
The genus *Xenolecia* (*Lecideaceae* s. lat., *Lecanoromycetidae* inc. sed.), including a second species in the genus from Campbell Island, New Zealand

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Abstract: The new species *Xenolecia cataractarum* Fryday is described from Campbell Island. It differs from *X. spadicomma*, the only other species of the genus, in having much smaller apothecia and ascospores, an olivaceous pigmented epihymenium (brown in *X. spadicomma*), and a thallus with a non-amyloid medulla and norstictic acid (amyloid medulla and confluent acid in *X. spadicomma*). *Xenolecia spadicomma* is reported here from several localities on the Falkland Islands and three from the Región de Los Lagos, Chile, which are the first reports of this species since its description from Isla Wellington in the south-west of Patagonia in 1868. A full description of *X. spadicomma* is also provided.

Key words: Chile, Falkland Islands, lichen, *Porpidiaceae*, subantarctic islands

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Introduction

The genus *Xenolecia* was erected by Hertel (1984) for the single species *Lecidea spadicomma* Nyl. which, at that time, was known only from the type collection made by R.O. Cunningham from Isla Wellington (XII Región de Magallanes y de la Antártica, Chile) in 1868. Hertel (*op. cit.*) placed the genus in the *Porpidiaceae* Hertel & Hafellner (now included in *Lecideaceae* Chevall.) on account of its *Porpidia*-type asci and separated it from other genera in that family by a combination of innate, immarginate apothecia and filiform conidia (Hertel *op. cit.*, Fryday & Hertel 2014). *Xenolecia spadicomma* has not been reported since but investigation of the rich material from southern South America, collected by Henry Imshaug and co-workers in 1968–71 (Fryday & Prather 2001) and housed in the herbarium of Michigan State University

(MSC), revealed several collections of this species from the Falkland Islands (under the *in sched.* name “*Lecanora falklandica* Imsh.”). Subsequent fieldwork by the authors on the Falkland Islands and in northern Patagonia (X Región de Los Lagos, Chile) has further increased the known range of this species, which appears to be locally common, and permits a more detailed description than that provided by either Nylander (Crombie 1876 [1877]) or Hertel (1984).

Also in MSC were several collections (under the *in sched.* name “*Aspicilia campbelliana* Imsh.”) from Campbell Island that were clearly congeneric with the Falkland collections but differed in having much smaller ascospores and a different thalline chemistry. These collections are described here as a second species of *Xenolecia*.

Materials and Methods

Specimens collected by Henry Imshaug and co-workers held in MSC, and recent collections from the Falkland Islands and Chile collected by the authors, were studied using standard microscopy techniques and reagents. Ascospore dimensions are given as *mean* ± 1SD with extremes in parentheses. Chemical constituents were identified by thin-layer chromatography in solvent C (Orange *et al.* 2001).

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Descriptions of ascus type follow Hafellner (1984) and nomenclature for apothecial pigmentation follows Meyer & Printzen (2000).

The Species

Xenolecia cataractarum Fryday sp. nov.

Mycobank No.: MB 819759

Differs from *Xenolecia spadicomma* (Nyl.) Hertel in having much smaller apothecia and ascospores, a greenish pigment in the epihymenium, a non-amyloid medulla and in the production of norstictic acid.

Type: New Zealand, Campbell Island, around waterfalls in *Dracophyllum* scrub on south slope of Mt. Honey, above Southeast Harbour, 21 January 1970, H. A. Imshaug 47396 (MSC0195380—holotype; CHR, BM, HO, M—iso-types).

(Figs 1A, 2, 3A, 4A)

Thallus creamy white, with a distinct, obscurely effigurate margin with a blue-black prothallus (Fig. 1A); *medulla* I-. *Photobiont* chlorococcoid, arranged in loosely defined vertical bundles; cells globose to slightly ovoid, sometimes irregularly shaped and angular (presumably disrupted), 5–7(–9) µm across.

