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Journal of Threatened Taxa

The international journal of conservation and taxonomy

www.threatenedtaxa.org

ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)

SHORT COMMUNICATION

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26 July 2016 | Vol. 8 | No. 7 | Pp. 9014–9023

10.11609/jott.1882.8.7.9014-9023



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ISSN 0974-7907 (Online)
ISSN 0974-7893 (Print)

A FIRST NOTE ON FOLIICOLOUS LICHENS OF ASSAM, INDIA

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Abstract: A first note on foliicolous lichens of Assam enumerating 26 species belonging to 15 genera and eight families are provided. Four species viz., *Bacidina apiahica*, *Byssoloma chlorinum*, *Calopadia fusca* and *Strigula nitidula* are reported for the first time from Assam. A number of rare species are present, including *Aulaxina uniseptata*, *Calenia aspidota* and *Psorotheciopsis patellarioides*.

Keywords: Assam, foliicolous lichens, new records.

Lichens inhabiting on living leaves belong to a wide range of systematic groups, comprising ca. 925 species worldwide and ca. 136 species in India (Awasthi 2010). Publications on the lichen mycota of Assam are mainly restricted to corticolous and saxicolous species (Rout et al. 2005, 2010; Sinha et al. 2013) and a comprehensive study on foliicolous lichens is unavailable except for a few sporadic records (Santesson 1952; Gupta & Sinha 2014; Singh & Pinokiyu 2014) although the state is well known for its tea gardens which have perennial leaves to support the growth of foliicolous lichens. This is the first report on foliicolous lichens from Assam enumerating 26 species with four additional records, viz., *Bacidina apiahica*, *Byssoloma chlorinum*, *Calopadia fusca* and *Strigula nitidula*, for Assam. These findings will lead to further research on foliicolous lichens and contribute to

a better knowledge of their distribution in Assam as well as in India.

MATERIALS AND METHODS

This study was based on freshly collected specimens from the state, deposited in the herbarium of Botanical Survey of India, Central Regional Centre, Allahabad (BSA) except for one report from the literature (*Calenia aspidota*). Species were identified mainly with the help of keys and descriptions provided by Santesson (1952) and Lücking (2008). All observations concerning morphological and anatomical details of thalii and ascumata were examined using an Olympus SZ61 Stereo microscope and a Nikon Eclipse 50i compound microscope. Squash preparations were studied in water or KOH solution (K) and the amyloid reactions were tested with Lugol's reagents, without (I) or with pre-treatment of KOH (K/I). A key to the species is provided for easy identification along with alphabetical enumeration of all taxa. The species marked by an asterisk (*) are additions to the lichen mycota of Assam.

1. *Asterothyrium microsporum* R. Sant., Symb. Bot. Upsal. 12(1): 320. 1952; Gupta & Sinha,

DOI: <http://dx.doi.org/10.11609/jott.1882.8.7.9014-9023>

Editor: Sanjeeva Nayaka, CSIR-National Botanical Research Institute, Lucknow, India.

Date of publication: 26 July 2016 (online & print)

Manuscript details: Ms # 1882 | Received 30 May 2015 | Final received 14 June 2016 | Finally accepted 01 July 2016

Citation: Gupta, P. & G.P. Sinha (2016). A first note on foliicolous lichens of Assam, India. *Journal of Threatened Taxa* 8(7): 9014–9023; <http://dx.doi.org/10.11609/jott.1882.8.7.9014-9023>

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Funding: The work was carried out in All India Co-ordinated Project on Taxonomy (AICOPTAX) under financial assistance from Ministry of Environment, Forests and Climate Change, New Delhi.

Conflict of Interest: The authors declare no competing interests.

Acknowledgements: The authors are thankful to Dr. Paramjit Singh, Director, Botanical Survey of India, Kolkata, for providing facilities and to the Ministry of Environment, Forests, & Climate Change, New Delhi for financial assistance under the All India Co-ordinated Project on Taxonomy (AICOPTAX).



Geophytology 44(1): 69. 2014. (Asterothyriaceae)

Specimen examined: 5521B (BSA), 20.iv.2010, Assam, Manas Tiger Reserve, coll. G.P. Sinha & Pooja Gupta.

Description: Thallus crustose, smooth, dispersed into rounded, confluent patches, light silvery grey to white; apothecia rounded, immersed-erumpent, 0.1–1 mm diam.; disc plane, pale yellow; margin thin, black, prominent, irregularly dissected; excipulum 6–9 μ m thick; hymenium colourless, 40–45 μ m high; asci 25–42 \times 4–6 μ m; ascospores fusiform-ellipsoid, transversely 1–septate, 7–13 \times 2–6 μ m.

Range of distribution: Argentina, Brazil, Colombia, Costa Rica, Ecuador, Guatemala, Mexico, Peru, Paraguay (Lücking et al. 2008), Bolivia (Flakus & Lücking 2008), Venezuela (Neuwirth 2007), and India (Assam).

2. *Aulaxina uniseptata* R. Sant., Symb. Bot. Upasal. 12(1): 298. 1952; Singh & Pinokiyo, Indian J. Forest. Addl. Ser. 4: 183–184. 2014. (Gomphillaceae)

Specimen examined: 5521A (BSA), 20.iv.2010, Assam, Manas Tiger Reserve, Mathanguri, up to 20 km area, coll. G.P. Sinha & Pooja Gupta.

Description: Thallus crustose, smooth to rough, irregular in outline, greenish-grey; apothecia rounded, adnate, crater-like, 0.2–0.3 mm diam.; disc plane, epruinose; thalline margin distinct, prominent, black; hymenium colourless, 30–35 μ m high; asci 20–25 \times 6–8 μ m; ascospores ellipsoid, transversely 1–septate, 6–9 \times 2.5–3 μ m.

Range of distribution: Brazil, Germany (Santesson 1952), and India (Assam).

3. *Bacidina apiahica (Müll. Arg.) Vězda, Folia Geobot. Phytotax. 25(4): 432. 1990; Singh & Pinokiyo, Indian J. Forest. Addl. Ser. 4: 212–214. 2014. *Patellaria apiahica* Müll. Arg., Lich. Epiph. Novi: 9. 1890. (Ramalinaceae) (Image 1).

