

Vrolijkheidia circumscissa (Pottiaceae), a new moss genus and species from the Succulent Karoo of South Africa

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SUMMARY

We describe *Vrolijkheidia circumscissa* as a new genus and species of Pottiaceae currently known only from the Worcester-Robertson centre in the succulent karoo biome of the Cape Floristic Region. The gametophyte of the new genus is distinguished by the combination of small plants with strap-shaped, bordered leaves red in KOH in which the costa has a single round to semicircular stereid band, the hydroid strand absent, and the adaxial epidermis differentiated. The cleistocarpic capsules with exothecial cells in only one layer and arranged in palisade bands, with circumscisile dehiscence along one or more lines, and no stomates are also unique.

KEYWORDS: Circumscisile dehiscence, ephemeral moss, Worcester-Robertson Karoo, Cape Flora.

INTRODUCTION

The Succulent Karoo and associated biomes of western South Africa constitute one of the globe's biodiversity hotspots (Myers *et al.*, 2000). Precipitation in the region falls almost entirely in the Southern Hemisphere winter (June–August), and these wet winter periods are interrupted by long summer droughts. The angiosperm flora is thus characterised by a large proportion of succulent life forms, as well as annual or ephemeral species that avoid drought periods by surviving in the seed bank (Cowling & Hilton-Taylor, 1999).

In the case of bryophytes, one might expect the combination of strong seasonality of precipitation and nutrient-rich clay soils to promote the evolution of ephemeral or annual taxa in this region. The bryophyte flora of the succulent karoo, however, remains very poorly recorded although the region is already known to include a number of distinctive and apparently endemic taxa including numerous ephemerals, of which *Cygnicollum* Fife & Magill of the Funariaceae, and *Acaulon recurvatum* Magill, *Ludorughya* Hedderson & Zander, *Microbryum rufochaete* (Magill), Zander *Microcrossidium* Guerra & Cano and *Pottia namaquensis* Magill of the Pottiaceae, constitute but a few examples (cf. Magill, 1981, 1987; van Rooy, 2003; Hedderson & Zander, 2007a, b). *Riccia*, the single bryophyte group that has been extensively studied in the region, shows a remarkably high level of diversity and endemism in the area (Perold, 1999).

Over the past few years, regular collections within the succulent karoo, particularly during the wet season, have revealed the existence of a large, distinctive, and apparently endemic moss flora in the Succulent Karoo and its associated biomes. This indeed includes a large proportion of ephemeral (or at least only seasonally visible) taxa. Not surprisingly, the Pottiaceae are very strongly represented among these and a large number of undescribed species and even genera of the family are now known to occur. In the present paper we describe *Vrolijkheidia circumscissa*, a new genus and species of Pottiaceae from this globally important biome.

DESCRIPTION

***Vrolijkheidia circumscissa* Hedd. & R.H. Zander gen. et sp. nov.** (Fig. 1)

Plantae minutae, caulibus usque 1 mm longis. Folia ovata vel longe ovato-lanceolata vel longe ligulata, longissima quoque falcata; margines planae vel subrecurvae, e seriebus cellularum angustarum laevium parietibus crassis limitatae; costa brevi-aristata excurrens, strato stereidarum rotundo dorsali, filo cellularum hydroiearum unico; cellulae distales laminales maximam partem brevi-rectangulares, papillosae; cellulae basales longiores, laeves. Autoicae. Seta brevissima. Capsula cleistocarpa, lineam mediam secus circumdehiscens, cellulis exothecialibus in strato unico dispositis, atque in seriebus verticalibus dispositis, stomatibus careens. Calyptra membranacea, conica vel cucullata. Sporae maximam partem 26–32 μ m.

