

**Three new corticolous species and two new records of *Rinodina* (Physciaceae, Ascomycota) from subtropical and tropical Australia**

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Three new corticolous species and two new records of *Rinodina*  
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*Australasian Lichenology* **87** (July 2020), 73–81

**Abstract**

The corticolous *Rinodina gerhardii* H.Mayrhofer & Elix and *R. heronensis* H.Mayrhofer & Elix from Queensland and *R. klauskalbii* H.Mayrhofer & Elix from New South Wales are described as new to science. In addition, *Rinodina galapagoensis* Giralto & Bungartz and *R. maculans* (Kremp.) Müll.Arg. are reported for the first time from Australia. A revised key to the corticolous species of *Rinodina* in Australia is provided.

**Introduction**

The corticolous and lignicolous species of *Rinodina* (Ach.) S.F.Gray in temperate Australia were revised by Mayrhofer *et al.* (1999), who recorded nine taxa, and a tenth has been recorded subsequently (Elix 2008). Those include five endemic taxa, *R. asperata* (Shirley) Kantvilas, *R. austroleprosa* Elix, *R. confusa* H.Mayrhofer & Kantvilas, *R. elixii* H.Mayrhofer & Kantvilas and *R. obscura* Müll.Arg., as well as the widespread *R. conradii* Körb. and *R. pyrina* (Ach.) Arnold. Further species include the pantropical *R. connectens* Malmé and *R. dolichospora* Malmé, the southern-temperate *R. australiensis* Müll.Arg., now known from Australia, southern Africa (Mayrhofer & Wirth 2011; Mayrhofer *et al.* 2014) and New Zealand (Elix *et al.* 2020). In this paper, we describe three new corticolous species of *Rinodina* from tropical and subtropical Australia, and we report the occurrence of *R. galapagoensis* Giralto & Bungartz and *R. maculans* (Kremp.) Müll.Arg. from Queensland.

**Methods**

Observations and measurements of photobiont cells, thallus and apothecium anatomy, asci and ascospores were made on hand-cut sections mounted in water and 10% KOH (K). Asci were also observed in Lugol's Iodine (I), with and without pretreatment in K. Medullary sections were treated with 10% sulfuric acid (H<sub>2</sub>SO<sub>4</sub>) and apothecial sections with 50% nitric acid (N).

**New species**

**1. *Rinodina gerhardii*** H.Mayrhofer & Elix, sp. nov.

Figs 1, 2

Mycobank number: **MB834816**

Similar to *Rinodina asperata*, but differs in having biatorine to lecideine apothecia and smaller ascospores.

Type: Australia, Queensland, Cape Hillsborough National Park, Hidden Valley, 30 km N of Mackay, 20°55'S, 149°03'E, 10 m alt., on trees and shrubs at the edge of rainforest, *G. Rambold* 4682 *pr. p.*, 21.ii.1986 (M – holotype).

*Thallus* to 15 mm wide, crustose, continuous, rimose, to 0.1 mm thick; upper surface matt, smooth, grey-brown; prothallus marginal, dark grey or black; medulla white, lacking calcium oxalate (H<sub>2</sub>SO<sub>4</sub>-), I-; photobiont cells 8–12 µm diam. *Apothecia* 0.1–0.4 mm wide, scattered or crowded, biatorine to lecideine, erumpent, then broadly adnate or sessile; disc dark brown to black, epruinose, weakly concave to plane or convex; thalline exciple apparent in only

juvenile apothecia, soon excluded in mature and older apothecia, concolorous with the thallus; proper excipulum black, persistent, in section 30–55 µm thick, outer zone deep red-brown, K–, N–, inner zone pale brown. *Ephymenium* 10–15 µm thick, red-brown, K–, N–. *Hypothecium* 30–40 µm thick, colourless to pale yellow, K–, N–. *Hymenium* 90–120 µm thick, colourless, not interspersed; paraphyses 1.5–2.5 µm wide, simple to branched, capitate, with apices 3.5–5 µm wide and brown caps. *Asci* of the *Lecanora*-type, 8-spored. *Ascospores* with internal wall thickenings of *Pachysporaria*-type II, 1-septate, brown, broadly ellipsoid, 11–[13.1]–16 × 6–[7.2]–8 µm, not constricted at the septum; ontogeny of type-A; torus broad, distinct; outer spore-wall smooth to finely ornamented. *Pycnidia* immersed, dark brown; conidia bacilliform, 3.5–5.5 × 1 µm.