Specimen examined: 3322D (BSA), 15.v.2006, Assam, Lakhimpur district, Koilamari, Koilamari T.E., coll. V.N. Singh.

Description: Thallus farinose, greenish-grey to pale green; apothecia rounded, 0.3–0.5 mm diam.; disc plane to slightly convex, pale yellow to orange-yellow; margin thin, evanescent, concolorous with disc or somewhat paler; excipulum 30–40 μ m thick; hymenium colourless, 32–40 μ m high; asci 30–38 \times 5–7 μ m; ascospores transversely 3–septate, 22–38 \times 1.5–2.0 μ m.

Range of distribution: Argentina, Brazil, Costa Rica, Ecuador, Guatemala, Guyana, Mexico, New Zealand, Panama, Paraguay, Peru, Venezuela (Lücking 2008), Australia (Lücking et al. 2001), Trinidad (Farkas & Hawksworth 2004), and India (Arunachal Pradesh, Assam and Tamil Nadu).

4. *Byssoloma chlorinum (Vain.) Zahlbr., Cat. Lich. Univ. 8: 233. 1932; Singh & Pinokiyo, Indian J. Forest. Addl. Ser. 4: 227–229. 2014. *Pilocarpon chlorinum* Vain., Univ. Calif. Publ. Bot. 12: 11. 1924. (Pilocarpaceae) (Image 2).

Specimen examined: 3322C (BSA), 15.v.2006, Assam, Lakhimpur District, Koilamari, Koilamari T.E., coll. V.N. Singh.

Description: Thallus crustose, minutely farinose



Image 1. *Bacidina apiahica* (Müll. Arg.) Vězda

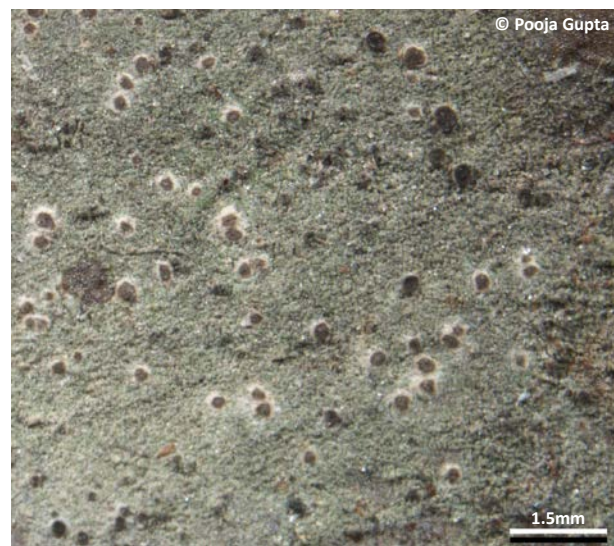


Image 2. *Byssoloma chlorinum* (Vain.) Zahlbr.

to granulose, pale green; apothecia rounded, 0.2–0.7 mm diam.; disc plane, dark brown to brown black; margin well-developed, densely byssoid, persistent and spreading laterally over thallus surface, white; excipulum 40–90 μm thick; hymenium colourless, 45–50 μm high; asci 30–40 \times 8–12 μm ; ascospores oblong – ellipsoid, transversely 3–septate, 12–15 \times 3–3.5 μm .

Range of distribution: Argentina, Bolivia, Brazil, Colombia, Costa Rica, Ecuador, Florida, French Guiana, Guatemala, Guyana, Indonesia, Mexico, Peru, Paraguay Society Islands (Lücking 2008), Australia (Lücking et al. 2001), and India (Andaman Islands, Arunachal Pradesh, Assam, Nagaland).

5. *Calenia aspidota* (Vain.) Vězda, Folia Geobot. Phytotax. 19(2): 195. 1984; Singh & Pinokiyo, Indian J. Forest. Addl. Ser. 4: 184–186. 2014. *Ectolechia aspidota* Vain. in Hiern, Cat. Welw. Afr. Pl. 2: 428. 1901. (Gomphillaceae)

Description: Thallus crustose, dispersed into rounded patches, white; apothecia rounded to slightly irregular in outline, immersed, 0.2–0.5 mm diam.; disc yellowish-grey but often with white pruina; margin distinct, strongly prominent, white; excipulum 5–15 μm thick; hymenium colourless, 60–90 μm high; asci 50–85 \times 15–32 μm ; ascospores oblong to ellipsoid, muriform, 40–80 \times 15–35 μm .

The species was first reported from India (Assam, Tingah Bam Jungle, near Naga Hills, 1899 Prain's collectors, *Pothos cathartii*: UPS) by Santesson (1952) as *Gyalectidium aspidatum*. It is included here on the basis of the earlier record.

Range of distribution: Brazil, Costa Rica, Cuba,

Mexico (Lücking 2008), and India (Arunachal Pradesh, Assam, Tamil Nadu).

***6. *Calopadia fusca* Vězda, Folia Geobot. Phytotax. 21: 208. 1986; Singh & Pinokiyo, Indian J. Forest. Addl. Ser. 4: 236–237. 2014. (Pilocarpaceae) (Image 3).**

Specimen examined: 5523B (BSA), 20.iv.2010, Assam, Manas Tiger Reserve, coll. G.P. Sinha & Pooja Gupta.

Description: Thallus crustose, smooth, greenish, dispersed into rounded confluent patches; apothecia rounded, sessile, constricted at base, 0.2–0.5 mm diam.; disc plane, brown, epruinose; margin distinct, grey; excipulum 30–65 μm thick; hymenium colourless, 150–200 μm high; asci 100–120 \times 35–45 μm ; ascospores oblong, muriform, 82–100 \times 20–38 μm .

Range of distribution: Angola, Argentina, Brazil, Costa Rica, Colombia, Cuba, Ecuador, French Guiana, Guatemala, Guyana, Mexico, Panama, Peru, U.S.A., Venezuela (Lücking 2008), Australia (Lücking et al. 2001), Bolivia (Flakus & Lücking 2008), and India (Andaman Islands, Arunachal Pradesh, Assam, Nagaland and Tamil Nadu).

