

## *Phyllopsora pyxinoides*, a new record of lichenized fungi to India and 29 others new to Assam

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**Abstract:** Present paper reports occurrence of 30 new records of lichen biota from Assam belonging to 23 genera and 16 families, from Ultapani Forest Range, Kokrajhar, Assam. Of these, *Phyllopsora pyxinoides* (Nyl.) Kistenich is identified as a new record to India. Crustose lichen is the most dominant form accounting 67% of the total species, followed by foliose and squamulose forms with 13% each and fruticose forms (7%). Frequent discovery of unreported species from the study area indicates the richness of lichen diversity in the region.

**Keywords:** Assam, Kokrajhar, lichenized fungi, new records, Ultapani

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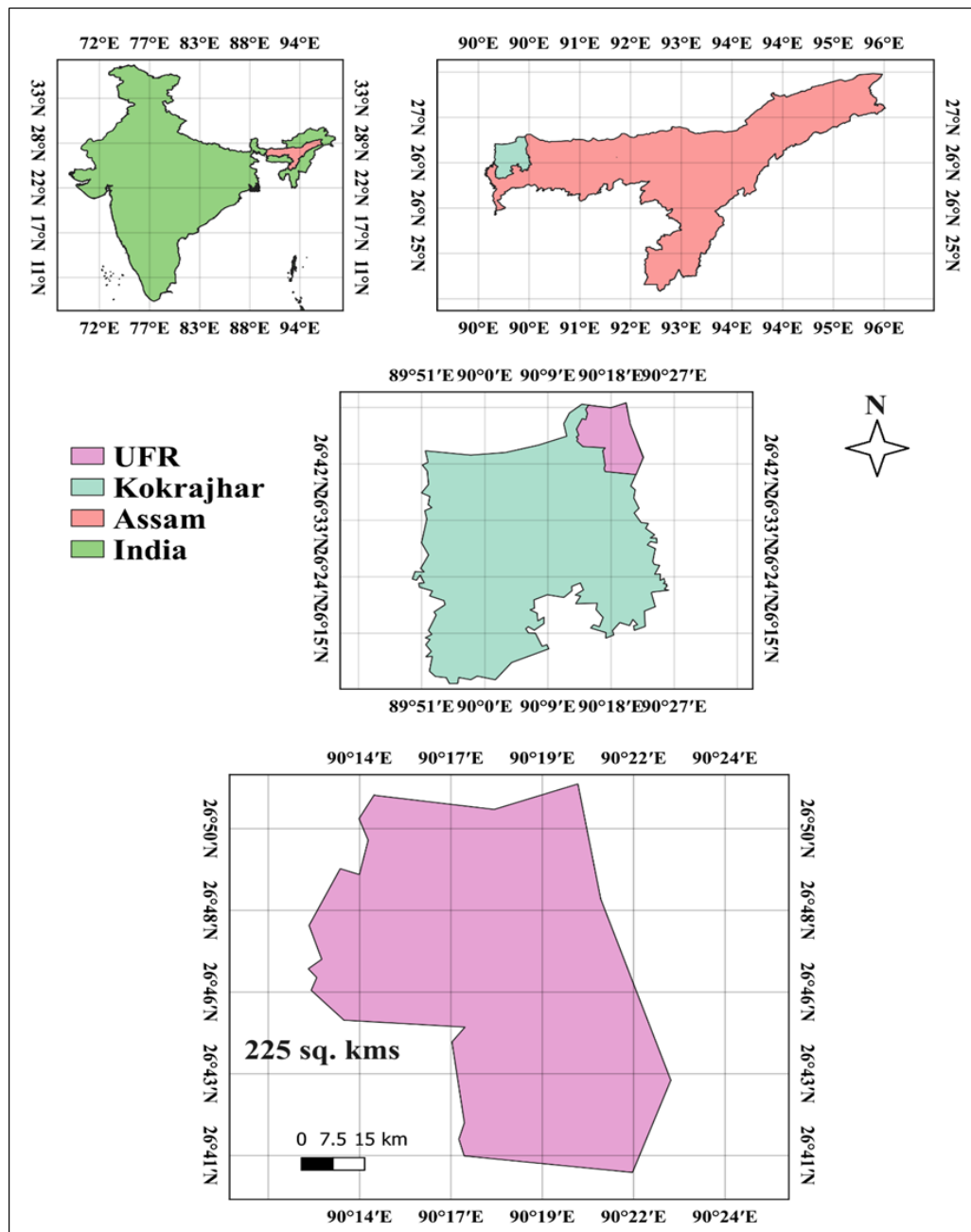
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### Introduction

India represents about 12% of the world lichen biota with 3236 taxa over 487 genera and 88 families (Sinha *et al.*, 2024). In the past few years, the state, Assam has made enormous contributions to the Indian lichen biota, with many lichen taxa that are either new to India or the regions under study. Ultapani Forest Range is one of the oldest reserve forests and biodiversity rich area, that falls under Manas Biosphere Reserve, Assam (Fig. 1). The Biosphere Reserve is prominent for its rich flora and fauna in North-east India. It spans across two districts, Bongaigaon and Barpeta. It lies between 89°51.45' E to 92°70.00' E and 26°30.00' N to 26°56.43' N with a total area of 2837 sq. kms. (Paul *et al.*, 2011). It is located in the foothills of Eastern Himalayas and shares its international border with Bhutan. In 1985, it was recognized as a UNESCO World Heritage site and named “Manas Wildlife sanctuary”. It serves as a vital conservation area for various endangered species, both flora and fauna. Within few years in 1989, it was expanded and designated as Manas Biosphere Reserve by the Government of India.

The name, “Ultapani Forest Range” is derived from its river, “Ultapani”, which flows in reverse direction from west to east. The Ultapani Forest Range (UFR) covers three sites, Labanyapur, Saralpara



**Fig 1.** Map showing the location of Ultapani Forest Range (UFR)

from west to east. The forest's most notable and distinctive features are its swampy and mangrove-like vegetation. The area is a recognized hub of orchid diversity, home to a significant number of threatened species. The UFR forest comprised of semi-evergreen and moist deciduous forest, riparian forest, degraded and scrub forests. Most plants in this area are semi-evergreen, with medicinal properties.

Some are also used for food, oil and timber, giving then significant economic value. The village inhabitants residing near the forest basically depend on the forest resources for their daily life. The region is renowned as a "heaven of butterflies" and is also home to the endangered Golden langur. It was recently recognized as the eight National Park by the State Government.

## Materials and methods

Lichen specimens were collected from Labanyapur, Saralpara and Ultapani of Ultapani Forest Range of Kokrajhar district, Assam, that falls under Haltugaon Forest Division. The specimens were identified based on morphology, anatomy and chemical substances present. Leica EZ4W stereo-zoom microscope was used to study the morphological characters. The anatomical details of thin sections of apothecia mounted on water and lactophenol cotton blue were studied under Leica DM750 trinocular microscope. The chemical test was carried out using spot tests by applying reagents K (aqueous potassium hydroxide solution), C (aqueous calcium hypochlorite solution), and P (0.5 g of para phenylenediamine dissolved in 5 ml of ethanol) on the thallus, medulla and apothecia. The lichen compounds in solvent system A were identified by thin layer chromatography (Orange *et al.*, 2010). Relevant literatures were cited for species identification (Awasthi, 1991; Awasthi, 2007; Thor, 2002; Nayaka, 2004; Makhija and Adawadkar, 2007; Lücking *et al.*, 2009; Mishra *et al.*, 2011; Aptroot, 2012; Sharma *et al.*, 2012; Joshi *et al.*, 2014; Breuss and Lücking, 2015; Aptroot and Lücking, 2016; Bajpai *et al.*, 2018; Joshi *et al.*, 2018). A set of voucher specimens have been deposited in the Department of Botany, Bodoland University, Kokrajhar, Assam and herbarium of CSIR- National Botanical Research Institute, Lucknow. Indexfungorum.org was used for lichen nomenclature, and the classification was updated after Wijayawardene *et al.*, 2020.

