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RESEARCH ARTICLE

Pyrenocarpous lichens in Goa with five new records to India

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ABSTRACT

The pyrenocarpous lichens are the one which produces perithecial ascocarps. They are one of the prominent groups of lichens in tropical forests. Frequent incidence of pyrenocarpous taxa in lichen biota of Goa prompted us to take up the exclusive study of this group in the State. The study revealed the occurrence of 79 species belonging to 15 genera and seven families. The family Pyrenulaceae had the maximum number of 23 species, while 20 belonged to the family Porinaceae. In comparison to North Goa, South Goa is fairly well explored for lichens representing 71 species from 11 localities. The following five species are reported as new to India — *Porina exserta*, *P. siamensis*, *Pyrenula dissimulans*, *P. pyrenastrospora* and *P. rinodinospora*. With the addition of five new records, the Goa State now represents 165 species of lichens, out of which 48% is represented by pyrenocarpous lichens. The present study will be useful for monographic studies on pyrenocarpous lichens and for environmental monitoring studies in the area, as this can be considered as a key indicator species.

Introduction

The Western Ghats traverses through the State of Goa, India and is a well-known biodiversity hotspot. Extensive lichen exploration in the State has been initiated recently, and so far, 160 species are reported (1-6). Frequent occurrence of pyrenocarpous lichens during the exploration in the State indicated their dominance which prompted us to carry out an exclusive study on this group. Pyrenocarpous are a group of lichens having perithecia as their ascocarps. Pyrenocarpous taxa commonly grow on the bark of trees, sometimes on rocks, soil or leaves, mostly in moist tropical regions of the world (7).

In the past, pyrenocarpous lichens collected from Goa were included in various monographic works (8-14) and few new species such as *Anthracothecium goaense* A. Singh [current name *Pyrenula gibberulosa* (Vain.) Aptroot] and *P. subacutalis* Upreti [current name *Pyrenula maravalensis* Vain.] were also described. The recent floristic studies in the State reported 14 pyrenocarpous taxa from the Cotigao Wildlife Sanctuary (15) and 13 taxa from Bondla and Bhagwan Mahavir Wildlife Sanctuaries (16). A list of lichens from the Goa State reveals 118 species under 42 genera and 23 families, of which 44 were pyrenocarpous lichens (1). Further, in an exclusive survey of Cotigao Wildlife Sanctuary 36 pyrenocarpous taxa were reported under nine genera (3). In the studies on foliicolous lichens, there enumerated a total of 15 pyrenocarpous lichens (2, 4). These reports clearly indicate that Goa State has a rich diversity of pyrenocapous lichens. Therefore, carrying out an exclusive study on pyrenocarpous lichens of the State was inevitable. The ultimate aim of the study was to produce a checklist and identification key for pyrenocarpous lichens of Goa State by compilation of previous reports and by more exploration in the State.

Materials and Methods

The present study is based on published literature, previously collected specimens deposited in the herbarium LWG of CSIR-National Botanical Research Institute, Lucknow and freshly collected specimens from Goa. About 350 specimens from 19 localities of Goa (Fig. 1) were available for the study. Morphological and anatomical characters were examined using stereo zoom Leica S8APO and light DM2500 microscopes attached to a camera. Thin sections of perithecia were cut using a razor blade under a stereo zoom microscope. All anatomical measurements were recorded in plain water, while

Fig. 1. Map of Goa showing North and South districts and localities surveyed for present study.

10% KOH was used for the detailed study of asci and ascospores. For spot tests, the usual reagents of K, C and P were used. To identify lichens substance, thin layer chromatography (TLC) was performed in solvent system C following the standard method (17). Fresh specimens were preserved in the herbarium of Goa University (GU), and a set of voucher specimens were deposited in herbarium LWG. The specimens were identified up to species level with the help of keys of earlier published literature (18-25). The classification of lichens summarized in reference 26 was followed for arranging species under their respective families. The identity of species was confirmed by matching with type specimens or well-identified specimens available at LWG.

Results

The study revealed the occurrence of 79 species of pyrenocarpous lichens belonging to 15 genera and seven families in Goa. Five species were recorded for the first time from the country (Table 1). The brief descriptions for the five newly recorded lichens and key for all the pyrenocarpous lichens encountered in Goa are provided. The Pyrenulaceae family was most dominant in the State, with 23 species followed by Porinaceae (20 spp.) and Monoblastiaceae (13 spp.). Among the genera, *Pyrenula* was dominant with 24 species, followed by *Porina* (19 spp.), *Anisomeridium* (12 spp.) and *Strigula* (8 spp.). All the species recorded were crustose except for *Endocarpon subrosettum* A. Singh & Upreti, which was squamulose. A total of 58 species were found to grow on tree trunks, branches and twigs (corticolous), followed by 16 species that grow on leaves (foliicolous), while five species grow on rocks (saxicolous). *Astrothelium meristosporum* (Mont. & Bosch) Aptroot & Lücking and *A. scoria* (Fée) Aptroot & Lücking exhibited their substrate specificity with restricted occurrence on cashew nut (*Anacardium occidentale* Linn.) trees. The species of *Porina* and *Pyrenula* exhibit maximum substrate diversity as they were found growing on various trees, leaves and rocks, while all *Strigula* species exhibit luxuriant growth only on leaves. *Artocarpus integrifolius* L.f., *Anacardium occidentale* L., *Cocos nucifera* L. and *Terminalia elliptica* Willd. were the common phorophytes for the growth of pyrenocarpous lichens. *Porina interestes* (Nyl.) Harm., *P. tetracerae* (Afz.) Müll. Arg., *Pyrenula aspistea* (Ach.) Ach., *P. oculata* A. Singh & Upreti and *Trypethelium eluteriae* Spreng. were the most common species of the State.

