Nuytsia

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Department of Biodiversity, Conservation and Attractions

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DEPARTMENT OF BIODIVERSITY, CONSERVATION AND ATTRACTIONS
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Nutysia

Nuytsia is an open access, peer-reviewed journal that publishes original research on the systematics, taxonomy and nomenclature of Australian (particularly Western Australian) plants, algae and fungi.

Descriptions of taxa, revisions, identification guides, nomenclatural and taxonomic issues, systematic analyses and classifications, censuses, and information on invasive species are all considered.

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Department of **Biodiversity, Conservation and Attractions**

CONTENTS

Nuytsia
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Updates to Western Australia's vascular plant census for 2020

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SHORT COMMUNICATION

The census database at the Western Australian Herbarium (PERTH), which provides the nomenclature for the website *FloraBase* (Western Australian Herbarium 1998–), lists current names and recent synonymy for Western Australia's native and naturalised vascular plants, as well as algae, bryophytes, lichens, slime moulds and some fungi. The names represented in the census are either sourced from published research or denote as yet unpublished names based on herbarium voucher specimens. We herein summarise the changes made to vascular plant names in this database during 2020.

Fifty-eight taxa were newly recorded for the State, of which nine are naturalised and 18 have been added to the *Threatened and Priority Flora list for Western Australia* (Smith & Jones 2018; Western Australian Herbarium 1998–) (Table 1). A total of 322 name changes were made, including the formal publication of 55 phrase-named taxa, and 4 manuscript names were changed to phrase names under Council of Heads of Australasian Herbaria (CHAH) guidelines for informal names (Barker 2005) (Table 2). Plant groups for which a number of name changes were made include *Boronia* Sm. (Duretto *et al.* 2020), *Eragrostis* Wolf (Barrett *et al.* 2020a), *Eucalyptus* L'Her. (French 2012; French & Nicolle 2019, Nicolle & French 2019) and *Oldenlandia* L. (Gibbons 2020). Numerous changes occurred in a revision of *Styphelia* Sm. to include all species within the *Styphelia–Astroloma* clade (Crayn *et al.* 2020); and a recircumscription of *Goodenia* Sm. resulted in four allied genera being subsumed in this genus (Shepherd *et al.* 2020). An article by Alex George which detailed names requiring orthographic corrections also resulted in several changes to the WA plant census (George 2019). Additionally, this year saw *Nuytsia*, the journal of the Western Australian Herbarium, celebrate its 50-year anniversary with a significant special edition involving the publication of 50 new Western Australian species from 50 different genera. Table 2 also includes cases where there has been a change of taxonomic concept, misapplication, exclusion or rank change.

https://florabase.dpaw.wa.gov.au/nuytsia/
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Table 1. New records added to Western Australia's vascular plant census during 2020. *in litt.* = in correspondence; *in sched.* = on herbarium sheet/label; pers. comm. = personal communication; * = naturalised; T, P1–P4 = Department of Biodiversity, Conservation and Attractions Conservation Codes for Western Australian flora (Smith & Jones 2018; Western Australian Herbarium 1998–).

New Name	Status	Comments
Acacia ammobia Maconochie		New record for WA. B.R. Maslin *in litt.* (03/07/2020).
Acacia vestita Ker Gawl.	*	New naturalised record for WA. G.J. Keighery *in litt.* (05/08/2020).
Althenia tzvelevii T.Macfarlane & D.D.Sokoloff		See Macfarlane *et al.* (2020c).
Anthelepis undulata (Thwaites) R.L.Barrett, K.L.Wilson & J.J.Bruhl		See Barrett *et al.* (2019).
Atriplex stipitata Benth. subsp. *stipitata*		See Walsh & Sluiter (2020).
Atriplex stipitata subsp. *miscella* N.G.Walsh & Sluiter		See Walsh & Sluiter (2020).
Austrostipa sp. Deception Hill (J. Warden & E. Ager LCH 31691)		A. Williams *in litt.* (24/02/2020).
Bauhinia purpurea L.	*	New naturalised record for WA. G.J. Keighery *in litt.* (24/01/2020).
Bossiaea sp. Mt Frankland (L. Graham 2174)	P2	G.J. Keighery *in litt.* (15/06/2020).
Calandrinia sp. Torndirrup (S.D. Hopper et al. SDH 8712)	P2	F. Obbens *in litt.* (19/12/2019).
Carica papaya L.	*	New naturalised record for WA. G.J. Keighery *in litt.* (15/01/2020).
Chamelaucium floriferum N.G.Marchant		See Marchant (2019).
Chamelaucium floriferum N.G.Marchant subsp. *floriferum*	P2	See Marchant (2019).
Cyperus platystylis R.Br.		New record for WA. M. Lyons *in litt.* (03/07/2020).
Deyeuxia abscondita T.Macfarlane	P1	See Macfarlane (2020).
Dissocarpus biflorus (R.Br.) F.Muell.		New record for WA. M. Hislop *in sched.* (15/07/2020).
Dissocarpus biflorus (R.Br.) F.Muell. var. *biflorus*		New record for WA. M. Hislop *in sched.* (15/07/2020).
Eremophila sp. Lake Carey (E. Mattiske LM 197)	P1	M. Hislop *in litt.* (16/12/2020).
Eucalyptus redunca Schauer subsp. *redunca*		See Nicolle & French (2019).
Galactia tenuiflora var. *macrantha* Domin		New record for WA. A.E. Holland *in sched.* (23/01/2020).
Gomphrena sp. Cambridge Gulf (K.F. Kenneally 11899 K)	P2	R. Davis *in litt.* (24/01/2020).
Goodenia sp. Midwest (K.A. Shepherd & C.F. Wilkins KS 1609)		K.A. Shepherd *in litt.* (07/05/2020).

New Name	Status	Comments
Hedera hibernica (G.Kirchn.) Bean	*	New naturalised record for WA. M. Hislop *in sched.* (13/10/2020).
Hibbertia asterella K.R.Thiele		See Thiele (2019a).
Hibbertia capensis K.R.Thiele		See Thiele (2019a).
Hibbertia proberae K.R.Thiele	P2	See Thiele (2020).
Hibbertia prolata K.R.Thiele		See Thiele (2019a).
Hibbertia subglabra K.R.Thiele	P3	See Thiele (2019a).
Hibbertia tuberculata K.R.Thiele	P1	See Thiele (2019b).
Hibbertia sp. Mt Holland (B. Ellery BE 1437)	P1	K.R. Thiele *in litt.* (03/01/2020).
Hypolepis rugosula (Labill.) J.Sm. subsp. *rugosula*	*	New naturalised record for WA. See Field (2020).
Isopogon sphaerocephalus subsp. *lesueurensis* Rye		See Rye & Macfarlane (2019).
Mimosa diplotricha C.Wright	*	New naturalised record for WA. G.J. Keighery *in litt.* (07/06/2020).
Mimosa diplotricha C.Wright var. *diplotricha*	*	New naturalised record for WA. G.J. Keighery *in litt.* (07/06/2020).
Moraea fugax (D.Delaroche) Jacq. subsp. *fugax*	*	New naturalised record for WA. T.D. Macfarlane pers. comm.
Myosotis australis R.Br. subsp. *australis*	P4	New record for WA. See Meudt *et al.* (2020).
Nymphaea carpentariae S.W.L.Jacobs & Hellq.	P1	New record for WA. M.D. Barrett *in litt.* (15/08/2019).
Potamogeton × *salicifolius* Wolfg.		New record for WA. See Kaplan *et al.* (2019).
Pterostylis crispula (D.L.Jones & C.J.French) D.L.Jones & C.J.French		See Jones & French (2019).
Pterostylis gracillima (D.L.Jones & C.J.French) D.L.Jones & C.J.French		See Jones & French (2019).
Pterostylis grossa (D.L.Jones & C.J.French) D.L.Jones & C.J.French		See Jones & French (2019).
Pterostylis polyphylla (D.L.Jones & C.J.French) D.L.Jones & C.J.French	P2	See Jones & French (2019).
Pterostylis saxum (D.L.Jones & C.J.French) D.L.Jones & C.J.French	P2	See Jones & French (2019).
Pterostylis scabrella (D.L.Jones & C.J.French) D.L.Jones & C.J.French		See Jones & French (2019).
Pterostylis tylosa (D.L.Jones & C.J.French) D.L.Jones & C.J.French	P2	See Jones & French (2019).
Pterostylis sp. Murchison (C.J. French CJF 12549)		C. French & G. Brockman *in litt.* (05/12/2018).
Ptilotus sp. Cue (P. Armstrong PA 16/362)	P1	T. Hammer *in litt.* (03/07/2020).

New Name	Status	Comments
Ptilotus sp. Kalgoorlie (J. Jackson & B. Moyle 260)	P1	T. Hammer *in litt.* (03/07/2020).
Ptilotus sp. Kookynie (J. Jackson & B. Moyle 261)	P1	T. Hammer *in litt.* (03/07/2020).
Rhodanthe sp. Yuna (G.J. Keighery, B.J. Keighery & B. Moyle 2820)	P3	G.J. Keighery *in litt.* (04/02/2020).
Rytidosperma robertsoniae Tiver		See Tiver (2020).
Sicyos australis Endl.		New record for WA. R. Davis *in litt.* (22/11/2019).
Streptoglossa sp. Cracking clays (S. van Leeuwen et al. PBS 7353)		S.J. Dillon *in litt.* (17/06/2020).
Swainsona sp. Brooking Gorge (A. Markey & K. Brown FV 11506)		A. Markey *in litt.* (12/02/2020).
Swainsona sp. Burnerbinmah (D. Edinger et al. 38)	P1	R. Davis *in litt.* (10/03/2020).
Tecoma capensis (Thunb.) Lindl.	*	New naturalised record for WA. G.J. Keighery *in litt.* (15/01/2020).
Typhonium sp. Middle Creek (M.D. Barrett MDB 3246)	P1	M.D. Barrett *in litt.* (04/09/2020).
Utricularia sp. Kununurra (C. Glover 81)	P2	M.D. Barrett *in litt.* (08/09/2020).

Table 2. Changes to existing entries in Western Australia's vascular plant census during 2020. Excluded taxon = a name used in the botanical literature that refers to a taxon never occurring in WA; misapplied name = a name used in the botanical literature but now considered to refer to one or more different WA taxa; nomenclatural synonym = a superseded name based on the same type specimen as the accepted name; taxonomic synonym = a superseded name based on a different type specimen to the accepted name; orthographic variant = mis-spelling of a name in original publication; *in litt.* = in correspondence; *in sched.* = on herbarium sheet/label. Status: * = naturalised; X, T, P1–P4 = Department of Biodiversity, Conservation and Attractions Conservation Codes for Western Australian flora (Smith & Jones 2018; Western Australian Herbarium 1998–).

Old Name	New Name	Status	Comments
Abutilon indicum (L.) Sweet	n/a		Excluded taxon. This taxon does not occur in WA. See Nimbalkar *et al.* (2019).
Abutilon indicum var. *australiense* Britten	*Abutilon australiense* (Britten) Nimbalkar, Nandikar & Sardesai		Nomenclatural synonym. See Nimbalkar *et al.* (2019).
Acacia saligna subsp. *lindleyi* (Meisn.) M.W.McDonald & Maslin ms	*Acacia saligna* subsp. Wheatbelt (B.R. Maslin 8602)		Name synonymised. To align with CHAH (2005) phrase name protocols.
Acacia saligna subsp. *pruinescens* M.W.McDonald & Maslin ms	*Acacia saligna* subsp. Tweed River (B.R. Maslin 8596)		Name synonymised. To align with CHAH (2005) phrase name protocols.
Acacia saligna subsp. *stolonifera* M.W.McDonald & Maslin ms	*Acacia saligna* subsp. Southern forest (B.R. Maslin & J.E. Reid BRM 9952)		Name synonymised. To align with CHAH (2005) phrase name protocols.

Old Name	New Name	Status	Comments
Acacia sp. F Kimberley Flora (J.J. Alford 557)	*Acacia phacelia* Maslin, M.D.Barrett & R.L.Barrett	P3	Name synonymised. B.R. Maslin *in sched.* (03/12/2013).
Acacia sp. Mt Holland (B. Ellery BE 1147)	*Acacia lachnocarpa* R.W.Davis & Hislop	P1	Taxon formally published. See Davis & Hislop (2020).
Alternanthera longipes (Moq.) Benth.	n/a		Error. A name of uncertain application. See CHAH (2014).
Amyema sp. Fortescue (M.E. Trudgen 5358)	*Amyema xiphophylla* Wege & Start		Taxon formally published. See Wege & Start (2020).
Apium prostratum subsp. Porongurup Range (G.J. Keighery 8631)	*Apium prostratum* subsp. *phillipii* Keighery	T	Taxon formally published. See Keighery (2020).
Arthropodium sp. Ironstone (J. Bull & J. Waters ONS PJ 36.01)	*Arthropodium vanleeuwenii* S.J.Dillon	P2	Taxon formally published. See Dillon & Macfarlane (2020).
Asplenium obtusatum G.Forst.	n/a		Excluded taxon. This taxon does not occur in WA. See Field (2020).
Asplenium obtusatum subsp. *northlandicum* Brownsey	*Asplenium decurrens* Willd.	P4	Taxonomic synonym. See Field (2020).
Astroloma acervatum Hislop & A.J.G.Wilson	*Styphelia acervata* (Hislop & A.J.G.Wilson) Hislop, Crayn & Puente-Lel.		Nomenclatural synonym. See Crayn *et al.* (2020).
Astroloma chloranthum Hislop & A.J.G.Wilson	*Styphelia chlorantha* (Hislop & A.J.G.Wilson) Hislop, Crayn & Puente-Lel.	P2	Nomenclatural synonym. See Crayn *et al.* (2020).
Astroloma ciliatum (Lindl.) Druce	*Styphelia discolor* (Sond.) Hislop, Crayn & Puente-Lel.		Taxonomic synonym. See Crayn *et al.* (2020).
Astroloma compactum R.Br.	*Styphelia compacta* (R.Br.) Spreng.		Nomenclatural synonym. See Crayn *et al.* (2020).
Astroloma drummondii Sond.	*Styphelia erectifolia* Hislop, Crayn & Puente-Lel.		Taxonomic synonym. See Crayn *et al.* (2020).
Astroloma epacridis (DC.) Druce	*Styphelia epacridis* (DC.) F.Muell.		Nomenclatural synonym. See Crayn *et al.* (2020).
Astroloma foliosum Sond.	*Styphelia foliosa* (Sond.) Hislop, Crayn & Puente-Lel.		Nomenclatural synonym. See Crayn *et al.* (2020).
Astroloma glaucescens Sond.	*Styphelia tortifolia* Hislop, Crayn & Puente-Lel.		Nomenclatural synonym. See Crayn *et al.* (2020).
Astroloma inopinatum Hislop	*Styphelia inopinata* (Hislop) Hislop, Crayn & Puente-Lel.	P1	Nomenclatural synonym. See Crayn *et al.* (2020).
Astroloma macrocalyx Sond.	*Styphelia macrocalyx* (Sond.) F.Muell.		Nomenclatural synonym. See Crayn *et al.* (2020).
Astroloma microcalyx Sond.	*Styphelia microcalyx* (Sond.) F.Muell.		Nomenclatural synonym. See Crayn *et al.* (2020).
Astroloma microdonta Benth.	*Styphelia microdonta* (Benth.) F.Muell.		Nomenclatural synonym. See Crayn *et al.* (2020).
Astroloma microphyllum Stschegl.	*Styphelia pentapogona* F.Muell.		Taxonomic synonym. See Crayn *et al.* (2020).
Astroloma oblongifolium A.J.G.Wilson & Hislop	*Styphelia oblongifolia* (A.J.G.Wilson & Hislop) Hislop, Crayn & Puente-Lel.		Nomenclatural synonym. See Crayn *et al.* (2020).

Old Name	New Name	Status	Comments
Astroloma pallidum R.Br.	*Styphelia pallida* (R.Br.) Spreng.		Nomenclatural synonym. See Crayn *et al.* (2020).
Astroloma prostratum R.Br.	*Styphelia prostrata* (R.Br.) F.Muell.		Nomenclatural synonym. See Crayn *et al.* (2020).
Astroloma serratifolium (DC.) Druce	*Styphelia serratifolia* (DC.) Hislop, Crayn & Puente-Lel.		Nomenclatural synonym. See Crayn *et al.* (2020).
Astroloma tectum R.Br.	*Styphelia tecta* (R.Br.) Spreng.		Nomenclatural synonym. See Crayn *et al.* (2020).
Austrostipa sp. Deception Hill (J. Warden & E. Ager LCH 31691)	*Austrostipa tuckeri* (F.Muell.) S.W.L.Jacobs & J.Everett		Name synonymised. A.R. Williams *in sched.* (05/10/2020).
Baeckea sp. Eujinyn (J. Buegge D 99)	*Baeckea exserta* S.Moore	P3	Name synonymised. B.L. Rye *in sched.* (16/04/2015).
Baeckea sp. Three Springs (M.E. Trudgen 5368)	*Babingtonia peteriana* Rye	P2	Name synonymised. See Rye (2020b).
Beyeria sp. Lake King (P.R. Jefferies 680514)	*Beyeria lateralis* Hislop	P2	Taxon formally published. See Hislop (2020f).
Blechnum orientale L.	*Blechnopsis orientalis* (L.) C.Presl		Nomenclatural synonym. See Field (2020).
Boronia acanthoclada Paul G.Wilson	*Cyanothamnus acanthocladus* (Paul G.Wilson) Duretto & Heslewood	P2	Nomenclatural synonym. See Duretto *et al.* (2020).
Boronia baeckeacea F.Muell.	*Cyanothamnus baeckeaceus* (F.Muell.) Duretto & Heslewood		Nomenclatural synonym. See Duretto *et al.* (2020).
Boronia baeckeacea F.Muell. subsp. *baeckeacea*	*Cyanothamnus baeckeaceus* (F.Muell.) Duretto & Heslewood subsp. *baeckeaceus*		Nomenclatural synonym. See Duretto *et al.* (2020).
Boronia baeckeacea subsp. *patula* Paul G.Wilson	*Cyanothamnus baeckeaceus* subsp. *patulus* (Paul G.Wilson) Duretto & Heslewood	P1	Nomenclatural synonym. See Duretto *et al.* (2020).
Boronia busselliana F.Muell.	*Cyanothamnus bussellianus* (F.Muell.) Duretto & Heslewood		Nomenclatural synonym. See Duretto *et al.* (2020).
Boronia coerulescens F.Muell.	*Cyanothamnus coerulescens* (F.Muell.) Duretto & Heslewood		Nomenclatural synonym. See Duretto *et al.* (2020).
Boronia coerulescens F.Muell. subsp. *coerulescens*	*Cyanothamnus coerulescens* (F.Muell.) Duretto & Heslewood subsp. *coerulescens*		Nomenclatural synonym. See Duretto *et al.* (2020).
Boronia coerulescens subsp. *spicata* Paul G.Wilson	*Cyanothamnus coerulescens* subsp. *spicatus* (Paul G.Wilson) Duretto & Heslewood		Nomenclatural synonym. See Duretto *et al.* (2020).
Boronia coerulescens subsp. *spinescens* (Benth.) Paul G.Wilson	*Cyanothamnus coerulescens* subsp. *spinescens* (Benth.) Duretto & Heslewood		Nomenclatural synonym. See Duretto *et al.* (2020).
Boronia defoliata F.Muell.	*Cyanothamnus defoliatus* (F.Muell.) Duretto & Heslewood		Nomenclatural synonym. See Duretto *et al.* (2020).
Boronia fabianoides (Diels) Paul G.Wilson	*Cyanothamnus fabianoides* (Diels) Duretto & Heslewood		Nomenclatural synonym. See Duretto *et al.* (2020).
Boronia fabianoides (Diels) Paul G.Wilson subsp. *fabianoides*	*Cyanothamnus fabianoides* (Diels) Duretto & Heslewood subsp. *fabianoides*		Nomenclatural synonym. See Duretto *et al.* (2020).

Old Name	New Name	Status	Comments
Boronia fabianoides subsp. *rosea* Paul G.Wilson	*Cyanothamnus fabianoides* subsp. *roseus* (Paul G.Wilson) Duretto & Heslewood		Nomenclatural synonym. See Duretto *et al.* (2020).
Boronia inconspicua Benth.	*Cyanothamnus inconspicuus* (Benth.) Duretto & Heslewood		Nomenclatural synonym. See Duretto *et al.* (2020).
Boronia penicillata Benth.	*Cyanothamnus penicillatus* (Benth.) Duretto & Heslewood		Nomenclatural synonym. See Duretto *et al.* (2020).
Boronia ramosa (Lindl.) Benth.	*Cyanothamnus ramosus* Lindl.		Nomenclatural synonym. See Duretto *et al.* (2020).
Boronia ramosa subsp. *anethifolia* (Bartl.) Paul G.Wilson	*Cyanothamnus ramosus* subsp. *anethifolius* (Bartl.) Duretto & Heslewood		Nomenclatural synonym. See Duretto *et al.* (2020).
Boronia ramosa subsp. *lesueurana* Paul G.Wilson	*Cyanothamnus ramosus* subsp. *lesueuranus* (Paul G.Wilson) Duretto & Heslewood	P2	Nomenclatural synonym. See Duretto *et al.* (2020).
Boronia ramosa (Lindl.) Benth. subsp. *ramosa*	*Cyanothamnus ramosus* Lindl. subsp. *ramosus*		Nomenclatural synonym. See Duretto *et al.* (2020).
Boronia subsessilis Benth.	*Cyanothamnus subsessilis* (Benth.) Duretto & Heslewood		Nomenclatural synonym. See Duretto *et al.* (2020).
Boronia westringioides Paul G.Wilson	*Cyanothamnus westringioides* (Paul G.Wilson) Duretto & Heslewood	P2	Nomenclatural synonym. See Duretto *et al.* (2020).
Bossiaea sp. Frankland (E.M. Sandiford EMS 896)	*Bossiaea reptans* T.Macfarlane & J.H.Ross	T	Taxon formally published. See Macfarlane *et al.* (2020e).
Caesia sp. Hopetoun (T.D. Macfarlane & C.J. French TDM 5228)	*Caesia arcuata* T.Macfarlane, Conran & C.J.French	P1	Taxon formally published. See Macfarlane *et al.* (2020b).
Calytrix sp. Kennedy Range (A. Markey & S. Dillon 6301)	*Calytrix insperata* Rye	P2	Taxon formally published. See Rye (2020a).
Carpobrotus pulcher Toelken ms	*Carpobrotus* sp. Lateral Flowers (N. Gibson & M. Lyons 973)	P2	Name synonymised. See CHAH (2005).
Chamelaucium sp. Canna (G. Keighery s.n. PERTH 02236435)	*Chamelaucium repens* (A.S.George) N.G.Marchant	P1	Name synonymised. See Marchant (2019).
Chamelaucium sp. Cape Vancouver (B. Swainson & D. Davidson s.n. PERTH 01259660)	*Chamelaucium orarium* N.G.Marchant	P2	Taxon formally published. See Marchant (2019).
Chamelaucium sp. Gingin (N.G. Marchant 6)	*Chamelaucium lullfitzii* N.G.Marchant	T	Taxon formally published. See Marchant (2019).
Chamelaucium sp. Mt Frankland (A.S. George 11117)	*Chamelaucium forrestii* (F.Muell.) N.G.Marchant	P2	Name synonymised. See Marchant (2019).
Chamelaucium sp. Nornalup (N.G. Marchant 76/125)	*Chamelaucium floriferum* subsp. *diffusum* N.G.Marchant	P2	Name synonymised. See Marchant (2019).
Chamelaucium sp. S coastal plain (R.D. Royce 4872)	*Chamelaucium roycei* N.G.Marchant	T	Taxon formally published. See Marchant (2019).
Chamelaucium sp. Walpole (P.G. Wilson 6318)	*Chamelaucium floriferum* subsp. *diffusum* N.G.Marchant	P2	Name synonymised. See Marchant (2019).

Old Name	New Name	Status	Comments
Chamelaucium sp. Waychinicup (D. Davidson s.n. PERTH 01486527)	*Chamelaucium xanthocladum* N.G.Marchant	P2	Taxon formally published. See Marchant (2019).
Chamelaucium sp. Yoongarillup (G.J. Keighery 3635)	*Chamelaucium erythrochlorum* N.G.Marchant	P4	Taxon formally published. See Marchant (2019).
Cleome arenitensis Craven, Lepschi & Fryxell	*Arivela arenitensis* (Craven, Lepschi & Fryxell) R.L.Barrett		Nomenclatural synonym. See Barrett *et al.* (2017).
Cleome cleomoides (F.Muell.) Iltis	*Arivela cleomoides* (F.Muell.) R.L.Barrett		Nomenclatural synonym. See Barrett *et al.* (2017).
Cleome kenneallyi Hewson	*Arivela kenneallyi* (Hewson) R.L.Barrett	P2	Nomenclatural synonym. See Barrett *et al.* (2017).
Cleome oxalidea F.Muell.	*Areocleome oxalidea* (F.Muell.) R.L.Barrett & Roalson		Nomenclatural synonym. See Barrett *et al.* (2017).
Cleome tetrandra DC.	*Arivela tetrandra* (DC.) R.L.Barrett		Nomenclatural synonym. See Barrett *et al.* (2017).
Cleome tetrandra var. *pentata* Hewson	*Arivela tetrandra* (DC.) R.L.Barrett		Taxonomic synonym. The taxonomic status of this variety is pending resolution of taxon boundaries. See Barrett *et al.* (2017).
Cleome tetrandra DC. var. *tetrandra*	*Arivela tetrandra* (DC.) R.L.Barrett		Nomenclatural synonym. The taxonomic status of this variety is pending resolution of taxon boundaries. See Barrett *et al.* (2017).
*Cleome uncifer*a Kers	*Arivela uncifera* (Kers) R.L.Barrett		Nomenclatural synonym. See Barrett *et al.* (2017).
Cleome uncifera subsp. *microphylla* Keighery	*Arivela microphylla* (Keighery) R.L.Barrett		Nomenclatural synonym. See Barrett *et al.* (2017).
Cleome uncifera Kers subsp. *uncifera*	*Arivela uncifera* (Kers) R.L.Barrett		Nomenclatural synonym. No subspecies recognised. See Barrett *et al.* (2017).
Cleome viscosa L.	*Arivela viscosa* (L.) Raf.		Nomenclatural synonym. See Barrett *et al.* (2017).
Cleome sp. Bonaparte Archipelago (A.A. Mitchell 4774)	*Arivela* sp. Bonaparte Archipelago (A.A. Mitchell 4774)		Name synonymised. See Barrett *et al.* (2017).
Coleanthera coelophylla (DC.) Benth.	*Styphelia coelophylla* (DC.) Hislop, Crayn & Puente-Lel.		Nomenclatural synonym. See Crayn *et al.* (2020).
Coleanthera myrtoides Stschegl.	*Styphelia coelophylla* (DC.) Hislop, Crayn & Puente-Lel.		Taxonomic synonym. See Crayn *et al.* (2020).
Coleanthera virgata Stschegl.	*Styphelia lanata* Hislop, Crayn & Puente-Lel.	X	Nomenclatural synonym. See Crayn *et al.* (2020).
Conostephium sp. Cascades (R. Bruhn 24/899 CAS)	*Stenanthera localis* Hislop	P1	Taxon formally published. See Hislop (2020g).
Conyza bonariensis (L.) Cronquist	*Erigeron bonariensis* L.	*	Nomenclatural synonym. See CHAH (2016a).
Conyza canadensis (L.) Cronquist	*Erigeron canadensis* L.	*	Nomenclatural synonym. See CHAH (2016b).
Conyza canadensis (L.) Cronquist var. *canadensis*	*Erigeron canadensis* L.	*	Nomenclatural synonym. No varieties recognised. See CHAH (2016b).

