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Tetratheca spenceri (Elaeocarpaceae), a new rare and range-restricted species from the Coolgardie bioregion, Western Australia

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Abstract

Butcher, R. & Cockerton, G.T.B. *Tetratheca spenceri* (Elaeocarpaceae), a new rare and range-restricted species from the Coolgardie bioregion, Western Australia. *Nuytsia* 22(3): 111–120 (2012). The new species of *Tetratheca* Sm. described herein was discovered opportunistically by Goldfields resident Charlie Spencer while exploring the Coolgardie bioregion in late 2011; it is named *T. spenceri* R.Butcher & Cockerton in honour of him. *Tetratheca spenceri* is currently known from a single population on a laterite outcrop south-east of Coolgardie and is of conservation significance. Five rare, short-range endemic *Tetratheca* taxa are already known from Banded Iron Formation ranges in the Coolgardie bioregion. *Tetratheca spenceri* can be distinguished from all other species of *Tetratheca* in the region by its combination of straight, finely wrinkled, glaucous stems, alternate, appressed, narrowly deltoid scale-leaves, moderately long peduncles bearing long, glandular hairs, uniformly pink petals, two ovules per locule, which are crowded together near the apex of the septum, and narrowly obovate, glabrous fruit. The new species is described and illustrated herein, its affinities are discussed, and its distribution mapped. A key to the 'leafless' taxa of *Tetratheca* in Western Australia is included.

Introduction

There are currently 50 described species of *Tetratheca* Sm. in Australia, 70% of which are endemic to Western Australia (Butcher 2009), with an additional four informally-named taxa also known from the State (Western Australian Herbarium 1998–). Twenty-seven of the Western Australian taxa have conservation status under the Department of Environment and Conservation's (DEC) Conservation Codes for Western Australian Flora. Of these, eight taxa are listed as Threatened Flora due to their highly restricted distributions and threats to habitat, primarily from mining activity, and one species (*T. fasciculata* Joy Thomps.) is listed as Presumed Extinct. Five of the eight Threatened taxa are endemic to the Coolgardie bioregion, each restricted to a single, small, disjunct Banded Iron Formation (BIF) range (Bull 2007; Butcher 2007; Butcher *et al.* 2007), *viz. T. aphylla* F.Muell. subsp. *aphylla* (Helena and Aurora Range), *T. erubescens* J.Bull (Koolyanobbing Range), *T. harperi* F.Muell. (Jackson Range), *T. paynterae* Alford subsp. *paynterae* (Windarling Range) and *T. paynterae* subsp. *cremnobata* R.Butcher (Die Hardy Range). An additional species from this area, *T. efoliata* F.Muell, is comparatively widespread, occurring in sandplain country in the Coolgardie, Avon Wheatbelt, Esperance Plains and Mallee bioregions.

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In this paper we describe a new species, *Tetratheca spenceri* R.Butcher & Cockerton, which is currently known from a single population on a weathered ironstone outcrop in the Coolgardie bioregion, *c.* 43 km south-east of Coolgardie. Like the five Threatened BIF taxa, *T. spenceri* is a clumped subshrub with small, appressed scale-leaves on its mature stems. These leaves fall early, leaving only small remnant bases, so that the plants are 'leafless' in appearance (s*ensu* Thompson 1976). Recent molecular phylogenetic analyses of *Tetratheca* (with *Platytheca* Steetz and *Tremandra* DC as outgroups) showed that despite their close geographic proximity, similar habitat niches and gross morphological similarity, *T. aphylla*, *T. erubescens*, *T. harperi* and *T. paynterae* do not belong to the same evolutionary lineage, and that the 'leafless' habit has arisen many times within the genus as a result of convergent evolution (Butcher *et al*. 2007; McPherson 2008).

