

## Twenty-seven new species of vascular plants from Western Australia

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### Abstract

Barrett, R.L. & Barrett, M.D. Twenty-seven new species of vascular plants from Western Australia. *Nuytsia* 26: 21–87 (2015). Twenty-seven new species are described from Western Australia. *Bossiaea arenitensis* R.L.Barrett, *B. zarae* R.L.Barrett (Fabaceae), *Commelina roensis* M.D.Barrett & R.L.Barrett (Commelinaceae), *Crinum joesmithii* M.D.Barrett & R.L.Barrett (Amaryllidaceae), *Eriocaulon rivicola* G.J.Leach, M.D.Barrett & R.L.Barrett (Eriocaulaceae), *Glycine remota* M.D.Barrett & R.L.Barrett (Fabaceae), *Hybanthus bennettiae* R.L.Barrett (Violaceae), *Mitrasacme thedae* M.D.Barrett & R.L.Barrett (Loganiaceae), *Nymphoides astoniae* M.D.Barrett & R.L.Barrett (Menyanthaceae), *Proiphys kimberleyensis* M.D.Barrett & R.L.Barrett (Amaryllidaceae), *Schoenus thedae* M.D.Barrett & R.L.Barrett (Cyperaceae), *Trachymene pavementum* M.D.Barrett & R.L.Barrett (Araliaceae), *Tribulopsis marliesiae* R.L.Barrett (Zygophyllaceae), *Triodia celsa* M.D.Barrett and *T. diantha* M.D.Barrett (Poaceae) are described from the Kimberley region. *Aphyllodium beardii* R.L.Barrett (Fabaceae) is described from the Great Sandy Desert and *Triodia basitricha* M.D.Barrett is described from the Pilbara region. *Calectasia demarzii* R.L.Barrett, *C. elegans* R.L.Barrett, *C. jubilaea* R.L.Barrett, *C. valida* R.L.Barrett (Dasypogonaceae), *Caustis deserti* R.L.Barrett, *C. gigas* Meney & K.W.Dixon ex R.L.Barrett, *Lepidosperma fairallianum* R.L.Barrett, *L. hopperi* R.L.Barrett, *L. oldhamii* R.L.Barrett (Cyperaceae) and *Poranthera asybosca* R.L.Barrett (Phyllanthaceae) are described from the south-west of Western Australia. All new species are illustrated and their conservation status assessed.

### Introduction

This paper formally names and describes a miscellany of twenty-seven new species of Western Australian vascular plants. About a third of these are apparently restricted to microhabitats (0.5–2,000 m across) associated with sandstone lithologies in the Kimberley region, including skeletal sand over sheeting sandstone pavements, cliff faces, shallow rock holes, and rock overhangs. The skeletal soils and resulting short growth season in these microhabitats means that they are dominated by annuals or perennating perennials, except for the cliff faces which are dominated by perennials, presumably because their roots can penetrate further into deep water reserves through fractures. Such microhabitats are also often naturally protected from fire and potentially provide a refuge for species requiring longer fire intervals than those experienced in the surrounding savannahs.

Due to the shallow soils, these sites dry out rapidly at the end of the wet season (usually in April) and consequently have been only incidentally surveyed by most previous collectors and often missed in targeted surveys, which for logistical reasons are typically carried out in the early dry season. In association with other survey team members (as detailed in the collection citations) we have targeted these sites across the Kimberley (see Barrett 2015), resulting in the discovery of many new taxa, most of which are apparently very restricted in population extent or species range. Twenty-one (78%) of the taxa described herein are listed as being of conservation concern, all of which require additional surveys to better understand their distribution and rarity. Given that many such isolated microhabitats in the Kimberley region have not yet been surveyed, many localised or rare species probably remain to be discovered and we suggest that these are the most restricted species that therefore may have the highest conservation significance.

Other species described in this paper come from across Western Australia. Some have long been recognised as distinct taxa and listed on *FloraBase* (Western Australian Herbarium 1998–) under phrase names (e.g. *Caustis* sp. Gigas (A.S. George 9318)) while others have only recently been recognised (e.g. *Poranthera asybosca* R.L.Barrett). *Aphyllodium beardii* R.L.Barrett and *Triodia basitricha* M.D.Barrett are described from remote parts of the arid zone, while *Lepidosperma oldhamii* R.L.Barrett is described from Kings Park in the centre of Perth. These species illustrate the point that there are many species throughout Western Australia that still require formal description. Indeed, there are almost 1,450 informal taxa currently listed on *FloraBase* (Western Australian Herbarium 1998–).

## Methods

The full range of variation in available specimens is given in the descriptions, but measurements outside the observed range can be expected given the limited range of available material. Most descriptions are based on herbarium specimens, though in some cases fresh material from the field or cultivation, or material preserved in 70% ethanol, was also utilised. Scanning Electron Microscope (SEM) images were produced from dry material gold-coated using an EMITECH K550X Sputter Coater and imaged at 15 KV<sub>a</sub> using a Jeol JCM 6000 NeoScope bench-top SEM.

## Taxonomy

### Amaryllidaceae

#### ***Crinum joesmithii*** M.D.Barrett & R.L.Barrett, *sp. nov.*

*Type:* cultivated: Kings Park and Botanic Garden [from a bulb collected in the Edkins Range], Western Australia [precise locality withheld for conservation reasons], 31 January 2014, *R.L. Barrett* RLB 8344 (*holo:* PERTH 08614466; *iso:* CANB, DNA, PERTH 08615004).

*Crinum* sp. West Kimberley (J.A. Smith s.n. 7/1/1979), Western Australian Herbarium, in *FloraBase*, <http://florabase.dpaw.wa.gov.au/> [accessed 1 March 2014].

Glabrous geophytic *perennial*, with a bulb that is often extended as a neck to ground level. *Leaves* 6–8, basal, sessile, deciduous, erect, 340–690 mm long, 5.1–11.7 mm wide, dull green to slightly glaucous, with parallel venation, not obviously keeled, with a lunate (U-shaped) channel 5.5–10.7 mm deep; base up to 20 mm wide where flaring, thickly spongy-succulent; margin sparsely but distinctly tuberculate along most of length; apex acute. *Inflorescence* a scapose umbel with 2(–6) flowers in a

single ‘whorl’; scape arising adjacent to leaves coincident with leaf development; peduncle 15–55 cm long above soil, 13 mm wide  $\times$  8–9 mm thick at base, 9.0–10.5 mm wide  $\times$  7–8 mm thick at middle, 10 mm wide  $\times$  7 mm thick just below apex (*i.e.* slightly flattened, fleshy, slightly tapering to apex), smooth, green, flaring just below bracts to a receptacle which is 14–16 mm long, *c.* 10 mm diam. and which remains green after the bracts dry creating a sharp demarcation between the receptacle and pale bracts. *Involucral bracts* 2, free, initially green as peduncle emerges, soon dry and membranous by time of full emergence, prominently veined, acute; outer bract 50–59 mm long, 22–25 mm wide, broadly triangular, acute, with *c.* 26 veins at 1/3 height, the veins parallel, not reticulate; inner bract 48–60 mm long, 15–20 mm wide, slightly overlapping outer bract at base, with *c.* 19 veins at 1/3 height. *Floral bracts* filiform, usually 1 per flower but often not directly subtending a flower and sometimes 1 or 2 small bracts in centre not subtending a developed flower, 17–60 mm long, 1–7 mm wide, decreasing in size toward centre of inflorescence, membranous, white to sub-hyaline or partly translucent when fresh, papery and parchment-like when dry (mostly dry at anthesis). *Flower buds* pendulous, yellowish cream externally just before anthesis, *c.* 60 mm long, 10–18 mm diam., narrowly obovoid, acute. *Flowers* sessile, bright white inside and out at anthesis, suffused with pink then maroon to dark purple with age (or rapidly after picking), sweetly scented, with a slender tube and spreading tepal lobes; tube 85–120 mm long, *c.* 5 mm diam. at base, 4.0–4.5 mm diam. in middle, 3–4 mm diam. at apex,  $\pm$ cylindrical but slightly tapering to apex,  $\pm$ smooth but becoming very shallowly and broadly grooved near apex, nectar-filled, with an abscission ring present at base at maturity; outer corolla lobes narrowly elliptic to narrowly obovate or oblanceolate, 62–87 mm long, 11–18 mm wide (shrinking to *c.* 12 mm wide on wilting); apex attenuate, acute to acuminate, tending to infold along apex margins and somewhat hooded with a small, white, reflexed apical appendage 5.5–15.0 mm long; appendage apex 0.2 mm long, cylindrical to  $\pm$ capitate and minutely to prominently papillose; inner corolla lobes 68–88 mm long, 13–15 mm wide (wilting to 12.5 mm), slightly smaller but similar in shape to outer lobes, lacking apical appendage. *Tepaline corona* absent. *Stamens* inserted at throat of perianth tube, subequal; filaments pinkish red to maroon in upper 1/2, usually white below, free, 35–57 mm long, filiform, fused to petals for *c.* 2 mm above corolla tube. *Anthers* greenish yellow, aging dark brown to black, 8.5–11.7 mm long, allantoid, medifixed, latrorse, turning inside out and frequently curving after anthesis; pollen yellow to orange. *Ovary* 3-locular, inferior, broadly spindle-shaped, green, 10–12 mm long, 6–7 mm diam., on a thick gynophore 2–4 mm long (sometimes appearing almost sessile); ovary beak absent; ovules *c.* 10 per loculus, in 2 rows. *Style* filiform, pinkish red to maroon, sometimes white in basal 1/2, exceeding stamens, 132–162 mm long, 0.7–0.9 mm diam., exceeding corolla tube by 67–72 mm, smooth, usually declinate; stigma shortly 2- or 3-lobed or sub-capitate, *c.* 1.3–2.2 mm diam., with a dense cluster of repeatedly dividing papillae. *Fruit* globular or irregular, 30–40 mm diam. *Seeds* 1–several, 7–10 mm across, irregular to subglobular. (Figure 1)

*Diagnostic characters.* Differs from all Australian species of *Crinum* L. by the following combination of characters: *leaves* U-shaped in section, 340–690 mm long, 5.1–11.7 mm wide, with a channel 5.5–10.7 mm deep; *inflorescence* arising adjacent to leaves, 2(–6)-flowered, buds pendulous; *perianth* tube 85–120 mm long, lobes 62–88 mm long, 11–18 mm wide; *flowers* bright white, suffused with maroon to dark purple with age.

*Other specimens examined.* WESTERN AUSTRALIA: [localities withheld for conservation reasons] 5 Jan. 2011, *M.D. Barrett* MDB 3237 (PERTH); 22 Feb. 2013, *M.D. Barrett* MDB 4003 (PERTH); 22 Feb. 2013, *M.D. Barrett* MDB 4006 (PERTH); 7 Jan. 1979, *J.A. Smith s.n.* (PERTH 03913465).

*Phenology.* Flowering and fruiting from January to May.

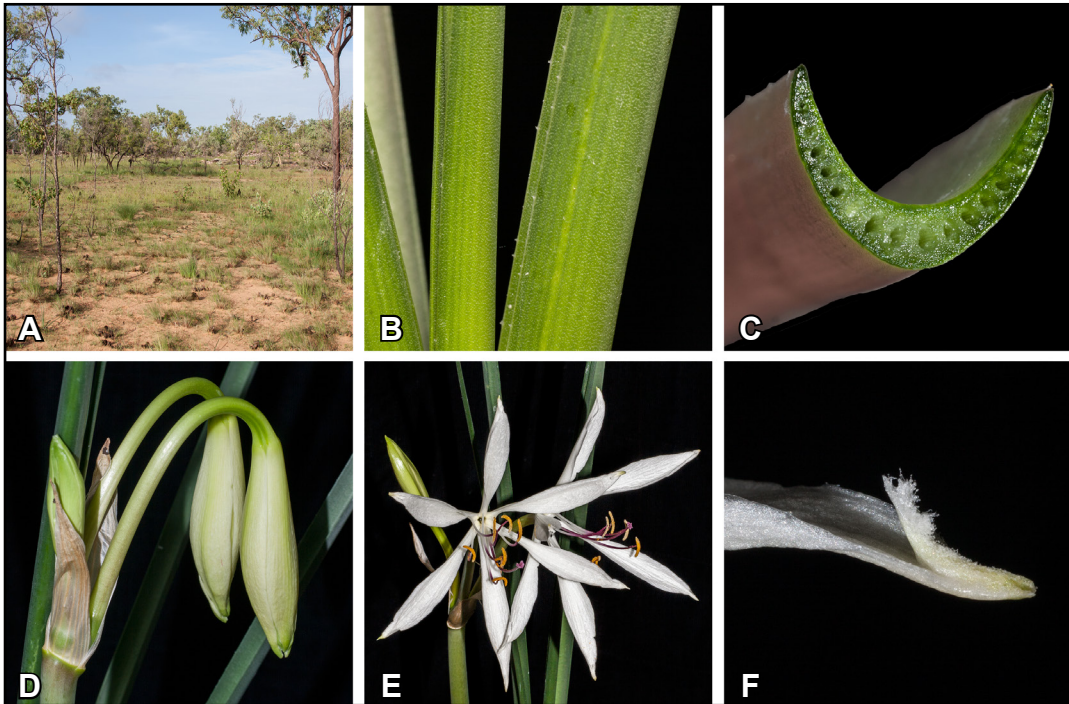


Figure 1. *Crinum joesmithii*. A – habitat of seasonally wet sand flats over sandstone; B – leaf, showing the marginal prickles; C – leaf section; D – buds; E – flowers; F – reflexed perianth appendage. Images from R.L. Barrett RLB 8344. Photographs by R.L. Barrett.

**Distribution and habitat.** Known from the Synnot Range, Edkins Range and headwaters of the Lawley River in the Kimberley region. Grows on seasonally wet sand flats on sandstone and in shallow, flooded soils over basalt. Recorded in association with *Alloteropsis semialata*, *Cochlospermum fraseri*, *Corymbia* spp., *Decaschistia occidentalis*, *Erythrophleum chlorostachys*, *Ipomoea* sp., *Owenia vernicosa*, *Terminalia canescens* and *Triodia* spp.

**Conservation status.** *Crinum joesmithii* is listed by Jones (2014) as Priority Three under Department of Parks and Wildlife Conservation Codes for Western Australian Flora, under the name *C.* sp. West Kimberley (J.A. Smith s.n. 7/1/1979).

**Etymology.** The epithet recognises the collecting efforts of Joseph (Joe) A. Smith, formerly of Amax Exploration, who was the first to collect this species and a number of other new and unusual taxa from the Mitchell Plateau.

**Notes.** Morphologically, *C. joesmithii* appears intermediate between *C. uniflorum* F.Muell. (*sensu* Lehmillier *et al.* 2012a) and *C. arenarium* Herb.<sup>1</sup> Its leaves resemble juvenile (pre-fertile) leaves of *C. arenarium*, but it differs from this species in having 2(–6) flowers per peduncle (*vs* (3–)5–10 in *C. arenarium*), very narrow peduncles and leaves (*vs* peduncle 12–18 mm diam. in *C. arenarium*),

<sup>1</sup>As recognised by Govaerts (2015), the name *Crinum angustifolium* R.Br. (1810), widely used in Australian literature, is a later homonym of both *C. angustifolium* Houtt. (1780) and *C. angustifolium* L.f. (1782) and is therefore illegitimate. The next available name for this taxon is *C. arenarium* Herb. (1822). This matter has been confused by the recognition of both *C. angustifolium* R.Br. and *C. arenarium* Herb. by Lehmillier *et al.* (2012b) without adequate justification or discussion. Further studies of species boundaries in this group are recommended.

leaves 5.1–11.7 mm wide (*vs* 45–110 mm wide in *C. arenarium*), and more-slender tepals that age to pink and eventually maroon to dark purple before wilting (*vs* remaining white in *C. arenarium*). It differs from *C. uniflorum* in having 2(–6)-flowered inflorescences (*vs* 1-flowered in *C. uniflorum*), and flat (though incurved) rather than triquetrous leaves. The pendulous buds are unusual in the genus and are a character shared with *C. uniflorum* and *C. kakaduensis* Lehmiller & Lykos (they are spreading to reflexed in *C. arenarium*).

*Crinum kakaduensis* differs from *C. joesmithii* in having broader leaves 17–35 mm wide (*vs* 5.1–11.7 mm wide) and 3–12 flowers per inflorescence (*vs* 2(–6)), and grows in seasonally inundated clay soils (*vs* sand or basalt). *Crinum joesmithii* is also similar in general appearance to *C. yorkensis* Lehmiller, Lykos & R.Ham. from north Queensland, which differs in having distinctly pedicellate flowers (Lehmiller *et al.* 2012a).

*Crinum joesmithii* could be of hybrid origin and maintained by asexual reproduction. Its distribution is completely within that of *C. uniflorum* and it occurs in regions where *C. arenarium* is also common. *Crinum joesmithii* maintains both morphological differences and habitat preferences compared with both of these species. In the Kimberley, *C. arenarium* appears restricted to seasonally very wet soils (cracking clay plains, shallow swamps or creek margins) while *C. uniflorum* occurs on flat, alluvial soils associated with small creeks and swamp overflows. *Crinum joesmithii* occurs most commonly on deep sand flats derived from sandstone (once recorded in shallow black soil over basalt). Both *C. uniflorum* and *C. joesmithii* occur on the Synnot Range on Charnley River Station, where *C. uniflorum* is confined to silt-rich alluvial flats associated with Lake Gilbert.

The vernacular name Kimberley Crinum Lily is suggested.

**Proiphys kimberleyensis** M.D.Barrett & R.L.Barrett, *sp. nov.*

*Type*: cultivated: Kings Park and Botanic Garden [from specimens collected on the Mitchell Plateau], Western Australia [precise locality withheld for conservation reasons], 31 January 2014, R.L. Barrett RLB 8343 [flowering specimen] (*holo*: PERTH 08614539; *iso*: CANB).

*Paratype*: Mitchell Plateau, Western Australia [precise locality withheld for conservation reasons], 24 January 2010, R.L. Barrett & M.D. Barrett RLB 6375 [leaf specimen] (*para*: PERTH 08617392).

*Illustrations*. B.L. Koch in J.R. Wheeler (ed.), *Fl. Kimberley Reg.*, p. 1002, Figure 300B, C (1992), as both *P. alba* (R.Br.) Mabb. and *P. amboinensis* (L.) Herb.

Glabrous geophytic *perennial* with a ±globular bulb; daughter bulbils present, aggregated in groups of 1–3, green, globular, large, smooth, rupturing irregularly at maturity. *Leaves* basal, expanding after flowering (not visible at anthesis), channelled above, to 490 mm long above ground level; petiole *c.* 190 mm long (above ground), 7–9 mm wide, 6.5–9.0 mm deep, ±terete but flattened to shallowly grooved on upper side, variously becoming more flattened or more grooved closer to blade, gradually merging into blade; blade thick, coriaceous, initially dark green becoming sub-glaucous in cultivation (often ±glaucous in field), narrowly elliptic to broadly ovate, (120–)200–275 mm long, (55–)80–140 mm wide, flat, with prominent midvein slightly raised above, distinctly raised below; primary venation curved, secondary venation parallel, with *c.* 7 or 8 primary veins across each side of midblade; base cuneate to truncate; apex sub-obtuse (*c.* 110°), with an abrupt, small, rounded apiculus. *Inflorescence* a scapose, terminal umbel, arising before the leaves; cataphylls 2, ±opposite,

protruding c. 10–35 mm above the ground, 5–15 mm wide, triangular-subulate, acute, membranous to thick-fleshy along midrib, lacking a blade, only slightly sheathing at base, thick, ±succulent; peduncle 450–670 mm long, 6–13 mm diam. at base, 6.5–7.0 mm diam. at apex, smooth, dark green, terete to slightly rounded-irregular in section; umbel with 17–21 flowers, erect to spreading. *Involucral bracts* 2 or 3, ±opposite (±equally spaced when 3), 36–60 mm long, 10.5–14.0 mm wide, free, narrowly ovate to narrowly triangular, acute, imbricate, sub-membranous, pale yellow and thin even when young; ±sharply to indistinctly grading into the floral bracts. *Floral bracts* 1 per flower (not always obviously subtending a flower at maturity), 12–33 mm long, 0.5–5.0 mm wide, triangular to linear, acute, white. *Pedicels* 24–71 mm long, green, terete, cylindrical, smooth. *Flower buds* obovoid-pyriform, c. 25 mm long, 8 mm diam. just prior to anthesis. *Flowers* sweetly scented, actinomorphic, bright white. *Corolla* funnel-shaped, 20–44 mm diam.; *tepals* pure white, connate at the base, the floral tube thus formed cylindrical to very narrowly conical, 14–20(–23) mm long but usually uniform in length within an umbel, 2.5–2.9 mm diam. just above ovary, 2.8–4.0 mm diam. at mid-point, 3.6–5.0 mm diam. at base of tepals, campanulate above tube, not or scarcely infundibuliform, slightly ribbed in upper part as inner tepals arise slightly inside level of outer tepals, glabrous internally and externally; tepal lobes subequal, not to strongly overlapping laterally, spreading, held at 30–45° to the style; outer lobes 21–31 mm long, 8.5–16.0 mm wide, narrowly elliptic to moderately obovate; inner lobes c. 2 mm shorter, apiculate, broadly elliptic to obovate, 19–30 mm long, 7.5–14.0 mm wide; tepaline corona absent. *Stamens* inserted in the throat of the perianth tube, level with tips of inner tepals or a little exserted; filaments expanded at the base and connate for 3.5–8.0 mm into a corona; corona white or yellow inside at base, 9–13 mm long, with 2 apical corona lobes between each filament, the lobes erect or spreading, 3.5–6.5 mm long with acute apices, each pair of corona lobes connate for most of their length with a notch 1.0–4.0 mm deep; free portion of filaments 8–14 mm long; anthers sub-medifixed at 1/3–2/5 from base, introrse, straight, 3.0–4.4 mm long when fresh, initially held erect then becoming more curved, versatile and lateral with age; pollen dark yellow. *Ovary* green, inferior, with withered flowers remaining attached for some time, globular, becoming ellipsoid in late anthesis, to c. 8 mm long, 3.5–4.0 mm diam., 1- or 2-locular; ovules 2 per locule, rounded, basally attached, each pair on a common fleshy stalk attached to a large, fleshy pad forming the basal part of the septum, held in the upper 1/2 of the ovary. *Style* filiform, equal to or usually exceeding anthers, white, 36–50 mm long, exserted 19–29 mm from the base of corona; stigma not expanded. *Fruits* globular, 15–20 mm diam., each producing several irregularly shaped bulbils. (Figure 2)

*Diagnostic characters.* Distinguished from all other species of *Proiphys* Herb. by the following combination of characters: *leaves* thick, coriaceous, narrowly elliptic to broadly ovate, and cuneate to truncate at base; *flower stalk* arising without leaves, which appear after anthesis of all flowers; *involucral bracts* pale yellow; *flowers* 17–21 per umbel; *stamen* filaments united for 3.5–8.0 mm; *corolla* tube 14–20(–23) mm long.

*Other specimens examined.* WESTERN AUSTRALIA: [localities withheld for conservation reasons] 21 Dec. 2011, *M.D. Barrett* MDB 3235 (CANB, CNS, DNA, PERTH); 24 Jan. 2010, *R.L. Barrett & M.D. Barrett* RLB 6375 (PERTH); 16 Oct. 1981, *T.P. Farrell* 970 (BRI *n.v.*, PERTH); 4 Feb. 1979, *K.F. Kenneally* 7017 (PERTH); 4 Dec. 1978, *J.A. Smith s.n.* (PERTH 03914194); 13 Jan. 1984, *J.A. Smith s.n.* (PERTH 03914151); 16 May 1985, *I.R. Telford* 10087 (CBG); 16 May 1985, *I.R. Telford* 10088 (CBG); 10 Jan. 1979, *E. Wittwer* S 4440 (PERTH).

*Phenology.* Flowering recorded in October and from December to February. Fruiting recorded in January.

*Distribution and habitat.* Recorded from three populations on the northern Mitchell Plateau and Lawley River valley (south-east of the Mitchell Plateau) in the Kimberley region. Grows in shallow,

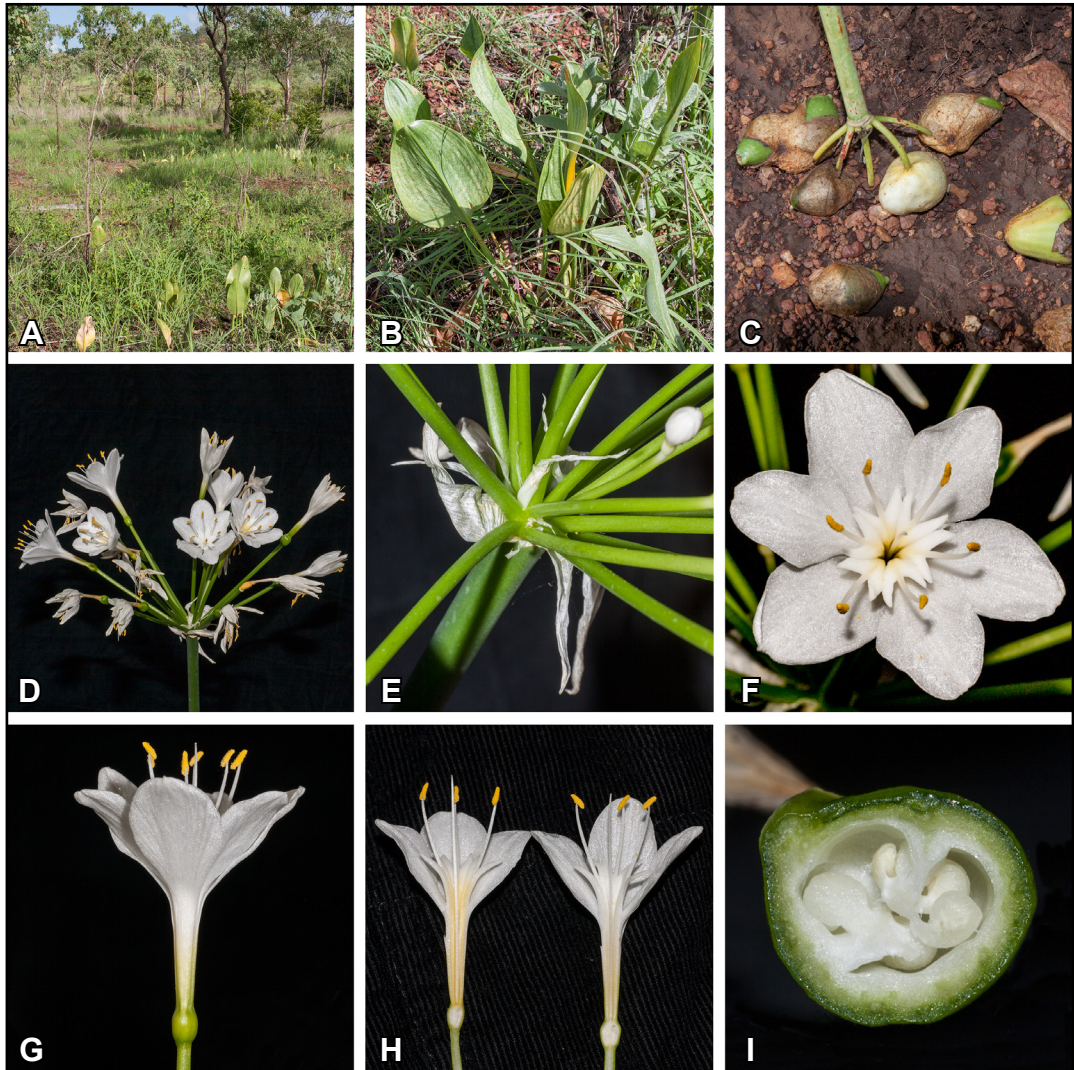


Figure 2. *Proiphys kimberleyensis*. A – habitat of open woodland on shallow basalt soils over massive sheeting basalt; B – leaves; C – infructescence; D – inflorescence; E – inflorescence bracts; F – flower showing staminal corona and versatile anthers; G – lateral view of flower showing imbricate tepals; H – dissected flower; I – cross-section of ovary. Images from R.L. Barrett & M.D. Barrett RLB 6375 (A–C) and R.L. Barrett RLB 8343 (D–I). Photographs by R.L. Barrett.

red clay soils over massive basalt pavements in low, open woodland of *Corymbia latifolia*, *Livistona eastonii* and *Terminalia canescens* over *Chrysopogon* sp., *Cleome* aff. *tetrandra*, *Cyperus* sp., *Eriosema chinense*, *Fimbristylis schultzei*, *Gossypium australe*, *Haemodorum macfarlanei*, *Heliotropium* sp., *Jacquemontia* spp., *Pimelea concreta*, *Polymeria* sp. A Kimberley Flora (T.E.H. Aplin et al. 418), *Rostellularia clementii*, *Synostemon* sp., *Tricoryne* sp. Kimberley (K.F. Kenneally 4857), *Triodia claytonii* and *Typhonium liliifolium*.

*Conservation status.* *Proiphys kimberleyensis* is to be listed as Priority One under Department of Parks and Wildlife Conservation Codes for Western Australian Flora (A. Jones pers. comm.). While this species is sometimes locally abundant in very small patches, it is very rarely collected and only one population of about 500 plants has been seen since 1981.

*Etymology.* The epithet refers to the Kimberley region of Western Australia where it is apparently endemic.

*Notes.* As this species flowers prior to leaf development and both leaves and flowers are important for identification, a paratype has been designated based on a leaf collection from the original population that the type was cultivated from.

Apparently most similar to *P. amboinensis* (L.) Herb., a relatively widespread species ranging from north Queensland through Malesia and to the Moluccas (Ambon). It differs in having thick, coriaceous (thin and flexible in *P. amboinensis*), differently shaped leaves (elliptic to suborbicular and cuneate to truncate at base vs suborbicular to reniform and weakly to distinctly cordate at base in *P. amboinensis*). In *P. kimberleyensis*, the flower stalk arises without leaves (leaves only arising after anthesis of all flowers) whereas leaves arise coincident or soon after the flower stalk and apparently begin to unfurl during (at least late) anthesis in *P. amboinensis*. Floral dimensions are similar between the two species (cf. Geerinck 1993; Jones & Dowe 2001).

*Proiphys alba* (R.Br.) Mabb. differs in having linear to lanceolate leaves (elliptic to suborbicular in *P. kimberleyensis*) and a shorter corolla tube 8–15 mm long (14–20(–23) mm long in *P. kimberleyensis*).

This species has been poorly known, with specimens previously incorrectly assigned to either *P. alba* or *P. amboinensis* by Telford (1987) and Koch (1992), even though most collections probably originate from a single population. Most of the fertile material known has been cultivated at either the Western Australian Herbarium or at Kings Park and Botanic Garden, initially based on specimens collected by Joseph Smith, who collected the first known specimens in 1978 while working for the Amax Exploration Company. Our field examination of the type population showed that leaf blade shape on individual plants is extremely variable, ranging from elliptic-oblong and almost as narrow as the broadest extreme of *P. alba*, through to almost as broad (but never cordate) as blades of *P. amboinensis*. Depending on the leaf shape of the collected plant, earlier collections were assigned to either *P. alba* or *P. amboinensis*, and the few available collections did not permit deduction that they belonged to a continuum. A further complication was the paucity of flowering collections, all from cultivated material, which differed greatly in flower size. This is possibly an artefact of cultivation in a temperate climate, but flowering field collections are required to test this hypothesis.

The vernacular name Kimberley Proiphys is suggested.

There is a single collection (*R.L. Barrett* RLB 757) at PERTH of true *P. amboinensis* from the Kimberley, a cultivated plant from a garden at Beverley Springs Station Homestead. This species is not known to be naturalised in Western Australia.

Five species are now recognised in the genus and a key to all species is provided below.

**Key to *Proiphys* species (partly adapted from Jones & Dowe 2001)**

1. Involucral bracts green. Flowers 5–12 per umbel. Stamen filaments united (from base to first level of division) for 12–16 mm. Leaf blade broadly ovate, tapered, rounded or occasionally shallowly cordate at base. (SE Qld, NSW) ..... ***P. cunninghamii***
- 1: Involucral bracts white. Flowers 5–30 per umbel. Stamen filaments united (from base to first level of division) for 2–12 mm. Leaf blade variable, from linear to broadly ovate or reniform, cordate at base or not..... **2**



2. Leaf blade broadly ovate to reniform, cordate or subcordate at base, at least in mature leaves ..... 3
- 2: Leaf blade linear to ovate or rarely broadly ovate, cuneate or sometimes broadly obtuse at base, but never cordate ..... 4
3. Flowers erect, funnel-shaped. Corolla lobes narrowly imbricate. Stamen filaments 18–30 mm long. (Qld) ..... **P. infundibularis**
- 3: Flowers porrect, bell-shaped. Corolla lobes widely separated. Stamen filaments 7–12 mm long. (Qld, Malesia, Thailand, Philippines, Indonesia, Moluccas (Ambon), PNG) ..... **P. amboinensis**
4. Leaves elliptic to suborbicular. Corolla tube 14–20(–23) mm long ..... **P. kimberleyensis**
- 4: Leaves linear to lanceolate. Corolla tube 8–15 mm long. (Qld, NT (Islands in Gulf of Carpentaria), PNG) ..... **P. alba**

## Araliaceae

### **Trachymene pavimentum** M.D.Barrett & R.L.Barrett, *sp. nov.*

*Type:* Theda Station, Western Australia [precise locality withheld for conservation reasons], 23 February 2005, *M.D. Barrett* MDB 1661 (*holo:* PERTH 08043531, *iso:* BRI, CANB, CNS, DNA, K, MEL, NSW).

*Trachymene* sp. Theda (M.D. Barrett MDB 1661), Western Australian Herbarium, in *FloraBase*, <http://florabase.dpaw.wa.gov.au/> [accessed 1 March 2014].

