

## Additional records of Pyrenocarpous lichens from the Andaman and Nicobar Islands, India

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### Publication Info

#### Article history:

Received : 09 September 2022

Accepted : 13 September 2022

DOI: 10.21756/cab.v6i1.05

#### Keywords:

Lichenized fungi, New records, Pyrenulaceae, Taxonomy,

Trypetheliaceae.

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### ABSTRACT

Nineteen species of pyrenocarpous lichens are added to the lichen flora of the Andaman and Nicobar Islands, India. *Lithothelium nanosporum* (C. Knight) Aptroot, *Nigrovothelium inspersotropicum* Aptroot & Diederich, *Pseudopyrenula media* Aptroot & Diederich, *Pyrenula ciliata* Aptroot, *P. cocoes* Müll. Arg., *P. fulva* (Kremp.) Müll. Arg., *P. septicollaris* (Eschw.) R.C. Harris, *P. sexocularis* (Nyl.) Müll. Arg. and *P. subglabrata* (Nyl.) Müll. Arg. are reported as new records for India.

### INTRODUCTION

Pyrenocarpous lichens form an important element of tropical lichen biotas. They are relatively little studied, because they are among the least attractive lichens in the field (Aptroot et al. 2008). The islands of Andaman and Nicobar are the part of two global biodiversity hotspots, Indo-Burma and Sundaland, and hence rich in flora and fauna. Similarly, the islands also harbour rich diversity of lichens represented by 552 taxa (Sinha 2021). The evergreen tropical rainforest, semi-deciduous, mangroves and beach forest of the Andaman and Nicobar Islands support rich corticolous pyrenocarpous lichens. More recently, several taxa were added as additional records to the region (Jagadeesh Ram and Sinha 2021). In the present paper, 19 species of pyrenocarpous lichens including nine new records for India are reported as additional records for the Andaman and Nicobar Islands. Enumeration of taxa with detailed descriptions, habit images of new records for India and brief descriptions of extended distribution are provided.

### MATERIALS AND METHODS

The pyrenocarpous lichen specimens deposited in herbarium PBL of Botanical Survey of India, Andaman and Nicobar Regional Centre, Port Blair were investigated. External morphological features were observed with a Nikon SMZ1500 stereomicroscope. Thin hand-cut sections of thalli and perithecia were mounted in water and examined with a Nikon Eclipse 50i light transmission microscope. The chemistry was investigated under UV light and tested with 10% KOH solution on sections and also on thallus surface. Hymenial amyloidity was checked with Lugol's iodine. The lichen substances were identified by thin layer

chromatography using solvent A (Orange et al. 2001).

### SPECIES

**1. *Anthracotheceum prasinum*** (Eschw.) R.C. Harris in Egan, Bryologist 90: 163. 1987. *Verrucaria prasina* Eschw. in Mart., Fl. Bras. Enum. Pl. 1(1): 124. 1833 (Pyrenulaceae). Thallus yellowish brown, not pseudocyphellate, corticate. *Perithecia* solitary, conical, 1–2.5 mm diam. *Ostiole* apical. *Hymenium* not interspersed, I+ blue-green. *Asci* cylindrical, 6–8-spored, 180–330 × 35–65 µm. *Ascospores* uniseriate, brown, ellipsoid-oblong, muriform, 60–110(–120) × 26–35 µm.

*Chemistry*: Thallus K–, UV–; no lichen substances detected.

*Distribution*: Pantropical. India (Arunachal Pradesh and Kerala), Borbon Islands, Africa and South America.

*Specimen examined*: Andaman Islands: South Andaman, Chidiyatapu, alt. 5 m, 12.2.2011, Jagadeesh Ram 44.

**2. *Dictyomeridium amylosporum*** (Vain.) Aptroot, M. P. Nelsen & Lücking, Lichenologist 48(6): 923. 2016. *Thelenella amylospora* Vain., Acta Soc. Fauna Fl. Fenn. 7(2): 218. 1890 (Trypetheliaceae).

Thallus whitish, ecorticate. *Perithecia* solitary, flask-shaped, 0.4–0.7 mm long, 0.4–0.6 mm high. *Ostiole* lateral. *Hymenium* not interspersed, I–. *Asci* 8-spored, 135–170 × 23–28 µm. *Ascospores* mostly biseriolate, colourless, ellipsoid to oblong-ellipsoid, muriform, 9–12 × 1–4 locular, 36–48 × 15–20 µm, I+ dark blue.

*Chemistry*: Thallus K–, UV–; no lichen substances detected.

*Distribution*: Pantropical. India (West Bengal), Australia,

Brazil, Costa Rica, Fiji, Hawaii Islands, Hong Kong, Mexico, New Caledonia, Papua New Guinea, Puerto Rico, South Africa, Seychelles and USA.

*Specimen examined:* Andaman Islands: Middle Andaman, Pooltala, 12°22'61.6' N, 92°46'57.2' E, alt. 30 m, 22.2.2013, Jagadeesh Ram 2529.

