West, North-East, South-East and South-West. Different areas were selected in these four zones based on feasibility for lichen collection. These areas were systematically studied for their lichen wealth growing particularly on *Shorea robusta* (Fig. 2).

A total of 21 sites are selected based on the feasibility of the collection of lichen samples. The climatic data were recorded from each site along with their altitudinal records. On every site 25m × 25m sample plots were selected for the study. In each sample plot, trees of *Shorea robusta* with and without the patches of lichen, together with other tree species were counted. Thereafter 20 trees of *Shorea robusta* were selected randomly from each plot. In each tree of *Shorea* three quadrates were taken, with 30cm × 10cm of size. The number of lichen thalli together with the size of lichen patches under these quadrates were measured. Each tree was taken for the quadrate study was measured for their girth at chest height. The characteristics features such as bark texture, thickness, moisture content, water holding capacity were calculated. The collected lichen specimens were identified following the available literature (Awasthi, 2000) and deposited in the herbarium of CSIR-NBRI, Lucknow.

Findings:

The study revealed the presence of 88 numbers of species belonging to 18 genera and 13 families, on the bark of *Shorea robusta* in the transitional zone of SBR (Table-1). The thin-out and patchy Sal forest bears scarce growth of foliose lichen genera such as *Dirinaria* and *Pyxine* together with crustose taxa *Pertusaria* and *Lecanora*, which exhibits their presence mostly in the North-West and somewhat in the South-West part of the SBR. However, the dense Sal forest with more or less humidity and shady areas are preferred by the species of *Bacidia*, *Caloplaca*, and *Cryptothecia*, exhibiting their presence in the North-West and South-West part of the SBR. The exposed forest at a greater elevation is mostly occupied by Parmeloid genera such as *Bulbothrix*. Thick fissured, rough tree trunk at base laden with soil and mosses provide suitable conditions for some of lichen taxa *Heterodermia* and *Parmotrema* (Fig.-3).

Based on species diversity in each family, out of 13 families found in the study area Graphidaceae family is found to be the most dominating representing 26 species followed by Pyrenulaceae family represented by 18 species (Fig.-4a). Out of 88 species *Pertusaria leucostoma* and *Lecanora achroa* are common to all 4-region divided broadly to the study area. The species such as *Bacidia submedialis*, *Cryptothecia porosa*, *Dirinaria aegialita*, *Phaeographis endophaeiza*, *Lecanora perplexa*, *Bulbothrix*

isidiza, *Parmotrema praesorediosum*, *Pertusaria pustulata* are common to three out of the four regions. However, *Dirinaria aegialita* and *Parmotrema praesorediosum* are growing luxuriantly on maximum sites out of all 21 sites selected in the transitional zone of SBR. Among the 18 genera, recorded *Pyrenula* is the most dominant one, represented by 17 numbers species followed by *Pertusaria* represented by 13 species (Fig.-4b). The localities belong to the North-West part of SBR constituting the highest number of lichen richness followed by the South-West, North-East and South-East regions respectively (Fig.-5a). Most of the sites are predominated by the crustose lichens which are represented by 67 species followed by 21 foliose species (Fig.-5b). The current study represents higher diversity of lichen which grows on *Shorea robusta* than the previous study in the northwest region of SBR representing 81 species (Singh & Kamal, 2012). The results can also be compared with different localities in India such as Midnapore (Sen, 2014), Achnakmar-Amarkantak Biosphere Reserve (Shukla & Singh, 2011), Jharsuguda (Upreti, 1996) and Corbett National Park which represents 74, 45, 35 and 15 numbers of species respectively.