Old Name	New Name	Status	Comments
Conyza parva Cronquist	*Erigeron canadensis* L.	*	Taxonomic synonym. See CHAH (2016b).
Conyza sumatrensis (Retz.) E.Walker	*Erigeron sumatrensis* Retz.	*	Nomenclatural synonym. See CHAH (2016c).
Corchorus sp. Fitzroy Crossing (A.J. Ewart s.n. PERTH 01526790)	*Corchorus fitzroyensis* S.J.Dillon & K.A.Sheph.	P3	Taxon formally published. See Dillon *et al.* (2020).
Crassula natans var. *minus* (Eckl. & Zeyh.) G.D.Rowley	*Crassula natans* var. *minor* (Eckl. & Zeyh.) G.D.Rowley	*	Orthographic variant. See George (2019).
Croninia kingiana (F.Muell.) J.M.Powell	*Styphelia kingiana* F.Muell.		Nomenclatural synonym. See Crayn *et al.* (2020).
Cryptandra sp. Cowcowing (Wittwer W 1210)	*Cryptandra subtilis* Rye & Hislop	P3	Taxon formally published. See Rye & Hislop (2020b).
Cyperus castaneus var. *brevimucronatus* Kük.	*Cyperus castaneus* Willd.		Taxonomic synonym. See Rye (1997).
Cyperus castaneus Willd. var. *castaneus*	*Cyperus castaneus* Willd.		Nomenclatural synonym. No varieties recognised. See Rye (1997).
Cyphanthera odgersii (F.Muell.) Haegi	*Grammosolen odgersii* (F.Muell.) Haegi		Nomenclatural synonym. See Haegi (2020).
Cyphanthera odgersii subsp. *occidentalis* Haegi	*Grammosolen odgersii* subsp. *occidentalis* (Haegi) Haegi	T	Nomenclatural synonym. See Haegi (2020).
Cyphanthera odgersii (F.Muell.) Haegi subsp. *odgersii*	*Grammosolen odgersii* (F.Muell.) Haegi subsp. *odgersii*	P2	Nomenclatural synonym. See Haegi (2020).
Dampiera sp. Jaurdi (D. Angus DA 268)	*Dampiera prasiolitica* Hislop & K.A.Sheph.	P1	Taxon formally published. See Shepherd & Hislop (2020c).
Darwinia sp. Canna (R. Davis 11241)	*Darwinia sphaerica* R.W.Davis & Rye	P2	Taxon formally published. See Davis & Rye (2020).
Daviesia euryloba Crisp & G.Chandler	*Daviesia eurylobos* Crisp & G.Chandler		Orthographic variant. See George (2019).
Denhamia ferdinandii (Jessup) M.P.Simmons	*Denhamia muelleri* (Benth.) Jessup		Nomenclatural synonym. See Halford & Jessup (2020).
Diaspasis filifolia R.Br.	*Scaevola filifolia* (R.Br.) K.A.Sheph.		Nomenclatural synonym. See Shepherd *et al.* (2020).
Drosera barrettorum Lowrie	*Drosera barrettiorum* Lowrie		Orthographic variant. See CHAH (2018).
Drosera coalara Lowrie & Conran	*Drosera citrina* Lowrie & Carlquist		Taxonomic synonym. See Krueger & Fleischmann (2020).
Drummondita rubroviridis R.A.Meissn.	*Drummondita rubriviridis* R.A.Meissn.	P1	Orthographic variant. See George (2019).
Ectrosia agrostoides Benth.	*Eragrostis agrostoides* (Benth.) R.L.Barrett & P.M.Peterson		Nomenclatural synonym. See Barrett *et al.* (2020a).
Ectrosia danesii Domin	*Eragrostis danesii* (Domin) R.L.Barrett & P.M.Peterson		Nomenclatural synonym. See Barrett *et al.* (2020a).
Ectrosia lasioclada (Merr.) S.T.Blake	*Eragrostis lasioclada* Merr.	P1	Nomenclatural synonym. See Barrett *et al.* (2020a).
Ectrosia leporina R.Br.	*Eragrostis leporina* (R.Br.) R.L.Barrett & P.M.Peterson		Nomenclatural synonym. See Barrett *et al.* (2020a).
Ectrosia leporina R.Br. var. *leporina*	*Eragrostis leporina* (R.Br.) R.L.Barrett & P.M.Peterson		Nomenclatural synonym. No varieties recognised. See Barrett *et al.* (2020a).

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Ectrosia leporina var. *micrantha* Benth.	*Eragrostis leporina* (R.Br.) R.L.Barrett & P.M.Peterson		Taxonomic synonym. See Barrett *et al.* (2020a).
Ectrosia scabrida C.E.Hubb.	*Eragrostis scabrida* (C.E.Hubb.) R.L.Barrett & P.M.Peterson		Nomenclatural synonym. See Barrett *et al.* (2020a).
Ectrosia schultzii Benth.	*Eragrostis nightingaleae* R.L.Barrett & P.M.Peterson		Nomenclatural synonym. See Barrett *et al.* (2020a).
Ectrosia schultzii var. *annua* C.E.Hubb.	*Eragrostis nightingaleae* R.L.Barrett & P.M.Peterson		Taxonomic synonym. See Barrett *et al.* (2020a).
Ectrosia schultzii Benth. var. *schultzii*	*Eragrostis nightingaleae* R.L.Barrett & P.M.Peterson		Nomenclatural synonym. No varieties recognised. See Barrett *et al.* (2020a).
Eichhornia crassipes (Mart.) Solms	*Pontederia crassipes* Mart.	*	Nomenclatural synonym. See Pellegrini *et al.* (2018).
Eragrostis australasica (Steud.) C.E.Hubb.	*Sporobolus ramigerus* (F.Muell.) P.M.Peterson, Romasch. & R.L.Barrett		Taxonomic synonym. See Barrett *et al.* (2020a).
Eremophila annosocaulis Chinnock	*Eremophila annosicaulis* Chinnock	P3	Orthographic variant. See George (2019).
Eremophila parvifolia subsp. *auricampa* Chinnock	*Eremophila parvifolia* subsp. *auricampi* Chinnock		Orthographic variant. See George (2019).
Eucalyptus celastroides Turcz. subsp. *celastroides*	*Eucalyptus celastroides* Turcz.		Nomenclatural synonym. No subspecies recognised. See French & Nicolle (2019).
Eucalyptus celastroides subsp. *virella* Brooker	*Eucalyptus virella* (Brooker) D.Nicolle & M.E.French		Nomenclatural synonym. See Nicolle & French (2019).
Eucalyptus cuspidata Turcz.	*Eucalyptus angulosa* Schauer		Taxonomic synonym. See French & Nicolle (2019).
Eucalyptus densa Brooker & Hopper subsp. *densa*	*Eucalyptus densa* Brooker & Hopper		Nomenclatural synonym. No subspecies recognised. See Nicolle & French (2019).
Eucalyptus densa subsp. *improcera* Brooker & Hopper	*Eucalyptus improcera* (Brooker & Hopper) D.Nicolle & M.E.French		Nomenclatural synonym. See Nicolle & French (2019).
Eucalyptus depauperata L.A.S.Johnson & K.D.Hill	*Eucalyptus tenera* L.A.S.Johnson & K.D.Hill		Taxonomic synonym. See French & Nicolle (2019).
Eucalyptus famelica Brooker & Hopper	*Eucalyptus litorea* Brooker & Hopper	P2	Taxonomic synonym. See French & Nicolle (2019).
Eucalyptus microschema Brooker & Hopper	*Eucalyptus subtilis* Brooker & Hopper		Taxonomic synonym. See French (2012).
Eucalyptus myriadena Brooker subsp. *myriadena*	*Eucalyptus myriadena* Brooker		Nomenclatural synonym. No subspecies recognised. See French & Nicolle (2019).
Eucalyptus myriadena subsp. *parviflora* Brooker & Hopper	*Eucalyptus myriadena* Brooker		Taxonomic synonym. See French & Nicolle (2019).
Eucalyptus nigrifunda Brooker & Hopper	*Eucalyptus capillosa* Brooker & Hopper		Taxonomic synonym. See French (2012).
Eucalyptus phaenophylla subsp. *interjacens* Brooker & Hopper	*Eucalyptus phaenophylla* Brooker & Hopper		Taxonomic synonym. See French & Nicolle (2019).
Eucalyptus phaenophylla Brooker & Hopper subsp. *phaenophylla*	*Eucalyptus phaenophylla* Brooker & Hopper		Nomenclatural synonym. No subspecies recognised. See French & Nicolle (2019).

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Eucalyptus pluricaulis Brooker & Hopper	*Eucalyptus redunca* subsp. *pluricaulis* (Brooker & Hopper) D.Nicolle & M.E.French		Nomenclatural synonym. See Nicolle & French (2019).
Eucalyptus pluricaulis Brooker & Hopper subsp. *pluricaulis*	*Eucalyptus redunca* subsp. *pluricaulis* (Brooker & Hopper) D.Nicolle & M.E.French		Nomenclatural synonym. See Nicolle & French (2019).
Eucalyptus pluricaulis subsp. *porphyrea* Brooker & Hopper	*Eucalyptus redunca* subsp. *porphyrea* (Brooker & Hopper) D.Nicolle & M.E.French		Nomenclatural synonym. See Nicolle & French (2019).
Eucalyptus thamnoides subsp. *megista* Brooker & Hopper	*Eucalyptus thamnoides* Brooker & Hopper		Taxonomic synonym. See French & Nicolle (2019).
Eucalyptus thamnoides Brooker & Hopper subsp. *thamnoides*	*Eucalyptus thamnoides* Brooker & Hopper		Nomenclatural synonym. No subspecies recognised. See French & Nicolle (2019).
Eucalyptus xanthonema subsp. *apposita* Brooker & Hopper	*Eucalyptus xanthonema* Turcz.		Taxonomic synonym. See French & Nicolle (2019).
Eucalyptus xanthonema Turcz. subsp. *xanthonema*	*Eucalyptus xanthonema* Turcz.		Nomenclatural synonym. No subspecies recognised. See French & Nicolle (2019).
Geleznowia sp. Red Bluff (A. Crawford ADC 597)	*Geleznowia amabilis* K.A.Sheph. & A.D.Crawford	P2	Taxon formally published. See Shepherd & Crawford (2020).
Glycine aphyonota B.E.Pfeil	*Glycine aphyonotos* B.E.Pfeil		Orthographic variant. See George (2019).
Glycine lactovirens Tindale & Craven	*Glycine lactivirens* Tindale & Craven	P3	Orthographic variant. See George (2019).
Gompholobium sp. Stirling Range (C.F. Wilkins et al. CW 2513)	*Gompholobium glabristylum* C.F.Wilkins & Sandiford	P2	Taxon formally published. See Wilkins & Sandiford (2020).
Gomphrena sp. Belele (D.W. Goodall 3215)	*Gomphrena verecunda* R.W.Davis		Taxon formally published. See Davis (2020b).
Goodenia sp. Cunyu (C.J. Nicholson & P.J. Curry 1001)	*Goodenia quartzitica* K.A.Sheph.	P1	Taxon formally published. See Shepherd (2020b).
Grammosolen sp. Mt Ridley (W.R. Archer 1210911)	*Grammosolen archeri* Haegi	P1	Taxon formally published. See Haegi (2020).
Grevillea curviloba McGill. subsp. *curviloba*	*Grevillea curviloba* McGill.	T	Nomenclatural synonym. No subspecies recognised. See Keighery *et al.* (2020).
Grevillea curviloba subsp. *incurva* Olde & Marriott	*Grevillea curviloba* McGill.	T	Taxonomic synonym. See Keighery *et al.* (2020).
Grevillea sp. Koolyanobbing (W.P. Muir WPM 3344)	*Grevillea hystrix* R.W.Davis	P1	Taxon formally published. See Davis (2020a).
Guichenotia basivirida C.F.Wilkins	*Guichenotia basiviridis* C.F.Wilkins		Orthographic variant. See George (2019).
Hakea cygna Lamont	*Hakea cygnus* Lamont		Orthographic variant. See George (2019).
Hakea cygna Lamont subsp. *cygna*	*Hakea cygnus* Lamont subsp. *cygnus*		Orthographic variant. See George (2019).
Hakea cygna subsp. *needlei* Lamont	*Hakea cygnus* subsp. *needlei* Lamont	P2	Orthographic variant. See George (2019).

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Hakea sp. Hay River (Randino 14)	*Hakea sulcata* R.Br.		Name synonymised. L. Haegi *in litt.* (29/03/2019).
Haloragis sp. Parrot Ridge (G.J. Keighery 11563)	*Haloragis luminosa* Wege & Orchard	P1	Taxon formally published. See Wege & Orchard (2020).
Heliotropium discorde Craven	*Heliotropium discors* Craven	P1	Orthographic variant. See George (2019).
Hemigenia dulca G.R.Guerin	*Hemigenia dulcis* G.R.Guerin	P1	Orthographic variant. See George (2019).
Hemigenia pimelifolia F.Muell.	*Hemigenia pimeleifolia* F.Muell.	P2	Orthographic variant. See George (2019).
Hemigenia sp. Three Springs (S. Patrick 4043 A)	*Hemigenia diadela* G.R.Guerin & Wege	P2	Taxon formally published. See Wege & Guerin (2020).
Heterachne abortiva (R.Br.) Druce	*Eragrostis abortiva* (R.Br.) Steud.		Nomenclatural synonym. See Barrett *et al.* (2020a).
Heterachne gulliveri Benth.	*Eragrostis lilliputiana* R.L.Barrett & P.M.Peterson		Nomenclatural synonym. See Barrett *et al.* (2020a).
Heterachne gulliveri var. *major* C.E.Hubb.	*Eragrostis lilliputiana* R.L.Barrett & P.M.Peterson		Taxonomic synonym. See Barrett *et al.* (2020a).
Hibbertia spicata subsp. *leptotheca* J.R.Wheeler	*Hibbertia leptotheca* (J.R.Wheeler) K.R.Thiele	P3	Nomenclatural synonym. See Thiele (2019a).
Hibbertia spicata F.Muell. subsp. *spicata*	*Hibbertia spicata* F.Muell.		Nomenclatural synonym. No subspecies recognised. See Thiele (2019a).
Hibiscus sp. Carnarvon (S. van Leeuwen 5110)	*Hibiscus chrysinocolla* McLay & S.J.Dillon	P1	Taxon formally published. See McLay & Dillon (2020).
Hybanthus aurantiacus (Benth.) F.Muell.	*Afrohybanthus aurantiacus* (Benth.) Flicker		Nomenclatural synonym. See Flicker & Ballard (2015).
Hybanthus bennettiae R.L.Barrett	*Afrohybanthus bennettiae* (R.L.Barrett) Messina	P2	Nomenclatural synonym. See Messina (2020).
Hybanthus enneaspermus (L.) F.Muell.	*Afrohybanthus enneaspermus* (L.) Flicker		Nomenclatural synonym. See Flicker & Ballard (2015).
Hydrocotyle blepharocarpa F.Muell.	*Hydrocotyle scutellifera* Benth.		Taxonomic synonym. See Perkins (2019).
Hydrocotyle pilifera Turcz.	*Hydrocotyle intertexta* A.Rich.		Taxonomic synonym. See Perkins (2019).
Hydrocotyle pilifera var. *glabrata* Benth.	*Hydrocotyle intertexta* A.Rich.		Taxonomic synonym. See Perkins (2019).
Hydrocotyle pilifera Turcz. var. *pilifera*	*Hydrocotyle intertexta* A.Rich.		Taxonomic synonym. See Perkins (2019).
Isopogon drummondii Jacques	*Isopogon sphaerocephalus* Lindl. subsp. *sphaerocephalus*		Doubtful taxonomic synonym. See Rye & Macfarlane (2019).
Isopogon sp. Newdegate (D.B. Foreman 771)	*Isopogon nutans* Rye & Hislop		Taxon formally published. See Rye & Hislop (2020a).
Isotropis sp. Arid zone (G. Byrne 2775)	*Isotropis iophyta* Wege & R.W.Davis		Taxon formally published. See Wege & Davis (2020b).
Kunzea parvifolia Schauer	n/a	*	Excluded taxon. This taxon does not occur in WA. M. Hislop *in litt.* (15/10/2020).

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Kunzea sp. Dragon Rocks (K. Kershaw KK 2184)	*Kunzea dracopetrensis* R.Butcher	P2	Taxon formally published. See Butcher (2020b).
Lasiopetalum sp. Wellstead (K.A. Shepherd & C.F. Wilkins KS 1650)	*Lasiopetalum hapalocalyx* K.A.Sheph. & C.F.Wilkins	P1	Taxon formally published. See Shepherd & Wilkins (2020b).
Lechenaultia sp. Cascade (W.R. Archer 212122)	*Lechenaultia orchestris* K.A.Sheph. & Hislop	P1	Taxon formally published. See Shepherd & Hislop (2020a).
Lepidosperma resinosum var. *pleianthemum* Kük.	n/a		Error. A name of uncertain application. See CHAH (2012a).
Lepidosperma resinosum (Lehm.) Benth. var. *resinosum*	*Lepidosperma resinosum* (Lehm.) Benth.		Nomenclatural synonym. No varieties recognised. See CHAH (2012b).
Leptosema cervicorne Crisp	*Leptosema cervicornu* Crisp		Orthographic variant. See George (2019).
Leucopogon allittii F.Muell.	*Styphelia allittii* (F.Muell.) F.Muell.	P3	Nomenclatural synonym. See Crayn *et al.* (2020).
Leucopogon blepharolepis (F.Muell.) Benth.	*Styphelia blepharolepis* F.Muell.	P4	Nomenclatural synonym. See Crayn *et al.* (2020).
Leucopogon brevicuspis Benth.	*Styphelia brevicuspis* (Benth.) F.Muell.	P2	Nomenclatural synonym. See Crayn *et al.* (2020).
Leucopogon breviflorus F.Muell.	*Styphelia breviflora* (F.Muell.) F.Muell.		Nomenclatural synonym. See Crayn *et al.* (2020).
Leucopogon conchifolius Strid	*Styphelia conchifolia* (Strid) Hislop, Crayn & Puente-Lel.		Nomenclatural synonym. See Crayn *et al.* (2020).
Leucopogon concinnus Benth.	*Styphelia concinna* (Benth.) F.Muell.		Nomenclatural synonym. See Crayn *et al.* (2020).
Leucopogon conostephioides DC.	*Styphelia conostephioides* (DC.) F.Muell.		Nomenclatural synonym. See Crayn *et al.* (2020).
Leucopogon cordifolius Lindl.	*Styphelia cordifolia* (Lindl.) F.Muell.		Nomenclatural synonym. See Crayn *et al.* (2020).
Leucopogon corynocarpus Sond.	*Styphelia corynocarpa* (Sond.) F.Muell.		Nomenclatural synonym. See Crayn *et al.* (2020).
Leucopogon crassiflorus (F.Muell.) Benth.	*Styphelia crassiflora* F.Muell.		Nomenclatural synonym. See Crayn *et al.* (2020).
Leucopogon crassifolius Sond.	*Styphelia crassifolia* (Sond.) F.Muell.		Nomenclatural synonym. See Crayn *et al.* (2020).
Leucopogon cuneifolius Stschegl.	*Styphelia lissanthoides* (F.Muell.) F.Muell.		Taxonomic synonym. See Crayn *et al.* (2020).
Leucopogon cymbiformis DC.	*Styphelia cymbiformis* (DC.) F.Muell.	P2	Nomenclatural synonym. See Crayn *et al.* (2020).
Leucopogon dielsianus E.Pritz.	*Styphelia dielsiana* (E.Pritz.) Sleumer		Nomenclatural synonym. See Crayn *et al.* (2020).
Leucopogon flavescens Sond.	*Styphelia flavescens* (Sond.) F.Muell.		Nomenclatural synonym. See Crayn *et al.* (2020).
Leucopogon flavescens var. *brevifolius* Benth.	*Styphelia densifolia* Hislop, Crayn & Puente-Lel.		Nomenclatural synonym. See Crayn *et al.* (2020).
Leucopogon flavescens Sond. var. *flavescens*	*Styphelia flavescens* (Sond.) F.Muell.		Nomenclatural synonym. No varieties recognised. See Crayn *et al.* (2020).
Leucopogon glaucifolius W.Fitzg.	*Styphelia glaucifolia* (W.Fitzg.) Hislop, Crayn & Puente-Lel.		Nomenclatural synonym. See Crayn *et al.* (2020).

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Leucopogon hamulosus E.Pritz.	*Styphelia hamulosa* (E.Pritz.) Sleumer		Nomenclatural synonym. See Crayn *et al.* (2020).
Leucopogon hispidus E.Pritz.	*Styphelia hispida* (E.Pritz.) Sleumer		Nomenclatural synonym. See Crayn *et al.* (2020).
Leucopogon insularis DC.	*Styphelia insularis* (DC.) Hislop, Crayn & Puente-Lel.		Nomenclatural synonym. See Crayn *et al.* (2020).
Leucopogon leptanthus Benth.	*Styphelia leptantha* (Benth.) F.Muell.		Nomenclatural synonym. See Crayn *et al.* (2020).
Leucopogon marginatus W.Fitzg.	*Styphelia marginata* (W.Fitzg.) Hislop, Crayn & Puente-Lel.	T	Nomenclatural synonym. See Crayn *et al.* (2020).
Leucopogon multiflorus R.Br.	*Styphelia multiflora* (R.Br.) Spreng.	P2	Nomenclatural synonym. See Crayn *et al.* (2020).
Leucopogon nutans E.Pritz.	*Styphelia nitens* Sleumer		Nomenclatural synonym. See Crayn *et al.* (2020).
Leucopogon obtectus Benth.	*Styphelia obtecta* (Benth.) F.Muell.	T	Nomenclatural synonym. See Crayn *et al.* (2020).
Leucopogon ovalifolius Sond.	*Styphelia retrorsa* Hislop, Crayn & Puente-Lel.		Nomenclatural synonym. See Crayn *et al.* (2020).
Leucopogon oxycedrus Sond.	*Styphelia erubescens* F.Muell.		Misapplied name. See Crayn *et al.* (2020).
Leucopogon pendulus R.Br.	*Styphelia pendula* (R.Br.) Spreng.		Nomenclatural synonym. See Crayn *et al.* (2020).
Leucopogon planifolius Sond.	*Styphelia planifolia* (Sond.) Sleumer		Nomenclatural synonym. See Crayn *et al.* (2020).
Leucopogon pogonocalyx Benth.	*Styphelia pogonocalyx* (Benth.) F.Muell.	P4	Nomenclatural synonym. See Crayn *et al.* (2020).
Leucopogon propinquus R.Br.	*Styphelia propinqua* (R.Br.) Spreng.		Nomenclatural synonym. See Crayn *et al.* (2020).
Leucopogon psilopus Stschegl.	*Styphelia psilopus* (Stschegl.) Hislop, Crayn & Puente-Lel.	P2	Nomenclatural synonym. See Crayn *et al.* (2020).
Leucopogon pubescens S.Moore	*Styphelia pubescens* (S.Moore) Hislop, Crayn & Puente-Lel.		Nomenclatural synonym. See Crayn *et al.* (2020).
Leucopogon racemulosus DC.	*Styphelia racemulosa* (DC.) F.Muell.		Nomenclatural synonym. See Crayn *et al.* (2020).
Leucopogon rigidus DC.	*Styphelia rigidus* (DC.) Hislop, Crayn & Puente-Lel.		Nomenclatural synonym. See Crayn *et al.* (2020).
Leucopogon rotundifolius R.Br.	*Styphelia rotundifolia* (R.Br.) Spreng.	P3	Nomenclatural synonym. See Crayn *et al.* (2020).
Leucopogon strictus Benth.	*Styphelia stricta* (Benth.) F.Muell.		Nomenclatural synonym. See Crayn *et al.* (2020).
Leucopogon strongylophyllus F.Muell.	*Styphelia strongylophylla* (F.Muell.) F.Muell.		Nomenclatural synonym. See Crayn *et al.* (2020).
Leucopogon tamminensis E.Pritz.	*Styphelia tamminensis* (E.Pritz.) Sleumer	P3	Nomenclatural synonym. See Crayn *et al.* (2020).
Leucopogon tamminensis var. *australis* E.Pritz.	*Styphelia decussata* Hislop, Crayn & Puente-Lel.		Nomenclatural synonym. See Crayn *et al.* (2020).
Leucopogon tamminensis E.Pritz. var. *tamminensis*	*Styphelia tamminensis* (E.Pritz.) Sleumer	P3	Nomenclatural synonym. No varieties recognised. See Crayn *et al.* (2020).