Table 1. List of pyrenocarpous lichens recorded from Goa and their distribution [Note: + = present, - = absent, **CR** = Crustose, **SQ** = Squamulose, **C** = Corticolous, **S** = Saxicolous, **F** = Foliicolous, **BMWS** = Bhagwan Mahavir Wildlife Sanctuary, **CWS** = Cotigao Wildlife Sanctuary, **BWS** = Bondla Wildlife Sanctuary, **Goa Uni**. = Goa University, *New record for India]

Sl. No.	Family and species	Growth form	Habitat	North Goa									South Goa									
				Amona	BWS	Goa Uni.	Melauli	Panjim	Ponda	Radigati	Valpoi	Agonda	BMWS	Caranzol	Colem	CWS	Mollem	Pirla	Quepem	Quinamol	Rivona	Tambdisurla
Arthopyreniaceae																						
1	*Arthopyrenia alboatra* (Kremp.) Müll. Arg.	CR	C	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
2	*A. finkii* Zahlbr.	CR	C	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
3	*A. grisea* (Schierch.) Körb.	CR	C	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
4	*A. indusiata* Müll. Arg.	CR	C	-	-	-	-	-	-	-	-	-	+	-	-	+	-	-	-	-	-	+
5	*A. nidulans* Müll. Arg.	CR	C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-
Monoblastiaceae																						
6	*Anisomeridium albidoatrum* (Nyl.) R.C. Harris	CR	C	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-
7	*A. angulosum* (Müll. Arg.) R.C. Harris	CR	C	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
8	*A. biforme* (Borrer) R.C. Harris	CR	C	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	*A. complanatum* (Makhija & Patw.) R. C. Harris	CR	C	-	-	-	-	-	-	+	-	-	-	-	-	+	-	-	-	-	-	-
10	*A. consobrinum* (Nyl.) Aptroot	CR	C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-
11	*A. glaucescens* (Müll. Arg.) R.C. Harris	CR	C	-	-	-	-	-	-	+	-	-	-	-	-	+	-	-	-	-	-	-
12	*A. indicum* (Makhija & Patw.) R. C. Harris	CR	C	-	-	-	+	-	-	-	-	+	-	-	-	-	-	-	-	-	-	+
13	*A. palavanum* (Vain.) R.C. Harris	CR	C	-	-	-	+	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-
14	*A. subnexum* (Nyl.) R.C. Harris	CR	C	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
15	*A. tarmugliense* (Makhija & Patw.) R.C. Harris	CR	C	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
16	*A. terminatum* (Nyl.) R.C. Harris	CR	C	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
17	*A. ubianum* (Vain.) R.C. Harris	CR	C	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	+	-
18	*Monoblastia pellucida* Aptroot	CR	C	-	-	+	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
Porinaceae																						
19	*Clathroporina mastoidea* (Ach.) R.C. Harris	CR	C	-	+	-	-	-	-	-	-	-	+	-	-	+	-	-	-	-	-	-
20	*Porina americana* Fée	CR	C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-
21	*P. atlantica* (Erich.) P. M. Jørg.	CR	C	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
22	*P. chrysophora* (Stirt.) R. Sant.	CR	F	-	-	-	-	-	-	-	-	-	+	-	-	+	-	-	-	-	-	-
23	*P. conica* R. Sant.	CR	F	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
24	*P. epiphylla* Fée	CR	F	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
25	*P. exserta* Müll. Arg.*	CR	C	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
26	*P. internigrans* (Nyl.) Müll. Arg.	CR	C	-	-	-	+	-	-	+	-	-	-	-	-	+	-	-	-	-	-	-
27	*P. interestes* (Nyl.) Harm.	CR	C	-	+	-	-	-	-	-	-	-	+	-	-	+	+	-	-	-	+	+
28	*P. karnatakensis* Makhija, Adaw. & Patw.	CR	F	-	-	-	-	-	-	-	-	-		-	-	+	-	-	-	-	-	-
29	*P. nitidula* Müll. Arg.	CR	F	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
30	*P. ochrostoma* Makhija, Adaw. & Patw.	CR	C	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
31	*P. pallescens* R. Sant.	CR	F	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
32	*P. rufula* (Kremp.) Vain.	CR	F	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
33	*P. siamensis* P.M. McCarthy*	CR	S	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
34	*P. subcutanea* Ach.	CR	C	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
35	*P. subhibernica* Upreti	CR	C	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	+	-
36	*P. subinterstes* (Nyl.) Müll. Arg.	CR	S	-	-	+	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
37	*P. tetracerae* (Afz.) Müll. Arg.	CR	S	-	+	-	-	-	-	-	-	-	+	+	-	+	-	-	-	-	+	-
38	*Trichothelium alboatrum* Vain.	CR	F	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
Pyrenulaceae																						
39	*Lithothelium decumbens* (Müll. Arg.) Aptroot	CR	C	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	+
40	*Pyrenula adacta* Fée	CR	C	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
41	*P. aggregata* (Fée) Fée	CR	C	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
42	*P. approximans* (Kremp.) Müll. Arg.	CR	C	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
43	*P. aspistea* (Ach.) Ach.	CR	C	-	-	-	-	+	-	-	+	-	-	+	-	-	-	-	+	-	-	+
44	*P. breutelii* (Müll. Arg.) Aptroot	CR	C	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
45	*P. brunnea* Fée	CR	C	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
46	*P. castanea* (Eschw.) Müll. Arg.	CR	C	-	-	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-
47	*P. dissimulans* (Müll. Arg.) R.C. Harris*	CR	C	-	-	+	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
48	*P. fetivica* (Krempelh.) Müll. Arg.	CR	C	-	+	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
49	*P. gibberulosa* (Vain.) Aptroot	CR	C	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
50	*P. immissa* (Stirt.) Zahlbr.	CR	C	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-
51	*P. leucostoma* Ach.	CR	C	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
52	*P. leucotrypa* (Nyl.) Upreti	CR	C	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
53	*P. mamillana* (Ach.) Trevis.	CR	C	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
54	*P. maravalensis* Vain.	CR	C	-	-	-	-	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-
55	*P. nitidula* (Bres.) R.C. Harris.	CR	C	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-