Erect to spreading, short-lived annual *herb* 10–30 cm high, with indumentum of sparse to very sparse, simple, non-glandular trichomes 0.5–2.5 mm long on leaves including petioles. *Leaves* cauline, alternate; *petiole* 11–21 mm long; *lamina* obovate in outline, 5–27 mm long, 8–32 mm wide, ternately dissected, divided almost to base into 3 segments, each additional level of division mostly with (2)3 ± equal parts; segments linear to oblanceolate, thin, 0.5–1.8 mm wide at their broadest, each with a single, narrow midnerve. *Umbels* solitary, held shortly above the leaves, 5–9 mm diam., 18–51-flowered. *Peduncle* 5–70 mm long. *Bracts* linear, entire, 3–7 mm long, 0.3 mm wide, or leaf-like and 3-segmented, the segments up to 12 mm long, 0.5 mm wide. *Involucral bracts* free, 8–12, 2.5–4.0 mm long, linear-subulate, glabrous. *Pedicels* 2.1–3.5 mm long, ±filiform, glabrous. *Sepals* inconspicuous, *c.* 0.1 mm long, linear-subulate. *Petals* 5, orbicular to suborbicular, 0.6–0.7 mm long, 0.5–0.6 mm wide, white aging apricot, mostly glabrous but minutely papillose (papillae *c.* 0.1 mm long) on the floral rim. *Staminal filaments* 0.5 mm long, terete, glabrous; *anthers* *c.* 0.20–0.25 mm long, *c.* 0.2 mm diam., glabrous. *Ovary* unilocular. *Carpels* glabrous. *Styles* 2, 0.6–0.8 mm long. *Fruiting umbel* 6–9 mm across. *Fruit* composed of only 1 mericarp; mericarp laterally compressed, 1.8–2.1 mm long, 0.7–1.0 mm wide, elliptic, smooth, glabrous; wing absent; carpophore entire, slightly tapering, 0.8–1.5 mm long. (Figure 3)

*Diagnostic characters.* Distinguished from all tropical species of *Trachymene* Rudge by the following combination of characters: short-lived *annual herb* 10–30 cm high with indumentum of simple, non-glandular trichomes; *leaves* deeply ternately dissected with ±linear segments <2 mm wide; *involucral bracts* linear-subulate, glabrous; *flowers* in solitary umbels of 18–51 flowers and held shortly above the leaves; *petals* white aging apricot; *fruit* composed of 1 smooth, glabrous mericarp.

*Other specimen examined.* WESTERN AUSTRALIA: [locality withheld for conservation reasons] 28 Mar. 2011, *M.D. Barrett* MDB 3358 (BRI, CANB, DNA, NY, PERTH).

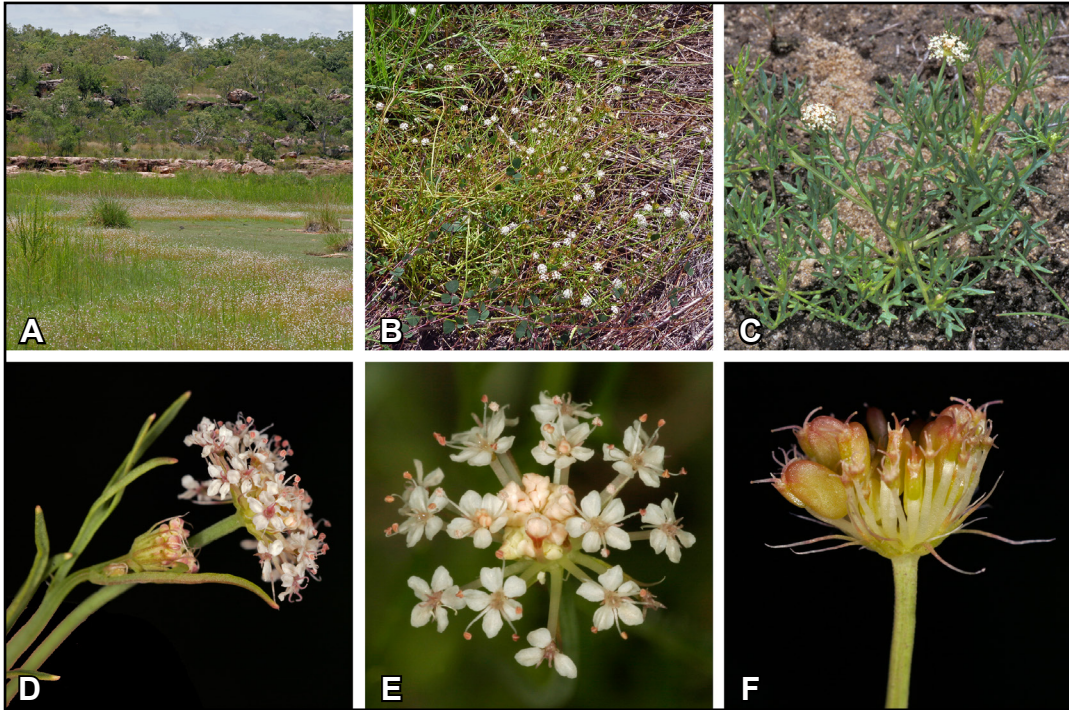


Figure 3. *Trachymene pavementum*. A – habitat of thin sand sheets on massive sheeting sandstone; B – habit; C – habit showing dissected leaves; D – lateral view of inflorescence and buds; E – inflorescence; F – infructescence. Images from M.D. Barrett MDB 3358 (B) and M.D. Barrett MDB 1661 (C–F). Photographs by R.L. Barrett (A, D–F); M.D. Barrett (B, C).

*Phenology.* Flowering and fruiting plants collected in February and March.

*Distribution and habitat.* Known from a single location on Theda Station, growing in skeletal sand over massive sheeting sandstone, with *Drosera* spp., *Eriachne* spp., *Fimbristylis* spp. and *Rhynchospora* sp. Arnhem (P.K. Latz 2999).

*Conservation status.* *Trachymene pavementum* is listed by Jones (2014) as Priority One under Department of Parks and Wildlife Conservation Codes for Western Australian Flora, under the name *T. sp.* Theda (M.D. Barrett MDB 1661). Hundreds of plants were present at the time of both collections, but they were restricted to an area *c.* 20 m across. It has not been found elsewhere on the same pavement, nor in other similar habitats nearby, despite extensive surveys in the area over a period of 14 years.

*Etymology.* The epithet is derived from the Latin *pavimentum* (a floor of stones) used as a noun in apposition, in reference to the sheeting sandstone pavement where the species grows.

*Notes.* Differs from all other Kimberley *Trachymene* species in being a small, short-lived (8–12 weeks) annual (*vs* robust perennial or biennial). *Trachymene pavementum* is morphologically closest to *T. microcephala* (Domin) B.L.Burt (to which it would key in Hart and Henwood 2006: 20), which differs in being a robust perennial to 70 cm tall with 30–70-flowered umbels in cymose inflorescences held well-above the basal leaves, and papillose mericarps.

The vernacular name Pavement Laceflower is suggested.

## Commelinaceae

### *Commelina roensis* M.D.Barrett & R.L.Barrett, *sp. nov.*

*Type*: Roe River pavement, Western Australia [precise locality withheld for conservation reasons], 23 April 2008, R.L. Barrett & M.D. Barrett RLB 4633 (*holo*: PERTH 08104956; *iso*: AD, CANB, DNA).

*Commelina* sp. Roe River (R.L. Barrett & M.D. Barrett RLB 4633), Western Australian Herbarium, in *FloraBase*, <http://florabase.dpaw.wa.gov.au/> [accessed 1 March 2014].

Perennating *herb* with prostrate, scrambling or ascending annual stems to 40 cm long which are glabrous or shortly multicellular-hairy on one side for some distance below nodes. *Leaves*: *sheath* 3–5 mm long, with strongly raised veins; *blade* lanceolate, 13–30 mm long, 4–6 mm wide, undulate, acute, pale green, with a prominent midrib, sparsely to moderately pilose with multicellular hairs 0.5–1.4 mm long. *Inflorescences* borne singly in leaf axils; *peduncles* 3–16 mm long, sparsely to moderately hairy. *Spathe* 12–15 mm long, 4.0–5.5 mm wide when folded, c. 9 mm wide and broadly ovate with weakly to strongly cordate base and abruptly acuminate apex (if flattened), pilose outside, glabrous inside, open to the base (not fused along the basal margins); margins of the broadest portion with a sparse fringe of tubercle-based multicellular hairs up to 1.4 mm long, but these scarcely differentiated in length or density from the surface hairs; veins not prominent or raised, only the midvein conspicuously keeled. *Cymes* 2 per spathe, each 1-flowered (so always 2 flowers per spathe); lower cyme with an axis 6–7 mm long, the flower always exerted from the spathe (lost or withered in type specimen and possibly functionally male?); upper cyme on an axis 4.0–6.5 mm long and usually developing a capsule inside the spathe. *Pedicels* c. 1.5 mm long. *Flowers* c. 2 cm across. *Calyx* segments c. 4.5 mm long, the upper slightly shorter than the lower, all fused  $\pm$ equally at base, glabrous, mucicous at apex. *Petals* 3, subequal in size and shape (none reduced), blue. *Stamens* and staminodes 3. *Ovary* 2-locular, with 2 ovules in each loculus. *Capsule* ovoid, 4–5 mm long, 3.5–4.0 mm diam., usually maturing 1 seed per loculus (i.e. 2 seeds per capsule). *Seeds*  $\pm$ obloid to sub-reniform, 3.5–3.8 mm long, obtusely 3-angled in section, dull, with scattered, shallow, broad depressions, the centre of depressions with a demarcated zone of small pits. (Figure 4)

*Diagnostic characters*. Distinguished from all Australian species of *Commelina* L. by the following combination of characters: *leaves* short, the blades 13–30 mm long; *spathes* open to the base, the margins ciliate but not conspicuously hairier than the spathe surfaces; *petals* subequal in size and shape; *ovules* 2 per loculus; *seeds*  $\pm$ obloid to sub-reniform with scattered, shallow, broad depressions.

*Other specimens examined*. Known only from the type collection.

*Phenology*. Very last flowers of the season and fruits observed in late April.

*Distribution and habitat*. Grows in the vicinity of the Roe River, in sand in damp places on sandstone slopes, in a broader vegetation association including *Byblis filifolia*, *Calandrinia* sp., *Centrolepis exserta*, *Cleome* aff. *kenneallyi*, *Cucumis umbellata*, *Cyperus* spp., *Eriachne* sp., *Eriocaulon* sp., *Ficus platypoda*, *Fimbristylis* spp., *Goodenia* sp., *Phyllanthus minutiflorus*, *Polycarpha breviflora*, *Polycarpha involucrata*, *Ptilotus polystachyus*, *Scaevola* sp., *Schizachirium* sp., *Solanum* sp., *Sorghum* sp., *Spermacoce* spp., *Stylidium perizostera*, *S. rivulosum*, *Triodia bynoei* and *Xyris* sp.

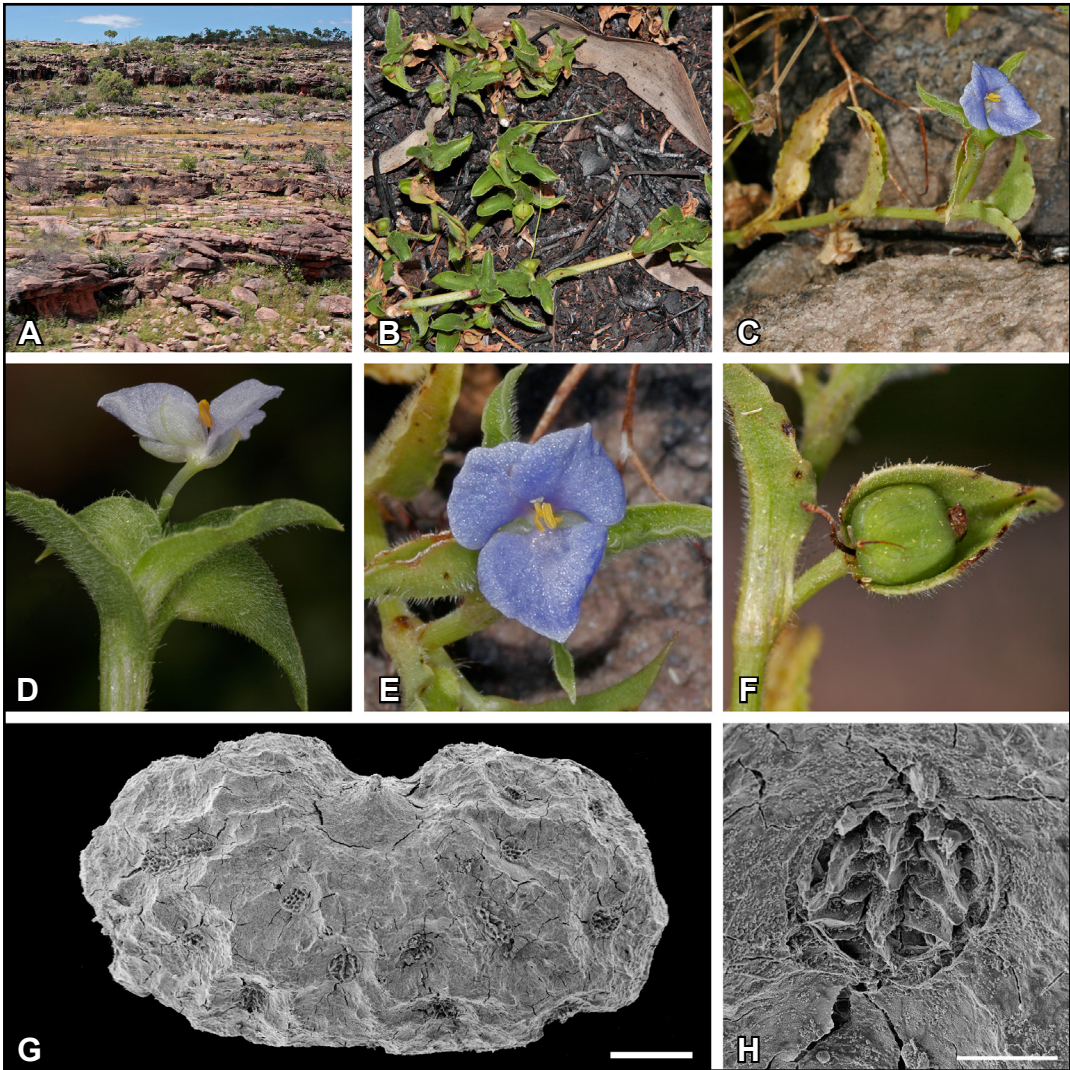


Figure 4. *Commelina roensis*. A – habitat of sandstone step-pavements on side of ridge at type location; B – habit; C – flowering branch; D – lateral view of inflorescence; E – flower; F – fruit; G – SEM of seed; H – SEM of bounded pit on seed surface. Scale bars = 1 mm (G); 100  $\mu$ m (H). Images from R.L. Barrett & M.D. Barrett RLB 4633. Photographs by R.L. Barrett (A–C); M.D. Barrett (D–H).

**Conservation status.** *Commelina roensis* is listed by Jones (2014) as Priority One under Department of Parks and Wildlife Conservation Codes for Western Australian Flora, under the name *C. sp. Roe River* (R.L. Barrett & M.D. Barrett RLB 4633). Only one group of c. 10 plants was found at the type locality.

**Etymology.** The epithet refers to the Roe River near which this species was discovered.

**Notes.** Of the *Commelina* species known from northern Australia, *C. roensis* differs from *C. ensifolia* R.Br. and *C. benghalensis* L. in having the spathe open at the base (fused in the latter two species). *Commelina reticulata* Stanley and *C. tricarinata* Stanley have reticulate seeds and occur on cracking clay plains (seeds with broad, shallow depressions and sandstone habitat in *C. roensis*). *Commelina agrostophylla* F.Muell. and *C. ciliata* Stanley have seeds that are smooth or minutely papillose without broad depressions, and longer leaves mostly >30 mm long. *Commelina lanceolata* R.Br.

and *C. diffusa* Burm.f. have pitted seeds, unequal stamens and 3–5-seeded fruit (seeds with broad, shallow depressions, equal stamens and 2-seeded fruit in *C. roensis*) and leaf blades mostly >30 mm long (13–30 mm long in *C. roensis*).

*Commelina roensis* is probably most similar to *C. sp. Sandstone* (R.J. Fensham 739) which occurs in sandstone areas of Litchfield National Park in the Northern Territory, but differs in having ±obloid to sub-reniform, obtusely 3-angled seeds with broad, shallow depressions (elliptic, compressed and lacking regular broad depressions in *C. sp. Sandstone*), and in having more uniformly hairy spathe surfaces, as well as smaller leaves (24–41 mm long, 3.6–5.0 mm wide in *C. sp. Sandstone*) with undulate margins.

The vernacular name Roe River Commelina is suggested.

## Cyperaceae

### *Caustis deserti* R.L.Barrett, *sp. nov.*

*Type*: north-east of Queen Victoria Spring, Western Australia [precise locality withheld for conservation reasons], 18 October 1995, *D.J. Edinger* 1019 (*holo*: PERTH 04241525).

*Rhizomatous perennial*; rhizome scales dark brown. *Culms* rigidly erect, smooth, distinctly grooved on one side, with 5–10 nodes, 21–38 cm tall, the primary culms 1.6–2.8 mm diam., glabrous; *infertile nodes* 5–8 per culm, each with 1–5 lateral branches, the ultimate branchlets (sterile pedicels) straight or slightly flexuose, tightly clustered, 0.8–1.5 mm diam. *Leaves* of mature plants reduced to dark brown, many-nerved sheathing scales with acuminate apiculum, 12–30 mm long; sheath margins very shortly ciliate; sheath and both surfaces of apiculum minutely puberulous when young, glabrescent. Young *flowering branches* somewhat contracted at first (eventually expanding, but the inflorescence remaining narrow), not or somewhat flexuose. *Spikelets* 25–46 per inflorescence, 9.5–17.0 mm long, usually 2-flowered, bisexual; glumes 3–5, white or pale to dark brown with opaque margins, long-acuminate, sparsely to densely appressed- to spreading-hairy particularly at base and on margins. *Stamens* 3 (but anthesis simultaneous in both flowers so 6 per spikelet); *filaments* 7–9 mm long; *anthers* 5.3–6.2 mm long including apiculum *c.* 0.4 mm long, 0.25 mm diam., reddish brown when dry; *pollen* triquetrous. *Style* 3-fid, hairy at base, *c.* 6 mm long, the branches *c.* 5.5 mm long. Mature *nut* not seen. (Figure 5)

*Diagnostic characters*. Distinguished from other species of *Caustis* R.Br. by the following combination of characters: *rhizomatous perennial* 21–38 cm tall; *culms* rigidly erect, the primary culms 1.6–2.8 mm diam., 1–5-branched at each node; *leaves* reduced to sheathing scales 12–30 mm long; *spikelets* 25–46 per inflorescence, 9.5–17.0 mm long, usually 2-flowered; *anthers* 5.3–6.2 mm long including apiculum, *c.* 0.4 mm long, 0.25 mm diam., reddish brown when dry.

*Other specimens examined*. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 14 Sep. 1995, *A. Chapman & D. Pearson* 49 (PERTH); 21 Sep. 1963, *A.S. George* 5878 (PERTH); 2 July 1966, *D.W. Goodall* 2949 (PERTH); 24 Mar. 1987, *D.J. Pearson* DJP 1068 (PERTH); 17 May 1992, *D.J. Pearson* DJP 1820 (PERTH); 28 July 1992, *D.J. Pearson* DJP 2236 (PERTH); 7 Sep. 1992, *D.J. Pearson* DJP 2781 (CANB, PERTH); 2 Oct. 1956, *R.D. Royce* 5532 (PERTH).

*Phenology*. Flowering recorded in September and October.

*Distribution and habitat*. Known only from the vicinity of Queen Victoria Spring to Cundeelee Mission (abandoned) in the southern Great Victoria Desert. Grows in low heath on yellow to orange sand plains.

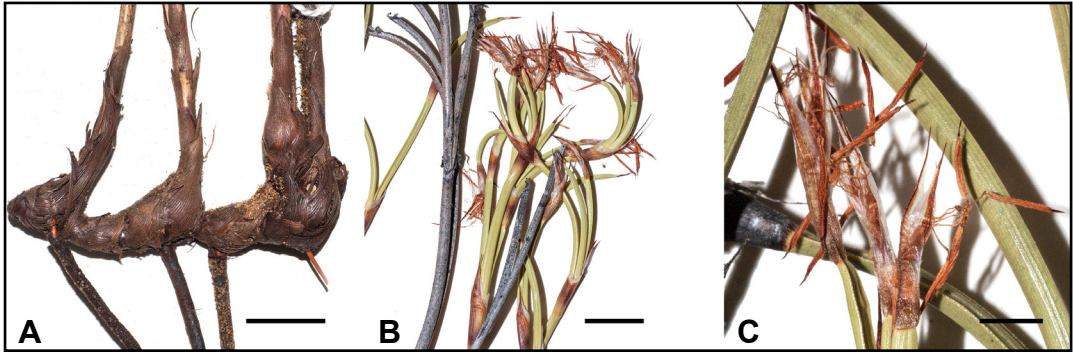


Figure 5. *Caustis deserti*. A – rhizome; B – flowering branchlets; C – spikelets and anthers. Scale bars = 1 cm. Images from D.J. Edinger 1019. Photographs by R.L. Barrett.

**Conservation status.** *Caustis deserti* is to be listed as Priority Three under Department of Parks and Wildlife Conservation Codes for Western Australian Flora (A. Jones pers. comm.).

**Etymology.** The epithet is the genitive case of the Latin noun *desertum* (a desert), in reference to the occurrence of this species in the Great Victoria Desert.

**Notes.** *Caustis deserti* is similar to *C. dioica* R.Br., but is distinctly more robust, with a shorter stature and fewer branches (culms 28–65 cm tall, the primary culms 1.7–3.1 mm diam. with 4–7 branches in *C. dioica*). The anthers of *C. deserti* are 5.3–6.2 mm long, vs 3.0–4.5 mm long in *C. dioica*.

*Caustis dioica* is a rather variable taxon and it is likely that additional taxa should be recognised in this complex; for example, low, slender plants co-occur with tall, robust plants in the Cape Riche area.

The vernacular name Desert Twigrush is suggested.

***Caustis gigas*** Meney & K.W.Dixon ex R.L.Barrett, *sp. nov.*

**Type:** Coorow – Green Head Road, Western Australia [precise locality withheld for conservation reasons], 14 May 1969, A.S. George 9318 (*holo*: PERTH 01278274; *iso*: AD, BM, BOL, BRI, CANB, GENT, HO, K, MEL, NE, NSW, NY, PERTH 01121332, PERTH 01278282).

*Caustis* sp. Gigas (A.S. George 9318), Western Australian Herbarium, in *FloraBase*, <http://florabase.dpaw.wa.gov.au/> [accessed 1 March 2014].

Rhizomatous *perennial*; rhizome scales dark brown. *Culms* rigidly erect, smooth, distinctly grooved on one side, with 5–15+ nodes, 0.7–2.5 m tall, the primary culms 2.2–5.0 mm diam., finely ciliate towards nodes, densely so in groove, glabrescent; *infertile nodes* 5–10 per culm, each with 1–3(–4) lateral branches, the ultimate branchlets (sterile pedicels) straight or flexuose, widely spreading, 0.7–1.4 mm diam. *Leaves* of mature plants reduced to dark brown, many-nerved sheathing scales with acuminate apiculum, 12–42 mm long; sheath margins distinctly long-ciliate; sheath and both surfaces of apiculum densely appressed-puberulous when young, glabrescent outside. Young *flowering branches* forming a pseudo-raceme of 3–12 spikelets, not contracted (narrow at first, the branches and branchlets greatly expanding), somewhat flexuose. *Spikelets* 30–300 per inflorescence, 10–16 mm long, 2–5-flowered, bisexual; glumes 5–8, dark brown, with non-opaque margins, long-acuminate, densely appressed- to

spreading-hairy all over with spreading ciliate margin. *Stamens* 3 (but anthesis simultaneous in all flowers, so up to 15 per spikelet); *filaments* 6.2–7.9 mm long; *anthers* 5.9–7.7 mm long including apiculum *c.* 0.5 mm long, *c.* 0.35 mm diam., reddish brown when dry; *pollen* triquetrous. *Style* 3-fid, hairy at base, *c.* 6.5 mm long, the branches 3.9–4.3 mm long; style base at maturity persistent, spindle-shaped and covered in short, erect hairs. Mature *nut* obovoid, cream, 8.9–9.8 mm long, 2.6–3.0 mm diam., the perianth forming a small rim fused to base of nut. (Figure 6)

*Diagnostic characters.* Distinguished from other species of *Caustis* by the following combination of characters: robust, erect, rhizomatous *perennial* to 2.5 m; *culms* rigidly erect, the primary culms 2.2–5.0 mm diam., with *infertile nodes* 5–10 per culm; *spikelets* 30–300 per inflorescence, 10–16 mm long, 2–5-flowered; *anthers* 5.9–7.7 mm long including apiculum *c.* 0.5 mm long, *c.* 0.35 mm diam., reddish brown when dry; *nut* 8.9–9.8 mm long, 2.6–3.0 mm diam.

*Other specimens examined.* WESTERN AUSTRALIA: [localities withheld for conservation reasons] 18 Oct. 2008, R.L. Barrett & B.G. Briggs RLB 5257 A (AD, BRI, CANB, NE, MEL, NSW, PERTH); 2 May 1973, C. Chapman *s.n.* (PERTH 01278304); 1 May 1991, R.J. Cranfield & P.J. Spencer 8001 (PERTH); Aug. 1988, K. Gillen 27 (PERTH); 12 Oct. 2005, A. Harris NL Opp 11 (PERTH); 3 Nov. 2006, K. McCreery, V. Yeomans & A. Mercier RV 4 - opp 2 (PERTH); 29 Aug. 1991, S.J. Patrick 733 (PERTH); 6 Aug. 1992, S. Patrick SP 1167 (PERTH); 5 July 2002, S. Patrick 4136 (PERTH); 9 Oct. 2002, S. Patrick SP 4472 (PERTH).

*Phenology.* Flowering from May to July. Fruiting from August to October.

*Distribution and habitat.* Restricted to a small area of the northern sandplain between Coorow and Chittering in south-western Western Australia. Grows on white sandplain below lateritic rises with *Adenanthos cygnorum*, *Banksia candolleana*, *Banksia glauca*, *Darwinia* sp., *Eucalyptus todiana*, *Hakea smilacifolia*, *Hibbertia hypericoides*, *Hibbertia* sp., *Lambertia multiflora*, *Leucopogon oldfieldii*, *Petrophile ericifolia*, *Petrophile* sp. and *Xanthorrhoea* sp.

*Conservation status.* *Caustis gigas* is listed by Jones (2014) as Priority Two under Department of Parks and Wildlife Conservation Codes for Western Australian Flora, under the name *C. sp. Gigas* (A.S. George 9318). Most collections have been made from a single locality.

*Etymology.* The epithet is from the Latin *gigas* (a giant), used as a noun in apposition, in reference to the tall stature and robust branchlets of this species.

*Notes.* The epithet was proposed by K.A. Meney and K.W. Dixon while the former was working on her PhD on the ecology of Restionaceae and Cyperaceae based at Kings Park and Botanic Garden, but the name was never published.

*Caustis gigas* has affinities with *C. pentandra* R.Br., a species complex in great need of revision, spanning much of southern Australia and extending to south-east Queensland. *Caustis gigas* differs in the usually larger plants (to 2.5 vs to 1.2 m, occasionally to 2.5 m), thicker primary culms (2.2–5.0 vs 1.9–3.2 mm diam.), larger anthers (5.9–7.7 vs 5–6 mm long) and larger nuts (8.9–9.8 vs 4.5–8 mm long).

The vernacular name Giant Twigrush is suggested.



Figure 6. *Caustis gigas*. A – rhizome; B – distinctly curled terminal branchlets; C – leaf reduced to a sheathing bract with acuminate apiculum; D – inflorescence; E – spikelets and anthers; F – nut. Scale bars = 1 cm (A, B, D, E); 5 mm (C, F). Images from A.S. George 9318 (A–E) and R.J. Cranfield & P.J. Spencer 8001 (F). Photographs by R.L. Barrett.

***Lepidosperma fairallianum* R.L.Barrett, sp. nov.**

*Type:* west base of Mount Ney at end of Mount Ney track and along western face, 40 km north of Condingup, Western Australia, 5 December 2005, R.L. Barrett & M.D. Barrett RLB 2985 (*holo:* PERTH 07304390; *iso:* NE, NSW).

*Lepidosperma* sp. Mt Burdett (M.A. Burgman & C. Layman MAB 3287), Western Australian Herbarium, in *FloraBase*, <http://florabase.dpaw.wa.gov.au/> [accessed 1 March 2014].

*Clump-forming, tufted perennial*, forming compact clones 0.3–1.2 m across. *Rhizomes* 20–60 mm long, horizontal; *rhizome scales* dark brown, becoming fibrous with age, 6.4–9.2 mm long, 2.0–3.3 mm diam., often only loosely appressed to the rhizome, the apex subacute to obtuse. *Culms* and *leaves* distichous; leaf to culm length ratio 0.6–0.9:1; angle of fan (ramet) spread 8–15°. *Leaves* equitant, stiff, erect; *sheath* dark brown at the base, yellow below the blade, glabrous, the base not becoming fibrous with age, with a small amount of pale yellow, weakly aromatic resin; *blade* well-developed, very compressed, flat to slightly concavo-convex, finely ridged or striate with 28–44 stomatal columns per face, 16–47 cm tall, 2.2–3.6 mm wide, 0.4–0.8 mm thick, dull green to mid- or darkish green, not glaucous; margins acute, initially with very fine, white, erect hairs to 0.05 mm long (visible at 40×), with a fine coating of clear resin at the base. *Culms* similar to leaves, with 34–48 stomatal columns per face, 17–47(–75) cm tall, 2.5–3.7 mm wide, 0.5–0.7 mm thick; margins as for leaves. *Inflorescence* compact to shortly elongate, narrow, almost linear to narrowly ovate in outline, 30–100 mm long, 10–32 mm diam., with numerous very short branches, one branch per node; basal branch 12–43 mm long with 7–44 spikelets, spikelets held in tight clusters that give the inflorescence an interrupted appearance;



involucral bract 21–43(–57) mm long, about 1/2 the length of the inflorescence. *Spikelets* 4.1–6.9 mm long, the upper flower bisexual, the lower flower functionally male. *Glumes* 5–7, keeled, dark reddish brown, aging grey, grading to narrow, opaque margins which are slightly fimbriate towards the apex, the exposed surface around the keel evenly covered with short, appressed to ascending white hairs (glabrous below), the apex apiculate; sterile glumes 1–3; fertile glumes 3.7–5.5 mm long, 1.0–1.2 mm wide. *Hypogynous scales* 6, falling with the nut, narrow-triangular, white, 0.9–1.3 mm long; apex attenuate, with scattered short hairs clustered at the tip. *Stamens* 3; filaments 2.4–3.3 mm long; *anthers* 2.1–2.8 mm long, 0.3–0.4 mm diam. with an apical appendage 0.3–0.5 mm long. *Style* 3-fid, unbranched portion 1.2–1.7 mm long, branches 1.3–2.2 mm long with dense, minute hairs; base continuous with ovary, caducous; stylar cap small, shortly hairy. *Nut* obovoid, terete, smooth, with 3 distinct ribs, 2.4–2.7 mm long, 1.0–1.2 mm diam., pale brown; epidermal cells mostly narrow-oblong. (Figure 7)

*Diagnostic characters.* Distinguished from *L. congestum* R.Br. and *L. viscidum* R.Br. by the following combination of characters: *leaf* blades 2.2–3.6 mm wide, 0.4–0.8 mm thick, flat to slightly concavo-convex, with the margins acute, initially with very fine, white, erect hairs to 0.05 mm long (visible at 40×), with a fine coating of clear resin at the base; *inflorescence* compact, spikelets held in tight clusters that give the inflorescence an interrupted appearance; *stylar cap* small, shortly hairy.

*Selected specimens examined* (c. 80 seen). WESTERN AUSTRALIA: Mt Burdett Nature Reserve, c. 400 m W of Wittenoom Hills Rd on Norwood Rd, S road reserve, 8 June 2007, *E.D. Adams* 5/0807 (PERTH); gravel pit, 1.2 km N on Dempster Rd from Scaddan Rd on W side, 28 Oct. 2005, *R.L. Barrett & M.D. Barrett* RLB 2891 A (PERTH); Quoin Head track, 50 m along W fork near Quoin Head, Fitzgerald River National Park, 6 Dec. 2005, *R.L. Barrett & M.D. Barrett* RLB 2993 (PERTH); c. 3 km SE of Mt Arid, 6.5 km along Fisheries Rd from Poison Creek Rd, Cape Arid National Park, 22 Jan. 2008, *R.L. Barrett & M. Moody* RLB 4327 (BRI, K, NE, NSW, PERTH); small hill, 11.3 km from Bremer Bay–Borden Rd on Dillon Bay Rd, then Foster Beach track (old Minarup Rd), N of Mt Remarkable, c. 15 km W of Bremer Bay, 8 Feb. 2008, *R.L. Barrett & M. Moody* RLB 4424 (MEL, NE, NSW, PERTH); Mt Burdett, 1 Sep. 1984, *M.A. Burgman & C. Layman* MAB 3287 (PERTH); 9 km NNE of Mt Ney, 7 May 1983, *M.A. Burgman & S. McNee* MAB 1265 (CANB, PERTH); Mt Ney, 1 Oct. 1983, *M.A. Burgman & S. McNee* MAB 2541 (PERTH); Cheadanup Reserve, Munglinup, 17 Apr. 2007, *G. Byrne* 2642 (PERTH); Shoemaker Levy, Ravensthorpe Nickel Operations mine tenement, c. 30 km E of Ravensthorpe, 19 Nov. 2005, *O. Davies* 10595 (PERTH); West Point Rd, c. 25 km NW of Cascade [Plot - GP01], 13 Oct. 2000, *G.J. Keighery & N. Gibson* 5519 (PERTH); Ravensthorpe Range, survey site R081, 19.1 km ESE of Ravensthorpe, 23 May 2007, *S. Kern, R. Jasper & D. Brassington* LCH 16930 (PERTH); Ravensthorpe Range, survey site R125, 9.0 km NNW of Ravensthorpe, 6 Sep. 2007, *S. Kern, R. Jasper & H. Hughes* LCH 17356 (PERTH); Mason Bay Rd, Ravensthorpe, 19 May 2005, *K. Mappin* 10816 (PERTH); 11 km S of Reynolds Hill, 29 Apr. 1974, *K.R. Newbey* 4112 (PERTH); 7 km E of Ellen Peak, 15 Apr. 1975, *K.R. Newbey* 4702 (PERTH); Belinup Hill, Cape Arid National Park, 7 Nov. 1980, *K.R. Newbey* 7896 (PERTH).