Old Name	New Name	Status	Comments
Leucopogon woodsii F.Muell.	*Styphelia woodsii* (F.Muell.) F.Muell.		Nomenclatural synonym. See Crayn *et al.* (2020).
Leucopogon sp. Bindoon (F. Hort 2766)	*Styphelia brevicuspis* (Benth.) F.Muell.	P2	Name synonymised. See Crayn *et al.* (2020).
Leucopogon sp. Flynn (F. Hort, J. Hort & A. Lowrie 859)	*Styphelia capillaris* Hislop & Puente-Lel.	T	Taxon formally published. See Hislop (2020d).
Leucopogon sp. Kau Rock (M.A. Burgman 1126)	*Styphelia subulata* (F.Muell.) Hislop, Crayn & Puente-Lel.		Name synonymised. See Crayn *et al.* (2020).
Leucopogon sp. Kirup (M. Hislop 3919)	*Leucopogon kirupensis* Hislop	P2	Taxon formally published. See Hislop (2020b).
Leucopogon sp. Northern Scarp (M. Hislop 2233)	*Styphelia retrorsa* Hislop, Crayn & Puente-Lel.		Name synonymised. See Crayn *et al.* (2020).
Leucopogon sp. Twertup (K.R. Newbey 10859)	*Styphelia crassifolia* (Sond.) F.Muell.		Name synonymised. See Crayn *et al.* (2020).
Levenhookia sp. Whicher Range (J.A. Wege 2090)	*Levenhookia aestiva* Wege		Taxon formally published. See Wege (2020a).
Lycopodiella cernua (L.) Pic.Serm.	*Palhinhaea cernua* (L.) Franco & Vasc.		Nomenclatural synonym. See Field (2020).
Lycopodiella serpentina (Kunze) B.Øllg.	*Pseudolycopodiella serpentina* (Kunze) Holub		Nomenclatural synonym. See Field (2020).
Microcorys sp. Mt Holland (D. Angus DA 2397)	*Microcorys elatoides* T.C.Wilson & Hislop	P1	Taxon formally published. See Wilson & Hislop (2020).
Oldenlandia argillacea (Halford) Halford	*Dolichocarpa argillacea* (Halford) K.L.Gibbons		Nomenclatural synonym. See Gibbons (2020).
Oldenlandia crouchiana (F.Muell.) F.Muell.	*Dolichocarpa crouchiana* (F.Muell.) K.L.Gibbons		Nomenclatural synonym. See Gibbons (2020).
Oldenlandia delicata (Halford) Halford	*Scleromitrion delicatum* (Halford) K.L.Gibbons		Nomenclatural synonym. See Gibbons (2020).
Oldenlandia galioides (F.Muell.) F.Muell.	*Scleromitrion galioides* (F.Muell.) K.L.Gibbons		Nomenclatural synonym. See Gibbons (2020).
Oldenlandia kochiae Halford	*Paranotis kochiae* (Halford) K.L.Gibbons		Nomenclatural synonym. See Gibbons (2020).
Oldenlandia laceyi (Halford) Halford	*Scleromitrion laceyi* (Halford) K.L.Gibbons		Nomenclatural synonym. See Gibbons (2020).
Oldenlandia largiflorens (Halford) Halford	*Scleromitrion largiflorens* (Halford) K.L.Gibbons		Nomenclatural synonym. See Gibbons (2020).
Oldenlandia mitrasacmoides (F.Muell.) F.Muell.	*Paranotis mitrasacmoides* (F.Muell.) K.L.Gibbons		Nomenclatural synonym. See Gibbons (2020).
Oldenlandia mitrasacmoides (F.Muell.) F.Muell. subsp. *mitrasacmoides*	*Paranotis mitrasacmoides* (F.Muell.) K.L.Gibbons subsp. *mitrasacmoides*		Nomenclatural synonym. See Gibbons (2020).
Oldenlandia pterospora (F.Muell.) F.Muell.	*Paranotis pterospora* (F.Muell.) K.L.Gibbons		Nomenclatural synonym. See Gibbons (2020).
Oldenlandia spermacocoides (F.Muell.) F.Muell.	*Dolichocarpa spermacocoides* (F.Muell.) K.L.Gibbons		Nomenclatural synonym. See Gibbons (2020).
Oldenlandia sp. Hamersley Station (A.A. Mitchell PRP 1479)	*Dolichocarpa* sp. Hamersley Station (A.A. Mitchell PRP 1479)	P3	Name synonymised. K.J. Gibbons *in litt.* (21/08/2020).

Old Name	New Name	Status	Comments
Olearia sp. Gregory (M. Hislop 3784)	*Olearia adpressa* Hislop	P1	Taxon formally published. See Hislop (2020e).
Operculina brownii Ooststr.	*Operculina codonantha* (Benth.) Hallier f.		Taxonomic synonym. See Staples *et al.* (2020).
Ornithogalum longebracteatum Jacq.	*Ornithogalum longibracteatum* Jacq.	*	Orthographic variant. See CHAH (2006).
Paracaleana sp. Laterite (G. Brockman GBB 3571)	*Paracaleana ferricola* A.P.Br. & G.Brockman	P2	Taxon formally published. See Brown & Brockman (2019).
Paraceterach muelleri (Hook.) Copel.	*Pellaea muelleri* (Hook.) A.R.Field		Nomenclatural synonym. See Field (2020).
Paraceterach reynoldsii (F.Muell.) Tindale	*Pellaea reynoldsii* (F.Muell.) A.R.Field		Nomenclatural synonym. See Field (2020).
Pentaptilon careyi (F.Muell.) E.Pritz.	*Goodenia careyi* (F.Muell.) K.A.Sheph.		Nomenclatural synonym. See Shepherd *et al.* (2020).
Philotheca sp. Mukinbudin (M. Hancock s.n. 08/09/1999)	*Philotheca richardsoniana* Wege & Hislop	P2	Taxon formally published. See Wege & Hislop (2020).
Pileanthus rubronitidus Keighery	*Pileanthus rubrinitidus* Keighery		Orthographic variant. See George (2019).
Pilostyles hamiltonii C.A.Gardner	*Pilostyles hamiltoniorum* C.A.Gardner		Orthographic variant. See George (2019).
Pimelea sp. Tarin Rock (E.J. Croxford 2118)	*Pimelea cruciata* Rye & Wege	P1	Taxon formally published. See Rye & Wege (2020).
Pityrodia sp. Marble Bar (G. Woodman & D. Coultas GWDC Opp 4)	*Quoya zonalis* K.A.Sheph. & Hislop	T	Taxon formally published. See Shepherd & Hislop (2020b).
Platyzoma microphyllum R.Br.	*Pteris platyzomopsis* Christenh. & H.Schneid.		Nomenclatural synonym. See Field (2020).
Pleurosorus rutifolius (R.Br.) Fee	*Asplenium subglandulosum* (Hook. & Grev.) Salvo, Prada & T.E.Díaz		Taxonomic synonym. See Field (2020).
Pleurosorus subglandulosus (Hook. & Grev.) Tindale	*Asplenium subglandulosum* (Hook. & Grev.) Salvo, Prada & T.E.Díaz		Nomenclatural synonym. See Field (2020).
Psammagrostis wiseana C.A.Gardner & C.E.Hubb.	*Eragrostis wiseana* (C.A.Gardner & C.E.Hubb.) R.L.Barrett & P.M.Peterson		Nomenclatural synonym. See Barrett *et al.* (2020a).
Pterostylis brevisepala D.L.Jones ms	*Pterostylis brevisepala* (D.L.Jones & C.J.French) D.L.Jones & C.J.French		Name synonymised. C.J. French *in litt.* (13/07/2020).
Pterostylis sp. Coastal clubbed sepals (G. Brockman GBB 255)	*Pterostylis actites* (D.L.Jones & C.J.French) D.L.Jones & C.J.French		Name synonymised. G.B. Brockman & C.J. French *in sched.* (13/05/2020).
Pterostylis sp. crinkled leaf (G.J. Keighery 13426)	*Pterostylis* sp. Bloated snail orchid (W. Jackson BJ 486)		Name synonymised. A.P. Brown *in sched.* (11/04/2019).
Pterostylis sp. inland (A.C. Beauglehole 11880)	*Pterostylis setulosa* (D.L.Jones & C.J.French) D.L.Jones & C.J.French		Name synonymised. G.B. Brockman & C.J. French *in sched.* (15/01/2020).
Ptilotus polakii subsp. *juxtus* Lally	*Ptilotus polakii* subsp. *juxta* Lally		Orthographic variant. See George (2019).

Old Name	New Name	Status	Comments
Ptilotus sp. Beaufort River (G.J. Keighery 16554)	*Ptilotus davisii* T.Hammer		Name synonymised. See Hammer (2020).
Ptilotus sp. Porongurup (R. Davis 10805)	*Ptilotus davisii* T.Hammer		Name synonymised. See Hammer (2020).
Quisqualis indica L.	*Combretum indicum* (L.) DeFilipps	*	Nomenclatural synonym. See Maurin *et al.* (2020).
Ricinocarpos sp. Eastern Goldfields (A. Williams 3)	*Ricinocarpos digynus* Hislop & Wege	P1	Taxon formally published. See Hislop & Wege (2020).
Scaevola collaris F.Muell.	*Goodenia collaris* (F.Muell.) K.A.Sheph.		Nomenclatural synonym. See Shepherd *et al.* (2020).
Schoenus curvifolius (R.Br.) Poir.	*Chaetospora curvifolia* R.Br.		Nomenclatural synonym. See Barrett *et al.* (2020b).
Schoenus subbulbosus Benth.	*Chaetospora subbulbosa* (Benth.) K.L.Wilson & R.L.Barrett		Nomenclatural synonym. See Barrett *et al.* (2020b).
Schoenus sp. Marble Bar (D. Coultas & S. Coultas DCSC-Opp 07)	*Schoenus coultasii* Hislop	P1	Taxon formally published. See Hislop (2020a).
Selliera radicans Cav.	*Goodenia radicans* (Cav.) Pers.	P1	Nomenclatural synonym. See Shepherd *et al.* (2020).
Seringia elliptica C.F.Wilkins	*Seringia exastia* (C.F.Wilkins) C.F.Wilkins & Whitlock	T	Taxonomic synonym. See Binks *et al.* (2020).
Solanum octonum A.R.Bean	*Solanum octona* A.R.Bean	P2	Orthographic variant. See George (2019).
Stachystemon sp. Keysbrook (R. Archer 17/11/99)	*Stachystemon exilis* Hislop & R.W.Davis	P1	Taxon formally published. See Hislop & Davis (2020)
Stylidium perizostera Lowrie & Kenneally	*Stylidium perizoster* Lowrie & Kenneally	P3	Orthographic variant. J.A. Wege *in litt.* (20/09/2020).
Stylidium sp. Dragon Rocks (J.A. Wege & K.A. Shepherd JAW 2054)	*Stylidium shepherdianum* Wege	P2	Taxon formally published. See Wege (2020b).
Styphelia melaleucoides F.Muell. var. *melaleucoides*	*Styphelia melaleucoides* F.Muell. subsp. *melaleucoides*		Nomenclatural synonym. See Crayn *et al.* (2020).
Styphelia melaleucoides var. *ovata* Benth.	*Styphelia melaleucoides* subsp. *ovata* (Benth.) Hislop, Crayn & Puente-Lel.		Nomenclatural synonym. See Crayn *et al.* (2020).
Styphelia rigidus (DC.) Hislop, Crayn & Puente-Lel.	*Styphelia rigida* (DC.) Hislop, Crayn & Puente-Lel.		Orthographic variant. M. Hislop *in litt.* (09/06/2020).
Styphelia sp. Bullfinch (M. Hislop 3574)	*Styphelia saxicola* Hislop	P3	Taxon formally published. See Hislop (2020c).
Styphelia sp. Great Victoria Desert (N. Murdock 44)	*Styphelia deserticola* Hislop	P2	Taxon formally published. See Hislop (2020c).
Synaptantha scleranthoides (F.Muell.) Halford	*Scleromitrion scleranthoides* (F.Muell.) K.L.Gibbons		Nomenclatural synonym. See Gibbons (2020).
Tecticornia sp. Sunshine Lake (K.A. Shepherd et al. KS 867)	*Tecticornia enodis* K.A.Sheph.	P1	Taxon formally published. See Shepherd (2020a).
Tephrosia sp. Saw Ranges (D. Kabay s.n. PERTH 06720544)	*Tephrosia cardiophylla* R.Butcher	P1	Taxon formally published. See Butcher (2020a).

Old Name	New Name	Status	Comments
Tephrosia sp. sparse pinnae (C.R. Michel 2202)	*Tephrosia* sp. Sparse pinnae (C.R. Michell 2202)		Name synonymised. R. Butcher *in litt.* (23/09/2019).
Teucrium sp. dwarf (R. Davis 8813)	*Teucrium diabolicum* R.W.Davis & Wege	P3	Taxon formally published. See Wege & Davis (2020a).
Thomasia sp. Arthur River (H.F. & M. Broadbent 1409)	*Thomasia julietiae* K.A.Sheph. & C.F.Wilkins	P1	Taxon formally published. See Shepherd & Wilkins (2020a).
Thryptomene sp. Londonderry (R.H. Kuchel 1763)	*Thryptomene planiflora* Rye	P1	Taxon formally published. See Rye (2020c).
Thysanotus sp. Kalbarri (D. & B. Bellairs 1523 A)	*Thysanotus kalbarriensis* T.Macfarlane, C.J.French & Conran	P2	Taxon formally published. See Macfarlane *et al.* (2020d).
Trophis scandens (Lour.) Hook. & Arn.	*Malaisia scandens* (Lour.) Planch.		Nomenclatural synonym. See Clement & Weiblen (2009).
Trophis scandens (Lour.) Hook. & Arn. subsp. *scandens*	*Malaisia scandens* (Lour.) Planch. subsp. *scandens*		Nomenclatural synonym. See Clement & Weiblen (2009).
Utricularia dichotoma Labill.	*Utricularia oppositiflora* R.Br.	P3	Misapplied name. R.W. Jobson *in litt.* (16/07/2020).
Velleia arguta R.Br.	*Goodenia arguta* (R.Br.) K.A.Sheph.		Nomenclatural synonym. See Shepherd *et al.* (2020).
Velleia connata F.Muell.	*Goodenia connata* (F.Muell.) K.A.Sheph.		Nomenclatural synonym. See Shepherd *et al.* (2020).
Velleia cycnopotamica F.Muell.	*Goodenia cycnopotamica* (F.Muell.) K.A.Sheph.		Nomenclatural synonym. See Shepherd *et al.* (2020).
Velleia daviesii F.Muell.	*Goodenia daviesii* (F.Muell.) K.A.Sheph.		Nomenclatural synonym. See Shepherd *et al.* (2020).
Velleia discophora F.Muell.	*Goodenia discophora* (F.Muell.) K.A.Sheph.		Nomenclatural synonym. See Shepherd *et al.* (2020).
Velleia exigua (F.Muell.) Carolin	*Goodenia exigua* F.Muell.	P2	Nomenclatural synonym. See Shepherd *et al.* (2020).
Velleia foliosa (Benth.) K.Krause	*Goodenia brendannarum* K.A.Sheph.		Nomenclatural synonym. See Shepherd *et al.* (2020).
Velleia glabrata Carolin	*Goodenia glabrata* (Carolin) K.A.Sheph.		Nomenclatural synonym. See Shepherd *et al.* (2020).
Velleia hispida W.Fitzg.	*Goodenia capillosa* K.A.Sheph.		Nomenclatural synonym. See Shepherd *et al.* (2020).
Velleia macrophylla (Lindl.) Benth.	*Goodenia macrophylla* (Lindl.) F.Muell.		Nomenclatural synonym. See Shepherd *et al.* (2020).
Velleia panduriformis Benth.	*Goodenia panduriformis* (Benth.) K.A.Sheph.		Nomenclatural synonym. See Shepherd *et al.* (2020).
Velleia rosea S.Moore	*Goodenia rosea* (S.Moore) K.A.Sheph.		Nomenclatural synonym. See Shepherd *et al.* (2020).
Velleia trinervis Labill.	*Goodenia trinervis* (Labill.) K.A.Sheph.		Nomenclatural synonym. See Shepherd *et al.* (2020).
Verreauxia dyeri Hemsl.	*Goodenia etheira* K.A.Sheph.		Nomenclatural synonym. See Shepherd *et al.* (2020).
Verreauxia paniculata Benth.	*Goodenia verreauxii* (de Vriese) K.A.Sheph.		Nomenclatural synonym. See Shepherd *et al.* (2020).
Verreauxia reinwardtii (de Vriese) Benth.	*Goodenia reinwardtii* (de Vriese) K.A.Sheph.		Nomenclatural synonym. See Shepherd *et al.* (2020).

Old Name	New Name	Status	Comments
Verreauxia verreauxii (de Vriese) Carolin	*Goodenia verreauxii* (de Vriese) K.A.Sheph.	P4	Nomenclatural synonym. See Shepherd *et al.* (2020).
Verticordia sp. Koolyanobbing (B.H. Smith 1457)	*Verticordia elizabethiae* Rye & M.D.Barrett	P1	Taxon formally published. See Rye & Barrett (2020).
Westringia capitonia G.R.Guerin	*Westringia capitonis* G.R.Guerin		Orthographic variant. See George (2019).
Wurmbea sp. Paynes Find (C.J. French 1237)	*Wurmbea flavanthera* T.Macfarlane, A.P.Br. & C.J.French		Taxon formally published. See Macfarlane *et al.* (2020a).
Xyris atrovirida Doust & B.J.Conn	*Xyris atriviridis* Doust & B.J.Conn		Orthographic variant. See George (2019).

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Key to the genera of Ericaceae subfamily Epacridoideae (formerly Epacridaceae) in Western Australia

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SHORT COMMUNICATION

The last key to include all Western Australian genera in the former Epacridaceae (now Ericaceae, subfamily Epacridoideae) appeared in *How to know Western Australian Wildflowers Part IIIB* (Blackall & Grieve 1981). Since then there has been much research done (e.g. Powell *et al.* 1997; Taaffe *et al.* 2001; Quinn *et al.* 2003) into higher relationships within the subfamily, aimed at producing a robust, phylogenetically-based generic classification. A recent landmark publication on the molecular phylogeny of the *Styphelia* Sm.–*Astroloma* R.Br. clade of tribe *Styphelieae* Bartl. (Puente-Lelièvre *et al.* 2016), and its taxonomic implications, has in large part brought this process to a conclusion. Its central finding that all members of this large clade should be treated as *Styphelia* has significant implications for the classification of the Western Australian epacrids.

The genus *Leucopogon* R.Br. is now more narrowly circumscribed so as to include only those species with terminal inflorescences and, in all but a few species, sterile anther tips. Those species with strictly axillary inflorescences and lacking sterile anther tips have been transferred to *Styphelia* together with all species previously in the genera *Astroloma* R.Br., *Coleanthera* Stschegl. and *Croninia* J.M.Powell. With the formalisation of these changes (Crayn *et al.* 2020) and no other significant modifications to the generic taxonomy expected, this is considered an appropriate time to present an updated key to subfamily Epacridoideae for Western Australia.

Key to Western Australian genera of Ericaeae subfamily Epacridoideae

All taxa belong to the tribe *Styphelieae* except where indicated by the following prefixes:
C = *Cosmelieae*; E = *Epacrideae*; O = *Oligarrheneae*; R = *Richeeae*

1. Ovules several to numerous per locule; fruit a capsule; leaves sheathing, or if not (*Lysinema*) then filaments free from corolla

2. Stems with annular leaf scars; corolla lobes white, broadly obovate, adaxial surface with a well-defined, medial ridge towards the base ..... (R) **Sphenotoma**

2: Stems without annular leaf scars; corolla lobes pink, red, blue or if white or cream, then not obovate, adaxial surface without well-defined medial ridge towards the base

3. Corolla red, glabrous throughout; filaments adnate to the corolla .....(C) **Cosmelia**

3: Corolla usually pink, white, cream or blue but if red then lobes hairy; filaments free from corolla tube

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4. Leaves not sheathing; corolla white or cream, tube not fully connate below the lobes, partially split and 5-partite for some of its length..... (E) **Lysinema**

4: Leaves sheathing; corolla pink, white, cream, blue or red, tube fully connate below the lobes..... (C) **Andersonia**

1: Ovules 1 per locule; fruit a fleshy or ± dry drupe; leaves not sheathing, filaments always adnate to the corolla tube

5. Corolla tube conical towards the apex, the visible portion pink or purple, the lobes small, erect or slightly spreading; filaments flat or compressed; inflorescence axis terminating in a flower, no bud rudiment present..... **Conostephium**

5: Corolla tube never conical, other characters never in the above combination

6. Corolla lobes glabrous, papillose, or if partially hairy, the hairs short and inconspicuous (< 0.4 mm long), and restricted either to a central longitudinal band, an adaxial keel or a small basal or apical tuft; corolla sometimes not opening at anthesis

7. Stamens inserted in the lower half of the corolla tube

8. Corolla lobes uniformly flat throughout, with an abruptly narrowed, inflexed tip; hair tufts lacking at base of tube ..... (O) **Needhamiella**

8: Corolla lobes keeled adaxially in the upper half, without an inflexed tip; hair tufts alternating with stamens at base of tube ..... **Melichrus**

7: Stamens inserted at the top of the corolla tube

9. Corolla lobes 4; stamens 2 ..... (O) **Oligarrhena**

9: Corolla lobes 5; stamens 5

10. Corolla white, greenish-white or cream

11. Corolla lobes narrowly triangular, distinctly keeled and papillose adaxially in the upper half; reflexed tufts of hairs in the throat; ovary 3-locular ..... **Brachyloma stenolobum**

11: Corolla lobes ovate or triangular, adaxial surface ± flat, lacking a keel, glabrous or with an inconspicuous hair tuft towards the base; the throat glabrous; ovary 1- or 2-locular

12. Ovary 1-locular; leaf margins recurved or revolute, apex sharply mucronate ..... **Monotoca aristata**

12: Ovary 2-locular; leaves flat or adaxially concave, apex not mucronate

13. Leaves readily abscising from dried specimens, ± sessile, the base cuneate or attenuate; stigma prominently 2-lobed; nectary partite ..... (O) **Dielsiodoxa**

13: Leaves usually persistent on dried specimens, long-petiolate, the base cordate; stigma not lobed; nectary annular, lobed..... **Leucopogon extremus**

10: Corolla pink, red, purple or greenish flushed purple

14. Inflorescence terminal or both terminal and upper axillary, more than 2-flowered

15. Inflorescence ± pendulous; corolla not opening at anthesis; leaves linear with revolute margins, apex sharply mucronate ..... **Lissanthe synandra**

15: Inflorescence erect; corolla opening fully at anthesis; leaves

ovate or narrowly ovate, margins not revolute, adaxially concave, apex not mucronate ..... **Leucopogon extremus**

14: Inflorescence strictly axillary, 1 or 2-flowered

16. Corolla tube > 10 mm long, with a glabrous throat, and with 5 hairy appendages close to the base; corolla lobes distinctly keeled towards the apex on adaxial surface, shortly and inconspicuously hairy about the keel ..... **Brachyloma baxteri**

16: Corolla tube < 5 mm long, with hair tufts, or hairy appendages in the throat but never close to the base; adaxial surface of corolla lobes ± flat

17. Corolla red or pink; lobes imbricate in bud ..... **Brachyloma**

17: Corolla deep purple; lobes valvate in bud ..... [1]**Acrotriche** sp. **Israelite Bay**

6: Corolla lobes manifestly hairy, hairs usually evenly distributed across the width of the lobes (concentrated towards the margins in *Styphelia quartzitica*), although sometimes restricted to a transverse subapical band (*Acrotriche*), usually much longer than 0.4 mm; corolla always open at anthesis

18. Inflorescence terminal, and usually also, upper-axillary

19. Leaves with revolute margins abutting the midvein and completely obscuring the abaxial surface, the apex often sharply mucronate; anthers lacking a sterile tip ..... **Lissanthe**

19: Leaf curvature variable, but if margins revolute then some portion (whether towards the apex or base) of the abaxial surface remaining visible, the apex although often acute, never sharply mucronate; anthers usually with a sterile tip ..... **Leucopogon**

18: Inflorescence not terminal, strictly axillary

20. Corolla green or yellow-green, sometimes suffused purple on the tube; lobes usually with hairs confined to a transverse, subapical band, occasionally with very sparse, long hairs scattered across the surface; tube densely hairy in the throat ..... **Acrotriche**

20: Corolla variously coloured, rarely green or yellow-green, but if so, then corolla hairs not distributed as above

21. Inflorescence axis terminating in a flower, no bud rudiment present (few *Styphelia spp*. but all *Stenanthera* have this combination)

22. Corolla white; fleshy appendages absent from base of corolla tube; leaf curvature variable ..... **Styphelia**

22: Corolla red; fleshy appendages present at base of corolla tube; leaf margins revolute ..... **Stenanthera**

21: Inflorescence axis extending above the uppermost floral node and terminating in a bud rudiment (most *Styphelia* spp. have this combination)

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[1]The phrase-named taxon *Acrotriche* sp. Israelite Bay was placed in its nominated genus as a matter of convenience at a time when its closer affinities were unknown. Unpublished molecular data (C. Puente-Lelièvre pers. comm.) now indicate that its closest relationships are with *Brachyloma* Sond. and *Melichrus* R.Br. but further research is needed to confirm its generic placement.

23. Corolla lobe hairs interspersed with numerous papillae ..... **Acrotriche dura**

23: Corolla lobe hairs not interspersed with papillae ..... **Styphelia**

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Interim key to, and composition of, species groups in Western Australian *Styphelia*

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SHORT COMMUNICATION

A recent paper (Crayn *et al.* 2020) has formalised the transfer to *Styphelia* Sm. of all taxa previously included in *Astroloma* R.Br., *Coleanthera* Stschegl. and *Croninia* J.M.Powell, together with those species of *Leucopogon* R.Br. that have strictly axillary inflorescences and which lack sterile anther tips.

While the overall phylogenetic framework established by Puente-Lelièvre *et al.* (2016) within *Styphelia* is now settled, further research is desirable before a formal infrageneric classification is published. The relationships of a number of eastern Australian taxa still need to be determined, and further consideration of the best way to classify the morphologically heterogeneous Group X (*sensu.* Puente-Lelièvre *et al.* 2016) is also required. In the meantime, the information presented here is intended to give users the means to locate specimens within the established groups and to provide a better understanding of relationships within Western Australian *Styphelia*.

The group numbers used in the key below are basically the same as those applied by Puente-Lelièvre *et al.* (2016) in their phylogeny of the *Styphelia–Astroloma* clade. The only difference is that a new group, Group IIIb, has been designated for the former *Coleanthera*, while Group IIIa (rather than simply III) now applies to the *S. intertexta* group. It is noteworthy that IIIa and IIIb have a strongly supported sister relationship in the phylogenetic tree, despite there being no morphological similarities that suggest a close relationship.