56	*P. ochraceoflava* (Nyl.) R. C. Harris	CR	C	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-
57	*P. oculata* A. Singh & Upreti	CR	C	-	-	-	+	-	+	-	-	+	+	-	-	-	+	-	-	-	-	-
58	*P. quassiaecola* (Fée) Fée	CR	C	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
59	*P. pyrenastrospora* Aptroot*	CR	C	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
60	*P. rinodinospora* Aptroot *	CR	C	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	+	-	-
61	*P. subumbilicata* (C. Knight) Aptroot	CR	C	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
Strigulaceae																						
62	*Strigula antillarum* (Fée) Müll. Arg.	CR	F	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
63	*S. concreta* (Fée) R. Sant.	CR	F	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
64	*S. janeirensis* (Müll. Arg.) Lücking	CR	F	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
65	*S. nitidula* Mont.	CR	F	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
66	*S. phyllogena* (Müll. Arg.) R.C. Harris	CR	F	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
67	*S. smaragdula* Fr.	CR	F	-	-	-	-	-	-	-	-	-	+	-	-	+	-	-	-	-	-	-
68	*S. subelegans* Vain.	CR	F	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
69*	*S. subtilissima* (Fée) Müll. Arg.	CR	F	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
Trypetheliaceae																						
70	*Astrothelium luridum* (Zahlbr.) Aptroot & Lücking	CR	C	-	-	-	-	-	-	-	-	-	-	-		+	-	-	-	-	-	-
71	*A. meristosporum* (Mont. & Bosch) Aptroot & Lücking	CR	C	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
72	*A. scoria* (Fée) Aptroot & Lücking	CR	C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-
73	*Marcelaria benguelensis* (Müll. Arg.) Aptroot, Nelsen & Parnmen	CR	C	-	-	-	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-
74	*Nigrovothelium bullatum* Lücking, Upreti & Lumbsch	CR	C	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
75	*N. tropicum* (Ach.) Lücking, M.P. Nelsen & Aptroot	CR	C	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	+	-	-	-
76	*Trypethelium eluteriae* Spreng.	CR	C	-	-	-	-	-	-	-	+	-	-	-	+	+	+	-	+	-	-	-
77	*T. plicatorimosum* Mahija & Patw.	CR	C	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
Verrucariaceae																						
78	*Endocarpon subrosettum* A. Singh & Upreti	SQ	S	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
79	*Staurothele fissa* (Taylor) Zwackh	CR	S	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-

The studied specimens belonged to nineteen localities; eleven were from North Goa, while eight localities were from South Goa. The maximum diversity of pyrenocarpous lichens is recorded in South Goa with 71 species, while North Goa recorded 29 species and 21 species are common between the two districts. It may be noted that South Goa has a more dense forest area which is also fairly well explored compared to North Goa. Among the different localities, Cotigao Wildlife Sanctuary (CWS) is the most extensively surveyed and has maximum diversity of pyrenocarpous lichens with 48 species, while Bhagwan Mahavir Wildlife Sanctuary (BMWS) has 17 and Valpoi has eight species. Ponda and Quinamol localities are poorly represented by pyrenocarpous lichens with one species each. Compared to other sites Ponda and Quinamol are anthropogenically more disturbed which may be the reason for low pyrenocarpous lichen diversity here.

New records

1. *Porina exserta* Müll. Arg. in Flora 71: 548. 1888.

Thallus corticolous, continuous to rimose, pale brownish to green, smooth to minutely rugulose, 35–80 µm thick, ecorticate; prothallus lacking. Perithecial verrucae, hemispherical to subglobose, 0.35–0.96 mm diam., brownish to blackish, apex rounded; ostiole usually inconspicuous; excipulum 20–30 µm thick, pale orange-brown, centrum 0.2–0.4 mm wide; subhymenium 15–35 µm thick; paraphyses unbranched, 0.7–1.2 µm wide, periphyses absent. Asci elongate to cylindrical 110–1160 × 14–18 µm, ascospores elongate to cylindrical, (11–)15–17 (–21) septate, 44–70 × 3.5–5.5 µm. Pycnidia absent. (Fig. 2A).

Chemistry:—Thallus K–, C–, KC–, PD–, UV–; no lichen substance present in TLC.

Distribution and ecology:—This species is found growing on the bark of *Terminalia paniculata* Roth in Cotigao Wildlife Sanctuary between altitude of 100–200 m. Earlier, this species was reported from Thailand, Christmas Island, the Northern Territory, eastern Queensland, Taiwan and Tahiti (27).

Specimen examined:—INDIA, Goa: South Goa, Cotigao Wildlife Sanctuary, Endrem, N14°59′51.2″, E 074°11′52.1″, 24 February 2018, *P. Randive GU-L 813* (LWG Acc. no. 36250!), on the bark.

Note:—*Porina exserta* closely resembles *P. bellendenica* Müll. Arg. in having similar perithecial verrucae and ascospores, but *P. bellendenica* differs in having a black basal layer and 15 septate ascospores.

2. *Porina siamensis* P. M. McCarthy in Lichenologist 31(3): 242. 1999.

Thallus saxicolous, rimose to areolate, smooth, matt, pale greyish to green, 20–80 µm thick, ecorticate; prothallus present, grey to black. Perithecia numerous, mostly solitary, semi-immersed to ± superficial, convex to hemispherical or subconical, 0.2–0.6 mm diam., greenish-brown to black, not overgrown by the thallus; ostiole inconspicuous or in a shallow depression; centrum subglobose to ovate, 0.10–0.25 mm diam.; excipulum hyaline to pale brown or yellowish-brown, 10–15 µm thick, subhymenium 20–40 µm thick; paraphyses unbranched, 0.8–1 µm wide, periphyses absent. Asci cylindrical to elongate, 72–86 × 8–9 µm, ascospores 3-septate, cylindrical to fusiform, 14–24 × 3–4.5 µm, lacking perispore. Pycnidia present. (Fig. 2B).

Chemistry:—Thallus K–, C–, KC–, PD–, UV–; no lichen substance present in TLC.