**3. *Lithothelium nanosporum*** (C. Knight) Aptroot, Australas. Lichenol. 60: 36. 2007. *Trypethelium nanosporum* C. Knight, in Bailey, Syn. Queensl. Fl. 1 (Suppl.): 78. 1886. *Lithothelium submuriforme* R.C. Harris & Aptroot in Aptroot, Bibliotheca Lichenol. 44: 69. 1991 (Pyrenulaceae). (Figs. 1 & 2).

Thallus corticolous, greenish grey to pale green, pale olive green, 4–8 cm across, smooth, not pseudocyphellate, lacking crystals, thin, with black prothallus at borders, weakly corticate, 35–60 µm thick; photobiont *Trentepohlia*. *Perithecia* numerous, emergent, superficial, flask-shaped, solitary to 2–4 radially fused by lateral ostiole (parmentarioid), individual perithecia 1–1.2 mm long and 0.7–0.9 mm broad, altogether 1.2–2 mm diam. or 1.2–2 mm long and 0.8–1.2 mm broad. *Perithecial wall* complete, not covered by thalline layer, carbonized, lacking crystals, 50–70 µm thick at base, 80–100 µm thick laterally. *Ostiole* lateral, distinct. *Hymenium* hyaline, not interspersed, I+ blue. *Paraphyses* unbranched, c. 1 µm wide. *Asci* cylindrical, 8-spored, 130–150 × 15–18 µm. *Ascospores* mostly uniseriate, red-brown, fusiform to ellipsoid with rounded ends, submuriform, transversely 3–5-septate, longitudinally 1–3 septate, with 5–10 (–12) locules, lumina angular to rounded, distoseptate, lacking eusepta, smooth walled, not

granular ornamented, 20–26 × 10–14 µm.

*Chemistry:* Thallus K–, UV–; no lichen substances detected.

*Remarks:* *Lithothelium nanosporum* is characterized by the parmentarioid perithecia and submuriform 20–26 × 10–14 µm ascospores. It is very close to *L. hieroglyphicum* Aptroot which is also having similar ascospores but has melanothecoid perithecia with apical ostiole (Aptroot 1991, 2007, 2021).

*Distribution:* Australia, Japan and South Africa. It is a new record for India.

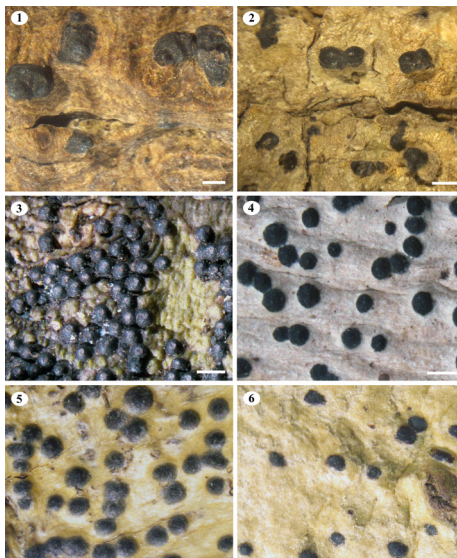
*Specimens examined:* Andaman Islands, North Andaman: Diglipur, Lamia Bay Beach forest, alt. 10 m, 21.04.2011, Jagadeesh Ram 220; Paget Island, 21.3.2012, Jagadeesh Ram 1377. South Andaman, Henry Lawrence Island, 11.5.2012, Jagadeesh Ram 1923.

**4. *Nigrovothelium inspersotropicum*** Aptroot & Diederich in Diederich et al., Herzogia 30 (1): 206. 2017 (Trypetheliaceae). (Fig. 3).

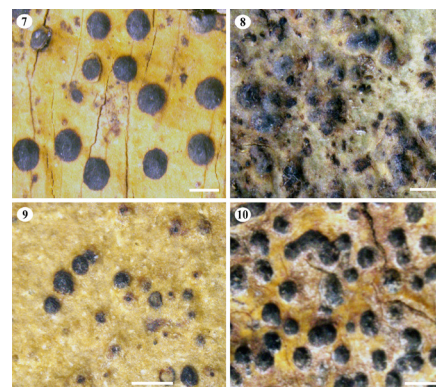
Thallus corticolous, epiphloeodal, orbicular to suborbicular, or irregular, up to 7 cm across, olive green to yellow brown, smooth, epruinose, even to uneven, continuous, verrucose, sometimes forming confluent radiating ridges, corticate, with black prothallus at borders, 80–200 µm thick; photobiont *Trentepohlia*. *Perithecia* solitary to confluent, emergent, subglobose, 0.5–0.9 mm diam., 0.35–0.6 mm high. *Perithecial wall* entire, carbonized, 46–200 µm thick laterally, 25–60 µm thick at base. *Ostiole* apical, punctate. *Hymenium* colourless, gelatinized, interspersed with oil droplets, I–. *Pseudoparaphyses* branched and anastomosing, 1–1.5 µm wide. *Asci* cylindrical to clavate, 8-spored, 88–115 × 12–18 µm. *Ascospores* mostly biseriate, colourless, fusiform to oblong-ellipsoid, 4-locular, lumina angular, 18–22 × 6–7 µm.