Key

1. Corolla various shades of red, pink, orange, pale yellow, cream or green; internal corolla tube usually with a well-defined whorl of hairs close to the base (absent only in *S. discolor* and *S. foliosa*); corolla lobes bi-textured, the distal portion of the corolla lobes abruptly smoother and paler than the basal portion; filaments flattened (linear in section) or occasionally compressed (narrowly elliptic in section) ..... **Group I**

1: Corolla mostly white, occasionally red, pink or cream; corolla tube usually without a well-defined whorl of hairs close to base (present only in *S. stomarrhena*); corolla lobes not bi-textured; filaments mostly ± terete, very occasionally plano-convex

2. Anthers conspicuously exserted from the corolla tube; corolla lobes usually spreading from base, revolute and often coiled abaxially (erect for up to 1/4 of

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their length and then spreading and becoming recurved to revolute in *S. stomarrhena* and *S. rectiloba*)

3. Anthers connate or cohering, around the style

4. Corolla pale pink or white; filaments glabrous; drupe ovoid, tapering markedly towards the apex; internal corolla tube glabrous towards the base ..... **Group IIIb**

4: Corolla dark pink or red; filaments densely hairy; drupe depressed-obovoid, apex obtuse; internal corolla tube with five basal hair tufts ..... **Styphelia stomarrhena**

3: Anthers completely free from style

5. Leaf apex obtuse; corolla red; internal corolla tube glabrous in the upper portion below the lobes, but with a discrete band of hairs in the basal 1/3–1/2 ..... **Styphelia hainesii**

5: Leaf apex long-mucronate, pungent; corolla white or cream; internal corolla tube hairy for some distance below the lobes and usually becoming glabrous towards the base, or occasionally hairy throughout

6. Leaf margins revolute, the abaxial surface deeply grooved and hairy, at least between the grooves ..... **Group IIIa**

6: Leaves mostly flat or adaxially concave or if occasionally adaxially convex, the margins not revolute and the abaxial surface glabrous

7. Anthers becoming shortly exserted from the tube and held at right angles to the floral axis post-anthesis; corolla lobes spreading and recurved when live but drying ± straight and reflexed; ovary 3-locular, hairy, with hairs extending onto the lower style ..... **Styphelia rectiloba**

7: Anthers long-exserted from tube; corolla spreading from base, revolute and coiled abaxially; ovary 5-locular glabrous

8. Corolla cream; nectary annular, much shorter than the ovary; drupe ovoid or ovoid-ellipsoid ..... **Group II**

8: Corolla white; nectary partite, ± equal to, or longer than, the ovary; drupe very narrowly ellipsoid to ± cylindrical, often curved ..... **Styphelia exserta**

2: Anthers included, partially exserted or if fully exserted from the corolla tube, then not exserted beyond the erect bases of the corolla lobes and therefore not appearing to be exserted; curvature of corolla lobes various, rarely spreading from the base, but if so then never revolute or coiled abaxially

9. Inflorescence and flowers pendulous or widely spreading

10. Nectary partite; ovary usually hairy, occasionally glabrous; drupe ± dry, without an obvious mesocarp ..... **Group VIII**

10: Nectary annular, either truncate or variously lobed; ovary always glabrous; drupe usually with a fleshy mesocarp

11. Sepals and bracteoles prominently striate when dry; sepals 5.6–6.5 mm long; ovary pale green in dried specimens ..... **Styphelia cernua**

11: Sepals and bracteoles ± smooth, not or scarcely striate when dry; sepals mostly < 5 mm long; ovary dark green to almost black in dried specimens ..... **Group V**

9: Inflorescence and flowers strictly erect

12. Inflorescence axis apparently terminating in a flower, no bud-rudiment present; style hairy, markedly narrowing towards the base and readily detached from ovary apex; ovary densely hairy with the surface obscured throughout, the longest ovary hairs 2–3 mm long; anther tips sterile ..... **Styphelia kingiana**

12: Character combination never as above

13. Sepals and bracteoles distinctly striate when dry; sepals 4.2–9.2 mm long..... **Group IX**

13: Sepals not, or barely striate when dry, bracteoles not, or rarely striate; sepals < 4.2 mm long

14. Sepal margins distinctly undulate; drupe with a truncate apex; outer surface of corolla lobes papillose..... **Group X**

14: Sepal margins not undulate; drupe apex never truncate; outer surface of corolla lobes glabrous or distinctly hairy

15. Leaf margins revolute, abaxial leaf surface deeply grooved and shortly hairy within the grooves..... **Styphelia subulata**

15: Leaf curvature various, but if the margins revolute then the abaxial surface never deeply grooved

16. Ovary uniformly dark green to almost black in dried specimens; leaves usually adaxially convex, often with recurved to revolute margins, very occasionally (*S. leptantha, S. obtecta*) adaxially concave..... **Group V**

16: Ovary pale to mid green in dried specimens or sometimes straw-coloured to pale brown; leaves usually adaxially concave, sometimes ± flat, rarely adaxially convex

17. Drupe strongly compressed (± linear to narrowly elliptic in section), with prominent venation; ovary 2-locular; single-flowered inflorescences without bracts below the bracteoles..... **Group XI**

17: Drupe circular in section; ovary usually 3- or 5-locular, rarely 2-locular, circular in section; bracts always present below the bracteoles

18. Ovary and drupe narrowly conical, narrowly fusiform, or ± cylindrical, the style not or barely differentiated from the ovary, or if relatively well-differentiated, then 0.4 mm long or less; ovary 3-locular, the individual locules minute and very obscure (only discernible under high magnification from a basal section of the ovary); nectary partite; filaments very short to *c.* 0.2 mm long..... **Group X**

18: Ovary variously shaped, rarely as above, the style always well-differentiated from the ovary, mostly > 0.4 mm long; ovary mostly 5-locular, occasionally 2-locular (3-locular in *L.* sp. outer wheatbelt), the locules readily discernible; nectary annular or partite; filaments usually > 0.2 mm long

19. Point of filament attachment to anthers at least 3/4 above anther base..... **Group X**

19: Point of filament attachment to anthers 1/2–2/3 above anther base

20. Leaves prominently ciliate with stiff, marginal hairs; nectary partite; ovary 2-locular..... **Styphelia hispida**

20: Leaves without prominent, marginal cilia; nectary annular; ovary 5-locular

21. Leaves linear, longitudinally twisted; corolla lobes erect for 1/2 −2/3 of their length and then spreading and recurved, sparsely hairy, with hairs concentrated towards the margins..... **Styphelia quartzitica**

21: Leaves ovate or obovate, never twisted; corolla lobes spreading from the base and recurved, densely and uniformly hairy..... **Group IV**

Composition of species groups

All taxa in the tables below were included in the molecular phylogeny of Puente-Lelièvre *et al.* (2016) apart from those with the * prefix which are placed in their respective groups on the basis of morphological extrapolation of critical features.

Appended numbers are used in the tables to cross-reference name changes that have been made subsequent to the publication of Puente-Lelièvre *et al.* (2016). Note however that this does not include those taxa whose recent transfer to *Styphelia* (Crayn *et al.* 2020) required no change to the species epithet.

Group I: Consists of 22 taxa previously in *Astroloma s. str.*

Styphelia acervata (Hislop & A.J.G.Wison) Hislop, Crayn & Puente-Lel.
Styphelia chlorantha (Hislop & A.J.G.Wison) Hislop, Crayn & Puente-Lel.
Styphelia compacta (R.Br.) Spreng.
Styphelia discolor (Sond.) Hislop, Crayn & Puente-Lel.[1]
Styphelia epacridis (DC.) F.Muell.
Styphelia erectifolia Hislop, Crayn & Puente-Lel.[2]
Styphelia foliosa (Sond.) Hislop, Crayn & Puente-Lel.
Styphelia inopinata (Hislop) Hislop, Crayn & Puente-Lel.
Styphelia macrocalyx (Sond.) F.Muell.
Styphelia microcalyx (Sond.) F.Muell.
Styphelia microdonta (Benth.) F.Muell.
Styphelia oblongifolia (A.J.G.Wison & Hislop) Hislop, Crayn & Puente-Lel.
Styphelia pallida (R.Br.) Spreng.
**Styphelia pentapogona* F.Muell.
Styphelia prostrata (R.Br.) F.Muell.
Styphelia serratifolia (DC.) Hislop, Crayn & Puente-Lel.
Styphelia tecta (R.Br.) Spreng.
Styphelia tortifolia Hislop, Crayn & Puente-Lel.[3]
Styphelia sp. Dumbleyung (A.J.G. Wilson 146)
Styphelia sp. Eneabba (N. Marchant s.n. (PERTH 01291777)
Styphelia sp. Nannup (R.D. Royce 3978)
Styphelia sp. Narrogin (R.D. Royce 8158)

[1] Referred to *Astroloma ciliatum* in Puente-Lelièvre *et al.* (2016).
[2] Referred to *Astroloma drummondii*
[3] Referred to *Astroloma glaucescens*

Group II: Consists of three taxa previously in *Styphelia*.

**Styphelia melaleucoides* F.Muell. subsp. *melaleucoides*

Styphelia melaleucoides subsp. *ovata* (Benth.) Hislop, Crayn & Puente-Lel.[4]

Styphelia tenuiflora Lindl.

[4] Referred to *Styphelia melaleucoides*

Group IIIa: Consists of four taxa previously in *Styphelia* and *Leucopogon*.

**Styphelia deserticola* Hislop

Styphelia intertexta A.S.George

Styphelia saxicola Hislop[5]

Styphelia subulata (F.Muell.) Hislop, Crayn & Puente-Lel.[6]

[5] Referred to *Styphelia* sp. Bullfinch (M. Hislop 3574)

[6] Referred to *Leucopogon* sp. Kau Rock (M.A. Burgman 1126)

Group IIIb: Consists of two taxa previously in *Coleanthera.*

Styphelia coelophylla (DC.) Hislop, Crayn & Puente-Lel.[7]

**Styphelia lanata* Hislop, Crayn & Puente-Lel.

[7] Referred to *Coleanthera myrtoides*

Group IV: Consists of three taxa previously in *Leucopogon* (phrase-name still formulated under *Leucopogon*).

Styphelia lissanthoides (F.Muell.) F.Muell.[8]

Styphelia rotundifolia (R.Br.) Spreng.

**Leucopogon* sp. Boorabbin (K.R. Newbey 8374)

[8] Referred to *Leucopogon cuneifolius*

Group V: Consists of 37 taxa previously in *Leucopogon* (most phrase-names still formulated under *Leucopogon*)[9].

**Styphelia allittii* (F.Muell.) F.Muell.

Styphelia brevicuspis (Benth.) F.Muell.[9]

Styphelia concinna (Benth.) F.Muell.

Styphelia cordifolia (Lindl.) F.Muell.

**Styphelia dielsiana* (E.Pritz.) Sleumer

Styphelia erubescens F.Muell.[10]

Styphelia filifolia Hislop & Puente-Lel.[11]

**Styphelia glaucifolia* (W.Fitzg.) Hislop, Crayn & Puente-Lel.

Styphelia insularis (DC.) Hislop, Crayn & Puente-Lel.

Styphelia leptantha (Benth.) F.Muell.

Styphelia nitens Sleumer[12]

Styphelia obtecta (Benth.) F.Muell.

Styphelia pendula (R.Br.) Spreng.

Styphelia planifolia (Sond.) Sleumer

Styphelia propinqua (R.Br.) Spreng.

**Styphelia psilopus* (Stschegl.) Hislop, Crayn & Puente-Lel.

Styphelia racemulosa (DC.) F.Muell.

Styphelia retrorsa Hislop, Crayn & Puente-Lel.[13]

Styphelia stricta (Benth.) F.Muell.

**Styphelia strongylophylla* (F.Muell.) F.Muell.

Styphelia woodsii (F.Muell.) F.Muell.

Styphelia sp. Albany (M. Hislop 2218)[14]

**Styphelia* sp. Cascades (R. Davis 11037)

Styphelia sp. Stirling Range (R.D. Royce 1087)[15]

**Styphelia* sp. Wandoo (F. & J. Hort 2441)

**Leucopogon* sp. Bungulla (R.D. Royce 3435)

Leucopogon sp. Coomallo (R.J. Cranfield 1457)

Leucopogon sp. Dumbleyung (M. Hislop & F. Hort MH 3239)

Leucopogon sp. Gingilup (N. Gibson & M. Lyons 590)

Leucopogon sp. Margaret River (J. Scott 207)

Leucopogon sp. Mid West (J.S. Beard 7388)

**Leucopogon* sp. Moresby Range (S. Patrick 2614)

Leucopogon sp. Port Gregory (C. Page 33)

Leucopogon sp. Southern Granite (E.D. Middleton EDM 266)

Leucopogon sp. Walpole (R.J. Cranfield 10940)

Leucopogon sp. Yanchep (M. Hislop 1986)

Leucopogon sp. Yanneymooning (F. Mollemans 3797)

[9] Referred to *Leucopogon* sp. Bindoon (F. Hort 2766)

[10] Referred to *Leucopogon oxycedrus*

[11] Referred to *Leucopogon* sp. Murdoch (M. Hislop 1037)

[12] Referred to *Leucopogon nutans*

[13] Referred to *Leucopogon* sp. Northern Scarp (M. Hislop 2233)

[14] Referred to *Leucopogon ovalifolius*

[15] Referred to *Leucopogon glaucifolius*

Group VIII: Consists of 12 taxa previously in *Leucopogon* (phrase-names still formulated under *Leucopogon*).

Styphelia conostephioides (DC.) F.Muell.

Styphelia filamentosa Hislop & Puente-Lel.[16]

Styphelia hispida (E.Pritz.) Sleumer

Styphelia pubescens (S.Moore) Hislop, Crayn & Puente-Lel.

**Styphelia rigida* (DC.) Hislop, Crayn & Puente-Lel.

**Leucopogon* sp. Carnamah (M. Hislop 2898)

Leucopogon sp. Cockleshell Gully (J.M. Powell 1749)

Leucopogon sp. Coujinup (M.A. Burgman 1085)

**Leucopogon* sp. Lake Tay (W.R. Archer 2104138)

Leucopogon sp. Newdegate (M. Hislop 3585)

Leucopogon sp. Northern ciliate (R. Davis 3393)

Leucopogon sp. short style (S. Barrett 1578)

[16] Referred to *Leucopogon* sp. Bifid Eneabba (M. Hislop 1927)

Group IX: Consists of seven taxa previously in *Astroloma* and *Leucopogon.*

Styphelia angustiflora Hislop & Puente-Lel.[17]

Styphelia cernua Hislop & Puente-Lel.[18]

Styphelia disjuncta Hislop & Puente-Lel.[19]

Styphelia longissima Hislop & Puente-Lel.[20]

Styphelia stomarrhena (Sond.) Sleumer

**Styphelia sulcata* Hislop & Puente-Lel.

Styphelia xerophylla (DC.) F.Muell.

[17] Referred to *Astroloma* sp. sessile leaf (J.L. Robson 657)

[18] Referred to *Astroloma* sp. Kalbarri (D. & B. Bellairs 1368)

[19] Referred to *Leucopogon* sp. Ongerup (A.S. George 16682)

[20] Referred to *Leucopogon* sp. ciliate Eneabba (F. Obbens & C. Godden s.n. 3/7/2003)

Group X: Consists of taxa 46 previously in *Leucopogon* and *Croninia* (most phrase-names still formulated under *Leucopogon*).

**Styphelia breviflora* (F.Muell.) F.Muell.

**Styphelia conchifolia* (Strid) Hislop, Crayn & Puente-Lel.

Styphelia corynocarpa (Sond.) F.Muell.

Styphelia crassiflora F.Muell.

**Styphelia crassifolia* (Sond.) F.Muell.

**Styphelia cymbiformis* (DC.) F.Muell.

Styphelia decussata Hislop, Crayn & Puente-Lel.[21]

**Styphelia hamulosa* (E.Pritz.) Sleumer

Styphelia kingiana F.Muell.

Styphelia marginata (W.Fitzg.) Hislop, Crayn & Puente-Lel.

**Styphelia multiflora* (R.Br.) Spreng.

**Styphelia pogonocalyx* (Benth.) F.Muell.

**Styphelia tamminensis* (E.Pritz.) Sleumer

Styphelia williamsiorum Hislop & Puente-Lel.[22]

Styphelia sp. South Coast (J.M. Powell 3374)[23]

Leucopogon sp. Arrino (M. Hislop 2675)

Leucopogon sp. Badgingarra (R. Davis 421)

**Leucopogon* sp. Bolgart (M. Hislop & F. Hort MH 2486)

Leucopogon sp. Bremer Bay (K.R. Newbey 4667)

Leucopogon sp. Brookton (K. Kershaw & L. Kerrigan KK 2192)

**Leucopogon* sp. Clyde Hill (M.A. Burgman 1207)

**Leucopogon* sp. Coolgardie (M. Hislop & F. Hort MH 3197)

**Leucopogon* sp. Corrigin (K. Kershaw & L. Kerrigan KK 2091)

**Leucopogon* sp. Dongolocking (K. Kershaw KK 2333)

Leucopogon sp. Forrestania (G.F. Craig 2386)

**Leucopogon* sp. Frank Hann (K.R. Newbey 11499)

Leucopogon sp. Great Southern (R.S. Cowan A 586)

Leucopogon sp. Gunapin (F. Hort 808)

Leucopogon sp. Howatharra (D. & N. McFarland 1046)

**Leucopogon* sp. Ironcaps (N. Gibson & K. Brown 3070)

**Leucopogon* sp. Jaurdi (M. Hislop 4172)

Leucopogon sp. Kalbarri (J.M. Powell 1695)

**Leucopogon* sp. Karroun Hill (K.R. Thiele 4167)

**Leucopogon* sp. Lake King (A.J.G. Wilson 65)

**Leucopogon* sp. Lort River (M. Golding 3)

**Leucopogon* sp. Manypeaks (A.S. George 6488)

Leucopogon sp. Mount Heywood (M.A. Burgman 1211)

**Leucopogon* sp. Murchison (R.J. Cranfield 9224)

**Leucopogon* sp. outer wheatbelt (M. Hislop 30)

**Leucopogon* sp. Salt Lake (G.F. Craig 3069)

Leucopogon sp. Tathra (M. Hislop 2900)

**Leucopogon* sp. Varley (M. Hislop 3659)

Leucopogon sp. Wandering (F. Hort 419)

**Leucopogon* sp. Wheatbelt (S. Murray 257)

Leucopogon sp. Yandanooka (M. Hislop 2507)

**Leucopogon* sp. Yellowdine (M. Hislop & F. Hort MH 3194)

[22] Referred to *Leucopogon* sp. Warradarge (M. Hislop 1908)
[23] Referred to *Leucopogon crassifolius*

Group X1: Consists of seven taxa previously in *Leucopogon* (phrase-names formulated under *Styphelia* and *Leucopogon*).

Styphelia blepharolepis F.Muell.

**Styphelia capillaris* Hislop & Puente-Lel.

Styphelia ciliosa Hislop & Puente-Lel.[24]

**Styphelia densifolia* Hislop, Crayn & Puente-Lel.

**Styphelia flavescens* (Sond.) F.Muell.

**Styphelia* sp. Tarin Rock (W.E. Blackall 1315)

**Leucopogon* sp. Lake Magenta (K.R. Newbey 3387)

[24] Referred to *Leucopogon* sp. Moore River (M. Hislop 1695)

Two morphologically anomalous species, *S. exserta* (F.Muell.) Sleumer and *S. hainesii* F.Muell., were not closely associated with any of the numbered groups in the phylogeny of Puente-Lelièvre *et al.* (2016). The closer affinities of two other anomalous species, *S. quartzitica* Hislop and *S. rectiloba* Hislop are still to be determined.

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Two new, orange-flowered *Tephrosia* (Fabaceae: Millettieae) species from the Kimberley region, in Western Australia's monsoon tropics

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Abstract

Butcher, R. Two new, orange-flowered *Tephrosia* (Fabaceae: Millettieae) species from the Kimberley region, in Western Australia's monsoon tropics. *Nuytsia* 32: 39–50 (2021). Ongoing taxonomic revision of *Tephrosia* Pers. in Australia is continuing to identify new taxa from study of existing herbarium collections as well as new material gathered from remote and under-collected areas. The Kimberley region of Western Australia is recognised for its biodiversity and endemism, but the recognition of new species is hampered by its inaccessibility, especially to areas of relief with complex microhabitats and refugia. It is from these areas that many recently described species, from across the Western Australian flora, have been collected. This paper describes and illustrates two new, poorly known, orange-flowered species of *Tephrosia* from the Kimberley region: *T. cowiei* R.Butcher, a close ally of the Northern Territory's *T. bifacialis* Cowie, and *T. funicularis* R.Butcher, a distinctive new species from sandstone habitats.

Introduction

Tephrosia Pers. (Fabaceae: Millettieae) is a pantropically distributed, species-rich genus of pea-flowered legumes, comprising 77[1] named and 57 unnamed native taxa in Australia, based on the *Australian Plant Census* and Butcher (2018a, 2018b, 2020, this publication). This is considered an underestimate of its true diversity in Australia, with many more putatively new taxa recognised informally within the Herbarium collections of Queensland (BRI), Western Australia (PERTH) and the Northern Territory (DNA) as a result of recent and ongoing taxonomic revisions.

Since Les Pedley (dec.) commenced his revision of *Tephrosia* in Australia in the 1970s, 11 new taxa have been formally described from Western Australia (Pedley 1977; Maconochie 1980; Cowie 2004; Butcher & Hurter 2012; Butcher 2018a, 2018b, 2020). Of these, four extend across the Australian Monsoon Tropics (AMT) (*sensu* Bowman *et al.* 2010) from the Kimberley region (i.e. Kimberley Plateau phytogeographic sub-region *sensu* Ebach *et al.* (2013), of the Northern phytogeographic region *sensu* González-Orozco *et al.* (2014) and Ebach *et al.* (2015)) and beyond (WA+NT: *T. procera* Cowie, *T. spechtii* Pedley, *T. valleculata* Cowie; WA+NT+Qld: *T. virens* Pedley). The remaining seven are known only from Western Australia, with six occurring in the Northern Desert or Eremaean phytogeographic regions (*sensu* González-Orozco *et al.* (2014) and Ebach *et al.* (2015)) (*T. andrewii* Cowie, *T. arenicola* Maconochie, *T. densa* (Benth.) Pedley ex R.Butcher, *T. gardneri* Pedley ex

[1]Counting the species name and the autonym (and its rank variations, e.g. in *T. filipes*) as one taxon where infrataxa are listed.

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R.Butcher, *T. oxalidea* R.Butcher & P.J.H.Hurter and *T. pedleyi* R.Butcher) and one (*T. cardiophylla* R.Butcher) apparently restricted to the Kimberley.

With a geomorphologically and physiographically diverse land area of 424,500 km^2, dominated by tropical savanna woodland punctuated with rainforest remnants, Western Australia's Kimberley region has a high level of richness and endemism for flora, fauna and fungi (e.g. Ladiges *et al.* 2011; Pepper & Keogh 2014; Barrett 2016). The region has a monsoonal climate, with average rainfall varying from 1,500 mm in the north-west coastal areas to under 350 mm in the south. Its varied terrain has evolved over 250 million years, supports a flora and fauna distinct from the remainder of Western Australia, and is a unique bioregion within the AMT (Pepper & Keogh 2014); it contains more than 2,000 plant species (Western Australian Herbarium 1998–) and is an area of endemism for many groups (e.g. species of *Eucalyptus* and *Corymbia*; Ladiges *et al.* 2011).

Thirty-eight (76%) of the 50 new species described in the collected papers of *Nuytsia* vol. 26, a special issue celebrating 50 years of the Botanic Gardens at Kings Park, are Kimberley taxa. The richest areas for new species discoveries have been highly seasonal sandstone pavements, mostly in the higher rainfall north-west Kimberley, as well as the peaks, plateaux, cliff-faces and gorges associated with dissected sandstone ranges, and outcrops (Barrett 2015). These environments provide microhabitats, and refugia from fire in surrounding savannas, with shallow soils undergoing complex wet-dry cycles supporting diverse communities of annual plants (Barrett 2015).

There are presently 151 informally named taxa on the Western Australian plant census (Western Australian Herbarium 1998–) that occur in the Kimberley region, a number that reflects only those collections that have sufficient material for taxonomic assessment, have been critically studied, and have been processed. Of these, 75 have conservation listing in Western Australia (T=1; P1=45; P2=12; P3=15), indicating their poorly known status[2]. There are undoubtedly many other putatively new Kimberley taxa among the specimens at PERTH that have not yet been identified as such or processed into the collection.

For Beard's (1980) Northern Botanical Province of Western Australia[3], an analysis of the PERTH specimen collection by former curator Kevin Thiele found that over the period 1980–2010, on average one new taxon was discovered for every 30 specimens collected (Government of Western Australia 2011). This average rose to one new taxon for every eight specimens collected when only wet season collections were analysed; most Kimberley specimens (>80%) have been collected during the dry season, when the region can be more easily accessed. Thiele's Kimberley analyses indicate that (1) the return (new taxa) on investment (specimens collected) is very high (particularly for wet season collections; see also Barrett 2015), and (2) our state of knowledge of the flora is a long way from complete and the rate of discovery is very high.

Species discovery in the Kimberley is hampered by the scale and remoteness of the region, as well as complex land tenures. Consequently, field work is logistically challenging and expensive, with accessibility issues (e.g. road closures etc.) significantly exacerbated in the wet season, when most species are fertile and collections are of greatest value. For much of the Kimberley we are data deficient and lack the collections needed to properly assess species boundaries in poorly known taxa (or to describe them in full) and the field experience necessary to develop our taxonomies meaningfully through *in situ* observations of morphological variation across different habitats. Both of these constraints apply to

[2]For definitions see: https://www.dpaw.wa.gov.au/images/documents/plants-animals/threatened-species/Listings/conservation_code_definitions.pdf

[3]Comprising the IBRA regions Dampierland, North Kimberley, Central Kimberley, and those areas of the Ord-Victoria Plains and Victoria Bonaparte west of the Northern Territory border.

Tephrosia in the Kimberley and across the AMT: many interesting singleton or incomplete specimens languish, unvalidated, in the collection, and many seemingly variable and widespread, putatively new taxa have fuzzy boundaries with one another across their range. Comparatively, the highest number of *Tephrosia* phrase names erected and resolved since commencement of recent study has been in the Pilbara bioregion, which reflects comprehensive survey effort there (Pilbara Region Biodiversity Survey; McKenzie *et al.* 2009), often facilitated by improved access and increased collecting activity associated with the mining industry, and subsequent taxonomic investigations (Butcher *et al.* 2017).

In this paper, two new, orange-flowered species of *Tephrosia* from Western Australia are described, both known only from the Kimberley region. The first belongs in a group of reticulate-nerved species treated by Cowie (2004), with sterile material recognised as being different from the closely allied species *T. bifacialis* Cowie in that publication and in his specimen determinations from 2011 (*T.* sp. aff. *bifacialis* and *T.* aff. *reticulata* Benth.). Now that flowering and fruiting material has been seen, it is named here in his honour as *T. cowiei* R.Butcher. The second, *T. funicularis* R.Butcher, was recognised as new during revisionary curation of the PERTH *Tephrosia* collection, with two specimens located under *T. remotiflora* Benth. and one under *T. supina* Domin. It is readily distinguishable from both, however, and its affinities lie closer to *T. crocea* Benth. That the first known collection of *T. funicularis* was made in 2001 serves to highlight how poorly collected many taxa are in this mostly inaccessible region and is yet another example of ongoing taxonomic discovery in the Kimberley.

Material and methods

All *Tephrosia* specimens housed at PERTH were critically studied, as were the collections housed at AD, BRI, CANB, DNA, MEL, NSW and NT, and Australian material on loan from K. Types of all Australian species have been viewed on loan, through *Global Plants* (https://plants.jstor.org) or as images (e.g. from PR). Bioregions and sub-bioregions referred to in the text and displayed on distribution maps follow *Interim Biogeographic Regionalisation for Australia* (IBRA) v. 7 (Department of the Environment 2013).

