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Reinstatement of *Stylidium rigidulum* (Stylidiaceae), with notes on the morphologically allied *S. kalbarriense*

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Abstract

Wege, J.A. Reinstatement of *Stylidium rigidulum* (Stylidiaceae), with notes on the morphologically allied *S. kalbarriense*. *Nuytsia* 16(1): 199–206 (2006). *Stylidium macrocarpum* (Benth.) F.L.Erickson & J.H.Willis and *S. leptophyllum* DC. var. *glabrescens* Mildbr. are placed into synonymy under *S. rigidulum* Sond. and a revised taxonomic description provided. A modified description is also provided for the morphologically allied *S. kalbarriense* Lowrie & Kenneally. A chromosome number of $n = 13$ is reported for *S. kalbarriense*, and a count of $n = 11$ confirmed for *S. rigidulum*. These species are noted to grow in sympatry east of Dongara. Both taxa are susceptible to infection by the rust *Puccinia stylidii* McAlpine.

Introduction

Stylidium rigidulum Sond. was described by Sonder (1845) as part of his revision of the genus for Lehmann's *Plantae Preissianae*; however, this epithet is notably absent from the most recent treatment of the genus, that of Mildbraed (1908). Type fragments of *S. rigidulum* housed at MEL were found by the present author to match that of the later-named *S. macrocarpum* (Benth.) F.L.Erickson & J.H.Willis. This paper serves to place *S. macrocarpum* into synonymy under *S. rigidulum* and to provide a revised species description. A revised description and chromosome data are also provided for the morphologically allied *S. kalbarriense* Lowrie & Kenneally.

Stylidium rigidulum and *S. kalbarriense* are endemic to the northern sandplains of south-west Western Australia. Both species are characterised by linear to narrowly oblanceolate leaves arranged in a basal rosette, glabrous lower scapes, a linear hypanthium, and white to pale pink laterally-paired corolla lobes with red/pink throat markings, no throat appendages and a prominent red/pink to maroon abaxial stripe.

Materials and methods

This study is based on herbarium specimens housed at AD, CANB, CGE, K, MEL, P, PERTH, RSA and W, and on the field observations of the author. Morphological characters were coded using a combination of fresh, spirit and herbarium material. Corolla lobe measurements were based solely on material preserved in 70% ethanol.

Buds from *Wege* JAW 317 were fixed in 3:1 absolute ethanol:glacial acetic acid for 24 hours, rinsed in 70% ethanol and subsequently stained with alcoholic hydrochloric acid carmine (Snow 1963). Three separate counts were obtained from pollen mother cell meiotic material using the squash technique. Photographs were taken using a Zeiss Axiophot microscope and images captured using 6ASA imagelink film.

Data were recorded as a DELTA dataset (Dallwitz *et al.* 1993), from which species descriptions were generated. The species distribution map was generated using NatureMap, a departmental mapping application, and is based on PERTH specimen data.

Taxonomy

Stylidium rigidulum Sond. in C. Lehmann, Pl. Preiss. 1: 389 (1845). *Type*: In regionibus interioribus Australiae meridionali-occidentalis, *Preiss s.n.*, Oct. 1840 (*holo*: MEL 2160214!).

Stylidium streptocarpum Sond. var. *?macrocarpum* Benth. Fl. Austral. 4: 28 (1868). *Stylidium macrocarpum* (Benth.) F.L. Erickson & J.H. Willis *Victorian Naturalist* 72: 135 (1956). *Type*: Swan River, *J. Drummond* 2nd Collection No. 271 (*lecto*: MEL 2069479!; *isolecto*: BM!, CGE!, K (2 sheets)!, P!, W!). Swan River, *J. Drummond* 131 (*paralecto*: K!, MEL 2156087!). Murchison River, *Oldfield s.n.* (*paralecto*: K 60853!, MEL 21560801!). Swan River, *Collie s.n.* (*paralecto*: K).