*Chemistry:* Thallus K–, UV–; no lichen substances detected.

*Remarks:* *Nigrovothelium inspersotropicum* is a recently



Figs 1–6. 1. *Lithothelium nanosporum* (J 1377), 2. *Lithothelium nanosporum* (J 1923), 3. *Nigrovothelium inspersotropicum* (J 4676), 4. *Pseudopyrenula media* (J 2592), 5. *Pyrenula ciliata* (J 4120) and 6. *P. cocoes* (J 1731)  
Scales = 1 mm.



Figs 7–10. *Pyrenula fulva* (J 1389), *P. septicollaris* (J 1353), *P. sexlocularis* (J 1628) and *P. subglabrata* (J 4283). Scales = 1 mm.

segregated species form *N. tropicum* (Müll. Arg.) Lücking, Nelsen & Aptroot by the hymenial inspersions. *Nigrovothelium tropicum* has a non-inspersed hymenium (Diederich et al. 2017). In India both *N. inspersotropicum* and *N. tropicum* were reported in the name of *Trypethelium tropicum* (Ach.) Müll. Arg. Therefore, re-examination of the Indian reports are necessary to know the distribution of these two species in India.

*Distribution:* Guyana and Seychelles.

*Specimens examined:* North Andaman, Saddle Peak National Park, alt. 512 m, 20.4.2011, Jagadeesh Ram 185. South Andaman, Port Blair, Haddo, Botanical survey of India campus, alt. 15 m, 5.2.2022, Jagadeesh Ram 4676.

**5. *Pseudopyrenula media*** Aptroot & Diederich in Diederich et al., *Herzogia* 30 (1): 213. 2017 (Trypetheliaceae). (Fig. 4).

Thallus corticolous, endophloeodal, suborbicular to irregular, up to 7 cm across, whitish, smooth, with black prothallus at borders, ecorticate, 25–50 µm thick; photobiont *Trentepohlia*. *Perithecia* superficial, moderate to numerous, solitary, sometimes confluent, scattered, subglobose to hemispherical, 0.4–0.8 mm diam., 0.3–0.5 mm high. *Perithecial wall* entire, carbonized, laterally spreading, 70–180 µm thick laterally, 15–30 µm thick at base. *Ostiole* apical, indistinct. *Hymenium* yellowish, inspersed with yellowish oil droplets and granules, K+ deep yellow to reddish, I-. *Pseudoparaphyses* branched and anastomosing, 1–1.5 µm wide. *Asci* clavate, 8-spored, 80–110 × 18–24 µm. *Ascospores* biserial, colourless, oblong to oblong-fusiform, 4-locular, lumina diamond shaped, wall smooth, 25–30 × 7.5–10 µm.

*Chemistry:* Thallus UV-, K-; hymenium K+ reddish, with yellow anthraquinone.

*Remarks:* *Pseudopyrenula media* is very close to *P. endoxantha* Vain. and *P. subgregaria* Müll. Arg., but both the latter species have smaller ascospores (Diederich et al. 2017).

*Distribution:* Seychelles. It is a new record for India.

*Specimens examined:* Andaman Islands, Middle Andaman, Pooltala, 12°22'61.6" N, 92°46'57.2" E, alt. 30 m, 22.2.2013, Jagadeesh Ram 2524. South Andaman, Baratang Island, Nayadera mangrove forest, 12°05'94.2" N, 92°44'50.3" E, alt. 10 m, 23.2.2013, Jagadeesh Ram 2592.

**6. *Pseudopyrenula subgregaria*** Müll. Arg., *Bot. Jahrb. Syst.* 6: 408. 1885 (Trypetheliaceae).

Thallus whitish, ecorticate. *Perithecia* solitary, sometimes confluent, scattered, subglobose to hemispherical, 0.35–0.5 diam. *Ostiole* apical. *Hymenium* yellowish, inspersed with oil droplets and colourless granules, K+ deep yellow to reddish, I-. *Asci* 8-spored, 65–100 × 12–16 µm. *Ascospores* biserial, colourless, oblong to oblong-fusiform, 4-locular, lumina angular to rounded, 18–22 × 5–7 µm.

*Chemistry:* Thallus UV-, K-; hymenium K+ reddish, with yellow anthraquinone.

*Distribution:* Pantropical. India (West Bengal), Australia, Brazil, China, Costa Rica, Cuba, El Salvador, French Guiana, Guiana, Indonesia, Java, Panama, Sri Lanka and USA.

*Specimens examined:* Andaman Islands, Baratang Island, Gandhighat mangrove forest, 12°18'39.6" N, 92°47'38.4" E, alt. 6 m, 22.2.2013, Jagadeesh Ram 2550, 2555.