*Phenology.* Flowering from April to May. Fruiting from July to October.

*Distribution and habitat.* Relatively widespread along the south coast of Western Australia, from Albany to Cape Arid. Grows in a range of habitats, on sandy loam with laterite, ironstone gravel, clayey sand, shallow sandy soil over granite or limestone to sandy silcrete. Found on upland flats, granite rock margins and slopes, and on open plains. Found in association with *Acacia mutabilis*, *Allocasuarina humilis*, *Baeckea crassifolia*, *Banksia cirsioides*, *B. lemanniana*, *B. media*, *Boronia inornata*, *Calothamnus pinifolius*, *Eucalyptus brachycalyx*, *E. falcata*, *E. incrassata*, *E. indurata*, *E. pluricaulis*, *E. varia*, *Gahnia ancistrophylla*, *G. sp. aff. lanigera*, *Melaleuca pentagona*, *M. rigidifolia* and *Tetrapora verrucosa*.

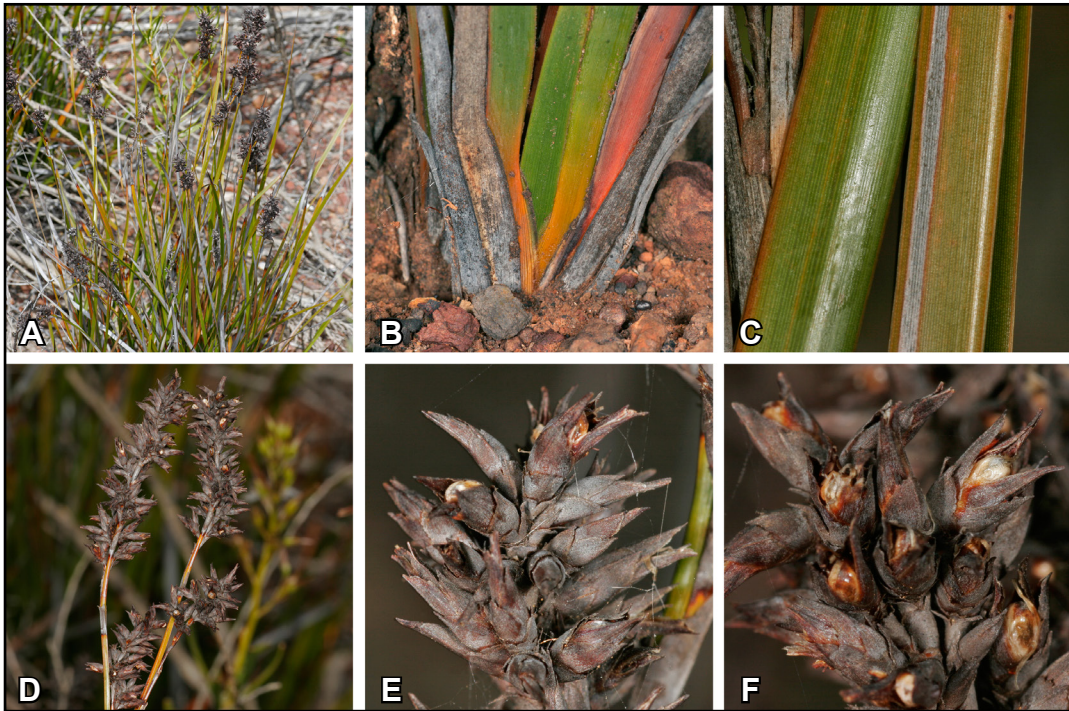


Figure 7. *Lepidosperma fairallianum*. A – habit; B – base of ramet; C – leaves; D – inflorescence; E – clustered spikelets; F – fruiting spikelets. Images from R.L. Barrett RLB 3480. Photographs by R.L. Barrett.

**Conservation status.** *Lepidosperma fairallianum* is widespread and is not considered threatened.

**Etymology.** The epithet honours Arthur Fairall (1920–1970), Kings Park Superintendent (1962–1970), and Pauline Fairall (*née* Bond, 1935–2010), Kings Park Herbarium Botanist (1963–1973, 1995–2003), for their efforts in botanical collecting and commitment to the work of Kings Park and Botanic Garden.

**Notes.** The closest relative of *L. fairallianum* was not strongly resolved by Barrett (2012b); however, a weak relationship with *L. congestum* and *L. viscidum* was suggested. Morphologically, *L. fairallianum* is possibly most similar to *L. congestum* with which it shares a condensed inflorescence, but the former differs in having darkly coloured spikelets arranged in distinct clusters (*vs* mid-brown spikelets that are condensed, but not clustered), a rather short, squat habit (*vs* erect, slender habit), and culms and leaves with yellowish bases with a small amount of clear resin (*vs* culms and leaves with green bases and plentiful resin).

The vernacular name Fairalls' Sword Sedge is suggested.

***Lepidosperma hopperi*** R.L.Barrett, *sp. nov.*

**Type:** on south side of walk trail from Mount Le Grand to Hellfire Bay, Cape Le Grand National Park, Western Australia, 22 January 2008, R.L. Barrett & M. Moody RLB 4317 (*holo:* PERTH 08614105; *iso:* BRI, MEL, NE, NSW, PERTH).

*Clump-forming, tufted perennial*, forming large, dense clones to about 5 m across. *Rhizomes* 50–300 mm long, horizontal; *rhizome scales* mid-brown to dark brown to almost black, darkest towards the soil

surface, not becoming fibrous with age, 8.3–11.5 mm long, 1.7–3.1 mm diam., closely appressed to the rhizome, the apex subacute to acute. *Culms* and *leaves* distichous; leaf to culm length ratio 0.8–0.9(–1):1; angle of fan (ramet) spread 20–40°. *Leaves* equitant, stiff, erect; *sheath* pale brown when light-exposed, dark brown to black below ground level, glabrous except for scattered hairs on margins, the base not becoming fibrous with age, with pale yellow resin having a weak citronella scent; *blade* well-developed, very compressed, flat to slightly concavo-convex, finely ridged or striate with 30–52 stomatal columns per face, 45–210(–300) cm tall, 7–14 mm wide, 0.5–0.8 mm thick, dull green to yellow-green, not glaucous; margins acute, reddish to semi-translucent with a continuous band of very fine erect hairs to 0.2 mm long, the hair bases often matted together with red resin (glabrescent on older growth). *Culms* similar to leaves, with 28–62 stomatal columns per face, 50–220(–300) cm tall, 8–16 mm wide, 1.2–1.8 mm thick; margins as for leaves. *Inflorescence* slender, elongate, ±lanceolate in outline (almost linear when young), 90–160 mm long, 24–48 mm diam., with numerous long branches, some of these with short secondary branches, one lateral branch per node; basal lateral branch 40–85 mm long with 35–68 spikelets; involucre bract 45–110 mm long, at least 1/2 as long as inflorescence. *Spikelets* 5.7–7.3 mm long, the upper flower bisexual, the lower flower functionally male. *Glumes* 5(–7), keeled, grey-brown to straw brown, grading to reddish brown towards the apex and with narrow, opaque, entire margins, the exposed surface around the keel evenly and densely covered with short, appressed to ascending white hairs (glabrous below), the apex acute to apiculate; sterile glumes 1(–3); fertile glumes 4.7–6.4 mm long, 1.3–1.6 mm wide. *Hypogynous scales* 6, falling with the nut, very narrowly triangular to subulate, white, 1.3–1.7 mm long; apex long-attenuate, with scattered short hairs in apical 1/3. *Stamens* 3; filaments 2.4–3.4 mm long; *anthers* 2.8–3.1 mm long, 0.3–0.4 mm diam. with an apical appendage 0.3–0.5 mm long. *Style* 3-fid, unbranched portion 1.9–2.1 mm long, branches 2.2–2.4 mm long with sparse, minute hairs; base continuous with ovary, caducous; stylar cap large, glabrous. *Nut* obovoid, terete, smooth, with 3 distinct ribs and sometimes with another 3 slender ribs between those, 3.1–3.3 mm long, 1.3–1.5 mm diam., pale brown; epidermal cells ±oblong. (Figure 8)

*Diagnostic characters.* Distinguished from *L. drummondii* Benth. by the following combination of characters: robust, clonal *perennial* sedge with leaves and culms to 2.2(–3) m tall; *leaf blades* 7–14 mm wide, 0.5–0.8 mm thick, resinous, dull green to yellow-green with a reddish to semi-translucent margin with a continuous band of very fine erect hairs to 0.2 mm long; *inflorescence* slender, elongate, ±lanceolate in outline; *spikelets* 5.7–7.3 mm long; *hypogynous scales* very narrowly triangular to subulate, 1.3–1.7 mm long, long-attenuate, with scattered short hairs in apical 1/3.

*Selected specimens examined* (c. 40 seen). WESTERN AUSTRALIA: Mt Clarence, 29 Aug. 1902, *C. Andrews s.n.* (PERTH); Mt Clarence, Albany, Jan. 1903, *C. Andrews s.n.* (PERTH); Possession Point, S of Albany, Torndirrup Peninsula, near lookout on point, 22 Mar. 2006, *R.L. Barrett* RLB 3340 (K, NSW, PERTH); lower slopes on mountain, on walk trail to summit (off Mt Lindesay Road), Mt Lindesay, Mt Lindesay National Park, N of Denmark, 21 June 2007, *R.L. Barrett & M. Wallace* RLB 4085 (AD, BRI, CANB, K, MEL, NE, NSW, PERTH); Mt Lindesay, Denmark, 17 Feb. 1995, *S. Barrett* 298 (PERTH); Mt Elphinstone, Albany, 13 Aug. 1996, *M.E. Nash* 2 (PERTH); Mt Elphinstone, Albany, 27 May 2000, *M.E. Nash* MEN 64 (PERTH); Bremer Bay, 30 Jan. 1972, *K. Newbey* 3526 (PERTH); Mt Clarence, Albany, 25 Apr. 1975, *K. Newbey* 4720 (NSW, PERTH).

*Phenology.* Flowering from April to May. Fruiting from August to October.

*Distribution and habitat.* Widespread and common on large granite domes in the southern forests and along the south coast of Western Australia, from Muirillup Rock (east of Northcliffe) and Winnejuup (south-east of Bridgetown) in the west, through Walpole, Mt Frankland, Mt Lindesay and the Porongurup

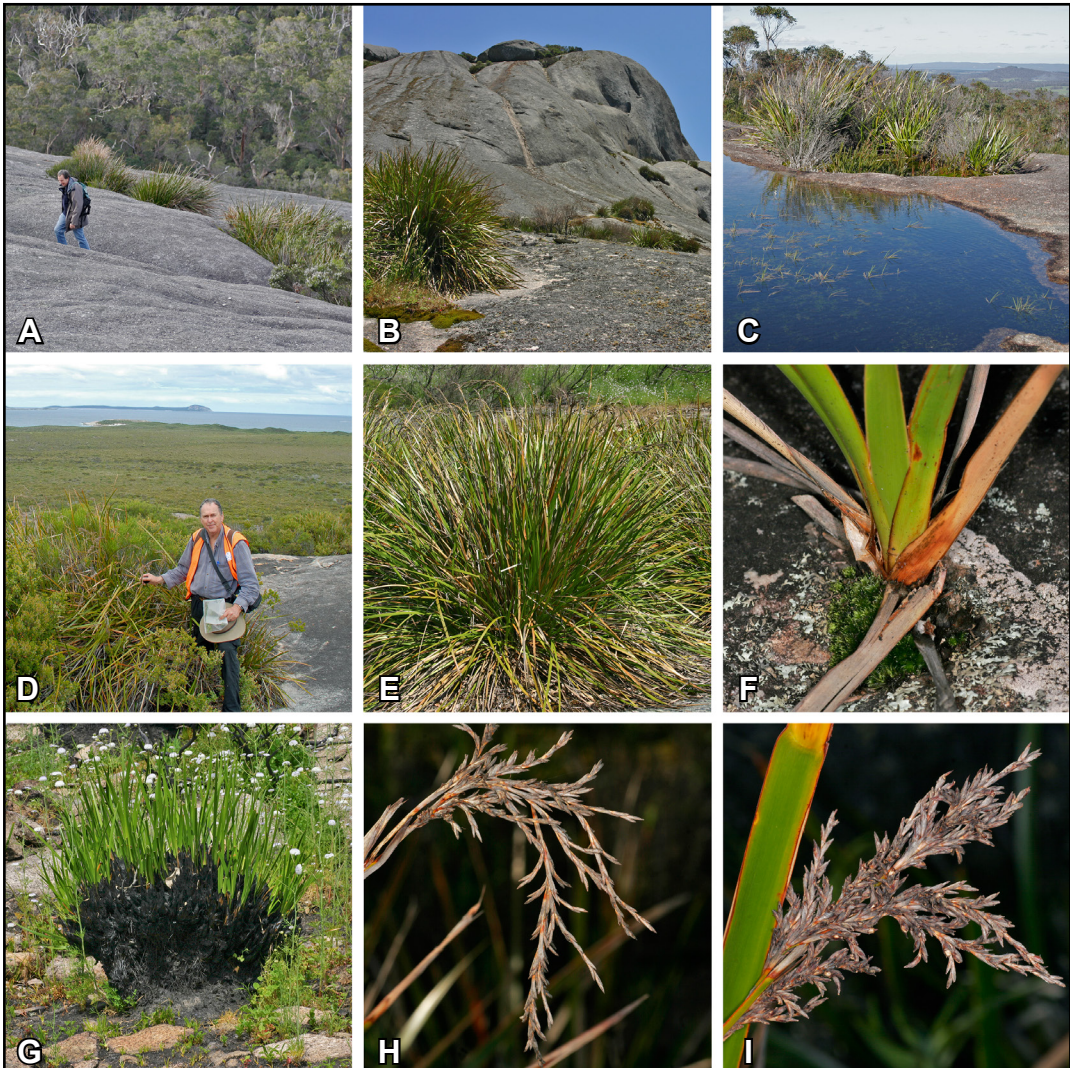


Figure 8. *Lepidosperma hopperi*. A – Steve Hopper in habitat with *L. hopperi* on Little Mt Lindesay; B – habitat in the Porongurup Range; C – habit on Mt Lindesay; D – Steve Hopper in habitat with *L. hopperi* on Chettenjacke rock, c. 3 km SE of the summit of Yorlinning (Mt Arid). Middle Island lies 10 km SSW offshore in the background; E – habit on Little Mt Lindesay; F – base of a young plant in granite fissure; G – tussock resprouting after fire in the Porongurup Range; H – budding inflorescence; I – inflorescence. Images from R.L. Barrett & M. Wallace RLB 4085 (C, F, H, I; others not vouchered). Photographs by R.L. Barrett (A–C, E–I); D. Reynolds (D).

Range, with a considerable disjunction then eastward to the Esperance–Cape Arid National Park coastal region. Particularly common on granite domes around Albany and Esperance. Grows as large tussocks on shallow soil on granite, often forming dense fringes to rock domes, growing with *Acacia conniana*, *A. heteroclita*, *A. myrtifolia*, *A. subcaerulea*, *Andersonia sprengelioides*, *Borya nitida*, *B. longiscapa*, *Calothamnus quadrifidus*, *Drosera* spp., *Eutaxia myrtifolia*, *Grevillea fuscolutea*, *Hakea clavata*, *H. drupacea*, *Lepidosperma* spp., *Leptospermum sericeum*, *Platysace compressa*, *Stypantra glauca*, *Taxandria callistachys*, *T. marginata* and *Trachymene caerulea*.

*Conservation status.* *Lepidosperma hopperi* is locally common and not currently threatened.

*Etymology.* The epithet honours the work of Stephen Donald Hopper, former Research Officer (Flora Conservation) with the Department of Fisheries and Wildlife, former Research Scientist with the Department of Conservation and Land Management, former Chief Executive Officer of the Botanic Gardens and Parks Authority, former Director (CEO and Chief Scientist) of the Royal Botanic Gardens, Kew, and now Professor of Biodiversity at The University of Western Australia. The choice of this species, characteristic of granite rocks, commemorates a career researching granite rock habitats in southern Western Australia and around the world, and the collection of many unusual sedge species.

*Notes.* Previously, *L. hopperi* has been confused with *L. drummondii*, a species of sandy and laterite plains that is also found in the Albany area. *Lepidosperma drummondii* and *L. hopperi* were both included in the original concept of *L. drummondii* by Bentham (1867; see Barrett & Wilson 2012) due to superficial similarities. Unlike *L. drummondii*, *L. hopperi* has a finer inflorescence, finer hairs and less resin on the leaf and culm margins, yellowish (vs dark green) leaves and culms, and a preference for granitic habitats (vs laterite or sand over laterite or clay). This taxon has for some years been known informally as *L. sp.* ‘Southern Granite’.

Genetic data support *L. hopperi* as sister to the morphologically dissimilar (fine, terete to semi-terete culms) but geographically sympatric *L. gracile* R.Br. species complex, while *L. drummondii* is related to *L. ustulatum* Steud. (Barrett 2012b).

*Lepidosperma hopperi* has also been widely confused with the similarly robust *L. effusum* Benth., which differs in having dark green culms and leaves with glabrous margins, a very elongated inflorescence and a preference for swampy, riverine or wet forest habitats (sometimes growing at the base of granite rocks in forests).

The vernacular name Hopper’s Sword Sedge is suggested.

***Lepidosperma oldhamii* R.L.Barrett, *sp. nov.***

*Type:* Kings Park bushland, near Eucalyptus Carpark, West Perth, Western Australia, 26 June 2014, R.L. Barrett RLB 9055 (*holo:* PERTH 08613893; *iso:* CANB, K, MEL, NE, NSW).

*Clump-forming, tufted perennial*, forming compact clones to c. 0.5 m across. *Rhizomes* 40–120 mm long, horizontal; *rhizome scales* dark brown to almost black, grading to grey-brown at the soil surface, becoming fibrous with age, 4.2–9.0 mm long, 1.6–2.4 mm diam., closely appressed to the rhizome, the apex acute. *Culms* and *leaves* distichous; leaf to culm length ratio 0.9–1.1:1; angle of fan (ramet) spread 8–15°. *Leaves* equitant, wiry, erect; *sheath* pale brown to dark brown, glabrous, the base becoming somewhat fibrous with age, lacking obvious resin; *blade* well-developed, very compressed, thinly biconvex, very finely ridged or striate with 12–16 stomatal columns per face, 26–59 cm tall, 1.2–1.9 mm wide, 0.4–0.6 mm thick, mid-green to dark green, not glaucous; margins acute, smooth, lacking obvious resin. *Culms* similar to leaves but more angular in section, with 36–40 stomatal columns per face, 55–80 cm tall, 2.0–2.9 mm wide, 0.8–1.4 mm thick; margins as for leaves. *Inflorescence* compact, usually held oblique to the culm axis, becoming reflexed with age, narrowly ovate to ±oblong in outline, 45–80 mm long, 12–27 mm diam.; primary axis with 4–7 short branches, occasionally some primary branches with a single secondary branch, one lateral branch per node; basal lateral branch 19–41 mm long with 14–37 spikelets in well-spaced, compact clusters; involucre bract (34–)46–80 mm long, usually just exceeding the inflorescence. *Spikelets* densely arranged, 5.4–7.3 mm long, the upper flower bisexual, the lower flower functionally male. *Glumes*

7–9, keeled, dark brown, grading to dark reddish brown towards the margins with narrow, opaque margins, the exposed surface around the keel with short, appressed or ascending white hairs, often concentrated along the nerves and margins (glabrous below), the apex acute to apiculate; sterile glumes 3–5; fertile glumes 5.9–7.6 mm long, 1.4–2.0 mm wide. *Hypogynous scales* 6, falling with the nut, narrow-triangular, white, 0.8–1.5 mm long; apex acute to attenuate, with a few short hairs. *Stamens* 3; filaments 2.8–4.2 mm long; *anthers* 2.8–3.2 mm long, 0.35–0.55 mm diam. with an apical appendage 0.4–0.5 mm long. *Style* 3-fid, unbranched portion 1.6–2.3 mm long, glabrous, branches 1.2–1.8 mm long with scattered, minute hairs; base continuous with ovary, caducous; styler cap small, glabrous. *Nut* obovoid, terete, smooth, with 3 indistinct ribs, 3.2–3.5 mm long, 1.3–1.5 mm diam., pale brown to reddish brown; epidermal cells indistinct, ±round to oblong. (Figure 9)

*Diagnostic characters.* Distinguished from both *L. squamatum* Labill. and *L. calcicola* R.L.Barrett & K.L.Wilson by the following combination of characters: *leaves* slender; *sheath* pale to dark brown, becoming fibrous with age; *blade* biconvex, 1.2–1.9 mm wide, 0.4–0.6 mm thick; *culms* 2.0–2.9 mm wide, 0.8–1.4 thick; *inflorescence* with well-spaced, compact clusters of spikelets.

*Other specimens examined.* WESTERNAUSTRALIA: Forrest Rd, Bibra Lake, Oct. 1979, *P. Bridgewater s.n.* (PERTH); private property, 2.7 km from coast on track between Deeside Coast Rd and the coast (Plot: dcr4), 5 May 1991, *N. Gibson & M. Lyons* 639 (PERTH); Gazetted Reserve 2471, Trigg Dunes Reserve, Trigg, 20 km N of Perth, 13 Nov. 1989, *G.J. Keighery* 10876 (PERTH).

*Phenology.* Flowering usually in May. Fruit mature from September to October.

*Distribution and habitat.* Probably common and relatively widespread on the Swan Coastal Plain in south-western Australia, but only a few collections from the Perth metropolitan area are currently assigned to this species. Grows on white to grey sands in woodland associated with *Acacia pulchella*, *Allocasuarina fraseri*, *A. humilis*, *Banksia attenuata*, *B. menziesii*, *Eucalyptus gomphocephala*, *Hypocalymma robustum*, *Levenhookia pusilla*, *Mesomelaena pseudostygia*, *Philotheca spicata*, *Pithocarpa cordata*, *Xanthorrhoea brunonis* and *X. preissii*.

*Conservation status.* *Lepidosperma oldhamii* appears to be relatively widespread on the Swan Coastal Plain in the south-west of Western Australia and is not currently considered threatened. It is, however, poorly collected and impacted by urbanisation, and further surveys and study are required to accurately determine its distribution.

*Etymology.* The epithet recognises the work of John Oldham (1907–1999), landscape architect for the City of Perth, who drew up some of the original landscaping plans that influenced the design of the Western Australian Botanic Garden at Kings Park, along with many other well-known features of the capital city, including the Swan River foreshore, the Narrows Interchange, Sir Charles Gairdner Hospital and Parliament House.

*Notes.* This species has been previously confused with *L. squamatum*, a name that has in the past been applied to a large number of distinct taxa but is correctly applied to a species from coastal areas between Esperance and Cape Arid (see Barrett 2012a for a description and discussion). *Lepidosperma oldhamii* has glabrous leaf and culm margins while *L. squamatum* has small, short, thick, white hairs that become reduced to small, scabrid projections on the margins. *Lepidosperma oldhamii* is similar in appearance to *L. calcicola* (see Barrett & Wilson 2013) with which it occasionally grows in Kings Park; however, it is not closely related to *L. calcicola*, differing in its taller stature, thicker, more rounded

leaves, denser culms, and a more robust inflorescence which is held obliquely, becoming reflexed with age. In *L. oldhamii*, the unbranched portion of the style is 1.6–2.3 mm long (*vs* 3.5–4.3 mm long in *L. calcicola*) and the nuts are 3.2–3.5 mm long (*vs* 2.3–2.5 mm long).

With the correct application of the name *L. squamatum*, a large clade of taxa previously referred to that name has been left with no named taxa (Barrett 2012b). While species boundaries in this difficult complex will need considerable work to be defined adequately, *L. oldhamii* is named here so the clade can be referred to using a validly named species.

The vernacular name Oldham's Sword Sedge is suggested.

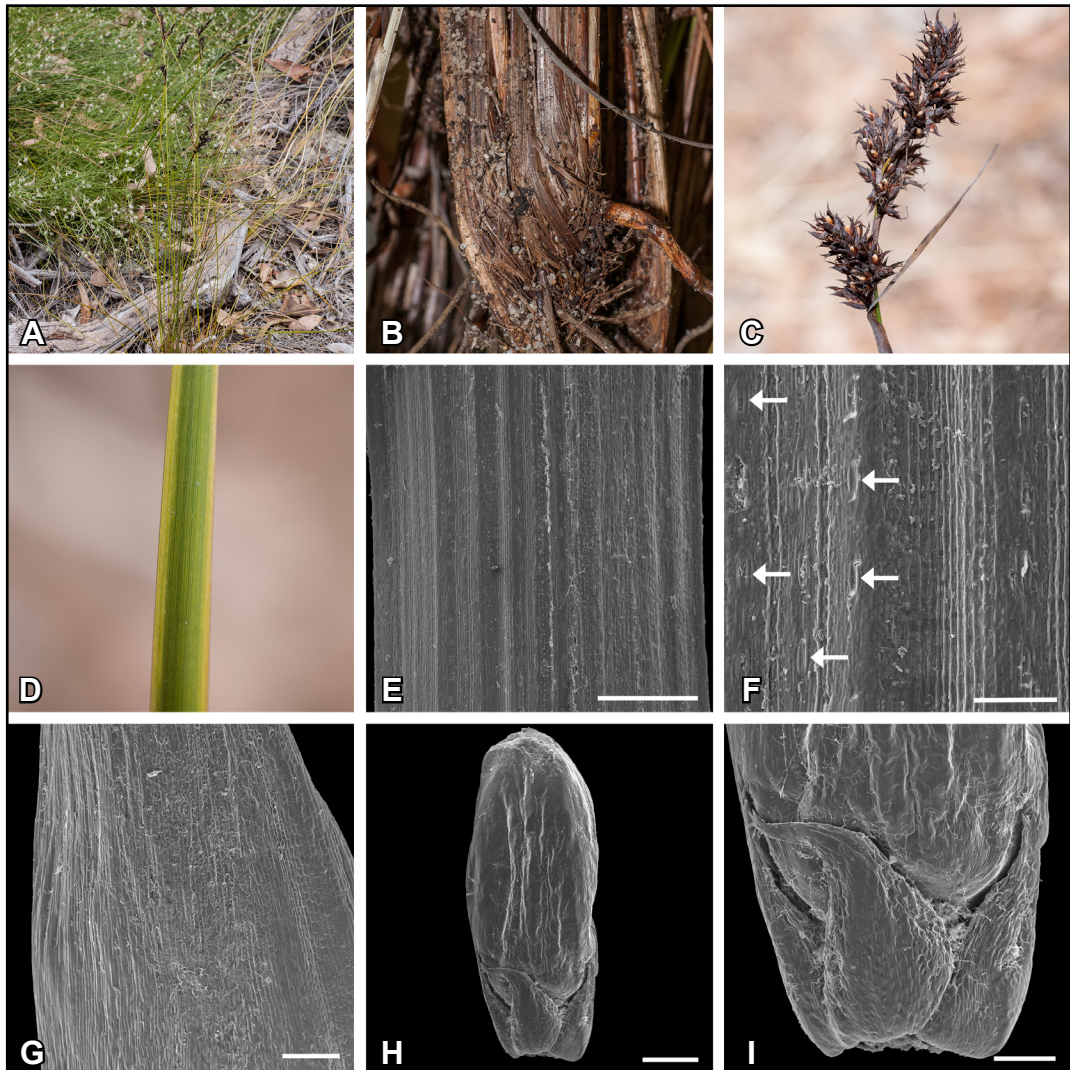


Figure 9. *Lepidosperma oldhamii*. A – habit; B – base of leaf sheaths; C – inflorescence; D – culm showing convex face; E – SEM of dry leaf face with gentle undulations; F – SEM showing stomatal columns on leaf face (arrowed); G – SEM of middle part of fertile glume; H – SEM of nut; I – SEM of hypogynous scales, with minute hairs visible at apices. Scale bars = 500  $\mu$ m (E, H); 100  $\mu$ m (F); 200  $\mu$ m (G, I). Images from R.L. Barrett RLB 9055. Photographs by R.L. Barrett.

**Schoenus thedae** M.D.Barrett & R.L.Barrett, *sp. nov.*

*Type:* Theda Station, Western Australia [precise locality withheld for conservation reasons], 10 March 2014, R.L. Barrett RLB 8891 (*holo:* PERTH 08613974; *iso:* CANB, K).

*Schoenus* sp. Theda (M.D. Barrett 1578 B), Western Australian Herbarium, in *FloraBase*, <http://florabase.dpaw.wa.gov.au/> [accessed 1 March 2014].

*Annual* caespitose herb 40–150 mm high, glabrous on all parts except glume keels; roots pinkish red. *Culms* 3–9 per plant, without nodes, slender, 0.3–0.4 mm wide, when dry irregularly ribbed, ridged or angled, sometimes almost 4-angled or flattened. *Leaves* sheathing; *sheath* closed, 4–10 mm long, membranous to weakly few-ribbed, pale translucent green to straw-coloured; *blade* 7–70 mm long, 0.3–0.6 mm wide, channelled on adaxial surface; *ligule* a thickened ridge of tissue *c.* 0.05 mm high. *Bracts* erect, with a green to reddish sheath 3–7 mm long and slender, leaf-like blade (3–)6–25 mm long. *Inflorescence* 18–50 mm long, 15–30 mm wide, with 2–8 long-pedunculate solitary spikelets per culm; peduncles in 1–3 (usually 2) clusters or levels, each subtended by a bract, peduncles 4–26(–52) mm long, ±filiform. *Spikelets* narrowly lanceolate to narrowly oblong, compressed, (5.5–)7.0–15.0 mm long, (1.2–)1.5–3.5 mm wide, 3–8-flowered, with 2 or 3 empty basal glumes; flowers sub-distichous; rachis 2–3 mm long, flattened and curved around each nut at maturity. *Basal sterile glumes* 2 or 3, broadly ovate to ovate, 1.6–3.5 mm long, keeled, apex acute. *Floral glumes* 3–6 (frequently 4), moderately narrowly ovate, 5.5–7.5 mm long, keeled, lacking nerves or with 1 obscure nerve on each side close to midrib, green or chestnut and minutely scabrous along midrib; apex mucicous; margins membranous and streaked reddish, sometimes also flushed chestnut, entire. *Perianth segments* 6, in 2 whorls of 3, not reduced. *Outer perianth segments* greatly exceeding the nut, 2.7–3.1 mm long, white, shed with the nut; distal 1/2 awn-like, glabrous but minutely antrorsely scabrous; basal part slightly shorter than nut, broader than awns (very narrowly lanceolate or thickly sub-terete) and with dense, fine, appressed to slightly ascending antrorse hairs over whole surface. *Inner perianth segments* alternating with and similar to outer segments but longer (3–4 mm long); basal part more distinctly flattened and broader (*c.* 0.15 mm wide), with a dark straw-coloured, very shortly hairy midline and paler, densely hairy margins. *Stamens* 3; *anthers* 3.0–3.8 mm long, yellow, minutely apiculate at apex, lacking basal or apical hairs. *Style* slender, terete, not expanded at base, not articulate, 3.5–4.5 mm long in undivided portion, with 3 stigmatic branches 1.0–1.5 mm long. *Nut* on a stipe *c.* 0.2 mm long, trigonous-obovoid and shortly beaked, 1.0–1.1 mm long (excluding beak), 0.7–0.8 mm diam., cream- to straw-coloured at maturity, strongly 3-ribbed, sub-glossy and smooth between ribs, with *c.* 10 rows of moderate-sized, obscure to weakly visible cells on each surface (discernible only at full maturity); ribs projecting at apical margins into a slight to prominent wing or thickened horn *c.* 0.1–0.4 mm high and smoothly rounded or projecting upward at outer margin, so that nut apex is weakly to very strongly 3-lobed, otherwise almost truncate; beak *c.* 0.2–0.3(–0.8) mm long, slender. (Figure 10)

*Diagnostic characters.* Distinguished from all tropical Australian species of *Schoenus* L. by the following combination of characters: annual herb; *inflorescence* few-noded, open; *spikelets* pedunculate, compressed, solitary; *perianth* not reduced, hairy, of 6 bristles longer than the nut; *nut* beaked, 1.0–1.1 mm long, 0.7–0.8 mm diam., strongly 3-ribbed.

*Other specimens examined.* WESTERN AUSTRALIA: [locality withheld for conservation reasons] 17 Feb. 2005, M.D. Barrett MDB 1578 B (PERTH); 17 Mar. 2011, M.D. Barrett MDB 3360 (PERTH); 28 Apr. 2008, M.D. Barrett & R.L. Barrett MDB 2147 (BM, BRI, MEL, NE, NSW, PERTH).