Tetratheca spenceri was discovered serendipitously by Southern Cross resident, gold prospector, and regional flora and fauna survey co-ordinator Charlie Spencer, while exploring breakaway country south of Coolgardie in November 2011 (Figure 1). Being familiar with the morphology and distribution of

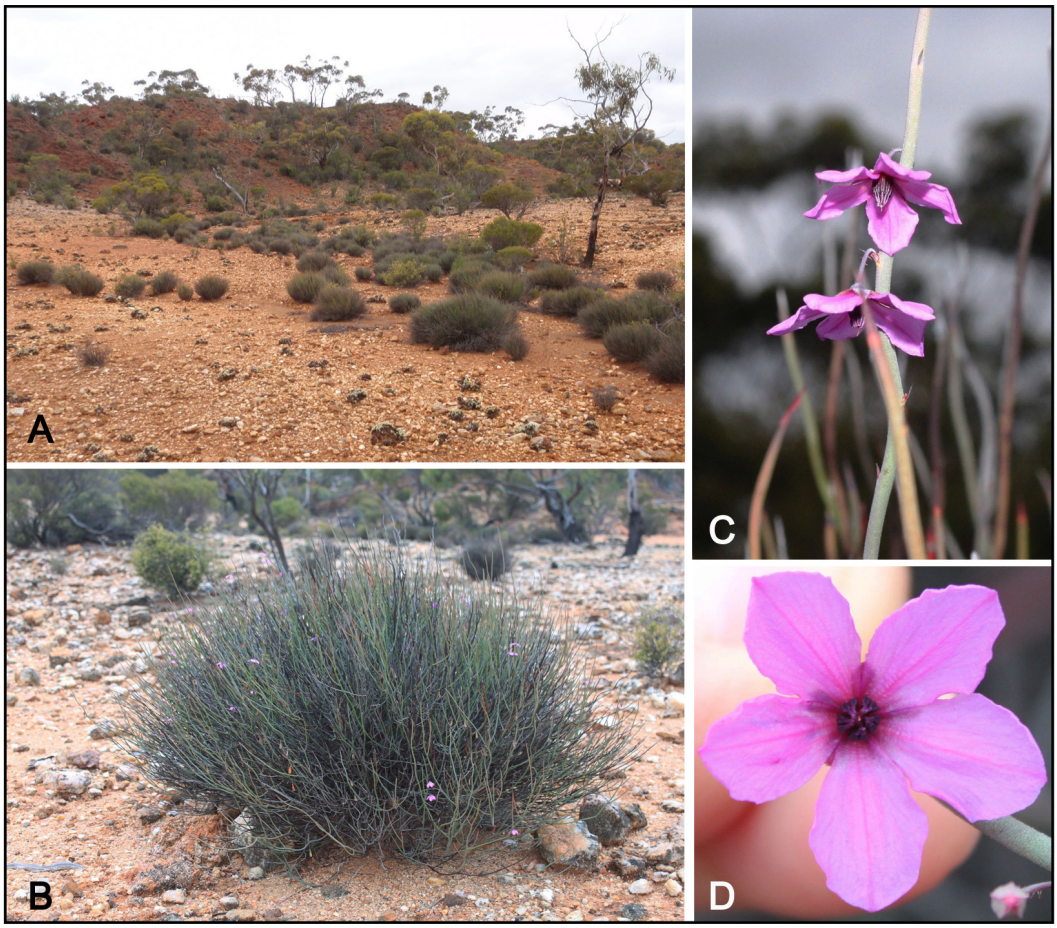

Figure 1. *Tetratheca spenceri*. A – habitat; B – habit; C – pendulous flowers *in situ*; D – single flower showing broadly obovate, uniformly pink petals. Photographs by Jonathan Warden (A) and Danae Warden (B–D).

the various *Tetratheca* taxa in the Coolgardie bioregion, Charlie recognised that this was an unusual population of plants and collected a specimen for taxonomic review. Preliminary examination of this specimen (by GC) determined that it did not match any of the known species from this taxon-rich area. Subsequent examination of specimens (by RB) collected in December 2011 confirmed that this is a distinct new species.