Leaf venation terminology follows Ellis *et al.* (2009). The inflorescence is interpreted as a pseudoraceme following Tucker (1987, 2003), where the elongate rachis has fascicles of flowers in the axils of first-order bracts (here termed 'inflorescence bract'), each flower subtended by a second-order bract (here termed 'floral bract'); paired bracteoles on the pedicel can be present or absent in the genus. Fascicles comprise one or more 3-flowered units, with the first two flowers opening in relatively close succession and the third flower in each unit often delayed developmentally, with anthesis commonly occurring once the first two flowers have developed into fruits. Seed length is measured from the hilar side (point of attachment) to the opposite side, with width measured at 90° to this; terminology surrounding the hilum and rim aril follows Butcher (2020) and references therein.

Taxonomy

Tephrosia cowiei R.Butcher, *sp. nov.*

Type: Durack Station, east of Durack River crossing on Gibb River Road, Western Australia [precise locality withheld for conservation reasons], 4 May 2018, *R. Butcher, E.M. Joyce & K. Thiele* RB 2186 (*holo*: PERTH 09316221; *iso*: BRI, CANB, DNA).

Tephrosia sp. Durack River (C.A. Gardner 9938), Western Australian Herbarium, in *FloraBase*, https://florabase.dpaw.wa.gov.au/ [accessed 7 February 2020].

Prostrate *subshrub*, few- to multi-stemmed, apparently perennial with annual above-ground parts, to 0.2 m tall including inflorescences, to 1.5 m wide; rootstock an undifferentiated taproot. *Branchlets, leaf and inflorescence rachides* moderately hairy, the hairs patent to spreading (in both directions) on the same plant, 0.3–1 mm long, straight to slightly wavy, white, hyaline. *Leaves* trifoliolate to pinnate, up to 90 mm long including petiole; *stipules* usually persistent, antrorse, reflexed with age, attenuate to ovate, 2–4.5 mm long, green ageing to yellow-brown, 3- or 5-nerved, sparsely to densely hairy; *petiole* 2–7 mm long; *ultrajugal rachis* 3.4–11 mm long; *stipellae* absent; *petiolules* 0.9–1.8 mm long; *leaflets* 3–7, elliptic to broadly oblong to obovate, flat in T.S. but depressed along midvein, at least some attached in the basal half of the leaf; base rounded; apex rounded to truncate, retuse, straight, not to scarcely mucronate, mucro 0.2–0.3 mm long on young leaves, otherwise vestigial; lateral leaflets 11–34 mm long, 8–24 mm wide, length 1.24–2.17 × width; terminal leaflet 1.05–1.32 × the length of adjacent laterals, 16–53.5 mm long, 10–31 mm wide, length 1.22–2.13 × width; lamina strongly discolorous, the upper surface mid- to dark green; upper surface glabrous, somewhat glaucous; lower surface indumentum moderately dense to dense, the hairs appressed, hyaline-white to silvery, sometimes visible from above as a hairy margin; secondary veins brochidodromous, in 8–13 pairs, the intersecondary veins reticulate, sometimes parallel at base before divaricating, veins raised on lower surface. *Inflorescence* pseudoracemose, terminal, to 325 mm long, fascicles well-spaced, 3–6(–9)-flowered; *inflorescence bracts* caducous (not seen); *floral bracts* antrorse, attenuate to deltoid, 0.6–1.5 mm long, caducous; *bracteoles* usually absent, if present then not on all flowers in inflorescence and spathulate, *c.* 0.2 mm long (excluding indumentum), caducous; *pedicels* 0.9–4.5 mm long. *Calyx* 2.2–3.6 mm long, indumentum moderately dense, the hairs ascending, hyaline-white, slightly wavy; tube 1.5–2.4 mm long, 1.1–1.6 × the length of lateral lobes; lower and lateral lobes narrowly deltoid to deltoid; vexillary lobes united higher than lower three, free for 0.2–0.6 mm; lowest lobe 1.1–1.8 mm long, ±equal to lateral lobes. *Flowers* pale orange, 5.5–7.5 mm long; standard 4.4–5.5 mm long, 5.5–7.4 mm wide, the claw 1–1.9 mm long, the blade depressed-ovate to transversely reniform, slightly callused at base with a shallowly emarginate apex; wings 4.6–5.8 mm long (incl. 1–2.3 mm long claw), 2.3–2.75 mm wide, longer than keel, the blade broadly oblong to obovate, with a broadly rounded apex; keel 3.9–5.6 mm long (incl. 0.7–2.2 mm long claw), 1.9–2.4 mm wide, the blade semi-circular, glabrous. *Staminal* tube glabrous, fenestrae a little thickened on margins towards the base; vexillary filament straight in lower half and not callused near base, glabrous; anthers 0.5–0.7 mm long, 0.4–0.6 mm wide, with a small apiculus between the cells. *Ovary* densely hairy; ovules 3 or 4, positioned in mid-region of ovary with notable voids at the proximal and distal ends (or just the proximal end). *Style* flattened, tapering to apex, some hairs at base on vexillary side; stigma ciliate, linear. *Pod* linear, straight, 30–40 mm long, 4–5.2 mm wide, tapering outwards from base to near apex because of ovule/seed position, stramineous (greyish pale brown by the following season), indumentum moderately dense, ascending to patent, white, the hairs straight to slightly wavy; beak excentric to central, deflexed; white tissue present between seeds and where seeds are absent. *Seeds* 1–4 per pod, 5.8–7 mm between centres of adjacent seeds, ±ellipsoid, slightly oblique at one end, very thick in the middle, 2.7–3.2 mm long, 4.4–4.7 mm wide, uniformly golden brown or flecked with gold and dark brown, yellow-gold around hilum, testa smooth; hilum slightly excentric, with an indistinct, golden, horse-collar shaped rim aril. (Figure 1)

Diagnostic features. Distinguished from all other Australian *Tephrosia* species by the following combination of characters: closely prostrate plants with 3–7, strongly discolorous, elliptic to obovate leaflets 11–53.5 × 8–31 mm; terminal pseudoracemes of pale orange flowers 5.5–7.5 mm long, with the calyx tube = to or longer than the lateral lobes, which are *c.* = in length to the lower lobe; glabrous staminal tube and vexillary filament; 3 or 4 ovules, which are positioned only in the mid-region of the ovary or centrally and distally; linear pod with an excentric to central, deflexed beak; and smooth, thick, obliquely ellipsoid, golden brown (often flecked) seeds 2.7–3.2 × 4.4–4.7 mm.

Figure 1. *Tephrosia cowiei*. A – small plant showing prostrate habit, 3–7 elliptic to obovate leaflets per leaf and spent, terminal infructescence (pods fallen); B – terminal pseudoraceme of pale orange flowers, showing the calyx tube longer than the deltoid lobes. Images from the type population (A) and the type, *R. Butcher, E.M. Joyce & K. Thiele* RB 2186 (B). Photographs by R. Butcher.

Specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 4 June 2012, *R.L. Barrett* RLB 7625 (DNA, NSW, PERTH); 4 May 2018, *R. Butcher, E.M. Joyce & K. Thiele* RB 2187 (PERTH); 20 May 1993, *I. Cowie* 4173 (BRI, CANB, DNA, MEL, PERTH); 15 May 2006, *I.D. Cowie* 11185 & *D. Dixon* (BRI, DNA, MEL, PERTH); 19 Oct. 2001, *A. Craig*

KNR_Ag0036 (PERTH); 30 Jan. 1951, *C.A. Gardner* 9938 (PERTH, 2 sheets); *s. dat.*, *B. Morgan s.n.* (PERTH 09316248).

Distribution. Currently known only from Durack River, Gibb River, and Doongan Stations, in the Central Kimberley and Northern Kimberley bioregions (Figure 2).

Habitat. Grows in sandy or gravelly, sometimes seasonally wet/waterlogged, soils over sandstone, in *Eucalyptus obconica* or *E. tectifera-Melaleuca sericea* woodland over *Aristida hygrometrica* and *Sorghum* sp.

Phenology. Flowering and fruiting periods are not properly known. Only three specimens have flowers, and these were collected in late January, May and August (many flowers); dehiscing pods with seed were collected in early May.

Conservation status. Listed as Priority One (Poorly Known Flora) under Conservation Codes for Western Australian Flora as *T.* sp. Durack River (C.A. Gardner 9938) (Smith & Jones 2018). This is equivalent to the IUCN rank Data Deficient. This species is very poorly known and has been collected only six times since 1951, over an area of *c.* 60 km, and mostly along the Gibb River Road. Access

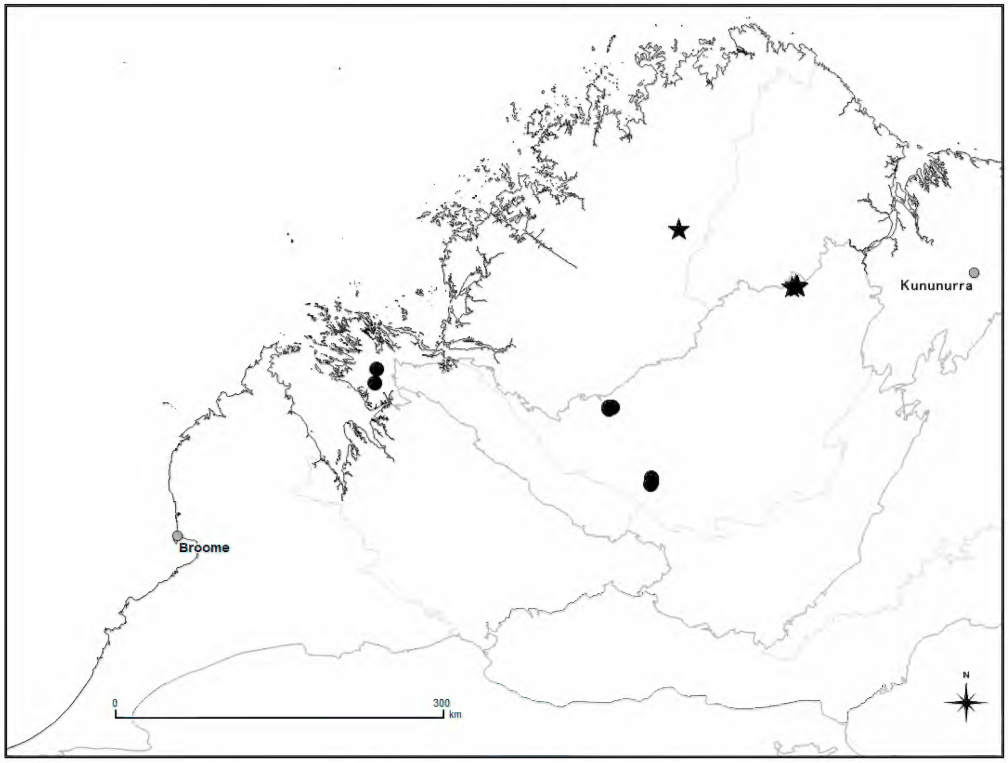

Figure 2. Distribution of *Tephrosia cowiei* (★) and *T. funicularis* (●) in the Kimberley region of northern Western Australia, where both species are known from the Central Kimberley and Northern Kimberley bioregions. *Interim Biogeographic Regionalisation for Australia* (IBRA) v 7 bioregions are shown in dark grey with subregions shown in light grey (Department of the Environment 2013).

issues in the Kimberley, combined with the unassuming, prostrate habit of this species, suggest that it may be more widespread than current collections indicate; however, this has yet to be determined.

Etymology. Named for *Tephrosia* specialist Ian Donald Cowie (1956–), Chief Botanist at the Northern Territory Herbarium, who was the first to recognise this species as distinct, during his revision of the reticulate-nerved taxa in northern Western Australia and the Northern Territory (see Cowie 2004).

Affinities and notes. *Tephrosia cowiei* is closely allied to the Northern Territory species *T. bifacialis*, which occurs *c.* 400 km to the north-east, between Daly River and Kakadu National Park, northward to Melville Island. Both species are prostrate with scarcely to shortly petiolate, ground-appressed leaves with strongly discolorous leaflets (upper surface green, glabrous; lower surface silver-white through dense indumentum), and pale orange flowers. *Tephrosia cowiei* differs notably, however, in having 3–7 leaflets that are 11–53.5 mm long and 8–31 mm wide (*vs* 3, rarely 1; 24–97 × 16–64 mm) with appressed indumentum on the lower leaflet surface (*vs* ascending, ±lanose), smaller flowers (5.5–7.5 mm long *vs* 7–14 mm long) and calyx (2.2–3.6 mm *vs* 4–9 mm), wings broadly oblong to obovate (*vs* elliptic), keel 3.9–5.6 mm long and straight on upper margin (*vs* 5–12 mm long, incurved on upper margin), staminal tube and vexillary filament glabrous (*vs* both significantly hairy) and three or four ovules positioned in the mid-region of the ovary (*vs* 6–12 ovules along the length of the placenta).

While the inflorescence and floral bracts of *T. bifacialis* are predominantly persistent and it has obvious bracteoles at either the junction of the pedicel and calyx tube or halfway down the pedicel (these caducous after flowering to persistent into fruit), the bracts of *T. cowiei* are caducous and the bracteoles are absent or rarely present (and caducous) on only a few flowers in the inflorescence.

When describing *T. bifacialis*, Cowie (2004: 172) noted that two incomplete, 5-foliolate collections from the central Kimberley (e.g. *I. Cowie* 4173) were allied to this but different, and he tentatively placed them with *T. reticulata*. Like *T. cowiei*, *T. reticulata* has more than three leaflets per leaf and a glabrous staminal tube and vexillary filament. This latter species is not known from Western Australia and differs in its: distinctly petiolate leaves with 7–13, very narrowly ovate to oblong leaflets that are (usually) not strongly discolorous and have prominently reticulate, raised venation on the upper surface of leaflets; persistent, lanceolate to ovate, leaf-like inflorescence and floral bracts; prominent, persistent bracteoles on the slender pedicel; longer calyx lobes relative to the calyx tube; and broader pods (6–7 mm wide). The two species can be distinguished even when sterile by their stipules (2–4.5 mm long, usually antrorse and attenuate to ovate in *T. cowiei vs* 4.8–10 mm long, prominently reflexed and narrowly ovate to ovate in *T. reticulata*) and visibility of the reticulating intersecondary venation on the lower leaflet surface (very obvious in *T. reticulata*).

Another very similar species is the Northern Territory taxon *T. humifusa* Cowie, which is vegetatively almost identical to *T. bifacialis* but can be readily distinguished by its purple flowers on longer pedicels in prostrate inflorescences, its shorter, broader, flatter pods, and fewer, larger, elongate-lenticular seeds with the hilum excentric. The secondary and intersecondary venation on the lower leaflet surface is also somewhat reddish (on specimens seen) in this species compared with *T. bifacialis*, a phenomenon common among pink/purple-flowered taxa across *Tephrosia*.

Highlighting again the remarkable convergence in vegetative morphologies in *Tephrosia*, *T. cowiei* shares its prostrate habit, and leaflet number, shape, size and colour with the North American species *T. chrysophylla* Pursh. They differ significantly in the colour and morphology of their flowers, however, with notable differences in the indumentum and apex shape of their pods, also.

Tephrosia funicularis R.Butcher, *sp. nov.*

Type: Mornington [Sanctuary], Western Australia [precise locality withheld for conservation reasons], *H. Dauncey* H 529, 3 March 2011 (*holo*: PERTH 08364133!; *iso*: CANB!, PERTH 08417393!).

Tephrosia sp. Yampi (A.N. Start per R.L. Barrett RLB 2291), Western Australian Herbarium, in *FloraBase*, https://florabase.dpaw.wa.gov.au/ [accessed 18 February 2020].

Sprawling, few-stemmed, perennial *subshrub*, 0.1–0.7 m tall, 0.2–0.7 m wide, with a slender taproot. *Branchlets, leaf and inflorescence rachides* with moderately dense, stiff, straight, patent to ascending, white indumentum, to 1.2 mm long. *Leaves* pinnate, 25–77 mm long including petiole, occasional unifoliolate leaves on flowering branchlets; *stipules* persistent, antrorse just at first then strongly reflexed with the apices frequently upturned (like a handlebar moustache), leaf-like, lanceolate to narrowly ovate, 3.5–6.5 mm long, green, 1- to 5-nerved, with only the central nerve extending to the apex; *petiole* 5–24 mm long; *ultrajugal rachis* 1.2–8.2 mm long; *stipellae* absent; *petiolules* 0.6–1.2 mm long; *leaflets* (3–)5–9(–11), almost oblong to elliptic to obovate, flat in T.S., at least some attached in the basal half of the leaf; bases rounded; apices rounded, straight, minutely mucronate with mucro 0.4–0.5 mm long; lateral leaflets 5.2–20 mm long, 2.5–8.7 mm wide, length 1.54–2.67 × width, gradually increasing in size from base to apex of rachis; terminal leaflet 1.15–1.45 × the length of adjacent laterals, 7–30 mm long, 3.9–11.7 mm wide, length 2.25–2.76 × width; lamina discolorous; upper surface appearing glabrous but with a moderately dense indumentum of short, gently ascending to patent, very fine, straight, silvery hyaline hairs; lower surface indumentum moderately dense, hairs ascending, straight, much longer than on upper, white; secondary veins brochidodromous, in 6–11 pairs, intersecondary veins obscure on lower surface, parallel at base, diffuse towards margin (seen on upper surface). *Inflorescence* pseudoracemose, leaf-opposed, often with a cluster of flowers in the leaf axil, or axillary only, pseudoraceme 9–153 mm long, fascicles well-spaced, 3–9-flowered; *inflorescence bracts* caducous to tardily so, ovate, acuminate, 1.6–2.1 mm long; *floral bracts* 0.4–1 mm long, attenuate to lanceolate and acuminate, caducous; *pedicels* 1.8–4.3 mm long; *bracteoles* absent. *Calyx* 3–4.6 mm long, moderately to densely hairy, the hairs loosely appressed to ascending, straight, white; tube 1.8–2.5 mm long, 0.9–1.25 × the length of lateral lobes; lower and lateral lobes lanceolate to narrowly deltoid, acuminate; vexillary lobes united higher than lower three, free for 0.6–1.2 mm (upper lip divided to 27–40% length); lowest lobe 2–2.7 mm, a little longer than lateral lobes. *Flowers* orange, 4–6.5 mm long; standard 4.5–5.7 mm long, 5.2–7 mm wide, the claw 1.5–1.65 mm long, the blade suborbicular to reniform, not callused at base, apex rounded, entire to shortly and broadly emarginate; wings 4.6–6 mm long (incl. 1.4–2.1 mm claw), 2.2–2.8 mm wide, a little longer than keel, the blade elliptic to obovate with rounded apex; keel 4.1–4.6 mm long (incl. 2–2.1 mm claw), 2.1–2.4 mm wide, the blade ±semi-circular, incurved just in front of spur, with a few hairs along lower margin near apex. *Staminal* tube glabrous, not callused; vexillary filament straight in lower half, glabrous, not callused; anthers 0.3–0.4 mm long, 0.2–0.4 mm wide. *Ovary* densely hairy; ovules 7 or 8. *Style* flattened, tapering to apex, glabrous, with hairs at base on vexillary side; stigma penicillate, linear. *Pods* linear, upturned at apex, 25–40 mm long, 3.8–5 mm wide, laterally compressed and indented between seeds, the lower margin slightly sinuate, the sutures somewhat thickened, pale to mid-brown at maturity; indumentum of moderately dense, patent, white to pale stramineous, hyaline hairs over numerous minute, shortly stalked glands; beak in line with the upper suture, straight to distinctly down-curved; white tissue present between seeds. *Seeds* 2–8 per pod on prominent funicles 0.6–1 mm long, with 3.5–5 mm between centres of adjacent seeds, lenticular but oblique on lower edge, 2.2–3 mm long, 2.2–3.7 mm wide, finely and darkly mottled, orange- to chocolate brown with tan-grey-brown and purplish grey-brown and black streaks, testa smooth; hilum ±central to excentric, containing a minute to distinct, annular, opaque rim aril (with tongue). (Figure 3)

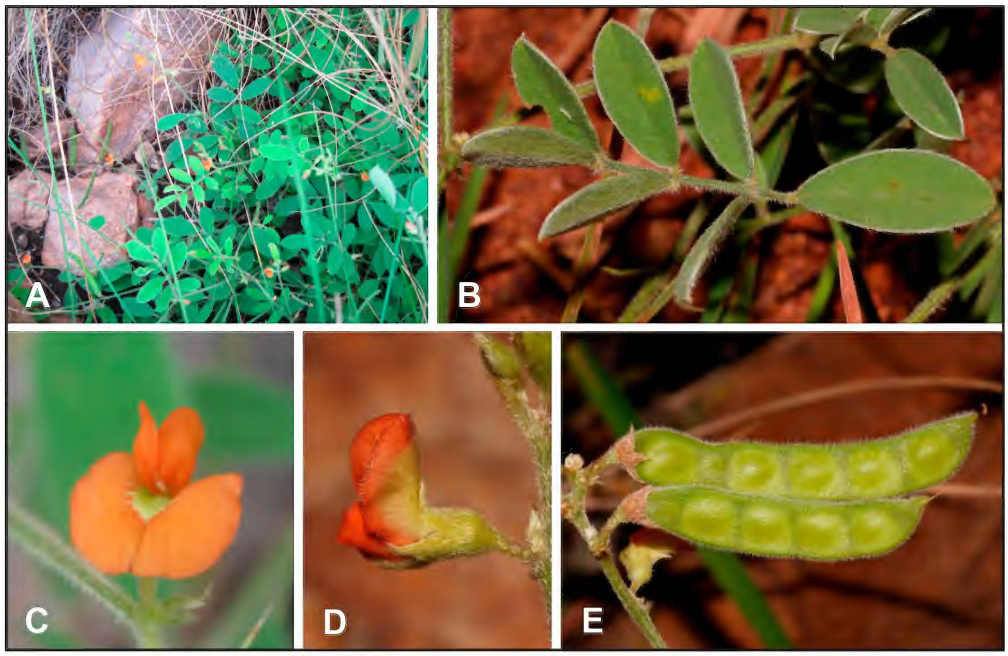

Figure 3. *Tephrosia funicularis*. A – plant sprawling among sandstone rocks; B – leaf showing elliptic leaflets with margin of hairs from lower surface; C – resupinate flower from front; D – flower from side showing calyx morphology and indumentum; E – immature pods. Images from the type *H. Dauncey* H 529 (A, C) and *A.N. Start per R.L. Barrett* RLB 2291 (B, D, E). Photographs © H. Dauncey (A, C) & © R. Barrett (B, D, E), used with permission.

Diagnostic features. *Tephrosia funicularis* is a distinctive species readily recognised by the following combination of characters: strongly deflexed stipules, which resemble a handlebar moustache; usually 5–9, elliptic leaflets that appear glabrous on the upper surface (actually very finely hairy) and have a distinct border of white hairs (formed from hairs that protrude beyond the margin from the appressed-hairy lower surface); pseudoracemes of orange flowers with the calyx tube *c.* = in length to the lobes; linear, ±straight, laterally compressed pods, which are flattened between the seeds; and seeds that are mottled purplish dark brown and have an elongate funicle 0.6–1 mm long.

Specimens examined. WESTERN AUSTRALIA. [localities withheld for conservation reasons] 13 Apr. 2013, *R.L. Barrett, M.D. Barrett & B. Anderson* RLB 8074 (CANB, DNA, PERTH); 11 Mar. 2001, *R.L. Barrett & T. Handasyde* RLB 1984 (PERTH); 15 May 2018, *R. Butcher, E.M. Joyce & K. Thiele* RB 2251 (PERTH, UWC); 16 May 2018, *R. Butcher, E.M. Joyce & K. Thiele* RB 2254 (PERTH); 13 May 2006, *I.D. Cowie* 11163 (BRI, DNA, MEL, PERTH); 14 Aug. 2011, *H. Dauncey* H 849 (K, PERTH); 13 Mar. 2001, *A.N. Start per R.L. Barrett* RLB 2291 (BRI, PERTH); 12 Mar. 2006, *S. Legge* 842 *& S. Murphy* (CANB).

Distribution. Currently known from two areas flanking the Wunaamin-Miliwundi Ranges (formerly King Leopold Ranges), with infrequent collections from the Yampi Peninsula (Mitchell sub-bioregion, North Kimberley) eastward to the Phillips Range and south-eastward to Mornington Sanctuary (Pentecost sub-bioregion, Central Kimberley); it is likely to also occur in intervening areas (Figure 2).

Habitat. Mostly collected from shallow brown loamy sand or red-brown clayey sand among sandstone rocks, with one record stating ‘sand over quartzite’. Grows in open *Corymbia* (*C. collina*,

C. confertiflora) or mixed woodland (including *Brachychiton viscidulus*, *Buchanania oblongifolia*, *Celtis philippensis*, *Erythrophleum chlorostachys*, *Ficus aculeata*, *Hakea arborescens*, *Lophostemon grandiflorus* subsp. *riparius*, *Sersalisia sericea*, *Terminalia hadleyana*, *Wrightia saligna*) over shrubs (e.g. *Acacia stigmatophylla*, *A. tumida*, *Calytrix brownii*, *Grevillea pyramidalis*) and grasses (e.g. *Sorghum*, *Triodia*), or in hummock grassland at more exposed sites. Observed to grow with or adjacent to other *Tephrosia* taxa, including *T. coriacea* Benth., *T. filipes* Benth., *T. oblongata* Benth. *s. lat.*, and *T.* sp. Sparse pinnae (C.R. Michell 2202).

Phenology. Phenology is poorly known because very few collections have been made. Flowers and fruits recorded in March and August; mature pods bearing seed recorded in May and August. Many *Tephrosia* taxa occurring at Mornington Sanctuary flower over a long period in response to rain (H. Dauncey, pers. comm.): the collections *H. Dauncey* H 529 and H 849, made in March and August 2011 respectively, are at the same stage of flowering and fruiting despite being collected five months apart, with a significant dry season rain event occurring in July (H. Dauncey, pers. comm.).

Conservation status. Listed as Priority Three (Poorly Known Flora) under Conservation Codes for Western Australian Flora as *T.* sp. Yampi (A.N. Start per R.L. Barrett RLB 2291) (Smith & Jones 2018). This is equivalent to the IUCN rank Data Deficient.

Etymology. Named for the prominent funicles (from L. *funis*; rope, cord) attaching the ovules and seeds to the carpel's placenta.

Affinities and notes. *Tephrosia funicularis* is similar to *T. crocea*, which also has orange flowers and leaf-like, recurved stipules, but this latter species has (5–)15–51 narrowly elliptic to cuneate leaflets (*vs* 3–11 sub-oblong, elliptic or obovate leaflets) that reduce in size toward the apex of the leaf (*vs* gradually increase in size), with the terminal leaflet dissimilar in shape to the adjacent laterals (similar, but larger in *T. funicularis*), as well as bracteoles on the pedicel (*vs* bracteoles absent). It also differs in its pods and seeds, the pods having an ascending beak that is often long (*vs* shorter, straight to down-curved beak), and the seeds being ellipsoid, uniformly tan to mottled yellow-tan with dark flecks, *c.* 2.8–2.9 × 3.7–3.8 mm, and attached to the placenta by short funicles 0.2–0.3 mm long (*vs* obliquely lenticular, darkly mottled, 2.2–3 mm × 2.2–3.7 mm, with funicles 0.6–1 mm long).