*Chemistry*: Thallus K–, C–, P–, UV–; no lichen substances detected by TLC.

*Etymology*: The species is named after Prof. Dr Gerhard Rambold, the collector of the type.

### Remarks

The new species is characterized by the thin, grey-brown, rimose thallus, the lecideine apothecia, the relatively small, persistently *Pachysporaria*-type II ascospores, 11–16 × 6–8 µm, and by the absence of lichen substances. The common Australian species *R. asperata* has persistently *Pachysporaria*-type II ascospores, but its spores are larger, 15–25 × 7–12 µm. *Rinodina asperata* also differs in having persistently lecanorine apothecia with a prominent thalline margin (Mayrhofer *et al.* 1999).

*Rinodina ficta* (Stizenb.) Zahlbr. also has small *Pachysporaria*-type II ascospores, but they differ in having type-B ontogeny. In addition, *R. ficta* has lecanorine apothecia with a persistent thalline margin, a thin, colourless proper excipulum, 5–20 µm wide, and a thinner hymenium to 80 µm high (Giralt & Mayrhofer 1991; Giralt 2001, as *R. boleana*).

At present, the new species is known only from the type collection.

### 1. *Rinodina heronensis* H. Mayrhofer & Elix, sp. nov.

Figs 3, 4

Mycobank number: **MB834817**

Similar to *Rinodina confusa* H. Mayrhofer & Kantvilas, but differs in having smaller, *Physcia*- to *Mischoblastia*-type ascospores.

Type: Australia, Queensland, Heron Island [23°26'32"S, 151°54'53"E], on branch of *Pisonia grandis*, *G. Hand*, v.1965 (COLO 235573 – holotype; MEL – isotype, not seen).

*Thallus* to 30 mm wide, crustose, rimose to verrucose-areolate or areolate; individual areoles 0.1–0.5 mm wide, to 0.2 mm thick; upper surface matt, uneven, esorediate, pale grey-brown; prothallus not apparent; medulla white, lacking calcium oxalate (H<sub>2</sub>SO<sub>4</sub>-), I–; photobiont cells 8–20 µm diam. *Apothecia* 0.1–0.4 mm wide, scattered or crowded, lecanorine, broadly adnate to sessile and basally constricted; disc pale brown to dark brown, epruinose, plane to convex; thalline exciple thick and raised above the disc at first, ± dentate, becoming thinner and reduced in older apothecia, concolorous with the thallus; proper excipulum brown to pale brown, persistent, thick, in section 20–30 µm thick, outer zone brown, K–, N–, inner zone colourless. *Ephymenium* 8–12 µm thick, brown, K–, N–. *Hypothecium* 25–35 µm thick, colourless, K–, N–. *Hymenium* 40–60 µm thick, colourless, not interspersed; paraphyses 1.5–2 µm wide, simple to branched, capitate, with apices 3–4 µm wide and pale brown caps. *Asci* of the *Lecanora*-type, 8-spored. *Ascospores* with internal wall thickenings transitioning from *Mischoblastia*- to *Physcia*-types at different stages of development (*Teichophila*-type), 1-septate, brown, broadly ellipsoid, 11–[13.3]–17 × 5–[6.0]–7 µm, not constricted at the septum; ontogeny of type-A; torus indistinct; outer spore-wall finely ornamented. *Pycnidia* not seen.

*Chemistry*: Thallus K–, C–, P–, UV–; no lichen substances detected by TLC.

*Etymology*: The species is named after the type locality.

### Remarks

In many respects, the new species closely resembles *R. confusa*, which is widespread in temperate southern Australia (Mayrhofer *et al.* 1999). Both have broadly adnate to sessile, lecanorine apothecia and *Teichophila*-type ascospores where the spore lumina transition from *Physcia*-, *Mischoblastia*-, *Milvina*- or *Pachysporaria*-types at different stages of development. However, the spore lumina of *R. confusa* and *R. heronensis* differ significantly, those of *R. heronensis* transitioning from *Mischoblastia*- to mainly *Physcia*-type, whereas those of *R. confusa* transition from *Physcia*-, rarely *Mischoblastia*- to mainly *Pachysporaria*-types. In addition, the ascospores of *R. confusa* are consistently larger, 14–[17.5]–23 × 6–[8.7]–13 µm.

