

Lichens of Cotigao Wildlife Sanctuary, Goa

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ABSTRACT

The detailed lichen study at Cotigao Wildlife Sanctuary, Goa is initiated recently. In the present study earlier report of lichens from the sanctuary and fresh collections are included. The study revealed the occurrence of 99 species belonging to 43 genera and 25 families of which 21 species are new records for the sanctuary and 15 species as new to Goa. Also, *Lepraria jackii* Tønsberg, a leprose lichen is reported as new to India. The sanctuary is dominated by bark inhabiting lichens, crustose forms with 83 species, and members of Graphidaceae family. The luxuriant growth of lichens at sanctuary indicates the availability the shady, moist conditions of the forest and less anthropogenic disturbances.

Key words: Biodiversity, Lichenized fungi, Protected area, new records, Western Ghats

INTRODUCTION

Lichens are organisms that are products of symbiotic association between algae and fungi. In India a total of 2511 lichen species are recorded so far (Singh and Dash 2017) and Goa is represented by 128 species (Randive *et al.* 2017a, b). Detailed study on lichens of Cotigao Wildlife Sanctuary is recently initiated owing to its rich biodiversity. Cotigao is located towards the south eastern border of the state within the Western Ghats ecosystems and was notified as Wildlife Sanctuary in 1958 (Naithani *et al.* 1997) (Fig. 1). The topography of the sanctuary is largely flat, becoming undulated as it meets the Western Ghats. The sanctuary is surrounded by some of the highest hills in this region on the west, the Anshi National Park (Karnataka) to the southeast and the Netravali Wildlife Sanctuary to the Northwest. The sanctuary covers an area of 85.65 km² while large portions of the sanctuary show a forest crown density > 40%. The sanctuary is noted for its lofty tree cover, some trees attaining heights up to 20 m. The undergrowth is mainly

composed of the now familiar scourge, *Eupatorium*. The weed growth is particularly dense in the Eucalyptus and teak plantations (Alvaris, 2002). Regarding the lichens earlier Phatak *et al.* (2004) reported 43 species, while some collections of one the author (PR) is included in the publication of Ranadive *et al.* (2017a, b). The present communication further updates the list of lichens from Cotigao Wildlife Sanctuary with several additions.

MATERIALS AND METHODS

The checklist of lichens included species reported earlier (Ranadive *et al.* 2017a, b) as well as fresh collections. About 350 samples of lichens were collected from Cotigao Wildlife Sanctuary during the year 2015 to 2017. These lichens were mostly growing over tree bark and collected following standard procedure, air dried and preserved at herbarium of Goa University with details. The lichens were identified by studying their morphology, anatomy and chemistry (Nayaka 2014). Orange *et al.* (2001) was followed for chemical analysis of the samples. Morphological details were examined using a stereo zoom Leica S8APO microscope. Anatomical details were studied using a light DM2500 microscopes attached with camera and image analysis software. Hand-cut sections of thalli and ascomata mounted in distilled water, KOH solution (K), lactophenol cotton blue (LPCB) were studied. The amyloid reactions were

tested in Lugol's iodine solution without (I) or with pre-treatment with KOH (KI). All measurements were made on material mounted in distilled water. Awasthi (1991, 2007) and other recent literature were consulted for identification of various lichen taxa.

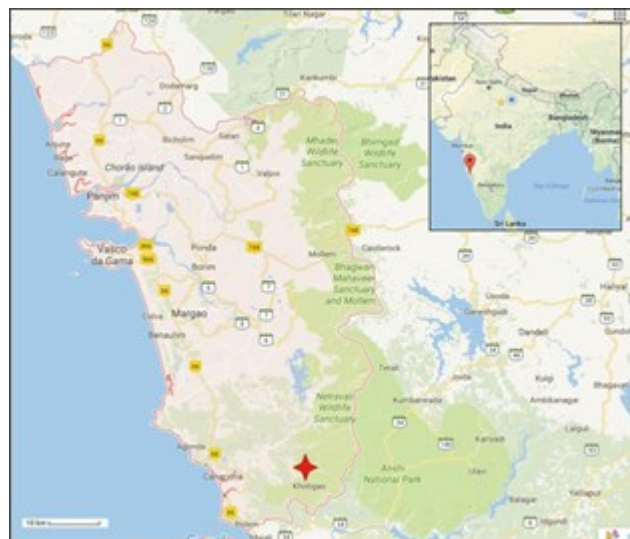


Figure 1. Map of Goa showing location of Cotigao Wildlife Sanctuary (star marked)