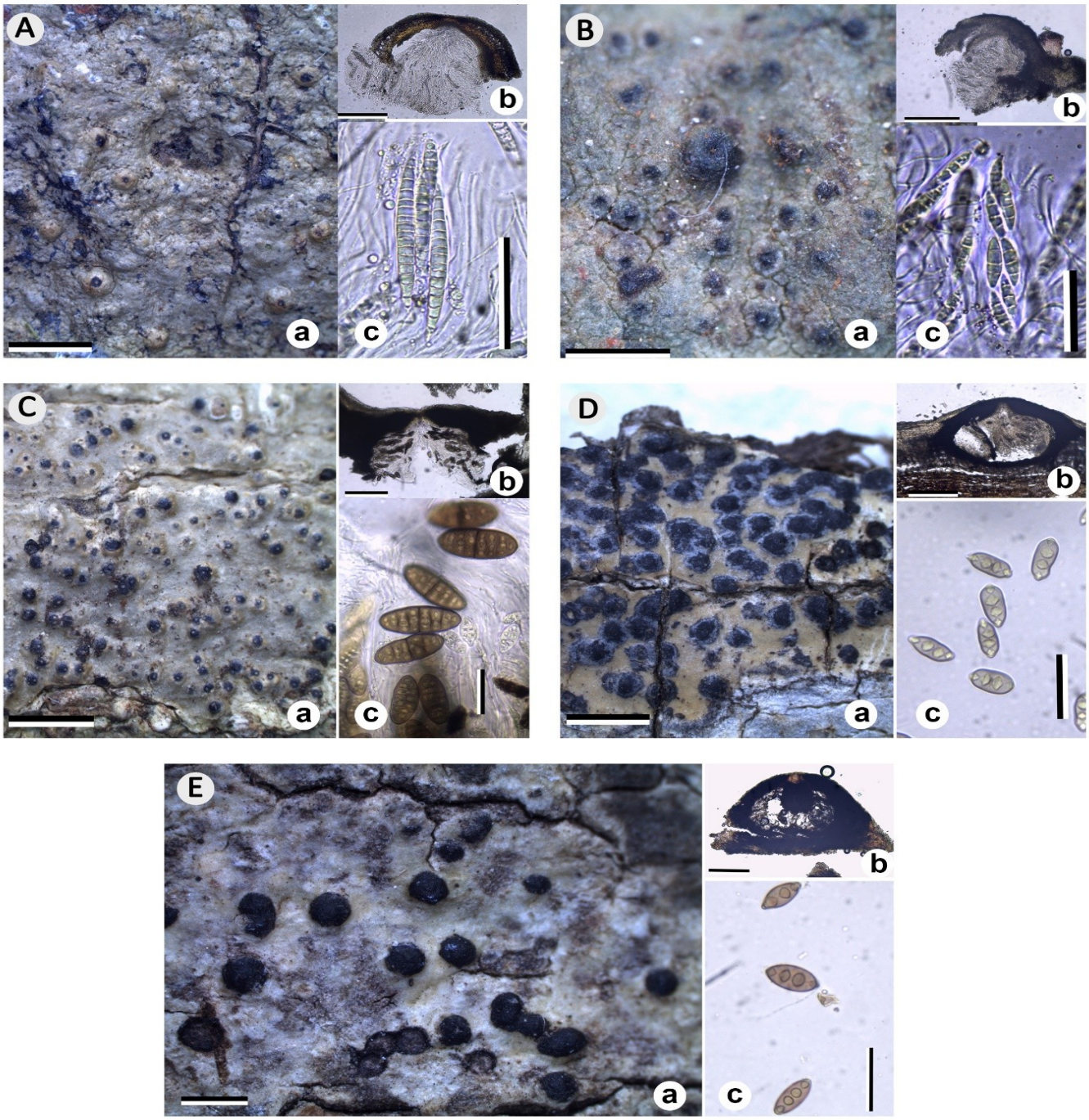

Fig. 2. Habit (a), perithecial section (b) and ascospres (c) of newly recorded pyrenocarpous lichens. **A**. *Porina exserta,* **B.** *P. siamensis,* **C**. *Pyrenula dissimulans.* **D**. *P. pyrenastrospora.* **E.** *P. rinodinospora* (Scale bars: habit A, C–E 2 mm, B 5 mm; perithecial section A–E 200 µm; ascospores A. 50µm, B – E 30 µm).

Distribution and ecology:—*Porina siamensis* was found growing on an open, exposed rock in Cotigao Wildlife Sanctuary at about ±200 m. Previously this species was known from Thailand (28).

Specimen examined:—INDIA, Goa: South Goa, Cotigao Wildlife Sanctuary, Cuncolim, Agonda, N15°13′13.0″, E073°97′99.5″, 28 December 2016, *P. Randive GU-L434* (LWG Acc. no. 36251!), on rock.

Note:—This species is similar to *Porina chlorotica* (Ach.) Müll. Arg. and *P. fortunata* P. M. McCarthy & Etayo in having black or dark reddish-brown perithecia. *P. chlorotica* also has three septate ascospores, but its perithecia are smaller (0.2–0.3 mm diam.) and ascospores are slightly larger (16–32 × 4–6 µm). In comparison, *P. fortunata* differs in having seven septate ascospores of size 18–33 × 5–4 µm and perithecia of 0.3–0.4 mm diam.

3. *Pyrenula dissimulans* (Müll. Arg.) R.C. Harris in More Florida lichens, Incl. 10 Cent Tour Pyrenol.: 110. 1995.

Thallus corticolous, corticated, smooth, continuous, brownish to yellowish, lacking pseudocyphellae. Perithecia simple, dispersed, conical, emergent, 0.25–0.6 mm diam., black; ostioles apical black; hamathecium hyaline. Asci cylindrical to clavate, 4–8 spored, ascospores muriform, 25–55 × 14–22 µm,

lumina mostly rounded, at least in the central part of ascospores. Pycnidia not seen. (Fig. 2C).

Chemistry:—Thallus K–, C–, KC–, PD–, UV–; no lichen substance present in TLC.

Distribution and ecology:—This species was found growing on the tree bark of *T. paniculata* in the Goa University campus approximately at an altitude of 100 m. Earlier, this species was known from North and South America (29-31).

Specimens examined:—INDIA, Goa: North Goa, Goa University campus, 02 October 2016, *P. Randive, GU-L305* (LWG Acc. no. 36252!) on bark, *GU- L318* (LWG Acc. no. 36253!) on bark.

Note:— *Pyrenula dissimulans* is close to *P. oleosa* R.C. Harris in having corticated thallus, apical ostioles and lacking oil inspersion in hamathecium, but the old ascospores in the latter species are filled with oil.

4. *Pyrenula pyrenastrospora* Aptroot in Biblthca Lichenol. 64: 165, 1997.