Apothecia numerous, black, innate with a concave disc, 0.2–0.5 mm diam.; *proper margin* not apparent but disc often surrounded by a blue-grey border, 0.05 mm wide, that is formed by the thallus cortex overreaching the epihymenium. *Proper exciple* poorly developed, annular, 10–15 µm wide, very dilute orange-brown, structure unclear but apparently little differentiated from the hymenium (Fig. 2A). *Hypothecium* dilute brown to dark brown, upper part composed of vertically arranged hyphae, lower part ±cellular, extending into the thallus for up to 160 µm. *Hymenium* c. 220–250 µm tall; *paraphyses* slender (1 µm wide), sparingly branched and anastomosing, not or only slightly swollen at the apex (Fig. 2B); *epihymenium* olivaceous (N+ red, K± brown; probably *Cinereorufa*-green and *Arnoldiana*-brown). *Asci* cylindrical-clavate, 50–60 × 15–18 µm, outer wall I+ blue, immature asci initially with a distinct I+ blue cap, occasionally with a less distinct ring structure extending down into the tholus (Fig. 3A), mature asci *Porpidia*-type, similar to that of *X. spadicomma* (Fig. 3B); *ascospores* simple, hyaline, with a thin gelatinous sheath (halonate),

broadly ellipsoid, (12–)14.84 ± 1.65(–18) × (6–)6.91 ± 1.02(–9) µm; l/w ratio 1.67–3.00, mean = 2.20, (n = 16).

Conidiomata pycnidia, black, immersed, abundant at the thallus edge when two thalli meet; *conidia* hyaline, filiform, 20–25 × 1 µm (n = 10).

Chemistry. K+ red, C–, KC–, PD+ yellow, UV+ dull white; norstictic acid by TLC.

Etymology. Named after the habitat of the only collection (Latin: ‘cataractarum’ = of waterfalls).

Distribution and Ecology. The new species is known only from the type locality on Mt. Honey, Campbell Island, New Zealand (Fig. 4A), where it is apparently quite frequent on siliceous rocks near a waterfall because Imshaug made four separate collections, along with several duplicates.

Additional specimens examined. **New Zealand**: *Campbell Island*: around waterfalls in *Dracophyllum* scrub on south slope of Mt. Honey, above Southeast Harbour, 1970, Imshaug 47386 (MSC0195381—topotype), 47395 (MSC0195382, BCRU, E, BG, HO, FH, GZU, H, OTA—topotypes), 47399 (MSC0195383—topotype).

Xenolecia spadicomma (Nyl.) Hertel

Beih. Nova Hedwigia 79: 440 (1984).

Basionym: *Lecidea spadicomma* Nyl., in Crombie, *J. Linn. Soc. Bot.* 15: 233 (1876); type: Chile, (XII Región de Magallanes y de la Antártica Chilena, Isla Wellington), Eden Harbour, in the bed of a stream, April 1868, R. O. Cunningham (BM!—holotype; BM!, E!, H —isotypes).

(Figs 1B & C, 3B, 4–6)

Thallus thick, rimose-areolate, cream-brown to yellow-orange, sometimes mottled with alternating dark grey and orange parts; upper section composed of vertically orientated hyphae without an upper cortex but surface cells with a dilute brown pigmentation (Fig. 1B & C); *medulla* I+ violet. *Photobiont* chlorococcoid, 7–12 µm diam.

Apothecia 0.5–2.2 mm diam., numerous, ±regularly scattered, innate, rounded, ±flat or occasionally concave; *proper margin* not evident; *disc* dark brown to black, paler brown when wet. *Proper exciple* annular, poorly developed, not