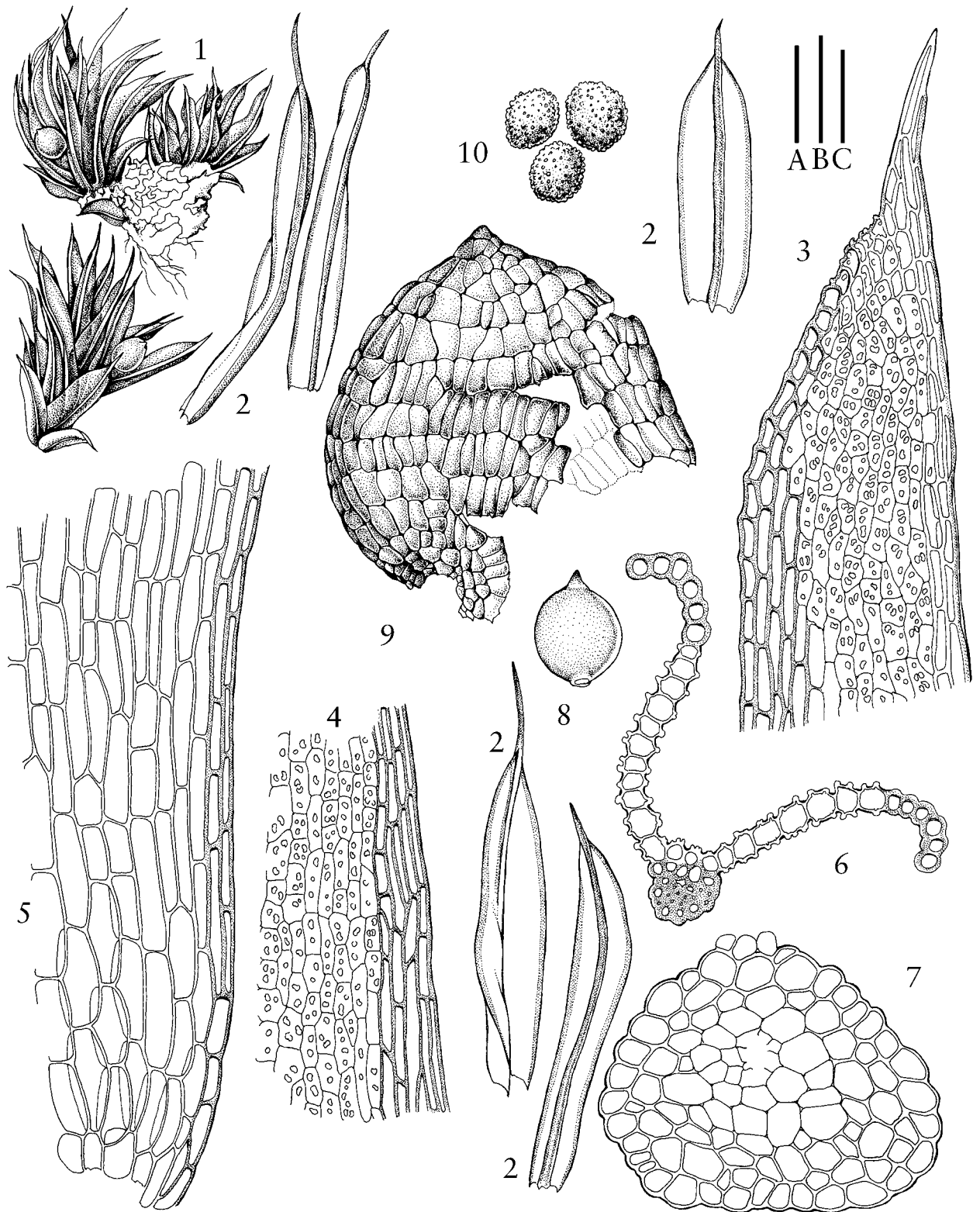


Figure 1. *Vrolijkheidia circumcissa*: 1, two habits; 2, five leaves; 3, leaf apex; 4, marginal cells of leaf; 5, basal cells of leaf; 6, section at mid leaf; 7, stem section; 8, capsule; 9, capsule crushed; 10, spores. Scale bars: A, 1=1 mm; B, 2 and 8=0.5 mm; C, 3–7 and 9–10=50 μ m.