**7. *Pyrenula acutispora*** Kalb & Hafellner, *Herzogia* 9(1-2): 84. 1992 (Pyrenulaceae).

Thallus yellow brown, not pseudocyphellate, corticate. *Perithecia* solitary, hemispherical, 0.4–0.6 mm diam. *Ostiole* apical. *Hymenium* not inspersed, I-. *Asci* 8-spored. *Ascospores* uniseriate to irregularly biserial, grey-brown, 3-septate, fusiform with pointed ends, lumina angular, terminal lumina separated from the exospores by a thick endospore layer, 20–23 × 8–10 µm.

*Chemistry:* Thallus K-, UV-; no lichen substances detected.

*Distribution:* Pantropical. India (West Bengal – Darjeeling).

*Specimen examined:* Nicobar Islands, Little Nicobar Island, Makachua forest, 7°24'54.2" N, 93°42'54.1" E, alt. 20 m, 8.12.2014, Jagadeesh Ram 4252.

**8. *Pyrenula bahiana*** Malme, *Ark. Bot.* 22A(no. 11): 26. 1929. *Verrucaria concatervans* Nyl., *Lich. Jap.*: 109. 1890 (Pyrenulaceae).

Thallus yellow brown, with or without pseudocyphellae, corticate. *Perithecia* solitary, subglobose, 0.4–0.6 mm diam. *Ostiole* apical. *Hymenium* not inspersed, I+ orange. *Asci* 8-spored, 90–110 × 10–15 µm. *Ascospores* mostly uniseriate, grey brown, ellipsoid, 3-septate, lumina angular, terminal lumina separated from the exospores by a thick endospore layer, old spores with reddish oil, 22–32 × 10–15 µm.

*Chemistry:* Thallus K-, UV-; no lichen substances detected.

*Distribution:* Pantropical. India (Manipur).

*Specimens examined:* Andaman Islands, North Andaman, Lamia Bay forest, alt. 10 m, 21.4.2011, Jagadeesh Ram 219. Kishorinagar, Tal Bhahan forest, alt. 50 m, 29.4.2011, Jagadeesh Ram 454; Ramnagar, Pathilevel forest, alt. 96 m, 24.3.2012, Jagadeesh 1444. Middle Andaman, Karmatang forest, 12°49'38.5" N, 92°54'38.1" E, alt. 60 m, 8.3.2012, Jagadeesh Ram 750; Interview Island WLS, 12°53'54.8" N, 92°42'39.9" E, alt. 25 m, 11.3.2012, Jagadeesh Ram 966; Bakultala, Shyankund mangrove forest, 12°29'53.7" N, 92°50'44.9" E, alt. 10 m, 15.3.2012, Jagadeesh Ram 1127; *ibid.*, 12°28'42.0" N, 92°50'40.0" E, Jagadeesh Ram 1144. South Andaman, Chidiyotapu forest, alt. 30



m, 6.7.2011, Jagadeesh Ram 689. Nicobar Islands, Great Nicobar Island, Campbell Bay, Lakshman Beach forest, 7°01'58.5" N, 93°54'90.0" E, alt. 4 m, 28.5.2014, Jagadeesh Ram 3168, 3169.

**9. *Pyrenula castanea*** (Eschw.) Müll. Arg., Flora, Regensburg 67(35): 664. 1884. *Verrucaria hymnothora* var. *castanea* Eschw., in Martius, Fl. Bras. enum. pl. 1 (1): 126. 1833 (Pyrenulaceae).

Thallus yellow brown, not pseudocyphellate, corticate. *Perithecia* solitary hemispherical to conical, 0.6–1.0 mm diam. *Hymenium* inspersed, I–. *Asci* 8-spored, 65–80 × 5–7 µm. *Ascospores* uniseriate to irregularly biseriata, grey-brown, ellipsoid, 3-septate, distoseptate, terminal lumina separated from the exospores by a thick endospore layer, 14–16 × 5–7 µm.

*Chemistry*: Thallus K–, UV–; no lichen substances detected.

*Distribution*: Pantropical. India (Arunachal Pradesh, Goa and West Bengal); Africa, Sri Lanka and Thailand.

*Specimen examined*: Andaman Islands, Rutland Island, R.M. Point to Kumra Nala forest, 11°29'89.6" N, 92°38'14.5" E, alt. 30 m, 24.12.2011, Jagadeesh Ram 660.