RESULTS AND DISCUSSION

The study resulted in 99 species belonging to 43 genera and 25 families in Cotigao Wildlife sanctuary of which 21 species are new records for the sanctuary. Of these 15 species are new addition to Goa lichen biota (Table 1).



Figure 2. *Lepraria jackii* Tønsberg, a new record for India

Table 1: List of lichens from Cotigao Wildlife Sanctuary, Goa [Note: CR = Crustose, FL = Foliose, SQ = Squamulose, LP = Leprose, Corti. = Corticolous, Folii. = Foliicolous, # = New record for Cotigao Wildlife Sanctuary, * = New record for Goa]

Sr. No.	Family	Taxa Name	Growth Form	Substratum
1	Arthoniaceae	<i>Arthonia cinnabarina</i> (DC.) Wallr.	CR	Corti.
2		<i>A. confertum</i> (A.L. Smith) Makh. & Patw.	CR	Corti.
3		<i>A. dispersula</i> Nyl.	CR	Corti.
4		<i>Cryptothecia faveomaculata</i> Makh. & Patw.	CR	Corti.
5		<i>C. subnidulans</i> Stirton	CR	Corti.
6		<i>C. subtecta</i> Stirton	CR	Corti.
7		<i>Herpothallon cinerenum</i> G. Thor	CR	Corti.
8		** <i>Tylophoron nidulans</i> Stirton	CR	Corti.
9	Arthopyreniaceae	<i>Arthopyrenia alboatra</i> (Krempfh.) Müll. Arg.	CR	Corti.
10		<i>A. finkii</i> Zahlbr.	CR	Corti.
12		<i>A. grisea</i> (Schierch.) Körb.	CR	Corti.
13		<i>A. indusiata</i> Müll. Arg.	CR	Corti.
14	Byssolomataceae	** <i>Byssoloma permutans</i> (Nyl.) Lücking	CR	Corti.
15	Caliciaceae	<i>Dirinaria aegialita</i> (Afz. in Ach.) Moore	FL	Corti.
16		<i>D. confluens</i> (Fr.) Awasthi	FL	Corti.,Folii
17		<i>Pyxine cocoes</i> (Sw.) Nyl.	FL	Corti.
18		* <i>Pyxine cylindrical</i> Kashiw.	FL	Corti.
19	Coenogoniaceae	<i>Coenogonium dilucidum</i> (Kremp.) Kalb & Lücking	CR	Folii
20		** <i>C. lutescens</i> (Vezda & Malcome) Malcome	CR	Corti.
21	Collemataceae	* <i>Leptogium austroamericanum</i> (Malme) C.W. Dodge	FL	Corti.
22		* <i>L. chloromelum</i> (Ach.) Nyl.	FL	Corti.
23		<i>L. denticulatum</i> Nyl.	FL	Corti.
24		<i>L. chloromelum</i> (Sw.) Nyl.	FL	Corti.
25	Fissurinaceae	** <i>Fissurina elaiocarpa</i> (A.W. Archer) Archer	CR	Corti.
26		** <i>F. immerse</i> B.O. Sharma, Khadilker & Makhija	CR	Corti.
27	Gomphillaceae	<i>Echinoplaca</i> sp.	CR	Corti.
28	Graphidaceae	<i>Diorygma confluens</i> (Fée) Kalb, Staiger & Elix	CR	Corti.
29		<i>Glyphis cicatricosa</i> Ach.	CR	Corti.
30		<i>Graphis nigroglauca</i> Leight.	CR	Corti.
31		<i>G. adscribens</i> Nyl.	CR	Corti.
32		<i>G. cleistoblephara</i> Nyl.	CR	Corti.
33		<i>G. pyrrohocheiloides</i> Zahlbr'	CR	Folii
34		<i>G. cincta</i> (Pers.) Aptroot	CR	Corti.
35		<i>Hemithecium echinatum</i> Aptroot, Lücking & Will-Wolf	CR	Corti.
36		<i>H. nakanishianum</i> (Patw. & C.R. Kulk.) Makh. & Dube	CR	Corti.
37		<i>H. peplophora</i> (M. Wirth & Hale) V. Tewari & Upreti	CR	Corti.