The new species is known only from Heron Island, a coral cay located near the Tropic of Capricorn in the southern Great Barrier Reef, 80 km NE of Gladstone, Queensland. Associated lichens include a species of *Bacidia* and *Caloplaca subpyracea* (Nyl.) Zahlbr.

### 3. *Rinodina klauskalbii* H. Mayrhofer & Elix, sp. nov.

Figs 5, 6

Mycobank number: **MB834818**

Similar to *Rinodina asperata*, but differs in having a squamulose to subsquamulose thallus and somewhat smaller ascospores that develop with type-B ontogeny.

Type: Australia, New South Wales, Patonga, E side of Patonga Creek, 33°33'S, 151°16'E, 1–2 m alt., on *Avicennia marina* in strand and mangrove vegetation, *K. Kalb 26206, A. Kalb, A. & P. Archer*, 10.viii.1992 (GZU – holotype).

*Thallus* to 15 mm wide, squamulose to subsquamulose, continuous, rimose, to 0.1 mm thick; upper surface matt, smooth, grey-brown; prothallus marginal, dark grey or black; medulla white, lacking calcium oxalate (H<sub>2</sub>SO<sub>4</sub>-), I–; photobiont cells 8–12 µm diam. *Apothecia* 0.1–0.4 mm wide, scattered or crowded, lecanorine, erumpent then broadly adnate or sessile; disc dark brown to black, epruinose, weakly concave to plane or convex; thalline exciple thick, well-developed, ± subsquamulose, concolorous with the thallus; proper excipulum black, persistent, in section 30–55 µm thick, outer zone deep red-brown, K–, N–, inner zone pale brown. *Ephymenium* 10–15 µm thick, red-brown, K–, N–. *Hypothecium* 30–40 µm thick, colourless to pale yellow, K–, N–. *Hymenium* 90–120 µm thick, colourless, not interspersed; paraphyses 1.5–2.5 µm wide, simple to branched, capitate, with apices 3.5–5 µm wide and brown caps. *Asci* of the *Lecanora*-type, 8-spored. *Ascospores* with internal wall thickenings of *Pachysporaria*-type II, 1-septate, brown, broadly ellipsoid, 11–[13.1]–16 × 6–[7.2]–8 µm, not constricted at the septum; ontogeny mainly of type-B; torus broad, distinct; outer spore-wall smooth to finely ornamented. *Pycnidia* immersed, dark brown; conidia bacilliform, 3.5–5.5 × 1 µm.

*Chemistry*: Thallus K–, C–, P–, UV–; no lichen substances detected by TLC.

*Etymology*: The species is named after the collector of the type specimen, Dr Klaus Kalb.

### Remarks

The new species is characterized by its squamulose to subsquamulose, grey-brown, rimose thallus, lecanorine apothecia, persistently *Pachysporaria*-type II ascospores, 11–16 × 6–8 µm, which develop with type-B ontogeny, and the absence of lichen substances. The common Australian species *R. asperata* has persistently *Pachysporaria*-type II ascospores, but its spores are larger, 15–22 × 7–12 µm, and they develop with type-A ontogeny (Mayrhofer *et al.* 1999). *Rinodina klauskalbii* and *R. ficta* have similar-sized, *Pachysporaria*-type II ascospores with type-B ontogeny, but *R. ficta* has a discontinuous, crustose, very thin to effuse granulose thallus with a narrower, colourless proper excipulum, 5–20 µm wide, and a thinner hymenium to 80 µm high (Giralt & Mayrhofer 1991, as *R. boleana*).

At present the new species is known from two localities in eastern New South Wales. Associated species occurring on mangroves at the type locality include *Caloplaca pulcherrima*

(Müll.Arg.) S.Y.Kondr. & Kärnefelt, *Chrysothrix xanthina* (Vain.) Kalb, *Dirinaria applanata* (Fée) D.D.Awasthi, *Lecanographa microcarpella* (Müll.Arg.) Egea & Torrente, *Pannaria elixii* P.M.Jørg. & D.J.Galloway, *Austroparmelina conlabrosa* (Hale) A.Crespo, Divakar & Elix, *Parmotrema crinitum* (Ach.) M.Choisy, *P. reticulatum* (Taylor) M.Choisy, *P. tinctorum* (Nyl.) Hale and *Relicina sydneyensis* (Gyeln.) Hale.