Thallus corticolous, corticated, smooth, brownish, lacking pseudocyphellae. Perithecia mostly aggregated with fused walls, conical, 0.3–0.6mm diam.; ostioles apical or when ecentric all opining the same direction, black; hamathecium not inspersed. Asci cylindrical to clavate, 4–8 spored, ascospores brown, 3-septate, fusiform, 16–25 × 6–10 µm, lumina in a straight line, terminal lumina directly against the exospores wall. Pycnidia absent. (Fig. 2D).

Chemistry:—Thallus K–, C–, KC–, PD–, UV–; no lichen substance present in TLC.

Distribution and ecology:—This species was found growing on the tree bark of *Tectona grandis* L.f. in Cotigao Wildlife Sanctuary at altitude ±200 m. Previously this species was known from Papua New Guinea (19).

Specimen examined:—INDIA, Goa: South Goa, Cotigao Wildlife Sanctuary, Bela lake, N14°57′23.7″, E074°09′09.3″, 15 January 2018, *P. Randive GU-L655* (LWG Acc. no.36254!), on bark.

Note:—*Pyrenula pyrenastrospora* is closely related *P. minarum* Vain., which differs in having inspersed hamathecium and partly eccentric ostioles.

5. *Pyrenula rinodinospora* Aptroot in Lichenologist 44(5): 611–618. 2012.

Thallus corticolous, corticate, smooth, continuous, thin, brownish, without pseudocyphellae. Perithecia simple, dispersed, conical, emergent, 0.3–0.5 mm diam., black, edges without thallus covering; ostioles black, apical; hamathecium hyaline, densely inspersed with oil droplets. Asci cylindrical to clavate, 8-spored, ascospores brown, 3-septate, fusiform, without constrictions, 20–30 × 11–12.5 µm, ends mostly pointed, lumina mostly quadrangular, angles blunt, terminal lumina elongated and not separated from the end wall by an endospore layer. Pycnidia not seen. (Fig. 2E).

Chemistry:—Thallus K–, C–, KC–, PD–, UV–; no lichen substance present in TLC.

Distribution and ecology:—This species was found growing on the bark of *Ficus benghalensis* L. in Coatigao Wildlife Sanctuary and en route to Sattari-Valpoi between altitude 100–200 m. Previously this species was known only from Papua New Guinea (32).

Specimens examined:—INDIA, Goa: South Goa, Cotigao Wildlife Sanctuary, Quinomol, N15°13′130″, E074°11′88.7″, 07 December 2016, *P. Randive GU-L414* (LWG Acc. no. 36255!) on bark; North Goa, Sattari-Valpoi, N15°31′66.7″ E074°12′41.1″, 07 March 2017, *P. Randive GU-L 548* (LWG Acc. no. 36256!), on bark.

Note:—*Pyrenula rinodinospora* closely resembles *Pyrenula maravalensis* Vain. in having similar morphology, but the latter species differs by the shorter ascospores of 20–25 µm long (18).

Key to the pyrenocarpous lichens of Goa

1a. Thallus foliicolous 2

1b. Thallus otherwise 17

2a. Asci functionally unitunicate, entirely thin-walled, perithecia covered by thallus, ascospores transversely 3–9 septate..... 3

2b. Asci functionally bitunicate (fissitunicate), apically thick-walled, perithecia not covered by thallus, ascospores transversely 1-septate..... 10

3a. Perithecia with 5–10 (–12) setae, soft, usually decurved, narrowly acute or bristle-like, whitish or black with white distal halves, ascospores fusiform to narrowly oblong, 7 septate, 25–35 × 4–6 µm ..... ***Trichothelium alboatrum***

3b. Perithecia lacking setae 4

4a. Area around the ostiole or perithecial surface rough, slightly papillose or tomentose 5

4b. Area around the ostiole and perithecial surface glabrous 6

5a. Perithecial wall colourless, ascospores 5 septate, fusiform, 22–30 × 4–5 µm ... ***Porina pallescens***

5b. Perithecial wall upper part blackish, lower part brownish, ascospores 5 septate, fusiform, 20–32 × 4–5.5 µm .....***Porina nitidula***

6a. Ascospores 3 septate 7

6b. Ascospores 7–9 septate 8

7a. Perithecial apex conical, translucent, ascospores 18–27 × 3–5 µm ..... ***Porina rufula***

7b. Perithecia apex rounded, not translucent, ascospores oblong, 14–20 × 2–4 µm .....***Porina chrysophora***

8a. Perithecia conical, apex with prominent, short cylindrical extension, ascospores narrowly fusiform to oblong, 34–48 7 × 4–6 µm ..... ***Porina conica***

8b. Perithecia apex without any extension 9

9a. Perithecia conical to wart-shaped when mature, with black dot around ostiole, ascospores narrowly fusiform, 33–63 × 4–6 µm, white prothallus sometimes present ....***Porina karnatakensis***

9b. Perithecia lens shaped to hemispherical, without dark spot, prothallus absent, ascospores oblong, 26–33 × 3–4 µm ..... ***Porina epiphylla***

10a. Ascospores large, 35–70 × 4–8 µm, often breaking into halves (each cell often with up to 3 secondary septa), oblong, with distinct constriction at septum ....***Strigula janeirensis***

10b. Ascospores small, up to 25 µm long 11

11a. Distal cell of the ascospore enlarged..... 12

11b. Distal cell not enlarged 13

12a. Thallus subcuticular, bright green, ascospores irregularly biseriate, 15–25 × 4–6 µm ..... ***Strigula antillarum***

12b. Thallus epiphyllous, pale greenish to bluish grey, ascospores biseriate, 15–25 × 4–6 µm ..... ***Strigula subelegans***

13a. Ascospores breaking into halves either inside or outside the asci 14

13b. Ascospores not breaking 15

14a. Thallus thin (8–15 µm), bright metallic green, margin effuse, with a thin blackish line, ascospores 8–12 × 2–3 µm ....***Strigula nitidula***

14b. Thallus thick (15–30 µm), pale greyish green, margin crenulate to lobulate, lacking blackish line, ascospores 8–12 × 2–3 µm ..... ***Strigula concreta***