7. *Calopadia subcoerulescens* (Zahlbr.) Vězda, Sched. Lich. Sel. Exs., Fasc. 88: 3, no. 2185. 1988; Singh & Pinokiyo, Indian J. Forest. Addl. Ser. 4: 242–244. 2014. *Lopadium subcoerulescens* Zahlbr. in Zahlbr. & al., Trans. Proc. New Zealand Inst. 59: 312. 1928. (Pilocarpaceae) (Image 4).

Specimen examined: 5523A (BSA), 20.iv.2010, Assam, Manas Tiger Reserve, coll. G.P. Sinha & Pooja Gupta.



Image 3. *Calopadia fusca* Vězda

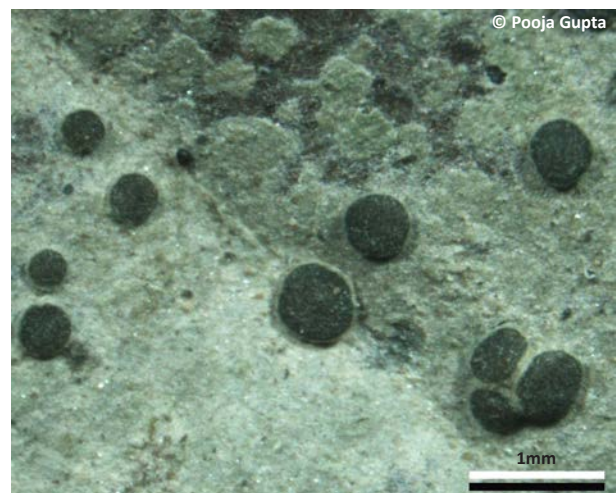


Image 4. *Calopadia subcoerulescens* (Zahlbr.) Vězda

Description: Thallus crustose, smooth, dispersed into rounded, confluent patches, pale grey; apothecia rounded, 0.2–0.5 mm diam.; disc plane to somewhat convex, black; margin thin, grey, base aeruginous; excipulum 16–20 μm thick; hymenium colourless, 85–90 μm high; asci 65–75 \times 20–25 μm ; ascospores ellipsoid, muriform, 70–85 \times 20–25 μm .

Range of distribution: Brazil, Costa Rica, Ecuador, Guyana, French Guiana, Honduras, Leeward Island, Mexico, U.S.A. (Lücking 2008), Australia (Lücking et al. 2001), Venezuela (Neuwirth 2007), Vietnam (Nguyen et al. 2011), and India (Andaman Islands, Arunachal Pradesh, Assam, Nagaland, Tamil Nadu and West Bengal).

8. *Coenogonium dilucidum* (Kremp.) Kalb & Lücking, Bot. Jahrb. Syst. 122: 29. 2000; Singh & Pinokiyo, Indian J. Forest. Addl. Ser. 4: 201–202. 2014. *Lecidea dilucida* Kremp., J. Mus. Godeffroy 1(4): 103. 1873. (Coenogoniaceae) (Image 5).

Specimen examined: 3273B (BSA), 15.v.2006, Assam, Lakhimpur district, Seajuli T. E., coll. V.N. Singh.

Description: Thallus crustose, slightly verrucose, smooth, green; apothecia rounded, sessile, attached to the substratum, 0.15–0.8 mm diam.; disc plane-concave, yellowish-brown, slightly translucent; margin prominent, smooth, concolorous with disc; excipulum 12–15 μm thick; hymenium colourless, l+ blue, 35–50 μm high; asci 40–45 \times 3–3.5 μm ; ascospores ellipsoid, transversely 1-septate, 9–12 \times 2–3 μm .

Range of distribution: Brazil, Costa Rica, Ecuador, Mexico, Panama, Thailand (Lücking 2008), and India (Andaman & Nicobar Islands, Assam).

9. *Coenogonium interplexum* Nyl., Ann. Sci. Nat., Bot., Ser. 4, 16: 92. 1862; Gupta & Sinha, Geophytology 44(1): 70. 2014. (Coenogoniaceae)

Specimen examined: 3271A (BSA), 15.v.2006, Assam, Lakhimpur district, Koilamari T. E., coll. V.N. Singh.

Description: Thallus filamentous, filaments 0.1–1.5 mm long, forming 3–5 mm across loose mats on substrate, yellowish-green; apothecia rounded, sessile to shortly stipitate, 0.3–0.6 mm diam.; disc plane, yellow to pale orange; margin thin, not prominent, smooth, light-brown; excipulum 14–18 μm thick; hymenium colourless, 46–57 μm high; asci 46–48 \times 5–7 μm ; ascospores ellipsoid, transversely 1-septate, 6–9 \times 2–3 μm .

Range of distribution: Brazil, Costa Rica, French Guiana, Guyana (Lücking 2008), and India (Assam).



Image 5. *Coenogonium dilucidum* (Kremp.) Kalb & Lücking

10. *Coenogonium minimum* (Müll. Arg.) Lücking, Fl. Neotrop. Monogr. 103: 572. 2008; Gupta & Sinha, Geophytology 44(1): 70. 2014. *Biatorinopsis minima* Müll. Arg. in Durand & Pittier, Bull. Soc. Bot. Belg. 30: 74. 1891. (Coenogoniaceae)

Specimen examined: 5523F (BSA), 20.iv.2010, Assam, Manas Tiger Reserve, coll. G.P. Sinha & Pooja Gupta.

Description: Thallus crustose, smooth, greenish-grey; apothecia sessile, strongly constricted at the base, 0.1–0.18 mm diam; disc plane or slightly concave, light yellowish-brown; margin somewhat prominent, thin, pale yellow, smooth; excipulum 16–24 μm thick; hymenium colourless, 40–52 μm high; asci 35–42 \times 9–12 μm ; ascospores ellipsoidal-fusiform, transversely 1-septate, 10–12 \times 3–4 μm .