#### ADDITIONAL SPECIMEN EXAMINED

New South Wales. ● Southern Tablelands, Jembaicumbene Creek, Araluen–Braidwood road, 35°32'S, 149°47'E, on twigs, *W.H. Ewers 4061*, 3.ix.1989 (CANB).

#### New records

**Rinodina galapagoensis** Giralt & Bungartz, *Bryologist* **119**, 67 (2016)

Type: Ecuador, Galapagos Islands, Santa Fé Island, near the beach and the ravine on the north coast of the island, 0°48'12.8"S, 90°02'35.2"W, 26 m alt., on bark of *Bursera graveolens* in dry area of open forest with shrubs and *Bursera graveolens* and *Opuntia echios* var. *barringtonensis* the dominant trees, *F. Nagra 486*, 25.x.2007. (holotype – CDS).

This species was previously known only from the Galapagos Islands (Bungartz *et al.* 2016). It is characterized by its brownish beige to olivaceous brown, rimose to areolate, distinctly squamulose thallus when well developed, usually containing the yellow pigment skyrin (often patchy, but present in the lower medulla or below the apothecia in the Australian specimen), and narrowly ellipsoid, *Pachysporaria*-type II ascospores, 14–[18.2]–22 × 7–[8.6]–11 µm, with elongated, lacrimiform lumina when young, wrinkled walls when old and mainly type-B ontogeny. A detailed description and illustrations are provided in Bungartz *et al.* (2016).

#### AUSTRALIAN SPECIMEN EXAMINED

Queensland. ● Approach to the Bunya Mountains, c. 12 km NNE of Mt Mowbull, 26°50'S, 151°38'E, 680 m alt., on bark, *K. Kalb 18977 pr. p. & R. Rogers*, 14.viii.1988 (herb. Kalb).

**Rinodina maculans** (Kremp.) Müll.Arg., *Flora* **72**, 66 (1889)

Type: Argentina, *Lorentz s.n.*, 1892 (holotype – G, not seen).

This corticolous species is widely distributed in eastern North America, Central and South America (Sheard 2010). It is characterized by a thin, pale grey to dark greenish grey, rimose to rimose-areolate, crustose thallus and narrowly ellipsoid *Pachyspora*-type II ascospores, 12–[17.5]–23 × 6–[8.1]–10 µm, which show type-B ontogeny. A detailed description and illustrations are provided by Sheard (2010).

#### SPECIMENS EXAMINED

Queensland. ● Cairns, 5 km N of city near the airport, 16°54'S, 145°45'E, 0 m alt., on *Rhizophora* in mangrove forest, *A. & M. Aptroot 22184*, iii.1988 (herb. Aptroot); ● Green Island, E of Cairns, 16°46'S, 145°58'E, on coastal trees, *H. Mayrhofer 11414 & E. Hierzer*, 5.viii.1993 (GZU); ● Cape Hillsborough National Park, Hidden Valley, 30 km N of Mackay, 20°55'S, 149°03'E, 10 m alt., on trees and shrubs at the edge of rainforest, *G. Rambold 4682 pr. p.*, 21.ii.1986 (M).

Jamaica. ● Saint Elizabeth, between Crawford and Sandy Ground, 4 km NW of Black River, 18°03'N, 77°52'W, on roadside tree, *K. & A. Kalb 36400*, 15.iv.1992 (CANB - W. Obermayer, *Dupla Graecensis Lichenum* no. 554 [2007]).

U.S.A. ● New Jersey, Peaslee Wildlife Management Area, 1.5 miles N of jct NJ 49 and CR 671 (Union Rd), W of CR 671 (Union Rd), S of powerline cut, 5 miles E of Millville, Vineland Township, 39°23'30"N, 74°56'30"W, on *Quercus* branches in open *Quercus-Pinus rigida* barrens with sandy openings, *J.C. Lendemer 15124*, 2.ii.2009 (CANB - *Lichens of Eastern North America Exsiccata*, Fasc. VII, no. 346 [2009]).

**Key to the corticolous and lignicolous species of *Rinodina* in Australia** [for illustrations of spore types and ontogeny, see Mayrhofer *et al.* 1999 and Sheard 2010].