15a. Thallus elobate, photobiont cells rectangular to angular-rounded, perithecia pure black, conical, delimited from surrounding thallus, ascospores 9–12 × 2–3 µm .....***Strigula phyllogena***

15b. Thallus crenulate lobate to distinctly lobate . 16

16a. Thallus with distinct lobes leaving small to large interspaces, greenish-brown, perithecia completely exposed but covered by thin thallus layer, ascospores oblong acicullar, with a slight constriction at septum, 10–18 × 2–3 µm ....***Strigula subtilissima***

16b. Thallus entire to crenulate or lobulate, sometimes whole thallus lobate-laciniate, bright green, perithecia immersed to erumpent, covered by algiferous thallus tissue up to ostiolum, ascospores 14–24 × 4–6 µm ....***Strigula smaragdula***

17a. Thallus saxicolous 18

17b. Thallus corticolous 22

18a. Thallus squmulose, squmules imbricate, up to 2.5 mm wide, perithecia 1–6 per squamule, ascospores 2 per asci, brown, muriform, 30–40 × 12–14 µm ..... ***Endocarpon subrosettum***

18b. Thallus crustose, continuous to areolate 19

19a. Ascospores muriform, 2 per acus, brown, 70–90 × 15–25 µm, perithecia sunken, algal cell in the hymenium globose, thallus rimose areolate, greyish brown ..... ***Staurothele fissa***

19b. Ascospores transversely septate, hyaline 20

20a. Ascospores 3 septate, cylindrical to fusiform, 14–24 × 3–5 µm, perithecia 0.2–0.6 mm diam., greenish-brown to black, not overgrown by the thallus, ostiole inconspicuous or in a shallow depression ..... ***Porina siamensis***

20b. Ascospores 7–9 septate 21

21a. Ostiole conspicuous, periostiolar region brown to black, perithecia 0.5 – 0.8 mm diam., 7–9 septate, 23–34 × 5–9 µm, fusiform with rounded ends ..... ***Porina subinterstes***

21b. Ostiole usually inconspicuous, periostiolar area pale to dark brown or blackish, perithecia 0.3-0.8 mm diam., ascospores 7 septate, 24–44 × 4–7 µm, cylindrical or narrowly obclavate..... .....***Porina tetracerae***

22a. Ascospores hyaline 23

22b. Ascospores greyish brown to brown 57

23a. Ascospores simple, subglobose to ellipsoid, surface ornamented with cristae, 9–13 × 7–9 µm, thallus slightly squamulose ....***Monoblastia pellucida***

23b. Ascospores septate 24

24a. Ascospores transversely septate 25

24b. Ascospores muriform 56

25a. Ascospores 1-septate 26

25b. Ascospores 3 or more septate..... 41

26a. Perithecial wall hyphal, containing bark cells, pseudoparaphyses branched, but not anastomosing 27

26b. Perithecial wall cellular, lacking bark cells, pseudoparaphyses slender, branched and anastomosing especially above the asci 30

27a. Ascospores 2 per asci, 1-septate, sometimes constricted at both ends and appearing as 3 septate, large (40–60 × 15–25 µm) .... ***Arthopyrenia finkii***

27b. Ascospores 8 per asci 28

28a. Distal cell of the ascospore is larger, ascospore 30–45 × 14–18 µm, perithecia solitary..... .....***Arthopyrenia nidulans***

28b. Both the cells are almost equal in size 29

29a. Ostiole mammilate, perithecia solitary to 2–3 aggregate, ascospores 25–43 × 6–11 µm..... .....***Arthopyrenia indusiata***

29b. Ostiole not mammilate, perithecia solitary, ascospores 10–18 × 5–7 µm .... ***Arthopyrenia alboatra***

30a. Thallus UV+ 31

30b. Thallus UV– 35

31a. Distal cell of the ascospores is larger, ascospores 23–30 × 7–10 µm, perithecia single, ostiole eccentric ....***Anisomeridium ubianum***

31b. Both the cells are of almost equal size 32

32a. Ostiole eccentric, perithecia single, ascospores 27–35 × 8–10 µm . ***Anisomeridium angulosum***

32b. Ostiole apical 33

33a. Ascospores smaller, 14–19 × 4–65 µm, narrowly fusiform, ascus mostly biseriate..... .....***Anisomeridium albidoatrum***

33b. Ascospores >20 µm long 34

34a. Ascospores 25–30 × 9–13 µm, elliptical to broadly elliptical, ascus mostly uniseriate..... .....***Anisomeridium consobrinum***

34b. Ascospores 30–45 × 13–16 µm, ovoid to broadly ovoid, ends somewhat pointed ....***Anisomeridium indicum***

35a. Ascospores 2–4 per ascus, 40–66 × 10–17 µm, perithecia solitary, ostiole black with white wide pore.....***Anisomeridium tarmugliense***

35b. Ascospores 8 per ascus 36

36a. Distal cell of ascospore larger in size 37

36b. Both the cells of ascospores are of almost equal in size 38

37a. Ostiole eccentric, ascospores 19–30 × 7–12 µm ..... ***Anisomeridium palavanum***

37b. Ostiole apical, ascospores 16–21 × 4–7 µm ..... ***Anisomeridium biforme***

38a. Ostiole apical, ascospores 23–27 × 9–11 µm, fusiform, biseriate or irregularly arranged in ascus ..... ***Anisomeridum subnexum***

38b. Ostiole eccentric 39

39a. Ascospores granular ornamented, fusiform to narrowly ovoid, 19–30 × 6–8 µm..... .....***Anisomeridium terminatum***

39b. Ascospores smooth 40

40a. Ascospores fusiform, with pointed ends, 30–37 × 9–11 µm ..... ***Anisomeridium glaucescens***

40b. Ascospores 30–40 × 6–8 µm ....***Anisomeridium complanatum***

41a. Ascospores lumina diamond-shaped 42

41b. Ascospores lumina rectangular-shaped 45

42a. Perithecia in distinct or diffuse pseudostroma, laterally covered by thallus 43

42b. Perithecia solitary to crowded, fully exposed, black 44

43a. Perithecia in diffuse stroma, upper portion blackish brown with whitish rim, erumpent, 0.3-0.5 mm diam., hamathecium inspersed, ascospores 3 septate, 15–27 × 7–10 µm, fusiform-ellipsoid .....***Astrothelium scoria***