## Results

### New record to India

#### Taxonomic description

##### Ramalinaceae

1. *Phyllopsora pyxinoides* (Nyl.) Kistenich, Timdal, Bendiksby & S. Ekman, *Taxon* 67(5):894. 2018. (Fig 4h).

Thallus squamulose, corticolous, greyish white to pale grey, spongy. A well-developed black hypothallus (the layer beneath the thallus) surrounds the lobes, providing a contrasting border. Apothecia not seen. Chemistry: Thallus K + yellow, C –, P + orange, UV –; TLC: Atranorin and stictic acid.

*Distribution:* Bolivia, Brazil, Colombia, Costa Rica, Cuba, Guatemala, Guyana, Haiti, Liberia, Peru, Thailand, Trinidad & Tobago, USA, Zimbabwe.

*Species examined:* INDIA– Assam, Kokrajhar district, Ultapani, 26°46.060' N, 90°17.249' E, Elev. 188 m, on the bark of *Magnolia hodgsonii*, 26/07/2020, 65080 (LWG); Pungbili Islary.

##### Arthopyreniaceae

2. *Arthopyrenia claviformis* (Stirt.) Hawksw. in Bull. Br. Mus. Nat. Hist. Bot. 14(2):142.1985. *Verrucaria claviformis* Stirt. in Proc. Roy. Phil. Soc. Glasgow 11:320. 1879 (Fig 2a).

Thallus crustose, corticolous, whitish to dull-grey, ecorticated. Ascomata perithecia, covered by whitish thalline layer, later nude. Peridium dimidiate, black, absent at base, paraphyses thick. Asci 8-spored, ascospores hyaline, oval to ellipsoid with blunt ends, transversely 3-septate, upper cell rounded, lower angular to triangular, 20–25 × 4–5 µm. Chemistry: Thallus K + pale yellow, C –, P + pale yellow, UV –; TLC: no substances detected.

*Distribution:* India (Arunachal Pradesh, Kerala and Tamil Nadu).

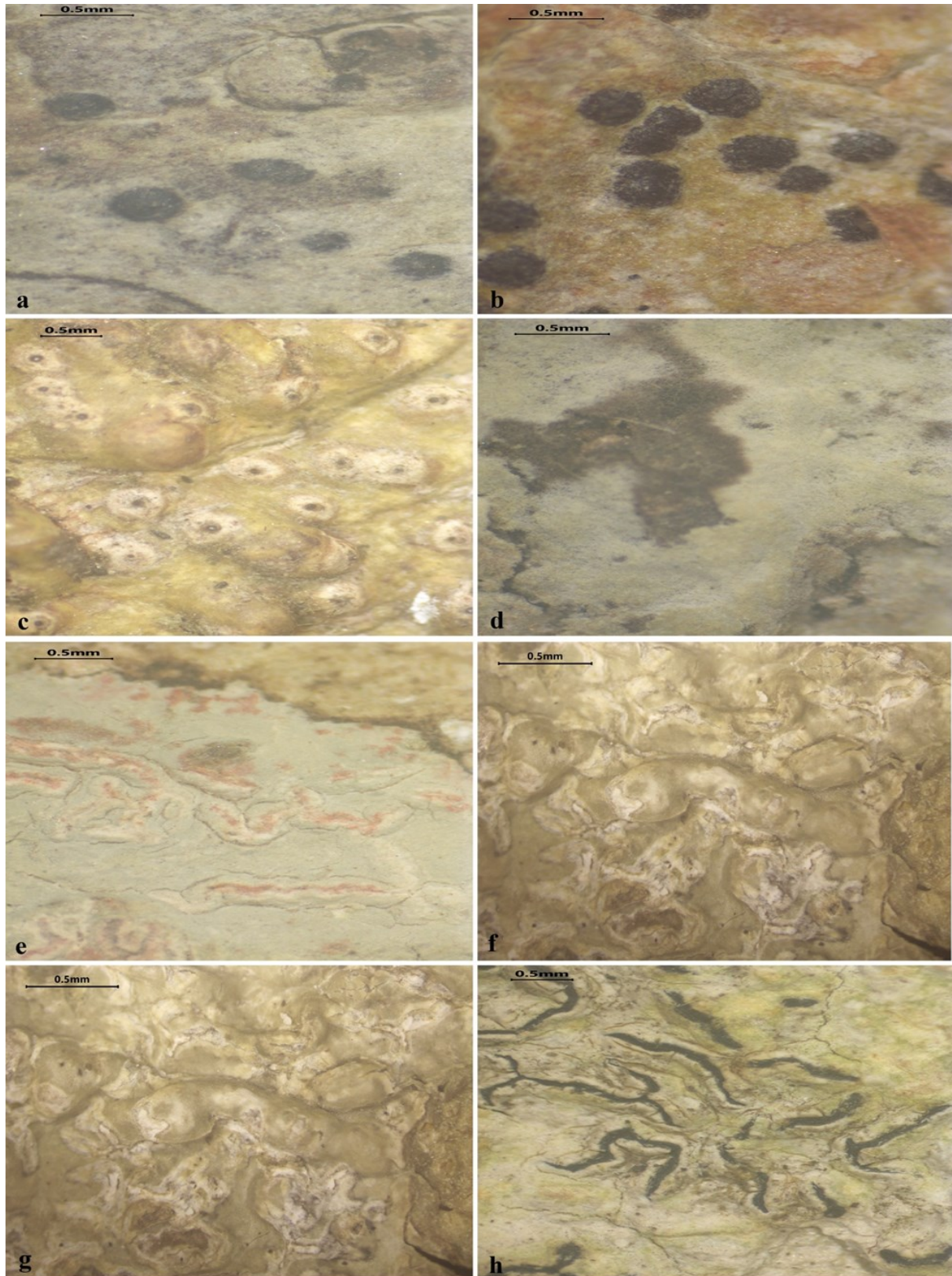
*Species examined:* INDIA– Assam, Kokrajhar district, Ultapani, 26°46.472' N, 90°14.546' E, Elev. 215 m, on the bark of *Ficus* sp., 02/04/2022, 2022–0469 (BUBH); Pungbili Islary.

3. *Arthopyrenia subvelata* (Nyl.) R.C. Harris, Lichenogy. Thomsoniana, North American Lichenology in Honor of John W. Thomson (Ithaca):147. 1998 (Fig 2b).