Stylidium leptophyllum DC. var. *glabrescens* Mildbr. in A. Engler, Pflanzenreich IV, 278: 91 (1908). *Type*: West-Australien: Ohne Standortsangabe, *Oldfield s.n.* (*lecto*, here designated: W!). Victoria, Greenough River Crossing bei Mullewa in lichtem Gebüsch auf Sandboden, *Diels* 6067, Sept. 1901 (*paralecto*: B, n.v., destroyed in WWII).

Illustrations. Erickson & Willis (1956) Plate IV, Figures 8–18, p. 132; Erickson (1958) Plate 42, Figures 1–9, p. 145; Grieve & Blackall (1982) No. 73, p. 754.

Perennial herb, 6.5–30 cm high. *Glandular trichomes* 0.15–0.4 mm long; heads red to red-black, ellipsoid; stalks translucent. *Stems* propped above the soil surface by stilt roots, shortly elongated or somewhat condensed. *Leaves* arranged in a basal rosette, linear to linear-oblongate, 1–6 cm long, 0.5–1.5 mm wide, subterete, glabrous (rarely scabrous); margin entire, or hyaline and serrulate, serrations often conspicuous at leaf apex only; apex mucronate, mucro 0.2–1 mm long. *Scape* 4.5–28 cm high, 0.3–1.2 mm wide, glabrous. Inflorescence paniculate, 3–60-flowered; inflorescence units cymose, 1.5–6.5 cm long, 2–23-flowered, glabrous or sparingly glandular. Bracts 1.5–9 mm long, 0.8–1.2 mm wide, glabrous. Bracteoles 0.8–4 mm long, glabrous. Pedicels ± absent. *Hypanthium* cylindrical, 4.5–17 mm long, 0.4–1.2 mm wide, compressed in T.S., glandular (hairs typically restricted to the upper half). *Calyx lobes* partly fused (2 fused, 3 free) or rarely free, 1.3–2.5 mm long, 0.5–0.7 mm wide, glabrous, margin entire, apex obtuse. *Corolla* white to apricot–pink, throat markings red, throat yellowish; abaxial surface striped red–maroon, glandular; tube 1.2–2 mm long; lobes laterally-paired, elliptic; anterior lobes 3–4.7 mm long, 1.9–2.7 mm wide; posterior lobes 3.8–5 mm long, 1.9–2.7 mm wide. *Labellum* boss yellow, orbicular, 0.45–0.8 mm long, 0.4–0.8 mm wide; margin papillose, red; lateral appendages 0.3–0.6 mm long, yellow to red. *Throat appendages* absent. *Column* 8.7–10.2 mm long; anthers yellow or red, subtending hairs translucent; pollen yellow; stigma sessile, cushion-like, entire (lower lobe fails to develop). *Capsule* 14–25 mm long; broad at base, tapered at apex and partially twisted. *Seeds* rust-coloured, ellipsoid to ovoid, 0.6–1.1 mm long, 0.2–0.5 mm wide, papillose.

Selected specimens examined. WESTERN AUSTRALIA: N of Claremont [Perth], Sept. 1902, *C. Andrews s.n.* (K, PERTH); Yanchep National Park, 55.2 km from Perth toward Lancelin, 5 Oct. 1968, *E.M. Canning* WA/68 3947 (CANB, L, PERTH); 38 km S of the Geraldton Hwy turnoff on the Eneabba Rd, 28 Sept. 1976, *R.J. Chinnock* 3199 (AD, PERTH); c. 9 miles S of Yanchep, 3 Nov. 1953, *R. Erickson s.n.* (PERTH); Farm, NE of Badgingarra Rd, NW of Dandaragan, 22 Sept. 1988, *E.A. Griffin* 5207B (PERTH); Melaleuca Park, W of Bullsbrook, 27 Oct. 1997, *M. Hislop* 976A (PERTH); Boonanarring Nature Reserve, Gingin, 8 Oct. 2001, *F. Hort* 1492 (PERTH); 0.3 km N along Sandy Point Rd from intersection with Jurien Rd, 9 Oct. 1985, *N. Hoyle* 749 (CANB, PERTH); S side of Hill River Bridge on road 9.5 m E Jurien Bay, S to Cadda, Oct. 1971, *S. James* 71.10/31 (PERTH); Wongan Hills Experimental Farm, Reserve 18672, Craig Rd, 11 Oct. 1985, *C.M. Parker & P.J. Poli* 351 (PERTH); Burma Road Nature Reserve, 22 Sept. 1999, *S. Patrick* 3249A (PERTH); 4.8 km N on Cockleshell Gully Rd from Jurien East Rd, 8 Oct. 2003, *J.A. Wege* JAW 920 (PERTH); N of Arrowsmith River on Brand Hwy, 8 Oct. 2003, *J.A. Wege* JAW 929 (PERTH); 6.5 km E on Mt Adams Rd from Brand Hwy, 8 Oct. 2003, *J.A. Wege* JAW 931 (PERTH); Between Badgingarra and Jurien Bay, 8 Oct. 1969, *D.J.E. Whibley* 3195 (AD, PERTH).