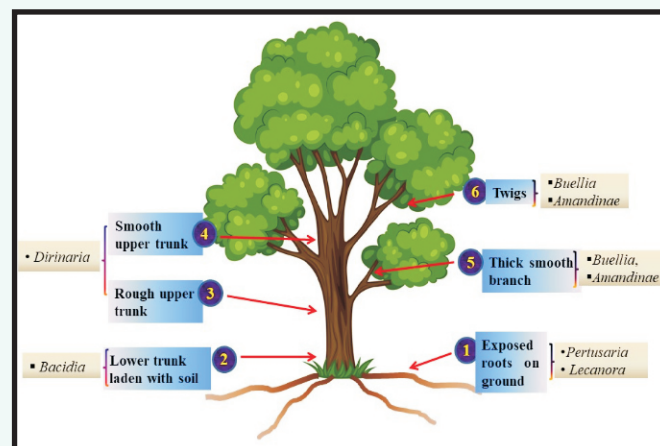


Figure-1: *Shorea robusta* showing different niches favouring growth of lichens

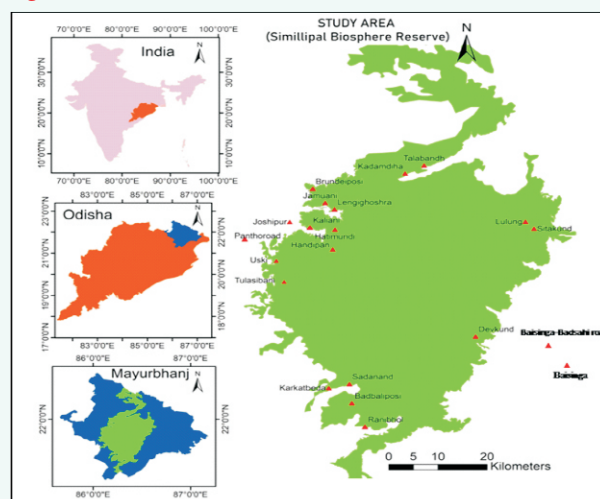


Figure-2: Sites for collection of Lichens in Similipal Bios. Res.

Table-1: Enumeration of lichen diversity on *Shorea robusta* in the transitional zone of Similipal Biosphere Reserve, Odisha

#	Family	G.F.	H.T.	NW	NE	SE	SW
Arthoniaceae							
1	<i>Cryptothecia caesia</i>	C	M	-	-	-	+
2	<i>Cryptothecia effusa</i>	C	MD	+	+	-	-
3	<i>Cryptothecia farinosa</i>	C	MD	-	+	-	-
4	<i>Cryptothecia lunulata</i>	C	MD	+	-	-	-
5	<i>Cryptothecia multipunctata</i>	C	M	+	-	-	+
6	<i>Cryptothecia porosa</i>	C	MD	+	+	-	+
7	<i>Cryptothecia striata</i>	C	MD	+	-	-	+
8	<i>Cryptothecia subsecta</i>	C	MD	+	-	-	-
9	<i>Cryptothecia verruculifera</i>	C	MD	-	+	-	+
Caliciaceae							
10	<i>Dirinaria aegialita</i>	F	MD	+	+	-	+
11	<i>Dirinaria applanata</i>	F	MD	+	+	-	-
12	<i>Dirinaria consimilis</i>	F	MD	+	-	-	-
13	<i>Pyxine coccifera</i>	F	MD	-	-	-	+
14	<i>Pyxine cocois</i>	F	MD	+	-	-	-
15	<i>Pyxine meissnerina</i>	F	MD	-	-	-	+
Collembataceae							
16	<i>Leptogium austroamericanum</i>	F	D	-	+	-	-
Chrysotrichaceae							
17	<i>Chrysothrix candelaris</i>	C	D	+	-	+	-
Graphidaceae							
18	<i>Graphis ajarekarii</i>	C	MD	-	+	-	+
19	<i>Graphis albidofarinacea</i>	C	D	+	-	-	-
20	<i>Graphis balaghatensis</i>	C	D	-	+	-	-
21	<i>Graphis caesiella</i>	C	D	+	-	-	-
22	<i>Graphis capillacea</i>	C	D	-	+	-	-
23	<i>Graphis chlorotica</i>	C	MD	-	-	-	+
24	<i>Graphis elegans</i>	C	MD	-	-	-	+
25	<i>Graphis furcata</i>	C	D	-	-	+	-
26	<i>Graphis lineola</i>	C	MD	-	-	-	+
27	<i>Graphis proserpens</i>	C	D	-	+	-	-
28	<i>Graphis scripta</i>	C	MD	+	-	-	+
29	<i>Phaeographis endophaeiza</i>	C	MD	+	+	-	+
Lecanoraceae							
30	<i>Lecanora achroa</i>	C	MD	+	+	+	+
31	<i>Lecanora allophana</i>	C	MD	+	-	-	+
32	<i>Lecanora helva</i>	C	MD	-	+	-	+
33	<i>Lecanora perplexa</i>	C	MD	+	+	-	+
34	<i>Lecanora tropica</i>	C	MD	+	-	-	-
Opegraphaceae							
35	<i>Opegrapha medusulina</i>	C	MD	+	-	-	-
Parmeliaceae							
36	<i>Bulbothrix isidiza</i>	F	MD	+	+	-	+
37	<i>Canoparmelia aptata</i>	F	D	+	-	-	-
38	<i>Canoparmelia pruinata</i>	F	D	+	-	-	-
39	<i>Parmotrema praesorediosum</i>	F	MD	+	+	-	+
40	<i>Parmotrema reticulatum</i>	F	MD	+	-	-	-
41	<i>Parmotrema saccatilobum</i>	F	M	+	-	-	+
42	<i>Parmotrema tinctorum</i>	F	MD	+	-	-	+
Pertusariaceae							
43	<i>Pertusaria cinchonae</i>	C	MD	+	-	-	+
44	<i>Pertusaria concinna</i>	C	D	+	-	-	+
45	<i>Pertusaria coronata</i>	C	D	+	-	-	+
46	<i>Pertusaria himalayensis</i>	C	MD	+	-	-	-
47	<i>Pertusaria indica</i>	C	D	-	+	-	-