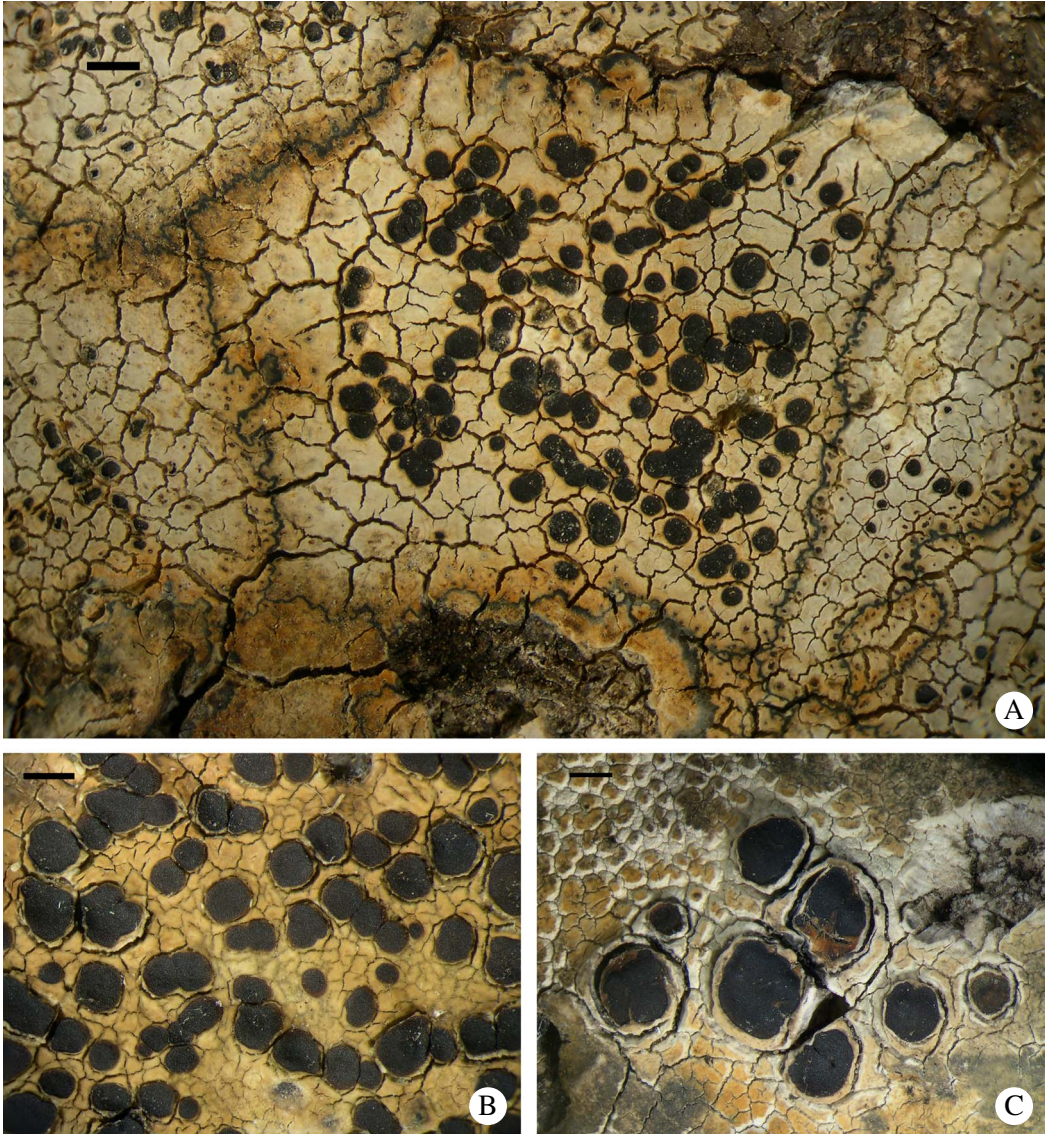


FIG. 1. Thallus and apothecia of *Xenolecia* species. A, *X. cataractarum* (Imshaug 47396—holotype). B & C, *X. spadicomma*; B, collection from the Falkland Islands (Imshaug 41459); C, holotype from Chile (in BM). Scales: A–C = 1 mm. In colour online.

reaching the thallus surface, dilute brown, 15–20 μm wide, composed of narrow septate hyphae. *Hypothecium* dark brown, 90–105 μm tall, often extending up to 350 μm into the thallus, composed of vertically arranged hyphae that merge with the hymenium, less well organized at base. *Hymenium* 180–200 μm tall; *paraphyses* slender, *c.* 1 μm thick, only slightly

swollen at apex, branched and anastomosing; *epihymenium* 12–20 μm thick, pale brown (Arnoldiana-brown). *Asci* 70–60 \times 20–25 μm , cylindrical-clavate, mature asci *Porpidia*-type (Fig. 3B; but cf. *X. cataractarum* for immature asci); *ascospores* simple, hyaline (15.4–)23.0 \pm 3.64 (–32.5) \times (6.0–)10.7 \pm 2.15 (–15.6) μm ; l/w ratio 1.7–2.6, mean = 2.20, ($n = 111$).