- |     |   |                         |
|-----|---|-------------------------|
| 1   | Ascospores 4-celled.....  | 2                       |
| 1:  | Ascospores 2-celled.....  | 3                       |
| 2   | Ascospores with type-B ontogeny; immature 2-celled ascospores with subcircular lumina [ <i>Physcia</i> -type].....  | <b>R. conradii</b>      |
| 2:  | Ascospores with type-A ontogeny; immature 2-celled ascospores with bone-shaped lumina .....   | <b>R. connectens</b>    |
| 3   | Most ascospores longer than 22 µm.....  | 4                       |
| 3:  | Most ascospores shorter than 22 µm.....   | 6                       |
| 4   | Ascospores <i>Pachysporaria</i> -type I; usually with minute granular or droplet-like inclusions.....   | <b>R. dolichospora</b>  |
| 4:  | Ascospores <i>Physcia</i> -type or <i>Mischoblastia</i> -, then <i>Pachysporaria</i> -type I; lacking minute granular or droplet-like inclusions .....                | 5                       |
| 5   | Ascospores <i>Physcia</i> -type; apothecia emerging from thalline warts.....  | <b>R. elixii</b>        |
| 5:  | Ascospores <i>Mischoblastia</i> - then <i>Pachysporaria</i> -type I; apothecia adnate to sessile from earliest stages.....  | <b>R. australiensis</b> |
| 6   | Ascospores <i>Physconia</i> -type; lacking apical thickenings when mature.....  | <b>R. pyrina</b>        |
| 6:  | Ascospores <i>Physcia</i> -, <i>Dirinaria</i> - <i>Mischoblastia</i> - or <i>Pachysporaria</i> -type II; with apical thickenings when mature.....                     | 7                       |
| 7   | Apothecia initially immersed, lecideine when mature.....  | 8                       |
| 7:  | Apothecia adnate to sessile from the beginning, distinctly lecanorine.....  | 9                       |
| 8   | Ascospores <i>Pachysporaria</i> -type II, 11–16 µm long.....  | <b>R. gerhardii</b>     |
| 8:  | Ascospores <i>Physcia</i> -type, 16–20 µm long .....  | <b>R. obscura</b>       |
| 9   | Ascospores persistently <i>Pachysporaria</i> -type II.....  | 10                      |
| 9:  | Ascospores otherwise .....  | 13                      |
| 10  | Hypothecium and subhypothecium yellow-orange, K+ blood-red ...  | <b>R. galapagoensis</b> |
| 10: | Hypothecium and subhypothecium colourless, K– .....   | 11                      |
| 11  | Thallus thick, squamulose to subsquamulose; ascospores dark brown; torus broad, distinct.....   | <b>R. klauskalbii</b>   |
| 11: | Thallus thin, crustose; ascospores pale brown; torus narrow, indistinct.....  | 12                      |
| 12  | Ascospore lumina rounded; ontogeny type-A; temperate .....  | <b>R. asperata</b>      |
| 12: | Ascospore lumina elongate; ontogeny type-B; tropical .....  | <b>R. maculans</b>      |
| 13  | Thallus sorediate; atranorin and zeorin present; ascospores persistently <i>Physcia</i> -type .....   | <b>R. austroleprosa</b> |
| 13: | Thallus esorediate; atranorin and zeorin absent; ascospores transitioning through <i>Mischoblastia</i> -, <i>Pachysporaria</i> -type II or <i>Physcia</i> -types..... | 14                      |
| 14  | Ascospores <i>Mischoblastia</i> - to mainly <i>Physcia</i> -type, 11–17 × 5–7 µm; tropical ....   | <b>R. heronensis</b>    |
| 14: | Ascospores <i>Physcia</i> -, <i>Mischoblastia</i> - then mainly <i>Pachysporaria</i> -type, 16–23 × 8–11 µm; temperate.....   | <b>R. confusa</b>       |

### Acknowledgements

H.M. acknowledges financial support from the Austrian Science Fund (FWF-projects P8500-BIO, P10514-BIO and P25237-B16). He is indebted to his wife Eleonore for her support during the field trip in 1993. We also thank Prof. Dr Gerhard Rambold, Dr Klaus Kalb and the curators of CANB and COLO for providing key specimens.