**10. *Pyrenula ciliata*** Aptroot in Aptroot et al., Bibliotheca Lichenol. 64: 154. 1997 (Pyrenulaceae). (Fig. 5).

Thallus corticolous, yellow brown to greenish brown, 6–8 cm across, smooth, not pseudocyphellate, with black prothallus at borders, corticate, lacking crystals, 70–120 µm thick; photobiont *Trentepohlia*. *Perithecia* numerous, subglobose to hemispherical, immersed to erumpent, 0.4–0.8 mm diam., 0.3–0.5 mm high. *Perithecial wall* completely carbonized, 100–200 µm thick laterally, 40–80 µm thick at base. *Ostiole* apical, indistinct. *Hymenium* not inspersed, I+ blue. *Paraphyses* unbranched, c. 1 µm wide. *Asci* cylindrical, 8-spored, 100–140 × 15–20 µm. *Ascospores* uniseriate, grey brown to dark brown, ellipsoid, with rounded ends, 3-septate, distoseptate, with diamond shaped middle lumina and angular terminal lumina, terminal lumina not separated from the exospores by a thick endospore layer, sometimes ends papillate, 22–30 × 10–14 µm, both ends or only the upper end with 3–8 (usually 4) flagellar appendages which are 10–15 µm long from the originating point at the apex.

*Chemistry*: Thallus K–, UV–; no lichen substances detected.

*Remarks*: *Pyrenula ciliata* is characterized by corticate thallus, 3-septate, ciliate, 22–30 × 10–14 µm ascospores. It is close to *P. hirsuta* Etayo which is also having ciliate transversely septate ascospores, but *P. hirsuta* has an inspersed hymenium, and large perithecia (1–1.5 mm diam.) and ascospores (55–65 × 22–26 µm) (Aptroot et al. 1997; Aptroot 2012, 2021; Etayo 1999).

*Distribution*: Papua New Guinea. It is a new record for India.

*Specimens examined*: Nicobar Islands, Car Nicobar Island, Kinmai, 9°14'13.6" N, 92°47'31.3" E, alt. 6 m, 23.9.2014, Jagadeesh Ram 4119, 4120.

**11. *Pyrenula cocoes*** Müll. Arg., Hedwigia 32: 136. 1893 (Pyrenulaceae). (Fig. 6).

Thallus ecorticate, whitish to creamish white, yellowish white, 2–6 cm across, smooth, not pseudocyphellate, with black prothallus at borders, ecorticate, without crystals, 40–60 µm thick; photobiont *Trentepohlia*. *Perithecia* numerous, scattered, solitary, subglobose to conical, emergent, sides often partly covered by thallus, 0.3–0.5 mm diam., 0.25–0.35 mm high. *Perithecial wall* carbonized, lacking crystals, 40–60 µm thick at base, 60–120 µm thick laterally. *Ostiole* apical. *Hymenium* not inspersed, I–. *Paraphyses* unbranched, c. 1 µm wide. *Asci* cylindrical-clavate, 8-spored, 70–90 × 13–18 µm. *Ascospores* irregularly biseriata, grey brown, fusiform with pointed or papillate ends, 3-septate, distoseptate, with 1–3 eusepta when old, lumina angular, terminal lumina directly against the exospore, wall smooth, wavy, 18–21 × 8–10 µm.

*Chemistry*: Thallus UV+ yellow, lichexanthone present.

*Remarks*: *Pyrenula cocoes* is characterized by whitish, ecorticate, UV+ yellow thallus, non-inspersed hymenium, 3-septate, 18–21 × 8–10 µm ascospores with terminal lumina directly against the exospore (Harris 1989; Aptroot 2012). It is very close to *P. xanthinpersa* Aptroot & M. Cáceres which has UV+ thallus and small 14–17 × 6.0–7.5 µm ascospores, but differs in the terminal lumina separated from the exospores by a thick endospore layer (Aptroot et al. 2018; Aptroot 2021).

*Distribution*: Pantropical. It is a new record for India.

*Specimen examined*: Andaman Islands, Little Andaman, South Bay beach forest, 5.5.2012, Jagadeesh Ram 1730.

**12. *Pyrenula fulva*** (Kremp.) Müll. Arg., Flora Regensburg 68: 335. 1885. *Verrucaria marginata* var. *fulva* Kremp., Nuovo G. bot. ital. 7(1): 49. 1875 (Pyrenulaceae). (Fig. 7).

Thallus corticolous, yellowish brown, smooth, not pseudocyphellate, up to 4.5 cm diam., with black prothallus at borders, corticate, 100–150 µm thick, lacking crystals; photobiont *Trentepohlia*. *Perithecia* numerous, solitary, hemispherical, emergent, 0.8–1.2 mm diam., 0.5–0.8 mm high. *Perithecial wall* carbonized, lacking crystals, laterally spreading, wall laterally up to 200 µm thick, 20–30 µm thick at base. *Ostiole* apical. *Hymenium* densely inspersed throughout, I–. *Paraphyses* unbranched, c. 1 µm wide. *Asci* clavate, 8-spored, 90–120 × 17–25 µm. *Ascospores* uniseriate to irregularly biseriata, dark brown to red-brown, 3-septate, distoseptate, with 1–3 eusepta when old, broadly fusiform, with pointed ends, middle lumina angular to rounded, end locules angular, bulging out into the spore tips, with or without endospores, 25–34 × 10–14 µm.

*Chemistry*: Thallus K<sup>-</sup>, UV<sup>-</sup>; no lichen substances detected.