Methods

All *Tetratheca* specimens at AD, BRI, MEL and PERTH, and specimens of Western Australian species on loan from NSW, were examined. The description is based on herbarium specimens, reconstituted flowers and material preserved in 70% ethanol. Herbarium acronyms follow Thiers (continuously updated). The distribution map was created using PERTH specimen data, and shows *Interim Biogeographical Regionalisation for Australia (IBRA) Version 6.1* boundaries (Department of the Environment, Water, Heritage and the Arts 2008). The taxonomic key presented here is modified from Butcher (2007, 2008) to include *T. spenceri* and the subspecies of *T. aphylla* and *T. paynterae*.

Key to species and subspecies of 'leafless' *Tetratheca* in Western Australia

1. Plants leafy ..... **group not addressed here**

1: Plants with a generally leafless aspect, although some leaves may be present

2. Stems winged. Ovules 1–5 per loculus (Yallingup, Balingup to Cape Riche) ..... **T. affinis**

2: Stems terete or tri- to quadrangular in cross-section. Ovules 1 or 2 per loculus

3. Ovules typically 1 per loculus

4. Peduncles and calyces densely pubescent, peduncles less than 5 mm in length

5. Peduncles and calyces hispid with few additional small, red, glandular hairs. Leaf margins flat (NE Southern Cross, Newdegate) ..... **T. aphylla**

5a. Stems striate, densely covered in very slender acute tubercles, appearing hispid. Flowers usually 5-merous, sometimes 4-merous. Fruits 5.5–10.2 mm long, 3.1–3.9 mm wide (Helena and Aurora Ra.) ..... subsp. **aphylla**

5a: Stems rugose, covered in short, acute tubercles and scattered, red, glandular hairs or remnant bases. Flowers usually 4-merous, sometimes 5-merous. Fruits 7.5–10.2 mm long, 4.9–6.3 mm wide (Newdegate) ..... subsp. **megacarpa**

5: Peduncles and calyces hispid with numerous additional large, red glandular hairs, these frequently bearing small, simple hairs towards their base. Leaf margins loosely revolute

6. Stems 0.8–0.9 mm broad in the flowering region. Anther body 1.9–2.5 mm long with the lowest 0.6–1.0 mm extremely flattened and resembling the 0.6–1.0 mm long filament (Beverley to Arrino) ..... **T. paucifolia**

6: Stems 1.7–1.9 mm broad in the flowering region. Anther body 2.5–2.6 mm long, not flattened in the lower region, curved at base adaxially and abruptly meeting the 1.1–1.8 mm long filament (Eneabba) ..... **T. nephelioides**

4: Peduncles and calyces glabrous or with occasional glandular hairs, peduncles 5 mm or more in length

7. Stems glabrous or very sparsely glandular hairy. Ovary pubescent to sericeous, with or without additional glandular hairs, or with glandular hairs only. Anther tube 0.35–1.6 mm long

8. Stems compressed to quadrangular (Badgingarra to Eneabba)..... **T. angulata**

8: Stems terete

9. Ovary covered with stout glandular hairs only. Style glabrous. Anther tube 1.3–1.6 mm long (NW Toodyay) ..... **T. spartea**

9: Ovary with a dense covering of simple hairs, with additional slender glandular hairs. Style pubescent at base. Anther tube 0.35–1 mm long

10. Body of anther flattened in lower third, filament 0.6–1.4 mm long, tube 0.6–1 mm long (Scattered; Dardadine, Broomehill, Ravensthorpe)..... **T. applanata**

10: Body of anther not flattened towards base, filament 0.2–0.35 mm long, tube 0.35–0.5 mm long (Darling Scarp) ..... **T. nuda**

7: Stems usually with fine to coarse, scattered to dense setae, occasionally glabrous. Ovary glabrous. Anther tube 1.5–2.5 mm long

11. Stems densely covered with patent, stout setae arising from broad tubercles. Leaves small (1.9–6.2 mm long) with flat, sparsely dentate and/or glandular hairy margins (NE Southern Cross)..... **T. harperi**

11: Stems glabrous or finely setose, setae reflexed to retrorse when present and arising from small tubercles. Leaves large (2–15.5 mm long) with revolute, glabrous margins

