

A new species of *Crossidium* (Pottiaceae, Bryophyta) from South Africa

Richard H Zander¹, Terry A Hedderson²

¹Missouri Botanical Garden, St Louis, MO, USA, ²Department of Botany, University of Cape Town, Rondebosch, South Africa

A new species of *Crossidium* (Pottiaceae, Bryophyta), *C. karoo*, is described for South Africa. It uniquely differs from congeners in tight encapsulation of the photosynthetic filaments by the clasping upper lamina.

Keywords: *Crossidium*, karoo, South Africa, Western Cape Province

Recent bryological exploration of the Western Cape Province of South Africa has been richly rewarded in discovery of taxa of unusual morphology and significant distribution (Hedderson & Zander, 2007a, b, 2008a, b, c; Zander & Hedderson, 2009). This paper documents a new species of *Crossidium* Jur. (Pottiaceae), a genus of about 11 species occurring in arid lands worldwide.

Crossidium karoo R.H.Zander & Hedd., *sp. nov.*
(Figure 1: 1–7)

Caulis exiguus, brevis; folia saturate atroviridia, saccata, marginibus incurvis et filamenta arcte circumplicantibus, apice leniter vel valde cucullato, sinu distali inciso, parte basali foliari leniter distincta, quadrata, lateribus strictis vel angustatis; filamenta costalia aream per lamina inclusam dense implentia, cellululis ultimis filamentorum parietibus crassis vel tenuibus, interdum sparse unipapillosis. Lamina KOH flava, distaliter proximaliterque rubro-maculata reagens.

Plants very small, gregarious, half-buried in soil, dark green to olive-green. Stem not branching, ca 0.5–1 mm long, 140–170 µm in diameter, delicate, transverse section rounded, of thin-walled cells, central strand apparently absent, sclerodermis absent; axillary hairs of ca 3 uniseriate, hyaline cells; brown rhizoids common at stem base, the narrower 12–17 µm in diameter mixed with wider 28–33 µm in diameter. Leaves deep, dark green, appressed and incurved when dry, reflexed at the base and wide-spreading when wet, short- to long-ovate or obovate, saccate, 0.3–0.5 mm in length, upper lamina broadly incurved throughout to fully clasping the bushy photosynthetic array; laminal margins incurved, weakly bordered by 1–2 rows of thinner-walled cells; leaf apex weakly but clearly cucullate in older and

just maturing leaves, acute and entire in leaves at base of stem, leaf margins meeting distally just below the apex in an acute angle as a narrow notch or even somewhat over-folded, apex broadly rounded across cucullate portion, often umbonate by the weakly bulging costa curving over the cucullate apex; leaf base narrower than upper leaf or flaring outwards in older leaves and broadened; costa wide, ending shortly before the apex, weakly convex dorsally, bulging ventrally, dorsal superficial cells 6–7 rows wide, fusiform, ca 3–6:1, smooth, distalmost 3/5 to 4/5 of ventral surface of costa with dense mass of branching chlorophyllose filaments filling the enfolded laminal capsule; costa in transverse section ovate, dorsal epidermis absent, dorsal stereid band strong, hydroid strand weak, guide cells enlarged, 4–6 across costa, filaments restricted to ventral surface of costa, 4–7 uniseriate cells in length, basally forming lamellae, terminal cells thick-walled and smooth grading to thin-walled, often with 1–2 simple papillae; upper laminal cells thick-walled, quadrate to rhombic or rectangular, 13–18 µm wide, 1–2 (–3):1, superficially flat to very weakly convex, papillae absent; basal laminal cells weakly differentiated across base, quadrate, thin- to thick-walled, 11–14 µm wide, marginally often elongate and hyaline. Apparently dioicous, only archegoniate plants seen, perichaetial leaves little differentiated. Laminal KOH color reaction yellow, with red blotches apically, line of cells at leaf insertion red.

Type: SOUTH AFRICA, Western Cape Province, Worcester Area. Karoo National Botanic Garden, succulent karoo vegetation on shale-derived, clay flats along walking trail at top of ridge. 415 m 33°36'34"S 19°27'04"E, 31 August 2008 T.A.J. Hedderson 16886 (holotype: BOL; isotype: MO), mixed with *Crossidium apiculatum* Magill.

Correspondence to: R H Zander, Missouri Botanical Garden, PO Box 299, St Louis, MO 63166, USA. Email: richard.zander@mobot.org