Range of distribution: Costa Rica, Leeward Islands, Mexico, Panama (Lücking 2008), Venezuela (Neuwirth 2007), Vietnam (Nguyen et al. 2011), and India (Assam),

11. *Echinoplaca marginata* Lücking, Biblioth. Lichenol. 65: 57. 1997; Gupta & Sinha, Geophytology 44(1): 82. 2014. (Gomphillaceae)

Specimen examined: 5522C (BSA), 20.iv.2010, Assam, Manas Tiger Reserve, coll. G.P. Sinha & Pooja Gupta.

Description: Thallus crustose, uneven to finely verrucose, verrucae 0.07–0.5 mm diam., greyish-white; apothecia rounded, adnate, spot-like, sometimes bordered by a thin, white thalline margin 0.1–0.7 mm diam.; disc plane-convex, dark brownish-black; margin absent or thin, slightly prominent, white, thalline margin present; excipulum 12–28 μm thick; hymenium

colourless, 52–85 μm high; asci 47–72 \times 16–30 μm ; ascospores ellipsoid-ovoid, muriform, 45–62 \times 14–24 μm .

Range of distribution: Brazil, Costa Rica, Ecuador, French Guiana, Leeward Islands, Peru, Puerto Rico, Trinidad, Tobago (Lücking 2008), Venezuela (Neuwirth 2007), and India (Assam).

12. *Fellhanera bouteillei* (Desm.) Vězda, Folia Geobot. Phytotax. 21: 214. 1986; Singh & Pinokiyo, Indian J. Forest. Addl. Ser. 4: 247–249. 2014. *Parmelia bouteillei* Desm., Ann. Sci. Nat., Bot., sér. 3 8: 191. 1847. (Gomphillaceae) (Image 6)

Specimen examined: 3273B (BSA), 15.v.2006. Assam, Lakhimpur district, Seajuli T. E., coll. V.N. Singh.

Description: Thallus crustose, granulose, pale bluish-grey; apothecia rounded, 0.1–0.3 mm diam.; disc plane-convex, yellowish-orange; margin thin, pale whitish, smooth; excipulum 15–18 μm thick; hymenium colourless, 45–55 μm high; asci 38–50 \times 10–15 μm ; ascospores 10–14 \times 2–4 μm .

Range of distribution: Argentina, Brazil, Costa Rica, Colombia, Cuba, Ecuador, French Guiana, Guatemala, Guyana, Mexico, Paraguay, Peru, Puerto Rico, Venezuela, U.S.A. (Lücking 2008), and India (Arunachal Pradesh, Assam, Manipur, Meghalaya, Nagaland, Sikkim, Tamil Nadu and West Bengal).

13. *Fellhanera semecarpi* (Vain.) Vězda, Folia Geobot. Phytotax. 21: 215. 1986; Singh & Pinokiyo, Indian J. Forest. Addl. Ser. 4: 251–254. 2014. *Catillaria semecarpi* Vain., Ann. Acad. Sci. Fenn., Ser. A, 15: 110. 1921. (Gomphillaceae)

Specimen examined: F746A, Assam, Kamrup district, Jhorabat hills, altitude 220m, Pinokiyo.

Description: Thallus crustose, smooth, dispersed into rounded patches, pale greenish-grey; apothecia rounded to slightly irregular in outline, 0.1–0.3 mm diam.; disc plane, ochraceous yellow to reddish-brown; margin thin, evanescent, pale grey; excipulum 10–12 μm thick; hymenium colourless, 45–50 μm high; asci 32–48 \times 8–10 μm ; ascospores oblong-ovoid, transversely 1-septate, 10–12 \times 4–6 μm .

Range of distribution: Australia, Brazil, Costa Rica, Ecuador, Mexico, New Zealand, Paraguay, Philippines (Lücking 2008), Venezuela (Neuwirth 2007), Vietnam (Nguyen et al. 2011), and India (Arunachal Pradesh, Meghalaya, Nagaland, Sikkim, Tamil Nadu and West Bengal).

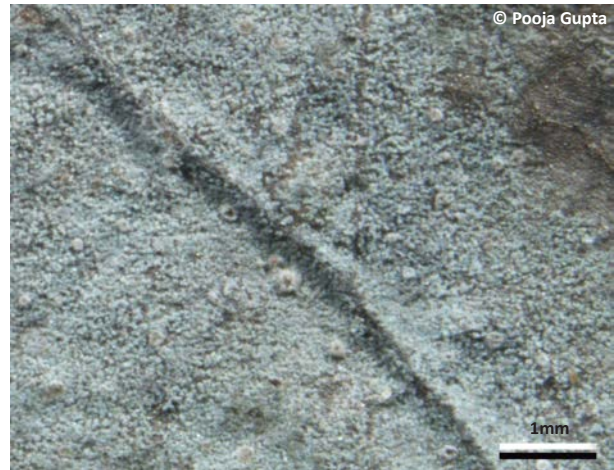


Image 6. *Fellhanera bouteillei* (Desm.) Vězda

14. *Mazosia melanophthalma* (Müll. Arg.) R. Sant., Symb. Bot. Upsal. 12(1): 117. 1952; Singh & Pinokiyo, Indian J. Forest. Addl. Ser. 4: 68–70. 2014. *Opegrapha melanophthalma* Müll. Arg., Flora 66: 348. 1883. (Roccellaceae)

Specimen Examined: 765 A, Assam, Kamrup district, Botahguli gaon, alt. 125m, Pinokiyo.

Description: Thallus crustose, finely verrucose, verrucae 0.05–0.1mm diam., slightly paler than thallus; apothecia rounded, 0.3–0.7 mm diam.; disc dark grey to black, translucent when moistened; margin gently sloping outwards; excipulum 10–15 μm thick; hymenium 50–75 μm high; asci 8-spored; ascospores fusiform, transversely 3-septate, 15–22 \times 3–5 μm .