48	<i>Pertusaria leioplacella</i>	C	D	+	-	-	-
49	<i>Pertusaria leucostoma</i>	C	MD	+	+	+	+
50	<i>Pertusaria pseudococcodes</i>	C	MD	-	-	-	+
51	<i>Pertusaria punctata</i>	C	MD	+	-	-	+
52	<i>Pertusaria pustulata</i>	C	MD	+	+	-	+
53	<i>Pertusaria quassiae</i>	C	D	+	-	-	-
54	<i>Pertusaria rigida</i>	C	D	+	-	-	-
55	<i>Pertusaria splendens</i>	C	D	+	-	-	-
Physciaceae							
56	<i>Heterodermia diademata</i>	F	M	+	-	-	-
57	<i>Heterodermia obscurata</i>	F	M	+	-	-	-
58	<i>Heterodermia speciosa</i>	F	M	+	-	-	-
59	<i>Physcia caesia</i>	F	M	+	-	-	-
60	<i>Physcia dilatata</i>	F	M	-	-	-	+
61	<i>Physcia solediosa</i>	F	M	+	-	-	+
62	<i>Physcia tribacioides</i>	F	M	+	-	-	-
Pyrenulaceae							
63	<i>Pyrenula aggregata</i>	C	M	-	-	-	+
64	<i>Pyrenula andina</i>	C	M	-	-	-	+
65	<i>Pyrenula approximans</i>	C	M	-	-	-	+
66	<i>Pyrenula balia</i>	C	MD	+	-	-	+
67	<i>Pyrenula circumfiniens</i>	C	MD	-	+	-	+
68	<i>Pyrenula dermatodes</i>	C	MD	-	+	-	-
69	<i>Pyrenula finitima</i>	C	MD	+	+	-	-
70	<i>Pyrenula leucotrypa</i>	C	MD	+	-	-	-
71	<i>Pyrenula maravalensis</i>	C	M	-	+	-	+
72	<i>Pyrenula mastophoroides</i>	C	MD	-	+	-	-
73	<i>Pyrenula nitida</i>	C	M	-	-	-	+
74	<i>Pyrenula nitidula</i>	C	M	-	-	-	+
75	<i>Pyrenula ochraceoflava</i>	C	M	-	-	-	+
76	<i>Pyrenula platystoma</i>	C	MD	+	-	-	-
77	<i>Pyrenula scutata</i>	C	M	-	-	-	+
78	<i>Pyrenula subducta</i>	C	M	-	-	-	+
79	<i>Pyrenula submastophora</i>	C	M	-	-	-	+
Ramalinaceae							
80	<i>Bacidia alutacea</i>	C	MD	-	-	+	+
81	<i>Bacidia convexula</i>	C	MD	-	+	-	-
82	<i>Bacidia incongruens</i>	C	MD	-	+	-	-
83	<i>Bacidia millegrana</i>	C	MD	+	-	-	-
84	<i>Bacidia nigrostricta</i>	C	MD	+	+	-	+
85	<i>Bacidia personata</i>	C	MD	+	-	-	-
86	<i>Bacidia submedialis</i>	C	MD	+	+	+	-
Teloschistaceae							
87	<i>Caloplaca bassiae</i>	C	MD	-	-	-	+
88	<i>Caloplaca orissensis</i>	C	MD	-	-	+	-

Abbreviation: G.F. - Growth form; H.T. - Habitat type; NW- North-West; NE- North-East; SE- South-East; SW- South-West
C - Crustose; F - Foliose; MD - Moist dry; D - Dry; M - Moist; + (Present); - (Absent).