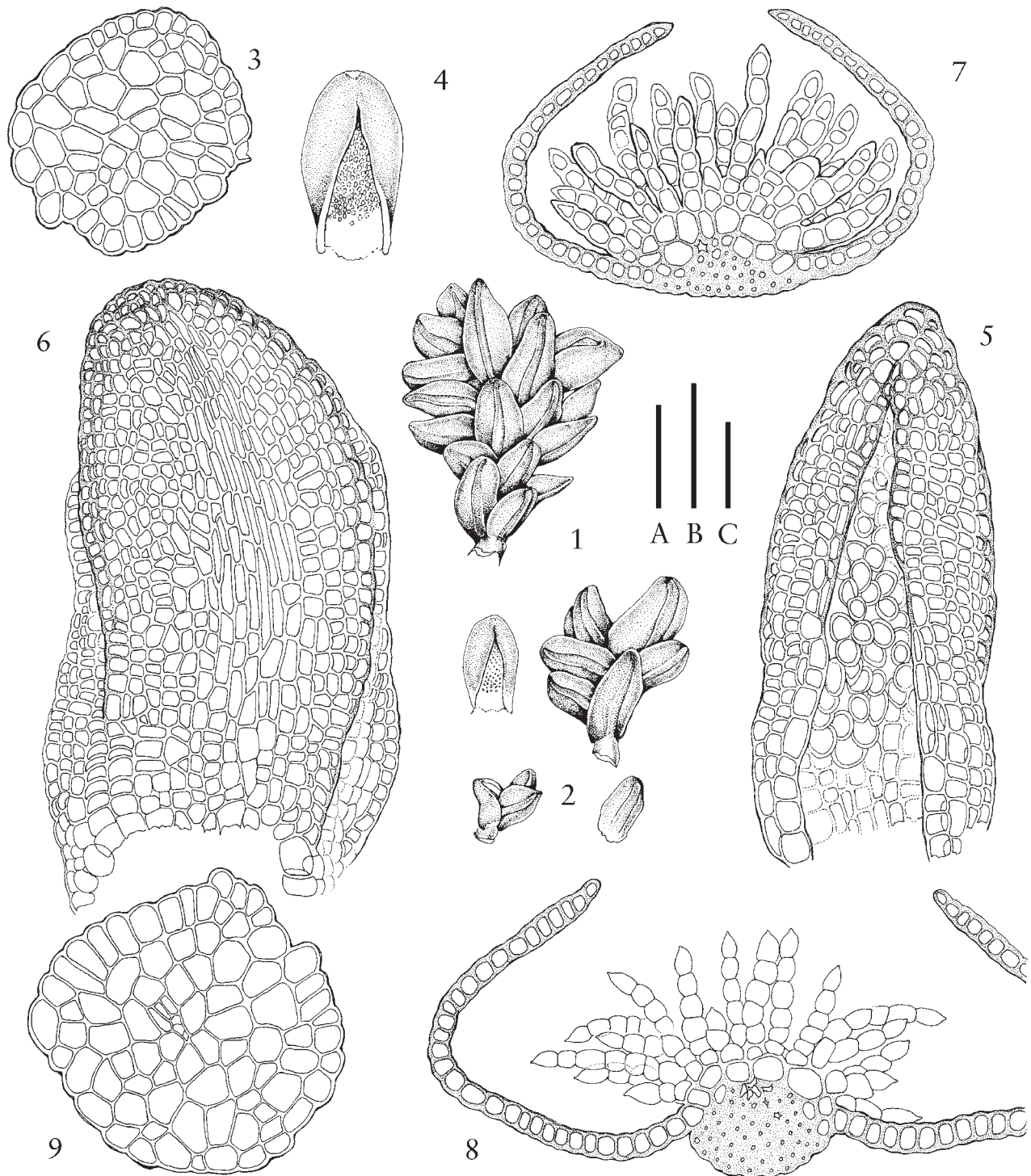


Figure 1 1–7. *Crossidium karoo*, Hedderson 16886, MO. 1. Habit. 2. Fragmenting plant. 3. Stem section. 4. Leaf. 5. Leaf detail, ventral view. 6. Leaf detail, dorsal view. 7. Section at mid-leaf. 8. *Crossidium woodii*, Wood 1623, E. Section at mid-leaf. 9. *Crossidium apiculatum*, Magill & Schelpe 3877, MO. Stem section. Scale bars: A=0.5 mm, 1–2; B=0.3 mm, 4; C=50 μ m, 5–9.

Paratype: SOUTH AFRICA, Western Cape Province, Worcester Area, Karoo National Botanic Garden, ridgetop trail, succulent karoo on shale-derived clay, 33°36'34"S, 19°26'56"E, 20 October 2004 T.A.J. Hedderson 15788a (BOL, MO), mixed with *Crossidium spiralifolium* Magill.

The specific epithet, karoo, is a Khoisan word whose original significance is unknown but now used for the semi-desert region of western and central South Africa. It is a noun in apposition and is not

declined. Another moss named thus is *Orthotrichum karoo* F.Lara, Garilleti & Mazimpaka, while there are more than 30 vascular plant names with epithets alluding to this area.