Distribution. Known from the Perth region north to the Geraldton vicinity. Two specimens from an outlier population at Wongan Hills (*C.M. Parker & P.J. Poli* 351 and *C.M. Parker* 274) appear comparable to *S. rigidulum*; however, this population has not been assessed in the field. (Figure 1B)

Habitat. Grows on sand in heath communities, *Banksia* woodland and *Eucalyptus* shrubland.

Phenology. Flowering specimens are known from September to early November.

Conservation status. Widespread and not considered to be under threat.

Typification. The holotype of *Stylidium rigidulum* housed at MEL comprises leaf portions, an inflorescence unit, dissected flower parts and capsules. Despite the poor quality of the specimen, it is readily matched to *S. macrocarpum* by the highly diagnostic capsules that are long (c. 18–22 mm in the type), narrowed at the apex, and partially twisted (Figure 1A). These capsules superficially resemble the beaked hypanthium present in members of *Stylidium* subgenus *Nitrangium* (Endl.) Mildbr. section *Rhynchangium* Benth., which perhaps explains why Sonder positioned his description of *S. rigidulum* between species from this section.

Sonder's type description of *S. rigidulum* can also be matched to *S. macrocarpum*. It was on the basis of this description that Bentham (1868: 28) suggested *S. rigidulum* may be a small form of *S. streptocarpum* Sond. *Stylidium streptocarpum* var. ?*macrocarpum* Benth. was later raised to species level by Erickson & Willis (1956).

The precise type locality of *S. rigidulum* is unclear. Preiss was established in Albany by October of 1840 (McGillivray 1975), well south of the known range of this taxon. There are many inconsistencies with Preiss's label information during October and November of that year and it is likely that the type material of *S. rigidulum* was received by Preiss from another collector (N. Marchant pers. comm.). The MEL sheet of *S. rigidulum* has been annotated by Sonder. No duplicate material has been located.

Type material of *S. leptophyllum* DC. var. *glabrescens* Mildbr. matches *S. rigidulum*. Erickson & Willis (1956) incorrectly postulated that this variety may be equivalent to *S. macrocarpum* var. *planifolium* Erickson & Willis (now known as *S. ricae* Carlquist). The specimen of *S. leptophyllum* var. *glabrescens* housed at W has been annotated by Mildbraed and has therefore been chosen as the

lectotype. Material that he may have studied at Berlin was destroyed during World War II (Botanical Museum Berlin-Dahlem 1999).

Notes. Juvenile leaves of *S. rigidulum* possess a conspicuous hyaline serrate margin and abaxial midrib; however, in mature leaves, the serrations tend to be restricted to the apex of the leaf, or may be absent altogether. In populations south-east of Geraldton (at the northern end of the range for *S. rigidulum*) the serrate margin borders all of the mature leaf, and papillae occur on the midrib area (e.g. *S. Patrick* 3249A, *JAW* 931). I initially thought that these northern populations may represent a new infraspecific taxon; however, there are a few examples of populations to the south that also possess these features (albeit not with the same prominence as the northern populations). Variation in the presence of leaf papillae is known to occur in other species of *Stylidium* (e.g. *S. hirsutum* R.Br.) and the taxonomic significance of this character must be carefully evaluated. Since additional morphological features separating the northernmost populations from the remaining populations could not be found, a separate taxonomic status is not thought warranted.