12. Leaf-blades tapered at the base. Anther filaments stout, *c.* 1 mm long (E side Darling Scarp, York to Albany)..... **T. virgata**

12: Leaf-blades broad at the base. Anther filaments slender, *c.* 0.5 mm long (Mt Lesueur) . **T. remota**

3: Ovules typically 2 per loculus

13. Stems densely covered in broad tubercles bearing patent, stout, somewhat senescent setae. Petals white to pale pink with dark pink spots or pale mauve (NE Southern Cross)..... **T. erubescens**

13: Stems smooth, rugulose or minutely tuberculate, usually glabrous or with scattered glandular hairs or retrorse setae. Petals uniformly dark or mauve-pink, occasionally white

14. Stems usually sinuous. Leaves usually in fascicles, or alternate. Anther tube 2.5–3.0 mm long with a conspicuously 2-lipped orifice (Tammin to Norseman)..... **T. efoliata**

14: Stems straight. Leaves alternate, never in fascicles. Anther tube 0.6–2.5 mm long, the orifice oblique or with a longer inner lip

15. Base of the plant usually covered with strongly retrorse, dark-coloured setae. Peduncles glabrous, 7–16 mm long. Leaves with revolute margins (Wongan Hills to Katanning)..... **T. retrorsa**

15: Base of the plant lacking strongly retrorse, dark-coloured setae. Peduncles scabrous to hispidulous, often with scattered, small glandular hairs or sub-glabrous with glandular hairs in the mid-region, 1–11 mm long. Leaves with flat margins

16. Stems rugulose, dull light green, glabrous. Peduncles and calyces dull, pinkish mauve to purple-red ..... **T. spenceri**

16: Stems tuberculate, mid-green, often with scattered glandular hairs. Peduncles and calyces glossy, green and red.

17. Stems minutely tuberculate. Calyx segments broadly elliptic (Carnarvon Ra.) .....**T. chapmanii**

17: Stems densely covered with rounded to truncate tubercles. Calyx segments narrowly triangular to lanceolate (NE Southern Cross) ..... **T. paynterae**

17a. Ovary with a dense covering of patent simple hairs and scattered glandular hairs, simple hairs extending along style in the lower 2/3. Leaves sparsely hispid on upper and lower surfaces (Windarling Ra.).....subsp. **paynterae**

17a: Ovary with scattered glandular hairs and a few simple hairs at the apex just below the style, glandular hairs extending along style in the lower 1/2. Leaves with occasional hairs abaxially and a few apical hairs adaxially (Die Hardy Ra.) ..... subsp. **cremnobata**

Taxonomy

Tetratheca spenceri R.Butcher & Cockerton, *sp. nov.*

Typus: Coolgardie bioregion, Western Australia [precise locality withheld for conservation reasons], 14 December 2011, *J. Warden* WB 33628 (*holo*: PERTH 08309582; *iso*: CANB, MEL, NSW).