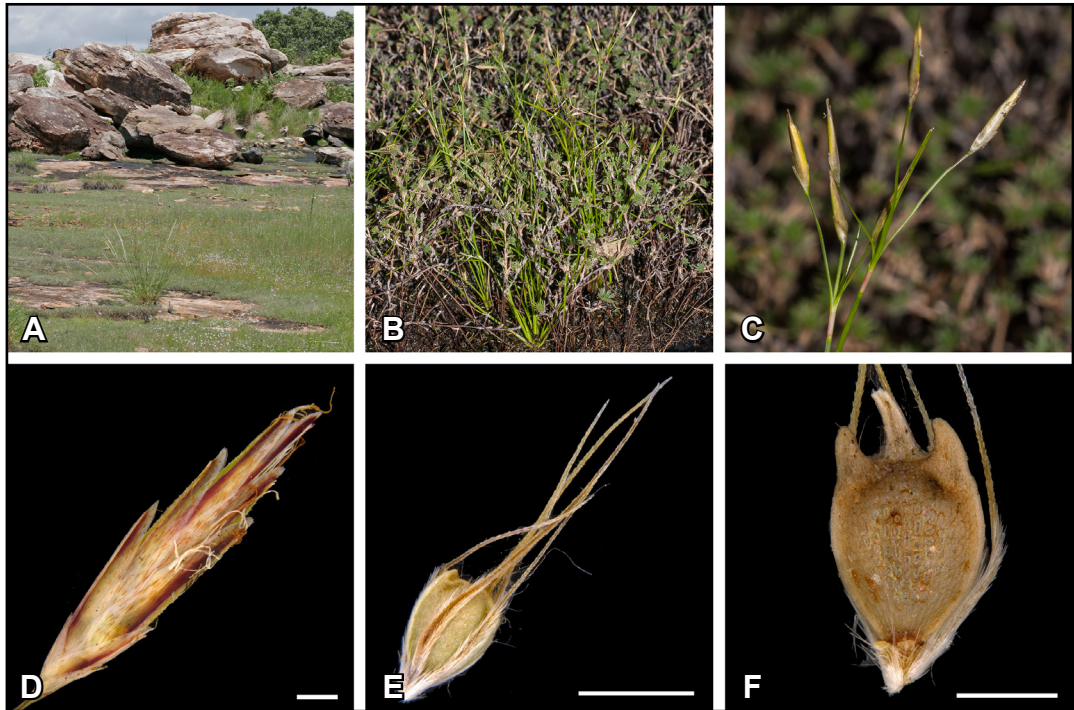


Figure 10. *Schoenus thedae*. A – habitat of thin sand sheet over massive sandstone pavement; B – habit; C – inflorescence; D – spikelet; E – nut and hypogynous bristles; F – nut and bristles. Scale bars = 1 mm (D, E); 500  $\mu$ m (F). Images from R.L. Barrett RLB 8891. Photographs by R.L. Barrett (A–C); M.D. Barrett (D–F).

*Phenology*. Flowering and fruiting recorded from January to March.

*Distribution and habitat*. Known only from a single location on Theda Station in the central North Kimberley where it grows on seasonally wet skeletal sands on a sandstone pavement which dries up rapidly when rains cease at the end of the wet season (about April). Grows with *Drosera cucullata*, *Eriocaulon scullionii*, *Micraira brevis*, *M. dunlop* and *Rhynchospora* sp. Arnhem (P.K. Latz 2999).

*Conservation status*. *Schoenus thedae* is listed by Jones (2014) as Priority One under Department of Parks and Wildlife Conservation Codes for Western Australian Flora, under the name *S. sp. Theda* (M.D. Barrett 1578 B). *Schoenus thedae* is currently known from only a single population despite having been subject to extensive wet season surveys between 2001 and 2014. Although the pavement it grows on is relatively large (c. 1 km across), the population appears restricted to an area c. 20 m across and is estimated to contain c. 500 plants.

*Etymology*. The epithet is derived from the name of the station where this species is found. Theda Station was apparently named for Theda, the wife of the founder of the station lease, hence the feminine gender.

*Notes*. *Schoenus thedae* differs from most other tropical Australian *Schoenus* species in being a small annual (vs robust perennials), with a few-noded, open inflorescence and having a non-reduced, hairy perianth of six bristles longer than the nut. *Schoenus yarrabensis* Domin, from Queensland, can also be an annual, but differs in being more robust (and sometimes perennial) and in having perianth segments more or less equal in length. *Schoenus thedae* does not appear to be closely related to any known taxon with molecular data placing it in an isolated, but unsupported, position in a detailed

phylogeny of the genus (A. Gibbs *et al.*, unpubl. data). It is most similar morphologically to *S. badius* Rye and *S. pennisetis* S.T.Blake (both endemic in south-western Australia; Rye 1997a). In a key to Western Australian annual Cyperaceae (Rye 1997b), *S. thedae* would key to *S. pennisetis*, but differs from this species in having perianth lobes long-awned and greatly exceeding the nut (*vs* as long as or shortly exceeding the nut in *S. pennisetis*; Blake 1949), the nut apex truncate or 3-lobed (*vs* acute in *S. pennisetis*), and longer spikelets (5.5–)7.0–15.0 mm long (*vs* 4–5 mm long in *S. pennisetis*). Of the eastern Australian annual *Schoenus* species, *S. thedae* appears to be most similar to *S. apogon* Roem. & Schult. and *S. paludosus* (R.Br.) Poir., differing in the perianth greatly exceeding the nut (subequal or shorter than the nut in the two south-east species), and in usually having longer peduncles. *Schoenus thedae* is also similar to *S. latelaminatus* Kük. from south-eastern Australia and *S. centralis* Latz from central Australia, species which differ in lacking or having a minute perianth, and having reticulate-pitted and acute nuts.

The vernacular name Kimberley Pavement Sedge is suggested.

### Dasypogonaceae

#### *Calectasia demarzii* R.L.Barrett, *sp. nov.*

*Type*: south-west of Wellstead, 1.1 km west on Mettler Road from Sandalwood Road, Western Australia, 4 October 1999, R.L. Barrett, K.W. Dixon & M.D. Barrett RLB 1348 (*holo*: PERTH 05542510; *iso*: AD 124526, BM, CANB 550057, KPBG, L, MEL 2290834, NSW, UWA).

*Calectasia grandiflora* (South Coast variant), R.L. Barrett & K.W. Dixon, *Nuytsia* 13: 427, Figure 7D–G (2001).

*Calectasia grandiflora* subsp. southern (H. Demarz 546), Western Australian Herbarium, in *FloraBase*, <http://florabase.dpaw.wa.gov.au/> [accessed 1 March 2014].

Clonal perennial; *rhizome* short, ‘looping’, with sand-binding roots. *Stems* to 35 cm high, with many short lateral branches usually crowded at the apex. *Leaves*: *sheath* with short, branched trichomes on margin, glabrous otherwise; *lamina* 5.2–13.0 mm long, 0.4–0.6 mm wide, glabrous; margins finely scabrous; apex acute with a mucro 0.3 mm long. *Bracts* 9.6–11.2 mm long, 1.3–2.5 mm wide, papery, white to pale brown with a pale brown apex; outer bracts reddish brown; margins pilose; apex with green vestigial leaf lamina 1.5–2.5 mm long, 0.4–0.5 mm wide. *Perianth* tube 9.4–10.2 mm long, pilose in lower 1/5, not prominently costate when dry; lobes 12.8–16.5 mm long, 2.6–4.7 mm wide, acuminate, blue-red fading to pale blue-red, pilose on abaxial side; margins opaque; throat with tangle of short, barbed hairs. *Staminal filaments* 2.8–3.7 mm long. *Anthers* 4.1–5.8 mm long, 0.7–1.2 mm diam., 3 slightly shorter, yellow, not turning orange-red with age; pores terminal. *Style* 12.5–13.8 mm long, exceeding anthers. *Seeds* not seen. (Figure 11)

*Diagnostic characters*. Distinguished from *C. grandiflora* L.Preiss by the following combination of characters: *rhizome* spreading, ‘looping’; *leaf blades* 5.2–13.0 mm long, 0.4–0.6 mm wide; *perianth* tube 9.4–10.2 mm long, pilose in lower 1/5; *perianth* lobes 12.8–16.5 mm long, 2.6–4.7 mm wide, blue-red fading to pale blue-red; *anthers* 4.1–5.8 mm long, yellow.

*Selected specimens examined* (c. 40 seen). WESTERN AUSTRALIA: junction of Rocky Crossing Rd and Willyung Rd, N of Albany, 30 Nov. 1965, J.C. Anway 253 (PERTH); 0.8 km into Stirling Range

National Park on Chester Pass Rd, 4 Oct. 1999, *R.L. Barrett, K.W. Dixon & M.D. Barrett* RLB 1351 (K, KPBG, NSW, PERTH); Red Gum Pass, Stirling Range National Park, 15 Sep. 1965, *A.C. Beauglehole* ACB 12945 (PERTH); 50 km NNE of Albany on Chester Pass Rd, 27 Sep. 2004, *R.K. Brummitt* 21375, *A.S. George & E.G.H. Oliver* (PERTH); Hunton Rd, off Nananup Rd, E of Albany, 1 Sep. 1984, *E.J. Croxford* 3593 (PERTH); Mt Josephine, Stirling Range, 9 Oct. 1962, *A.R. Fairall* 485 (KPBG, PERTH); Mount Barker hill, 1 Nov. 1995, *T.R. Lally* 850 (CANB, PERTH); Tick Flat, Two Peoples Bay Nature Reserve, 5 Oct. 1972, *G.T. Smith & L.A. Moore s.n.* (PERTH); Scenic Drive, Porongurup National Park, 18 Oct. 1999, *J.R. Wheeler* 4014 (PERTH).

*Phenology.* Flowering and fruiting from October to November.

*Distribution and habitat.* Restricted to a small area in south-western Australia between Cape Riche, the Stirling Range and Walpole, with possible outlying populations near Dunsborough requiring further study. Grows in sparse woodland in sand with *Agonis*, *Allocasuarina* or *Eucalyptus* spp., often near granite outcrops and in open kwongan with low Proteaceae and Myrtaceae heath.

*Conservation status.* Widespread in several national parks and nature reserves and not considered threatened.

*Etymology.* The epithet recognises the work of Herbert Demarz, seed collector for Kings Park and Botanic Garden from 1970–1990. Demarz was also a prolific collector of insects, with several species having been named in his honour.

*Notes.* *Calectasia demarzii* was previously included in a broad concept of *C. grandiflora* (Barrett & Dixon 2001) and later given a phrase name at subspecific rank under that species. Following additional fieldwork, species rank is considered appropriate as the ranges of these taxa do not overlap and no intergrades are known. *Calectasia demarzii* can be distinguished from *C. grandiflora* by its smaller habit (stems to 35 cm vs to 60 cm), with spreading, ‘looping’ rhizomes (vs relatively compact, non-looping rhizomes), and slender leaf blades 0.4–0.6 mm wide (vs 0.8–1.2 mm wide).

The vernacular name Demarz’s Tinsel Lily is suggested.

***Calectasia elegans*** R.L.Barrett, *sp. nov.*

*Type:* Pinjar [north of Perth], Western Australia [precise locality withheld for conservation reasons], 8 November 2005, *C. Tauss* 557 (*holo:* PERTH 07215363).

*Calectasia* sp. Pinjar (*C. Tauss* 557), Western Australian Herbarium, in *FloraBase*, <http://florabase.dpaw.wa.gov.au/> [accessed 1 March 2014].

Clonal perennial, with stilt roots to 8 cm long; *rhizome* absent. *Stems* to 45 cm high, with many short lateral branches. *Leaves:* *sheath* with short, branching trichomes on margin and a line of long, stiff hairs near the margin, otherwise glabrous; *lamina* 5.0–8.8 mm long, 0.38–0.53 mm wide, glabrous; margins scabrous at apex, otherwise glabrous; apex with a pungent mucro 0.2–0.5 mm long. *Bracts* 6.2–7.2 mm long, 1.4–2.4 mm wide, papery, translucent and off-white to opaque and pale brown; outer bracts similar; margins with unbranched or shortly branched trichomes, these sometimes also on midrib below apex; apex with green vestigial leaf lamina 1.4–2.0 mm long, 0.3–0.4 mm wide. *Perianth* tube 6.5–7.3 mm long, shortly pilose in lower 1/2 with 4 lines of hairs continuing for entire

length, prominently costate when dry; lobes 6.9–7.9 mm long, 1.8–2.2 mm wide, acute, blue, not becoming red with age, shortly pilose on abaxial side; margins opaque; throat glabrous above sinus with short hairs inside. *Staminal filaments* 2.1–2.3 mm long. *Anthers* 4.2–4.4 mm long, 0.90–0.95 mm diam., yellow turning orange-red with age; pores terminal. *Style* 6.0–7.7 mm long, exceeding anthers. *Seeds* not seen. (Figure 12)

*Diagnostic characters.* Distinguished from all other species by the following combination of characters: *undershrub* with stilt roots; *leaf blades* 5.0–8.8 mm long, 0.38–0.53 mm wide, glabrous; *perianth tube* 6.5–7.3 mm long, shortly pilose in lower 1/2 with 4 lines of hairs continuing for entire length, prominently costate when dry; *perianth lobes* 6.9–7.9 mm long, 1.8–2.2 mm wide, not aging red; *anthers* 4.2–4.4 mm long, turning orange-red with age.

*Other specimens examined.* WESTERN AUSTRALIA: [localities withheld for conservation reasons] 11 Dec. 2008, *B. Fellows & J. Waud* BCF 10 (K, PERTH); 16 Sep. 2008, *M.E. Hoskins 13 & L.W. Sage* (CANB, PERTH); 16 Sep. 2008, *M.E. Hoskins 14 & L.W. Sage* (MEL, PERTH); 28 Oct. 2008, *M.E. Hoskins & L.W. Sage* 2854 (PERTH); 11 Sep. 2008, *D. Mickle* 117 (PERTH); 11 Sep. 2008, *D. Mickle* 118 (PERTH).

*Phenology.* Flowering recorded for November (probably also flowering in earlier months).

*Distribution and habitat.* Known only from a few locations from the northern outskirts of the Perth Metropolitan Region between Pinjar and Bullsbrook on deep, grey, quartz sand in habitats that have experienced infrequent fires. Recorded growing in *Banksia menziesii* and *B. attenuata* woodland in association with *Adenanthos cygnorum*, *Alexgeorgea nitens*, *Andersonia heterophylla*, *Austrostipa compressa*, *Beaufortia elegans*, *Calothamnus sanguineus*, *Calytrix flavescens*, *Desmocladius flexuosus*, *Eremaea pauciflora*, *Hensmania turbinata*, *Hibbertia aurea*, *H. sericosepala*, *Jacksonia floribunda*, *Lechenaultia floribunda*, *Leucopogon conostephioides*, *Melaleuca seriata*, *Nuytsia floribunda*, *Patersonia occidentalis*, *Phlebocarya ciliata*, *Thysanotus thyrsoideus* and *Verticordia nitens*.

*Conservation status.* *Calectasia elegans* is listed by Jones (2014) as Priority One under Department of Parks and Wildlife Conservation Codes for Western Australian Flora, under the name *C. sp.* Pinjar (C. Tauss 557). It is an apparently rare species, known only from four very small populations, one on State-owned land, one in a nature reserve and two in a State forest reserve. Targeted survey is required to ascertain whether this species warrants listing as Threatened.

*Etymology.* The epithet is Latin for elegant, and refers to the attractive habit and flowers.

*Notes.* *Calectasia elegans* is similar in appearance to *C. gracilis* Keighery, differing in its many-branched habit (*vs* usually few-branched), very slender leaves 0.38–0.53 mm wide (*vs* 0.5–0.6 mm wide), always pungent leaf apices (*vs* obtuse to pungent), prominently ribbed perianth tube 6.5–7.3 mm long (*vs* not or weakly ribbed, 5.7–6.9 mm long) that is pilose in the lower half and with four lines of hairs continuing for the entire length (*vs* lacking four lines of hairs) and smaller anthers, 4.2–4.4 mm long (*vs* 5.0–5.4 mm long).

The vernacular name Elegant Tinsel Lily is suggested.

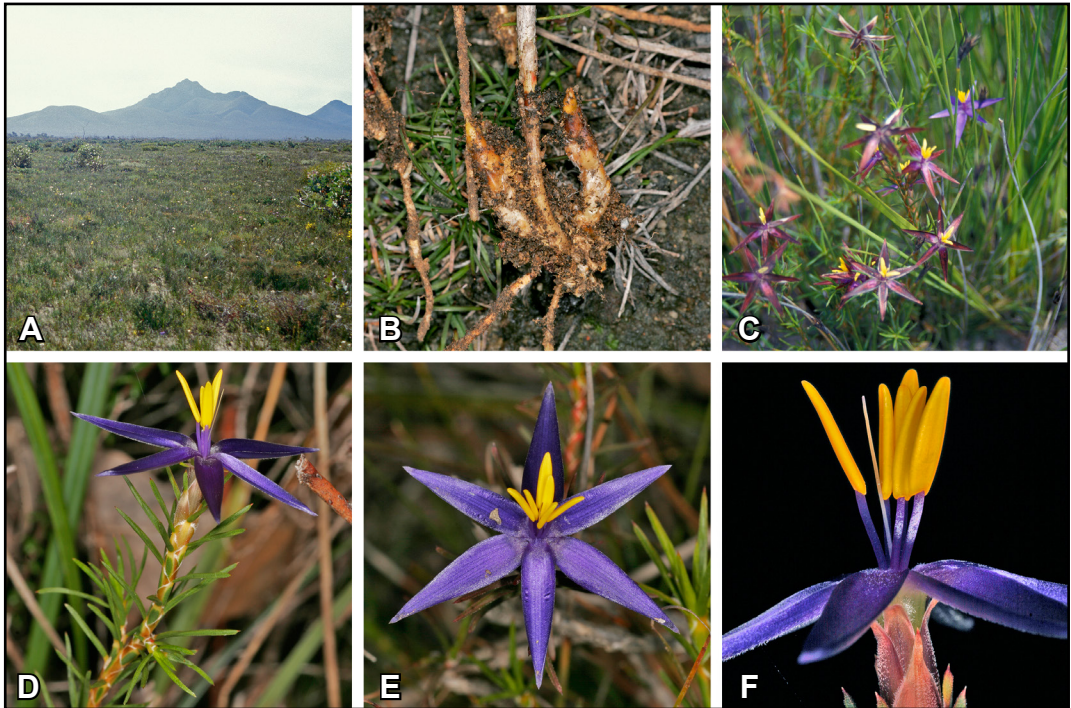


Figure 11. *Calectasia demarzii*. A – habitat of low kwongan heath on sandy plain south of the Stirling Range; B – excavated rhizome; C – flowering branchlets; D – leaves and flower; E – flower; F – anthers and style. Images from R.L. Barrett & B.R. Gaskell RLB 3426 (B, D–F) and R.L. Barrett, K.W. Dixon & M.D. Barrett RLB 1348 (C). Photographs by R.L. Barrett.

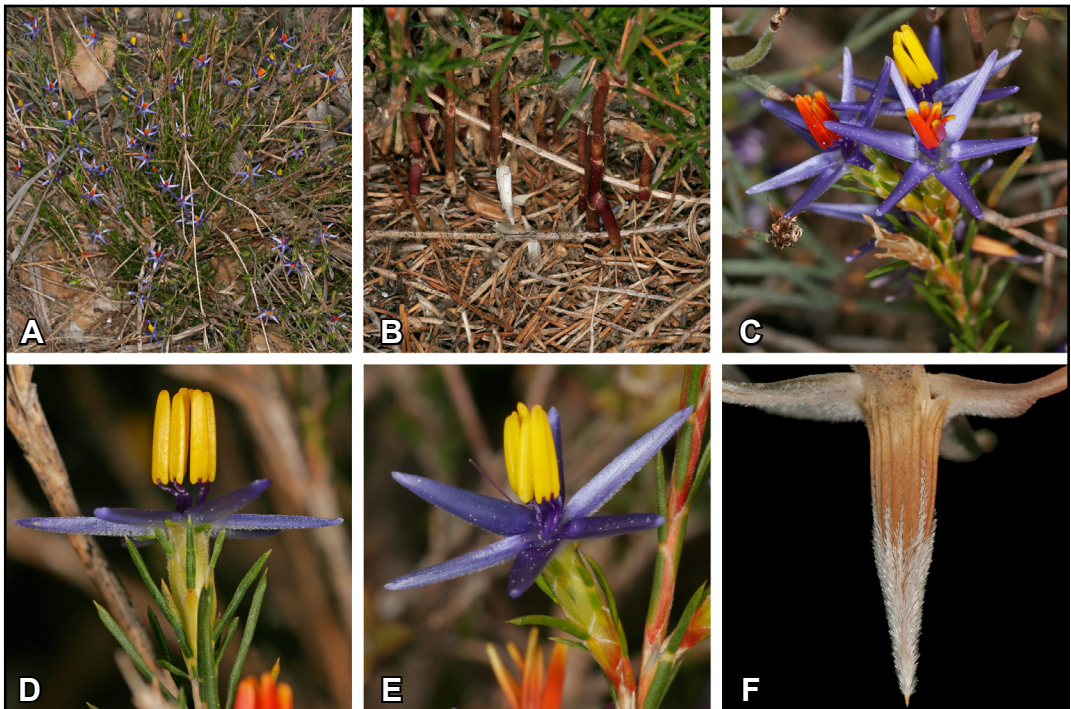


Figure 12. *Calectasia elegans*. A – flowering plant; B – stilt roots; C – flowering branchlets with fresh (yellow) and old (red) anthers; D – lateral view of flower showing hairs on tepals; E – flower showing style; F – prominently ribbed perianth tube. Images from type location, not vouchered. Photographs by R.L. Barrett.

**Calectasia jubilaea** R.L.Barrett, *sp. nov.*

*Type:* Cape Le Grand National Park, Western Australia [precise locality withheld for conservation reasons], 14 July 2005, *R.L. Barrett* RLB 2748 (*holo:* PERTH 08617384; *iso:* BM, CANB, K, MEL, NSW).

Clonal perennial; *rhizome* short but spreading, with sand-binding roots. *Stems* to 45 cm high, with many short lateral branches. *Leaves:* *sheath* surface and margins covered with branched trichomes; *lamina* 8–18 mm long, 1.0–1.2 mm wide, shortly hairy below; margins scabrous; apex acute with a pungent mucro 0.3–0.6 mm long. *Bracts* 14–15 mm long, 2.4–2.7 mm wide, papery, white with purple apex, hairy with short, unbranched hairs; outer bracts reddish brown; margins with branched trichomes; apex with vestigial leaf lamina 1.0–3.5 mm long, 1.0–1.2 mm wide. *Perianth* tube 11.5–13.5 mm long, pilose in lower 1/4 with golden to silvery hairs, not prominently costate when dry; lobes 12–14 mm long, 2.6–3.0 mm wide, acute, blue becoming red with age, pilose on abaxial side; margins opaque; throat glabrous above sinus with short hairs inside. *Staminal filaments* 4.6–5.2 mm long. *Anthers* 6.2–6.6 mm long, 0.9–1.2 mm diam., yellow, not turning orange-red with age; pores terminal. *Style* 10.5–11.3 mm long, exceeding anthers. *Seeds* not seen. (Figure 13)

*Diagnostic characters.* Distinguished from *C. valida* R.L.Barrett by the following combination of characters: *plant* clonal; *rhizome* short but spreading; *perianth* tube 11.5–13.5 mm long, pilose in lower 1/4 with golden to silvery hairs; *perianth* lobes 12–14 mm long, 2.6–3.0 mm wide, becoming red with age; *anthers* 6.2–6.6 mm long, yellow.

*Other specimen examined.* WESTERN AUSTRALIA: [locality withheld for conservation reasons] 29 Oct. 2005, *R.L. Barrett & M.D. Barrett* RLB 2927 (PERTH).

*Phenology.* Flowering and fruiting from July to November.

*Distribution and habitat.* Known from near Lucky Bay and Mt Ragged east of Esperance in southwestern Australia. Occurs in low kwongan dominated by Myrtaceae and Proteaceae.

*Conservation status.* *Calectasia jubilaea* is to be listed as Priority Two under Department of Parks and Wildlife Conservation Codes for Western Australian Flora (A. Jones pers. comm.). It occurs in Cape Le Grand National Park and Cape Arid National Park and is not under immediate threat.

*Etymology.* The epithet is from the Latin *jubilaeus*, a celebration, particularly every 50 years, in reference to the 50-year anniversary of the Western Australian Botanic Garden at Kings Park.

*Notes.* This species is closest to *C. valida*, differing in having a more slender habit, finer leaves and narrower tepals, and in the distribution of the hairs on the perianth tube. It is possibly also related to *C. intermedia* Sond. which has golden hairs on the perianth tube. *Calectasia jubilaea* and *C. valida* co-occur in Cape Arid National Park, growing intermixed.

The vernacular name Jubilee Tinsel Lily is suggested.

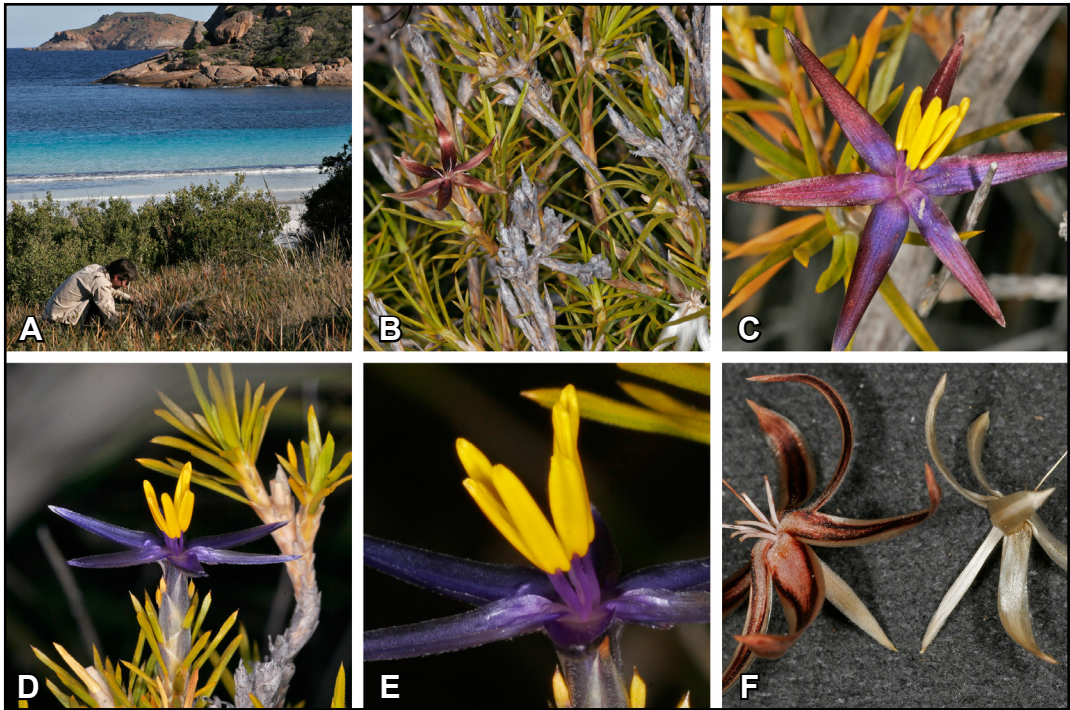


Figure 13. *Calectasia jubilaea*. A – habitat of low kwongan heath on sand over laterite at type location; B – branchlets with old flower; C – flower aging red (note anthers remaining yellow); D – flower; E – anthers; F – old perianth (right) which is pilose in lower quarter of tube and glabrous above (flower on left is *C. valida*). Images from R.L. Barrett RLB 2748 (B–E); R.L. Barrett & M.D. Barrett RLB 2932 (F, left) and R.L. Barrett & M.D. Barrett RLB 2927 (F, right). Photographs by R.L. Barrett.

***Calectasia valida* R.L. Barrett, *sp. nov.***

*Type:* Quairading Town Reserve, in north-east section at the junction of the Highway and cemetery entrance road, Western Australia, 20 September 2005, R.L. Barrett & G. Messina RLB 2851 (*holo:* PERTH 08614156; *iso:* AD, BM, CANB, K, MEL, NSW).

*Calectasia grandiflora* (Wheatbelt variant), R.L. Barrett & K.W. Dixon, *Nuytsia* 13: 427, Figure 7A–C (2001).

*Calectasia grandiflora* subsp. Wheatbelt (A.M. Coates 4315), Western Australian Herbarium, in *FloraBase*, <http://florabase.dpaw.wa.gov.au/> [accessed 1 March 2014].

Clonal perennial; *rhizome* short, compact, with sand-binding roots. *Stems* to 65 cm high, robust, with many long lateral branches. *Leaves:* sheath with branched trichomes on margin, otherwise glabrous; *lamina* 8.8–12.9 mm long, 0.6–1.3 mm wide, with branched trichomes on abaxial side, becoming glabrous; margins finely scabrous; apex acute with a pungent mucro 0.6 mm long. *Bracts* 11.9–14.9 mm long, 2.7–3.2 mm wide, brown; margins with long branched trichomes; apex with brown vestigial leaf lamina 3.8–4.2 mm long, 0.9–1.3 mm wide. *Perianth* tube (8–)9.2–12.7 mm long, pilose in lower 1/2 to full length, not prominently costate when dry; lobes 8.2–16.2 mm long, 2.0–4.1 mm wide, acuminate, blue-red, fading to pale blue-red, pilose on abaxial side; margins opaque; throat with tangle of short, barbed hairs. *Staminal filaments* 2.7–4.2 mm long, purple. *Anthers* 3.5–6.7 mm long, 0.8–1.5 mm diam., yellow, not turning orange-red with age; pores terminal. *Style* 14.3–17.9 mm long, exceeding anthers. *Seeds* not seen. (Figure 14)

*Diagnostic characters.* Distinguished from *C. grandiflora* by the following combination of characters: *rhizome* short, compact; *stems* to 65 cm high, robust; *leaf blades* 8.8–12.9 mm long, 0.6–1.1 mm wide; *perianth* tube (8–)9.2–12.7 mm long, pilose in lower 1/2 to full length; *perianth lobes* 8.2–16.2 mm long, 2.0–4.1 mm wide, fading to pale blue-red; *staminal filaments*, 2.7–4.2 mm long; *anthers* 3.5–6.7 mm long, yellow.

*Selected specimens examined* (c. 100 seen). WESTERN AUSTRALIA: slope of hill (N facing) on W side of Bremer Bay, 25 Aug. 1965, *J.C. Anway* 280 (PERTH); 9.1 km E on Norseman Rd from Lake King, N side of road, 26 Oct. 2005, *R.L. Barrett & M.D. Barrett* RLB 2855 (PERTH); along Ravensthorpe–Hopetoun Road, 31.6 km from Ravensthorpe on W side of road, 24 Aug. 1999, *M. Bennett* 504 (PERTH); 0.4 km NW of the 90 mile tank on the Lake King–Norseman Rd, 18 June 2006, *G. Byrne* 2107 (PERTH); Salt River Rd, Cranbrook, 10 Oct. 1982, *E.J. Croxford* 2206 (PERTH); Jingaring Nature Reserve, 8 June 1998, *R. Davis* 6334 (PERTH); Thumb Peak range, 31 Oct. 1965, *A.S. George* 7128 (PERTH); 9 km E of Lake King along road to Kumarl, 13 Oct. 1991, *W. Greuter* 22786 (PERTH); S of Koorarawalyee, 4 Sep. 2009, *J. Jackson* 72 (PERTH); ‘Holland’s Track’ [Holland Track], 7.17 km NW of the Hyden–Norseman Track and 15.7 km from North Ironcap, 18 June 1990, *F.H. & M.P. Mollemans* 2836 (CBG, K, PERTH); E from Solomons Well, 28 Sep. 1902, *A. Morrison s.n.* (PERTH); Esperance Bay district. Neridup, c. 3 km NE of Howick Hill, 21 Sep. 1968, *A.E. Orchard* 1110 (AD, PERTH); gate in Rabbit Proof Fence, E of Jerramungup, 13 Aug. 1951, *R.D. Royce* 3691 (PERTH); Lake King–Newdegate Rd, 9 Oct. 2011, *K.R. Thiele* 4352 (PERTH); S side of Kulin–Holt Rock Rd at the W boundary of Dragon Rocks Nature Reserve, 15 Oct. 2003, *J.A. Wege & C. Wilkins s.n.* (PERTH).

*Phenology.* Flowering from July to October.

*Distribution and habitat.* Widespread in south-western Australia, and particularly common in the Avon Wheatbelt, occurring from Esperance to north of the Stirling Range, north to Tammin and towards Southern Cross, with a disjunct occurrence near Kalbarri. Commonly found in shrub mallee-heath on white sand or in eucalypt woodland on loam. Recorded in association with *Allocasuarina pinaster*, *Banksia erythrocephala*, *B. sphaerocarpa*, *Beaufortia bracteosa*, *B. micrantha*, *Callitris roei*, *Calytrix leschenaultii*, *Eremaea pauciflora*, *Eucalyptus albida*, *E. pleurocarpa*, *Grevillea cagiana*, *Melaleuca pungens* and *Petrophile ericifolia*.

*Conservation status.* This species is not under threat, but little of its original habitat remains due to extensive clearing for agriculture.

*Etymology.* The epithet is from the Latin *validus* (robust) and refers to the robust nature of the species relative to *C. grandiflora*.

*Notes.* This is a stabilised tetraploid taxon (Barrett & Dixon 2001). It is morphologically closest to the diploid species *C. grandiflora*, differing in its generally shorter staminal filaments (2.7–4.2 mm long vs 3.5–4.1 mm), robust habit (vs somewhat lax, slender stems), compact rhizome (vs somewhat spreading) and thick, broad leaves 0.6–1.3 mm wide (vs thin, angular leaves, 0.8–1.2 mm wide).

The vernacular name Robust Tinsel Lily is suggested.