*Remarks*: *Pyrenula fulva* is very close to *P. acutalis* R.C. Harris, but differs in totally inspersed hymenium. *Pyrenula acutalis* R.C. Harris has a hymenium inspersed above the *Asci* (Harris 1989; Aptroot 2012).

*Distribution*: Seychelles. It is a new record for India.

*Specimen examined*: Andaman Islands, North Andaman, Paget Island, 21.3.2012, Jagadeesh Ram 1389.

**13. *Pyrenula rinodinospora*** Aptroot, *Lichenologist* 44(5): 615. 2012 (Pyrenulaceae).

Thallus yellow brown to greenish brown, not pseudocyphellate, corticate. *Perithecia* solitary, conical to hemispherical, 0.8–1.2 mm diam. *Ostiole* apical. *Hymenium* densely inspersed, I<sup>-</sup>. *Asci* 8-spored, 100–130 × 16–24 μm. *Ascospores* uniseriate to irregularly biseriate, grey brown, fusiform, 3-septate, middle lumina angular, terminal lumina elongated and not separated from the exospores by an endospore layer, 26–30 × 10–12 μm.

*Chemistry*: Thallus K<sup>-</sup>, UV<sup>-</sup>; no lichen substances detected.

*Distribution*: India (Goa) and Papua New Guinea.

*Specimen examined*: Nicobar Islands, Pulo Pattia forest, 7°19'45.2" N, 93°43'46.5" E, alt. 5 m, 9.12.2014, Jagadeesh Ram 4349.

**14. *Pyrenula septicollaris*** (Eschw.) R.C. Harris, *Mem. N. Y. bot. Gdn.* 49: 101. 1989. *Pyrenastrum septicollare* Eschw., *Syst. Lich.*: 25, fig. 15, a-d. 1824 (Pyrenulaceae). (Fig. 8).

Thallus corticolous, greyish brown, over 10 cm across, smooth, not pseudocyphellate, with black prothallus at borders, corticate, 60–100 μm thick, lacking crystals; photobiont *Trentepohlia*. *Perithecia* numerous, flask-shaped, immersed to semi-immersed, 2–6 joined by fused *Ostioles*, altogether 1–2 mm diam., 0.4–0.5 mm high. *Perithecial wall* completely carbonized, lacking crystals, laterally carbonized, 80–200 μm thick laterally, 30–50 μm thick at base. *Ostiole* lateral, fused together, opens separately in a translucent region. *Hymenium* hyaline, not inspersed, I<sup>-</sup>. *Paraphyses* unbranched, 1 μm wide. *Asci* cylindrical, 8-spored, 80–100 × 9–14 μm. *Ascospores* uniseriate, grey-brown, ellipsoid, with rounded ends, with constrictions, 3-septate, distoseptate, with 1–3 eusepta, with rounded to ± diamond shaped lumina, terminal lumina angular, pointed to middle, separated from the exospore by endospore thickening, 13–18 × 6–8 μm.

*Chemistry*: Thallus K<sup>-</sup>, UV<sup>-</sup>; no lichen substances detected.

*Remarks*: *Pyrenula septicollaris* is characterized by parmentarioid perithecia, 3-septate, 13–18 × 6–8 μm ascospores with angular terminal lumina separated from the exospore by endospore thickening (Harris 1989; Aptroot 2012). It is very close to *Pyrenula cubana* (Müll. Arg.) R.C. Harris, but that has 21–25 × 8–10 μm ascospores (Harris 1989).

*Distribution*: Pantropical. It is a new record for India.

*Specimen examined*: Andaman Islands, North Andaman, Coffee Dera, Lamba Baalu Beach forest, 20.3.2012, Jagadeesh Ram 1353.

**15. *Pyrenula sexlocularis*** (Nyl.) Müll. Arg., *Flora, Regensburg* 60: 475. 1877. *Verrucaria sexlocularis* Nyl., *Annls Sci. Nat., Bot., sér.* 4, 20: 249. 1863. *Pyrenula concatervans* (Nyl.) R.C. Harris in Tucker & R.C. Harris, *Bryologist* 83: 15. 1980. *Verrucaria concatervans* Nyl., *Lich. Jap.*: 109. 1890 (Pyrenulaceae). (Fig. 9).

Thallus corticolous, yellow to greenish yellow, irregular, 2–7 cm across, continuous, smooth, epruinose, with or without pseudocyphellae, with black prothallus at borders, often with pockets of white crystals, corticate; 50–80 μm thick. *Perithecia* numerous, semi-immersed, or emergent, scattered, solitary to confluent, black, subglobose, 0.3–0.5 mm diam., 0.3–0.4 mm high. *Ostiole* apical, plane, indistinct. *Perithecial wall* entire, carbonized, with crystals, ± uniform to thickened, 30–80 μm thick. *Hymenium* colourless, not inspersed with oil droplets, I<sup>+</sup> orangish. *Paraphyses* unbranched, c. 1 μm wide. *Asci* cylindrical, 8-spored, 80–120 × 15–24 μm. *Ascospores* uniseriate to biseriate, brown, ellipsoid, 5-septate, distoseptate, with 1–3 eusepta, middle lumina rounded to diamond shaped, terminal lumina pointed towards median and separated from the exospore by a thick endospore, post mature ascospores with reddish oily substance, 23–30 × 9–12 μm.