Clumped *sub-shrub*, 0.5–0.6 m high, 0.8–1 m wide. *Stems* numerous from base; branches alternate, rarely opposite, stout, terete, straight, terminating in a slender, brown or silver point, 1.3–1.6 mm wide in flowering region; juvenile stems pink-red, becoming yellowish olive-green, rugulose; mature stems light green, dull, rugulose; all stems glabrous, frequently glaucous. *Leaves* reduced to scales, sparse (1 or 2 per cm stem length), alternate, appressed to stem, sessile, caducous; blade narrowly triangular to lanceolate, 1.2–2.7 mm long, 0.3–0.4 mm wide; apex acute to acuminate; margins entire, flat; adaxial and abaxial surfaces pink-red to light green, glabrous, not glaucous. *Flowers* axillary, solitary, pendulous. *Bracts* paired, ovate to broadly ovate, acuminate, 0.8–1.2 mm long, 0.3–0.8 mm wide, strongly concave in TS, red; adaxial surface pubescent, the hairs simple; abaxial surface glabrous. *Peduncles* gently curved, lengthening as flowers develop, 3–9 mm long, 0.3–0.4 mm wide, purple-red, dull, longitudinally ridged, with a cluster of slender, small-headed glandular hairs (0.1–0.6 mm long) in the lower 2/3 or mid-region, glaucous, tapering gradually along length then expanding into a ridged, angular, glabrous receptacle 1–1.5 mm wide. *Calyx* segments (4)5, inserted on edge of receptacle rim, the base not thickened or folded, deciduous, narrowly elliptic to narrowly obovate, 2.4–3.6 mm long, 1.2–2 mm wide, concave in T.S.; apex acute, obtuse or rounded with a small apiculus; margins flat; outer surface pinkish light purple, dull, glabrous; inner surface with a band of fine, simple hairs just inside the margin; mid-vein thickened. *Petals* (4)5, deciduous, broadly obovate, 5.9–9 mm long, 3.4–6.3 mm wide with the widest point at 5–5.7 mm (*c.* 1/3 from the apex), uniformly pink but with a minute yellow area at base; apex rounded, with a small triangular fold from centre. *Stamens* (8)10, 3.4–4.2 mm long, shortly fused into pairs at base; filaments thick, compressed, obliquely angled, 0.4–0.55 mm long, red, with scattered, short, simple hairs near junction with anther body on lateral and outer surfaces; anther body gently curved from the filament on inner and outer edges with sides ±parallel, the inner edge gently curved into anther tube, the outer edge with an abrupt transition into anther tube, 1.9–2.5 mm long, dark red, smooth on outer surface, minutely tuberculate and hispidulous on inner and lateral surfaces; anther tube incurved along its length, 1.1–1.3 mm long; orifice narrow,

shortly two-lipped, the lower lip longer than the upper, red, mostly smooth, minutely tuberculate and hispidulous on lower surface near base. *Ovary* elliptic, compressed, slightly thickened at base, 1.5–2.1 mm long, 1–1.5 mm wide, dark red, glabrous except for a small area of short simple hairs near apex, these often shortly extending along midline from apex and onto style base, glabrous inside loculi; *style* gently to strongly sinuate in mid-region, thick, tapering towards apex, 1.5–2.2 mm long, dark red, slightly paler at apex, mostly glabrous but papillate to sparsely hispidulous at base; *stigma* simple, shortly papillose; *ovules* 4, 2 in each locule, both attached towards the apex of the septum by small, colourless placentas. *Fruit* compressed-narrowly obovoid to -broadly ellipsoid, 5.5–11.5 mm long, 3.3–4.7 mm wide, greenish yellow to pink, suture line and apex pink to red, dull, lightly glaucous, glabrous; rim of receptacle prominent and persistent, gently angled; style persistent. *Seed* obliquely obloid to narrowly obovoid, the proximal end obtuse, the distal end truncate, 3.1–3.5 mm long, 1.3–1.6 mm wide, light tan, with antrorse, loosely appressed, fine, white, simple hairs; *elaiosome* prominent, irregularly coiled beyond the seed in 3 or 4 coils, 1.4–2 mm long in coiled state, terete and tan at base, becoming flattened and white after the first coil, with spreading to patent, fine, white, simple hairs. (Figures 1, 2)

Diagnostic features. Distinguished from all other species of *Tetratheca* by the following combination of characters: stems straight, finely wrinkled, glabrous, frequently glaucous; scale-leaves alternate, appressed, narrowly deltoid; peduncles moderately long (3–9 mm) with short to long, glandular hairs in the lower two-thirds or clustered in the mid-region; petals uniformly pink; ovules two per locule, these crowded together near the apex of the septum; fruit narrowly obovate, glabrous.

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 14 Dec. 2011, *J. Warden* WB 33620 (K, PERTH); 14 Dec. 2011, *J. Warden* WB 33630 (AD, PERTH).