Range of distribution: Argentina, Bolivia, Brazil, Costa Rica, Ecuador, French Guiana, Guatemala, Guyana, New Zealand, Panama, Paraguay, Peru, the Philippines, Puerto Rico, St. Vincent, Venezuela (Lücking 2008), Tanzania (Farkas 1987), and India (Andaman & Nicobar Islands, Arunachal Pradesh, Assam, Kerala, Nagaland and Tamil Nadu).

15. *Porina karnatakensis* Makhija, Adaw. & Patw., J. Econ. Taxon. Bot. 18(3): 538. 1994; Singh & Pinokiyo, Indian J. Forest. Addl. Ser. 4: 135–137. 2014. (Porinaceae) (Image 7)

Specimen examined: 3273B (BSA), 15.v.2006, Assam, Lakhimpur district, Seajuli T. E., coll. V.N. Singh.

Description: Thallus crustose, minutely verrucose, uneven, greenish-grey, calcium oxalate crystals present; perithecia conical to wart shaped, adnate, surface smooth, surrounded by thallus but with black dot around ostiole, 0.5–0.7 mm diam.; excipulum 10–12 μm thick; asci 58–70 \times 13–16 μm ; ascospores oblong to fusiform,

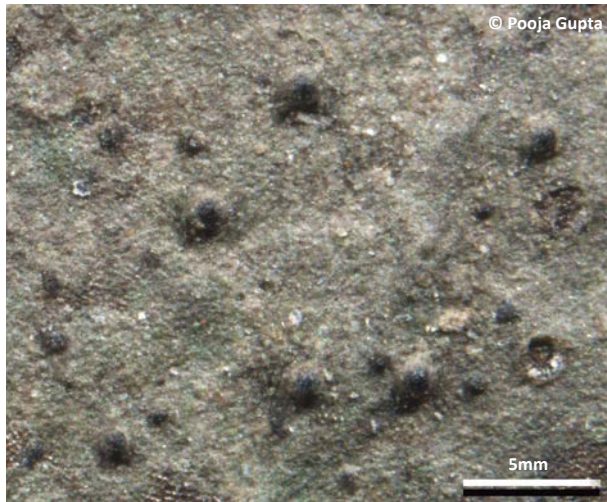


Image 7. *Porina karnatakensis* Makhija, Adaw. & Patw.

transversely 7-septate, $24\text{--}26 \times 3\text{--}3.5 \mu\text{m}$.

Range of distribution: Argentina, Australia, Brazil, Brunei, China, Colombia, Costa Rica, Darussalam, Dominica, Ecuador, French Guiana, Guadeloupe, Guyana, Honduras, Kenya, Mexico, New Caledonia, Papua New Guinea, Peru, St. Vincent, Thailand, Vietnam (Lücking 2008), Bolivia (Flakus & Lücking 2008), Venezuela (Neuwirth 2007), and India (Arunachal Pradesh, Assam, Karnataka, Kerala and Tamil Nadu).

16. *Psorotheciopsis patellarioides* (Rehm.) R. Sant., Symb. Bot. Upsal. 12(1): 336. 1952; Gupta & Sinha, Feddis Repert. 124: 154–156. 2013. *Calloria patellarioides* Rehm, Hedwigia 39: 85. 1900. (Asterothyriaceae)

Specimen examined: 3271B (BSA), 15.v.2006, Assam, Lakhimpur district, Koilamari T. E., coll. V.N. Singh.

Description: Thallus crustose, smooth, dispersed into rounded patches, white-silvery grey, incrustated with crystals, and each patch bordered by a thin, black line; apothecia rounded, sessile, constricted at the base, mostly appear from margin of the patch, $0.1\text{--}0.5 \text{ mm}$ diam.; disc plane to slightly concave, yellowish-grey, translucent (especially when wet); margin thin, slightly prominent, minutely verruculose-dentate, black; excipulum $18\text{--}45 \mu\text{m}$ thick; hymenium colourless, $50\text{--}57 \mu\text{m}$ high; asci $28\text{--}40 \times 4\text{--}6 \mu\text{m}$; ascospores oblong – ellipsoid, transversely 1-septate, $8\text{--}11 \times 3\text{--}4 \mu\text{m}$.

Range of distribution: Belgium Congo, Brazil, Columbia, Costa Rica, Ecuador, Gold Coast, Mexico, New Guinea, Nigeria, Philippines, Togoland and Uganda (Lücking 2008), Australia (Lücking et al. 2001), and India (Assam).

17. *Strigula antillarum* (Fée) Müll. Arg., Bot. Jahrb. 6: 379. 1885; Singh & Pinokiyo, Indian J. Forest. Addl. Ser. 4: 84–85. 2014. *Melanophthalmus antillarum* Fée, Essai Crypt. Ecorc.: 94, 100, 1824. (Strigulaceae)

Specimen Examined: 775, Assam, Kamrup district, Rani Reserve forest, alt. 140–300 m, Pinokiyo.

Description: Thallus crustose, subcuticular, dispersed into rounded, confluent patches; perithecia hemispherical to wart-shaped, $0.3\text{--}0.5 \text{ mm}$ diam., black; excipulum $7\text{--}12 \mu\text{m}$ thick; involucrellum carbonaceous, $20\text{--}30 \mu\text{m}$ thick; asci $60\text{--}70 \times 8\text{--}11 \mu\text{m}$; ascospores fusiform, transversely 1-septate, $15\text{--}25 \times 4\text{--}6 \mu\text{m}$.

Range of distribution: Argentina, Brazil, Costa Rica, Ecuador, French Guiana, Guatemala, Guyana, India (Andaman & Nicobar Islands, Arunachal Pradesh, Assam and Meghalaya), Mexico, Panama, Peru (Lücking 2008), Bolivia (Flakus & Lücking 2008), and Australia (Lücking et al. 2001).

18. *Strigula maculata* (Cooke & Masee) R. Sant., Symb. Bot. Upsal. 12(1): 186. 1952; Singh & Pinokiyo, Indian J. Forest. Addl. Ser. 4: 88–90. 2014. *Micropeltis maculata* Cooke & Masse in Cooke, Grevillea 18: 35. 1889. (Strigulaceae)

Specimen Examined: 777, Assam, Kamrup district, Rani Reserve forest, alt. 140–300 m, Pinokiyo.