Stylidium kalbarriense Lowrie & Kenneally. *Nuytsia* 11: 189 (1997). *Type*: 20 km E of Kalbarri, on Ajana–Kalbarri Rd, S side of road, Western Australia, 4 Sept. 1992, *A. Lowrie* 638 (*holo*: PERTH 04452445!; *iso*: MEL!).

Illustrations. Lowrie & Kenneally (1997), Figure 3, p. 190.

Perennial herb, 6–28 cm high. *Glandular trichomes* 0.15–0.4 mm long; heads red, ellipsoid; stalks translucent to reddish. *Stems* typically positioned just below the soil surface, condensed and slightly thickened (rarely shortly elongated). *Leaves* arranged in a basal rosette, linear to linear-oblongate, 0.8–9.5 cm long, 0.7–1.5 mm wide, subterete, glabrous; margin entire along leaf length, hyaline serrations present at apex and typically along the apical abaxial midrib; apex mucronate, mucro 0.2–1.2 mm long. *Scapes* 5–27 cm high, 0.3–1.5 mm wide, glabrous at base, glandular along inflorescence axis. Inflorescence paniculate, 9–c.50-flowered; inflorescence units cymose, 1.5–9 cm long, 2–13-flowered, glandular. Bracts 1.8–6 mm long, 1.2–1.5 mm wide, glabrous. Bracteoles 1.2–2 mm long, glabrous. Pedicels=absent, or 0.5–1 mm long, glandular. *Hypanthium* oblong to cylindrical, 3–11 mm long, 0.5–1.3 mm wide, compressed in T.S., glandular. *Calyx lobes* free or partly fused (2 fused and 3 free), 1.5–2.8 mm long, 0.5–1.2 mm wide, glandular, margin entire, apex obtuse. *Corolla* white to pale pink, throat markings red, throat yellowish; abaxial surface striped red–maroon, glandular; tube 1.5–2.5 mm long; lobes laterally-paired, elliptic; anterior lobes 2.3–4.5 mm long, 1.6–3 mm wide; posterior lobes 2.5–5 mm long, 1.6–3 mm wide. *Labellum* boss white or yellow, orbicular to broadly ovate, 0.6–0.9 mm long, 0.5–0.8 mm wide; margin papillose, red; lateral appendages 0.2–0.9 mm long, red to yellow. *Throat appendages* absent. *Column* 7–11.5 mm long; anthers red–black, subtending hairs translucent; pollen white to yellow; stigma sessile, cushion-like, bilobed (upper lobe developing first). *Capsule* 8.5–16 mm long; untwisted. *Seeds* brown to rust-coloured, ellipsoid, 0.6–1 mm long, 0.3–0.5 mm wide, surface textured but not papillose.

Selected specimens examined. WESTERN AUSTRALIA: Murchison Gorge, 30 Aug. 1984, *R. Bates* 3894 (PERTH); By Ajana–Kalbarri road at turnoff to Ross Graham Lookout, Kalbarri National Park, 8 Aug. 1993, *K. Bremer & M. Gustafsson* 31 (PERTH, UPS); 3 miles N of the road from Badgingarra to Jurien Bay, on Cockleshell Gully Rd, 4 Oct. 1974, *S. Carlquist* 5917 (PERTH, RSA); Kalbarri, 15 Aug. 1966, *R. Erickson s.n.* (PERTH); 7 km N of Gee Gie Outcamp, 52 km SW of Nerren Nerren Homestead, 14 Sept. 1979, *S.D. Hopper* 1313 (PERTH); Cooloomia Nature Reserve, 20 km S of Cooloomia on the Old Telegraph Line, 20 Sept. 1979, *S.D. Hopper* 1438 (PERTH); Coolimba–Eneabba Rd, 2.9 km E of the Coast Rd, 26 Oct. 2002, *F. & J. Hort* 1882 (PERTH); 42.6 km W along State Barrier Fence Access track W from NW Coastal Highway, Site zu5; 26 Aug. 1994, *G.J. Keighery & N. Gibson* 1333 (PERTH); Kalbarri airstrip, 5 km S of