Distribution and habitat. To date, this species is only known from a single population occurring on low, lateritic outcrops *c.* 43 km south-east of Coolgardie (Figure 3). Field observations by Jonathan Warden (Western Botanical) indicate that *T. spenceri* occurs primarily along drainage channels, with the population starting on the upper slopes of weathered duricrust and extending down to the rocky lower slopes, where it seems restricted to a dark band of possibly iron-rich soil. Associated vegetation comprises sparse mallee woodland dominated by *Eucalyptus stricklandii*, over sparse tall shrubland dominated by *Alyxia buxifolia*, *Leucopogon* sp. Kambalda (J. Williams s.n. PERTH 07305028) and *Melaleuca leiocarpa* with a sparse understorey of low shrubs and herbs, in which *Lepidosperma* sp. Parker Range (M. Gibson & M. Lyons 2094), *Ptilotus helichrysoides*, *Scaevola spinescens* (narrow-leafed, spiny form) and *T. spenceri* are dominant.

Phenology. Collected in flower in November and mid-December, with immature and sub-mature fruits also seen in mid-December. Flowers, mature fruit and seed were present on various plants in the population in mid-February.

Etymology. Named for Paul Geoffrey (Charlie) Spencer (4th May 1959–) who discovered this species while exploring the unique landscapes of the Coolgardie bioregion, in which he has lived for most of his life and for which he has great passion. The common names Spencer's Tetratheca and Charlie's Gold are suggested here to mark his valuable find.

Conservation status. To be listed as Priority One under DEC Conservation Codes for Western Australian Flora due to its small area of occupancy and threats to its habitat associated with mineral