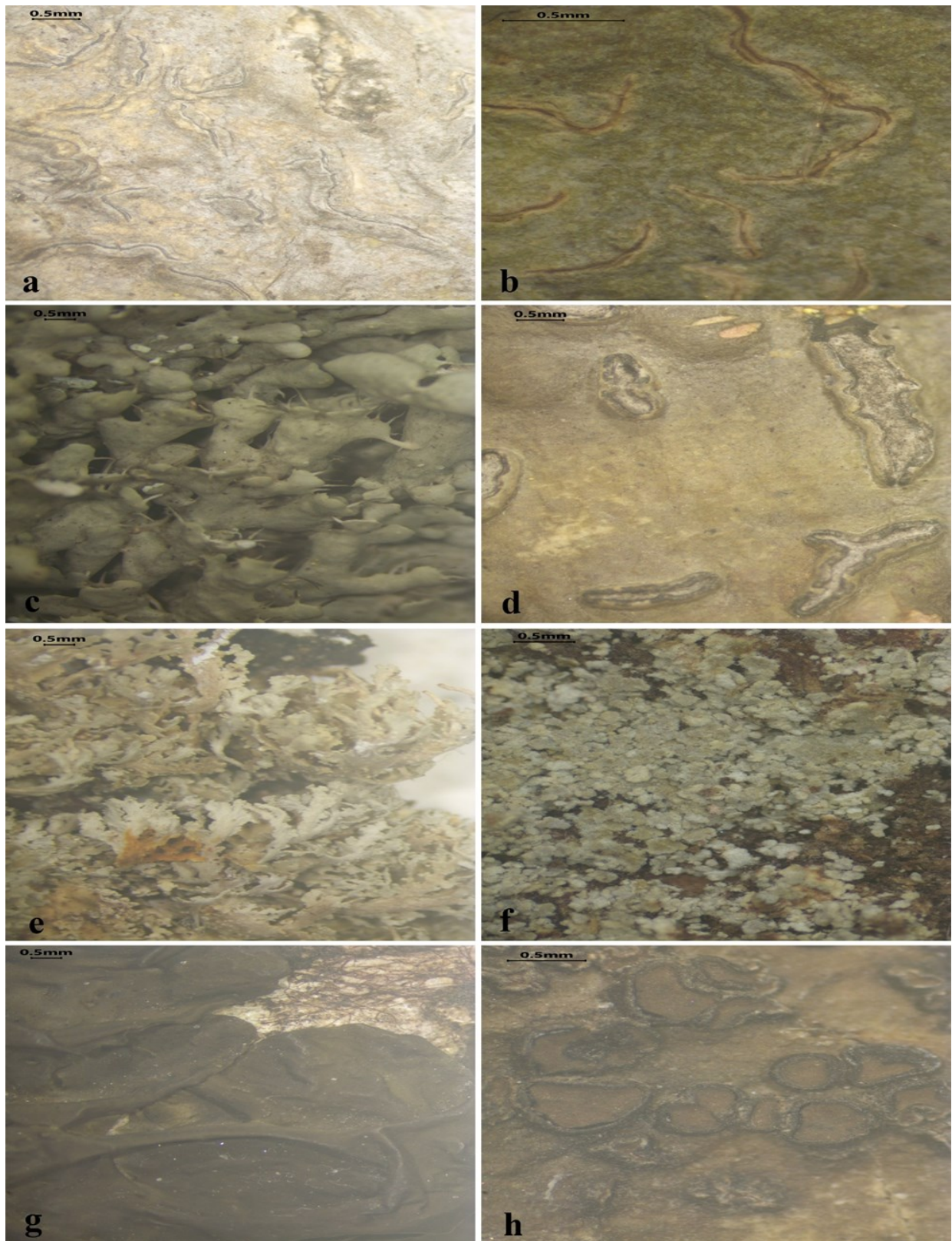
Thallus crustose, corticolous, whitish, thin, ecorticated. Ascomata perithecia, covered by thallus, black, hemispherical, 0.1–0.3 mm diam., ostiole vertical. Peridium dimidiate, black, hymenium yellow and interspersed with oil globules, paraphyses branched. Asci 8-spored, ascospores hyaline, oblong, transversely 3-septate, 25–30 × 8–12 µm. Chemistry: Thallus K –, C –, P –, UV –; TLC: no substances detected.

*Distribution:* India (Odisha, Puducherry, West Bengal), USA.

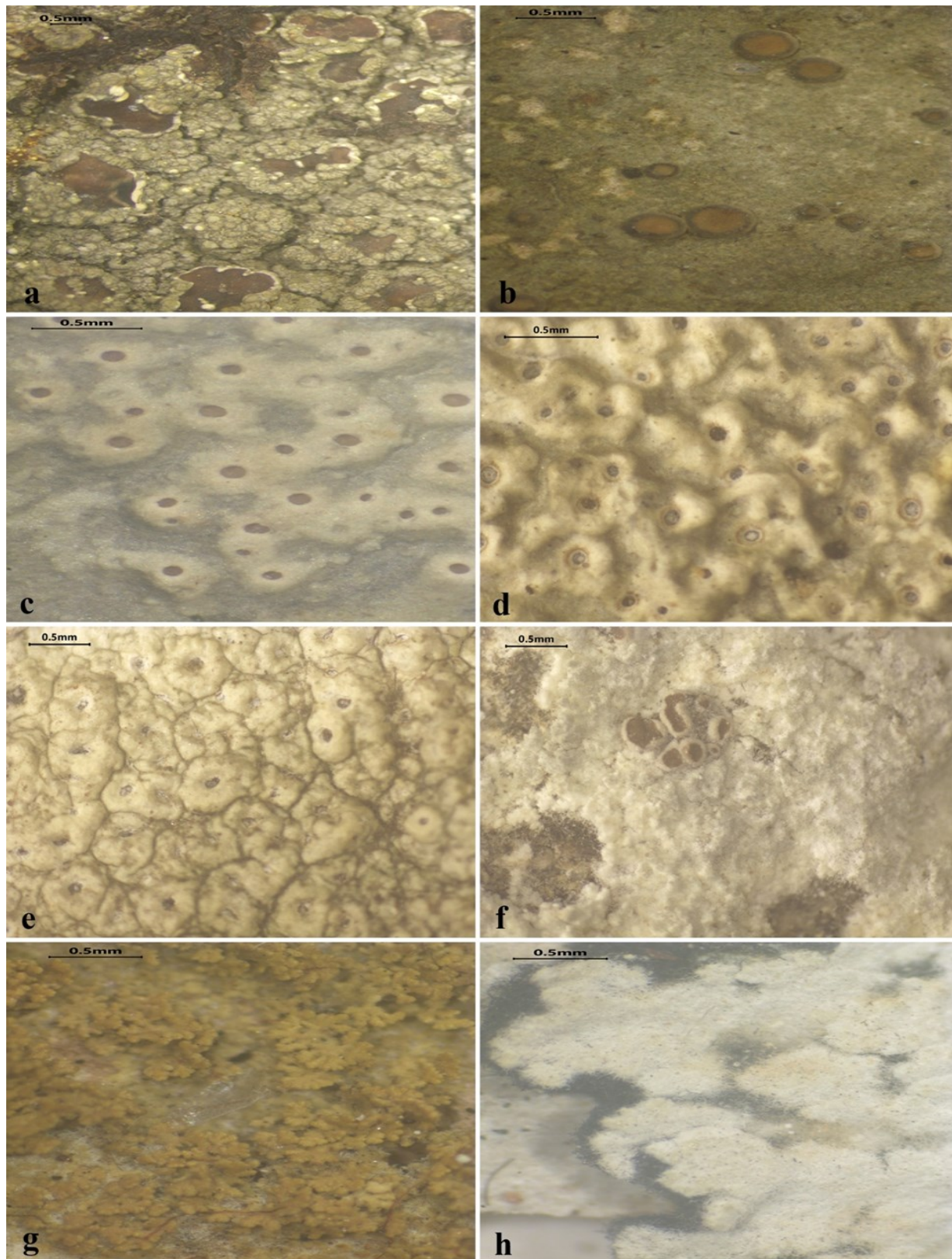
*Species examined:* INDIA– Assam, Kokrajhar district, Ultapani, 26°47.06' N, 90°16.00' E, Elev. 181 m, on the bark of *Ficus* sp., 28/11/2022, 2022–1006 (BUBH); Pungbili Islary.