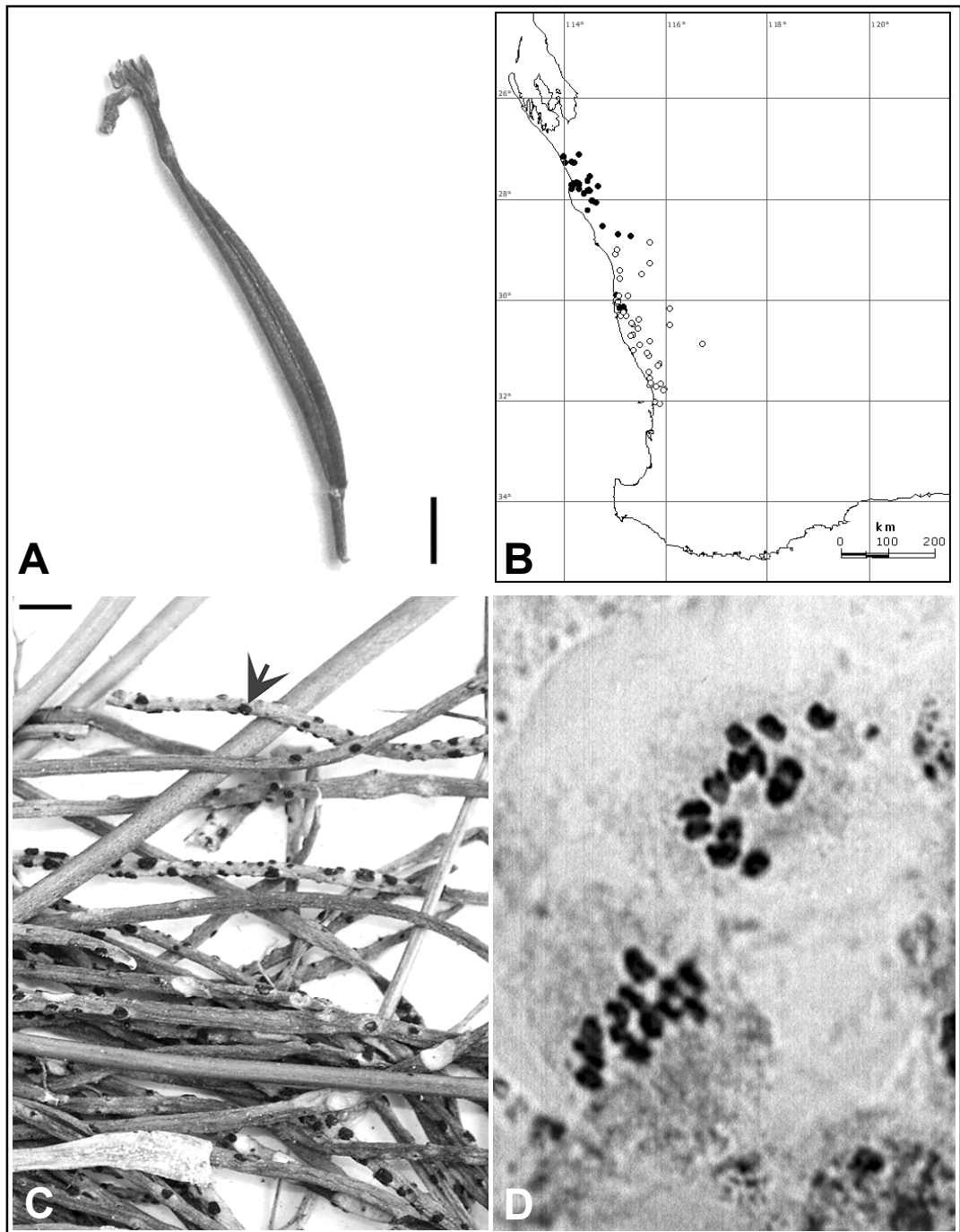


Figure 1. A – Capsule from the holotype of *Stylidium rigidulum* (MEL 2160214); B – Distribution of *Stylidium kalbarriense* (●) and *S. rigidulum* (○); C – Rust sori on the leaves of *Stylidium kalbarriense* (Carlquist 5917, PERTH 03122867); D – Chromosome preparation ($n = 13$) for *Stylidium kalbarriense* (Wege JAW 317). Scale bars at 3mm.