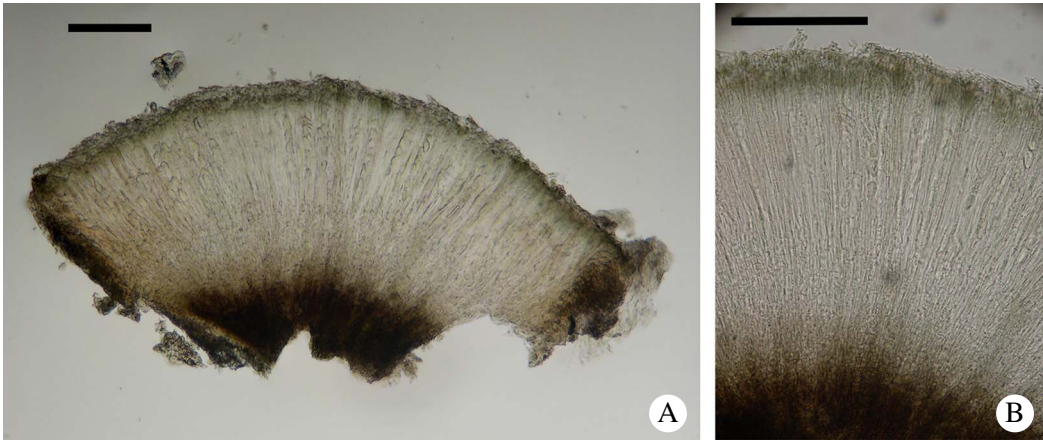


FIG. 2. *Xenolecia cataractarum*, sections through apothecia. Scales: A & B = 100 μ m. In colour online.

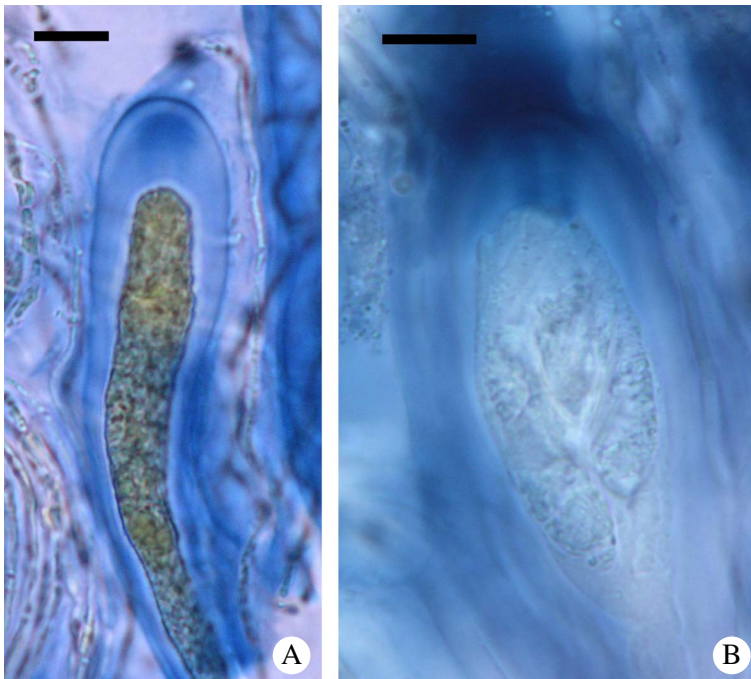


FIG. 3. *Xenolecia* asci. A, *X. cataractarum*, immature ascus (Imshaug 47396—holotype); B, *X. spadicomma*, mature ascus (Imshaug 41889). Scales: A & B = 10 μ m. In colour online.

Conidiomata pycnidia, usually present, dark brown to black, 0.05–0.10 mm diam., immersed in the thallus, most frequent along the thallus margin adjacent to other thalli; *conidia* hyaline, filiform, (18–)25–30 \times 1 μ m ($n = 10$).

Chemistry. K–, C–, Pd–, UV+ dull white. Confluent acid (major), 2'-*O*-methylmicrophyllinic acid (minor) by TLC.