Description: Thallus crustose, subcuticular, forming thin, completely confluent lobes, typically with crenulate margins and individual lobes bordered by thin, black line; perithecia completely exposed but covered by a thin, thallus layer up to ostiole, conical, $0.3\text{--}0.5 \text{ mm}$ diam., grayish to greenish-black; excipulum $10\text{--}15 \mu\text{m}$ thick; involucrellum carbonaceous, $15\text{--}30 \mu\text{m}$ thick; asci $40\text{--}60 \times 5\text{--}8 \mu\text{m}$; ascospores oblong to bacillar, transversely 1-septate, $12\text{--}18 \times 2.5\text{--}3.5 \mu\text{m}$.

Range of distribution: Brazil, Costa Rica, Ecuador, French Guiana, Guatemala, Guyana, Indonesia, Mexico, Paraguay, Peru, Philippines (Lücking 2008), Australia (Lücking et al. 2001), Tanzania (Farkas 1987), and India (Arunachal Pradesh, Assam, Kerala, Meghalaya, Sikkim and West Bengal).

19. *Strigula nemathora* Mont. in Sagra, Hist. Phys. Cuba, Bot., Pl. Cell.: 143. 1842; Singh & Pinokiyo, Indian J. Forest. Addl. Ser. 4: 94–96. 2014. (Strigulaceae)

Specimens Examined: 774, Assam, Kamrup district, Rani Reserve forest, alt. 140–300 m, Pinokiyo.

Description: Thallus crustose, subcuticular, forming thin to rather broad, radiating, often confluent lobes, minutely papillose; perithecia wart-shaped and often ridged, semi-immersed and covered by a thick thallus

layer up to the ostiole, 0.4–0.7 mm diam., greenish-grey to white but upper part often darker grey; excipulum 10–15 μm thick; involucrellum colourless to pale brown, 20–40 μm thick; asci 70–100 \times 7–10 μm ; ascospores fusiform, transversely 1-septate, 15–22 \times 4–6 μm .

Range of distribution: Argentina, Brazil, Costa Rica, Cuba, Ecuador, French Guiana, Guatemala, Guyana, Honduras, Japan, Kenya, Mexico, Panama, Paraguay, Peru, the Philippines, South Africa, Sri Lanka, Trinidad & Tobago, Venezuela, Vietnam (Lücking 2008), Tanzania (Farkas 1987), and India (Andaman & Nicobar Islands, Arunachal Pradesh, Assam and Tamil Nadu).

20. *Strigula nitidula Mont. in Sagra, Hist. Phys. Cuba, Bot., Pl. Cell.: 184. 1842; Singh & Pinokiyo, Indian J. Forest. Addl. Ser. 4: 96–98. 2014. (Strigulaceae)

Specimen examined: 5523F (BSA), 20.iv.2010, Assam, Manas Tiger Reserve, coll. G.P. Sinha & Pooja Gupta.

Description: Thallus crustose, subcuticular, partly confluent patches, more rarely lacinate; perithecia wart-shaped to almost conical, completely exposed, 0.2–0.5 mm diam., black and shiny; excipulum 8–12 μm thick; involucrellum carbonaceous, 12–32 μm thick; asci 55–82 \times 4–6 μm ; ascospores ellipsoid, transversely 1-septate, 8–14 \times 2–3 μm .

Range of distribution: Argentina, Brazil, Columbia, Costa Rica, Cuba, French Guiana, Guatemala, Guyana, Honduras, Leeward Island, Mexico, Peru, Paraguay, Venezuela (Lücking 2008), Papua New Guinea (Lücking et al. 2001), Tanzania (Farkas 1987), and India (Andaman Islands, Arunachal Pradesh, Assam, Meghalaya, Sikkim, Tamil Nadu and West Bengal).

21. *Strigula orbicularis* Fr., Linnaea 5: 549. 1830; Singh & Pinokiyo, Indian J. Forest. Addl. Ser. 4: 99–101. 2014. (Strigulaceae)

Specimen Examined: 763A, Assam, Kamrup district, Jhorabat hills, Pinokiyo.

Description: Thallus crustose, subcuticular, with crenulate or shortly lobulate margins and often furnished with white to yellow hairs, pale greyish-green; perithecia wart-shaped and typically with applanate top, semi-immersed and covered with thick thallus layer almost up to the ostiole, 0.2–0.3 mm diam., pale greyish-green to white but top usually with a black spot; excipulum 5–10 μm thick; involucrellum weakly carbonaceous, 10–20 μm thick; ascospores oblong, 3-septate, 14–24 \times 4–6 μm .

Range of distribution: Angola, Brazil, Costa Rica, Cuba, Dominican Republic, El Salvador, French Guiana, Guatemala, Haiti, Indonesia, Mexico, Philippines,



Image 8. *Strigula phyllogena* (Müll. Arg.) R.C. Harris

Puerto Rico, Trinidad & Tobago, Uruguay, Venezuela (Lücking 2008), Bolivia (Flakus & Lücking 2008), and India (Andaman & Nicobar Islands, Arunachal Pradesh, Assam, Kerala and Meghalaya).

22. *Strigula phyllogena* (Müll. Arg.) R.C. Harris, More Florida Lichens: 159. 1995; Singh & Pinokiyo, Indian J. Forest. Addl. Ser. 4: 101–103. 2014. *Porina phyllogena* Müll. Arg., Flora 66: 335. 1883. (Strigulaceae) (Image 8)

Specimen examined: 5523(BSA), 20.iv.2010, Assam, Manas Tiger Reserve, coll. G.P. Sinha & Pooja Gupta.

Description: Thallus crustose, smooth, greenish-grey; perithecia conical, exposed, sometimes covered by a thin thallus layer, 0.2–0.5 mm diam., black; excipulum 8–10 μm thick; involucrellum carbonaceous, 15–20 μm thick; asci 20–30 \times 4–6 μm ; ascospores fusiform-ellipsoid, transversely 1-septate, 8–10 \times 2–2.5 μm .