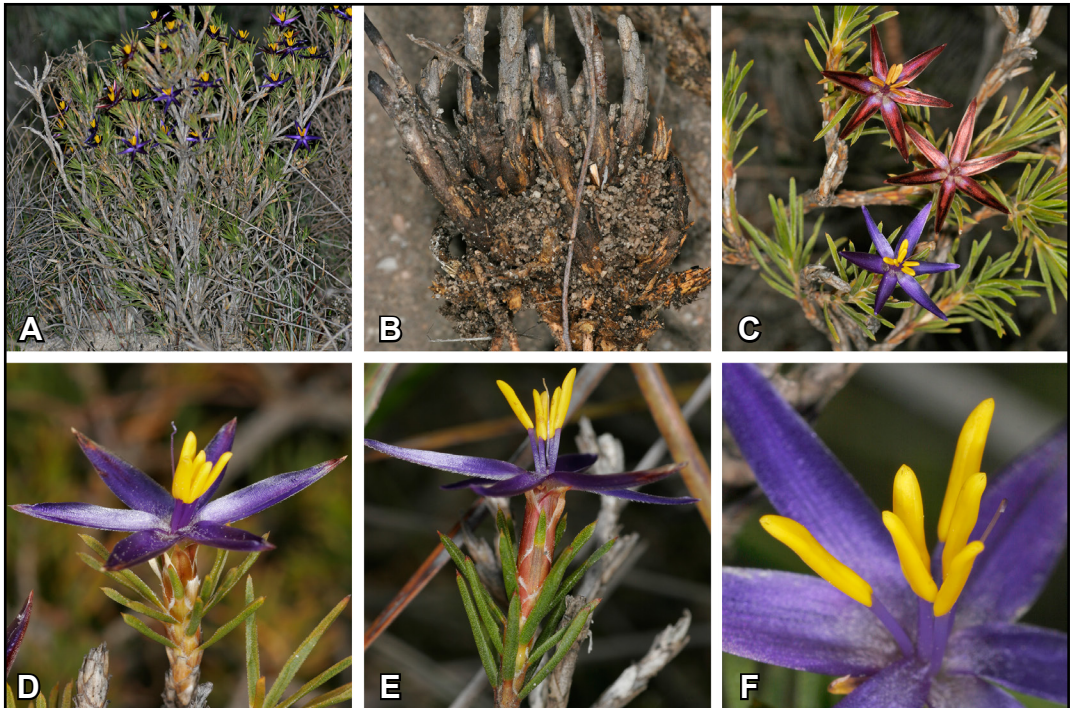


Figure 14. *Calectasia valida*. A – habit; B – compact, robust rhizome; C – flowering branchlets with old and fresh flowers (note anthers remaining yellow); D – flower; E – flower showing reddish floral bracts; F – anthers. Images from R.L. Barrett & G. Messina RLB 2851 (A, B); R.L. Barrett & M.D. Barrett RLB 2855 (C–F). Photographs by R.L. Barrett.

## Eriocaulaceae

### *Eriocaulon rivicola* G.J. Leach, M.D. Barrett & R.L. Barrett, *sp. nov.*

*Type*: east of the Prince Regent Nature Reserve [National Park], Western Australia [precise locality withheld for conservation reasons], 27 March 2010, R.L. Barrett & M.D. Barrett RLB 6730 (*holo*: PERTH 08614172; *iso*: BRI, CANB, DNA, K, MEL, NSW).

*Eriocaulon* sp. E, G.J. Leach in J.R. Wheeler (ed.), *Fl. Kimberley Reg.*, p. 1034, Figure 309C (1992).

*Eriocaulon* sp. E Kimberley Flora (A.S. George 12635), Western Australian Herbarium, in *FloraBase*, <http://florabase.dpaw.wa.gov.au/> [accessed 1 March 2014].

Submerged, aquatic, usually annual *herb* to 440 mm high. *Leaves* basal, linear, 115–300 mm long, 1.0–2.5 mm wide, 4–12-veined, glabrous or with tangled hairs at base. *Peduncle* 110–440 mm long; sheath 40–65 mm long. *Flower heads* emergent, globular to depressed-globular, 3.0–6.5 mm long, 4.0–7.5 mm diam. *Involutural bracts* translucent, broadly obovate to ovate, 1.5–2.5 mm long, 0.7–1.9 mm wide, glabrous, obtuse, moderately to strongly reflexed at maturity. *Floral bracts* translucent, obovate to lanceolate, 2.0–2.5 mm long, 0.8–1.0 mm wide, glabrous or with sparse to dense white hairs in apical 1/3, acute. *Receptacle* glabrous. *Male flowers*: outer perianth segments 3, black, connate but split on one side, spathe-like, 1.4–1.8 mm long, 0.5–0.8 mm wide, with a dense apical fringe of white hairs, truncate; inner perianth segments 3, translucent, with a dense apical fringe of white hairs, acute, with conspicuous or obscure dark apical gland; *anthers* yellow. *Female flowers*: outer perianth segments

3, equal, translucent, free, linear, acute, 1.0–1.6 mm long, with a few white hairs at apex and sparse, hyaline hairs on margin; inner perianth segments 3, equal, translucent, not thickened, narrowly elliptic to narrowly obovate, 0.8–1.3 mm long, glabrous outside, hairy inside with dense white hairs in upper 1/5–1/2 and sometimes with translucent hairs basally, obtuse, with conspicuous brown to black apical gland or gland obscure; *ovary* 3-locular, sessile; *style branches* 3. *Seeds* c. 0.5 mm long, almost smooth with obscure epidermal cells. (Figure 15)

*Diagnostic characters.* Distinguished from other *Eriocaulon* L. species by the following combination of characters: plants fully *aquatic* (except emergent inflorescence); *leaves* flattened, in a basal rosette, 115–300 mm long, 1.0–2.5 mm wide; *floral bracts* acute, pale to translucent, typically hairy; *male sepals* connate into a spathe; *anthers* yellow; *female flowers* with outer perianth segments linear, inner perianth segments thin, hairy internally, glabrous outside; *ovary* 3-locular; *style branches* 3; *seeds* with obscure epidermal cells due to persistent outer integument.

*Other specimens examined.* WESTERN AUSTRALIA: [localities withheld for conservation reasons] 6 July 1993, M.D. Barrett & R.L. Barrett MDB 237 (CANB, PERTH); 30 Mar. 2010, R.L. Barrett & M.D. Barrett RLB 6879 (CANB, DNA, PERTH); 25 Aug. 1974, A.S. George 12635 (PERTH); 31 May 2003, T. Handasyde TH 1989 (DNA, PERTH); 22 July 2015, G.J. Leach 4733 (BRI, CANB, DNA, PERTH).

*Phenology.* Flowering and fruiting recorded between March and August.

*Distribution and habitat.* Known from six locations over a range of about 75 km in the vicinity of the Prince Regent River and York Sound, all on broken sandstone in small, ephemeral or permanent creeks.

*Conservation status.* *Eriocaulon rivicola* is listed by Jones (2014) as Priority Two under Department of Parks and Wildlife Conservation Codes for Western Australian Flora, under the name *E. sp.* E Kimberley Flora (A.S. George 12635).

*Etymology.* The epithet is from the Latin *rivus* (brook, small stream) and *-cola* (dweller), in reference to the occurrence of this species in small, highly ephemeral or permanent streams on broken sandstone.

*Notes.* This species was first recognised by Leach (1992) based on a single collection. The combination of a glabrous receptacle, yellow anthers, 3-merous flowers, female sepals lacking a dorsal wing, and male sepals connate into a spathe-like structure place it in a group which includes several other species endemic in the north-west of Australia including *E. patericola* G.J.Leach, *E. scullionii* G.J.Leach, *E. sp.* Morgan River (A.T. Cross ATC 62) and *E. sp.* Harding Range (M.D. Barrett & R.L. Barrett MDB 1826). *Eriocaulon rivicola* differs from all these, and the related *E. cinereum* R.Br., in being much more robust in all parts, most notably the leaves which are 115–300 mm long (usually less than 50 mm long in the other species; up to 90 mm in *E. cinereum*). *Eriocaulon rivicola* differs in ecology from the other species listed, being restricted to fast flowing sandstone rivulets, while the other species are restricted to rockpools (*E. patericola*, *E. sp.* Morgan River, *E. sp.* Harding Range, some populations of *E. cinereum*), sandstone pavements (*E. scullionii*), or seepage and swampy areas, and stream margins (*E. cinereum*).

The species is usually annual, but sometimes occurs in permanent spring-fed creeks and possibly then persists for more than one season.

The vernacular name Sandstone Creek Eriocaulon is suggested.

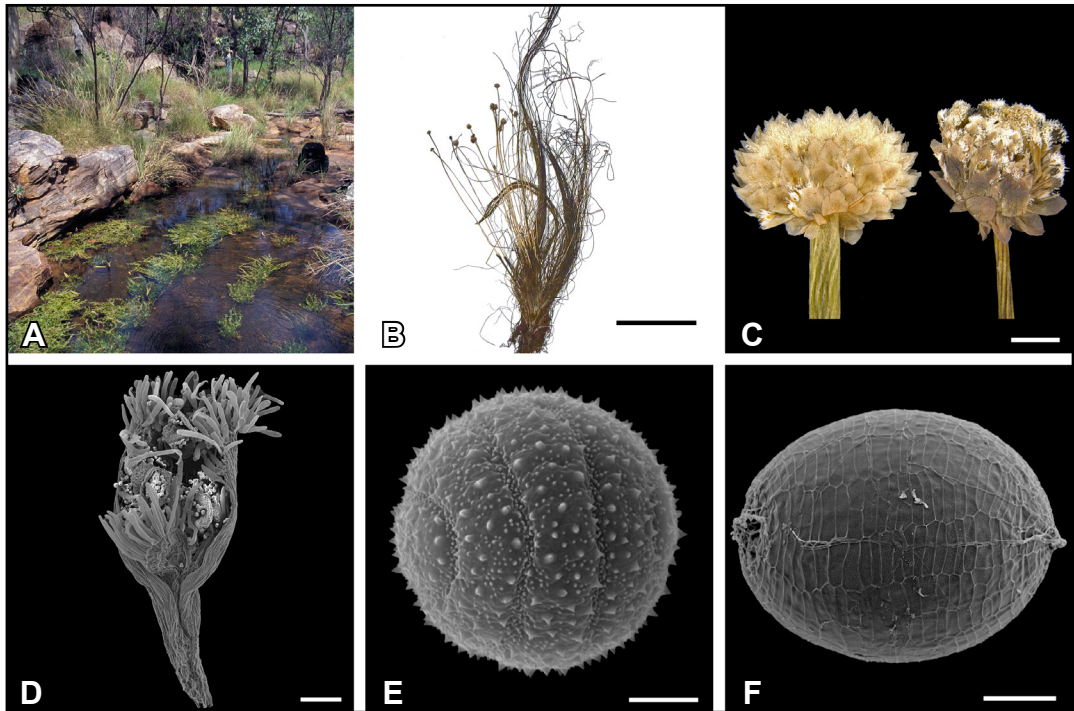


Figure 15. *Eriocaulon rivicola*. A – habitat in ephemeral stream at type location; B – habit; C – inflorescence; D – SEM of a male flower; E – SEM of pollen; F – SEM of seed. Scale bars = 5 cm (B); 2 mm (C); 200  $\mu\text{m}$  (D); 5  $\mu\text{m}$  (E); 100  $\mu\text{m}$  (F). Images from R.L. Barrett & M.D. Barrett RLB 6730. Photographs by R.L. Barrett (A); M.D. Barrett (B–F).

## Fabaceae

### *Aphyllodium beardii* R.L.Barrett, *sp. nov.*

*Type*: [Great Sandy Desert,] Western Australia [precise locality withheld for conservation reasons], 4 July 1968, J.S. Beard 5685 (*holo*: PERTH 02627329).

*Aphyllodium* sp. Great Sandy Desert (C.P. Campbell 3689), Western Australian Herbarium, in *FloraBase*, <http://florabase.dpaw.wa.gov.au/> [accessed 1 March 2014].

Erect to spreading *subshrub* to 0.7 m tall, to 0.8 m diam.; branchlets pilose with hairs 0.5–1.0 mm long; stipules 1.8–5.5 mm long with long marginal hairs. *Leaves* 3-foliolate. *Leaflets* oblong or orbicular, obtuse at base and apex, moderately pilose on both surfaces; terminal and lateral leaflets about equal in size, 2.8–5.6 mm long, 2.6–4.5 mm wide, 1.0–1.2 $\times$  longer than wide; stipels minute; petiole 2.5–3.8 mm long. *Inflorescence* 13–49 mm long; primary and secondary bracts 2.8–4.0 mm long; *pedicels* 1.1–2.0 mm long. *Calyx* with sparse indumentum of short, uncinuate hairs and longer, straight marginal ones, 3.9–4.4 mm long; tube 2.6–3.1 mm long; lobes 0.8–1.7 mm long, subequal, the upper pair slightly longer than the lower 3, broadly triangular. *Corolla* pink, glabrous; *standard* obovate with short claw, 7.1–7.9 mm long, 4.0–4.2 mm wide; *wings* rectangular, auriculate, 5.0–5.5 mm long, 1.1–1.2 mm wide on claw 2.1–3.4 mm long; *keel* slightly longer than wings, narrowly ovate. *Ovary* pubescent. *Style* flattened towards the tip, 7.0–7.5 mm long; *stigma* minute, fringed with hairs. *Pod* a loment of 1 or 2 articles with distinctly raised veins, densely appressed-hairy, greatly constricted on

both sides; articles 5.7–8.2 mm long, 4.2–5.8 mm wide; mature *seeds* not seen (immature seed olive green, 2.6 mm long, 2.0 mm diam.). (Figure 16)

*Diagnostic characters.* Distinguished from other *Aphyllodium* (DC.) Gagnep. species by the following combination of characters: erect *subshrub* to 70 cm; *leaflets* oblong or orbicular, obtuse at base and apex, moderately pilose on both surfaces, 2.8–5.6 mm long, 2.6–4.5 mm wide, 1.0–1.2× longer than wide; *Pods* of 1 or 2 densely appressed-hairy articles, each 5.7–8.2 mm long and 4.2–5.8 mm wide.

*Other specimens examined.* WESTERN AUSTRALIA: [localities withheld for conservation reasons] 11 June 1996, B. Allwright s.n. (PERTH 05585090); 30 Aug. 2001, C.P. Campbell 3689 (PERTH); 27 June 2009, G.F. Griffin & S.R. Dunlop GSD 09-68 (PERTH).

*Phenology.* Flowering and fruiting from June to August.

*Distribution and habitat.* Known only from the north-west of the Great Sandy Desert where it grows on the crests of red sand dunes with *Dampiera cinerea*, *Dicrasyllis cordifolia*, *Gompholobium simplicifolium*, *Newcastelia cladotricha* and *Triodia epactia*.

*Conservation status.* *Aphyllodium beardii* is listed by Jones (2014) as Priority One under Department of Parks and Wildlife Conservation Codes for Western Australian Flora, under the name *A. sp.* Great Sandy Desert (C.P. Campbell 3689).

*Etymology.* The epithet recognises the work of the late John Beard (1916–2011), former director of Kings Park and Botanic Garden, who first collected this species while mapping the vegetation of Western Australia (Beard & Webb 1974; Beard 1980, 1990).

*Notes.* Pedley (1999) included material of *A. beardii* when preparing his description of *A. parvifolium* Pedley, and even intended to base that name on the specimen here designated as the holotype of *A. beardii* (see annotations on PERTH 02627329). Instead, Pedley designated a collection from north of Broome as the type of *A. parvifolium* (PERTH 01112694) which he considered to be the same taxon. Specimens matching the type of *A. parvifolium* are, however, distinct from *A. beardii*, differing in their decumbent habit, narrowly ovate leaflets with more or less appressed hairs, elongate inflorescence, and pods with two or three articles. The two species are disjunct, with *A. beardii* restricted to red sand dunes in the north-western Great Sandy Desert, and *A. parvifolium* endemic on the Dampier Peninsula between Willie Creek and Taylors Lagoon where it is highly restricted to seasonally wet swamps and creek margins. The type population of *A. parvifolium* cannot be relocated and it has possibly become locally extinct due to a combination of fire and grazing by cattle. *Aphyllodium parvifolium* is actually more closely related to *A. biarticulatum* (L.) Gagnep. and its relationship with that taxon requires further examination. The inflorescence is contracted relative to *A. biarticulatum*, but the two taxa are otherwise very similar. As part of a review of *A. biarticulatum*, a new description of *A. parvifolium* should also be prepared since Pedley's (1999) description relates best to the specimens here referred to *A. beardii*.

The vernacular name Beard's Sand Dune Pea is suggested.

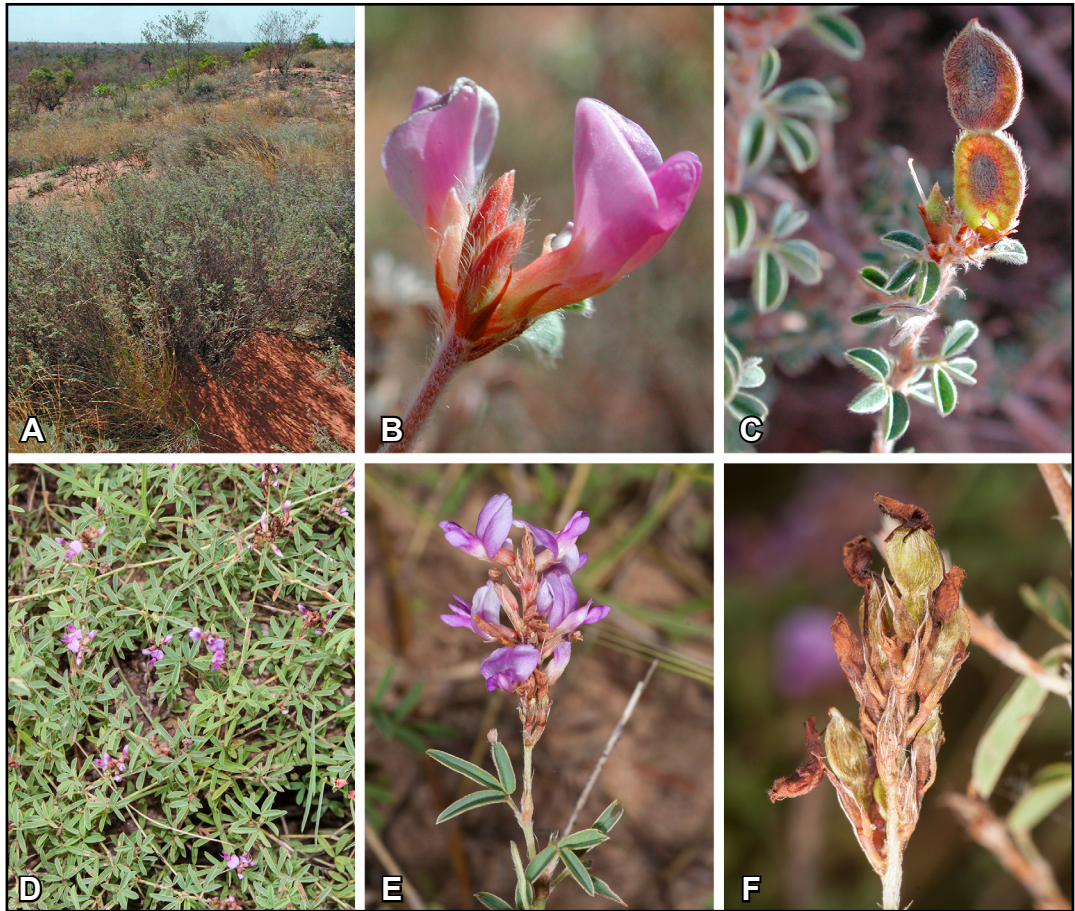


Figure 16. *Aphyllodium beardii*. A – habit and habitat on sand dune crest; B – inflorescence; C – leaves and fruit. *Aphyllodium parvifolium*. D – decumbent habit; E – leaves and inflorescence; F – infructescence. Images from C.P. Campbell 3689 (A–C) and R.L. Barrett, K.F. Kenneally & T. Willing RLB 5580 (D–F). Photographs by C.P. Campbell (A–C); R.L. Barrett (D–F).

**Bossiaea** Vent.

The four *Bossiaea* species recognised here are clearly most closely related to each other based on their morphological characteristics. The closest relative of this group is presumed to be *B. armitii* F.Muell. from northern Queensland and the adjacent Northern Territory, the only other leafless *Bossiaea* species with an entirely tropical distribution (see Thompson 2012). Ross (2006) noted that the hairs in the sinus of the keel of *B. bossiaeoides* (A.Cunn. ex Benth.) Court are unusual in the genus. The two new species described here both share that feature, confirming their relationship with *B. bossiaeoides*. The shape of the calyx lobes and inflorescence type is also similar, though *B. bossiaeoides* often has more than two flowers per axil, while the other species usually only have one or two.

**Key to *Bossiaea* species in the Kimberley region of Western Australia**

- 1. Stems scarcely winged; decumbent subshrub; standard and keel petals glabrous ..... **B. barrettiorum**
- 1: Stems distinctly winged; erect subshrub; standard and keel petals sparingly to densely pubescent in the sinus ..... **2**
- 2. Stem wings serrated in outline, at their widest prominently exceeding nodes; standard 15–19 mm long; keel <twice as long as wings..... **B. bossiaeoides**

- 2: Stem wings  $\pm$ even in width, not or scarcely exceeding nodes; standard 8.5–14 mm long; keel  $\geq$ twice as long as wings..... 3
- 3: Lower stems to 11 mm wide; upper stems usually <4 mm wide, dark green to sub-pruinose; ultimate branches of cladodes 1.9–3.4(–6.3 when young) mm wide; pedicels 1.5–5.8 mm long in flower, to 7 mm long in fruit; standard 8.5–12.6 mm long, 7.0–9.1 mm wide; keel 12.1–15.4 mm long, >twice as long as wings; seedling leaves narrowly ovate, 28–34 mm long, 6.5–9 mm wide, the petiole *c.* 3.2 mm long ..... **B. zarae**
- 3: Lower stems to 17 mm wide; upper stems usually 6–9(–15) mm wide, usually pruinose; ultimate branches of cladodes 6–18(–31) mm wide; pedicels 3.4–8.9 mm long in flower, 7–14 mm long in fruit; standard 10.3–13.7 mm long, 10.2–13 mm wide; keel 13.2–17.9 mm long,  $\pm$ twice as long as wings; seedling leaves orbicular to obovate, 14–22 mm long, 7–13 mm wide, the petiole 2.7–7 mm long ..... **B. arenitensis**

**Bossiaea arenitensis** R.L.Barrett, *sp. nov.*

*Type:* Crinia Flat (informal name), 9.8 km east-north-east of Mount Jameson; 6.6 km south-east of Mount Agnes, Mount Elizabeth Station, north of Munja track, Western Australia, 28 January 2007, *R.L. Barrett & M.D. Barrett* RLB 4045 (*holo:* PERTH 08103925; *iso:* CANB, CNS, DNA, K, MEL, NSW).

*Bossiaea* sp. West Kimberley (R.L.Barrett & M.D.Barrett RLB 4045), Western Australian Herbarium, in *FloraBase*, <http://florabase.dpaw.wa.gov.au/> [accessed 17 April 2014].

Erect *shrub* to 2.5(–5) m high and 1–2(–4) m diam., many-branched. *Seedlings* with orbicular to obovate leaves, 14–22 mm long, 7–13 mm wide, the petiole 2.7–7 mm long. *Stems* oval, elliptic or flattened in TS, winged, up to 17 mm wide, pruinose, almost glabrous apart from hairs in axils of scale leaves; ultimate branches of cladodes 6–18(–31) mm wide, winged; wings not broader than, and incised at, nodes. *Leaves* reduced to dark brown, scarios, narrowly ovate scales 2.2–2.7 mm long, glabrous apart from marginal cilia. *Flowers* solitary or paired at nodes; *pedicels* 3.4–8.9 mm long in flower, 7–14 mm long in fruit, glabrous; *bracts* imbricate, narrowly ovate, increasing in size from the outer to the inner, the inner to 2.8 mm long and similar to the bracteoles, inconspicuously longitudinally striate, glabrous apart from marginal hairs especially towards apex and sometimes along midline apically, chestnut brown, persistent; *bracteoles* narrowly ovate, 1.3–1.8 mm long, inserted at about middle of pedicel, glabrous, inconspicuously longitudinally striate, persistent. *Calyx* glabrous outside apart from hairs on margins of lobes, 6.3–9.5 mm long, suffused with red; 3 lower lobes 1.7–1.9 mm long, acute, shorter than tube; 2 upper lobes rounded-truncate, diverging at apex, obtuse, free, 2.9–4.3 mm long. *Corolla: standard* 10.3–13.7 mm long including a claw 3.3–4.0 mm long, 10.2–13 mm wide, shorter than keel, golden yellow internally with a continuous, red, horseshoe-shaped basal flare around a paler yellow throat, externally yellow-orange with faint, red, longitudinal striations radiating from base into lamina; *wings* 7.0–8.9 mm long including a claw 3.2–3.6 mm long, 2.5–3.1 mm wide, distinctly auriculate basally, uniformly yellow or flushed with orange, glabrous; *keel* 13.2–17.9 mm long including a claw 4.8–5.8 mm long, 3.6–6.5 mm wide, externally yellow to burgundy, hairy apically in the sinus. *Staminal filaments* 6.7–16.0 mm long. *Ovary* 6.8–13.1 mm long, on a stipe to 2.4 mm long, 8–11-ovulate, glabrous. *Style* 1.1–5.5 mm long. *Pods* oblong, 36–49 mm long, 6.8–10.8 mm wide; stipe exceeding calyx, 6.5–9.5 mm long; valves inconspicuously transversely veined, glabrous, dark reddish brown when mature. *Seeds* ellipsoid, 3.6–3.8 mm long, 1.9–2.2 mm diam., chestnut brown with subtle, darker mottles; *aril* white, comma-shaped, 1.5 mm long. (Figure 17)

*Diagnostic characters.* Distinguished from *B. bossiaeoides* by the following combination of characters: erect *shrub* to 2.5(–5) m high, conspicuously pruinose; *stems* winged, the wings not broader than the

nodes; ultimate branches of cladodes 6–18(–31) mm wide; *pedicels* 3.4–8.9 mm long; *standard* golden yellow, 10.3–13.7 mm long; *keel* 13.2–17.9 mm long.

*Other specimens examined.* WESTERN AUSTRALIA: 20 km E of Tableland Station Homestead, 1 July 1972, *T.E.H. Aplin* 5102 (PERTH); sandstone ridges around summit of Mt Bomford, 5 Jan. 2001, *R.L. Barrett & M.D. Barrett* RLB 1539 (PERTH); on W side of gorge on S Bachsten Creek, level with falls, 23 Jan. 2007, *R.L. Barrett & M.D. Barrett* RLB 3790 B (PERTH); Roe River pavement 1, on mainland, 3 km ESE of Gertrude Cove on Kiska Island, 23 Apr. 2008, *R.L. Barrett & M.D. Barrett* RLB 4567 (PERTH); Roe Sinkhole, Prince Regent Nature Reserve, 19 Jan. 2010, *R.L. Barrett, M. Maier & P. Kendrick* RLB 6299 (MEL, PERTH); Little Mertens Falls, Mitchell Plateau, 24 Jan. 2010, *R.L. Barrett & M.D. Barrett* RLB 6474 (CANB, PERTH); c. 1.5 km E of Mount Russ, 28 Mar. 2010, *R.L. Barrett & M.D. Barrett* RLB 6765 (NSW, PERTH); gutter swamp site, N of Bachsten Gorge, Prince Regent Nature Reserve, 13 Mar. 2014, *R.L. Barrett* RLB 9018 (CANB, DNA, PERTH); Naturalist Island in Prince Frederick Harbour at mouth of Hunter River, 21 June 1984, *M. Evans* 11 (CANB, PERTH); at the beginning of the trail to Mitchell Falls, near the helicopter pad in the camping area, Kimberley, 26 Apr. 1996, *G. Graham* 4 (PERTH); c. 7 km WSW of the beginning of the trail to Mitchell Falls near the helicopter pad in the camping area, 25 Apr. 1996, *G. Graham* 35 (PERTH); N side of Boomerang Bay, Bigge Island, 2 June 1972, *N.G. Marchant* 72/89 (MEL, PERTH); loc. 2, Katers Island, 10 June 1972, *N.G. Marchant* 72/299 (PERTH).

*Phenology.* Flowering from January to April. Fruiting from February to July.

*Distribution and habitat.* Reasonably widespread in the west Kimberley, from Bachsten Creek and the Prince Regent River north to the Mitchell Plateau and Bigge Island, with a disjunct record from Tableland Station. Grows on broken sandstone ridges, outcrops, creek beds, or below cliffs, in grey sand in low, open woodland of *Corymbia* and *Eucalyptus* over low shrubs and grasses including *Triodia*. There is a single record from dolerite, but this was probably an instance of sandstone-derived soils overlying dolerite.

*Conservation status.* Reasonably widespread in the west Kimberley and not considered threatened. It is conserved within Prince Regent National Park.

*Etymology.* The epithet is derived from arenite (sandstone) and refers to the substrate this species grows on.

*Notes.* *Bossiaea arenitensis* is closely related to *B. bossiaeoides*, sharing broad stem-wings and large flowers, but is distinguished by its stem-wing segments, which do not or scarcely exceed the node width and are conspicuously pruinose. It is also distinguished by its shorter standard (10.3–13.7 mm long vs 15–19 mm in *B. bossiaeoides*). Unlike *B. bossiaeoides*, *B. arenitensis* grows on sandstone ridges (vs sand flats in woodland); both species can be found growing in close proximity, or rarely with a very narrow zone of overlap, at the base of sandstone scree. Ross (2006) notes that *B. bossiaeoides* is variable with respect to flower size and stem-wing width, but no specimens of *B. arenitense* were seen by him. *Bossiaea arenitensis* is also similar to *B. zarae*, a species with narrower stem-wings, smaller flowers and shorter pedicels, and which grows on sandstone pavements.

Plants of *B. arenitensis* are generally killed by fire, in contrast to *B. bossiaeoides* which can usually resprout.

The vernacular name Sandstone Winged Pea is suggested.

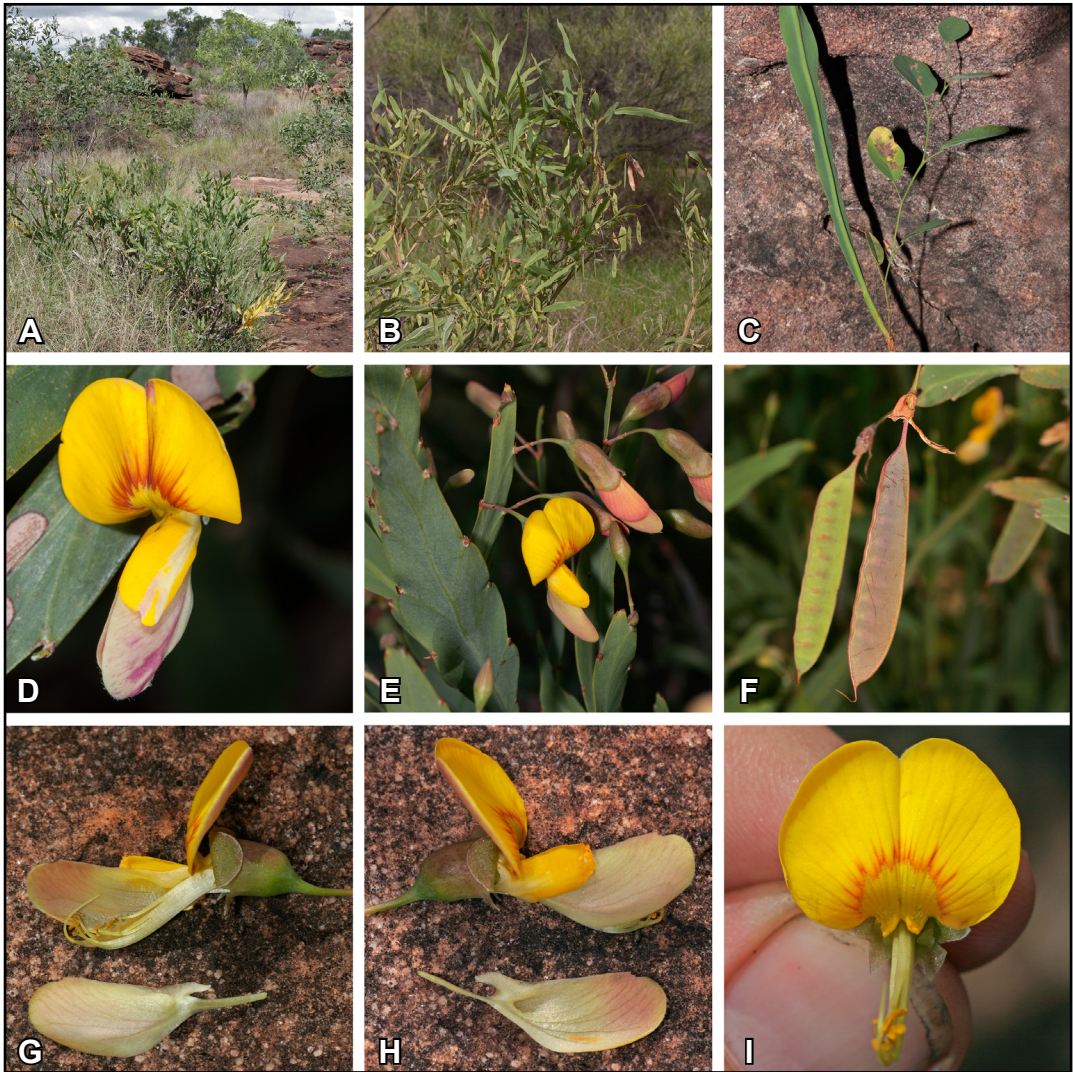


Figure 17. *Bossiaea arenitensis*. A – habitat on broken sandstone ridges; B – habit; C – seedling; D – flower showing pale keel with pink flecks; E – flowering branchlets showing red-backed standard in unopened flowers; F – fruit; G, H – partially dissected flower; I – flower with keel and wings removed to show auricles at base of standard. Images from R.L. Barrett & M.D. Barrett RLB 4045. Photographs by R.L. Barrett.