Distribution and ecology. The distribution of *X. spadicomma*, with three widely separated

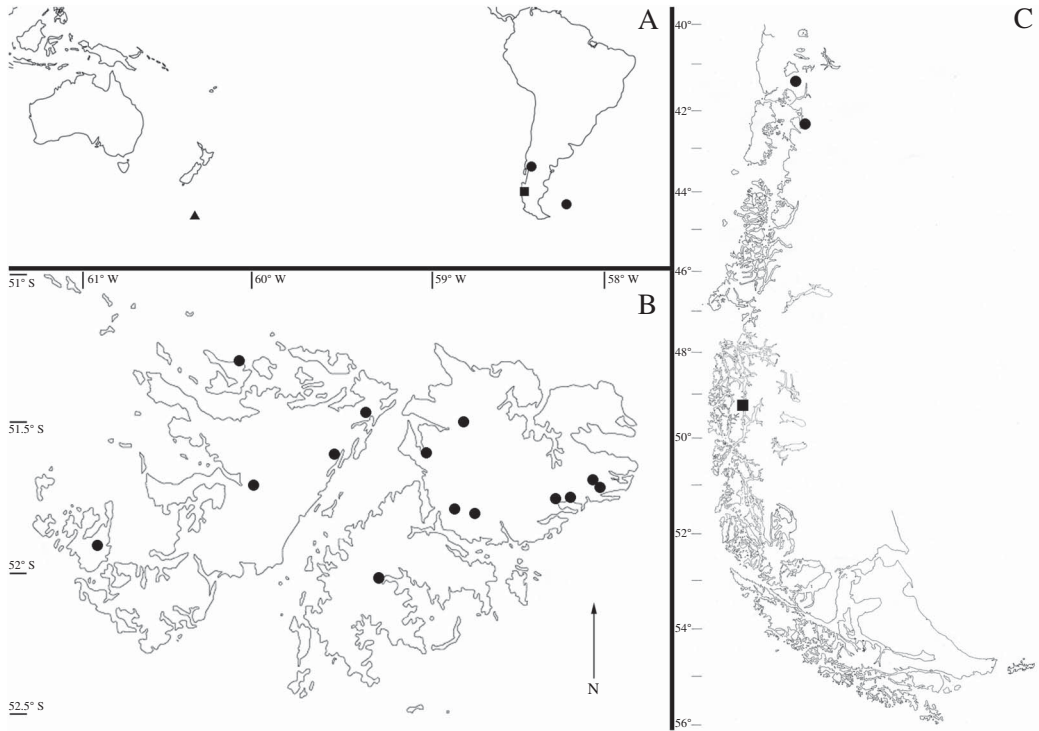


FIG. 4. *Xenolecia* distribution. A, world; B, Falkland Islands; C, Chile. ● = *X. spadicomma*; ■ = type of *X. spadicomma*; ▲ = *X. cataractarum*.

localities from the Falkland Islands (where it is common) to northern Patagonia (Fig. 4), suggests that it is a widespread species in the area, although its absence from the extensive collections made from western Patagonia and Fuegia (Isla Grande and Isla de los Estados) by Imshaug and co-workers (Fryday & Prather 2001) is surprising.

Xenolecia spadicomma is primarily a species of semi-inundated streamside rocks (Fig. 5), although it has also been collected from mountain summits (Imshaug 41549) and in rainwater-collecting depressions in otherwise dry rocks (Fryday 11355).

Additional specimens examined. Chile: *X Región, Los Lagos* (northern Patagonia): Comau Fjord, Huinay, Rio Lloncochaigua, 42°22'03.7"S, 72°24'26.0"W, rapids 1 km upstream of junction with Rio Huinay, on large gneiss boulders, c. 2 m above low water level in partially shaded river bank, i 2014, Thüs (BM001088488); *ibid.*, cascades of nameless streamlet below reservoir of hydroelectric power plant for Huinay Research Station, 42°22'58.39"S, 72°24'40.59"W, on large partly shaded boulder in splash water zone, i 2014, Thüs