Table 1: Continued...

Sr. No.	Family	Taxa Name	Growth Form	Substratum
38		<i>Leucodecton anamalaiense</i> (Patw. & C.R. Kulk.) Rivas Platas & Lücking	CR	Corti.
39		<i>Myriotrema subconforme</i> (Nyl.) Hale	CR	Corti.
40		<i>Ocellularia groenhartii</i> Hale	CR	Corti.
41		<i>Pallidogramme chrysenderodes</i> (Nyl.) K. Singh & Swarnalatha	CR	Corti.
42		<i>Phaeographis brasiliensis</i> (A. Massal.) Kalb & Matthes-Leicht	CR	Corti.
43		<i>P. platycarpa</i> Müll. Arg.	CR	Corti.
44		<i>P. extrusula</i> (Stirton) Zahlbr.	CR	Corti.
45		<i>Platygramme wattiana</i> (Müll. Arg.) V. Tewari & Upreti	CR	Corti.
46	Lecanoraceae	<i>Lecanora andina</i> Räsänen	CR	Corti.
47		<i>L. chlorotera</i> Nyl.	CR	Corti.
48		<i>L. helva</i> Stizenb.	CR	Corti.
49		<i>L. leproplaca</i> Zahlbr.	LP	Corti.
50		<i>L. tropica</i> Zahlbr.	CR	Corti.
51		*# <i>Lecidella</i> sp.	CR	Corti.
52	Malmidaceae	<i>Malmidea granifera</i> (Ach.) Kalb, Rivas Platas & Lumbsch	CR	Corti.
53	Monoblastiaceae	<i>Anisomeridium angulosum</i> (Müll. Arg.) R.C. Harris	CR	Corti.
54		<i>A. complanatum</i> (Makh. & Patw.) R.C. Harris	CR	Corti.
55		<i>A. subnexum</i> (Nyl.) R.C. Harris	CR	Corti.
56		*# <i>A. tarmuqliense</i> (Makhija & Patw.) R.C. Harris	CR	Corti.
57		# <i>Monoblastia pellucida</i> Aptroot	CR	Corti.
58	Naetrocymbaceae	<i>Naetrocymbe fraxini</i> (A. Massal.) R.C. Harris	CR	Corti.
59	Parmeliaceae	<i>Parmotrema latissimum</i> (Fée) Hale	FL	Corti.
60	Pertusariaceae	<i>Pertusaria concinna</i> Erichson	CR	Corti.
61		<i>P. punctata</i> Nyl.	CR	Corti.
62	Physciaceae	<i>Heterodermia obscurata</i> (Nyl.) Trevisan	CR	Corti.
63		<i>Physcia tribacia</i> (Ach.) Nyl.	FL	Corti.
64	Pilocarpaceae	<i>Felhanera bouteillei</i> (Desm.) Vezda.	CR	Corti.
65	Porinaceae	<i>Porina internigrans</i> (Nyl.) Müll. Arg.	CR	Corti.
66		*# <i>P. interstes</i> (Nyl.) Harm.	CR	Corti.
67		<i>P. kameruensis</i> F. Schill	CR	Folii
68		<i>P. nitidula</i> Müll. Arg.	CR	Folii
69		<i>P. karnatakensis</i> Makhija, Adawadkar & Patw.	CR	Folii
70		*# <i>P. rufula</i> (Kremp.) Vain.	CR	Folii
71		<i>P. subcutanea</i> Ach.	CR	Corti.
72		<i>P. subhibernica</i> Upreti	CR	Corti.
73		<i>P. tetracerae</i> (Afz.) Müll. Arg.	CR	Corti.
74		*# <i>Trichothelium alboatrum</i> Vain.	CR	Corti.