*Chemistry*: Thallus K<sup>-</sup>, UV<sup>-</sup>; no lichen substances detected.

*Remarks*: *Pyrenula sexlocularis* is characterized by corticate UV<sup>-</sup> thallus, 5-septate, 23–30 × 9–12 μm ascospores with terminal lumina separated from the exospore by a thick endospore and post mature ascospores with reddish oily substance (Aptroot et al. 2013). In India *Pyrenula seminuda* (Müll. Arg.) Sipman & Aptroot (–*Anthracothecium seminudum* Müll. Arg.) was reported as *Pyrenula concatervans* (Nyl.) R.C. Harris (Singh and Sinha 2010; Jagadeesh Ram et al. 2012). Harris (1989) suggested that the report of *Anthracothecium seminudum* by A. Singh (1985) from West Bengal is a possible synonym of *Pyrenula concatervans*. The view of Harris was followed in Singh and Sinha (2010) and Jagadeesh Ram et al. (2012).

*Distribution*: Pantropical. It is a new record for India.

*Specimens examined*: Andaman and Nicobar Islands: North Andaman, Kalipur, alt. 10 m, 19.4.2011, Jagadeesh Ram 122. Middle Andaman, Sound Island, 12°56'35.2" N, 92°58'21.3" E, alt. 10 m, 10.3.2012, Jagadeesh Ram 877. South Andaman, Chidiyatapu forest, alt. 15 m, 12.2.2011, Jagadeesh Ram 30; Outram Island, 10.5.2012, Jagadeesh Ram 1822. Little Andaman, Butler Bay Beach forest, 3.5.2012, Jagadeesh Ram 1628. Nicobar Islands: Car Nicobar Island, Passa Beach forest, 9°12'86.5" N, 92°45'93.1" E, alt. 5 m, 21.9.2014, Jagadeesh Ram 3833. Nancowry Island, Champin, 8°01'43.3" N, 93°32'74.3" E, alt. 5 m, 5.6.2014, Jagadeesh Ram 3496A. Little Nicobar

Island, Makachua forest, 7°24'54.2" N, 93°42'54.1" E, alt. 20 m, 8.12.2014, Jagadeesh Ram 4251. Great Nicobar Island, Campbell Bay, Near Airport Seashore, 7°00'43.4" N, 93°55'06.8" E, alt. 5 m, 14.12.2014, Jagadeesh Ram 4622A.

**16. *Pyrenula subglabrata*** (Nyl.) Müll. Arg., Bot. Jb. 6: 410. 1885. *Verrucaria subglabrata* Nyl., in Nylander & Crombie, J. Linn. Soc., Bot. 20: 60. 1883 (Pyrenulaceae). (Fig. 10).

Thallus corticolous, greenish brown to yellow brown, 3–6 cm across, thin, smooth, not pseudocyphellate, with black prothallus at borders, lacking crystals, corticate, 60–110 µm thick; photobiont *Trentepohlia*. *Perithecia* numerous, solitary, subglobose to hemispherical, immersed to emergent, 0.4–0.7 mm diam., 0.25–0.35 mm high. *Perithecial wall* completely carbonized, lacking crystals, laterally 70–150 µm thick, 30–110 µm thick at base. *Ostiole* apical, indistinct. *Hymenium* heavily interspersed throughout, I–. *Paraphyses* unbranched, c. 1 µm wide. *Asci* cylindrical, 8-spored, 70–100 × 12–20 µm. *Ascospores* uniseriate to irregularly biseriata, grey brown to dark brown, ellipsoid, with pointed ends, 3-septate, distoseptate, sometimes with 1 euseptum, with diamond shaped middle lumina and angular terminal lumina, terminal lumina not separated from the exospores by a thick endospore layer, sometimes ends papillate, wall smooth, mature spore wall wavy, 18–22(–24) × (7–)8–10(–12) µm.

*Chemistry*: Thallus K–, UV–; no lichen substances detected.

*Remarks*: *Pyrenula subglabrata* is characterized by corticate, UV– thallus, heavily interspersed hymenium, 3-septate, 18–24 × 7–12 µm ascospores with terminal lumina not separated from the exospores by a thick endospore layer (Aptroot 2012, 2021). It is very close to *P. occidentalis* (R.C. Harris) R.C. Harris, but differs in having K+ purple anthraquinones in the thallus of the latter species (Aptroot 2021).

*Distribution*: Singapore and Sri Lanka. It is a new record for India.

*Specimen examined*: Nicobar Islands, Little Nicobar Island, Makachua School Point Beach, 7°23'67.0" N, 93°43'58.3" E, alt. 5 m, 8.12.2014, Jagadeesh Ram 4283.