***Bossiaea zarae* R.L.Barrett, *sp. nov.***

*Type:* Bigge Island, Kimberley, Western Australia [precise locality withheld for conservation reasons], 17 February 2008, M.N. Lyons & G.J. Keighery *s.n.* (*holo:* PERTH 08635056 [sheet 1 of 2], PERTH 08635137 [sheet 2 of 2]); *iso:* CANB, DNA).

*Bossiaea* sp. Princess May Range (M.D. Barrett & R.L. Barrett MDB 1326), Western Australian Herbarium, in *FloraBase*, <http://florabase.dpaw.wa.gov.au/> [accessed 17 April 2014].

Erect *shrub* to 2.2 m high and 1.2 m diam., many-branched. *Seedlings* with narrowly ovate leaves, 28–34 mm long, 6.5–9 mm wide, the petiole *c.* 3.2 mm long. *Stems* oval, elliptic or flattened in TS,



winged, up to 11 mm wide, not pruinose, almost glabrous apart from hairs in axils of scale leaves; ultimate branches of cladodes 1.9–3.4(–6.3 when young) mm wide, winged; wings not broader than, and scarcely incised at, nodes. *Leaves* reduced to dark brown, scarious, narrowly ovate scales 1.1–2.0 mm long, glabrous apart from marginal cilia. *Flowers* solitary or paired at nodes; *pedicels* 1.5–5.8 mm long in flower, to 7 mm long in fruit, glabrous; *bracts* imbricate, narrowly ovate, increasing in size from the outer to the inner, the inner to 2.1 mm long and similar to the bracteoles, inconspicuously longitudinally striate, glabrous apart from marginal hairs especially towards the apex and sometimes along the midline apically, chestnut brown, persistent; *bracteoles* narrowly ovate, 0.9–1.1 mm long, inserted at about the middle of the pedicel, glabrous, inconspicuously longitudinally striate, persistent. *Calyx* glabrous outside apart from hairs on the margins of lobes, 5.3–7.0 mm long, suffused with red; 3 lower lobes 1.1–1.4 mm long, acute, shorter than tube; 2 upper lobes rounded-truncate, diverging at apex, obtuse, free, 1.7–2.5 mm long. *Corolla: standard* 8.5–12.6 mm long including a claw 2.8–3.2 mm long, 7.0–9.1 mm wide, shorter than keel, golden yellow internally with a faint, discontinuous, red-brown, horseshoe-shaped basal flare around a paler yellow throat, externally yellow with faint, red-brown, longitudinal striations radiating from the base into lamina; *wings* 5.3–6.3 mm long including a claw 1.5–2.0 mm long, 1.8–2.3 mm wide, distinctly auriculate basally, uniformly yellow, glabrous; *keel* 12.1–15.4 mm long including a claw 2.5–3.4 mm long, 4.8–6.0 mm wide, externally pale yellow or greenish yellow, hairy apically in the sinus. *Staminal filaments* 10.0–13.2 mm long. *Ovary* 7.2–9.9 mm long, on a stipe to 1.5 mm long, 13- or 14-ovulate, glabrous. *Style* 4.4–4.8 mm long. *Pods* oblong, (29–)43–47 mm long, (5.5–)6.6–7.1 mm wide; stipe greatly exceeding calyx, 5.0–7.9 mm long; valves inconspicuously transversely veined, glabrous, dark reddish brown when mature. *Seeds* ellipsoid, 3.1–3.7 mm long, 1.8–2.1 mm diam., mostly black with brown mottles; *aril* white, comma-shaped, *c.* 1.1 mm long. (Figure 18)

*Diagnostic characters.* Distinguished from *B. bossiaeoides* by the following combination of characters: erect *shrub* to 2.2 m high and 1.2 m diam.; *leaves* scale-like; *stems* very narrowly winged, the wings not broader than the nodes; ultimate branches of cladodes 1.9–3.4(–6.3 when young) mm wide; *standard* golden yellow, 8.5–12.6 mm long; *wings* 5.3–6.3 mm long; *keel* 12.1–15.4 mm long.

*Other specimens examined.* WESTERN AUSTRALIA: [localities withheld for conservation reasons] 19 Jan. 2003, M.D. Barrett & R.L. Barrett MDB 1326 (PERTH); 20 Jan. 2003, M.D. Barrett & R.L. Barrett MDB 1350 (PERTH); 21 Jan. 2003, M.D. Barrett & R.L. Barrett MDB 1362 (PERTH); 25 Jan. 2007, R.L. Barrett & M.D. Barrett RLB 3906 (PERTH); 25 Jan. 2007, R.L. Barrett & M.D. Barrett RLB 3949 (PERTH); 28 Jan. 2007, R.L. Barrett & M.D. Barrett RLB 4060 (PERTH); 19 Jan. 2010, R.L. Barrett, M. Maier & P. Kendrick RLB 6292 (PERTH).

*Phenology.* Flowering and fruiting recorded for January.

*Distribution and habitat.* Restricted to sandstone pavements or low, fire-protected sandstone ridges in the Kimberley region, occurring between the headwaters of the Prince Regent River and the Princess May Ranges, and further north on Bigge Island. Grows in low shrubland or with scattered trees over *Triodia* spp.

*Conservation status.* *Bossiaea zarae* is listed by Jones (2014) as Priority Two under Department of Parks and Wildlife Conservation Codes for Western Australian Flora, under the name *B. sp.* Princess May Range (M.D. Barrett & R.L. Barrett MDB 1326); however, it has recently been downgraded to Priority Three (Western Australian Herbarium 1998–). Current records suggest *B. zarae* is uncommon. It is known from only six populations, two of which are within Prince Regent National Park. All

known populations are locally restricted by the extent of their habitat, and are potentially threatened by changes in fire regime.

*Etymology.* From the Arabic and Hebrew name Zara (meaning princess), used here in reference to the Princess May Ranges where this species was first recognised as distinct.

*Notes.* *Bossiaea zarae* is closely related to *B. barrettiorum* J.H.Ross, sharing very narrow stem-wings, but distinguished by its erect habit, slightly broader stem-wing segments, larger flowers (standard 8.5–12.6 mm long vs to 9.2 mm long) and by having scattered hairs in the sinus of the keel (vs glabrous). It is also similar to *B. arenitensis*, a species with much broader stem wings, larger flowers, and longer pedicels and peduncles, and which grows on sandstone ridges and scree. *Bossiaea arenitensis* and *B. zarae* have both been found at the same location, growing in adjacent habitats.

The vernacular name Princess May Winged Pea is suggested.

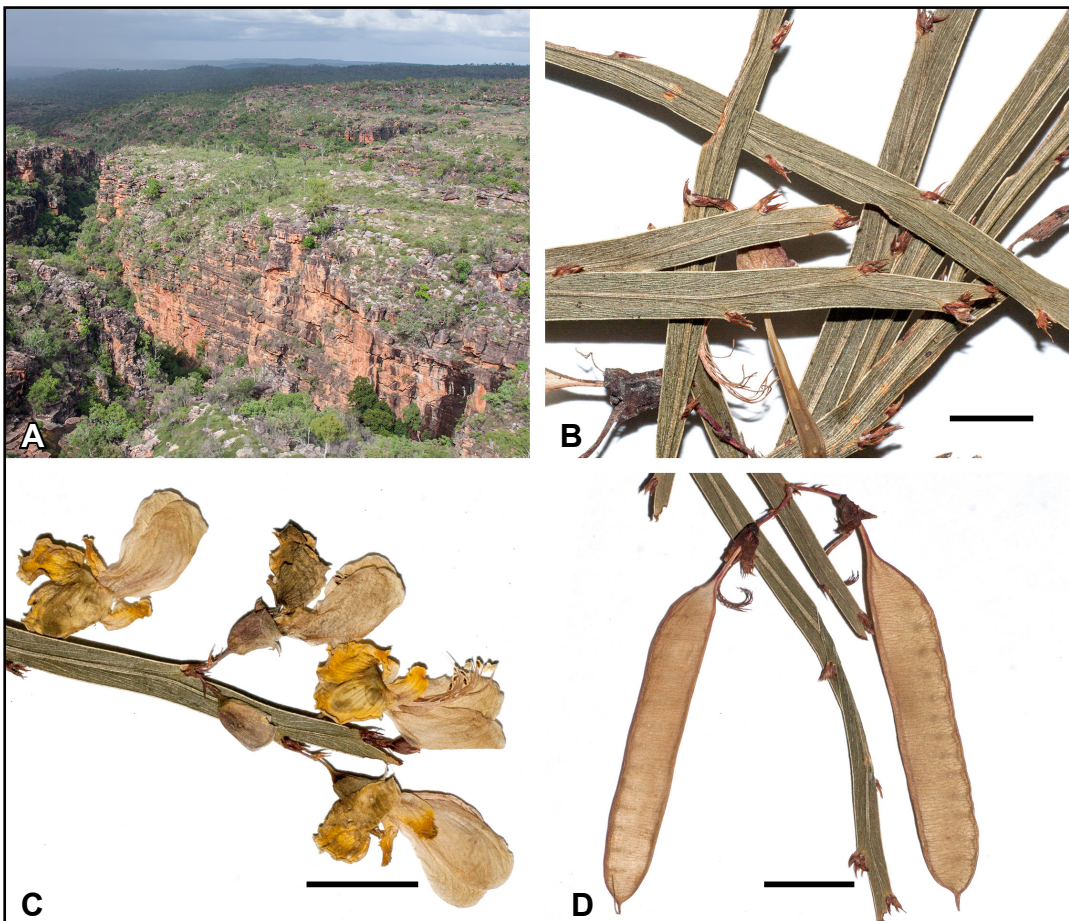


Figure 18. *Bossiaea zarae*. A – sandstone mesa habitat in Prince Regent National Park; B – cladodes showing very narrow stem wings; C – flowering cladode; D – fruit. Scale bars = 5 mm (B); 1 cm (C, D). Images from the holotype M. Lyons & G.J. Keighery s.n. (B–D). Photographs by R.L. Barrett.

***Glycine remota*** M.D.Barrett & R.L.Barrett, *sp. nov.*

*Type:* east-north-east of junction of Pitta Creek and Prince Regent River, Western Australia [precise locality withheld for conservation reasons], 11 January 2001, *M.D. Barrett* 1201 (*holo:* PERTH 06348157).

*Glycine* sp. Pitta Creek (M.D. Barrett 1201), Western Australian Herbarium, in *FloraBase*, <http://florabase.dpaw.wa.gov.au/> [accessed 17 April 2014].

Lax, prostrate, perennial *herb*, to 0.15 m high and 2 m diam.; *taproot* distinctly woody, *c.* 190 mm long, *c.* 11 mm diam. at widest point, conical with  $\pm$ truncate apex. *Stems* not rooting at nodes, 0.5–0.7 mm diam., subterete, elliptic or angular, weakly to moderately ribbed but not winged, tomentose with mostly pale ferruginous (some white) hairs that are mostly erect (some spreading) and very variable in size and thickness, 0.1–1.1 mm long. *Stipules* 2.5–4.3 mm long, 1.1–1.5 mm wide, lanceolate, long-acute, with 5–7 strong veins, weakly ribbed, broadly attached at the obtuse base (i.e. not peltate or cordate). *Leaves* unifoliolate; *petiole* 15–26 mm long, indumentum as for stems; *stipels* 2, linear, acute to narrowly subulate, 1.7–2.0 mm long, 1-veined, the vein strongly produced and moderately tomentose on abaxial surface; *petiolule* 1.3–2.0 mm long; *leaflet* 24–42 mm long, 17–39 mm wide, ovate, obtuse, rounded to very broadly obtuse at base, L:W ratio (1.1–)1.5–2.3:1,  $\pm$ concolorous, moderately to sparsely hairy above, the hairs densest along veins and mostly white except on margins where mostly pale ferruginous, sparser below; secondary veins 7 or 8 on each side of midrib; tertiary venation reticulate, prominent, slightly raised on adaxial surface, prominently raised on abaxial surface. *Inflorescence* axillary, of (apparently) chasmogamous flowers in terminal condensed-racemose clusters on short shoots; *peduncle* 2–11 mm long, with moderately dense, white, appressed-ascending to ascending hairs; rachis 1.5–4.0 mm long, bearing *c.* 6–9 flowers, indumentum as for peduncle; *pedicels* 0.5–1.0 mm long, glabrous; *bracts* 1.7–2.7 mm long, subulate, prominently 1-veined on adaxial surface, moderately densely hairy, the hairs appressed-ascending; *bracteole* 1 at apex of each pedicel, 2.0–2.2 mm long, subulate, prominently 1-veined on adaxial surface, moderately densely clothed with appressed-ascending hairs. *Calyx* *c.* 4.6 mm long including tube, moderately densely appressed-hairy with white hairs outside, greenish; tube *c.* 2.1 mm long; 3 lower lobes 2.1–2.4 mm long, slightly longer than tube, acute; 2 upper lobes *c.* 2.4 mm long, joined for most of their length but free for distal 0.4–0.5 mm, the apex erect, acute. *Corolla: standard* *c.* 7.0 mm long including a claw *c.* 1.8 mm long, *c.* 4.0 mm wide, slightly longer than keel, sharply folded along centre line; apex rounded with a slight notch, white to pale cream; *wings* *c.* 6.1 mm long including a claw *c.* 2.1 mm long, *c.* 1.2 mm wide, equalling keel, distinctly auriculate basally (auricle *c.* 0.8 mm long), shortly fused to keel just above claw, uniformly white to cream, not blackening with age, glabrous; *keel* *c.* 6.1 mm long including a claw *c.* 2.0 mm long, *c.* 2.5 mm wide when flattened, notched at apex for *c.* 1 mm, pink with a pale midline and claw, glabrous. *Stamens* 10; filaments 5.3–5.9 mm long, connate into a tube for 2/3–3/4 of their length; vexillar stamen freer than others; *anthers* *c.* 0.45 mm long. *Ovary* *c.* 2.2 mm long at anthesis, on a stipe *c.* 0.5 mm long, 3-ovulate, glabrous except for a line of moderately dense, colourless, appressed hairs on upper midline. *Style* upcurved, *c.* 4.0 mm long, tapering to the stigma, glabrous except for a line of colourless, appressed hairs on upper side in basal 1/2 and a few sparse hairs on lower midline at the base; stigma capitate, *c.* 0.2 mm diam., surrounded by a ring of erect, colourless hairs *c.* 0.05 mm long. *Legume* oblong, non-moniliform, 11–23 mm long, 4.5–6.0 mm wide; stipe 1–2 mm long; valves not transversely veined, moderately densely white and pale ferruginous-hairy, pale brown when mature, non-striate, containing 1–3 seeds; style persistent, straight or upcurved, *c.* 1 mm long. *Seeds* oblong-subreniform, with ends  $\pm$ truncate, 3.4–3.5 mm long, 2.3–2.6 mm wide, *c.* 2.0 mm thick, L:W ratio *c.* 7:5, black, not mottled, minutely alveolate

and tuberculate; caruncle small, flap-like, c. 0.6–0.7 mm long, cream. *Cleistogamous subterranean flowers* not seen. (Figure 19)

*Diagnostic characters.* Distinguished from all *Glycine* Willd. species by the following combination of characters: *leaves* unifoliolate, leaflets ovate; *stem indumentum* pale ferruginous; *peduncles* 2–11 mm long; *flowers* in condensed axillary clusters; *corolla* white to pale cream with a pink keel; *seeds* black, alveolate and tuberculate.

*Other specimen examined.* WESTERN AUSTRALIA: [locality withheld for conservation reasons] 27 Mar. 2010, M.D. Barrett & R.L. Barrett MDB 2845 (CANB, DNA, PERTH).

*Phenology.* Flowering and fruiting observed in January; fruiting also in March.

*Distribution and habitat.* Known from a single location in the vicinity of Pitta Creek, growing in *Eucalyptus miniata*-*E. tetradonta* woodland in sandy soil on sandstone slopes.

*Conservation status.* *Glycine remota* is listed by Jones (2014) as Priority One under Department of Parks and Wildlife Conservation Codes for Western Australian Flora, under the name *G. sp.* Pitta Creek (M.D. Barrett 1201). Few plants are known at the only known location. The note on M.D. Barrett 1201 states that plants are ‘relatively common’, but this mistakenly refers to a similar looking pea (a *Galactia* sp.) which has the same habit and is abundant at the site, and greatly hinders searches for plants of the much rarer *Glycine*.

*Etymology.* The epithet is from the Latin *remotus* (remote), in reference to the only known population being distant from population centres and roads.

*Notes.* Differs from all other Australian *Glycine* species in having unifoliolate leaves (digitately or pinnately trifoliolate in other species). Similar to *G. lactovirens* Tindale & Craven and *G. albicans* Tindale & Craven, sharing white flowers in condensed clusters, more or less ovate leaflets, black, alveolate and tuberculate seeds, and north-west Kimberley distribution. *Glycine lactovirens* and *G. albicans* form a clade and are given a unique *Glycine* genome designation, the ‘I Genome’ (Brown *et al.* 2002). *Glycine remota* is close to *G. lactovirens* and almost certainly belongs to the same clade; it is most likely (if diploid) to have the same genome group. In addition to being unifoliolate, it differs from *G. lactovirens* and *G. albicans* in having much shorter peduncles (2–11 mm long vs 15–90 mm long), smaller, oblong seeds (3.4–3.5 mm long with a L:W ratio of 7:5 in *G. remota* vs 4.0–5.5 mm with a

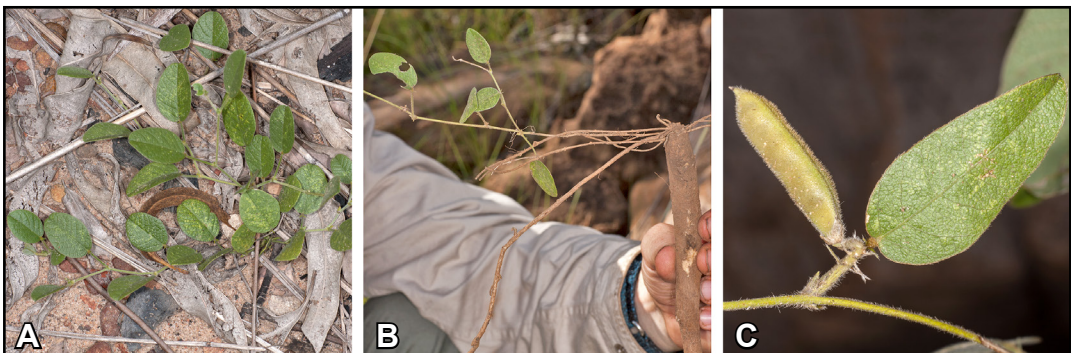


Figure 19. *Glycine remota*. A – habit; B – tuberous tap root and trailing stem; C – unifoliolate leaf and fruit. Images from M.D. Barrett & R.L. Barrett MDB 2845. Photographs by R.L. Barrett.

L:W ratio of 6:5 and more or less rounded). It differs further from *G. albicans* in having a ferruginous stem indumentum (*vs* white). In the key to *Glycine* of north-west Australia (Pfeil & Craven 2002), *G. remota* would key to *G. lactovirens*, differing in the characters mentioned above.

The description above is based on dissection of a single flower, due to the limited available material on the type specimen.

The vernacular name Prince Regent Soybean is suggested.

The key in Pfeil *et al.* (2006) can be modified to include *G. remota* as follows:

3. Plant moderately erect; leaflet abaxial surface hairs dense, abaxial areoli obscured by hairs; rhizome bearing cleistogamous flowers or fruit..... **G. albicans**
- 3: Plant prostrate; leaflet abaxial surface hairs moderately dense to dense, abaxial areoli not obscured by hairs; usually not rhizomatous (if so, then lacking cleistogamous flowers or fruit)
- 3A. Leaves unifoliolate; peduncles 2–11 mm long ..... **G. remota**
- 3A: Leaves digitately or pinnately trifoliolate; peduncles 15–90 mm long
4. Leaves digitately trifoliolate; calyx *c.* 5 mm long; standard petal 7–7.5 mm long; petiole and abaxial leaflet hairs cream or pale ferruginous..... **G. lactovirens**
- 4: Leaves pinnately trifoliolate; calyx up to 2.5 mm long; standard petal 5 mm long; petiole and abaxial leaflet hairs white..... **G. montis-douglas**

## Loganiaceae

### **Mitrasacme thedae** M.D.Barrett & R.L.Barrett, *sp. nov.*

*Type:* Theda Station, Western Australia [precise locality withheld for conservation reasons], 16 February 2006, R.L. Barrett & M.D. Barrett RLB 3121 (*holo:* PERTH 08615241; *iso:* BRI, CANB, DNA, K, MEL, NSW).

*Mitrasacme* sp. Theda (K. Menkhorst s.n. 18/04/1988), Western Australian Herbarium, in *FloraBase*, <http://florabase.dpaw.wa.gov.au/> [accessed 1 March 2014].

Annual *herb*, 32–70(–100) cm high, glabrous. *Stem* an erect scape, solitary, terete, 1.0–1.9 mm diam. in mid-section, thinner at base, hollow. *Leaves* 2–4 pairs in a basal rosette, withering before fruiting, sessile, ovate to broadly elliptic, 23–52 mm long, 7.5–25 mm wide, subacute to obtuse, strongly 3-veined, glabrous. *Inflorescence* compound, of 1–3 umbels of 1–7 flowers each. *Pedicels* terete, 7–30 mm long, 0.4–0.9 mm thick, glabrous. *Calyx* strongly ribbed at anthesis, swollen and ±cylindrical in fruit, 4.5–5.5 mm long including lobes; tube 2.5–4.5 mm long, with green to white scale-like projections between the thickened, 3-veined, glabrous ribs; lobes 1–2 mm long, with a dark-coloured, thickened central part extending above the membranous margins, acute. *Corolla* white with a small, round, green spot each side of the base of each lobe (making an interrupted green ring around the throat), with pale apricot flush on abaxial surface and unopened buds, 40–45 mm diam.; tube cylindrical, 12–19 mm long, 1.0–1.2 mm diam. in basal 2/3, dilated to 2.0–3.5 mm diam. in upper 1/3 but reducing abruptly to 1.5–1.6 mm diam. at throat, glabrous or with sparse, short, erect hairs in upper 1/4 of tube outside, mostly glabrous at throat with a narrow band of small scale-like hairs around the rim and tangled hairs inside at base; lobes connate in basal 1.2–1.9 mm from throat, 9–18 mm long, 6.2–11.0 mm wide, each

with a blunt, retrorse lobe at the throat opening, obtuse with a short apiculus; throat square. *Stamens* all fertile or rarely some reduced to staminodes, inserted in upper 1/4 of tube, 8–12 mm long; filaments adnate to tube along much of their length forming vertical ribs, free for *c.* 0.2 mm. *Anthers* ±sessile, included, linear to oblong, (1–)1.8–2.3 mm long, latrorse. *Style* included, 12–17 mm long at anthesis, gradually dilating toward tip, with 2 flattened lobes at apex; lobes obovate, obtuse, 0.6–1.3 mm long. *Capsule* globular, 4–6 mm long (including horns), 3.7–4.2 mm diam., glabrous; horn apices connate; style 9.0–14.5 mm long, falling early. *Seeds* not seen. (Figure 20)

*Diagnostic characters.* Distinguished from *M. elata* R.Br. and *M. nudicaulis* Reinw. ex Blume by the following combination of characters: *leaves* large (23–52 mm long), 3-veined, in a basal rosette; *flowers* large, white with small, green spots at the base of each lobe, with a pale apricot flush on the abaxial surface, and a distinctly square mouth to the corolla tube.

*Other specimens examined.* WESTERN AUSTRALIA: [localities withheld for conservation reasons] 12 Apr. 2013, R.L. Barrett, M.D. Barrett & B. Anderson RLB 8008 (PERTH); 7 Mar. 2014, R.L. Barrett RLB 8825 (BM, BRI, CANB, DNA, K, L, MEL, NSW, PERTH); 18 Apr. 1988, K. Menkhorst s.n. (DNA, MEL, PERTH 03461629).

*Phenology.* Flowering and fruiting recorded from January to April.

*Distribution and habitat.* Locally common in places on Theda Station and south of Kalumburu in the North Kimberley. Occurs on red, basalt-derived soils on rocky slopes and in flat areas, in open woodland. Suitable habitat is more or less continuous over many of the basalt hills on Theda Station, west to the Mitchell Plateau and north towards the Carson River, which coupled with available collections suggests a likely broader distribution for the species.

*Conservation status.* *Mitrasacme thedae* is listed by Jones (2014) as Priority One under Department of Parks and Wildlife Conservation Codes for Western Australian Flora, under the name *M. sp.* Theda (K. Menkhorst s.n. 18/04/1988).

*Etymology.* The epithet is derived from the name of the station where this species is found. Theda Station was apparently named for Theda, the wife of the founder of the station lease, hence the feminine gender.

*Notes.* *Mitrasacme thedae* is similar to *M. elata* and *M. nudicaulis*, with which it shares large leaves restricted to a basal rosette, and a calyx with white, pustulate scales between the lobes. It is apparently most closely related to *M. elata* from the Northern Territory, Lesser Sunda Islands and New Guinea (see Leenhouts 1962; Dunlop 1996), differing in having more or less globular capsules that are 4–6 mm long (*vs* oblong and 5–7 mm long), and staminal filaments that are mostly adnate to the tube and with the free part *c.* 0.2 mm long (*vs* only partly adnate and with free part 7–11 mm long). *Mitrasacme thedae* differs from both *M. nudicaulis* var. *nudicaulis* and var. *citrina* Dunlop in having larger leaves, a corolla tube that is prominently dilated in the upper third and 2–2.5× the width of the lower part (*vs* evenly cylindrical in *M. nudicaulis*), an open, square-shaped throat due to a small retrorse lobe in the throat (*vs* a thin, cross-shaped throat in *M. nudicaulis*), and stamens inserted just below throat (*vs* in the lower quarter of the tube in *M. nudicaulis*). *Mitrasacme thedae* and *M. nudicaulis* var. *citrina* grow intermixed on Theda Station.

The vernacular name Theda Cross-flower is suggested.

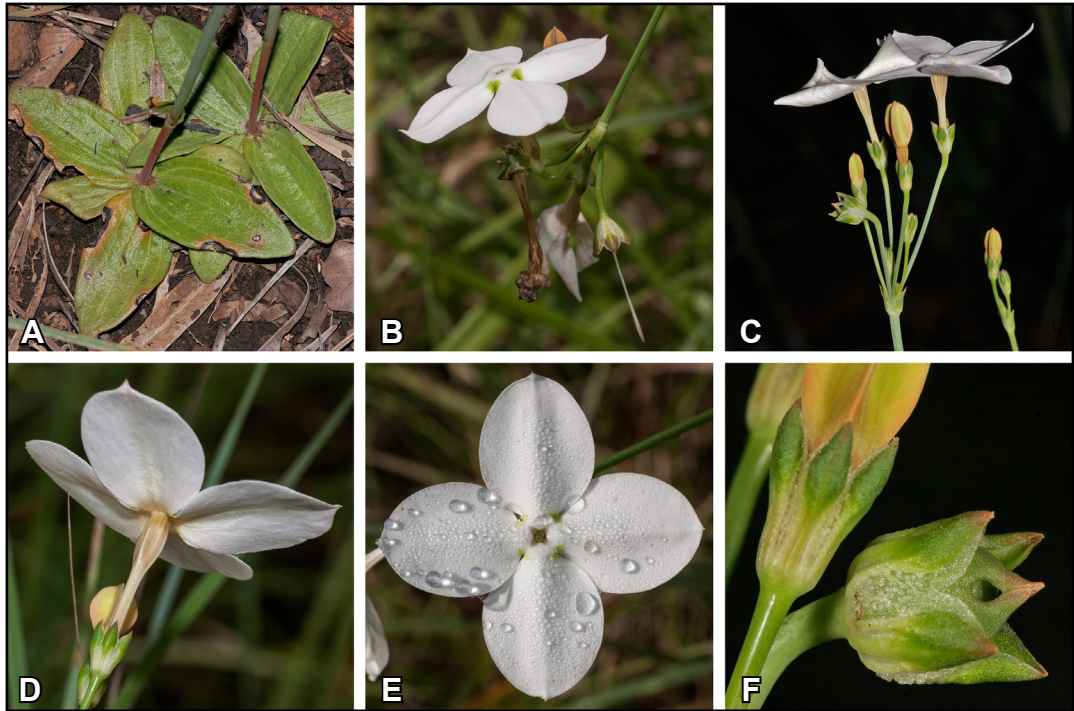


Figure 20. *Mitrasacme thedae*. A – leaf rosette showing prominent venation; B, C – inflorescence showing flowers, style, buds and fruit; D – lateral view of flower showing calyx and expanded floral tube below throat; E – flower showing  $\pm$ square throat; F – calyx and fruit. Images from R.L. Barrett RLB 8825. Photographs by R.L. Barrett.

## Menyanthaceae

### *Nymphoides astoniae* M.D.Barrett & R.L.Barrett, *sp. nov.*

*Type:* Mitchell Plateau, Western Australia [precise locality withheld for conservation reasons], 25 January 2010, R.L. Barrett & M.D. Barrett RLB 6425 (*holo:* PERTH 08613869; *iso:* PERTH (spirit), BRI, CANB, DNA, K, MEL).

*Nymphoides* sp. Mitchell Plateau (R.L. Barrett & M.D. Barrett RLB 2640), Western Australian Herbarium, in *FloraBase*, <http://florabase.dpaw.wa.gov.au/> [accessed 1 March 2014].

*Nymphoides* sp. 2 (Barrett & Barrett 2640), in N.P. Tippery & D.H. Les, *Syst. Bot.* 36: 1113 (2011).

Aquatic *annual*. *Stems* few, petiole-like, arising from the plant base, slender, flexuose, 8–15 cm long, *c.* 0.3–0.6 mm diam.; true petiole of stem leaves inconspicuous, 0.2–1.0 mm long, much shorter than the length of the blade, thicker than the stem and tapering through the inflorescence node,  $\pm$ continuous with the stem, tinged or deeply coloured with maroon-purple. *Basal leaves* apparently absent. *Floating leaves:* blades entire, chevron-shaped to laterally compressed-horseshoe-shaped, deeply cordate with an open basal sinus *c.* (20–)40–70% of total blade length, of *c.* 20–100° angle, the obtuse lobes never overlapping (occasional immature leaves broadly elliptic to ovate and lacking a sinus), (6–)11–23 mm long, (5–)11–24 mm wide, usually widest just above apex of basal lobes (in least deeply lobed young leaves, widest just above the level of petiole insertion), dark green above, paler green tinged with

purple to deep maroon-purple beneath, somewhat spongy and deeply pitted beneath, the pits rounded to elliptic, 0.2–0.6 mm in longest dimension. *Inflorescence* as for the ‘*indica* group’; rachis not distinct; *pedicels* in a solitary cluster scarcely distanced from the subtending leaf blade by an inconspicuous petiole, 7–11 per cluster, crowded, 10–32 mm long, *c.* 0.1–0.2 mm diam.; *bract* 1 subtending each pedicel, acute, 0.6–1.5 mm long, slender, pale yellowish green or tinged with pale to deep maroon-purple. *Flowers* bisexual, (3)4(5)-partite, heterostylous, the long-styled flowers dominant. *Calyx* 1.5–2.0 mm long; lobes lanceolate to narrowly ovate, acute to subobtuse, 1.5–1.9 mm long. *Corolla* (3)4(5)-lobed, 1.7–3.1 mm long, 3.0–6.5 mm diam., white with central sections of lobes yellow; *tube* slightly shorter than the calyx, 1.0 mm long; papillae of tube crowded in a dense cluster on the petal midline just below level of throat, 0.2–0.4 mm long, the cluster united at base on a stalk *c.* 0.1 mm long; *lobes* ovate, emarginate to acute, 1.6–3.6 mm long, to 1.5 mm wide, with a transverse row of fimbriae across base and a basal tufted appendage arching inward toward style; mid-section of lobe glabrous except a sparse row of laciniae (corona) level with insertion of anther cells and well-above level of insertion of filament; side wings of lobe very narrow except at apex where 0.3–0.7 mm wide, undulate, not or very sparsely lacinate except at apex where moderately densely shortly lacinate, longest laciniae 0.3–0.6 mm long. *Stamens* with free part of filaments *c.* 0.2 mm long in long-styled flowers, 0.5–0.9 mm long in short-styled flowers (such that anthers are held well-above styles). *Anthers* oblong, 1.0–1.5× as long as broad, 0.3–0.6 mm long, 0.2–0.4 mm diam. *Gynoecium* 0.8–1.0 mm long at anthesis; ovary ellipsoid, gradually tapered into style; placentas 3 or 4, about 1/2 length of ovary, fused to ovary wall, each bearing a single ovule; *ovules* 2–4, *c.* 0.4 mm long and flattened tear-shaped at anthesis, with a thickened basal margin near the attachment from an early age; *style* (in long-styled flowers) 1.6–2.0 mm long, slender, exerted well-above tube and stigmas held above level of anthers; *stigmas* 2, with broad, erect wings, *c.* 0.4–0.5 mm long, *c.* 0.7 mm wide, divided into numerous papillae, brush-like (short-styled flowers similar except styles to 0.5 mm long, stigmas smaller, with 2 spreading wings 0.3 mm long, 0.4 mm wide, and free part of anther filaments 0.5–0.9 mm long, so that anthers are held well-above styles). *Capsule* depressed-globose, ±globose to asymmetrically depressed-turbinate, slightly exceeding calyx, 1.8–2.1 mm long, 2.0–3.5 mm diam., often distorted by seeds at maturity, thin-walled at maturity with persistent style base 0.2–0.4 mm long. *Seeds* 2 or 3 per capsule; body of seed tear-shaped, laterally compressed, acute, attached centrally at basal end, with 2 symmetrically thickened scars along lower margin, 1.9–2.0 mm long, 1.0–1.1 mm diam., 0.35–0.40 mm thick, dark grey, brown or black when mature, shiny, the surface minutely pitted, lacking tubercles; caruncle absent. (Figure 21)

*Diagnostic characters.* Distinguished from other *Nymphoides* Seg. species by the following combination of characters: *leaves* chevron-shaped to horseshoe-shaped at maturity with open sinuses; abaxial surfaces somewhat spongy with broad pits (but not blistered); *inflorescence* a dense cluster of pedicels subtended by a floating leaf; *corolla* white; *seeds* dark grey, brown or black, shiny, laterally compressed, tear-shaped; caruncle absent.