(BM001089604); *ibid.*, National Park Llanquihue, Calbuco Volcano, S-slope, bridge of Sendero Alerce Andino over tributary to Rio Blanco, 1 km N of CONAF checkpoint, in splash water zone of shaded rapids on permanently wet volcanic (mafic) rock outcrops, 41°22'51.3"S, 72°38'39.3"W, i 2014, Thüs (BM001085888).—**Falkland Islands** (all in MSC): *East Falkland*: Mt. Osborne, valley SW of Mt. Osborne, 21F UC 7068 (51°43.240'S, 58°52.650'W), 200 ft. (61 m), along stream in *Cortaderia*-heath and sandstone outcrops, 1968, Imshaug 40177, 40190, 40195 (MSC0011043, MSC0011038, MSC0011039); Stanley, headwaters of Mullet Creek Stream, 1968, 21F VC 3270 (51°42.570'S, 57°58.820'W), 200 ft. (61 m), mosaic of *Empetrum*-heath and peat bogs, Imshaug 41438, 41459 (MSC0011044, MSC0011037); *ibid.*, Mullet Creek Stream, below fiord, 21F VC 3270 (51°42.970'S, 57°58.570'W), 150 ft. (45.75 m), 1968, Imshaug 41464, 41484 (MSC0011040, MSC0011042); *ibid.*, cliffs on rock dome at summit of Mt. Kent, 21F VC 2374 (51°42.550'S, 58°0.900'W), 1500 ft. (457.5 m), 1968, Imshaug 41549 (MSC0011041). *Saunders Island*: Rookery Cottage, -51.306687°, -60.098780°, 44 m, pebbles in *Empetrum*-heath, 2015, Fryday 11355 (MSC0195384). *Weddell Island*: Waterfall Valley, W of settlement, 21F TC 2842 (51°54.040'S, 60°56.820'W), 300–700 ft. (91.5–213.4 m), stream bed, 1968, Imshaug 41889 (MSC0011036); *ibid.*, -51.901456°, -60.948128°,



FIG. 5. Habitat of *Xenolecia spadicomma* (Patricia Luxton NNR, Chartres, East Falkland, Falkland Islands). *Xenolecia spadicomma* is the orange lichen just above the water line.

190 m, sloping, semi-inundated rocks, 2015, Fryday 10855 (MSC0195385). *West Falkland*: Chartres, Patricia Luxton NNR, -51.724676° , -59.985162° , 13 m, sloping rock by river, inundation zone, 2015, Fryday 11001 (MSC0195386).

Discussion

All the collections of *Xenolecia cataractarum* were made over 45 years ago and consequently it was not possible to confirm its generic placement by molecular methods. However, although the two species described here differ in numerous characters (size of apothecia and ascospores, epihymenium pigmentation, thalline chemistry and medulla amyloidity), they are united by their general anatomical structure (slender, branched and anastomosing paraphyses, a strongly reduced proper exciple, *Porpidia*-type asci, a hypothecium composed of vertical hyphae

that intergrades with the hymenium without an intervening subhymenium, and filiform conidia). They are also very similar in gross morphology, having a pale creamy orange thallus delimited by a black prothallus, with innate, immarginate apothecia and producing abundant pycnidia where adjacent thalli meet (Fig. 1A). Consequently, we are confident that the new species is congeneric with *X. spadicomma*. *Paraporpidia* Hertel and *Stephanocyclos* Hertel are two other Southern Hemisphere genera with *Porpidia*-type asci and filiform conidia but species of both these genera have a well-developed proper exciple. In *Stephanocyclos* the proper exciple is irregular and carbonaceous whereas *Paraporpidia* is further distinguished by the ascospores lacking a gelatinous sheath (Hertel 1984; Fryday & Hertel 2014).

The olivaceous pigmentation present in the ephymenium of *X. cataractarum* is common in the porpidioid genera of the *Lecideaceae*, as well as many other genera of the Lecanoromycetidae, and was previously referred to by the first author as Macrocarpa-green (Fryday 2002, 2005). However, we now consider this coloration to be the result of at least two separate pigments, Cinereorufa-green and Arnoldiana-brown, which are also frequent in these genera. A chemical characterization of these coloured components, however, is still outstanding.

The variation in ascospore dimensions of *X. spadicomma* is large (Fig. 6, Table 1), and we considered the possibility that our collections represented a separate species distinct from *X. spadicomma*. Unfortunately, owing to

issues associated with the small sample size of our data (holotype, 1 collection; NW Patagonia, 3 collections) the results of standard statistical tests would have been invalid. However, it can be seen from a plot of the ascospore dimensions (Fig. 6) that those of the type collection, although at the upper end of the range, fall within the limits of the other collections. Consequently, in the absence of molecular data and until further material from the vicinity of the type collection becomes available, we are including our collections in *X. spadicomma*.