**17. *Pyrenula sublaevigata*** (Patw. & Makhija) Upreti, Nova Hedwigia 66(3-4): 574. 1998. *Anthracothecium sublaevigatum* Patw. & Makhija, Kavaka 8: 25. 1980 (Pyrenulaceae).

Thallus yellow-brown, pseudocyphellate, corticate. *Perithecia* solitary, subglobose, 0.7–1 mm diam. *Ostiole* apical. *Hymenium* interspersed, I+ orange. *Asci* 8-spored, 120–150 × 25–30 µm. *Ascospores* uniseriate to irregularly biseriata, grey-brown to brown, ellipsoid, muriform, 8 × 1–3 locular, lumina rounded to angular, 30–45 × 12–17 µm.

*Chemistry*: Thallus K–, UV–; no lichen substances detected.

*Distribution*: India (Arunachal Pradesh and Karnataka) and Brazil.

*Specimen examined*: Andaman Islands, Middle Andaman, Rampur Beach, 12°52'19.8" N, 92°55'39.8" E, alt. 12 m, 7.3.2012, Jagadeesh Ram 700A.

**18. *Pyrenula thailandica*** Aptroot, Lichenologist 44(5): 617. 2012 (Pyrenulaceae).

Thallus yellow-brown, not pseudocyphellate, corticate. *Perithecia* solitary, globose, 0.6–0.9 mm diam. *Ostiole* apical. *Hymenium* hyaline, not interspersed with oil droplets, I+ partly orange and pale blue. *Asci* 8-spored, 140–200 × 22–35 µm. *Ascospores* uniseriate to biseriata or irregular, grey brown, 3-septate, fusiform, lumina quadrangular, terminal lumina separated from the exospore by an endospore layer, postmature ascospores with reddish oil, (30–)35–46 × (10–)14–20 µm.

*Chemistry*: Thallus K–, UV–; no lichen substances detected.

*Distribution*: India (Arunachal Pradesh), Papua New Guinea and Thailand.

*Specimens examined*: Andaman Islands, South Andaman, Chidiyatapu, alt. 15 m, 12.2.2011, Jagadeesh Ram 47. Nicobar Islands, Car Nicobar Island, Tapoiming, 9°12'74.9" N, 92°47'72.4" E, alt. 8 m, 21.9.2014, Jagadeesh Ram 3970; *ibid.*, 9°12'77.0" N, 92°47'76.6" E, alt. 8 m, 21.9.2014, Jagadeesh Ram 3974.

**19. *Pyrenula thelomorpha*** Tuck., Gen. lich. (Amherst): 275. 1872 (Pyrenulaceae).

Thallus greenish brown, pseudocyphellate, corticate. *Perithecia* solitary, subglobose, 0.4–0.6 mm diam. *Ostiole* apical. *Hymenium* not interspersed, I+ orange. *Asci* cylindrical, 8-spored, 130–155 × 25–40 µm. *Ascospores* uniseriate to biseriata, grey brown, broadly ellipsoid, muriform, with 8 rows of up to 6–8 lumina, lumina initially angular, becoming rounded, 25–45 × 11–17 µm.

*Chemistry*: Thallus K–, UV–; no lichen substances detected.

*Distribution*: Pantropical. India (Arunachal Pradesh, Goa, Himachal Pradesh, Karnataka, Kerala, Manipur, Sikkim, Uttarakhand and West Bengal).

*Specimens examined*: Andaman Islands, South Andaman, Chidiyatapu forest, alt. 5 m, 12.2.2011, Jagadeesh Ram 22. Little Andaman, Vivekanandapur, Kalapathar seashore, 6.5.2012, Jagadeesh Ram 1815. Nicobar Islands: Car Nicobar Island, Malacca, 9°10'35.6" N, 92°49'53.0" E, alt. 6 m, 24.9.2014, Jagadeesh Ram 4149. Passa Beach forest, 9°12'85.4" N, 92°45'92.2" E, alt. 5 m, 21.9.2014, Jagadeesh Ram 3859; Tapoiming, 9°12'77.0" N, 92°47'76.6" E, alt. 8 m, 21.9.2014, Jagadeesh Ram 3973. Katchal Island, Meenakshi Village, 8°01'08.7" N, 93°23'16.5" E, alt. 5 m, 12.6.2014, Jagadeesh Ram 3619.

#### ACKNOWLEDGEMENTS

I am thankful to Dr. A.A. Mao, Director, Botanical Survey of India, Kolkata; Dr. M.U. Sharief, Head, Botanical Survey of India, Southern Regional Centre, Coimbatore and Dr. Lal



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Ji Singh, Botanical Survey of India, Andaman and Nicobar Regional Centre, Port Blair for facilities; Dr Siljo Joseph, Kerala Forest Research Institute, Peechi for assistance with literature. I wish to express my sincere gratitude to the Authorities of the Department of Environment and Forests, Andaman and Nicobar Islands for their co-operation on the field works.

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