*Other specimen examined.* WESTERN AUSTRALIA: [locality withheld for conservation reasons] 22 Jan. 2003, R.L. Barrett & M.D. Barrett RLB 2640 (PERTH).

*Phenology.* Flowering and fruiting only known in January, but probably occurring at least until March.

*Distribution and habitat.* Known from only two locations near the Mitchell River in the Kimberley region, where it grows in ephemeral, rain-fed rock pools among massive, sheeting sandstone with *Eriocaulon* sp.



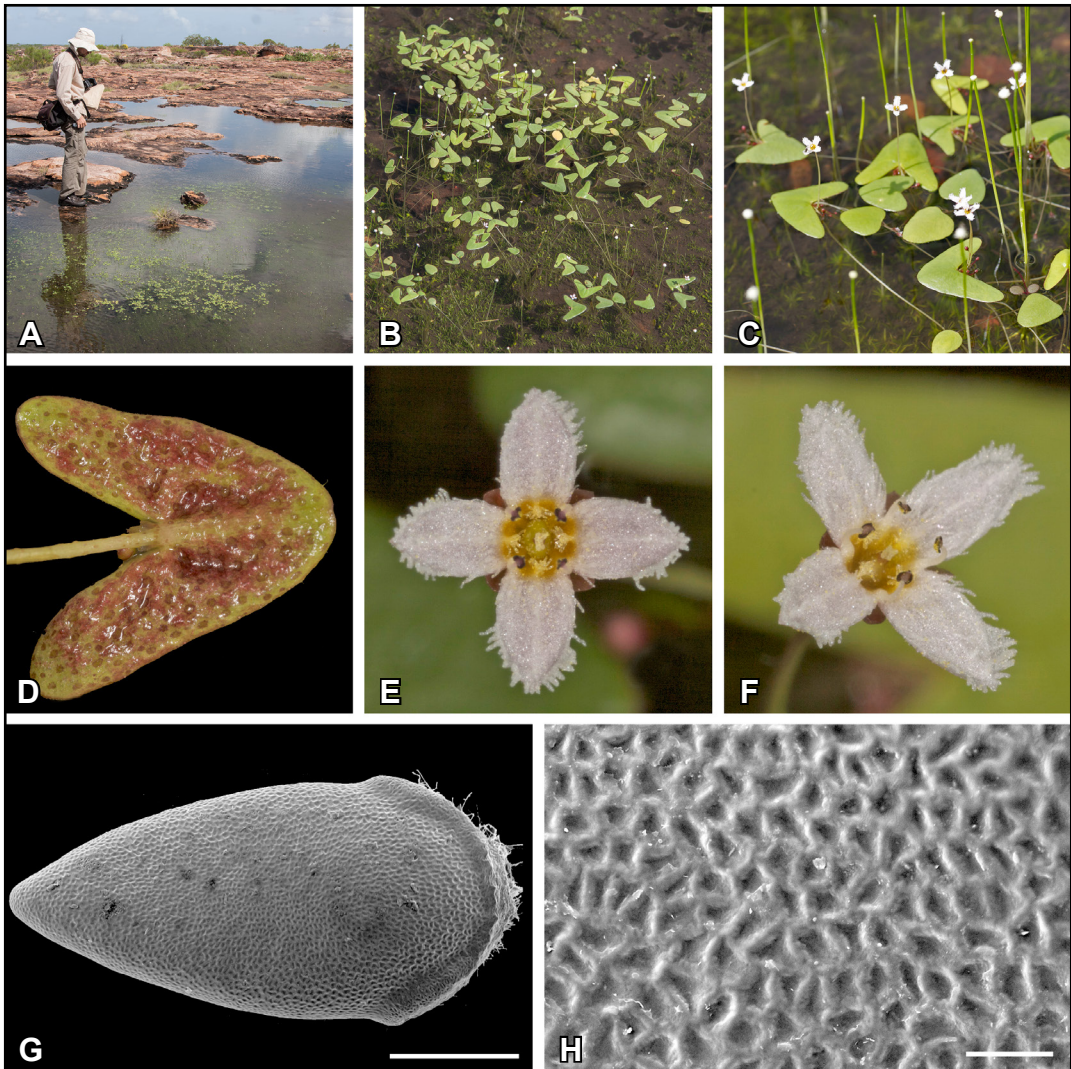


Figure 21. *Nymphoides astoniae*. A – habitat in shallow rock pool on sandstone pavement; B – habit; C – floating young and mature leaves with emergent flowers; D – lower surface of leaf; E – long-styled flower; F – short-styled flower; G – SEM of seed; H – SEM of seed surface. Scale bars = 500  $\mu$ m (G); 50  $\mu$ m (H). Images from R.L. Barrett & M.D. Barrett RLB 6425. Photographs by R.L. Barrett (A, B); M.D. Barrett (C–H).

**Conservation status.** *Nymphoides astoniae* is listed by Jones (2014) as Priority One under Department of Parks and Wildlife Conservation Codes for Western Australian Flora, under the name *N. sp.* Mitchell Plateau (R.L. Barrett & M.D. Barrett RLB 2640).

**Etymology.** The epithet honours Helen Aston, one of Australia's leading aquatic plant taxonomists, who revised the Australian *Nymphoides* species (e.g. Aston 1973, 1982, 1987, 1992, 2003, 2009) along with several other aquatic genera.

**Notes.** *Nymphoides astoniae* was referred to as '*Nymphoides sp. 2* (Barrett & Barrett 2640)' in Tippery and Les (2011), where it grouped in a strongly supported clade with *N. furculifolia* Specht, *N. parvifolia* (Griseb.) Kuntze, *N. quadriloba* Aston and '*N. sp. 1* (Cowie 4390)' (= *N. quadriloba*

variant of Aston 2003) in phylogenies derived from both ITS and *trnK* intron sequences. Within this clade, *N. astoniae* was unresolved in phylogenetic analyses of *trnK* intron data, but was strongly supported (100% bootstrap support) as sister to ‘*N. sp. 1*’ by ITS data. *Nymphoides astoniae* differs from all other species in this clade in having a strongly pitted lower leaf surface, and a unique, laterally compressed and tear-shaped seed (*vs* circular in outline and subglobose to laterally compressed in the other taxa). The spongy leaves, flattened seeds and rockpool habitat are reminiscent of *N. planosperma* Aston from sandstone areas of Kakadu National Park in the Northern Territory, but the leaf abaxial surfaces are pitted (*vs* blistered in *N. planosperma*) and the seeds are tear-shaped (*vs* narrowly elliptic). Phylogenetic analyses by Tippery and Les (2011) place *N. planosperma* with *N. simulans* Aston and *N. spongiosa* Aston, well-removed from *N. astoniae*.

The vernacular name Aston’s Marshwort is suggested.

## Phyllanthaceae

### **Poranthera asybosca** R.L.Barrett, *sp. nov.*

*Type*: [near Eneabba,] Western Australia [precise locality withheld for conservation reasons], 26 October 1993, R. Cranfield & D. Kabay 8958 (*holo*: PERTH 03321428).

Monoecious, erect *annual*, 20–45 mm tall. *Stems* to 9-branched, reddish green; branchlets smooth, glabrous, 0.3–0.8 mm across; leaf scars obscure. *Stipules* white, narrowly triangular, 1.0–2.2 mm long, entire. *Leaves* opposite, spaced along branchlets and crowded at apex; *petiole* 0.4–1.6 mm long, green; *blade* grading into petiole, lanceolate, acute, attenuate at base, 2.0–7.2 mm long, 0.6–1.3 mm wide, flat or margins slightly recurved at base, smooth and glabrous adaxially and abaxially, green, slightly paler below; midrib obscure adaxially, slightly raised abaxially. *Racemes* solitary, dense, terminal, umbel-like; *rachis* *c.* 1 mm long; *bracts* narrowly obovate, 1.7–2.5 mm long, 0.8–1.0 mm wide, acute to obtuse. *Male flowers* with a pedicel *c.* 2 mm long; *calyx tube* *c.* 0.5 mm long; *calyx lobes* 5, pink to greenish, lanceolate, acute, *c.* 1 mm long, *c.* 0.2 mm wide, concave or convex; *petals* 5, pale pink, erect, ovate, obtuse, *c.* 2.5 mm long, *c.* 0.4 mm wide; glands obscure; *stamens* 5, filaments *c.* 2 mm long, straight; *anthers* *c.* 0.25 mm long; *rudimentary ovary* a minute hemispherical dome. *Female flowers* with a pedicel to 2.5 mm long, extending to 3.1 mm long in fruit; *calyx lobes* 5, green to reddish, lanceolate to narrowly oblong, acute, *c.* 0.5 mm long, 0.2–0.3 mm wide, concave to convex; *petals* obscured by sepals; *ovary* depressed-globose, *c.* 0.5 mm across, 6-lobed, emarginate distally, rough; *styles* 3, appearing 6, *c.* 0.3 mm long, divided almost to base, slender. *Capsule* depressed-globose, 1.5–2.0 mm long, 2–3 mm diam., prominently 6-lobed, emarginate distally, rough and wrinkled. *Seeds* broadly wedge-shaped to sub-ovoid, *c.* 0.45 mm long, *c.* 0.40 mm wide, *c.* 0.35 mm deep; testa with interlocking ovoid domes that bear numerous secondary transverse ridges (cerebriform), pale brown, lacking a waxy coating. (Figure 22)

*Diagnostic characters.* Distinguished from other *Poranthera* Rudge species by the following combination of characters: *stems* reddish green; *leaves* with indistinct petioles 0.4–1.6 mm long; *stipules* entire; *seeds* with a regular cerebriform pattern.

*Other specimen examined.* WESTERN AUSTRALIA: [locality withheld for conservation reasons] 28 Sep. 2012, R.L. Barrett RLB 7813 (PERTH).

*Phenology.* Flowering and fruiting recorded from September to October.

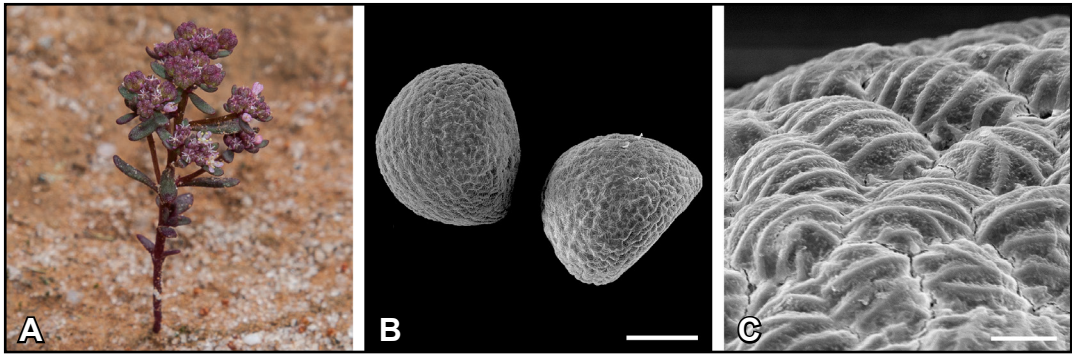


Figure 22. *Poranthera asybosca*. A – flowering plant; B – SEM of seed; C – SEM of seed surface. Scale bars = 200  $\mu$ m (B); 10  $\mu$ m (C). Images from R.L. Barrett RLB 7813 (A) and R. Cranfield & D. Kabay 8958 (B, C). Photographs by R.L. Barrett.

*Distribution and habitat.* Only known from a small area between Badgingarra and Eneabba. Open kwongan shrubland on white sand over laterite.

*Conservation status.* *Poranthera asybosca* is to be listed as Priority One under Department of Parks and Wildlife Conservation Codes for Western Australian Flora (A. Jones pers. comm.).

*Etymology.* The epithet is a contraction of letters from the Australasian Systematic Botany Society, terminated by *-a*, acknowledging the work of the society in promoting plant systematics in Australia. The second known collection of this species was made during the post-conference field trip of the Australasian Systematic Botany Society conference held in Perth in 2012.

*Notes.* Previously confused with *P. microphylla* Brongn. which is distinctive in having a white, waxy coating on the seeds (absent in *P. asybosca*), but probably more closely allied to *P. leiosperma* Halford & R.J.F.Hend. which differs in having smooth rather than cerebriform seeds (Halford & Henderson 2005).

The vernacular name Cerebriform-seeded *Poranthera* is suggested.

## Poaceae

### *Triodia basitricha* M.D.Barrett, *sp. nov.*

*Type:* [near] Mount Florence Homestead, Western Australia [precise locality withheld for conservation reasons], 11 May 1996, A.A. Mitchell PRP 1035 (*holo:* PERTH 04995619; *iso:* CANB).

*Triodia* sp. Millstream (A.A. Mitchell PRP 207), Western Australian Herbarium, in *FloraBase*, <http://florabase.dpaw.wa.gov.au/> [accessed 7 July 2014].

Tussock-forming *perennial*, non-resinous or weakly resinous, not obviously stoloniferous; *tussocks* compact, *c.* 30–40 cm high, 40–60 cm diam.; *flowering culms* 35–70 cm high. *Culm internodes* all short (never elongated as in *T. claytonii* Lazarides), <1 cm long and completely obscured by subtending foliage, straw-coloured to dark red-brown, glabrous; aerial roots not found. *Leaf sheaths* 2.6–4.0 mm wide near apex, sparsely to moderately pilose on surface with hairs 1.1–2.2 mm long, not resinous, straw-coloured, strongly nerved; margins glabrous; margins of orifice truncate or sub-auriculate, with a dense fringe of hairs, the longest hairs 2.2–4.0 mm long. *Ligule* a dense fringe of hairs *c.* 0.25 mm

long; *pseudopetiole* not distinct. *Leaf blades* flattened-V-shaped when fresh, conduplicate and tightly in-rolled when dry, initially straight but becoming curled in older and dead leaves, 13.0–27.5 cm long, 0.5–0.9 mm diam. when rolled (unrolled leaves not seen), when fresh relatively soft, weakly pungent, glabrous abaxially, adaxial surface densely papillose, often resinous over abaxial surface, bright green, drying pale yellow-green; stomatal grooves on abaxial surface confined to central part, 4 (2 either side of small midrib), equally spaced, grooves absent on marginal *c.* 1/3 but finely obscurely ribbed, stomatal grooves on abaxial surface 7 or 8 each side of midrib; margins minutely scabrous with prickly hairs <0.1 mm long. *Panicle* 7–15 cm long, 2–4 cm wide; branches openly racemose (or extreme base of longest branches very shortly ternate), moderately dense to loose, lanceolate to narrowly triangular, glabrous except minute tufts of hairs *c.* 0.3 mm long in branch axils, non-resinous; primary axis angular to ribbed or flattened; longest basal panicle branches 2.7–8.0 cm long, terete to angular or weakly flattened, with 4 or 5 loosely arranged,  $\pm$ uniform-sized spikelets, which are 4.5–11.5 mm apart (measured from base of pedicels) and partly overlapping; basal pedicels (on longest lower panicle branches) 2.0–2.5 mm long, 0.11–0.13 mm diam., filiform, becoming slightly thicker just below spikelet, terete, minutely scabrous; terminal pedicel 5.5–8.0 mm long. *Spikelet* 7–10 mm long, 3–4 mm wide (excluding awns), loosely 3- or 4-flowered with 2 or 3(?4) fertile florets (apparently 1 or 2 sterile florets at apex, but these possibly merely immature), narrowly oblong or narrowly lanceolate; lowest rachilla internode *c.* 2.2 mm long, *c.* 0.12 mm diam., minutely scabrous; spikelets disarticulating above glumes and at rachilla internodes at maturity. *Lower glume* 10.0–12.5 mm long, 3.6–3.8 mm wide, lanceolate, acuminate, sometimes very slightly aristulate, but lacking awns or a distinct arista, equal to or longer than the combined spikelet florets (excluding awns), scarious, sometimes with narrow membranous margins, with minute scabrosities <0.05 mm long over whole surface, 3(sub-5)-nerved, the midnerve slightly raised, laterals scarcely raised, glabrous on margins. *Upper glume* inserted *c.* 0.5 mm above lower glume, 11–13 mm long, similar to and subequal to (usually very slightly longer than) lower glume, subequal to or slightly longer than the combined florets. *Lowest lemma* 15.0–16.5 mm long including lobes, oblanceolate, strongly bitextured (lower part indurated, upper part membranous-chartaceous, the underside with a thickened callosity at the junction), deeply 3-lobed, 3-awned; body 3.7–4.5 mm long including callus, the indurated part with sparse to dense, appressed (sometimes some slightly lifting) hairs 0.2–0.3 mm long, not visibly nerved, the membranous part with 3 groups of 3 obscure nerves radiating into lobes and awns; midlobe 10–12 mm long (including awn), narrowly triangular at base narrowing into an awn, slightly to distinctly narrower than lateral lobes; lateral lobes 7–8 mm long (including awn), narrowly triangular at base narrowing into an awn, margins with a narrow, membranous wing; *callus* 0.20–0.25 mm long, slightly curved, attached obliquely, blunt, obtuse in face view, white-bearded, the longest hairs *c.* 0.5 mm long. *Upper lemmas* similar to but smaller than lowest lemma. *Palea* of basal lemma distinctly longer than lemma body, 5.1–5.5 mm long, 0.6–0.8 mm wide, narrowly oblanceolate, 2-keeled, bitextured, lower part indurated and appressed-hairy, upper part translucent-membranous, hairs becoming less dense toward the glabrous apex, apex distinctly bifid with acute lobes 1.3 mm long; keels raised but not winged, keel margins densely scabrous; flaps *c.* 0.10–0.15 mm wide, broadest in upper membranous part, narrower than 1/2 width of the palea body and not overlapping, entire. *Anthers* 3, 2.3–2.5 mm long, exerted at maturity. *Styles* 2, *c.* 1.7 mm long. *Caryopsis* not seen. (Figure 23)

*Diagnostic characters.* Distinguished from *T. bitextura* Lazarides by the following combination of characters: *leaves* with sheaths sparsely to moderately pilose and margins glabrous; *leaf blades* non-resinous or weakly resinous, ‘soft’-type, lacking stomatal grooves on lateral abaxial surfaces; *lemmas* awned, body bitextured, appressed-hairy in lower 1/2.

*Other specimens examined.* WESTERN AUSTRALIA: [localities withheld for conservation reasons] 12 Mar. 2013, *M.D. Barrett & B.M. Anderson* MDB 4023 (PERTH); 31 Mar. 1994, *A.A. Mitchell* PRP

207 (CANB, PERTH); 2 Apr. 1995, *A.A. Mitchell* PRP 258 (CANB, PERTH); 7 Aug. 2007, *E. Thoma* ET 1325 (PERTH); 26 July 2002, *S. van Leeuwen* 5071 (PERTH).

*Phenology.* Fertile collections have been made between March and August, but core flowering and fruiting is most likely from January to March.

*Distribution and habitat.* Occurs in the western and central Pilbara region of Western Australia, and also from Barlee Range Nature Reserve south of the Pilbara. Collections are all from the slopes or crests of rocky hills, which may indicate a more 'refugial habitat' requirement, as is common to several other Pilbara 'soft' *Triodia* R.Br. species such as *T. biflora* Lazarides, *T. sp.* Robe River (M.E. Trudgen et al. MET 12367) and *T. sp.* Karijini (S. van Leeuwen 4111).

*Conservation status.* *Triodia basitricha* is listed by Jones (2014) as Priority Three under Department of Parks and Wildlife Conservation Codes for Western Australian Flora, under the name *T. sp.* Millstream (A.A. Mitchell PRP 207). It is known from seven locations and appears to occur in isolated patches, albeit across a relatively large area of the Pilbara. Collection notes report it as common (*A.A. Mitchell* PRP 207; *S. van Leeuwen* 5071) or sparse (*A.A. Mitchell* PRP 258).

*Etymology.* The epithet is from the Greek *basis* (base) and *trichos* (hair) and refers to the hairy leaf sheaths.

*Notes.* *Triodia basitricha* was treated as part of a broad concept of *T. bitextura* by M. Lazarides (*in sched.*), by virtue of the shared bitextured lemma and palea, awned lemma lobes, and short, blunt (obtuse) calli. Specimens have since been determined either as *T. bitextura* or *T. schinzii* (Henrard) Lazarides. *Triodia basitricha* differs from *T. bitextura* in having sparsely to moderately densely hairy (pilose) leaf sheath surfaces (in all other forms of *T. bitextura* the sheath surfaces are glabrous, or occasionally minutely tomentose near the nodes), and leaf sheath margins that are glabrous except at the sheath orifice (in *T. bitextura* they are glabrous or pilose). It differs from *T. schinzii* and *T. helmsii* (C.E. Hubb.) Lazarides in having hairy leaf sheaths, smaller glumes, and blunt calli (acute in *T. schinzii* and *T. helmsii*).

The only other Pilbara taxon with a bitextured lemma is *T. sp.* Mt Ella (M.E. Trudgen 12739), which differs in having glabrous leaf sheath surfaces and strongly resinous foliage (not or weakly resinous in *T. basitricha*). The two taxa have disjunct distributions, with *T. sp.* Mt Ella occurring in the eastern Hamersley Range and *T. basitricha* to the west and north.

*Triodia basitricha* comprises a distinct lineage in an (unpublished) ITS phylogeny (>1,000 specimens sampled, including six samples of *T. basitricha*). The type of *T. bitextura* is from islands in the Gulf of Carpentaria. Although authentically topotype material has not yet been sequenced, ITS (and ETS for some) nrDNA sequences have been obtained for numerous other collections throughout northern Australia. *Triodia bitextura* is clearly polyphyletic in trees reconstructed from these regions. All other lineages in the *T. bitextura* complex are phylogenetically remote from *T. basitricha* (M.D. Barrett, unpubl. data).

The vernacular name Pilbara Curly Spinifex is suggested.

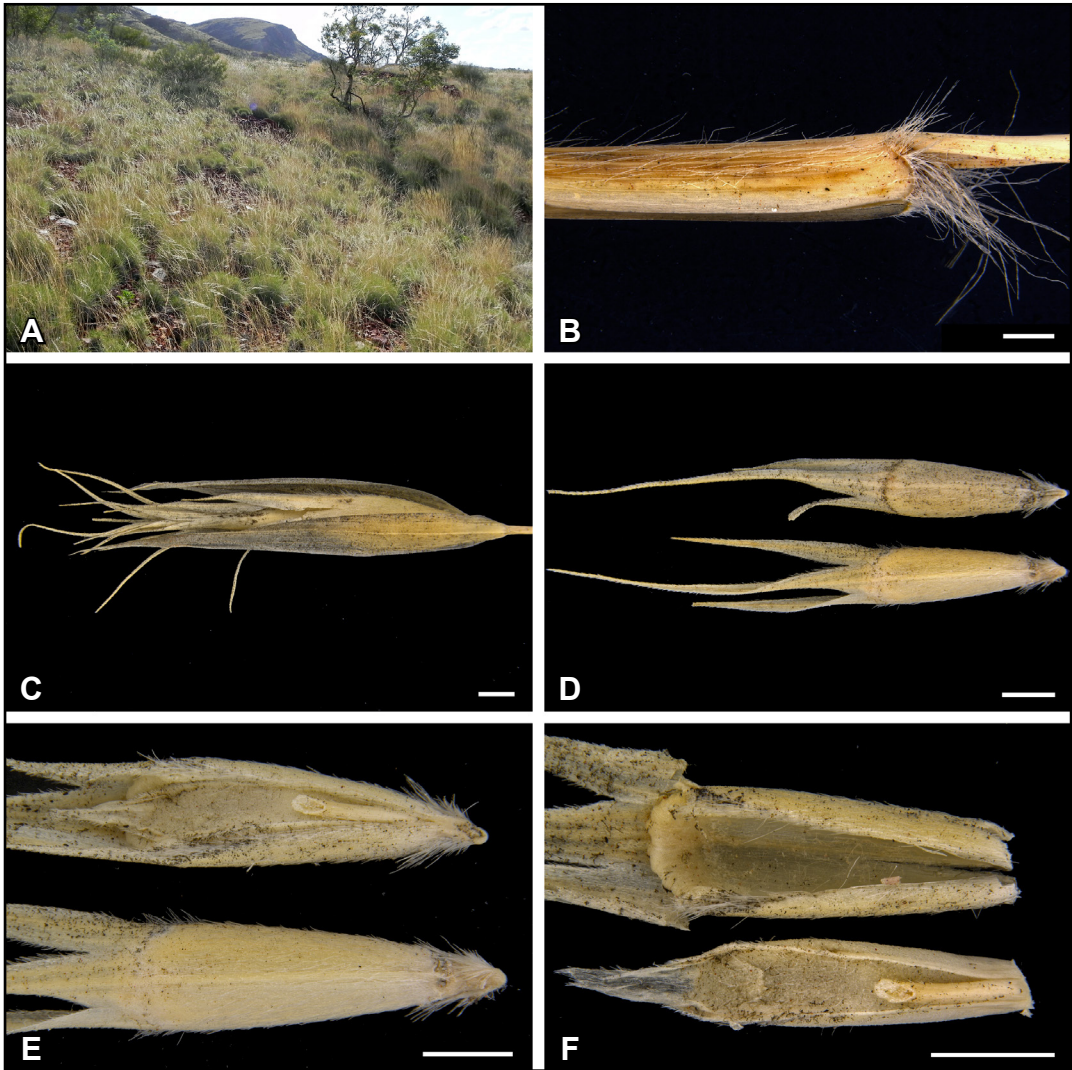


Figure 23. *Triodia basitricha*. A – habitat and habit on rocky hill slope; B – junction of leaf sheath and blade showing long hairs on the orifice, and diagnostic sparse hairs on the sheath surface; C – spikelet; D – lemmas; E – upper (top) and lower lemma; F – underside of lower spikelets with palea in situ (lower) and palea removed (upper) to expose the thickened callosity at the texture junction. Scale bars = 2 mm (B–D); 1 mm (E, F). Images from *M.D. Barrett & B.M. Anderson* MDB 4023. Photographs by M.D. Barrett.

***Triodia celsa* M.D.Barrett, *sp. nov.***

*Type:* Prince Regent Nature Reserve [National Park], West Kimberley Region, Western Australia [precise locality withheld for conservation reasons], 30 March 2010, *M.D. Barrett & R.L. Barrett* MDB 2952 (*holo:* PERTH08613990; *iso:* BRI, CANB, DNA, K, NSW, NY, PERTH 08615071).

Tussock-forming *perennial*, non-resinous, not conspicuously stoloniferous; *tussocks* dense, 0.6–0.9 m high, 0.5–0.8 m diam.; *flowering culms* 1.1–1.4 m high. *Culm internodes* mostly short, a few elongated, dark red-brown, sub-shiny, glabrous; longest internodes to 70 mm long; aerial roots absent. *Leaf sheaths* 3.5–6.0 mm wide near apex, glabrous on surface, non-resinous, straw-coloured, many-nerved; margins glabrous in upper *c.* 1/2, pilose with hairs 2–6 mm long in basal *c.* 1/2; margins of orifice broadly

rounded,  $\pm$ truncate or shortly auriculate with broad shallow auricles *c.* 0.1–0.3 mm long, with hairs 2–5 mm long. *Ligule* a dense fringe of hairs with a thin, membranous part *c.* 0.1 mm long, the hairs 0.2–1.0 mm long, longer in central zone and shorter near margins; *pseudopetiole* absent. *Leaf blades*  $\pm$ flat when fully hydrated, conduplicate and tightly in-rolled when stressed or dried, (3–)17–37 cm long, 2.0–2.5 mm wide when unrolled, flexible, shortly pungent with a dark mucro 0.4–1.1 mm long, glabrous abaxially, adaxial surface glabrous or sometimes pilose along adaxial veins in basal 1 cm, non-resinous, green; stomatal grooves on abaxial surface clustered centrally, 4 (2 grooves either side of a moderately broad midrib), grooves absent on lateral surfaces, the lateral surfaces smooth to very obscurely longitudinally ribbed; margins with sparse, blunt, appressed prickly hairs 0.01–0.05 mm long (sometimes a few sharp, erect ones at base to 0.1 mm long). *Panicle* (7.5–)22–29 cm long, 2.5–4.0 cm wide, open, narrowly lanceolate in outline, lacking hairs in axis and divisions, non-resinous; branches in 3s throughout, only racemose at apex where terminal 3 or 4 spikelets directly inserted on main axis, all axes minutely antrorsely scabrous; primary axis angular in TS; longest basal branches 46–80 mm long, lenticular to irregularly angular in TS, with 7–9 regularly biseriate, non-secund spikelets which are 6–11 mm apart (measured from base of pedicels) and mostly not overlapping, but some slightly overlapping toward the apex; basal pedicels (on longest lower panicle branches) 5–8 mm long, decreasing in length toward apex where 1.5–2.5 mm long, *c.* 0.15–0.30 mm wide, lenticular to flattened in TS with angular margins; terminal pedicel 3–6 mm long. *Spikelet* 5.0–6.0 mm long, 2.0–3.0 mm diam., 3–5-flowered (3 or 4 florets fertile, 1 at apex possibly sterile), narrowly elliptic to narrowly ovate or ovate; lowest rachilla internode 0.2–0.3 mm long, *c.* 0.2 mm thick, glabrous; spikelets disarticulating above glumes as a unit, or also above first rachilla at maturity. *Lower glume* 3.5–4.5 mm long, 1.1–1.2 mm wide in face view (natural curvature), 1.0 mm wide in side view, elliptic, apex acute, minutely mucronulate (mucro to 0.25 mm long), minutely erose or minutely 3-lobed (lateral lobes shorter than central mucro, up to *c.* 0.1 mm long), not awned, slightly shorter than the combined florets *in situ*, chartaceous, minutely scabrous all over surface (the projections slightly longer on midnerve and margins), 3-nerved, the midnerve most prominent, thin, slightly raised, lateral nerves scarcely raised; margins entire, glabrous. *Upper glume* inserted 0.2–0.3 mm above lower, 3.8–4.5 mm long, similar to lower glume except apex always 3-lobed (midlobe 0.2–0.4 mm long, thin and often mucronate, lateral lobes shorter to subequal to the midlobe, broader than midlobe and  $\pm$ flattened), slightly shorter and not reaching or slightly exceeding apex of lower glume, shorter than combined florets. *Lowest lemma* 4.4–5.5 mm long including lobes, narrowly ovate to  $\pm$ elliptic (ovate if flattened), 3-lobed, not awned; body 3.0–3.5 mm long, chartaceous-indurated, equally thick throughout (margin not membranous), with a sparse to moderately dense indumentum of colourless, ascending hairs to 0.5 mm long arranged in distinct rows along obscure nerves over basal 3/4–4/5, the nerves 9 in 3 groups of 3 nerves (the central nerve in each group obscure, the laterals very obscure), the main midnerve prominent and weakly keeled; lobes 20–30% of the total lemma length, with nerves  $\pm$ equally spaced, obscure; midlobe 1.0–2.1 mm long, narrowly triangular and acuminate, a little narrower than the laterals especially near base; lateral lobes 0.6–1.4 mm long and less than 1/4 to subequal the midlobe, margins not winged or membranous, similar in texture to body; *callus* 0.05–0.10 mm long, attachment slightly oblique, blunt, obtuse in face view, glabrous or sometimes with a few hairs on lateral margins just above callus on lemma body. *Upper lemmas* each smaller than the one below. *Palea* of basal lemma slightly longer than lemma body, 3.5–4.0 mm long, *c.* 0.9 mm wide, 2-keeled, membranous, not bitextured, narrowly obovate, blunt to erose or notched, glabrous; keels prominent, with a distinct but narrow wing *c.* 0.05–0.10 mm wide, minutely scabrous on wing margin, which runs out just before membranous apex; flaps 0.15–0.30 mm wide, much narrower than body and not overlapping, membranous, entire. *Anthers* 3, 2.0–2.5 mm long. *Styles* 2, *c.* 1.8 mm long. *Caryopsis* 1.8–2.0 mm long, 0.7–0.8 mm wide, L:W ratio 1.8–2.5:1, narrowly elliptic, obtuse at apex, acute at base, terete or slightly dorsiventrally flattened in TS, pale reddish straw-coloured, base of styles slightly thickened; hilum 0.5–0.8 mm long. (Figure 24)

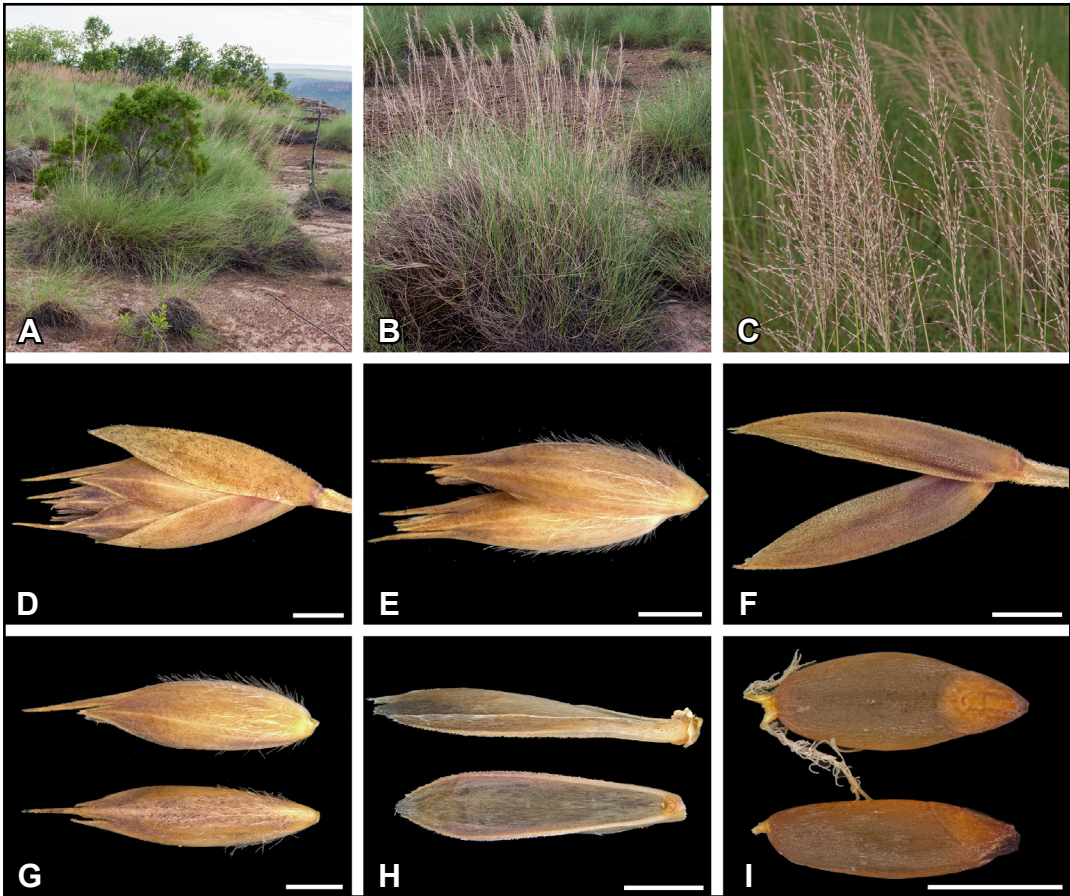


Figure 24. *Triodia celsa*. A – habitat on sandstone mesa summit; B – habit; C – inflorescence; D – spikelet; E – floret; F – glumes; G – side and top view of lemma; H – side and top view of palea; I – side and top view of caryopsis. Scale bars = 1 mm. Images from M.D. Barrett & R.L. Barrett MDB 2952. Photographs by R.L. Barrett (A–C); M.D. Barrett (D–I).