Type: SOUTH AFRICA: Western Cape Province, Robertson District, McGregor Area, Vrolijkheid Nature Reserve, on clay banks in succulent karoo vegetation on clay flats derived from shales, 33°54'40"S, 19°53'32"E,

280 m. *Hedderson 15239*, 27 September 2003. Holotype BOL.

Paratype: SOUTH AFRICA: Western Cape Province, Robertson District, McGregor Area, Vrolijkheid Nature

Reserve, on clay flats with shale outcrops, covered with succulent karoo vegetation, 3319DD, *Hedderson 15237C* BOL.

Plants terricolous, gregarious or forming loose turf, upper parts dark green to reddish green, sometimes brown below, 0.8–2.8 mm high. *Stems* simple, to 1 mm, transverse section round, central strand present or eroded and centre hollow, otherwise undifferentiated; axillary hairs of *ca* 4 uniseriate rectangular thin-walled cells, all clear; very sparsely radiculose. *Leaves* erect to recurved when wet, longer ones somewhat falcate, little altered on drying, lowest ovate but remainder oblong-lanceolate to long-ligulate, 0.9–2.3 mm in length, 0.24–0.35 mm wide, 5–9 times longer than wide, lamina \pm flat, margin weakly reflexed to recurved at least at mid-leaf and often from base to 1/4 way below apex, entire or slightly crenulate-dentate by protruding cell ends at the narrowly to broadly acute to obtuse apices; costa strong and excurrent in a short, smooth, reddish awn, superficial cells elongate and smooth dorsally, on ventral surface elongate and smooth below but short-rectangular to quadrate above mid-leaf and with a few papillae, transverse section round, ventral epidermis present, ventral stereid band absent, guide cells 2 (-3) in a single layer, dorsal stereid band round to semicircular, dorsal epidermis not differentiated or as larger-lumened cells, hydroid strand absent but a lacuna sometimes present; upper laminal cells short-rectangular to elongate-hexagonal or rarely quadrate, 16–25 (-35) μm \times 11–16 μm , 1.1–2.5 (-5.0) \times longer than wide, firm-walled, with 4–5 simple or bifid hollow papillae; basal cells rectangular, smooth, with thinner, yellowish walls, 40–70 μm \times 11–19 μm ; margins with 2–3 rows of narrowly rectangular, smooth, thick-walled cells forming a distinct border extending from near base almost to apex. *Autoicous*. *Perichaetia* terminal, leaves similar to upper stem leaves but more narrow and elongate, the innermost lacking papillae, to 11 times longer than wide. *Perigonia* budlike, 1–2 just below perichaetia or in leaf axils at plant bases; bracts 2–3, short, ovate to ovate-triangular, sharply apiculate, often with a few sharp teeth at upper margins. *Seta* very short to virtually absent, fragile, with capsules detaching very readily. *Capsules* 1–3 per perichaetium, immersed in perichaetial leaves, brown to reddish brown, 0.28–0.48 mm \times 0.25–0.35 mm, broadly ellipsoidal to nearly spherical; apiculus low but distinct, *ca* 50 μm ; operculum not differentiated; exothecial cells rectangular, in one layer, in \pm regular encircling bands (palisades), dehiscing along 1–3 latitudinal lines of weakness between adjacent rows, stomata absent. *Calyptra* cucullate or rarely conic, 0.15–0.22 mm, membranous and adherent to top 1/2–3/4 of capsule, colourless, cells thin-walled, smooth or minutely papillose. *Spores* spherical to slightly ellipsoidal, (22-) 26–32 (-35) μm in diameter, pale yellowish-brown, finely papillose. *Laminal KOH colour reaction* red.