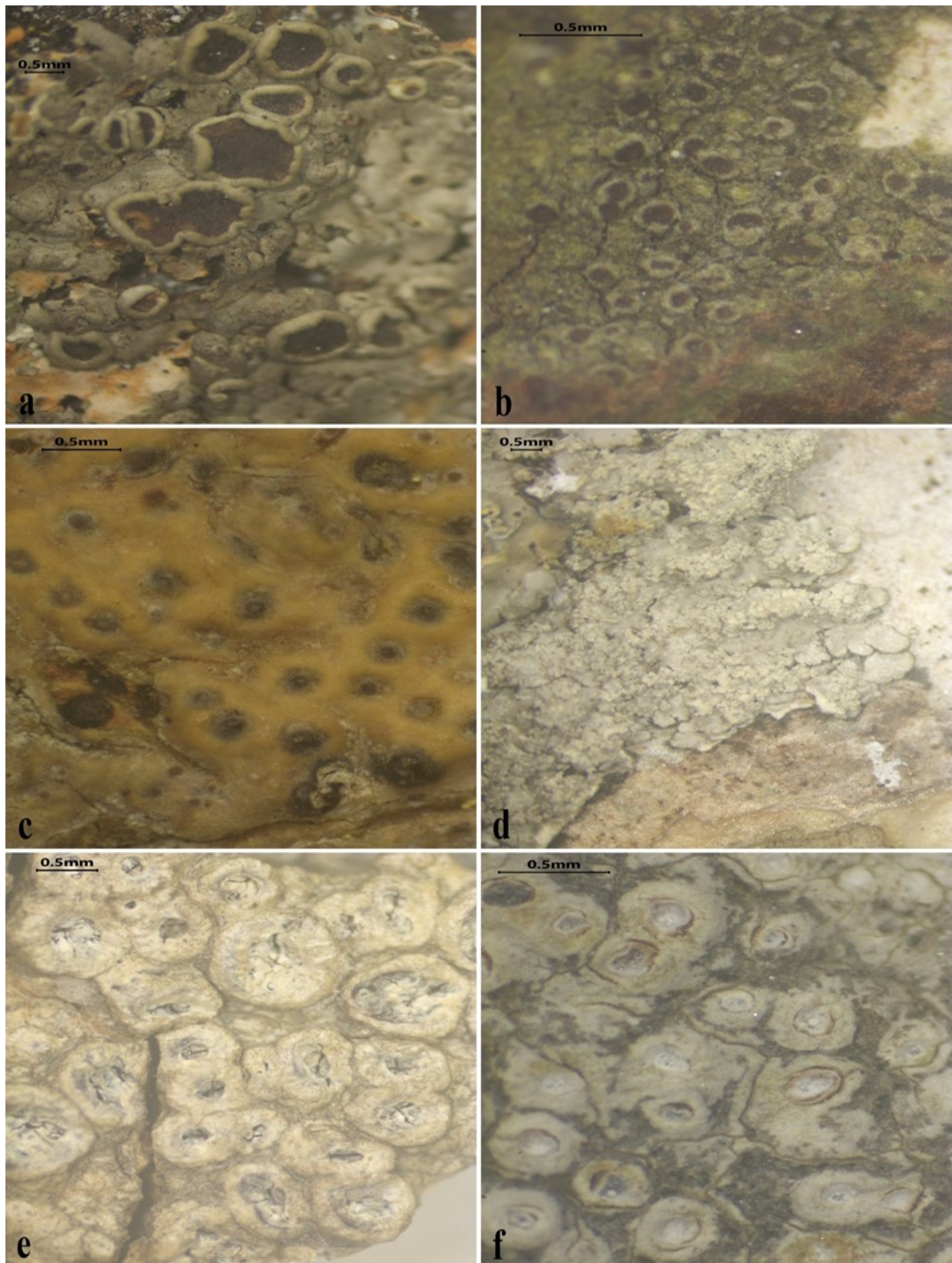
**Fig 2.** Lichen thallus. *Arthopyrenia claviformis* (a); *A. subvelata* (b); *Astrothelium cinereorosellum* (c); *Dichosporidium boschianum* (d); *Diorygma roseopruinatum* (e); *Fissurina simplex* (f); *F. subnitidula* (g) ; *Graphis copelandii* (h)



**Fig 3.** Lichen thallus. *Graphis fulvescens* (a); *Hemithecium amboliense* (b); *Heterodermia comosa* (c); *Leiorreuma exaltatum*(d); *Lepraria arbuscula* (e); *Leprocaulon adhaerens* (f); *Leptogium brebissonii* (g); *Lopadium coorgianum* (h).



**Fig 4.** Lichen thallus. *Malmidea duplomarginata* (a); *M. leptoloma* (b); *Myriotrema olivaceum* (c); *Ocellularia thelotremoides* (d); *O. wandoorensis* (e); *Phyllopsora gossypina* (f); *P. manipurensis* (g); *P. pyxinoides* (h).



**Fig 5.** Lichen thallus. *Physcia stellaris* (a); *Polyozosia sambuci* (b); *Pyrenula punctella* (c); *Pyxine endochrysin* (d); *Rhabdodiscus indicus* (e); *Thelotrema canarense* (f).

### Caliciaceae

4. *Pyxine endochrysin* Nyl., Lich. Japon. 34. 1890. (Fig 5d).

Thallus foliose, corticolous, heteromerous, corticated on both side, lobes 1.5–2.5 mm wide, upper side grey to brownish grey, isidia laminal to marginal, simple to branched, stout, becoming pustulate, exposing white base, producing white soredia, lower side brown to black rhizines. Medulla orange yellow to ochraceous, P –. Apothecia not seen. Chemistry: Thallus K + yellow, C –, P + light orange, UV –; TLC: Atranorin, norstictic and zeorin.

*Distribution:* India (Manipur, Kerala), Africa, Australia, Japan, Korea, Russian Federation, Taiwan, Tanzania.

*Species examined:* INDIA– Assam, Kokrajhar district, Saralpara, 26°51.011' N, 90°15.517' E, Elev. 281 m, on the bark of *Tetrameles nudiflora*, 05/03/2023, 65117 (LWG), 2023–1586 (BUBH); Pungbili Islary.

### Collemaaceae

5. *Leptogium brebissonii* Mont. in Barker-Webb & Berthelot, Hist. Nat. Iles Canar. 3(2):130. 1840. (Fig. 3g).

Thallus foliose, corticolous, olive-grey to black, thin, wrinkled, homoiomerous, corticated on both sides in a single layered, lacking tomentum on lower side. Apothecia constricted at base, to 1.5 mm in diam. Asci 8-spored, ascospores hyaline, fusiform, transversely 5–7-septate, apices acuminate, 32–35 × 5–7 µm. Thallus K –, C –, P –, UV –; TLC: no substances detected.

*Distribution:* India (Kerala, Tamil Nadu), Australia, Brazil, Canary Island, Europe, France, Iceland, Kenya, Nepal, Northern Ireland, Portugal, South Africa, Spain, Tanzania, USA.

*Species examined:* INDIA– Assam, Kokrajhar district, Saralpara, 26°49.946' N, 90°15.558' E, Elev. 244 m, on the bark of *Magnolia champaca*, 05/03/2023, 2023–1502 (BUBH); Pungbili Islary.

### Diploschistaceae

6. *Myriotrema olivaceum* Fee, Essai La Crypt. 103. 1824. (Fig. 4c).

Thallus crustose, corticolous, olive green to green,

smooth to uneven, dense prosoplectenchymatus cortex. Photobiont layer and medulla with calcium oxalate crystals. Ascomata apothecia, immersed, rounded, 0.2–0.3 mm diam., disc narrow, 0.05–0.2 mm wide pore, invisible, margin entire, white, splitting between thallus and proper margin. Columella absent, excipulum colourless, hymenium clear, periphysoids absent, paraphyses simple. Asci 8-spored, ascospores hyaline, ellipsoid with thick septa and lens-shaped lumina, 11–18 × 6–9 µm, I + violet blue. Chemistry: Thallus K + orange yellow, C –, P + olive yellow, UV –; TLC: Olivaceic acid.

*Distribution:* India (Andaman & Nicobar Islands), Australia, Belize, Brazil, Cameroon, Colombia, Dominica, France, Fiji, French Guiana, Indonesia, Jamaica, Malaysia, New Caledonia, Papua New Guinea, Philippines, Saint Kitts & Nevis, Saint Lucia, Solomon Islands, Sri Lanka, Tanzania, Thailand, Trinidad & Tobago, USA.

*Species examined:* INDIA– Assam, Kokrajhar district, Ultapani, 26°46.330' N, E90°16.778' E, Elev. 178 m, on the bark of *Syzygium formosum*, 10/10/2020, 2020–1019 (BUBH); Pungbili Islary.

7. *Ocellularia thelotremoides* (Leight.) Zahlbr., Cat. Lich. Univ. 2:603. 1924. *Ascidium thelotremoides* Leight. in Trans. Linn. Soc. Lond. 27(2):170.1869. (Fig. 4d).