Tephrosia funicularis has some similarity to the phrase-named taxon *T.* sp. Northern (K.F. Kenneally 11950) in the number and shape of its leaflets, but this can be distinguished from *T. funicularis* by its eucamptodromous to apically brochidodromous secondary venation (with indistinct intersecondary veins) (*vs* brochidodromous venation), antrorse to inclined stipules (*vs* strongly reflexed), larger flowers with calyx lobes to 7 mm long that are characteristically longer than the tube (*vs* 1.8–2.7 mm long, *c.* = to the tube), turgid pods (*vs* laterally compressed), and ellipsoid (*vs* obliquely lenticular) seeds.

Two of the specimens (*A.N. Start per R.L. Barrett* RLB 2291; *R.L. Barrett & T. Handasyde* RLB 1984) were originally identified as being a hairy form of *T. remotiflora*; this species is superficially similar to *T. funicularis* but has smaller, purple flowers, reddish venation on leaflets, and narrower fruits with fine, appressed or patent hairs.

The minute glands that are readily visible on pods were also observed in lower numbers on pedicels and inflorescence rachides of some specimens.

Acknowledgements

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Pterostylis occulta (Orchidaceae), a new species from the south-west of Western Australia

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SHORT COMMUNICATION

Pterostylis sargentii C.R.P.Andrews was described in 1905 from specimens collected by Oswald Sargent near York (Andrews 1905) and subsequently recorded from sites across south-western Australia, with the exception of the high rainfall zone (Nicholls 1969; Western Australian Herbarium 1998–; Brown *et al.* 2013; Hoffman *et al.* 2019). Our studies of both living material and preserved specimens have revealed that a second, widely distributed taxon has been included within *P. sargentii*. First collected and painted by Rica Erickson from Bolgart in 1936, it is described below as *P. occulta*.

Pterostylis occulta G.Brockman & C.J.French, *sp. nov.*

Type: Luptons Nature Reserve [Lupton Conservation Park], 2.9 km south of Woods Loop, south of Brookton Highway, Western Australia, 13 October 2005, *G. Brockman* GBB 1662 (*holo*: PERTH 07287690).

Illustrations. R. Erickson, Frog Greenhood (*Pterostylis sargentii*), Bolgart, 18 September 1936, original artwork available at https://slwa.wa.gov.au/erickson/pages/32.html [accessed 11 March 2021]; W. Nicholls, *Orchids of Australia: the complete edition* p. 335, figures d, h (1969), as *P. sargentii*; N. Hoffman, A.P. Brown & J. Brown, *Orchids of south-west Australia*, *4th edn.* p. 429 (2019), as *P. sargentii*.

Terrestrial, tuberous *herb* 3.5–18 cm high. *Tuber* ellipsoid, 10–15 × 8–12 mm, white, replaced annually. *Basal rosette* absent in flowering plants; sterile plants with a rosette of 5–12 spreading, petiolate leaves 6–25 mm × 4–10 mm. *Scape* to 18 cm high, *c.* 1 mm diam., dull greenish yellow; leaves 3–7, olive green, sessile, spreading, 4–45 mm × 1–5 mm when flattened; floral bracts sheathing, to 25 × 5 mm when flattened, acuminate; pedicels 10–20 mm long, *c.* 1 mm diam., wiry. *Flowers* 1–3(4), 14–17 mm long, pale to dark olive green with translucent white striations; galea 10–13 mm long, bulbous, glabrous, shallowly curved at base, mostly flat across middle then deflexed with a 1–3 mm long apical point. *Dorsal sepal* 11–13 mm long including apical point, decurved, acute. *Lateral sepals* deflexed, connate in upper 2/3, shallowly concave, elliptic when flattened, 8–11 × 3–4 mm, glabrous, tapering abruptly to free points 2–3 mm long; margins infolded throughout length. *Petals* ± ovate when flattened, 8–10 mm long including a broad, reddish apical point 0.5–1 mm long; upper marginal line of dense trichomes

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to 1 mm long on internal surface; lower proximal 2/3 of margin extended, deflexed laterally, entire. *Labellum* on a broad claw 1–1.5 mm wide; upper lobes arising basally, partially hidden in sinus in set position, reclined with the distal third further mildly recurved, linear, 1.5–2 mm long, obtuse, dark grey to black, densely hairy; laminae tri-lobed, ciliate, central lobe triangular, 1–1.5 mm long and with an upturned apex, lateral lobes narrowly triangular, shorter than central lobe (*c.* 1 mm long) and incurved. *Column* 9–11 mm long, down-curved, green with translucent striations, winged; wings orbicular, 2 mm long, incurved, opaque, with barrier trichomes. *Ovary* narrowly ovoid, 6–8 mm × 1.5–2 mm. *Capsule* elliptic, 5–6 × 3–6 mm, glabrous. *Anther* 1–1.5 mm long, yellowish green. *Pollinia* 1–1.5 mm long, yellow. *Stigma* ovate, 1 × 2 mm, dull yellow. (Figure 1A (right hand flower), C)

Diagnostic features. *Pterostylis occulta* can be distinguished from all other members of the genus by the following combination of characters: sterile and fertile plants dimorphic; inflorescence multi-flowered; galea with a single opening; synsepalum deflexed; labellum 3-lobed, upper lobes linear and hairy, basal appendages absent; column wings with barrier trichomes.

Selected specimens. WESTERN AUSTRALIA: Trainers Rock, 2.3 km N of edge of Lake Barlee, 5 Sep. 1999, *A.P. Brown* 3629 B (PERTH); Bolgart, 18 Sep. 1936, *R. Erickson s.n.* (PERTH 04875834); Mount Short, N of Ravensthorpe, 30 Aug. 1963, *A.S. George* 5728 (PERTH); 171.5 miles, Great Eastern Highway, 12 Sep. 1965, *A.S. George* 6806 (PERTH); South Tammin Reserve, 12 Sep. 1967, *A.S. George* 9199 (PERTH); 1 mile W of Highbury, 21 Sep. 1957, *A.S. George s.n.* (PERTH 04875842); *c.* 25 m NE of South Ironcap Trig. (Plot - STHC01), 7 Sep. 1996, *N. Gibson & K. Brown* 3035 (PERTH); Site 231. E of Rasmussen Rd, E of intersection with Chinocup Rd, N of Pingrup. 24 Sep. 2008, *M. Hislop & H. Mills* WW 231-35 (PERTH); *c.* 15 km S of the Bodallin Townsite, 8 Sep. 1998, *C. Keating et al.* BBOD5/21 (PERTH); 19 km SSW of Queen Victoria Rock, 24 Sep. 1993, *G.J. Keighery* 13920 (PERTH).

Phenology. Flowering from late August to mid-October. Fruiting October to November.

Distribution and habitat. *Pterostylis occulta* is widely distributed in Western Australia in the wheatbelt and adjacent inland semi-arid goldfields from Northampton to Mt Ragged, growing in scrubland or mallee woodland on stony breakaways and granite outcrops.

Conservation status. Widely distributed and conserved in nature reserves.

Etymology. The specific epithet, from the Latin *occultus* (hidden), alludes to herbarium collections of this species, which have remained hidden under *P. sargentii* for more than eighty years.

Common Name. Little Frog Orchid.

Affinities. The new species is similar to *P. sargentii*. It is easily distinguished from that species by the upper lobes of the labellum, which are linear, reclined and densely hairy (Figure 1C) rather than bulbous, glabrous and erect (Figure 1B). It also has smaller flowers (14–17 mm *cf.* 21–24 mm long in *P. sargentii*) that are more widely spaced and have a shorter free point on the sepals (1–3 mm *cf.* 4–6 mm in *P. sargentii*) and extended petal inferior margins that are entire (*cf.* dentate in *P. sargentii*). *Pterostylis occulta* and *P. sargentii* have broadly overlapping distributions and are often found growing in close proximity. Generally, the new species commences flowering four to six weeks later; however, where they are found together, *P. sargentii* is sometimes in late flower or fruit while *P. occulta* is in bud or early flower.

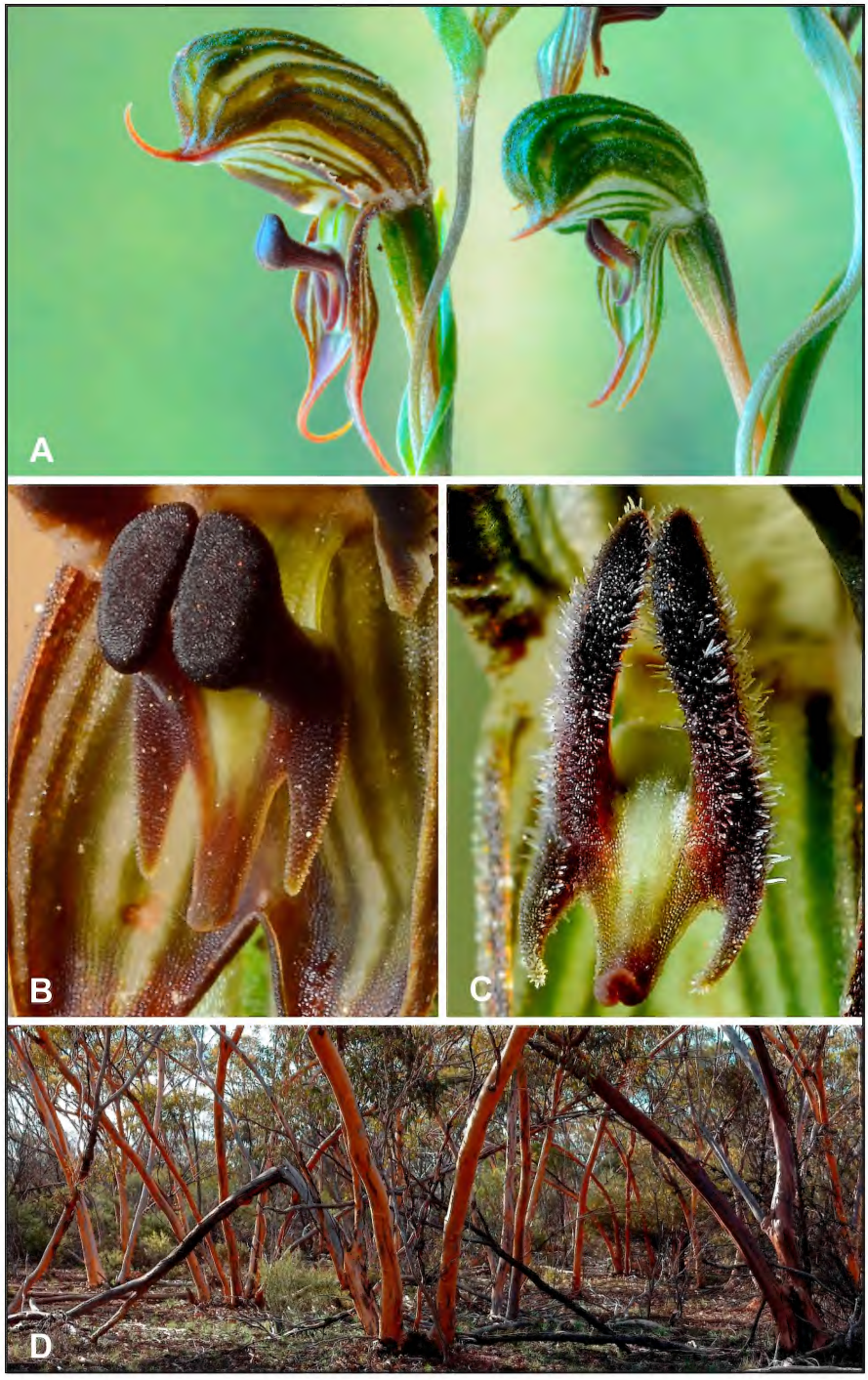

Figure 1. A – *Pterostylis sargentii* (L) from Boyagin Nature Reserve and *P. occulta* (R) from Horne Nature Reserve, showing relative flower size; B – labellum of *P. sargentii* with bulbous, glabrous and erect upper lobes; C – labellum of *P. occulta* with linear, obtuse, reclined and densely hairy upper lobes; D – characteristic habitat of *P. occulta* at a site off Brookton Highway. Photographs by Garry Brockman.

Notes. This species, and the similar *P. sargentii*, have not been observed or collected in the high rainfall zone in the south-west of the state. A small, as yet unvouchered population of plants has recently been discovered inland from Busselton. These plants have similar flower size and labellum features to *P. occulta*, but also have dentate petal margins, similar to *P. sargentii.* Further research is needed to determine the status of this population.

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Caladenia multiplex (Orchidaceae), a new, sexually deceptive species from the south-west of Western Australia

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SHORT COMMUNICATION

Caladenia multiplex A.P.Br. & R.D.Phillips, *sp. nov.*

Type: south of Moora, Western Australia [precise locality withheld for conservation reasons], 26 August 2012, *G. Brockman* GBB 2880 (holo: PERTH 09134999; iso: CANB).

Caladenia sp. Bulbarnet (G. Brockman GBB 2880), Western Australian Herbarium, in *Florabase*, https://florabase.dpaw.wa.gov.au [accessed 8 February 2021].

Plants solitary or in clumps. *Leaf* 5–20 cm long, 6–13 mm wide, linear, erect, incurved in TS, pale green, the basal 1/3 irregularly blotched with red-purple, densely hirsute with patent eglandular trichomes > 5 mm long with expanded barrel-shaped basal cells. *Scape* hirsute 22–40 cm tall with patent eglandular trichomes similar to those on the leaf, erect, wiry, with an erect sheathing, acuminate, externally hirsute cauline bract half way up and a similarly shaped floral bract under each pedicel. *Flowers* 1–3(4), 7–10 cm across, often stiffly held, creamy-white with green to yellowish-green suffusions; floral odour faintly sweet or absent. *Sepals and petals* linear-lanceolate in the basal 1/3 to 2/5 then abruptly narrowing before terminating in a brown to reddish-brown glandular apex. *Dorsal sepal* 4.0–5.5 cm long, 2–3 mm wide, erect and slightly incurved, terminating in a swollen osmophore that is 10–22 mm long and covered in short glandular hairs to 0.1 mm long. *Lateral sepals* 5.5–7.5 cm long, 5–8 mm wide, spreading horizontally near the base and downcurved to pendulous towards the apex, terminating in a swollen osmophore that is 12–25 mm long and covered in short glandular hairs to 0.1 mm long. *Petals* shorter than the sepals, 3.5–4.5 cm long, 3–4 mm wide, spreading horizontally or downcurved, more rarely upcurved, usually lacking an osmophore or, when present, scarcely thickened and 5–8 mm long. *Labellum* obscurely 3-lobed, uniformly creamy-white except the red calli and basal lamina which sometimes has green to yellowish-green suffusions, stiffly articulated on a claw *c*. 2 mm

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wide; lamina 15–22 mm long, 10–13 mm wide, narrowly triangular in outline, erect with entire margins in the basal 1/4 to 1/3, nearly horizontal in middle 1/3 and apical 1/3 with a prominently recurved apex; lateral lobes with forward facing, maroon, sometimes white-tipped, apically thickened marginal calli > 8 mm long that are decrescent towards the midlobe; lamina calli maroon, hockey-stick-shaped, > 1 mm tall, in 4–8 longitudinal rows extending 3/4 to 4/5 the length of the labellum, decrescent towards the apex. *Column* 12–15 mm long, 4–6 mm wide, broadly-winged, opaque, creamy-white, pale yellow and green with pale red markings, sparsely hirsute with short glandular hairs on outer surface. *Anther* 2–3 mm long, 2–3 mm wide, greenish-yellow. *Pollinia* > 2 mm long, kidney-shaped, flat, yellow, mealy. *Stigma* 2.0–2.5 mm long, 2.0–2.5 mm wide. *Capsule* not seen. (Figure 1A, B)

Diagnostic features. *Caladenia multiplex* can be distinguished from all other members of the genus by the following combination of characters: Flowers creamy-white with green to yellowish-green suffusions; lateral sepals spreading horizontally near the base and downcurved to pendulous towards the apex, terminating in a swollen osmophore; petals shorter than the sepals, spreading horizontally or downcurved, more rarely upcurved, usually lacking a terminal osmophore; labellum, including apex, creamy-white, sometimes with green to yellowish-green suffusions; labellum marginal calli maroon, sometimes white-tipped, apically thickened; labellum lamina calli maroon, hockey-stick-shaped, in 4–8 longitudinal rows.

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 25 Aug. 2016, *G. Brockman* GBB 3483 (PERTH); 3 Sep. 2018, *R. Phillips* RDP 0475 (PERTH); 3 Sep. 2016, *R. Phillips* RDP 0392 (PERTH); 29 Aug. 2015, *R. Phillips* RDP 0314 (PERTH); 15 Aug. 2015, *R. Phillips* RDP 0305 (PERTH); 5 Sep. 2014, *R. Phillips* RDP 0202 (PERTH); 26 Aug. 2014, *R. Phillips* RDP 0287 (PERTH); 13 Sep. 2019, *R.D. Phillips & A.P. Brown* RDP 0476 (PERTH).

Phenology. Flowering August to mid-September. Fruiting September to early October.

Distribution and habitat. Found over a narrow geographic range between Moora and Gillingarra with an outlying population south-west of Bolgart. The species grows in brown loam in open *Eucalyptus wandoo* woodland with *Acacia acuminata*, *Eucalyptus loxophleba*, *Hakea* and *Daviesia* species. It often occurs low in the landscape on the slopes to seasonal creeklines and around the margins of winter wet depressions (Figure 1C).

Conservation status. To be listed as Priority Two under Conservation Codes for the Western Australian Flora (M. Smith pers. comm.). Although not considered under immediate threat, *Caladenia multiplex* is known from just five extant populations, three in nature reserves and two in rail reserves. One of the nature reserve populations extends onto a road reserve that has been partly cleared since the orchid's discovery.

Etymology. From the Latin *multiplex* (many at once/together, numerous), in reference to the more numerous rows of labellum lamina calli commonly found this species compared to related species.

Vernacular name. Bulbarnet Spider Orchid.

Affinities. *Caladenia multiplex* appears intermediate in morphology between the *C. longicauda* Lindl. and *C. huegelii* Rchb.f. complexes, sharing with members of the *C. longicauda* complex predominantly creamy-white flowers and a creamy-white labellum apex and with members of the *C. huegelii* complex shortened petals and swollen sepaline osmophores.

Figure 1. *Caladenia multiplex*. A – flowering plants *in situ* showing the often stiffly held flowers and shortened petals characteristic of this species; B – flowers showing the more numerous rows of labellum lamina calli and relatively short labellum marginal calli compared to most members of the *Caladenia longicauda* complex; C – habitat of *Caladenia multiplex*. Photographs by A.P. Brown.

Caladenia multiplex can be distinguished from members of the *C. longicauda* complex by its shortened petals and swollen sepaline osmophores. Its petals and lateral sepals are also more stiffly held when compared to most of members of the *C. longicauda* complex and it regularly has more numerous rows of labellum lamina calli. The labellum marginal calli are also somewhat shortened when compared to many members of the *C. longicauda* complex and have thicker apices. The only member of the *C. longicauda* complex to grow with or near *C. multiplex* is *C. longicauda* subsp. *eminens* Hopper & A.P.Br. However, unlike that taxon, which is pollinated by nectar seeking insects, *C. multiplex* is pollinated by a sexually deceived thynnine wasp (an undescribed species of *Thynnoides*; see Phillips *et al*. 2017). Observations of plants in populations at Bulbarnet, Koojan and SW of Bolgart have shown that they all attract sexually deceived males of this pollinator species (Phillips, unpublished data).

From members of the *C. huegelii* complex, *C. multiplex* can be distinguished by its predominantly creamy-white flowers and creamy-white, rather than red, labellum apex.

The creamy-white flowers and the presence of swollen sepaline osmophores places *C. multiplex* with *C. leucochila* A.P.Br. & R.D.Phillips and *C. lodgeana* Hopper & A.P.Br. It can be distinguished from *C. leucochila* by its larger flowers 7–10 cm across (*cf*. 4–6 cm across in *C. leucochila*), less prominently swollen sepaline osmophores, broader labellum 10–13 mm wide (*cf*. 7–9 mm wide in *C. leucochila*, up to eight rows of labellum lamina calli (*cf*. up to four rows in *C. leucochila*). and taller column 12–15 mm long (*cf*. 10–12 mm long in *C. leucochila*). From *C. lodgeana*, *C. multiplex* can be distinguished by its shortened petals 3.5–4.5 cm long (*cf*. 4–6.5 cm long in *C. lodgeana*) and up to eight rows of labellum lamina calli (*cf*. up to six rows in *C. lodgeana*). It is also geographically isolated from these species with *C. leucochila* and *C. lodgeana* respectively occurring 270 km and 380 km south of *C. multiplex*. Each of these three species attracts different species of sexually deceived thynnine wasps as pollinators (Phillips *et al*. 2017).

Notes. *Caladenia multiplex* hybridises with *C. longicauda* subsp. *eminens* producing intermediate forms that, compared with *C. multiplex*, have longer, pendulous lateral sepals which either lack or, where present, have longer, narrower sepaline osmophores, i.e. *R. Phillips* RDP 0393 (PERTH).

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Review of the infrageneric classification of *Adenanthos* (Proteaceae)—the subsections of *Adenanthos* are polyphyletic

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SHORT COMMUNICATION

Adenanthos Labill. (Proteaceae) is an endemic Australian genus comprising 31 species (Nge *et al.* 2021). Most species are restricted to southwest Western Australia, with two in South Australia. The genus was divided into two sections, sect. *Eurylaema* Benth. and sect. *Adenanthos* Benth., by Bentham (1870) based on anther and style morphology (Figure 1).

Nelson (1978), in the most recent full revision of the genus, erected a subsection (subsect. *Anaclastos* E.C.Nelson) within sect. *Adenanthos* (thus also establishing the autonymic subsect. *Adenanthos*) based on the single character of perianth length (Figure 1).

***Adenanthos* sect. *Eurylaema* Benth.**

One anther sterile; style-end flattened, much broader than style

(3 species: *A. detmoldii* F.Muell., *A. barbiger* Lindl., *A. obovatus* Labill.)

Adenanthos* sect. *Adenanthos

All anthers fertile; style-end conical, not broader than style

(All remaining species)

subsect. *Anaclastos* E.C.Nelson

Perianth 10–15 mm long

(3 species: *A. apiculatus* R.Br., *A. dobagii* E.C.Nelson, *A. drummondii* Meisn.)

subsect. *Adenanthos*

Perianth > 15 mm long

(All remaining species)

Figure 1. Nelson's (1978) infrageneric classification of *Adenanthos*, with diagnostic characters and species numbers.

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Nge *et al.* (2021) have shown that the two sections are reciprocally monophyletic, but the two subsections of sect. *Adenanthos* are polyphyletic, with strong support, in Bayesian and Maximum Likelihood phylogenetic analyses using nuclear and chloroplast gene sequences. The three species of *A.* subsect. *Anaclastos* are nested within other clades comprising taxa belonging to *A.* subsect. *Adenanthos* (Figure 2).

Polyphyly of the subsections in the chloroplast topology could be attributed to introgression and chloroplast capture, which was shown to be very common within *Adenanthos* (Nge *et al.* 2021). However, polyphyly is also strongly supported in analyses based on 35 nuclear gene regions, and these are expected to provide a more accurate estimation of the species phylogeny. The nuclear topologies of Nge *et al.* (2021), from both coalescent and concatenated analyses, are largely congruent with morphological delimitations of species in *Adenanthos.*

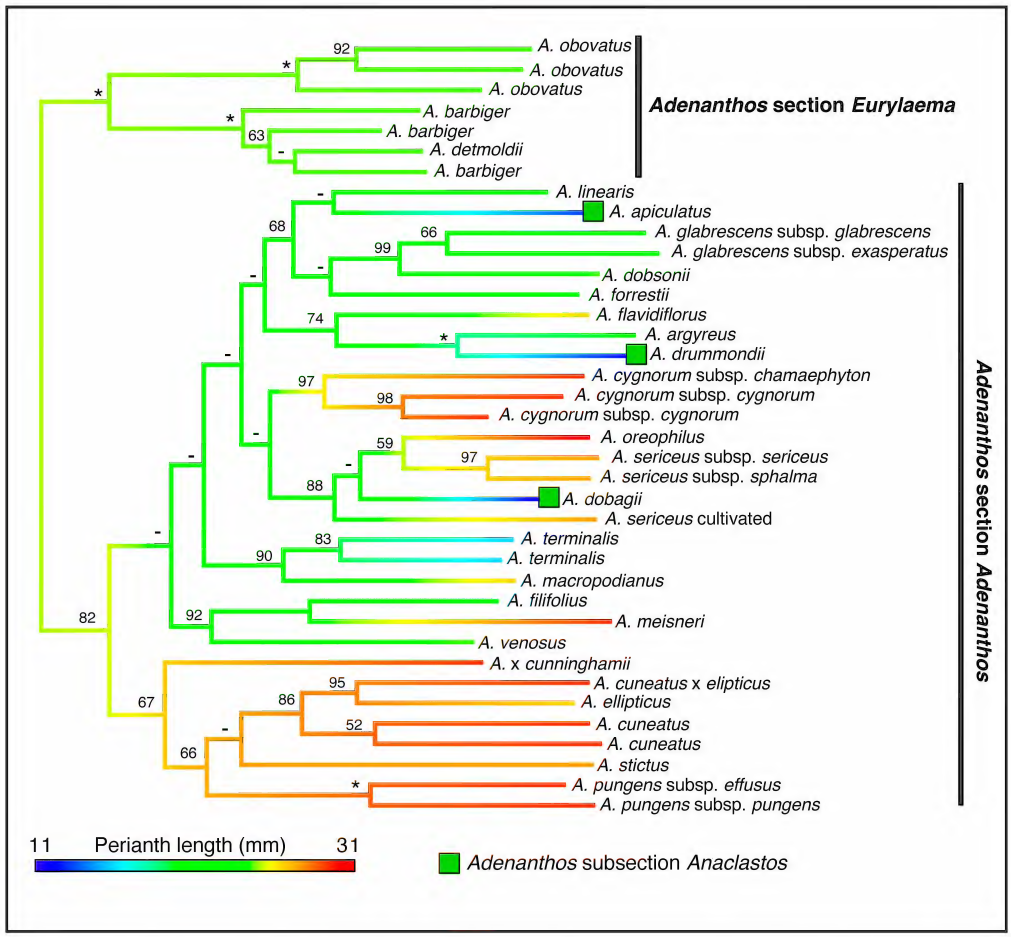

Figure 2. The floral character used to delimit *Adenanthos* subsect. *Anaclastos* (perianth length) mapped onto a Maximum Likelihood RAxML phylogram of *Adenanthos,* based on 35 nuclear genes, using the 'anc.ML' function in the phytools package in R (R Core Team 2016). Perianth length (mm) is coloured from blue–red (short–long). The three species in *A.* subsect. *Anaclastos* are highlighted with green squares. Bootstrap support values are indicated at each node (very strongly supported branches [100 bootstrap] are represented by '*', weakly supported branches [< 50 bootstrap] are represented by '-'). The tree was sourced and adapted from Nge *et al.* (2021).