Table 1: Continued...

Sr. No.	Family	Taxa Name	Growth Form	Substratum
75	Pyrenulaceae	<i>Pyrenula approximans</i> (Krempelh.) Müll. Arg.	CR	Corti.
76		<i>P. breutelii</i> (Müll. Arg.) Aptroot	CR	Corti.
77		<i>P. brunnea</i> Fée	CR	Corti.
78		*# <i>P. leucotrypa</i> (Nyl.) Upreti	CR	Corti.
79		*# <i>P. macularis</i> (Zahlbr.) R. C. Harris	CR	Corti.
80		<i>P. mamillana</i> (Ach.) Trevisan	CR	Corti.
81		<i>P. nitidula</i> (Bres.) R.C. Harris.	CR	Corti.
82		*# <i>P. nodulata</i> (Stirton) Zahlbr.	CR	Corti.
83	Ramalinaceae	<i>Bacidia connexula</i> (Nyl.) Zahlbr.	CR	Corti.
84		<i>B. rosella</i> (Pers.) De Not.	CR	Corti.
85		<i>Phyllopsora manipurensis</i> (Müll. Arg.) G. Schneider	SQ	Corti.
86		<i>P. nemoralis</i> Timdal & Krog	SQ	Corti.
87		<i>P. parvifolia</i> (Pers.) Müll. Arg.	SQ	Corti.
88	Roccellaceae	<i>Enterographa pallidella</i> (Nyl.) Redinger	CR	Corti.
89	Stereocaulaceae	*# <i>Lepraria jackii</i> Tønsberg	CR	Corti.
90	Strigulaceae	<i>Srtigula nitidula</i> Mont	CR	Folii
91		*# <i>S. orbicularis</i> Fr.	CR	Corti.
92		<i>S. phyllogena</i> (Müll. Arg.) R.C. Harris	CR	Folii
93		<i>S. smaragdula</i> Fr.	CR	Folii
94	Teloschistaceae	<i>Blastenia ferruginea</i> (Huds.) A. Massal.	CR	Corti.
95	Trypetheliaceae	<i>Laurera meristospora</i> (Mont. & Bosch) Zahlbr.	CR	Corti.
96		# <i>Trypethelium eluteriae</i> Spreng.	CR	Corti.
97		<i>T. endosulphureum</i> Makh. & Patw.	FL	Corti.
98		*# <i>T. plicatorimosum</i> Makhija	CR	Corti.
99		<i>T. tropicum</i> (Ach.) Müll. Arg.	FL	Corti.

Graphidaceae family is dominant with 17 species followed by Porinaceae (10 spp.), Pyrenulaceae (8 spp.), Arthoniaceae (8 spp.) and Lecanoraceae (6 spp.). The lichens were growing over tree bark while a total of 10 species were also recorded from leaves. The lichen biota of the sanctuary is mostly dominated by crustose forms represented by 83 species, while foliose and squamulose forms have only 11 and three species respectively. In present study *Lepraria jackii* Tønsberg, a leprose-crustose lichens is reported as new record for India (Fig. 2). The species is found growing on the tree trunk in the sanctuary. It is characterized by leprose, powdery thallus with diffuse margin, lacking lobes and true medulla, sparse to continuous

hypothallus, fine to coarse soredia with projecting hyphae, containing atranorin and zeorin secondary metabolites. Earlier, *L. jackii* was known from Europe, North America, Asia, Australia and Central Europe (Saag *et al.* 2009).

CONCLUSION

The present study clearly indicates lichen richness of Cotigao Wildlife Sanctuary. The luxuriant growth of foliicolous lichens at sanctuary indicates the availability the shady, moist conditions of the forest and less anthropogenic disturbances. This information

would be helpful for biomonitoring studies in the area in future. Also, these lichens can be utilized for bioprospecting for novel biomolecules.

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