Kalbarri, 1 Oct. 1979, *J. Taylor, M.D. Crisp & R. Jackson* JT 1037 (CANB, PERTH); c. 2 km S along Meenara Hill Rd from the Ajana–Kalbarri Rd, 14 Aug. 1997, *J.A. Wege & R. Butcher* JAW 317 (PERTH); 1.35 km S from Coorow–Greenhead Rd on track 2.5 km E of Cockleshell Gully Rd, 25 Oct. 2002, *J.A. Wege* JAW 744 (PERTH); 6.5 km E on Mt Adams Rd from Brand Hwy, 8 Oct. 2003, *J.A. Wege* JAW 930 (PERTH).

Distribution. Known from the Murchison region south to Lesueur National Park. (Figure 1B)

Habitat. Grows in sand, often associated with limestone, in heathland or low scrub.

Phenology. Flowering specimens have been collected from August to October.

Conservation status. This species is widespread and not under threat.

Affinities. *Stylidium kalbarriense* can be readily differentiated from *S. rigidulum* by its glandular-hairy inflorescence axis and calyx lobes, and untwisted capsules. These two species also differ slightly in habit: the stems of *S. rigidulum* are always raised well above ground level by stilt roots, whereas the stems of *S. kalbarriense* tend to be buried just under the soil surface (although in some specimens the most recent season's growth increment may be elongated and above ground level).

Notes. The geographic ranges of *S. kalbarriense* and *S. rigidulum* overlap in the Lesueur and Eneabba regions (Figure 1B). They grow in sympatry east of Dongara, and were observed by the author growing side by side without hybridization. Curation of the collection at PERTH uncovered a second potential site of sympatry between these two species: two specimens (*K.F. Kenneally* 4696 and 4697), collected on the same day from the same location. This site, which is NW of Eneabba, has not been successfully relocated in the field.

Rust

Roger Shivas has identified a fungal pathogen, *Puccinia stylidii* McAlpine (Pucciniaceae), on a specimen of *S. kalbarriense* from the Murchison area (PERTH 2527847). Examination of herbarium material housed at PERTH has found that the majority of collections of both *S. kalbarriense* and *S. rigidulum* show some sign of infection by what is presumably the same species of rust (although this has not been confirmed by a rust expert). In both species, the sori are typically restricted to the leaves (Figure 1C), but sometimes occur on the lower scape and, in one specimen of *S. rigidulum* (PERTH 03123030), on the inflorescence and immature capsules.

Puccinia stylidii was first described from a specimen of *S. graminifolium* Sw. ex Willd. from Tasmania (McAlpine 1906). This species of rust has also been documented on the south-west Australian endemics *S. pycnostachyum* Lindl. (Shivas 1989) and *S. merrallii* (F. Muell.) T. Durand & B.D. Jackson (Kenneally & Lowrie 1994). It is not known how many more species of *Stylidium* are hosts for this rust.

Chromosomedata

James (1979) recorded two different chromosome numbers for *S. macrocarpum*: $n = 11$ (Hill River Bridge) and $2n = 26$ (Cockleshell Gully). The Hill River Bridge voucher, collected by James, has been located at PERTH (sheet number 03123170) and is confirmed as *S. rigidulum*. A voucher specimen

collected by James from Cockleshell Gully has not been located; however, a specimen of *S. kalbarriense* collected from this location by G. Stone and G.J. Keighery (who were students at UWA at the time) is housed at PERTH (PERTH03123189). It is likely that this specimen is the $2n=26$ voucher. A chromosome number of $n=13$ for *S. kalbarriense* is confirmed by the present author (Figure 1D) from a population within Kalbarri National Park (Wege JAW 317; PERTH05596157).

Studies on several closely related species complexes have established that a change in chromosome number is often a feature of species differentiation in *Stylidium* (e.g. Banyard & James 1979; Coates 1982; Farrell & James 1979; Lowrie *et al.* 1998). *Stylidium rigidulum* and *S. kalbarriense* provide yet another example of this phenomenon.

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