Thallus crustose, corticolous, olivaceous-green to olive yellow, corticated. Ascomata apothecia, immersed to strongly emergent. Columella carbonized, confined apically, excipulum slightly carbonized at apices, hymenium clear, paraphyses simple. Asci 8-spored, ascospores hyaline, muriform, 6–10 × 1–4 locular, 17–28 × 8–12 µm, I + violet blue (amyloid). Chemistry: Thallus K + yellow, C –, P + orange yellow, UV –; TLC: Protocetraric acid.

*Distribution:* India (Karnataka, Kerala, Manipur, Tamil Nadu), Australia, Malaysia, Papua New Guinea, Sri Lanka, Thailand, Venezuela.

*Species examined:* INDIA– Assam, Kokrajhar district, Ultapani, 26°46.095' N, 90°17.311' E, Elev. 179 m, on the bark of *Syzygium* sp., 14/07/2020, 2020–1579 (BUBH); Pungbili Islary.

8. *Ocellularia wandoorensis* Nagarkar, Sethy & Patw. in Mycotaxon 27:78. 1986. (Fig. 4e).

Thallus crustose, corticolous, whitish to greyish-white, corticated. Ascomata apothecia, semi-emergent to emergent, 0.5–1.0 mm diam., pore 0.1–0.2 mm wide. Excipulum carbonized, columella irregularly reticulate, with pruinose, carbonized, hymenium inspersed, paraphyses simple. Asci 8-spored, ascospores hyaline, fusiform, transversely 3-septate,  $14\text{--}16 \times 8\text{--}10 \mu\text{m}$ . Chemistry: Thallus K + olive yellow, C –, P –, UV –; TLC: no substances detected.

*Distribution*: India (Andaman & Nicobar Islands).

*Species examined*: INDIA– Assam, Kokrajhar district, Saralpara,  $26^{\circ}50.769' \text{N}$ ,  $90^{\circ}16.510' \text{E}$ , Elev. 255 m, on the bark of *Terminalia* sp., 14/03/2023, 2023–1512 (BUBH); Pungbili Islary.

9. *Rhabdodiscus indicus* Singh & Singh in Taiwania 58 (4):246. 2013 (Fig. 5e).

Thallus crustose, corticolous, yellow to yellowish grey, lacking isidia, corticated. Photobiont layer and medulla with calcium oxalate crystals. Ascomata apothecia, numerous, rounded to irregular, disc white-pruinose. Columella reticulate, excipulum brown, hymenium clear, paraphyses simple. Asci 8-spored, ascospores hyaline, transversely 3-septate, C –, P + yellow, UV –; TLC: Unknown substances present.

*Distribution*: India (Arunachal Pradesh).

*Species examined*: INDIA– Assam, Kokrajhar district, Ultapani,  $26^{\circ}49.21' \text{N}$ ,  $90^{\circ}17.43' \text{E}$ , Elev. 242 m, on the bark of *Aglaia spectabilis*, 02/04/2023, 2023–1546 (BUBH); Pungbili Islary.

#### Fissurinaceae

10. *Fissurina simplex* Sharma, Khadilkar & Makhija in Lichenologist 44(3):351. 2012 (Fig. 2f).

Thallus crustose, corticolous, greenish, glossy, verrucose, corticated. Ascomata apothecia, lirellate, 0.6–1.4 mm long, simple, straight, somewhat curved, immersed to slightly raised, concolorous with thallus, disc narrow, sunken, non-pruinose. Excipulum entire, non-carbonized, convergent, orange-brown, hymenium clear, colourless,  $122\text{--}145 \mu\text{m}$  high, I –, KI –, hypothecium indistinct, paraphyses

simple. Asci 1–4-spored, ascospores hyaline, muriform,  $70\text{--}75 \times 20\text{--}23 \mu\text{m}$ , I –. Chemistry: Thallus K + yellow, C –, P + pale yellow, UV –; TLC: Stictic acid.

*Distribution*: India (Karnataka, Kerala).

*Species examined*: INDIA– Assam, Kokrajhar district, Ultapani,  $26^{\circ}47.06' \text{N}$ ,  $90^{\circ}16.10' \text{E}$ , Elev. 181 m, on the bark of *Dillenia indica*, 28/11/2022, 2022–1467 (BUBH); Pungbili Islary.

11. *Fissurina subnitidula* (Nyl.) Staiger in Bibliotheca Lichenol. 85:153. 2002. *Graphis subnitidula* Nyl. in Tuckerman, Syn. Nor. Amer. Lich. 2:123. 1888. (Fig 2g).

Thallus crustose, corticolous, verrucose, slightly glossy, corticated. Ascomata apothecia, lirellate, 0.5–1.0 mm long, immersed to semi emergent, concolorous with thallus, disc narrow to broad, brown, non-pruinose. Excipulum entire, non-carbonized, brown, convergent, hymenium colourless, clear,  $55\text{--}70 \mu\text{m}$  high, I –, K –, hypothecium indistinct, paraphyses simple and branched at tips. Asci 8-spored, ascospores hyaline, transversely 3-septate,  $10\text{--}15 \times 5\text{--}7 \mu\text{m}$ , I –. Chemistry: Thallus K –, C –, P –, UV –; TLC: no substances detected.

*Distribution*: India (Karnataka), Colombia, Congo, Costa Rica, El Salvador, Hong Kong, Puerto Rico, USA.

*Species examined*: INDIA– Assam, Kokrajhar district, Ultapani,  $26^{\circ}41.926' \text{N}$ ,  $90^{\circ}18.834' \text{E}$ , Elev. 113 m, on the bark of *Elaeocarpus* sp., 08/01/2023, 2023–1469 (BUBH); Pungbili Islary.

#### Graphidaceae

12. *Diorygma roseopruinatum* Papong, Lücking & Parnmen in Phytotaxa 189(1):207. 2014. (Fig. 2e).

Thallus crustose, corticolous, whitish grey to dull grey, corticated. Ascomata lirellae, immersed to emergent, simple to branched, disc exposed, wide, covered by red-pruinose. Excipulum well developed, non-carbonized, hymenium clear and colourless, I + bluish-violet, paraphyses simple. Asci clavate to cylindrical, 1-spored, ascospores ellipsoid-oblong, hyaline, muriform,  $110\text{--}118 \times 34\text{--}40 \mu\text{m}$ . Chemistry: Thallus K + yellow turning red, C –, P + orange, UV –; TLC: Norstictic acid.

*Distribution:* India (Meghalaya), New Caledonia.

*Species examined:* INDIA– Assam, Kokrajhar district, Ultapani, 26°41.915' N, 90°18.823' E, Elev. 112 m, on the bark of *Elaeocarpus* sp., 08/01/2023, 2023–1578 (BUBH); Saralpara, 26°51.293' N, 90°15.755' E, Elev. 283 m, on the bark of *Magnolia champaca*, 05/03/2023, 65086 (LWG), 2023–(BUBH); Pungbili Islary.

13. *Graphis copelandii* Vain. in Ann. Acad. Sci. Fenn. ser. A, 15(6):207. 1921 (Fig. 2h).

Thallus crustose, corticolous, greenish yellow to yellowish grey, corticated. Ascomata apothecia, lirellate, immersed to erumpent, with lateral thalline margin, elongate and irregularly branched (*deserpens*-morph), disc exposed, non-pruinose. Labia entire, excipulum laterally carbonized, hymenium clear. Asci 2-spored, ascospores hyaline, muriform, 47–55 × 21–24 µm. Chemistry: Thallus K + yellow turning red, C –, P + yellow, UV – or whitish; TLC: Norstictic acid.

*Distribution:* India (Karnataka), Brazil, Philippines.

*Species examined:* INDIA– Assam, Kokrajhar district, Ultapani, 26°46.508' N, 90°14.286' E, Elev. 204 m, on the bark of *Ficus* sp. in forest 02/04/2022, 2022–0522 (BUBH); coll. Pungbili Islary.

14. *Graphis fulvescens* M. Nakan., Kashiw. & K.H. Moon, J. Jap. Bot. 90(4): 228 (2015) (Fig. 3a).