### References

- Bungartz, F; Giralt, M; Sheard, JW; Elix, JA (2016): The lichen genus *Rinodina* (Physciaceae, Teloschistales) in the Galapagos Islands, Ecuador. *Bryologist* **119**, 60–93.
- Elix, JA (2008): Four new lichens from tropical and subtropical Australia. *Australasian Lichenology* **62**, 35–40.
- Elix, JA; Edler, C; Mayrhofer, H (2020): Two new corticolous species of *Rinodina* (Physciaceae, Ascomycota) from New Zealand. *Australasian Lichenology* **86**, 95–101.
- Giralt, M (2001): The lichen genera *Rinodina* and *Rinodinella* (lichenized Ascomycetes, Physciaceae) in the Iberian Peninsula. *Bibliotheca Lichenologica* **79**, 1–160.
- Giralt, M; Mayrhofer, H (1991): *Rinodina boleana* spec. nova, a new lichen species from north-eastern Spain. *Mycotaxon* **40**, 435–439.
- Mayrhofer, H; Wirth, V (2011): *Rinodina australiensis* (lichenized Ascomycetes, Physciaceae) recorded from Africa. *Herzogia* **24**, 53–57.
- Mayrhofer, H; Kantvilas, G; Ropin, K (1999): The corticolous species of the lichen genus *Rinodina* (Physciaceae) in temperate Australia. *Muelleria* **12**, 169–194.
- Mayrhofer, H; Obermayer, W; Wetschnig, W (2014): Corticolous species of *Rinodina* (lichenized Ascomycetes, Physciaceae) in southern Africa. *Herzogia* **27**, 1–12.
- Sheard, JW (2010): *The Lichen Genus Rinodina* (Ach.) Gray (Lecanoromycetidae, Physciaceae) in North America, North of Mexico. NRC Research Press, Ottawa.

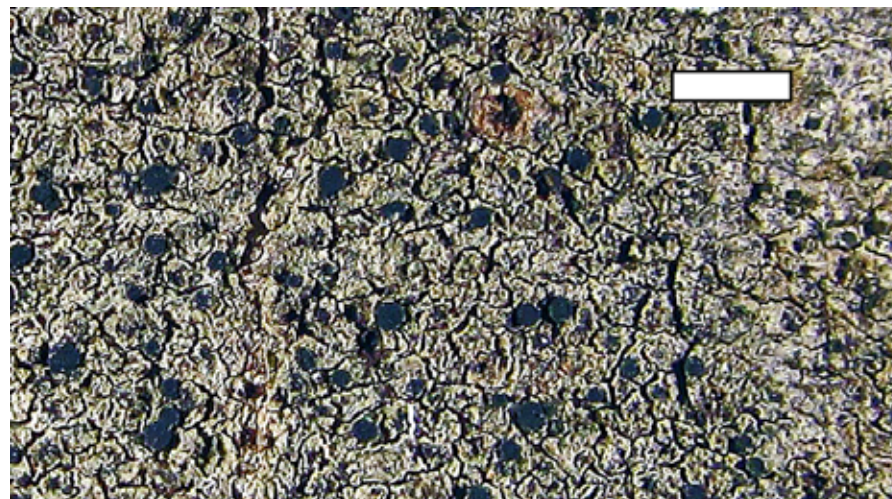


Figure 1. *Rinodina gerhardii* (holotype in M). Scale = 1 mm.

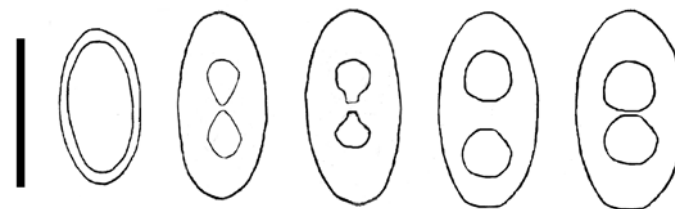


Figure 2. Ascospore ontogeny of *R. gerhardii*. Scale = 10  $\mu$ m.