**Diagnostic features.** Distinguished from other *Triodia* species by the following combination of characters: *leaf blades* (3–)17–37 cm long, lacking stomatal grooves on the adaxial marginal *c.* 1/3 ('soft'-type anatomy), non-resinous; *inflorescence* a panicle; longest branches 46–80 mm long; panicle axis and branches densely minutely antrorsely scabrous all over, giving the plant a rough sandpaper texture when stroked against the grain; *spikelets* with 3–5 florets; *callus* blunt, very small, glabrous; *lemma* with hairs distinctly arranged in rows along the nerves, 3-lobed, not awned, midlobes 1.0–2.1 mm long, acute; *palea* membranous, not bitextured, with narrow wings 0.05–0.10 mm wide; *caryopsis* elliptic, terete or slightly dorsiventrally flattened, 1.8–2.0 mm long.

**Other specimens examined.** WESTERN AUSTRALIA: [locality withheld for conservation reasons] 29 Aug. 1974, A.S. George 12786 (PERTH); 30 Mar. 2010, M.D. Barrett & R.L. Barrett MDB 2953 (MEL, PERTH); 30 Mar. 2010, M.D. Barrett & R.L. Barrett MDB 2954 (NSW, PERTH).

**Distribution and habitat.** Known from a single location in Prince Regent National Park. Occurs amongst stones on the flat or gently undulating plateau of a sandstone mesa, in sandy soils and low, open *Acacia* woodland.



*Phenology.* Fertile material has been collected in March and August, but the latter record was during an unusual year in which it rained most months. In most years there is very little or no rainfall between May and September and therefore flowering at that time is uncommon.

*Conservation status.* *Triodia celsa* is to be listed as Priority Two under Department of Parks and Wildlife Conservation Codes for Western Australian Flora (A. Jones pers. comm.). At the single known site it is a dominant understorey plant over several hectares. It has not been found in surrounding basalt lowlands (where habitat is unsuitable) or on nearby sandstone mesas. It has the potential to be impacted by inappropriate fire regimes.

*Etymology.* The epithet is from Latin *celsus* (upraised, high, lofty) and refers to the elevated habitat at the type locality.

*Notes.* The differences between the Pungens and Procera groups of Lazarides *et al.* (2005) are subtle, and *T. celsa* straddles the group definitions in some characters (lemma lobe length, and the distribution of hairs on the callus and lemma). It must therefore be contrasted with species in both groups. *Triodia celsa* is perhaps most similar to taxa in the Pungens group, but can be distinguished by its non-resinous leaves, sheaths and panicles (*vs* strongly resinous, at least on the leaves). It is most similar morphologically to *T. pungens* R.Br. and *T. mitchellii* Benth., differing in being non-resinous (*vs* strongly to moderately resinous) and with a glabrous callus 0.05–0.10 mm long (*vs* 0.2–0.3 mm long and hairy, at least laterally). *Triodia celsa* differs from *T. epactia* S.W.L.Jacobs and *T. marginata* N.T.Burb. in lacking wings on the lateral margins of the outer lemma lobes (*vs* wings present), and from *T. latzii* Lazarides and *T. hubbardii* N.T.Burb. by its 0.05–0.10 mm long, glabrous callus (*vs* 0.3–0.5 mm long and bearded laterally). *Triodia celsa* differs from *T. longiloba* Lazarides in having paniculate inflorescences (*vs* racemose or sub-racemose) and lemma (mid)lobes that are 1.0–1.9 mm long (*vs* 2.5–5.5 mm long).

*Triodia celsa* differs from *T. procera* R.Br. (which can be non-resinous like *T. celsa*) in having lemmas hairy on the body (*vs* glabrous) and with longer (mid)lobes (1.0–1.9 mm long *vs* to 0.7 mm long), and a Kimberley distribution (*vs* north-east Northern Territory and Queensland). *Triodia celsa* differs from most members of the Procera group (other than *T. procera*, i.e. *T. biflora*, *T. burbridgeana* S.W.L.Jacobs, *T. microstachya* R.Br. and *T. radonensis* S.W.L.Jacobs) in having non-resinous foliage (*vs* resinous), and hairy lemmas with (mid)lobes 1.0–1.9 mm long mm long (*vs* glabrous and to 1 mm long). *Triodia celsa* differs from *T. cunninghamii* Benth. in having a lemma body with sparse to moderately dense hairs arranged in distinct rows along obscure nerves (*vs* densely and extensively hairy) and lemma lobes that are mostly distinctly unequal (*vs* lobes more or less equal). *Triodia celsa* differs from *T. stenostachya* Domin in having lemma lobes that are acute to acuminate but lacking a distinct bristle-like arista (*vs* central lobe with a distinct bristle-like arista).

*A.S. George* 12786 was previously identified by M. Lazarides as *T. aff. plectrachnoides* N.T.Burb. *Triodia celsa* superficially resembles *T. plectrachnoides* in the non-resinous foliage, long leaf blades and similar lemma lobe length, but the leaf anatomical type is ‘hard’ in *T. plectrachnoides*. The work of Mant (1998), Mant *et al.* (2000) and Toon *et al.* (2015) demonstrates that leaf anatomy is more phylogenetically informative than lemma lobing. The similarity to *T. plectrachnoides* is therefore superficial, and closest relatives should be sought amongs the ‘soft’ species of *Triodia*.

In Lazarides *et al.* (2005), *T. celsa* would key to *T. roscida* N.T.Burb. in Group 4 (assuming the longest pedicels are allowed to be as small as 5–8 mm long at step 9 in the group key, but clearly not matching

the alternative, up to 3 mm long and uniform in size), from which it is immediately distinguished by having long leaves with ‘soft’ type anatomy (*vs* blades to 15 cm long and ‘hard’ type), and lemma hairs that are relatively sparse and grouped in lines along the nerves (*vs* hirsute over most of the lemma body). Note that the report of hairs only on the midline and near the base of the lemma in *T. roscida* in Lazarides *et al.* (2005) refers to a different, undescribed taxon; *T. roscida s. str.* has hairs more or less uniformly distributed over most of the lemma body (Burbidge 1953).

With the addition of unreported variation (including new taxa) from the north-west of Australia, the keys presented in Lazarides (1997) and Lazarides *et al.* (2005), and also Simon and Alfonso (2011–) no longer allow adequate discrimination between many *Triodia* taxa and also the groups of Lazarides *et al.* (2005). Descriptions of further taxa and a revised key are in preparation by one of us (MDB).

The vernacular name Mount Trafalgar Spinifex is suggested.

***Triodia diantha*** M.D.Barrett, *sp. nov.*

*Type:* Phillips Range, Marion Downs Station, Western Australia, 28 March 2010, *G. Armstrong s.n.* (*holo:* PERTH 08615098).

Hummock or tussock-forming *perennial*, resinous, stolons very short and not protruding from tussock; *tussocks* loose, *c.* 1 m high; *flowering culms c.* 1.0–1.5 m high. *Culm internodes* (basal-most nodes not seen) wiry, elongated, 4–9 cm long, red-brown, glabrous. *Leaf sheaths* 2–5 mm wide near apex, glabrous on surface, resinous, straw-coloured, with the nerves  $\pm$ equally spaced; margins glabrous except at orifice; margins of orifice not auriculate, with hairs 1.5–3.0 mm long. *Ligule* with a very short membranous part below a dense fringe of hairs 0.6–0.9 mm long; *pseudopetiole* distinct or not, when distinct 1–4 mm long. *Leaf blades* flat in TS when fresh and maximally expanded, conduplicate and tightly in-rolled when dry, 9–22 cm long, 0.9–1.7 mm wide when flattened, flexible, glabrous, weakly pungent (long-attenuate) for 1.0–1.5 mm, weakly to moderately resinous, green; stomatal grooves on abaxial surface restricted to central region, 4, in 2 close pairs either side of a broader smooth midrib, stomatal grooves absent on lateral surfaces, but may be very finely and obscurely longitudinally grooved; margins sparsely scabrid with trichomes 0.05–0.15 mm long. *Panicle* 9–11 cm long, 1–5 cm wide, linear to ovate when branches spread, loose; branchlets in 3s in basal part, not becoming racemose at apex; axes minutely scabrous (prickle hairs *c.* 0.5 mm long), not resinous; primary axis angular to slightly flattened; longest basal panicle branches 30–50 mm long, the axes terete, angular or in places flattened, with 5–7 loosely arranged spikelets which are 6–13 mm apart (measured between panicle branch nodes) and not overlapping; basal pedicels (on longest lower panicle branches) 4–13 mm long, significantly decreasing in length along branch toward apex (where 0.6–3.0 mm long); terminal pedicel 6–8 mm long; all pedicels  $\pm$ filiform, *c.* 0.1–0.2 mm diam., terete to angular or slightly flattened just below spikelet, with thin scabrous projections *c.* 0.05–0.10 mm long, the longest near pedicel apex. *Spikelet* 3.0–5.0 mm long, 1.7–2.4 mm diam., uniformly 3-flowered but appearing 2-flowered (the lower 2 florets fertile and well-developed, with an additional minute, long-stalked vestigial sterile floret only visible upon dissection), narrowly to moderately ovate; lowest rachilla internode 0.2–0.3 mm long, *c.* 0.2 mm thick; second rachilla internode 1.5 mm long, much longer than first and filiform (*c.* 0.02 mm diam.), bearing the vestigial floret; spikelets disarticulating above rachilla internodes at maturity. *Lower glume* 2.7–3.0 mm long, 1.6–2.5 mm wide when flattened (*c.* 1.0 mm wide unflattened), broadly ovate, obtuse to acute, not apiculate or shortly so, not awned, shorter than to shortly exceeding upper lemma body but not reaching apex of lemma lobes, moderately indurated, glabrous, 3-nerved, the midnerve moderately raised, lateral nerves not raised; margins inconspicuously minutely fimbriate. *Upper glume* inserted 0.3 mm above lower, 2.7–3.3 mm long, similar to lower

but apex obtuse, more frequently and more abruptly apiculate (when present the apiculus to 0.25 mm long), not quite or shortly exceeding lemma body but not reaching apex of lemma lobes. *Lowest lemma* 3.1–4.4 mm long including lobes, elliptic to narrowly elliptic in face view, 3-lobed but not awned; body 2.6–3.1 mm long, mostly indurated, not obviously bitextured but with a subtle change in texture and colour just below the lobe sinus, with appressed hairs to 0.5 mm long especially in the lower *c.* 2/3 in a broad zone around the midline, obscurely 3-nerved (most distinctly visible from below), lateral margins near lobes not winged; lobes narrowly triangular, acute, ±chartaceous, obscurely 3-nerved; midlobe 1.3–1.4 mm long; lateral lobes 0.8–1.0 mm long, slightly broader than the midlobe; *callus* 0.1–0.2 mm long, a small knob or rounded thickening, attachment shallowly oblique, blunt, with a thin continuous band of hairs 0.6–0.7 mm long (bare midline absent). *Second lemma* slightly shorter than lowest one. *Third lemma* vestigial, knob-like, *c.* 0.45 mm long, falling attached to rachis with second palea and hidden by it. *Palea* of basal lemma longer than lemma body, reaching *c.* 1/2 way along the lemma lobes, 3.3–3.7 mm long, *c.* 0.9 mm wide with flaps folded underneath, 2-keeled, ±chartaceous becoming membranous-translucent near base, lanceolate, acute, entire, minutely hairy in upper 1/2 on abaxial surface and minutely hairy only at apex on adaxial surface; keels prominent, thickened and raised but not winged, *c.* 0.05 mm wide, scabrous in upper 2/3; flaps 0.1–0.3 mm wide (broadest near base), *c.* 1/4 body width and not overlapping, membranous, entire. *Anthers* 3, 1.8–1.9 mm long. *Styles* 2, *c.* 1.5 mm long. *Caryopsis* not seen. (Figure 25)

*Diagnostic features.* Distinguished from other *Triodia* species by the following combination of characters: *culms* with upper nodes elongated, red-brown; *leaves* lacking stomatal grooves on the adaxial outer margins ('soft'-type anatomy), resinous, flexible; *pedicels* unequal, markedly decreasing in size along panicle branches; *florets* apparently 2 per spikelet, subequal (resembling the 2 equal florets of *Eriachne* R.Br.), with a vestigial, long-stalked third spikelet; *lemma* body appressed-hairy, lacking a sharp transverse line of change in texture, 3-lobed, the lobes acute, erect, subequal, with laterals slightly shorter than midlobe; *callus* hairy.

*Other specimens examined.* Known only from the type collection.

*Distribution and habitat.* Known only from the Phillips Range in the west Kimberley, where it grows on the steep slope of a sandstone escarpment. Associated vegetation is unknown.

*Phenology.* The only known specimen was in flower in late March.

*Conservation status.* *Triodia diantha* is to be listed as Priority One under Department of Parks and Wildlife Conservation Codes for Western Australian Flora (A. Jones pers. comm.).

*Etymology.* The epithet is from the Greek *di-* (two-) and *anthos* (flower), and refers to the two fertile florets per spikelet.

*Notes.* The spikelet composition of this species, with two fertile florets and a long-stalked vestigial one, is uniform on all flowers of the type specimen, regardless of degree of maturation. The spikelet condition is not an aberration due to drought conditions, since the anthers of many flowers are becoming exposed, while in other flowers the styles are fully expanded; in addition the terminal rachilla internode is fully expanded. Drought conditions in other *Triodia* species have been observed to truncate development, preventing anthers and styles from being exerted, aborting the terminal florets (as fully-formed but miniature version of the lower floret, not as vestigial knobs) and have never been observed causing abnormal rachilla elongation (instead drought appears to limit the development of

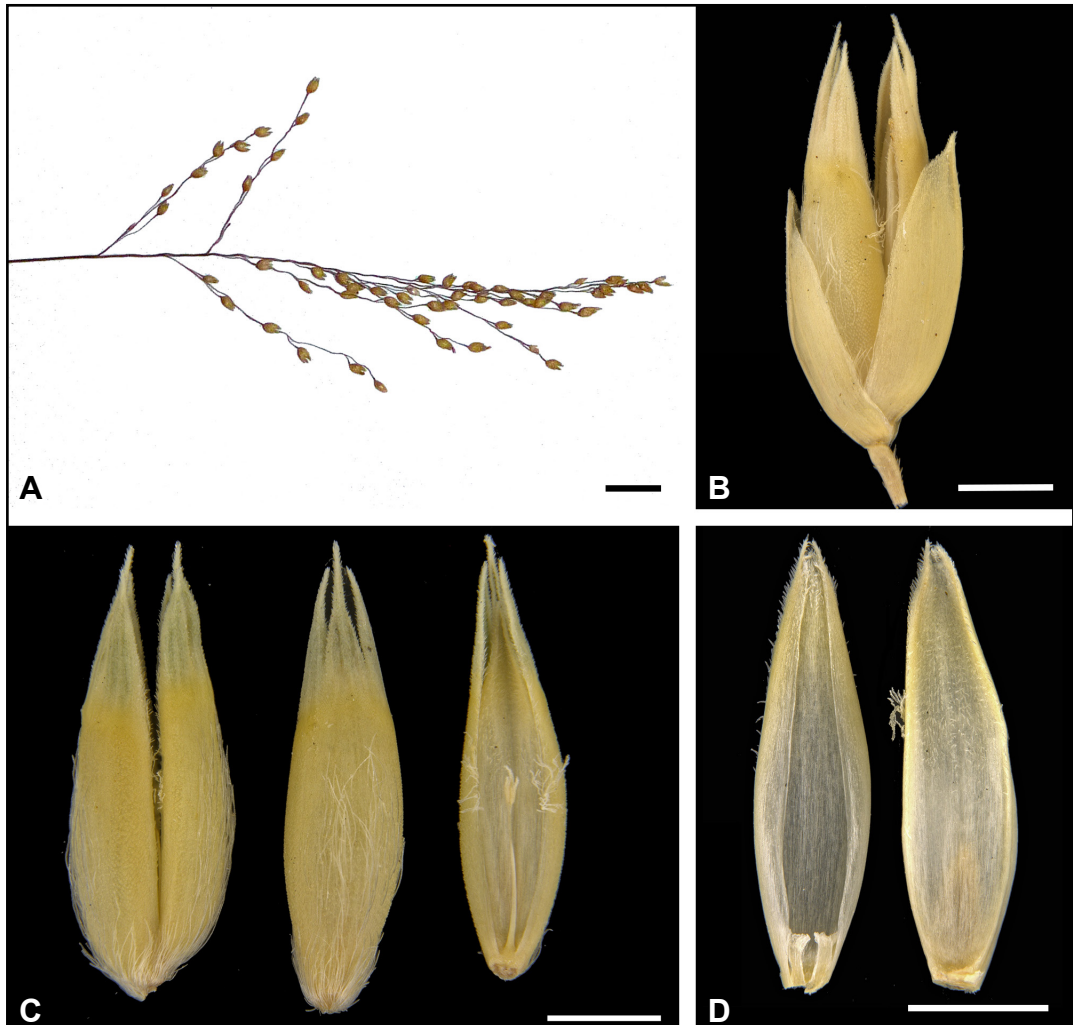


Figure 25. *Triodia diantha*. A – inflorescence; B – spikelet; C – floret (L), outer surface of lemma (Centre) and inner surface of second floret, showing vestigial third floret on a long rachillas (R); D – palea inner (L) and outer (R) surfaces. Scale bars = 1 cm (A); 1 mm (B–D). Images from the holotype G. Armstrong s.n. Photographs by M.D. Barrett.

the rachillas). Although *T. diantha* is currently only known from a single collection, the plant condition and uniformity satisfy us that it is a species distinct from all other species of *Triodia*, and not merely an abnormality. The specimen came from a population of uniform-looking plants, and so was not a single aberration (G. Armstrong pers. comm.).

*Triodia diantha* is superficially similar to *T. pungens* and *T. epactia*, sharing ‘soft’ type leaf anatomy, resinous foliage, distinctly lobed but non-awned lemmas, and hairy lemma surfaces. It differs in having two fertile florets and a single, long-stalked vestigial floret (vs variably 3–9(–17) fertile florets, never having an elongated terminal rachilla internode, and terminal florets not reduced to a minute knob), distinctly elongated, wiry culms (vs not obviously elongated), and usually smaller floral dimensions.

*Triodia diantha* is also similar, especially in habit, to *T. claytonii*, but differs in lacking lemma awns and in having two fertile florets (vs one fertile floret), resinous foliage (vs usually, but not always, non-resinous), and only a subtle change in lemma texture (vs a strong sharp line at the base of the

lemma lobes marking the change of texture). It is superficially similar to *T. cunninghamii*, differing in having less-hairy lemmas, smaller inflorescence and floral dimensions, and two fertile florets and a single, long-stalked vestigial floret (*vs* three florets, the apical-most one smaller but not vestigial). *Triodia diantha* is also superficially similar to *T. stenostachya*, but differs in having subequal lemma lobes (*vs* the lateral lobes distinctly shorter than the central lobe), a narrowly triangular lemma midlobe with an acute apex (*vs* bristle-like) and two fertile florets plus a single, long-stalked vestigial one (*vs* three florets, the apical-most one smaller but not vestigial).

*Triodia diantha* has a spikelet reminiscent of the Pilbara endemic *T. biflora*, but differs from this species in having hairy lemmas and calli (*vs* glabrous) and distinct lemma lobes (*vs* entire or with minute lobes). *Triodia diantha* differs from *T. celsa* in having resinous foliage (*vs* non-resinous), a hairy callus (*vs* glabrous) and two fertile florets plus a single, long-stalked vestigial one (*vs* 3–5 florets with the apical-most one smaller but not vestigial in *T. celsa*).

The vernacular name Phillips Range Spinifex is suggested.

## Violaceae

### **Hybanthus bennettiae** R.L.Barrett, *sp. nov.*

*Type*: east of Prince Regent Nature Reserve [National Park], Western Australia [precise locality withheld for conservation reasons], 16 January 2010, R.L. Barrett, M.D. Barrett & M. Maier RLB 6109 (*holo*: PERTH 08614601; *iso*: CANB, DNA).

Compact *annual* herb, 5–10 cm high, many-stemmed (to 57 stems recorded per plant); *stems* unbranched, finely ribbed, not forming corky bark at base, green to reddish purple, decumbent, with scattered, short, scabrid hairs. *Stipules* linear to narrowly lanceolate, 1.1–2.2 mm long. *Leaves* alternate, widely spaced, sessile or with a petiole to 1.5 mm, narrowly ovate to ovate, sparsely serrate to dentate with 1–6 teeth, or often entire, 6–17 mm long, 1.5–6.0 mm wide, minutely densely papillate, shortly scabrid on margins, dark green. *Flowers* solitary; peduncle 2.5–5.5 mm long; pedicel recurved, 0.4–1.0 mm long, subtended by 2 bracts *c.* 0.6 mm long. *Sepals* narrowly triangular to narrowly ovate, acute, keeled, 1.9–2.6 mm long, with a few scattered hairs along keel and margins otherwise glabrous. *Petals* imbricate, orange; anterior petal spatulate, 5–7 mm long, with a short, blunt spur; 2 outer lateral petals narrowly oblong, *c.* 1.7 mm long; 2 inner lateral petals curved, lanceolate-falcate, 2.0–2.7 mm long. *Stamens* free; filaments dimorphic,  $\pm$ equal in length, *c.* 0.4 mm long, 2 anterior bearing sessile, sparsely hairy nectaries; *anthers* 0.6–0.8 mm long, oblong-elliptic, with a broad, imbricate, terminal, connective appendage. *Capsule* globular, 3.5–5.0 mm long. *Seeds* *c.* 6 per capsule, 1.7–1.8 mm long, 0.9–1.0 mm diam., with longitudinal rows of minute pits, yellowish white. (Figure 26)

*Diagnostic characters*. Distinguished from *H. aurantiacus* (F.Muell. ex Benth.) F.Muell. by the following combination of characters: *annual* herb with decumbent branches; *stipules* short, 1.1–2.2 mm long; *leaves* densely papillate with few marginal teeth or entire; *flowers* small with anterior petal 5–7 mm long; *seeds* *c.* 6 per capsule, 1.7–1.8 mm long, 0.9–1.0 mm diam., with longitudinal rows of minute pits.

*Other specimens examined*. Known only from the type collection.

*Phenology*. Flowering and fruiting recorded in January and March; probably occurring from December to April.



Figure 26. *Hybanthus bennettiae*. A – habitat on thin sheet of sand on sandstone pavement; B – prostrate habit; C – stipules; D – ascending branchlet apex with flower and fruit (below). Images from R.L. Barrett, M.D. Barrett & M. Maier RLB 6109 (A, B) and Prince Regent National Park (C, D). Photographs by R.L. Barrett.

**Distribution and habitat.** Known to occur in the vicinity of Prince Regent National Park in the Kimberley region. Grows on sandstone pavements in herbfields and among sandstone boulders.

**Conservation status.** *Hybanthus bennettiae* is to be listed as Priority Two under Department of Parks and Wildlife Conservation Codes for Western Australian Flora (A. Jones pers. comm.). It has been observed within Prince Regent National Park and collected just outside its boundary.

**Etymology.** The epithet acknowledges the work of Eleanor M. Bennett in revising the genus *Hybanthus* Jacq. in Australia (Bennett 1972) and for producing the first guide to the plants of Kings Park (Bennett & Dundas 1988).

**Notes.** *Hybanthus bennettiae* is most closely related to *H. aurantiacus*, differing in its many-stemmed,

decumbent habit (*vs* 1- or few-stemmed and erect), short stipules (*vs* very long) and densely papillate leaves with few (or no) marginal teeth (*vs* usually glabrous with many marginal teeth). Wahlert *et al.* (2014) recently recommended that the *H. enneaspermus* L. clade, to which *H. bennettiae* belongs, should be recognised as a distinct genus that is yet to be named, so a change in generic name can be anticipated in the near future. A considerable amount of variation was included in a broad concept of *H. aurantiacus* by Bennett (1972) and a detailed revision of this species complex is to be encouraged.

The vernacular name Bennett's Violet is suggested.

## Zygophyllaceae

### **Tribulopsis marliesiae** R.L.Barrett, *sp. nov.*

*Type*: [north-east of Broome,] Western Australia [precise locality withheld for conservation reasons], 25 November 2013, R.L. Barrett & C. Bennison RLB 8305 (*holo*: PERTH 08614504).

?*Tribulus angustifolius* var. *clementii* Domin, *Biblioth. Bot.* 89: 281 (1926). *Type*: Ashburton and Yule rivers, Western Australia, *s. dat.*, *E. Clement s.n.* (probable *holo*: PR *n.v.*; *iso*: K 725229 image seen).

Slender *herb* with perennial rootstock bearing corky bark, to 40 cm high and 80 cm across. *Stems* erect to spreading at length, 15–45 cm long, sub-glabrous (with just a few minute, scattered, appressed hairs on stems visible at 25×, the hairs more crowded and somewhat erect at base of stem). *Leaves* with (1)2 or 3(4) pairs of leaflets, the lowest pair inserted well-above leaf base; *axis* 26–45 mm long; *leaflets* spreading, filiform to linear, terete to slightly compressed with a subtle groove above when fresh, appearing flat when pressed, 12–36 mm long, 0.4–1.0 mm wide, acute, very sparsely appressed-hairy adaxially and abaxially. *Pedicels* 33–62 mm long and erect in flower, 35–65 mm long and deflexed in fruit. *Sepals* 4.9–6.1 mm long, lanceolate, with scattered appressed hairs to 0.2 mm long adaxially and scattered spreading hairs to 0.5 mm long on margins. *Petals* obovate, obtuse to emarginate, 7.9–11.5 mm long, yellow throughout. *Extrastaminal glands* 5; *intrastaminal glands* lacking. *Stamens* 10, 5 usually shorter, all fertile, at maturity equal to stigma; *filaments* 2.1–3.8 mm long; *anthers* compressed-ovoid, *c.* 0.5 mm long. *Ovary* 5-lobed, with moderately dense to dense, white, appressed hairs. *Style* (including stigma) 3.7–3.9 mm long. *Fruit* appressed-pubescent, comprising usually 5 tardily dissociating, fully developed cocci which are *c.* 7 mm high, smooth, and unarmed. (Figure 27)

*Diagnostic characters.* Distinguished from *T. angustifolia* R.Br. by the following combination of characters: erect *perennial* herb with branches decumbent at length; *stem* with corky bark at base when old; *indumentum* very sparse, appressed; *leaves* usually with 2 or 3 pairs of filiform, linear leaflets that are subtly grooved above; *flowering pedicels* 33–62 mm long.

*Other specimens examined.* WESTERN AUSTRALIA: [localities withheld for conservation reasons] 27 Nov. 2013, R.L. Barrett & C. Bennison RLB 8325 (PERTH); 28 Nov. 2013, R.L. Barrett & C. Bennison RLB 8338 (PERTH); 14 Nov. 1999, Duero [D. Dureau], [T.] Handasyde, McCartney & [T.] Willing WESD2-37a (PERTH); 14 Nov. 1999, Duero [D. Dureau], [T.] Handasyde, McCartney & [T.] Willing WESD2-37b (PERTH); 1 Oct. 2004, G. Byrne 1279 (PERTH); 24 Aug. 2001, C.P. Campbell 3563 (PERTH).

*Phenology.* Flowering and fruiting recorded from August to November.

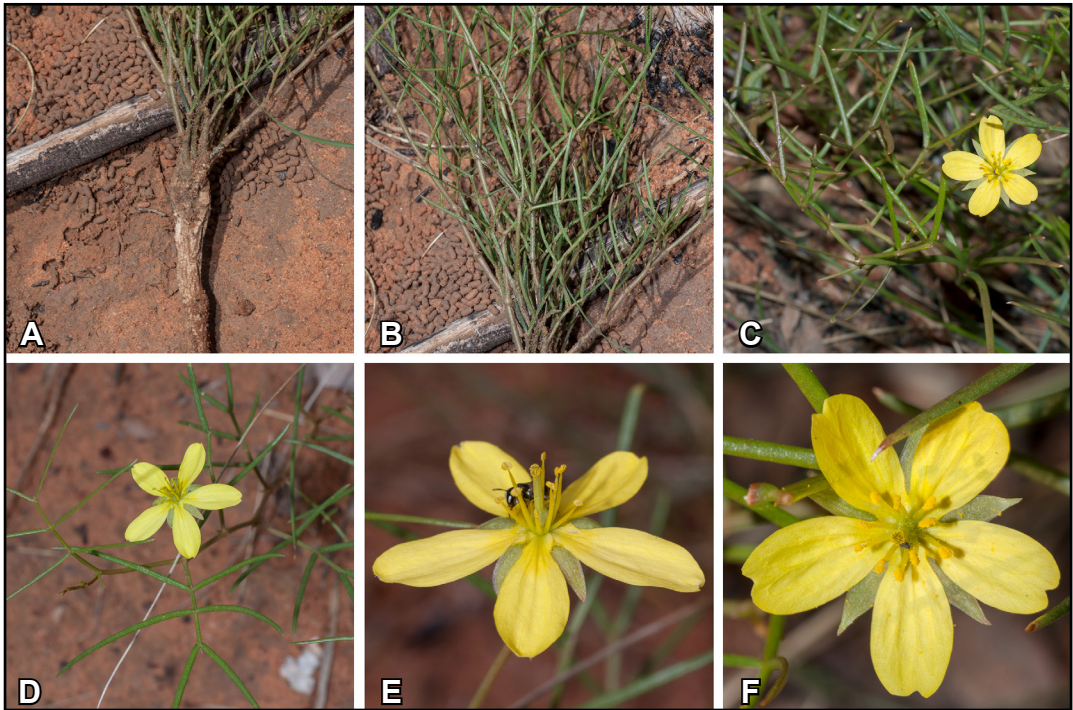


Figure 27. *Tribulopsis marliesiae*. A – corky, perennial stem base; B – erect branchlets with pinnate leaves; C, D – flowering branchlet with filiform leaflets; E – lateral view of flower; F – top view of flower. Images from R.L. Barrett & C. Bennison RLB 8305. Photographs by R.L. Barrett.

*Distribution and habitat.* Occurs from Pardoo Roadhouse north to Roebuck Plains Station in the Dampier Botanical District and inland to the northern Great Sandy Desert. Restricted to red sands in heath and low pindan, particularly with *Acacia tumida*. This species often co-occurs with *Tribulopsis angustifolia* R.Br.

*Conservation status.* *Tribulopsis marliesiae* is to be listed as Priority Three under Department of Parks and Wildlife Conservation Codes for Western Australian Flora (A. Jones pers. comm.). It is known only from five widely disjunct locations, but probably occurs in intervening locations as well.

*Etymology.* The epithet honours the late Marie-Luise (Marlies) Eichler (dec. 2010), for her support of her husband Hansjörg Eichler (1916–1992) who studied Zygophyllaceae (Eichler 1981, 1984; Barker 1996, 2013) and her generous support of the Australasian Systematic Botany Society.

*Notes.* The few collections made of this species were either not identified to species, or had been assigned to *T. angustifolia*. Field observations of *T. marliesiae* by one of us (RLB) found that it grew intermixed with *T. angustifolia* but with no morphological intermediates. *Tribulopsis angustifolia* differs in being a prostrate or decumbent annual (*vs* erect perennial with a corky barked stem) with flat leaflets (0.5–)0.8–1.5(–3.5) mm wide (*vs* terete to compressed, 0.4–1.0 mm wide).

As a perennial, *T. marliesiae* has the ability to flower quickly following rain, allowing collection of fertile material at the onset of the wet season. Flowering probably continues through the wet season when access to habitats is more difficult.



The type of *Tribulus angustifolius* var. *clementii* Domin appears to match this taxon, but only an image of the sheet at Kew has been examined and no modern collections are known from the Yule or Ashburton Rivers; further studies are recommended.

The vernacular name Eichler's Tribulopsis is suggested.

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