Crossidium karoo is distinguished from all congeners by the epicostal photosynthetic tissue being tightly and almost entirely encapsulated by the clasping upper lamina. Other traits significant in combination are the tiny size of plants, leaves saccate, leaf apex weakly cucullate, lamina weakly bordered

by thin-walled cells, lack of a costal excurrency, terminal cell of photosynthetic filaments often thick-walled and if thin-walled then smooth or rarely with 1–2 hollow simple papillae terminally or just subterminally, terminal young leaves with reduced basal portions and with appearance of bullets. *Aloinella* Cardot has ventrally epicostal filaments and cucullate leaf apices but differs in the clear yellow KOH reaction of the entire plant. *Crossidium* species generally have a stem central strand, but in *C. karoo* the central strand is apparently absent. In spite of the small size of the stems, several attempts at sectioning resulted in three or four sections definitely lacking a central strand. The restriction in stem thickness may developmentally constrain expression of the strand. *Aloina* Kindb., likewise with epicostal filaments and cucullate leaf apex differs in entirely red KOH color reaction, and the origin of ventral photosynthetic filaments on the lamina as well as the costa (Zander, 1993). A few brood bodies were found scattered among plants of the new species, borne on rhizoids, multicelled, broadly elliptical, light green or brown, ca 90–125 μm in longest dimension, but cannot definitely be ascribed to *C. karoo*.

Crossidium karoo is similar to three other species with short or absent costal excurrencies and somewhat cucullate leaf apices with laminae strongly incurved at least at apex — *Crossidium crassinerve* (De Not.) Jur., *C. woodii* (Delgad.) R.H.Zander and *C. apiculatum* Magill. The first has at least occasionally the distinctive notch formed by the two inrolled leaf margins meeting in the subcucullate apex (illustrated by Zander, 1993), but differs saliently in the short to elongate hair point, and leaf margins recurved in lower 2/3. The second was originally published as a new genus, *Pseudaloina woodii* Delgad. (Delgadillo, 1982), from Yemen and recently reported from Argentina (Cano *et al.*, 2011). It was originally distinguished (Delgadillo, 1975) in part by strongly involute leaves with subcucullate apex, percurrent costa, origination of ventral chlorophyllous filaments restricted to the costa, perichaetial leaves not sheathing, and stem with central strand. This genus was synonymized with *Crossidium* by Zander (1993) because it was quite similar to *C. apiculatum*, a species with short-apiculate leaves and strongly infolded cupulate leaves. Examination of the genotype and single species in *Pseudaloina*, *P. woodii* Delgad. at E, indicated that contrary to the original description, the species did have, rarely, papillae terminally or subterminally on the terminal cell of the costal filaments, and did have a hydroid strand in the leaf (8 in Figure 1), although usually represented by a central, irregular crack between the guide cells and the stereid band.

Cano *et al.* (1993) recognized *C. apiculatum* as representing a new genus *Microcrossidium* J.Guerra & M.J.Cano, based on bulbiform habit, lack of stem central strand, peristome reduced to 15 incomplete double and poorly articulated teeth, remaining erect when dry, and spore sculpturing with several additional layers of granulae, never vermiculate as in *Crossidium*. *Crossidium apiculatum* of South Africa is indeed similar in having extremely small plants and short infolded and incurved leaves, but differs in the occasional presence of a central strand, leaves only weakly cucullate, apiculus of several cells, lamina open, cupulate, not tightly encasing the photosynthetic filaments, which fill only 1/4 of the laminal cup, and laminal cells and filaments thin-walled. The absence of a stem central strand as reported by Cano *et al.* (1993) is true for some specimens with nearly isodiametric cells throughout the central cylinder, but a distinct stem central strand (9 in Figure 1) was observed in two specimens of *C. apiculatum* at MO, and the common appearance of a central cavity in sterile (to distinguish the cavity associated with a sporophyte foot) specimens also signals a stem strand. *Crossidium apiculatum* is fairly well represented at MO by sporophyte-bearing material. The material at MO revealed the occasional appearance of a stem central strand, contrary to the original description. The size of the plants is similar to that of *C. karoo*, the leaves end in a multicelled apiculus and are cucullate, and the filaments are smooth to weakly papillose. The nearly unarticulated teeth seem merely a variant of peristome reduction, and two species of *Crossidium*, *C. rosei* Williams and *C. squamiferum* var. *pottioideum* (De Not.) Mönk., also have a reduced peristome. Thus, *Microcrossidium* rests largely on a single trait of spore ornamentation. Like *C. karoo*, both *Pseudaloina* and *Microcrossidium* appear to be strongly reduced members of *Crossidium*. Molecular data are needed to address the issue, but for now these genus names are both considered synonyms of *Crossidium* (Zander 1993).

Crossidium karoo is superficially similar to *Aloinella catenula* Cardot of Mexico, Ecuador and Bolivia, which differs in its strong stem, leaves commonly distant, not deciduous, of light green color, naviculate with parallel sides, with strongly cucullate apex and oval distal opening, basal portion of leaf well differentiated, rectangular to broadened-ovate; filaments not filling the laminal enclosure, which loosely cups them, and end cell of filament thin-walled.

At present *C. karoo* is known from only two populations, a few meters apart, in Robertson karoo (vegetation follows Mucina & Rutherford, 2006). It is likely to occur at other localities through this fairly

extensive vegetation type, but the small size and partially buried habit make it difficult to find.

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Taxonomic Additions and Changes: *Crossidium karoo* R.H.Zander & Hedd., sp. nov.

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