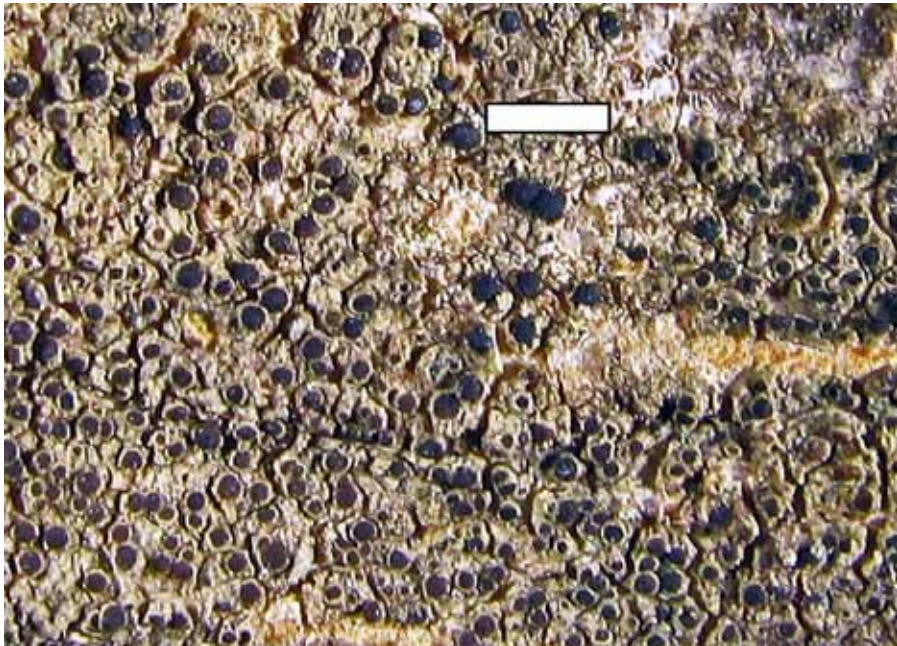


Figure 3. *Rinodina heronensis* (holotype in COLO). Scale = 2 mm.

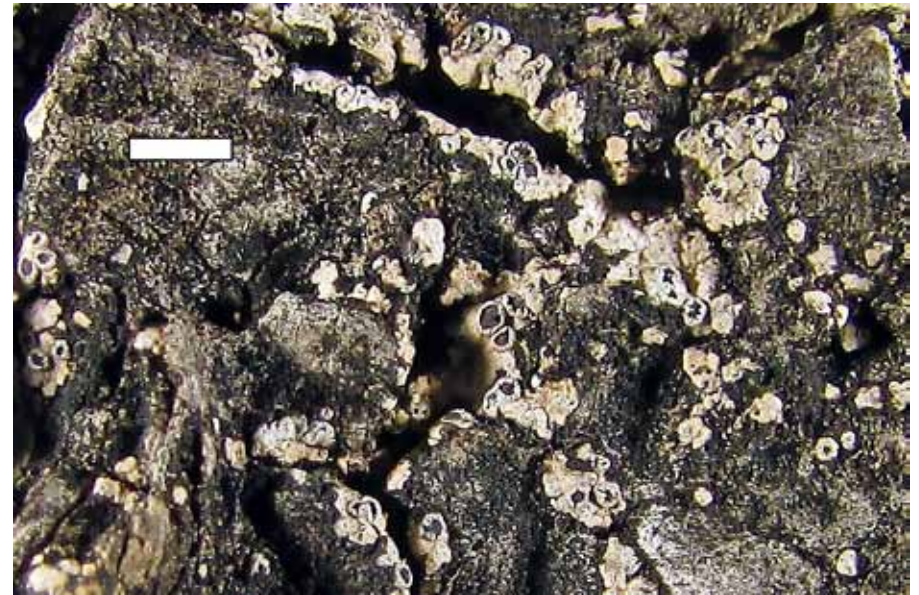


Figure 5. *Rinodina klauskalbii* (holotype in herb. KALB). Scale = 2 mm.

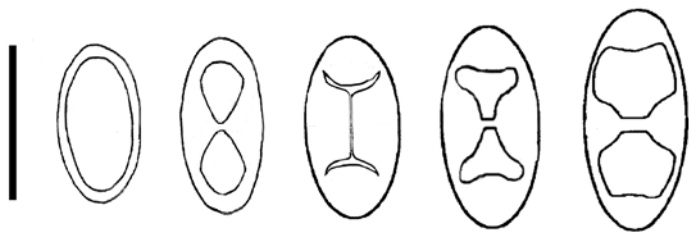


Figure 4. Ascospore ontogeny of *R. heronensis*. Scale = 10  $\mu$ m.

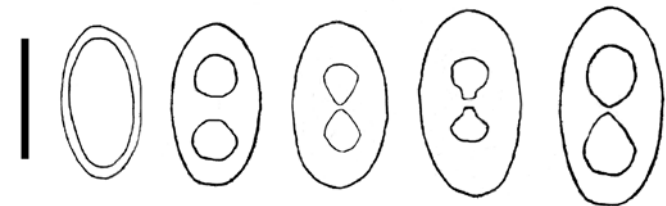


Figure 6. Ascospore ontogeny of *R. klauskalbii*. Scale = 10  $\mu$ m.