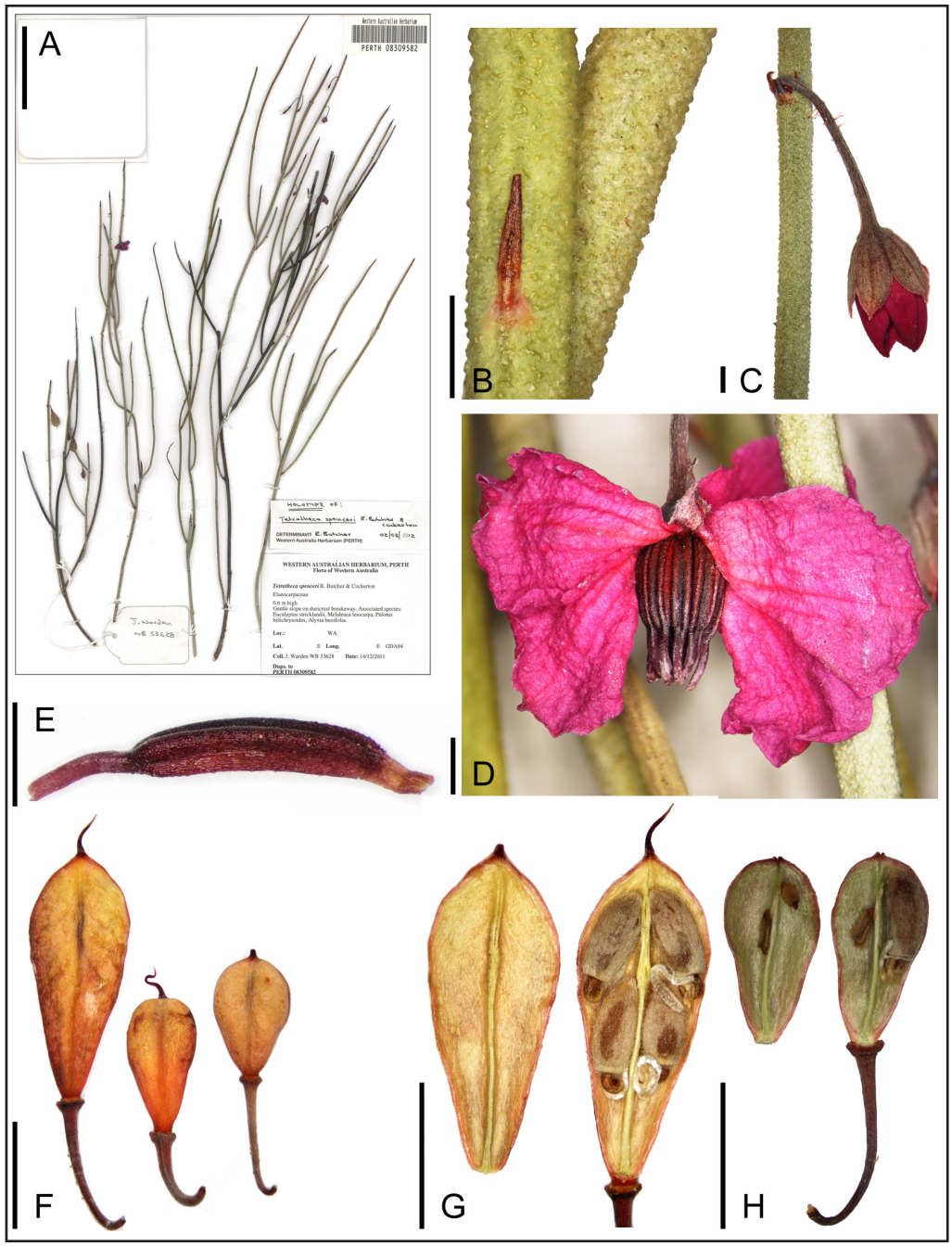

Figure 2. *Tetratheca spenceri*. A – holotype; B – glaucous wrinkled stems and appressed, lanceolate scale-leaf; C – pressed flower in late bud showing glandular hairs on peduncle, glabrous, narrowly obovate calyx segments and paired, red bracts; D – pressed flower; E – stamen showing curved anther tube with narrow orifice; F – glabrous fruit showing size and shape variation related to seed development; G – large, narrowly obovoid fruit opened to show four fully-developed seeds; H – small, obovoid fruit opened to show one fully-developed seed and three aborted ovules. Images taken from *J. Warden* WB 33628 (A, B, F, G) and *J. Warden* WB 33630 (F, H). Scale = 5 cm (A); 1 mm (B–D); 5 mm (F–H).

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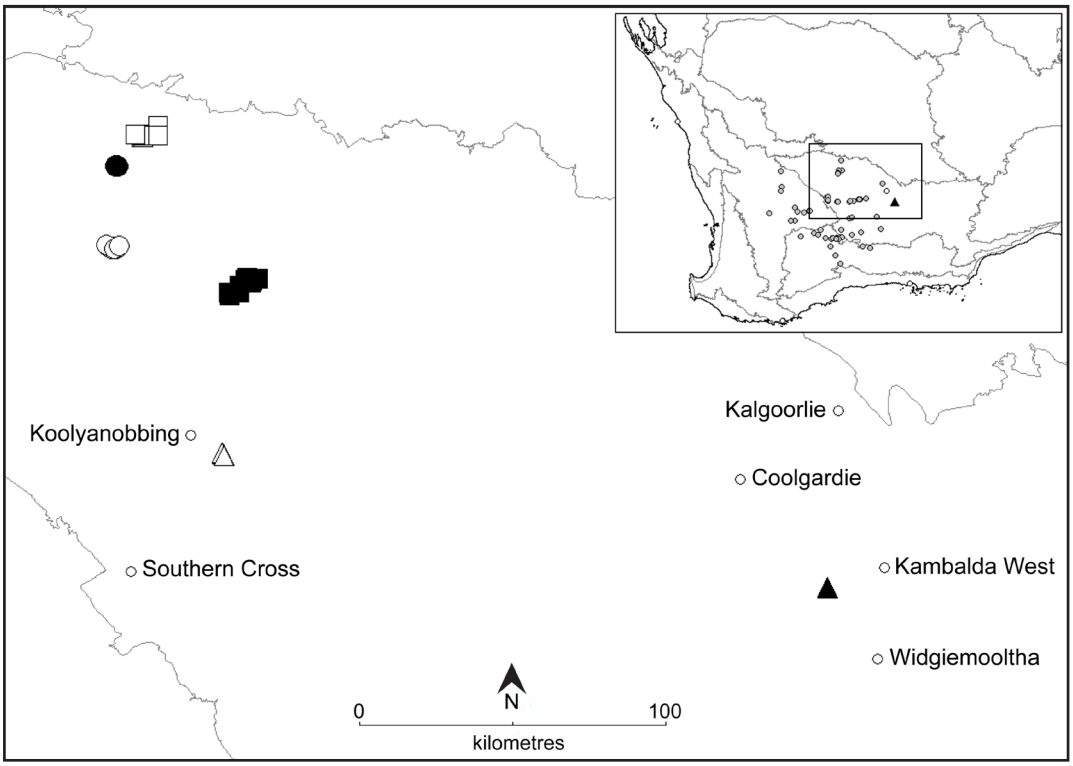