Thallus crustose, corticolous, greyish white, corticated. Photobiont layer and medulla with dense crystals. Ascomata apothecia, lirellate, 1–6 mm long, immersed, simple to branched, disc exposed. Excipulum entire, brown, hymenium clear. Asci 8-spored, ascospores hyaline, transversely 10–12-septate, 31–45 × 8–10 µm. Chemistry: Thallus K + yellow turning red, C –, P + yellow, UV –; TLC: Norstictic and Protocetraric acid.

*Distribution:* India (Karnataka).

*Species examined:* INDIA– Assam, Kokrajhar district, Ultapani, 26°46.59' N, 90°16.33' E, Elev. 169 m, on the bark of *Stereospermum chelonoides*, 28/11/2022, 2022–1004 (BUBH); Pungbili Islary.

15. *Hemithecium amboliense* Makhija & Dube in Mycotaxon 93:367. 2005 (Fig. 3b).

Thallus crustose, corticolous, green to whitish grey,

glossy, corticated. Photobiont layer and medulla with dense crystals. Ascomata apothecia, lirellate, 4–12 mm long, semi-emergent to distinctly emergent, sparsely branched, disc exposed. Excipulum dark blackish brown to slightly carbonized at the tips, 3–4 striate, hymenium clear, paraphyses simple. Asci 8-spored, ascospores hyaline, transversely 13–18-septate, 82–109 × 8–13 µm. Chemistry: Thallus K + yellow turning red, C –, P + yellow, UV –; TLC: Norstictic and stictic acid.

*Distribution:* India (Arunachal Pradesh, Maharashtra).

*Species examined:* INDIA– Assam, Kokrajhar district, Ultapani, 26°43.183' N, 90°17.535' E, Elev. 127 m, on the bark of *Magnolia hodgsonii*, 08/01/2023, 2023–1407 (BUBH); Pungbili Islary.

16. *Leiorreuma exaltatum* (Mont. & Bosch) Staiger in Biblthca. Lichenol. 85:298. 2002. *Lecanactis exaltata* Mont. & Bosch in Montagne, Syll. Gen. Spec. Plant. Crypt. 351. 1856 (Fig. 3d).

Thallus crustose, corticolous, olive green to grey green, hard, verrucose. Ascomata apothecia, lirellate, numerous, sessile, mostly scattered, scarcely aggregate, simple to infrequently branched, 2–4 × 1–2 mm, disc exposed, black, covered with white-pruinose. Excipulum carbonized, hymenium colourless, interspersed with oil droplets, epihymenium distinct, brown, subhymenium indistinct. Asci clavate, 8-spored, I –, ascospores hyaline, fusiform with round to subacute ends, transversely 8–10-septate, 30–42 × 6–8 µm, I –. Chemistry: Thallus K –, C –, P –, UV –; TLC: no substances detected.

*Distribution:* India (Andaman & Nicobar Islands, Arunachal Pradesh, Manipur, Nagaland, Odisha, West Bengal), Australia, Brazil, Chile, Chinese Taipei, Costa Rica, Dominica, Fiji, Hawaii, Indonesia, Japan, Jawa, Malaysia, Mexico, New Zealand, Papua New Guinea, Philippines, Solomon Islands, Thailand, Vanuatu.

*Species examined:* INDIA– Assam, Kokrajhar district, Ultapani, 26°46.232' N, 90°14.179' E, Elev. 183 m, on the bark of *Ficus* sp., 02/04/2022, 2022–1623 (BUBH), Pungbili Islary.

## Lecanoraceae

17. *Polyozosia sambuci* (Pers.) S.Y. Kondr., Kokos Farkas, Acta bot. hung. 61(1-2):157. 2019 (Fig. 5h).

Thallus crustose, corticolous, olive grey, smooth, corticated. Ascomata apothecia, sessile, lecanorine, 0.2–0.7 mm diam., disc non-pruinose, dark brown. Amphithecium lacking crystals, hypothecium colourless to pale yellowish. Asci > 8-spored, ascospores hyaline, simple,  $10\text{--}12 \times 6\text{--}8 \mu\text{m}$ . Chemistry: Thallus K + pale yellow, C –, P + olive yellow, UV –; TLC: no substances detected.

*Distribution:* India (Manipur, Uttarakhand), Canada, Czechia, Estonia, France, Germany, Netherlands, Northern Ireland, Russian Federation, *Sambucus nigra*, Spain, Sweden, Switzerland.

*Species examined:* INDIA– Assam, Kokrajhar district, Ultapani,  $26^{\circ}47.697' \text{ N}$ ,  $90^{\circ}17.809' \text{ E}$ , Elev. 191 m, on the bark of *Tetrameles nudiflora*, 02/04/2023, 2023–1548 (BUBH); Pungbili Islary.

### Lopadiaceae

18. *Lopadium coorgianum* Patw. & Makhija in Ind. J. Bot. 4(1):22. 1981 (Fig. 3h).

Thallus crustose, corticolous, greyish green to yellowish, smooth. Ascomata apothecia, solitary, 0.4–1.0 mm diam., disc plane, convex, black, sometimes aggregated. Excipulum black, hymenium hyaline, 100–150  $\mu\text{m}$  in height, hypothecium pale brown, epithecium thick. Asci cylindrical to clavate, 8-spored,  $120\text{--}136 \times 28\text{--}33 \mu\text{m}$ , ascospores hyaline, ellipsoid, muriform, with 8–10-transverse septa, and 1–2- vertical septa,  $48\text{--}50 \times 16\text{--}19 \mu\text{m}$ . Chemistry: Thallus K + orange turning red, C –, P –, UV –; TLC: no substances detected.

*Distribution:* India (Karnataka).

*Species examined:* INDIA– Assam, Kokrajhar district, Ultapani,  $26^{\circ}46.262' \text{ N}$ ,  $90^{\circ}15.293' \text{ E}$ , Elev. 178 m, on the bark of *Ficus* sp., 02/04/2022, 2022–0526 (BUBH); Pungbili Islary.

### Leprocaulaceae

19. *Lepraria arbuscula* (Nyl.) Lendemer & B.P. Hodk., Mycologia 105(4):1005. 2013 (Fig. 3e).

Thallus fruticose, corticolous, grey, primary thallus not seen, pseudopodetia attached by rooting base, upwards dendroid branched, branches dorsiventral or flattened in one plane, fragile, soft, greyish white

to yellow brown, phyllocladial granules on ultimate branchlets, often dissolute into powdery particles. Pseudopodetia anatomically differentiated into central axis of longitudinally compact hyphae. An outer mantle composed of loose intricate hyphae. Photobiont on pseudopodetium surface or in powder granules encased by hyphae. Chemistry: Thallus K –, C –, P + red, UV –; TLC: Atranorin and protocetraric acid.

*Distribution:* India (Himachal Pradesh, Meghalaya, Sikkim, Uttarakhand, West Bengal), Australia, Bhutan, Bolivia, Brazil, China, Colombia, Costa Rica, Cuba, Ecuador, El Salvador, Indonesia, Japan, Kenya, Korea, Nepal, New Zealand, Papua New Guinea, Solomon Islands, Thailand, Vietnam, Venezuela.

*Species examined:* INDIA– Assam, Kokrajhar district, Ultapani,  $26^{\circ}47.228' \text{ N}$ ,  $90^{\circ}17.193' \text{ E}$ , Elev. 183 m, on the bark of *Syzygium formosum*, 04/06/2023, 65098 (LWG), 2023–1587 (BUBH); Pungbili Islary.

20. *Leprocaulon adhaerens* (Knudsen, Elix & Lendemer) Lendemer & Hodk. in Mycologia 105 (4):1007. 2013. *Lepraria adhaerens* Knudsen, Elix & Lendemer in Opusc. Philolich. 4:5. 2007 (Fig. 3f).

Thallus fruticose, corticolous, grey, granular, margin diffuse, without lobes and medulla, soredia abundant fine to medium 40–100  $\mu\text{m}$  diam. and clumped together, older thallus forming a lower necral layer of gelatinized granules, projecting hyphae absent but frequently with thin colourless hyphae acting as anchors or rhizines. Chemistry: Thallus K –, C –, KC –, P + orange, UV –; TLC: Atranorin, pannarin, zeorin.