43b. Perithecia in distinct stroma, upper portion dark, erumpent to prominent, 0.8-1.5 mm broad, ostiolar region internally with yellow pigment, hamathecium clear, ascospores 7–11 septate, fusiform, 55–88 × 13–28 µm..... .....***Astrothelium luridum***

44a. Thallus strongly verrucose-bullate, olive-green to brownish, perithecia 0.2–0.3 mm diam., sessile, stioles visible as tiny black dots, ascospores fusiform, 20–25 × 8–10 µm ....***Nigrovothelium bullatum***

44b. Thallus smooth to uneven, olive-green to yellowish-brown, perithecia 0.2–0.3 mm diam., prominent to sessile, subglobose to barrel-shaped with a flattened top, ostiolar area greyish, ascospores fusiform-ellipsoid, 20–25 × 7–10 µm ..... ***Nigrovothelium tropicum***

45a. Ascospore 3 septate, perithecia solitary or 2–3 aggregated, ostiole apical, umbonate, 19–23 × 5–7 µm, thallus endophloeodal..... ..... ***Arthopyrenia grisea***

45b. Ascospores more than 3 septate 46

46a. Perithecia highly crowded to pseudostromatic 47

46b. Perithecia solitary or aggregated, never in pseudostroma, but in verrucae 48

47a. Perithecia in diffuse pseudostroma, brown-black, 0.5–1.0 mm, basally covered by thallus but upper part exposed, flattened and disc-shaped, ascospores 12–17-septate, fusiform, 45–55 × 6–8 µm, thallus olive-green to yellowish ..... ***Trypethelium plicatorimosum***

47b. Perithecia in distinct pseudostroma, brownish to dark brown, covered by yellow pigment, 1–2 mm diam., ascospores 9–13-septate, fusiform, 37–52 × 8–11 µm..... ..... ***Trypethelium eluteriae***

48a. Ostiole K+ reddish, perithecia 0.45-0.6 mm diam., ascospores 7 septate, elliptic, 19–30 × 4–7 µm .....***Clathroporina mastoidea***

48b. Ostiole K- 49

49a. Ascospores >13 septa 50

49b. Ascospores 6–13 septa 51

50a. Perithecia brownish blackish, ostiole inconspicuous, ascospores 11–21 septa, elongate to cylindrical, 47–70 × 4–6 µm..... .....***Porina exserta***

50b. Perithecia greenish grey, area around ostiole black, ascospores 13-16 septate, straight to curved with pointed ends, 50–70 × 5–7 µm ..... ***Porina subhibernica***

51a. Hamathecium inspersed with oil 52

51b. Hamathecium not inspersed 53

52a. Ascospores 7–9 septate, oblong ellipsoid, 60–85 × 12–20 µm, ostiolar region brown black..... .....***Porina subcutanea***

52b. Ascospores 11–12 septate, fusiform, 89–92 × 16–20 µm, ostiolar region black..... .....***Porina americana***

53a. Ostiolar region yellow to light brown, surrounded by black priostiolar rim, ascospores

7–9 septate, fusiform with acute ends, 43–50 × 4–6 µm ..... ***Porina ochrostoma***

53b. Ostiolar region variously coloured, peri ostiolar rim lacking 54

54a. Ostiolar region brown-black, ascospores 7–8 septate, fusiform, acute ends, 32–48 × 4–7 µm..... .....***Porina interestes***

54b. Ostiolar region otherwise, ascospores much larger 55

55a. Ostiolar region orange, pinkish, reddish to brownish, rarely dark brown, ascospores 7–9 (–13) septate, fusiform with rounded ends, 44–80 × 7–13 µm ..... ***Porina atlantica***

55b. Ostiolar region orange-brown to black to black, ascospores fusform round ended, 45–60 ×11–18 µm ..... ***Porina internigrans***

56a. Thallus olive-green, yellow-orange pruinose, UV+, perithecia flattened top, solitary to irregularly grouped and confluent, covered with yellow-orange pigment, hamathecium densely inspersed, ascospores fusiform-ellipsoid, 50–80 × 17–23 µm .....***Marcelaria benguelensis***

56b. Thallus light olive-green, pigmented pruina absent, UV+, flattened top, solitary to grouped, covered by thallus up to ostiole, hamathecium inspersed, ascospores oblong-fusiform, 120–220 × 25–40 µm, with thickened median septum..... ..... ***Astrothelium meristosporum***

57a. Ascospores transversely 3 septate 58

57b. Ascospores submuriform to muriform 74

58a. Perithecia in pseudostroma, 1–12 carpic, thallus yellowish-brown to brown, K+ red, ascospores ellipsoidal, 13–23 × 6–10 µm .... ***Pyrenula leucotrypa***

58b. Perithecia solitary or aggregated, not forming pseudostroma 59

59a. Ascomata mostly aggregated, with fused walls but with separate ostioles, conical, 0.3–0.6 mm diam., ostioles apical, black, ascospores brown, 3 septate, fusiform 16–25 × 6–10 µm..... .....***Pyrenula pyrenastrospora***

59b. Ascomata solitary 60

60a. Ascospores red-brown, lumina becoming rounded when older, 15–20 × 9–10 µm, ellipsoid, hamathecium inspersed, thallus olive-brown shining.....***Lithothelium decumbens***

60b. Ascospores grey to brown, rarely red-brown and then lumina angular 61

61a. Ostiole eccentric, perithecia solitary, ascospores 35–45 × 15–18 µm, terminal lumina separated from the exospore wall by endospore thickening ..... ***Pyrenula adacta***

61b. Ostiole apical 62

62a. Hamathecium inspersed 63

62b. Hamathecium not inspersed.....69

63a. Thallus pseudocyphellate, yellow-brown buff, perithecia solitary or 1–4 coalescing, ostiole indistinct, ascospores oblong ellipsoid, 32–45(–60) × 15–27 µm ..... ***Pyrenula immissa***