Figure 3. Distribution of *Tetratheca spenceri* (▲) in the Coolgardie bioregion of Western Australia. The distributions of the rare BIF taxa *T. aphylla* subsp. *aphylla* (■), *T. erubescens* (△), *T. harperi* (○), *T. paynterae* subsp. *cremnobata* (□) and *T. paynterae* subsp. *paynterae* (●) are also shown. The inset shows the distribution of *T. spenceri* relative to the widespread sandplain species *T. efoliata*.

prospecting and mining. Survey of the only known population by Charlie Spencer and Jonathan Warden in December 2011 located *c.* 1,350 plants in an area of *c.* 300 m^2. The smallest discrete aggregate of plants comprised *c.* 30 individuals and the largest *c.* 250 individuals.

Affinities. *Tetratheca spenceri* shares characters with all of its regional congeners (Table 1), but can be readily distinguished from each by the unique combination of characters given above. Of the other taxa having two ovules per locule, *T. spenceri* is most similar to *T. paynterae* in the shape and colour of its petals, to *T. efoliata* in its stem and fruit morphology, and to *T. erubescens* in its glabrous ovary and stamen morphology. Parsimony analysis of combined ITS and *trn*L–*trn*F data indicates a close relationship between the sandplain endemic *T. efoliata* and the BIF taxa *T. paynterae* subsp. *paynterae* and subsp. *cremnobata* (McPherson 2008; bootstrap 87%; Bayesian posterior probability 0.9), despite the species' morphological differences. This moderately well supported clade is sister to a clade containing the nearby BIF taxa *T. erubescens* and *T. aphylla* subsp. *aphylla*. *Tetratheca spenceri* is hypothesised to be closely related to *T. efoliata*, *T. erubescens* and *T. paynterae*, and this could be tested in future studies by phylogenetic analysis of morphological and molecular datasets.

Notes. Fruit shape and length is variable depending on the number of ovules which develop fully into seeds. When all four ovules develop, fruit are characteristically compressed-narrowly obovoid.

Table 1. Key similarities and differences between *Tetratheca spenceri* and other 'leafless' taxa from the Coolgardie bioregion.

	T. aphylla	T. efoliata	T. erubescens	T. harperi	T. paynterae	T. spenceri
Stem						
shape	straight	sinuous	straight	straight	straight	straight
surface	acute tubercles	rugulose	broad tubercles + setae	broad tubercles + setae	rounded tubercles	rugulose
vestiture	not glaucous	glaucous	glaucous	glaucous	not glaucous	glaucous
Leaves						
phyllotaxis	alternate	fasciculate or alternate	alternate	alternate	alternate	alternate
orientation	appressed	ascending	appressed	appressed	appressed	appressed
type	scale-leaf	true leaf	scale-leaf	scale-leaf	scale-leaf	scale-leaf
margin	flat	recurved	flat	flat	flat	flat
Petals						
markings	none	dark purple patch at base	darker streaks from base	darker streaks from base	none	none
Ovary						
simple hairs	present	absent	absent	absent	present (subsp. *paynterae*) or absent (subsp. *cremnobata*)	absent
glandular hairs	present	present	absent	absent	present (both subspecies)	absent
Ovules						
#/locule	1	2	2	1	2	2

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