Range of distribution: Argentina, Brazil, Costa Rica, Cuba, Ecuador, French Guiana, Guatemala, Guyana, Honduras, Mexico, Panama, Peru, Surinam, Venezuela (Lücking 2008), and India (Andaman Islands, Arunachal Pradesh, Assam, Meghalaya, Nagaland, Sikkim, Tamil Nadu and West Bengal).

23. *Strigula smaragdula* Fr., Linnaea 5: 550. 1830; Singh & Pinokiyo, Indian J. Forest. Addl. Ser. 4: 103–105. 2014. (Strigulaceae) (Image 9)

Specimen examined: 3273A (BSA), 15.v.2006, Assam, Lakhimpur district, Seajuli T. E., coll. V.N. Singh.

Description: Thallus crustose, dispersed into rounded to irregular, partly confluent patches, bright green; perithecia hemispherical, immersed-errumpent, covered by thallus tissue up to the ostiole, 0.2–0.5 mm

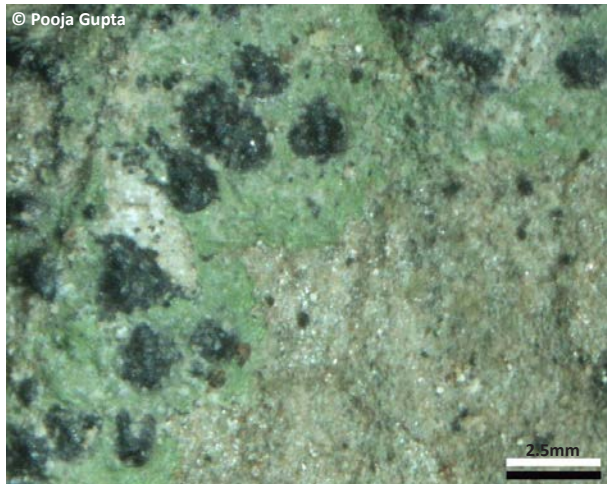


Image 9. *Strigula smaragdula* Fr.

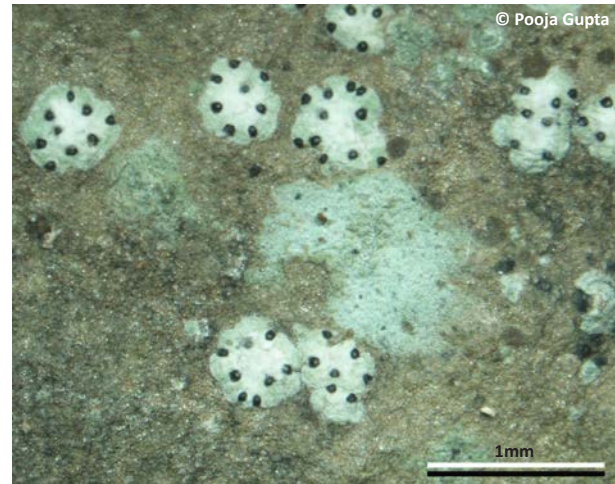


Image 10. *Strigula subelegans* Vain.

diam., black; excipulum 10–15 μm thick; involucrellum carbonaceous, 20–25 μm thick; asci 50–60 \times 8–10 μm ; ascospores fusiform, transversely 1-septate, 12–20 \times 4–5 μm .

Range of distribution: Angola, Argentina, Belize, Bolivia, Brazil, Cameroon, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, French Guiana, Guatemala, Guyana, Haiti, Honduras, Indonesia, Japan, Madagascar, Mauritius, Mexico, Nepal, New Caledonia, Nicaragua, Nigeria, Panama, Paraguay, Peru, Philippines, Puerto Rico, Sri Lanka, Surinam, Trinidad & Tobago, U.S.A., Venezuela, Virgin Islands (Lücking 2008), Australia (Lücking et al. 2001), and India (Andaman Islands, Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tamil Nadu and West Bengal).

24. *Strigula subelegans* Vain., Ann. Acad. Sci. Fenn., Ser. A, 19: 23. 1923; Singh & Pinokiyo, Indian J. Forest. Addl. Ser. 4: 106–107. 2014. (Strigulaceae) (Image 10)

Specimen examined: 3322B (BSA), 15.v.2006, Assam, Lakhimpur district, Koilamari, Koilamari T.E., coll. V.N. Singh.

Description: Thallus crustose, smooth dispersed into rounded, pale greenish-grey, partly confluent patches, white, lacking black line; perithecia rounded, immersed–erumpent, 0.3–0.5 mm diam., excipulum 8–10 μm thick; involucrellum carbonaceous, 20–22 μm thick; hymenium colourless, 32–40 μm high; asci 48–57 \times 10–12 μm ; ascospores ellipsoid–fusiform, transversely 1-septate, 12–20 \times 3–3.5 μm .

Range of distribution: Brazil, Costa Rica, French Guiana, Panama, Peru, Puerto Rico (Lücking 2008), Australia (Lücking et al. 2001), and India (Arunachal

Pradesh, Assam, Meghalaya, Nagaland, Sikkim, Tamil Nadu and West Bengal)

25. *Tricharia farinosa* R. Sant., Symb. Bot. Upsal. 12(1): 387. 1952; Gupta & Sinha, Geophytology 44(1): 84. 2014. (Pilocarpaceae)

Specimen examined: 5523E (BSA), 20.iv.2010, India, Assam, Manas Tiger Reserve, G.P. Sinha & Pooja Gupta.

Description: Thallus crustose, coarsely verrucose due to incrustation with calcium oxalate crystals, white, furnished with black, tapering 0.8–1 mm long hairs; apothecia rounded, sessile, strongly constricted at the base, 0.3–0.6 mm diam.; disc plane to slightly concave, with brown farinose covering; margin slightly prominent; hymenium colourless, 78–92 μm high; asci 72–92 \times 20–28 μm ; ascospores ellipsoid-oblong, muriform, 68–84 \times 18–25 μm .

Range of distribution: Argentina, Brazil, Costa Rica, Columbia, Ecuador, French Guiana, Guyana, Guatemala, Venezuela (Lücking 2008), India (Assam).