Short and long perianths have both evolved multiple times independently in the genus (Figure 2), presumably as adaptations to different pollinators. The placement of species in the two subsections based on whether the perianth is 10–15 mm long (subsect. *Anaclastos*) or > 15 mm long (subsect. *Adenanthos*) is not supported phylogenetically. Accordingly, the sections, but not the subsections, are accepted here as infrageneric taxa in *Adenanthos* and subsect. *Anaclastos* is reduced to a synonym of sect. *Eurylaema*.

Revised classification

Adenanthos Labill., *Pl. Nov. Holl.* i. 28. t. 36 (1804). *Lecto*: *Adenanthos cuneatus* Labill., *fide* E.C. Nelson, *Brunonia* 1: 316 (1978) [as *A. cuneata*].

Adenanthos sect. **Eurylaema** Benth., *Fl. Austral.* 5: 350 (1870). *Lecto*: *Adenanthos obovatus* Labill., *fide* E.C. Nelson, *Brunonia* 1: 322 (1978) [as *A. obovata*].

Adenanthos Labill. sect. **Adenanthos**

Adenanthos subsect. *Anaclastos* E.C.Nelson, *Brunonia* 1(3): 332 (1978), *syn. nov. Type*: *Adenanthos apiculatus* R.Br.

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Eremophila rarissima (Scrophulariaceae), a new rarity from Western Australia

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SHORT COMMUNICATION

Eremophila rarissima Buirchell & A.P.Br., *sp. nov.*

Type: Wongan Hills, Western Australia [precise locality withheld for conservation reasons], 15 February 2009, *R.J. Dadd* 14 (*holo*: PERTH 08239037).

Eremophila glabra subsp. Wongan Hills (M. Hislop 2079), Western Australian Herbarium, in *FloraBase*, https://florabase.dpaw.wa.gov.au/ [accessed 9 February 2020].

Illustration. A.P. Brown & B.J. Buirchell, *A field guide to the Eremophilas of W. Austral.,* p. 136 (2011), as *E. glabra* R.Br. subsp. 'Wongan Hills'.

A low growing, spreading, much-branched *shrub* 30–50 cm high, 75–100 cm wide. *Branches* grey, terete, old and new growth covered in short glandular hairs. *Leaves* green, alternate, porrect, lamina linear to oblanceolate, flattened, 10–20 mm long, 1–4 mm wide, with scattered short glandular hairs that are more prominent on the abaxial surface, margins dentate distally. *Flowers* 1 per leaf axil, upright, pedicellate; pedicel terete, 5–6 mm long, glandular-hairy. *Sepals* 5, imbricate, subequal, narrowly triangular, acute, 3.5–8 mm long, 1–1.5 mm wide, not enlarging after flowering; outer and inner surfaces green, glandular-hairy. *Corolla* zygomorphic, bilabiate, 11–22 mm long, outer and inner surfaces glandular-pubescent; lobes reddish pink, unspotted, unequal, recurved. *Stamens* 4, prominently exserted, paired and attached to the lateral portions of the tube; filaments mostly glabrous, with the odd, short, glandular hair; anthers glabrous. *Ovary* glabrous; *style* glabrous. (Figure 1)

Diagnostic features. Eremophila rarissima may be distinguished from all other members of *E.* sect. *Stenochilus* Benth. by the following combination of characters: a low growing habit; glandular hairs on the vegetative and reproductive parts; green, linear to oblanceolate leaves with a flattened lamina 10–20 × 1–4 mm; imbricate, subequal, narrowly triangular sepals; and a corolla that is reddish pink, zygomorphic and with prominently exserted stamens.

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Figure 1. *Eremophila rarissima*. A – flowering plant *in situ* showing the low, spreading habit; B – flowering stem, showing the characteristic reddish pink and upright flowers. Photographs by B.J. Buirchell from the type locality.

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] Sep. 1947, *A. Ashby* 127 (AD *n.v.*, PERTH); 1 Aug. 2000, *M. Hislop* 2079 (PERTH); 13 Sep. 1968, *M.E. Phillips* WA/68 913 (CANB *n.v.*, PERTH).

Distribution and habitat. Four collections of this species have been made, three north of Wongan Hills and one near Kulin some 300 km to the south-east. North of Wongan Hills it is found growing among *Acacia*, *Hakea preissii* and *Maireana* in grey loamy soil adjacent to saline flats and amongst open mallee shrubland with *Eucalyptus erythronema* and *Melaleuca marginata*in bare pale brown clayey loam. The collection from Kulin lacks habitat information.

Conservation status. Recently listed as Priority One under Conservation Codes for Western Australian Flora (Western Australian Herbarium 1998–), under *E. glabra* subsp. Wongan Hills (M. Hislop 2079). This species is currently known from just one extant population, which is on a narrow, degraded road reserve.

Etymology. The epithet is derived from the Latin *rarissimus* (very rare) and is a reference to the species being known from just four collections (and only one extant population) from areas that have been intensively cleared for farming.

Affinities. *Eremophila rarissima* belongs to *E.* sect. *Stenochilus* and based on current morphological evidence has affinity to *E. viridissima* Chinnock and *E. subteretifolia* Chinnock (Table 1). It is similar to *E. viridissima* in having upright flowers, but these are reddish pink (vs yellow) with a smooth ovary (vs tuberculate). *Eremophila rarissima* also grows in grey loamy soils in shrublands rather than on red sandy rises around salt lakes like *E. viridissima*. *Eremophila rarissima* is found some 450 km west-south-west of where *E. viridissima* is located.

From *E. subteretifolia*, *E. rarissima* differs in having reddish pink flowers (vs orange-red) and linear to oblanceolate, flattened leaves (vs linear and subterete) with prominently dentate margins, especially towards the apex (vs entire or occasionally dentate distally). *Eremophila subteretifolia* grows on white sand over clay in open woodlands around salt lakes while *E. rarissima* is not associated with lake

margins and grows in grey loamy clays in open mallee shrublands. *Eremophila rarissima* is found some 150 km (Kulin collection) to 300 km north-west of *E. subteretifolia*.

When *E. rarissima* was given its phrase name it was included as a subspecies of *E. glabra* R.Br. because of its affinity to *E. glabra* subsp. *verrucosa* Chinnock. Chinnock (2019) elevated *E. glabra* subsp. *verrucosa* to species level as *E. viridissima,* thus removing the only subspecies of *E. glabra* that had glandular hairs on the leaves, stems, sepals and pedicels. As *E. rarissima* has these characters and has greater affinity to *E. viridissima* and *E. subteretifolia*, we considered it was misplaced as a subspecies of *E. glabra*.

Notes. Chinnock (2007) included a collection from Kulin under *E. glabra* subsp. *verrucosa* stating 'Although I have included the collection from Kulin under this subspecies, the material lacked fruits and together with other differences this population may possibly represent another taxon'. We consider this collection to represent a southern population of *E. rarissima* on account of its flattened leaves, upright, reddish pink flowers and the glandular hairs on vegetative and reproductive parts. While we have searched around Kulin we have not been able to locate the collection site. We have also visited the site where M. Hislop collected *E. rarissima* in 2000 but were unable to locate any plants. The only extant population of *E. rarissima* is the one north of Wongan Hills, which comprises only eight plants.

The species does well in cultivation but is compromised in its natural habitat.

Table 1. A morphological comparison of *Eremophila rarissima*, *E. subteretifolia* and *E. viridissima*.

Character	***E. rarissima***	***E. subteretifolia***	***E. viridissima***
Height (m)	0.3–0.5 × 0.75–1.0	0.05–0.15 × 1.0–1.5	0.15–0.5 × 0.5–1.3
Stem hairs	glandular	glandular	absent, glandular or stellate
Leaf shape	linear to oblanceolate, flattened in T.S.	linear, flattened or subterete in T.S.	linear to oblanceolate, flattened in T.S.
Leaf hairs	glandular	absent or glandular	absent or stellate
Leaf margin	dentate distally	entire or occasionally dentate	irregularly toothed
Leaf dimensions (mm)	10–20 × 1–4	12–19 × 0.9–1.3	12–20 × 1.7–4.5
Pedicel hairs	glandular	glandular	glandular or absent
Pedicel length (mm)	5–6	2–6	4–7
Sepal shape	narrowly triangular	narrowly triangular to lanceolate	ovate-triangular to lanceolate
Sepal hairs	glandular	glandular	glandular or absent
Sepal dimensions (mm)	3.5–8 × 1–1.5	2.5–6 × 1–2	4–8 × 1.2–2.4
Corolla colour	reddish pink	orange red to yellow	yellow
Ovary surface	smooth	smooth	tuberculate

Acknowledgements

We would like to thank Ron Dadd of Goomalling for bringing this species to our notice and the staff at the Western Australian Herbarium for their continued support of our work.

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Redefinition of *Tephrosia supina* (Fabaceae: Millettieae), a north-west Western Australian endemic, and description of two similar species

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Abstract

Butcher, R. & Cowie, I.D. Redefinition of *Tephrosia supina* (Fabaceae: Millettieae), a north-west Western Australian endemic, and description of two similar species. *Nuytsia* 32: 67–83 (2021). The application of the name *Tephrosia supina* Domin is clarified herein, with this species determined as being a north-west Western Australian endemic subshrub with pink-purple flowers; *T. supina s. str.* is differentiated from two similar taxa, which also occur in the Northern Territory and Queensland. These are described herein as *T. insolens* R.Butcher & Cowie and *T. lithosperma* R.Butcher & Cowie, and *T. supina* is lectotypified. Full descriptions and images are provided for these three species and their histories and affinities are discussed.

Introduction

The taxonomic concept of *Tephrosia supina* Domin has long been confused, with a wide variety of forms included under that name across northern and central Australia. Informal segregation of herbarium specimens into putative taxa, Australia-wide, had identified several pink/purple-flowered and orange-flowered entities given the name *T. supina*; however, it had not been confidently applied to any of these forms. The taxonomic uncertainty surrounding this name is evident throughout the literature where the flowers of *T. supina* are variously described as pink/purple (Jessop & Toelken 1986), as orange (Maconochie 1981; Wheeler 1992; Paczkowska & Chapman 2000; Harden 2002), or as both (Hacker 1990); the original description (Domin 1926) does not provide any flower colour information.

Type material of *T. supina* has now been viewed on loan from the Herbarium of the Royal Botanic Gardens, Kew (K), and as a scanned specimen from Domin's herbarium at Prague (PR), and the name is confidently applied to a pink/purple-flowered taxon occurring in north-west Western Australia. Two similar, pink/purple-flowered segregate taxa, namely *T.* sp. Willowra (G.M. Chippendale 4809) and *T.* sp. Magazine Hill (P. Jones 365) [*syn. T.* sp. O.T. Station (S.T. Blake 17659); CHAH 2016], have been confirmed as distinct from *T. supina s. str.*, and they are formally described herein as *T. insolens* R.Butcher & Cowie and *T. lithosperma* R.Butcher & Cowie respectively. These three taxa are similar in their spreading subshrub habit; small, pink-purple flowers; an indumentum of white to golden, spreading hairs on stems, leaves, inflorescences and calyces; persistent stipules and inflorescence bracts; variably reddish primary, secondary, intersecondary and tertiary venation (where visible);

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and laterally compressed pods with gently upturned apices. The orange-flowered entities previously included under *T. supina* do not match any named taxa in Australia and are in the process of being formally described.

Both new species described herein are widespread across the Northern Territory and Queensland, but only relatively recently known from Western Australia and only from a few collections. A specimen of *T. lithosperma* was collected from the Hamersley Range in 1997 as *T. stipuligera* W.Fitzg. and redetermined as *T.* sp. Magazine Hill in 2014; it remains the only specimen from Western Australia to date and represents a large western disjunction for the species. A specimen of *T. insolens* was collected from south-west of the Jimblebar mine site (E of Newman) as *T. supina* in 2013 and redetermined as *T.* sp. Willowra in 2015; later in the same year it was collected from near Lake Mackay (Great Sandy Desert), with two additional Western Australian collections from that area made in 2016.

Following on from Cowie (2004), this paper is the seventh in an ongoing series (Butcher 2012, 2018a, 2018b, 2020, 2021; Butcher & Hurter 2012) that aims to resolve the taxonomy of *Tephrosia* in northern Western Australia and the Northern Territory, and to describe new species.

Materials and methods

All *Tephrosia* specimens housed at PERTH were critically studied, as were the collections housed at AD, BRI, CANB, DNA, MEL, NSW and NT, and on loan from K. Types of all Australian species have been viewed on loan or as images through *Global Plants* (https://plants.jstor.org) and courtesy of PR. Field work in the Carnarvon, Murchison and Pilbara bioregions was undertaken in 2011 and allowed for *in situ* examination of plants. Bioregions referred to in the text and displayed on distribution maps follow *Interim Biogeographic Regionalisation for Australia* (IBRA) v. 7 (Department of the Environment 2013). Abbreviations in taxon distribution statements for each jurisdiction indicate bioregions for Western Australia and the Northern Territory (Department of the Environment 2013) and botanical districts (= pastoral districts) for Queensland (Henderson 1974). To assist in the curation of herbarium collections, and to provide cross-references for grey literature reports, synonymy statements include informal names *in sched.* and the Herbaria at which these have been seen, with abbreviations following Thiers (continuously updated).

Leaf venation terminology follows Ellis *et al.* (2009). The inflorescence is interpreted as a pseudoraceme following Tucker (1987, 2003), where the elongate rachis has fascicles of flowers in the axils of first-order bracts (here termed 'inflorescence bracts'), each flower subtended by a second-order bract (here termed 'floral bract'); paired bracteoles on the pedicel can be present or absent in the genus. Fascicles comprise one or more 3-flowered units, with the first two flowers opening in relatively close succession and the third flower in each unit often delayed developmentally, with anthesis commonly occurring once the first two flowers have developed into fruits. Seed length is measured from the hilar side (point of attachment) to the opposite side, with width measured at 90° to this; terminology surrounding the hilum and rim aril follows Butcher (2020) and references therein.

Taxonomy

Tephrosia supina Domin, *Biblioth. Bot.* 89: 201 (1926). *Type*: 'N.W. Australia. Between the Ashburton and De Gray [Grey] rivers. [*s. dat.*] *Dr E. Clement*' (*lecto*, here designated: K 000217142!; *isolecto*: PR 527277, image seen).

Tephrosia sp. Pilbara (A.L. Payne PRP 1393), Western Australian Herbarium, in *FloraBase*, https://florabase.dpaw.wa.gov.au/ [accessed 27 January 2021].

T. minor Pedley ms, L. Pedley *in sched.* (e.g. PERTH 02925133; PERTH 02925168 [as *T. ?minor*]).

T. sp. aff. *clelandii* sp. nov. Pedley ms, L. Pedley *in sched.* (e.g. PERTH 03080293, PERTH 02923270); '*T.* aff. *clelandii* (after Pedley)' *p.p.*, M.E. Trudgen *in sched.* (e.g. PERTH 01228080, PERTH 02942674).

Low, weakly domed *subshrub*, semi-prostrate to erect, few-stemmed, perennial, 0.15–1 m tall, 0.4–0.6 m wide; rootstock a slender taproot. *Branchlets*, *leaf and inflorescence rachides* indumentum moderately dense to dense, the hairs declined to spreading, hyaline-white through stramineous to yellow-brown, 0.8–1.6 mm long. *Leaves* pinnate, up to 120 mm long including petiole; *stipules* persistent, antrorse to inclined, patent to reflexed with age, attenuate to narrowly deltoid, 1.7–10 mm long, red-brown drying yellow-brown, 1- or 3-nerved, hairy; *petiole* 6.1–20 mm long; *ultrajugal rachis* 0.4–9 mm long; *stipellae* absent; *petiolules* 1–1.5 mm long; *leaflets* 5–11, narrowly elliptic to obovate, flat to slightly keeled in T.S., at least some in the proximal part of the leaf, base cuneate, apex rounded, truncate or retuse, straight, shortly mucronate, mucro 0.3–1.4 mm long; *lateral leaflets* 7.2–33 mm long, 3–13 mm wide, length 1.5–3.5 × width; *terminal leaflet* 1–1.3 × the length of adjacent laterals, 7.6–37 mm long, 3.1–17.5 mm wide, length 1.8–3.3 × width; lamina slightly discolorous, the upper surface lighter than lower; secondary veins in 6–15(–18) pairs, eucamptodromous, brochidodromous at apex of leaflet, the intersecondary veins parallel at base becoming reticulate towards margin; upper surface indumentum moderately dense, occasionally sparse, the hairs soft, ascending to patent, hyaline-white to stramineous; lower surface with raised veins, indumentum moderately dense to dense, rarely sparse, the hairs soft, ascending to patent, hyaline-white to stramineous. *Inflorescence* pseudoracemose, leaf opposed in terminal position, 70–320 mm long, fascicles well-spaced, 3- or 6-flowered; *inflorescence bracts* persistent or falling late, antrorse, patent and apically reflexed with age, lanceolate, acuminate, 2.6–7 mm long; *floral bracts* caducous or falling late, antrorse, subulate to attenuate, acute, 0.8–3.5 mm long; *pedicels* 0.9–4.3 mm long; *bracteoles* absent. *Calyx* 2.1–5.3 mm long, indumentum moderately dense to dense, the hairs ascending to patent, stramineous to yellow-brown; tube 1.2–2.5 mm long, 0.6–1.4 × the length of lateral lobes; lobes deltoid to attenuate; vexillary lobes united higher than lower three, free for 0.45–1.5 mm; lowest lobe 1–3.6 mm long, ±equal to lateral lobes or a little longer. *Corolla* pink to purple, with a yellow-green eye at throat, 6–8.5 mm long; *standard* (4.5–)5.7–7.2 mm long, 6.9–9.4 mm wide, the claw 1–2.3 mm long, the blade broadly ovate to suborbicular, callused at base with a retuse to broadly emarginate apex; *wings* (4.5–)5.5–8 mm long (incl. 1.1–3 mm long claw), 2.7–4.1 mm wide, longer than keel, the blade elliptic to broadly obovate with upper and lower edges ±parallel at base, apex broadly rounded; *keel* 4.6–6.2 mm long (incl. 1.1–2.6 mm long claw), 2.5–3.1 mm wide, usually glabrous but rarely with a few hairs at apex, the blade semicircular. *Staminal tube* 4.1–5 mm long, usually hairy near fenestrae, which are prominently callused on margins towards the apex; vexillary filament usually straight in lower half and callused near base, usually patently hairy on and in front of calluses; anthers narrowly ovate, 0.4–0.5 mm long, 0.3–0.4 mm wide. *Ovary* densely hairy; ovules 5–8. *Style* flattened, gently tapering, glabrous; stigma villous, linear. *Pod* linear, gently upturned [just] at apex, laterally compressed, 24–40 mm long, 2.7–4.6 mm wide, white tissue absent between seeds, tan to yellow-brown, indumentum moderately dense, the hairs patent, stramineous to yellow-brown; beak in line with upper suture, straight to upcurved. *Seeds* 4–8 per pod, 4–5 mm between centres of adjacent seeds, transversely ellipsoid-reniform to pulvinate, laterally compressed, 1.6–2.8 mm long, 2.4–4.2 mm wide; testa smooth, finely mottled cream-tan and brown with black flecks and streaks and an orange area surrounding hilum; hilum excentric or nearly central; caruncle a minute, cream, rim aril 0.1–0.2 mm long. (Figures 1, 5A)

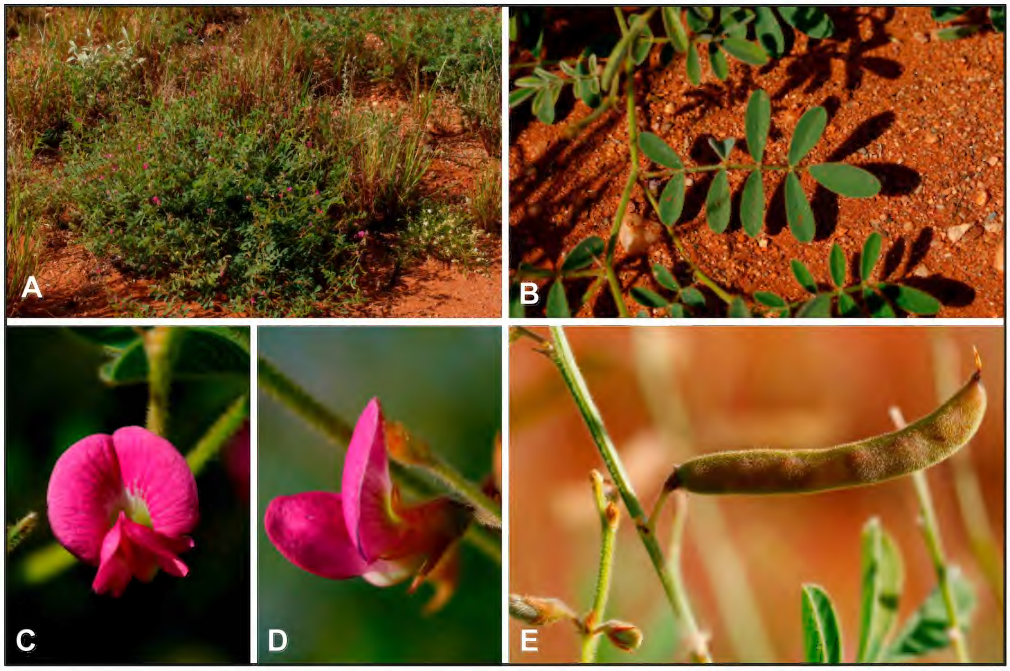

Figure 1. *Tephrosia supina*. A – plant *in situ*; B – 9-foliolate leaves with short petioles and the terminal leaflet not greatly enlarged; C – flower from front; D – flower from side showing calyx lobes *c.* equal to the tube; E – pod. Photographs by R. Butcher from *R. Butcher & S. Dillon* RB 1537 (A, B) & 1486 (C–E).

Diagnostic features. Low subshrub, usually with an indumentum of spreading, usually golden hairs; pinnate leaves with antrorse to divergent stipules, becoming patent to reflexed with age, and 5–11, elliptic to obovate leaflets 7.2–37 mm long, with the terminal leaflet equal to or slightly larger than the laterals (1–1.3 × length); small (6–8.5 mm long) pink to purple flowers with the calyx tube a little shorter than to longer than the deltoid to attenuate lateral lobes, held in pseudoracemes (70–320 mm long) with persistent, antrorse inflorescence bracts; the staminal tube usually hairy near fenestrae, which have prominently callused margins, and filament usually hairy near the base on and around calluses; pods linear, gently upturned just at apex, 24–40 mm long, 2.7–4.6 mm wide, laterally compressed, not strongly depressed between seeds (with patent, stramineous indumentum); transversely ellipsoid-reniform seeds with a mottled, smooth testa (and ±central to slightly excentric hilum).

Selected specimens examined. WESTERN AUSTRALIA: 4.2 km S of Rubin junction, E of Goldsworthy and *c.* 140 km E of Port Hedland, 22 Apr. 2006, *A.R. Bean* 25041 (BRI, DNA, PERTH); 20.3 km from HS between Diorite and Bill Bore, Nyang Stn, 29 May 2004, *G. Byrne* 1013 (PERTH); small granite range on N side of North West Coastal Hwy, *c.* 56 SW of Nanutarra Roadhouse, 20 May 2011, *R. Butcher & S. Dillon* RB 1486 (BRI, DNA, MEL [2 sheets], NSW, PERTH); 60.1 km S of North West Coastal Hwy on Towera Rd, W side of road, 31 May 2011, *R. Butcher & S. Dillon* RB 1537 (K, MO, PERTH, UWC); E Burrup Peninsula, adjacent to NE part of Withnell Bay, Trudgen and Ass. (2002) plot 185, 27 May 2009, *R. Butcher, K.A. Shepherd, J.A. Wege, S. van Leeuwen & V. Long* RB 1393 (DNA, PERTH); ExSB 101, Towera Stn, 4 Aug. 1981, *R.J. Cranfield* 1744 (PERTH [2 sheets]); repeater tower on gas pipeline, 2 km SW of Mt Stuart Rd, 15 km W of Cane River Stn, 80 km SE of Onslow, 25 May 1999, *D.J. Edinger* 1588 (CANB, PERTH); Telfer, *s. dat.*, *E.M. Goble-Garratt* 95 (NT, PERTH); Harding River crossing, 23 km N (by road) along pipeline service track from Snappy Gum Drive, Millstream, *D. Halford* Q 9275 (BRI, DNA, MEL, PERTH); Rudall River region, June

1987, *R.P. Hart* 589 (PERTH); Glenflorrie Stn, Upper Gascoyne, 9 May 1971, *J.N. Hutchinson* 123 (PERTH); site: DRW09, N side of Fortescue River Mouth access track, 6.5 km W of North West Coastal Hwy, 16.1 km NW of Mt Virchow, 67.5 km SW of Dampier, Mardie Stn, 10 Aug, 2005, *S. van Leeuwen et al.* PBS 0285 (DNA, PERTH [2 sheets], UEC); site: MBE07, 500 m S of Chocolate Hill, 7.4 km SSE of The Island Hill, 44.5 km SW of Marble Bar, Panorama Stn, 30 Apr. 2006, *S. van Leeuwen et al.* PBS 0286 (AD, PERTH [2 sheets]); site: OYE04, N side of road, 170 m off road, 3.4 km E of Pannawonica–Cape Lambert railway crossing on Pannawonica–Millstream Rd, 20.3 km NNW of Mt Elvire, 40.9 km ESE of Pannawonica, Yalleen Stn, 30 Aug. 2006, *S. van Leeuwen et al.* PBS 0288 (PERTH); site: PW13, E side of road, 7.2 km N of Python Pool creek crossing on Roebourne–Munjina Rd, 6.6 km ENE of Mt Herbert, 61.7 km SSE of Roebourne, Millstream-Chichester N.P., 17 Aug. 2004, *S. van Leeuwen et al.* PBS 0291 (BRI, PERTH); Anketell Ridge, Great Sandy Desert, 14 May 1979, *A.S. Mitchell* 1208 (DNA, PERTH); 298 km N of Meekatharra on road to Mt Augustus, S of The Pink Hills, 12 Aug. 2002, *S.J. Patrick* 4241 (CANB, PERTH); *c.* 15 km E of Bonney Downs HS, I271, 27 July 1996, *A.L. Payne* PRP 1393 (PERTH); site number: 1087. 8.7 km WSW of Mt Herbert, Millstream-Chichester N.P., Hamersley Ra., 18 Sep. 1997, *M.E. Trudgen* MET 17758 (PERTH); 6.2 km along track to Carawine Gorge, Fortescue District, 4 Sep. 1991, *P.G. Wilson & R. Rowe* PGW 911 (BRI, NSW, PERTH).