*Distribution:* India (Himachal Pradesh, Kerala, Madhya Pradesh, Rajasthan, Uttarakhand), Canada, Peru, USA.

*Species examined:* INDIA– Assam, Kokrajhar district, Ultapani,  $26^{\circ}46.180' \text{ N}$ ,  $90^{\circ}18.245' \text{ E}$ , Elev. 168 m, on the bark of *Ilex odorata*, 25/12/2020, 65097 (LWG), 2020–1595 (BUBH); Pungbili Islary.

### Malmideaceae

21. *Malmidea duplomarginata* (Papong & Kalb) Kalb & Papong in Bibliotheca Lichenol. 106:165. 2011. *Malcolmiella duplomarginata* Papong & Kalb. in Mycotaxon 110:116. 2009 (Fig. 4a).

Thallus crustose, corticolous, green, corticated. Ascomata apothecia, round, with continuous thalline excipulum, disc dark brown-black, margin with medullary layer throughout. Medulla of verrucae lemon yellow, K + orange yellow. Excipulum with greyish granules, epihymenium indistinct, hymenium colourless to pale, hypothecium dark brown. Asci 8-spored, ascospores hyaline, simple, thick wall,  $20\text{--}24 \times 10\text{--}14\text{ }\mu\text{m}$ . Chemistry: Thallus K + yellow, C –, P + orange, UV –; TLC: Atranorin.

*Distribution:* India (Andaman & Nicobar Islands, Goa), Colombia, Sri Lanka, Thailand.

*Species examined:* INDIA– Assam, Kokrajhar district, Saralpara, N26°50.054', E90°15.73', Elev. 237 m, on the bark of *Magnolia champaca*, 05/03/2023, 65102 (LWG); Pungbili Islary.

22. *Malmidea leptoloma* (Müll. Arg.) Kalb & Lücking in *Biblthca. Lichenol.* 106:165. 2011. *Lecidea leptoloma* Müll. Arg. in *Flora* 64(32):518. 1881. Fig. 4b).

Thallus crustose, corticolous, greenish grey, rugulose, ecorticated, without isidia and soredia. Ascomata apothecia, round, without thalline excipulum, disc beige, margin thin, yellowish brown to apically blackish, lacking medullary layer. Medulla of thallus colourless, K + pale yellow. Excipulum colourless to pale, K + greyish granules, epihymenium pale to colourless, hymenium colourless, hypothecium pale. Asci 8-spored, ascospores hyaline, simple, thick wall,  $9\text{--}13 \times 5\text{--}7\text{ }\mu\text{m}$ . Chemistry: Thallus K –, C –, P –, UV –; TLC: no substances detected.

*Distribution:* India (Andaman & Nicobar Islands), Australia, Brazil, Colombia, El Salvador, French Guiana, Guyana, Mexico, Singapore, Solomon Islands, USA.

*Species examined:* INDIA– Assam, Kokrajhar district, Ultapani, 26°46'04.64" N, 90°17'33.67" E, Elev. 213 m, on the bark of *Semecarpus anacardium*, 13/12/2019, 65107 (LWG); Pungbili Islary.

### Physciaceae

23. *Heterodermia comosa* (Eschw.) Follmann & Redón in *Willdenowia* 6(3):446. 1972. *Parmelia comosa* Eschw. in *Martius et al.*, *Icon. Plant. Crypt.* 2:25 (Fig. 3c).

Thallus foliose, corticolous, to 6 cm across, lobes suberect, spatulate, to 4–6 mm wide at apices, heteromorous, corticated only on upper side, upper side whitish grey, with dense concolorous cilia, lower side ochraceous, veined. Medulla white, K + yellow, C –, P –. Apothecia not seen. Chemistry: Thallus K + yellow, C –, P + orange, UV –; TLC: Atranorin and zeorin.

*Distribution:* India (Karnataka, Kerala, Manipur, Mizoram, Nagaland, Sikkim, Tamil Nadu, Uttarakhand, West Bengal), Africa, Argentina, Australia, Bhutan, Bolivia, Chinese Taipei, Mexico, Nepal, Papua New Guinea, Paraguay, Sri Lanka, Thailand, USA.

*Species examined:* INDIA– Assam, Kokrajhar district, Saralpara, 26°49.941' N, 90°15.568' E, Elev. 240 m, on the bark of *Magnolia champaca*, 05/03/2023, 2023–1509 (BUBH); Pungbili Islary.

24. *Physcia stellaris* (Linn.) Nyl. in *Bot. Notiser* (10-11):155. 1853. *Lichen stellaris* Linn., *Sp. Plant.* 2:1144.1 753 (Fig. 5a).

Thallus foliose, corticolous, to 5 cm across, lobes upto 3 mm wide, heteromorous, corticated on both sides, without isidia and soredia, upper side grey, lacking maculae, lower side pale brown, with concolorous rhizines, lower cortex prosoplectenchymatous. Medulla white, K –. Ascomata apothecia, laminal, to 3 mm diam. Asci 8-spored, ascospores brown, 2-celled,  $16\text{--}22 \times 6\text{--}9\text{ }\mu\text{m}$ . Thallus K + yellow, C –, P –, UV –; TLC: no substances detected.

*Distribution:* India (Himachal Pradesh, Jammu & Kashmir, Karnataka, Uttarakhand), Africa, Europe, France, Japan, Nepal, New Zealand, Sri Lanka, Sweden, USA.

*Species examined:* INDIA– Assam, Kokrajhar district, Saralpara, 26°51.289' N, 90°15.755' E, Elev. 287 m, on the bark of *Elaeocarpus* sp., 05/03/2023, 2023–1500 (BUBH); Pungbili Islary.

### Pyrenulaceae

25. *Pyrenula punctella* (Nyl.) Trevis. *Conspec. Verruc.* 13. 1860. *Verrucaria punctella* Nyl., *Exp. Syn. Pyrenocarp.* 46. 1858 (Fig. 5c).

Thallus crustose, corticolous, olive green to yellowish green, corticated. Perithecia solitary, sometimes confluent,

This alconfluent, black, < 0.7 mm diam., ostiole apical, depressed. Peridium not spreading laterally and carbonized, hymenium clear, colourless, paraphyses simple. Asci 8-spored, ascospores brown, oval to ellipsoidal, without dark bands, transversely 3-septate, rounded lumina, end lumina not elongated and separated from the exospore wall from endospore thickening,  $35\text{--}42 \times 17\text{--}20 \mu\text{m}$ . Chemistry: Thallus K –, C –, P + light yellow, UV – or whitish reflecting; TLC: no substances detected.

*Distribution:* India (Arunachal Pradesh, Sikkim, West Bengal), Australia, Colombia, Mexico, Sri Lanka, USA.

*Species examined:* INDIA– Assam, Kokrajhar district, Ultapani,  $26^{\circ}46.00' \text{ N}$ ,  $90^{\circ}18.23' \text{ E}$ , Elev. 140 m, on the bark of *Magnolia champaca* in forest, 16/12/2022, 2022–1328 (BUBH); Labanyapur,  $26^{\circ}49.289' \text{ N}$ ,  $90^{\circ}17.895' \text{ E}$ , Elev. 210 m, on the bark of *Wrightia arborea* in forest, 29/01/2023, 2023–1468 (BUBH); coll. Pungbili Islary.

#### Ramalinaceae

26. *Phyllopsora gossypina* (Sw.) Kistenich, Timdal, Bendiksby & S. Ekman, *Taxon* 67(5):894. 2018. (Fig 4f).

Thallus squamulose, corticolous, greenish grey, spongy, adnate, subcrenate-imbricate, subplacodioid-effigurate. Hyphae rugulose, loosely intertwined, simple to irregularly branched, septate, embedded with gonidia. Ascomata apothecia, lecanorine, disc brown to black, plane to convex, 0.3–0.6 mm diam. Hymenium colourless, epithecium pale brown, hypothecium brown. Asci 8-spored, ascospores simple, ellipsoid to oblong,  $4\text{--}6 \times 2 \mu\text{m}$ . Chemistry: Thallus K + pale yellow, C –, P –, UV –; TLC: Atranorin.