26. *Tricharia vainioi* R. Sant., Symb. Bot. Upsal. 12(1): 382. 1952; Singh & Pinokiyo, Indian J. Forest. Addl. Ser. 4: 199–200. 2014. (Pilocarpaceae)

Specimen examined: 767, Assam, Kamrup district, Botaguli Goan, alt. 200m, Pinokiyo.

Description: Thallus crustose, smooth and lacking calcium oxalate crystals, with numerous, sterile setae, pale greenish-grey; setae 0.5–1 mm long, black; apothecia rounded, sessile, 0.3–0.5 mm diam.; disc plane, yellowish-brown to brown, slightly translucent; margin thin, not prominent, smooth, brown to dark brown; excipulum 10–30 μm thick; hymenium colourless, 50–70 μm high; asci 50–70 \times 20–30 μm ; ascospores ellipsoid,

Key to the foliicolous lichen species of Assam

1a.	Ascomata apothecia	2
1b.	Ascomata perithecia	18
2a.	Apothecia immersed-erumpent	3
2b.	Apothecia otherwise	6
3a.	Thallus ecorticate or cortex cartilaginous or formed by an irregular layer of rounded cells	4
3b.	Thallus with distinct cortex formed by rectangular, dead cells in regularly radiate visible plates above; ascospores often thick walled	5
4a.	Thallus finely verrucose	<i>Mazosia melanophthalma</i>
4b.	Thallus smooth	<i>Aulaxina uniseptata</i>
5a.	Apothecia immersed, zeorine; excipulum I+ red	<i>Asterothyrium microsporum</i>
5b.	Apothecia sessile, lecideine; excipulum I-	<i>Psorotheciopsis patellarioides</i>
6a.	Apothecia spot-like, not raised over the thallus, emarginated	<i>Echinoplaca marginata</i>
6b.	Apothecia sessile	7
7a.	Hyphophores present	8
7b.	Hyphophores absent	10
8a.	Setae or hairs pale or white	<i>Calenia aspidota</i>
8b.	Setae or hairs black	9
9a.	Ascospores large, 68–84 × 18–25 μm	<i>Tricharia farinosa</i>
9b.	Ascospores smaller, 34–48 × 12–28 μm	<i>Tricharia vainioi</i>
10a.	Photobiont <i>Trentepohlia</i> ; asci entirely thin-walled, unitunicate, I- or I+ bluish-brownish; paraphyses unbranched, distinct	11
10b.	Photobiont chlorococcoid; asci apically thick-walled, lecanoroid, I+ bluish; paraphyses usually branched or anastomosing, indistinct	13
11a.	Thallus filamentous or densely pilose	<i>Coenogonium interplexum</i>
11b.	Thallus crustose	12
12a.	Apothecia pale-yellow to orange-brown; ascospores 9–12 × 2–3 μm	<i>Coenogonium dilucidum</i>
12b.	Apothecia light brown, wax coloured; ascospores 10–12 × 3–4 μm	<i>Coenogonium minimum</i>
13a.	Conidiomata campylidia	14
13b.	Conidiomata pycnidia	15
14a.	Apothecial disc dark brown; spores 82–100 × 20–38 μm	<i>Calopadia fusca</i>
14b.	Apothecial disc greenish-black; spores 70–85 × 20–25 μm	<i>Calopadia subcoerulescens</i>
15a.	Ascospores bacillary	<i>Bacidina apiahica</i>
15b.	Ascospores oblong-ellipsoid	16
16a.	Apothecia with byssoid margin	<i>Byssoloma chlorinum</i>
16b.	Apothecia with compact margin	17
17a.	Thallus with distinguished bluish-tinge, soredate	<i>Fellhanera bouteillei</i>
17b.	Thallus without bluish-tinge, esoredate	<i>Fellhanera semecarpi</i>
18a.	Asci functionally unitunicate, entirely thin-walled	<i>Porina karnatakensis</i>
18b.	Asci functionally bitunicate (fissitunicate), apically thick-walled	19
19a.	Thallus supracuticular, smooth, easily separable from leaf	<i>Strigula phyllogena</i>
19b.	Thallus subcuticular, not separable from leaf	20
20a.	Involucrellum colourless	<i>Strigula nemathora</i>
20b.	Involucrellum black	21
21a.	Perithecia wart shaped; ascospores 3-septate	<i>Strigula orbicularis</i>
21b.	Perithecia conical; ascospores 1-septate	22
22a.	Thallus thicker, pale greenish-grey to bright green, thallus lobes without black line	23
22b.	Thallus very thin, green to dark green or greenish-brown, thallus lobes with black line	25
23a.	Thallus pale greenish-to bluish-grey	<i>Strigula subelegans</i>
23b.	Thallus bright green	24
24a.	Perithecia exposed, black; ascospore one cell enlarged	<i>Strigula antillarum</i>
24b.	Perithecia covered by thallus tissue, dark green, Upper part black	<i>Strigula smaragdula</i>
25a.	Perithecia pure black, totally exposed; ascospores 8–14 μm long, uniseriate	<i>Strigula nitidula</i>
25b.	Perithecia greyish-black, covered by thin thallus layer; ascospores 14–24 μm long, biseriata	<i>Strigula maculata</i>

muriform, 35–65 × 15–28 µm.

Range of distribution: Argentina, Bolivia, Brazil, Colombia, Costa Rica, Ecuador, French Guiana, Guatemala, Guyana, Malaysia, Mexico, Panama, Paraguay, Peru, Philippines, Puerto Rico, tropical Africa, U.S.A. (Lücking 2008), Australia (Lücking et al. 2001), Venezuela (Neuwirth 2007), and India (Arunachal Pradesh and Nagaland).

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ISSN 0974-7907 (Online); ISSN 0974-7893 (Print)

July 2016 | Vol. 8 | No. 7 | Pages: 8953–9052

Date of Publication: 26 July 2016 (Online & Print)

DOI: 10.11609/jott.2016.8.7.8953-9052

www.threatenedtaxa.org

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