Conclusion:

The study reveals that most of the lichens are growing in moist and shady places near the small water streams inside the dense forest. As the area in the transitional zone of SBR mostly dominated by Sal Forest and all trees equally exposed to the rainfall, lichens growing luxuriantly over it. *Dirinaria aegialita* and *Parmotrema praesorediosum* growing in most of the areas can be useful for their further bio-prospection. Further intensive study in the buffer and

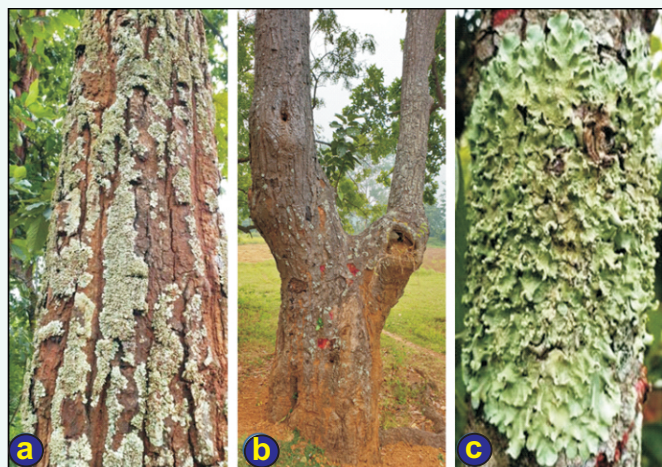


Figure-3: Luxuriant growth of lichen on Shorearobusta: (A) on rough fissured bark (B) on lower trunk (C) on young smooth bark

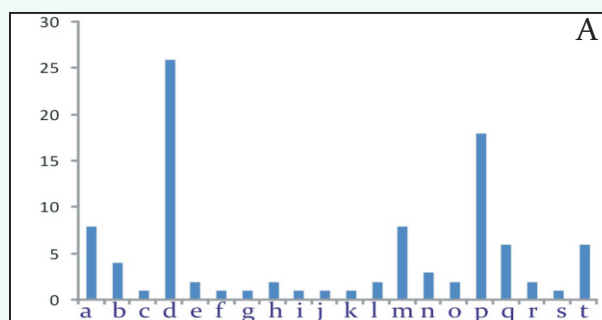


Figure 4: (A) Showing occurrence of a number of Lichen species per family. Abbreviation: a-Arthoniaceae, b-Caliciaceae, c-Collemataceae, d-Graphidaceae, e-Lecanoraceae, f-Leprocaulaceae, g-Letrouitiaceae, h-Malmideaceae, i-Monoblastiaceae, j-Mycoporaceae, k-Opegraphaceae, l-Parmeliaceae, m-Pertusariaceae, n-Physciaceae, o-Porinaceae, p-Pyrenulaceae, q-Ramalinaceae, r-Stereocaulaceae, s-Teloschistaceae, t-Trypetheliaceae

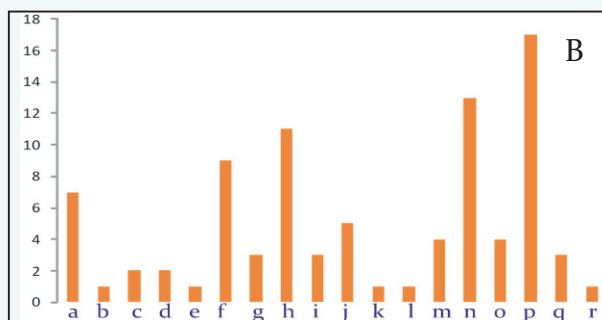


Figure 4: (B) Showing occurrence of a number of species per genera. Abbreviation: a-Bacidia, b-Bulbothrix, c-Caloplaca, d-Canoparmelia, e-Chrysothrix, f-Cryptothecia, g-Dirinaria, h-Graphis, i-Heterodermia, j-Lecanora, k-Leptogium, l-Opegrapha, m-Parmotrema, n-Pertusaria, o-Physcia, p-Pyrenula, q-Pyxine, r-Phaeographis