63b. Thallus lacking pseuodcyphellae 64

64a. Ascospore 27–50 × 15–18 µm, oblong ellipsoid, perithecia solitary, completely embedded in thalline verrucae, ostiole indistinct, thallus ochre-yellowish brown ..... ***Pyrenula oculata***

64b. Ascospore <30 µm long 65

65a. End lumina of the ascospore is elongated 66

65b. All lumina ± rounded to angular 67

66a. Thallus brownish to pale brown, ascomata emergent 0.3–0.5 mm diam., hemithecium densely impressed with oil droplets, ascospores 20–25 × 6–10 µm ..... ***Pyrenula maravalensis***

66b. Thallus ochraceous yellow to brownish, ascomata semiemergent 0.5- 1.0 mm diam., hemithecium without oil droplets, ascospores 20–30 × 11–13 µm .... ***Pyrenula rinodinospora***

67a. Ostiole mamillate papillate, dull black, perithecia solitary, ascospores oblong ellipsoid, 17–20×7–9 µm, thallus buff to yellow-brown ....***Pyrenula mamillan***

67b. Ostiole otherwise, centrum I ± perithecia solitary or semi-solitary, ascospores ellipsoid, thallus brownish yellow to brown 68

68a. Psudocyphellae present, ascocarp 0.8–1.0 mm in diameter, conical- hemispherical, centrum I+ blue, ascospores 16–24 × 8–13 µm ....***Pyrenula fetivica***

68b. Psudocyphellae absent, ascocarp 1.0–2.5 (–3.0) mm in diameter, flat, convex to conico-depressed, centrum I -, ascospores 15–17 × 5–7 µm ..... ***Pyrenula castanea***

69a. Thallus with pseudocyphellae, brownish to olive-green, ascospore fusiform, 22–38 × 8–15 µm, lumina rounded to somewhat angular ..... ***Pyrenula quassiaecola***

69b. Thallus lacking pseudocyphellae 70

70a. Terminal lumina mostly separated from exospore wall 71

70b. Terminal lumina not separated from exospore wall 73

71a. Perithecia slightly larger, 0.6–1.0 mm diam., ascospores oblong ellipsoid, 12–17 × 5–7 µm ....***Pyrenula brunnea***

71b. Perithecia smaller 72

72a. Perithecia 0.2–0.6 mm diam., ascospores oblong ellipsoid, 17–22 × 9–10 µm ...***Pyrenula aspistea***

72b. Perithecia 0.4–0.7 mm diam., ascospores oblong ellipsoid, 15–21 × 8–10 µm..... .....***Pyrenula aggregata***

73a. End lumina elongated, ascospore 20–29 ×9–11 µm ..... ***Pyrenula approximans***

73b. All lumina ± rounded to angular, ascospores 13–16 × 7–8 µm ..... ***Pyrenula nitidula***

74a. Ostioles eccentric, fused, perithecia usually in groups of 2–6, ascospores submuriform, with 5 transverse septa and few longitudinal septa, fusiform, with pointed ends, 24–32 × 10–13 µm, thallus yellowish to olive-green .... ***Pyrenula subumbilicata***

74b. Ostiole apical, not fused, perithecia mostly solitary 75

75a. Thallus and perithecia yellow to orange, indistinctly to faintly papillate, ascospores ellipsoidal, 12–18 × 7–10 µm .... ***Pyrenula ochraceoflava***

75b. Thallus and perithecia otherwise 76

76a. Old ascospores filled with orange oil, muriform, 25–30 × 10–15 µm, pantropical distribution ..... ***Pyrenula breutelii***

76b. Old ascospores lacking orange oil, submuriform..... 77

77a. Thallus yellow-brown, pseudocyphellate, UV+ yellowish, ostioles indistinct to mamillate-papillate, hamethecium not inspresed, ascospores 23–35 × 10–12 µm long .... ***Pyrenula gibberulosa***

77b. Thallus otherwise, ostioles apical, ascospores larger, up to 45–55 µm long 78

78a. Lumina of the ascospore mostly round, ascospore 25–55 × 14–22 µm, ostioles apical, naked, black, thallus yellowish-brown.....***Pyrenula dissimulans***

78b. Lumina relatively large and angular, ascospore 24–46 × 9–20 µm, ostiolar region naked, brownish-black to black, thallus greenish straw coloured, yellow to yellow-brown ....***Pyrenula leucostoma***

Discussion

The semi-evergreen forest in the Goa region exhibits maximum diversity of pyrenocarpous species. The trees along the streams in moist, shady habitats bear luxuriant growth of pyrenolichens which mostly belong to *Porina* and *Pyrenula* species. The occurrence of pyrenocarpous lichens indicates the abundant presence of smooth-barked trees in the State. Further, the occurrence of a large number of foliicolous lichens indicates that the State has several healthy and undisturbed forests. Bhagwan Mahavir Wildlife Sanctuary as a whole and within Cotigao Wildlife Sanctuary, Avem, Bela to Zombolim,, Endrem to Tulshimol, Kuske waterfall area, Marlem, Nadkem and Ravan Donger are few such pristine habitats. With the addition of five new records, the total number of lichens species in Goa State increases to 165 species, out of which pyrenocarpous lichens represent almost half (48%).

Conclusion

The present study indicates the occurrence of a rich diversity of pyrenocarpous lichens in the Western Ghats forests of Goa. It can be noted that among the protected areas within Goa, Cotigao Wildlife Sanctuary represents more number of pyrenocarpous lichens. Further, along with the forest areas within Goa, the coconut, arecanut orchards and several cultivated plants also provide suitable habitats for lichen growth. The present study will be highly useful for monographic studies on pyrenocarpous lichens of India or the world and for environmental monitoring studies in the area.

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Authors' contributions

PR collected fresh samples of pyrenocarpous lichens from Goa and carried out their preliminary identification. GKM studied pyrenocarpous lichen specimens preserved in herbarium LWG and drafted the manuscript. SN authenticated identity of some pyrenocaprous lichens reported in the manuscript, improved the manuscript and supervised the whole study. DKU authenticated identity of some pyrenocarpous lichen specimens and suggested improvement in the manuscript. MKJ conceptualized the idea of studying lichens of Goa, supervised the work of author PR and provided intellectual inputs to the study.

Conflict of interests

The authors do not have any conflict of interests to declare.

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