The genus name honours the type, and currently the only known, locality for this genus and species. The Afrikaans word vrolijkheid (the locality retains the original Dutch spelling), with its connotations of cheerfulness, joy, happiness, glee, bliss, and conviviality, aptly describes the

pleasure found in both the locality and in the discovery of this unusual moss. The cultural paradigm is the old Afrikaans folk song 'Al de Veld is Vrolik'. In Afrikaans, the *V* is usually pronounced as *F*, and the *ei* is pronounced approximately as the English *ay* or as the long-a sound in *bate*. The species epithet refers to the mode of capsule dehiscence.

DISCUSSION

The new genus *Vrolijkheidia* is fully unique in the combination of small plants with strap-shaped bordered leaves with red KOH reaction, the costa with a single round to semicircular stereid band, hydroid strand absent, and costa adaxial epidermis differentiated, perichaetial leaves falcate, and cleistocarpic capsules with exothecial cells in only one layer and arranged in palisade bands, with circumscissile dehiscence along one or more lines, and no stomates. The single-layered capsule wall and lack of stomates indicates extreme sporophyte reduction, comparable to that of certain species of *Micromitrium* (Ephemeraceae).

Although exothecial cells in the Pottiaceae are commonly elongate, those of ovoid or spheric capsules are usually short-rectangular to quadrate or hexagonal. *Vrolijkheidia*, however, has vertically elongate exothecial cells arranged in transverse rows, similar to the palisade arrangement described for *Tortula maritima* (R. Br. ter.) R. H. Zander and species of *Aschisma* Lindb. and *Tetrapterum* Hampe. *Aschisma* also lacks stomata. Members of Ephemeraceae, at least some of which may belong in Pottiaceae (Hedderson *et al.*, 2004; Werner *et al.*, 2004), also exhibit very reduced sporophytes, in certain cases also including the palisade arrangement of exothecial cells and lack of stomata. These taxa, all very different from each other (see complete descriptions by Zander, 1993), also all diverge from *Vrolijkheidia* in a plethora of gametophytic characters including, *inter alia*, KOH colour reaction, costa anatomy, and details of leaf areolation. Given the great differences among the gametophytes, the extreme sporophyte reduction seen across these groups is likely the result of convergence.

Among recognised genera in the Pottiaceae, the gametophyte is perhaps most similar to that of *Hennediella* Par. in the red colour in KOH, leaf margins with a border of elongate, thicker walled, smooth cells, and rounded dorsal stereid band. *Vrolijkheidia* differs from the known species of that genus, however, in the oblong-lanceolate to ligulate leaves with the margins usually at least partially reflexed to recurved, the costa lacking a hydroid strand (although a lacuna of concave-rhomboidal outline is sometimes evident), and the uniquely modified capsules.

The new genus is one of a number of unusual taxa associated with winter-wet Mediterranean climates at the southwest tip of Africa (e.g. Magill, 1981; Hedderson & Zander, 2007a, b). It is currently known only from a single locality in the Breede River Valley, in the Worcester-Robertson Karoo, a well-known centre of generic and species

endemism for angiosperms, and particularly xerophytic plants (van Wyk & Smith, 2001). The two populations are associated with nutrient-rich soils that have high clay content; such soils are relatively widespread in the Worcester-Robertson area and the species should be sought elsewhere. The presence of just-mature capsules in September suggests that the species is a late winter/spring ephemeral. Until the distribution can be better documented, it remains unknown to what extent the species may be threatened by habitat transformation, particularly for viticulture, in the Breede River Valley (cf. van Wyk & Smith, 2001; Bruyns, Nowell & Hedderson, 2005). Perhaps the current association with one of the few Nature Reserves in the Worcester-Robertson Karoo Centre is telling.

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TAXONOMIC ADDITIONS AND CHANGES: *Vrolijkheidia circumscissa* Hedd. & R. H. Zander gen. et sp. nov.

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