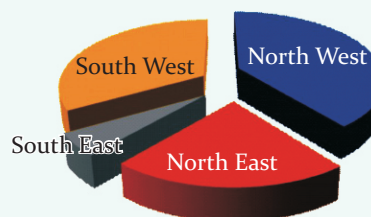


Figure-5: Distribution pattern of lichen in different geographical region of Similipal Biosphere Reserve,

core area will provide more diversity of lichens species that are favourable to grow on the bark of *Shorea robusta*.

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References:

- Awasthi, D.D. (2000): **Lichenology in Indian subcontinent: A Supplement to "A Handbook of Lichens"**. Pub. by: Bishen Singh Mahendra Pal Singh, Dehradun, India.
- Ellis, C.J. (2012): Lichen epiphyte diversity: a species, community and trait-based review. *Persp. Plant Ecol., Evol. System.*, 14(2):131-152.
- Joshi, Y., Tripathi, M., Jinnah, Z., Bisht, K. & Upreti, D.K. (2016): Host specificity of epiphytic macrolichens: a case study of Jageshwar forest (Uttarakhand) India. *Trop. Ecol.*, 57(1):1-8.
- Karnik, M.G., Bhatia, K. & Lal, J. (1968): Sal bark *Shorea robusta* Gaertn.f.: its commercial potentialities. *Indian Forest.*, 94:253-258.
- Liira, J., Suija, A. & Jürjado, I. (2020): Habitat and host specificity of epiphytic lichens in a rural landscape: cultural heritage habitats as refugia. *Biodiver. Conserv.*, 29(7):2141-2160.
- Pyasi, A., Soni, K.K. & Verma, R.K. (2013): Effect of ectomycorrhizae on growth and establishment of sal (*Shorea robusta*) seedlings in central India. *Nusantara Biosci.*, 5(1).
- Satya, Upreti D.K. & Nayaka, S. (2005): *Shorea robusta*-an excellent host tree for lichen growth in India. *Current Sci.*, 89(4):594-595.
- Sen, U.K. (2014): Assessment of lichens in selected sacred groves of West Midnapore district, West Bengal, India. *Int. J. Conserv. Sci.*, 5(1).
- Sequiera, S. & Kumar, M. (2008): Epiphyte host relationship of macrolichens in the tropical wet evergreen forests of Silent Valley National Park, Western Ghats, India. *Tropical Ecol.*, 49(2):211.
- Shravanakumara, S., Vinayaka, K.S., Kumaraswamy Udupa, E.S., Shashirekha, B., Praveena, V. & Krishnamurthy, Y.L. (2010): Diversity and Host specificity of Lichens in Koppa Taluk of Central Western Ghats, Karnataka, India. *Indian J. Forest.*, 33(3):437-442.
- Shukla, A.N. & Singh, K.P. (2011): A note on lichens on *Shorea robusta* in a biosphere reserve, Central India. *Indian Forest.*,

- 137(5):649-652.
- Singh, K.P. & Kamal, K. (2012): A note on the lichens from Similipal Biosphere Reserve. *Indian J. Forest.*, 35(3):383-390.
- Sipman, H.J. (1997): Observations on the foliicolous lichen and bryophyte flora in the canopy of a semi-deciduous tropical forest. *Abstracta Botanica*, pp.153-161.
- Upreti D.K. (1996): Lichens on *Shorea robusta* in Jharsuguda district, Orissa, India. *Flora Fauna*, 2:159-161.
- Upreti D.K., Nayaka, S. & Satya (2005): Enumeration of Lichens from Madhya Pradesh and Chhattisgarh, India. *Indian J. Appl. Biosci.*, 31(1):55-63.
- Upreti, D.K. & Tandon, P.K. (2013): Species diversity and host specificity of epiphytic lichens: a case study in two forest stands of Central India. *Int. J. Ecol. Environ. Sci.*, 39(4):251-270.
- Vinayaka, K.S. (2021): Ecology and distribution pattern of lichens in tropical forests of Koppa taluk, Karnataka. *Ecol. Res.*, 1(3):177.