The ascus structure of *Xenolecia* was described by Hertel (1984) as *Porpidia*-type but we found that immature asci differ from that type as described by Hafellner (1984) and have some resemblance to the *Lecidea*-type (Hafellner 1984). Both *Lecidea*- and *Porpidia*-type asci have a KI+ pale blue tholus but whereas the *Lecidea*-type have a small, darker staining cap, possibly with a small ring structure beneath it, the *Porpidia*-type lack a cap but have a distinct darker-staining ring structure for the full height of the tholus (Hafellner 1984). Initially, asci of *Xenolecia* have only a well-defined, dark staining cap but an indistinct ring structure the full height of the tholus develops (Fig. 3A) and only mature asci are of the typical *Porpidia*-type (Fig. 3B). *Xenolecia* was placed in the *Porpidiaceae* by Hertel (1984), which is now included in the *Lecideaceae*, but the combination of *Porpidia*-type asci, filiform conidia and the hymenium structure, lacking a subhymenium and with the paraphyses grading directly into the hypothecium composed of vertically orientated hyphae, is anomalous for that family and preliminary molecular data

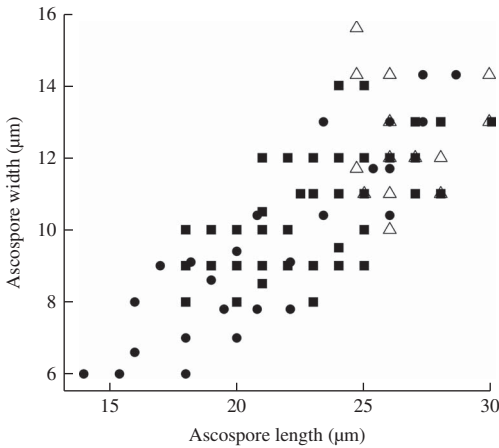


FIG. 6. *Xenolecia spadicomma*, comparison of ascospore dimensions of type specimens with other collections from NW Patagonia and the Falkland Islands. △ = type collection; ● = NW Patagonia; ■ = Falkland Islands.

TABLE 1. Dimensions of ascospores from different populations of *X. spadicomma* given as mean ± standard deviation.

Locality	Number of collections	Number of ascospores measured	Length (µm)	Width (µm)
Type: SW Patagonia	1	18	26.4 ± 1.6	12.7 ± 1.6
Non-type: NW Patagonia + Falkland Islands	13	93	22.4 ± 3.6	10.3 ± 2.0
NW Patagonia	3	38	21.2 ± 4.1	9.7 ± 2.5
Falkland Islands	10	55	23.2 ± 2.9	10.7 ± 1.6

(T. Wheeler, pers. comm.) indicate a placement for the genus outside the core *Lecideaceae*.

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REFERENCES

- Crombie, J. M. (1876) On the lichens collected by Prof. R.O. Cunningham in the Falkland Islands, Fuegia, Patagonia and the Island of Chiloe during the voyage of H.M.S. Nassau 1867–1869. *Journal of the Linnean Society* **15**: 222–235.
- Fryday, A. M. (2002) A revision of the species of the *Rhizocarpon hochstetteri* group occurring in the British Isles. *Lichenologist* **34**: 451–477.
- Fryday, A. M. (2005) The genus *Porpidia* in northern and western Europe, with special emphasis on collections from the British Isles. *Lichenologist* **37**: 1–35.
- Fryday, A. M. & Hertel, H. (2014) A contribution to the family *Lecideaceae* s. lat. (Lecanoromycetidae inc. sed., lichenized Ascomycota) in the southern subpolar region; including eight new species and some revised generic circumscriptions. *Lichenologist* **46**: 389–412.
- Fryday, A. M. & Prather, L. A. (2001) The lichen collection of Henry Imshaug at the Michigan State University Herbarium (MSC). *Bryologist* **104**: 464–467.
- Hafellner, J. (1984) Studien in Richtung einer natürlicheren Gliederung der Sammelfamilien *Lecanoraceae* und *Lecideaceae*. *Beiheft zur Nova Hedwigia* **79**: 241–371.
- Hertel, H. (1984) Über saxicole, lecideoide Flechten der Subantarktis. *Beiheft zur Nova Hedwigia* **79**: 399–499.
- Meyer, B. & Printzen, C. (2000) Proposal for a standardized nomenclature and characterization of insoluble lichen pigments. *Lichenologist* **32**: 571–583.
- Orange, A., James, P. W. & White, F. J. (2001) *Microchemical Methods for the Identification of Lichens*. London: British Lichen Society.