*Distribution:* India (Andaman & Nicobar Islands, Kerala), Australia, Brazil, Colombia, Congo, Costa Rica, Cuba, France, French Guiana, Guyana, Jamaica, Japan, New Caledonia, Sri Lanka, Suriname, Papua New Guinea, USA, Venezuela.

*Species examined:* INDIA– Assam, Kokrajhar district, Ultapani,  $26^{\circ}45.894' \text{ N}$ ,  $90^{\circ}16.992' \text{ E}$ , Elev. 178 m, on the bark of *Syzygium formosum*, 16/10/2020, 2020–1611 (BUBH); Pungbili Islary.

27. *Phyllopsora manipurensis* (Müll. Arg.) Müll.

Arg. in Bull. Soc. Roy. Bot. 32(1):132. 1893. *Psora manipurensis* Müll. Arg. in J. Linn. Soc. 29:219. 1893 (Fig. 4g).

Thallus squamulose, corticolous, squamules yellowish to greenish, 0.1–0.3 mm wide, without isidiate and sorediate, prothallus white, hypothecium dark brown. Apothecia not seen. Chemistry: Thallus K –, C –, P –, UV –; TLC: Atranorin and triterpenes.

*Distribution:* India (Goa, Karnataka, Kerala, Maharashtra, Madhya Pradesh, Manipur, Meghalaya, Odisha, Sikkim, Uttarakhand).

*Species examined:* INDIA– Assam, Kokrajhar district, Saralpara,  $26^{\circ}50.982' \text{ N}$ ,  $90^{\circ}15.696' \text{ E}$ , Elev. 259 m, on the bark of *Magnolia champaca*, 14/03/2023, 65115 (LWG); Pungbili Islary.

#### Roccellaceae

28. *Dichosporidium boschianum* (Mont.) Thor in Op. Bot. 103:64. 1991. *Chiodecton boschianum* Mont., Syll. Gen. Sp. Plant. Crypt. 356. 1856 (Fig. 2d).

Thallus squamulose, corticolous, grey with yellowish green tinge, byssoid. Prothallus whitish in inner part and brown in outer part. Medulla whitish thin or sometimes lacking, with few calcium oxalate granules. Ascomata pseudoangiocarpic apothecia, numerous, aggregated, into distinctly elevated stroma with distinctly constricted bases. Excipulum brown, hymenium I + pale blue turns red, hypothecium fusing with medulla, upper part black and lower part pale brown, paraphysoids branched. Asci  $85\text{--}97 \times 14\text{--}17 \mu\text{m}$ , ascospores hyaline, obovate, hooked, transversely 5–8-septate,  $60\text{--}65 \times 3\text{--}4 \mu\text{m}$ . Pycnidia few, conidia bacilliform,  $4\text{--}6 \times 1 \mu\text{m}$ . Chemistry: Thallus K –, C –, P + yellow, UV –; TLC: Salazinic acid.

*Distribution:* India (Andhra Pradesh, Karnataka, Kerala), Australia, Costa Rica, Cuba, Fiji, France, Guadeloupe, Guyana, Japan, Malaysia, New Caledonia, Panama, Papua New Guinea, Philippines, Puerto Rico, Singapore, Sri Lanka, Suriname, Thailand, USA, Vietnam, Western Samoa.

*Species examined:* INDIA– Assam, Kokrajhar district, Labanyapur,  $26^{\circ}47.912' \text{ N}$ ,  $90^{\circ}18.770' \text{ E}$ , Elev. 182 m, on the bark of *Citrus* sp., 10/11/2021, 2021–1601 (BUBH); Pungbili Islary.

### Thelotremataceae

29. *Thelotrema canarense* Patw. & Kulk. in Norw. J. Bot. 24:128. 1977 (Fig. 5f).

Thallus crustose, corticolous, thin, smooth, whitish grey, corticated. Photobiont layer and medulla with calcium oxalate crystals. Ascomata thelotremoid apothecia, solitary, opening broader, immersed, lepadinoid, with pruinose, 0.3–0.6 mm diam., disc 0.08–0.2 mm wide pore, margin entire, gap in between of double margin. Columella absent, excipulum colourless, hymenium clear, periphysoids present, paraphyses simple. Asci 8-spored, ascospores hyaline, muriform,  $22\text{--}28 \times 9\text{--}14 \mu\text{m}$ . Chemistry: Thallus K + yellow turning red, C –, P + olive yellow, UV –; TLC: constictic and norstictic acid.

*Distribution:* India (Karnataka, Kerala, Uttarakhand, West Bengal), France, Tanzania, Thailand.

*Species examined:* INDIA– Assam, Kokrajhar district, Ultapani,  $26^{\circ}47.13' \text{N}$ ,  $90^{\circ}16.11' \text{E}$ , Elev. 171 m, on the bark of *Tetrameles nudiflora*, 28/11/2022, 2022–1002 (BUBH); Pungbili Islary.

### Trypetheliaceae

30. *Astrothelium cinereorosellum* (Kremp.) Aptroot & Lücking in Lichenologist 48(6):853. 2016. *Trypethelium cinereorosellum* Kremp. in Nuo. Gior. Bot. ital. 7 (1):56. 1875 (Fig. 2c).

Thallus crustose, corticolous, olive green, without pigment, smooth to uneven, corticated. Ascomata perithecia, covered by thallus except ostiole, solitary to irregularly confluent, erumpent, not distinctly pseudostromatic, 0.3–0.5 mm diam., lichexanthone on perithecia, ostiole apical. Peridium black, hamathecium inspersed, paraphyses branched. Asci 8-spored, ascospores hyaline, fusiform, transversely 5–8-septate,  $40\text{--}60 \times 8\text{--}13 \mu\text{m}$ , IKI –. Chemistry: Thallus K –, C –, P + orange yellow, UV + yellow; TLC: unknown substances present.

*Distribution:* India (Andaman & Nicobar Islands, Kerala, Tamil Nadu), Australia, Borneo, Indonesia, Papua New Guinea, Sarawak, Thailand.

*Species examined:* INDIA– Assam, Kokrajhar district, Ultapani,  $26^{\circ}43.46' \text{N}$ ,  $90^{\circ}17.40' \text{E}$ , Elev. 237 m, on the bark of *Trema orientale*, 02/04/2023, 2023–1581 (BUBH); Pungbili Islary.

### Discussion

After the checklist provided by Gogoi *et al.*, 2022, the Assam's lichen biota have increased upto 725 species with the current record of 30 species. UFR itself represents a total of 10 new records of lichen species for India and 49 species for Assam (Islary *et al.*, 2021a, 2021b, 2021c, Behera *et al.*, 2024). Published records of lichenized fungi confirm the richness of lichen in the study area, where the mangrove-like-forest provides a favorable environment for their growth. However, the Ultapani Forest Range, is being seriously affected by various human activities. These threats have being observed since 2009, with significant issues, including deforestation, illegal tree felling, fishing, poaching, grazing, clearing, burning and encroachment. If these activities continue, the entire forest could deteriorate significantly, leading to ecological imbalance. Lichens, as a vital part of the ecosystem, are also negatively impacted, as habitat loss is major threats to their diversity. These findings call for conservation measures and more exploration of Assam's remote unexplored areas for lichenology.

### Conclusion

This study confirms 29 lichenized fungi as new additions to Assam and one, *Phyllopsora pyxinoides* as a new record to India. These discoveries significantly enhance the regions known lichen diversity, bringing the total number of species under the genus *Phyllopsora* to 20. These findings reveal the rich yet largely untapped lichen flora of Assam, underscoring the importance of continued field surveys and taxonomic research in Northeast Indian bio-diversity hotspot. The new records also highlights the urgent need for conservation efforts amid ongoing habitat changes.

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