Phenology. Flowering is in response to rain; in the Pilbara rain is usually associated with the cyclone season. Most flowering specimens collected from March to September (peaking May to August) with pods present from April to September, and mature seed collected mostly in August and September.

Distribution. Western Australia (CAR, GAS, GSD, LSD, PIL): *T. supina* appears to be endemic to north-west Western Australia, with collections made in the area roughly bounded by Mt Sandiman Station–Mt Augustus in the south-west, Giralia Station (S of Exmouth Gulf) to the west, north-eastward to Anna Plains Station (S of Broome) near the coast and inland to Rudall River (Figure 2). The species has also been recorded from West Lewis Island, Barrow Island and Hermite Island, off the Pilbara coast.

Habitat. *Tephrosia supina* occurs in flat to undulating areas usually associated with watercourses, drainage lines and lower slopes of ridges and hills. Substrate is brown to red-brown sandy loam to red clay, frequently gravelly and often with a cracking surface. Bedrock usually comprises granites. Grows in open tall shrubland dominated by *Acacia* species (e.g. *A. ancistrocarpa*, *A. citrinoviridis*, *A. inaequilatera*, *A. kempeana*, *A. pyrifolia* or open to very open low woodland (including *A. coriacea*, *Corymbia hamersleyana*, *Eucalyptus victrix*, *Terminalia canescens*), over low shrubs, grasses, sedges and herbs, or in *Triodia* hummock grassland.

Conservation status. Widespread across north-west Western Australia and not at risk. Occurs in several conservation reserves and national parks.

Etymology. From the Latin *supinus* (bent backwards, prostrate), possibly in reference to its low and spreading habit, the deflexed hairs on its stems or to the orientation of its lower lateral leaflets.

Typification. *Tephrosia supina* is lectotypified here to remove any confusion arising from the citation of three specimens, representing three different species, in Domin's (1926) protologue. Although Domin clearly noted that one of the specimens ('N.W. Australia. Between the Ashburton and De Gray [Grey] rivers, *Dr. E. Clement* [*s.n.*]') was the basis for the species' description ('planta descripta'), he also noted that the other two ('R. Brown, Iter Australiense, 1802–05, Island Z [Inglis Island, Northern Territory], *R. Brown* Bennett No. 4102 als *Galega* No. 15' and 'R. Brown, Iter Australiense, 1802–05,

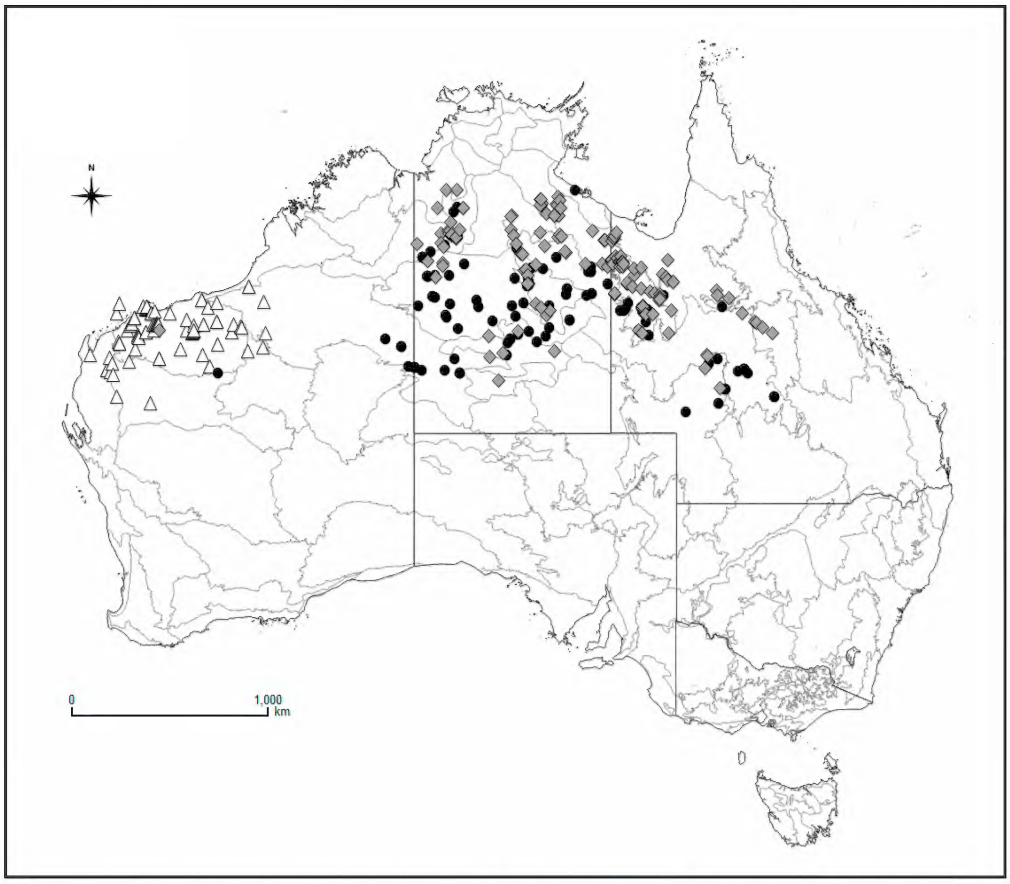

Figure 2. Distribution of *Tephrosia supina* (△), *T. insolens* (●) and *T. lithosperma* (◆) in northern Australia. Both *T. insolens* and *T. lithosperma* have outlying collections from the Pilbara bioregion, Western Australia, within the range of *T. supina*.

North Coast, *R. Brown* Bennett No. 4100 als *Galega supina* R.Br. [name not published]') exhibited different forms of the species as described by him (Domin 1926: 201); we do not agree with Domin's observation. Brown's specimen from 'Island Z' (No. 4102) is superficially similar to Clement's but can be assigned to *T. pumila* (Lamk.) Pers., while his specimen from the 'North Coast' (No. 4100) is *T. remotiflora* Benth. and is cited as a syntype under that name by Bentham (1864: 209).

All three specimens are held at K, with a duplicate of the Clement specimen in Domin's herbarium at PR and duplicates of both Brown specimens at E (seen via *GlobalPlants*). It is probable that Domin saw both Clement specimens while preparing the description of *T. supina*, with the PR sheet having the same Clement label as the K specimen as well as a typed Domin 'Iter Australiense a. 1909–1910' label with the identification '*Tephrosia supina* DOM.n.sp.', and with 'Queensland' struck out and replaced with 'N.W. Austr.: inter flumina Ashburton et De Gray River /planta descripta/'. If this label was not produced by Domin himself it would have been produced by an assistant under Domin's supervision (O. Šída, pers. comm.). While it is known that Domin prepared his descriptions of Australian species for the *Beitrage* while at K, it is not known whether he saw both Clement specimens there, nor when that material arrived at PR and by what route (O. Šída, pers. comm.). As such, *T. supina* is lectotypified on the K sheet of Clement's collection, with the PR sheet designated as an isolectotype.

Affinities and notes. *Tephrosia supina* is morphologically most similar to the two new species described herein. Of the two, *T. insolens* is most similar to *T. supina* in the size and shape of its pods, its seed morphology, and its larger, flatter, elliptic to obovate leaflets, but can be readily distinguished by the following characters: leaves usually with 3 or 5 leaflets; the terminal leaflet distinctly larger (1.3–2.5 ×) than the adjacent laterals in *T. insolens* (vs 1–1.3 × in *T. supina*); the pseudoracemes much shorter; the calyx lobes long, slender and *c.* 1.5–3 × longer than the tube (vs 0.6–1.4 × tube length); the staminal tube and upper filament glabrous (vs usually hairy); the pods with longer, finer hairs and the valve faces with more pronounced indentation between the seeds.

Tephrosia lithosperma can be readily distinguished from *T. supina* by the following characters: finer stems and inflorescence rachides; paler indumentum; longer, more slender, distinctly spreading to recurved stipules; generally smaller leaflets with a more prominent mucro; the lower leaflet surface with darker red veins that are distinctly thickened and raised; smaller flowers (corolla 3.7–5.5 mm vs 6–8.5 mm long); the calyx lobes *c.* 2–3 × longer than the tube; narrower pods with a more strongly upturned apex and a (generally) longer beak (often with style ±persistent); laterally compressed, finely rugose seeds that are uniformly red-brown or flecked with dark brown or black (vs testa smooth, finely mottled cream-tan, brown and black).

Some PERTH specimens from north of the Kennedy Range with very small leaflets (*R.J. Cranfield* 1744, 2 sheets; *R.J. Cranfield* 1753; *A.A. Mitchell* 1208; *D. Wilcox* 44) were determined as '*T. minor* sp. nov.' by L. Pedley in December 1984. Leaf and leaflet size are very variable in *T. supina*, however, and many collections display a range of leaflet sizes on a single plant. Specimen re-collections by RB in 2011 from the same area as Pedley's '*T. minor*' located only plants with larger leaflets suggesting that different climatic conditions between years can influence leaflet size.

A handful of PERTH specimens (*T.E.H. Aplin* 4669; *B. Bignold s.n.* PERTH 03080293; *A.S. George* 3401; *E.C.B. Langfield* 274, 2 sheets; *R.D. Royce* 7364; *D. Rust* 9) were identified as '*Tephrosia* sp. aff. *T. clelandii* sp. nov. from Central Australia' by L. Pedley in December 1984. Of these, two (*B. Bignold s.n.*, Roebourne; *R.D. Royce* 7364, West Lewis Island in the Dampier Archipelago) are slightly hairier specimens of *T. supina s. str.*, two (*D. Rust* 9; *T.E.H. Aplin* 4669; both from station country in the Kimberley) are specimens of *T.* sp. Northern (K.F. Kenneally 11950), and one (*A.S. George* 3401, E of Whim Creek) is a specimen of *T.* sp. NW Eremaean (S. van Leeuwen et al. PBS 0356). The last specimen (*E.C.B. Langfield* 274, Burt Range, E of Kununurra on the Western Australia/Northern Territory border) is densely hairy throughout and differentiated from others in the *T. supina* group by its pods, which have a centrally positioned beak and appressed indumentum; it remains unidentified.

Unfortunately, the name '*T.* aff. *clelandii*' has been taken up by some Western Australian botanists and broadly applied within the PERTH collection, with most of these determinations applied '(after Pedley)' to specimens of *T. supina s. str*. Some recent lodgements at PERTH from the Onslow–Pannawonica area of the Pilbara have also been determined as '*T.* aff. *clelandii*' but these have a closer affinity to *T. remotiflora* than to any taxon previously included under *T. supina*. As '*T. clelandii*' is an unpublished name with a confused taxonomy[1] and without any diagnostic information (see Paczkowska & Chapman 2000: 449), it is strongly recommended that this name, and its derivative '*T.* aff. *clelandii*', should not be used in Western Australia.

[1]Herbarium visits to BRI identified that *T. 'clelandii'* is also known as *T. 'latzii'* there, with these equated to the name *T.* sp. Balcanoona Creek (K. Alcock AQ 457802), a.k.a. *T.* sp. Q 11, recorded as occurring in the Northern Territory, Queensland and South Australia. Two sheets of the voucher specimen for *T.* sp. Balcanoona Creek have been viewed and found to be the same taxon as *T.* sp. Granite (P.K. Latz 12116), a central Australian affiliate of *T. brachyodon* Domin; these informal names have now been reconciled in the APC under *T.* sp. Granite (P.K. Latz 12116).

Because it was widely thought that *T. supina* was an orange-flowered taxon, specimens at PERTH now attributed to *T. supina s. str.* had been segregated and placed under the phrase name *T.* sp. Pilbara (A.L. Payne PRP 1393); that is now an informal synonym.

Tephrosia insolens R.Butcher & Cowie, *sp. nov.*

Type: 16 km south-south-east Sangsters Bore, Tanami Desert, Northern Territory, 12 July 1993, *P.K. Latz* 13250 (*holo*: DNA A0089629!; *iso*: CANB 485365.1!, NSW 582578!, NT A0089629!).

Tephrosia sp. Willowra (G.M. Chippendale 4809), Cowie [Northern Territory Herbarium], in Albrecht, D.E., Dugiuid, A.W., Coulson, H., Harris, M.G. & Latz, P.K. (2007), *Vasc. Pl. Checkl. for the S. Bioreg. of the N. Territory: Nomencl., Distrib. and Cons. Stat.* 2nd Edn: 127; Short, P.S., Albrecht, D.E., Cowie, I.D., Lewis, D.L.& Stuckey, B.M. (ed.) (2011), *Checkl. of the Vasc. Pl. of the N. Territory*: 36.

Tephrosia 'A4089 Willowra', in Dunlop, C.R., Leach, G.J., Latz, P.K., Barritt, M.J., Cowie, I.D. & Albrecht, D.E. (1995), *Checkl. of the Vasc. Pl. of the N. Territory, Austral.*: 54; Albrecht, D.E., Dugiuid, A.W., Latz, P.K., Coulson, H. & Barritt, M.J. (1997), *Vasc. Pl. Checkl. for the S. Bioreg. of the N. Territory: Nomencl., Distrib. and Cons. Stat.*: 112.

Tephrosia 'quinqefolia', in sched. [BRI].

Prostrate, spreading or rounded woody *herb* or erect *dwarf shrub*, multi-stemmed, annual or perennial (based on specimen labels), to 0.6 m tall, to 2 m wide; rootstock a long, semi-woody taproot. *Branchlets, leaf and inflorescence rachides* slender, with moderately dense to dense, often very fine, patent to slightly ascending indumentum of usually white, occasionally stramineous hairs, 0.4–1.2 mm long. *Leaves* pinnate, up to 66 mm long including petiole; *stipules* persistent, antrorse at first, diverging to patent with age, then eventually recurved, very narrow, attenuate, 2.7–8 mm long, green with red veins through red-brown to yellow-brown with age, 1- or 3-nerved depending on width, hairy; *petiole* 5–18 mm long; *ultrajugal rachis* 1.8–8 mm long; *stipellae* absent; *petiolules* 0.9–1.8 mm long; *leaflets* 3–5(–7), broadly oblong, elliptic, or narrowly obovate to obovate, usually flat in T.S., all positioned in the distal half of the leaf when 3-foliolate, some in the proximal half when 5(–7)-foliolate, base cuneate to slightly rounded, apex rounded to emarginate, straight but minute mucro (0.5–0.7 mm long) often reflexed; *lateral leaflets* 6–23 mm long, 3.5–10 mm wide, length 1.8–3.3 × width; *terminal leaflet* noticeably larger (1.3–2.5 × the length of adjacent laterals) on most leaves, 11.5–35 mm long, 5.7–17 mm wide, length 2.7–4.3 × width; lamina discolorous, the upper surface olive green, the lower surface dark olive green; secondary veins brochidodromous, in 6–13 pairs, intersecondary veins parallel at base, then reticulating; upper surface with sparse to moderately dense, inclined, straight, white hairs, these soft to quite rigid, hyaline; lower surface with raised veins, these fine, cream to pink-red to deep red, indumentum denser and longer than on upper surface, hairs inclined to patent, straight, white, soft to quite rigid, hyaline. *Inflorescence* pseudoracemose, leaf-opposed, usually with a cluster of axillary flowers at base, 10–100 mm long, with usually 3 flowers developing sequentially at each node, more in axillary clusters; *inflorescence bracts* persistent, antrorse, attenuate, reddish, 2.6–5.3 mm long; *floral bracts* falling late, antrorse, attenuate, 1–2.3 mm long; *pedicel* 1.5–6 mm long; *bracteoles* usually absent (1 flower seen with bracteoles 0.4 mm long at junction of pedicel and calyx tube). *Calyx* 5–7.5 mm long, moderately hairy with patent, white to pale stramineous, hyaline hairs; tube 2.3–2.6 mm long, 0.35–0.75 × the length of lateral lobes; lobes lanceolate at base then filiform; vexillary lobes united slightly higher than the lower three, free for 3–3.5 mm (divided to 70–91% length); lowest lobe 3.6–5 mm long, *c.* equal in length to lateral lobes. *Corolla* pink to scarlet or mauve to purple, 5.5–7 mm

long; *standard* 4.5–6 mm long, 5–7 mm wide, with a broad 1.7–2.1 mm long claw, the blade broadly ovate to suborbicular, slightly and linearly callused at base, with a rounded to slightly emarginate apex; *wings* 5.5–6.7 mm long (incl. 2–2.4 mm long claw), 1.9–2.6 mm wide, longer than keel, the blade ±oblong to broadly obovate with a small pouch in front of spur, the apex rounded, slightly oblique; *keel* 5.2–5.9 mm long (incl. 2.1–2.5 mm long claw), 2.4–3 mm wide, the blade ±semi-circular, gently incurved along upper edge and pouched in front of spur, glabrous. *Staminal* tube 4–4.7 mm long, glabrous, margins of fenestrae inrolled, not significantly thickened and not callused, or slightly thickened with small, rounded calluses at apex; vexillary filament slightly geniculate at base, not or slightly callused, glabrous; anthers narrowly ovate to oblong, 0.4–0.45 mm long, 0.3–0.4 mm wide. *Ovary* densely hairy with inclined, straight hairs, frequently thick-walled; ovules 6–8. *Style* flattened, almost uniform to tapering to *c.* 1/2 width, glabrous; stigma with moderately short flexible hairs at base, linear. *Pods* linear, slightly upturned at apex to curved along length, laterally compressed, the sides indented between seeds at maturity, 30–41 mm long, 3–4.5 mm wide, length 8.2–11.9 × width, tissue absent between seeds, pale yellow to tan at maturity, with a moderately dense, somewhat tangled indumentum of ascending, soft and thin, or patent and more coarse, white to pale stramineous hairs; beak in line with the upper suture, straight to gently uncinate. *Seeds* (3–)5–8 per pod, 4–5.5 mm between centres of adjacent seeds, transversely obloid to narrowly ellipsoid, 2.1–2.8 mm long, 2.6–3.3 mm wide, testa smooth to broadly dimpled, finely mottled orange-light brown and brown with flecks of cream or pinkish light brown and black; hilum ±central to slightly excentric with a minute, annular rim aril (with tongue), this transparent-cream, 0.07–0.1 mm long. (Figures 3, 5B)

Diagnostic features. Low, spreading, woody herb or subshrub with an indumentum of ±patent pale hairs; pinnate leaves with persistent, recurved, red-brown stipules and 3–5(–7), broadly oblong to obovate leaflets 6–35 mm long, with the terminal leaflet usually noticeably larger than adjacent laterals (1.3–2.5 × longer); small (5.5–7 mm long), pink to purple flowers with the calyx tube *c.* 1/3–3/4 the length of the slender lateral lobes, held in short pseudoracemes (to 100 mm long) with persistent, antrorse inflorescence bracts; the staminal tube and vexillary filament glabrous; pods linear, straight with the apex upturned or curved along length, 30–41 mm long, 3–4.5 mm wide, laterally compressed at maturity and depressed between seeds, usually with a slightly tangled indumentum of fine white hairs; transversely obloid to ellipsoid seeds that are not laterally compressed and have a finely mottled, and smooth to broadly dimpled testa, and a ±central to slightly excentric hilum.

Selected specimens examined. WESTERN AUSTRALIA: Kiwirrkurra Indigenous Protected Area; *c.* 1.1 km S of Gary Junction Rd, *c.* 31.7 km due WNW of the NT/WA border on Gary Junction Rd, 4 June 2016, *D.E. Albrecht* 14641 (CANB); 106 km ESE of Kiwirrkurra, 20 June 2016, *A. Schubert* 834 (NT); SW Jimblebar, 40 km E of Newman, 3 Sep. 2013, *R. Tomanovic* SWJ 36.11 (PERTH); 5 km NW of Bibarrd, 31 July 2016, *P. Trickett* DD 1153 (PERTH). NORTHERN TERRITORY: 63 km WSW of Wycliffe Well, 1 Mar. 2009, *D.E. Albrecht & P.K. Latz* 12844 (DNA, NT); 69 mi NW of Willowra HS, 31 July 1958, *G.M. Chippendale* 4809 (AD, CANB, DNA, NSW); sand sheet near Wilson Creek flood out, North Tanami Desert, 30 Apr. 2004, *B. Crase & A. Duguid* 1337 (DNA, MO); Tennant Creek, Peko Rd, 29 Mar. 1994, *J.L. Egan* 3436 (DNA); 40 km W of Sup[p]lejack HS, 30 Sep. 1978, *T.S. Henshall* 2320 (BRI [2 sheets], DNA, NT); Annitowa Stn, 9 May 1977, *P.K. Latz* 7008 (BRI, CANB, K, NT, PERTH); 1 km E of WA border on Kintore Rd. Plot 1181, 27 Apr. 1988, *G. Leach & M.B. Leach* 1954 (BRI, DNA, NT); Mt Putardi area, 5 Apr. 1972, *J.R. Maconochie* 1366 (BRI, CANB, DNA, K, NT); Barkly Tablelands, Mittabah Stn, 13 July 2001, *C.P. Mangion* 1505 & *J.A. Risler* (DNA, LD, MO, NT); NW Wakaya Desert, 10 May 1993, *D.J. Parsons* 534 (CANB, DNA, NT); Humbert River Stn, S fenceline of Cow Speyed Paddock, 25 Apr. 2003, *J.A. Risler & D.L. Lewis* 3073 (DNA, NT). QUEENSLAND: 42.7 km along Silsoe Rd, W of Longreach, 15 May 2004, *A.R. Bean* 22211 (BRI, NSW); May Downs Stn, *c.* 88 km NW of Mount Isa, 27 May 2010, *R. Booth* NWH2-6 &

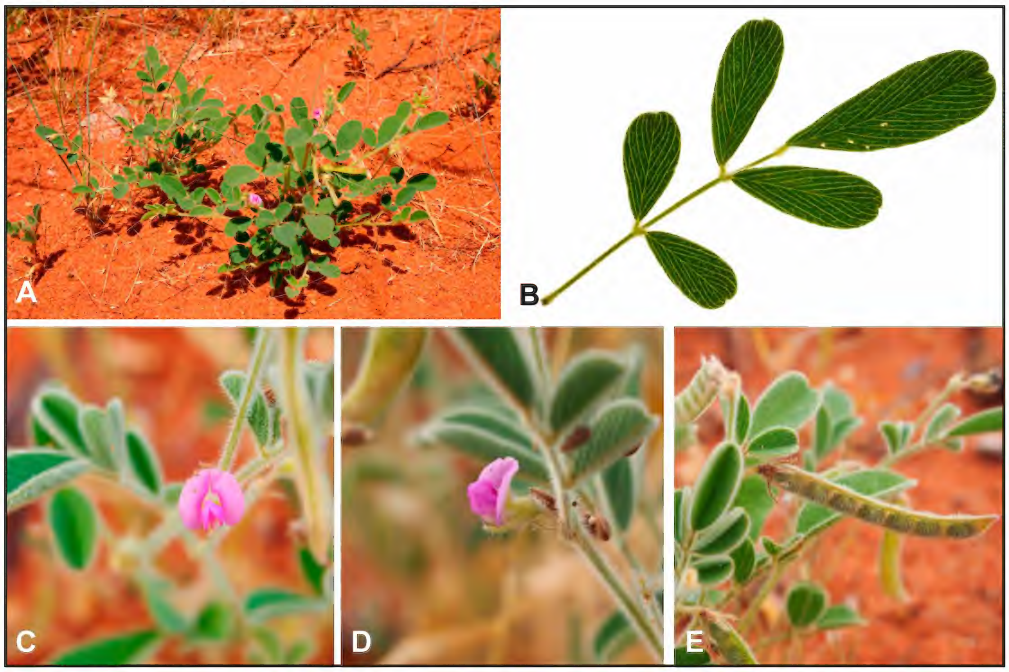

Figure 3. *Tephrosia insolens*. A – flowering plant *in situ* showing spreading habit and leaves with enlarged terminal leaflet, and habitat; B – single leaf showing venation; C – flower from front; D – flower from side showing calyx morphology; E – pod showing calyx lobes much longer than the tube, long indumentum, and indentation between the seeds. Photographs by Mike Marathon (Wikimedia Commons) (A, C–E) and K. Brennan from *K. Brennan* 8914 (B).

D.T. Kelman (BRI); Lochern N.P., Eurondella Back Paddock, 25 Mar. 1998, *P.I. Forster & R. Booth* PIF22367 (BRI); 170 km N of Boulia-Mount Isa Rd [Diamantina Development Rd], 31 May 1984, *J.B. Hyland* BH596 (BRI); 59 km by road S of Winton towards Jundah, Warnambool Downs, 23 Sep. 2005, *M.B. Thomas* 2928 & *D.A. Halford* (BRI, MEL, NSW).

Phenology. From the specimens examined, flowers and fruits occur throughout the year (January to November) probably initiated by localised rainfall events.

Distribution. Western Australia (GSD, PIL), Northern Territory (BRT, DMR, GFU, GSD, GUC, MGD, MII, OVP, TAN) and Queensland (BK, GN, MI): widespread across central Australia in the area roughly bounded by Newman (WA) to the west, Yarralin (NT) to the north, Alice Springs (NT) to the south and Blackall (Qld) to the east, with a north-eastern outlier from Bing Bong Station (NT) on the Gulf of Carpentaria (Figure 2).

Habitat. Most frequently collected from red sand, sandy loam and clay loam in desert country, infrequently from lower scree slopes and gravelly soils with outcropping rock. Associated vegetation is variable and includes very open, low eucalypt woodland with spinifex, mulga woodland, open shrubland, and both tussock and hummock grasslands. The life-form of *T. insolens* is uncertain or variable and it is recorded as annual or perennial on specimen labels. Plants seen by RB near Kiwirrkurra (WA) and around Kintore (NT) in September 2015 were mostly dead across the populations with high numbers of fallen fruits and seeds. Plants were abundant at each site where the species was seen.

Conservation status. This species does not have a conservation listing in Western Australia. Although only known from five collections from two disjunct areas in the State, those from around Lake Mackay are contiguous with collections in the Northern Territory; it is probably widespread throughout the under-collected northern interior. It is ranked as Least Concern in the Northern Territory under the *Territory Parks and Wildlife Conservation Act 2000* (TPWCA) using IUCN guidelines and is not conservation-listed in Queensland.

Etymology. The epithet *insolens* (L. proud, haughty, arrogant) is used here in reference to the 'bigheadedness' of this species' leaves, in which the obovate terminal leaflet is usually prominently enlarged relative to the laterals.

Affinities and notes. *Tephrosia insolens* has characters in common with *T. supina* and *T. lithosperma*, but it is readily differentiated from both by the combination of its lower number of leaflets (usually 3 or 5, sometimes 7) with the terminal leaflet usually distinctly larger than the adjacent laterals; slender, elongate calyx lobes that are *c.* 1.5–3 × longer than the tube; a glabrous staminal tube and upper filament; and longer hairs on its pods, which are prominently indented between the seeds when mature.

Many specimens of *T. insolens* were originally identified as *T. flagellaris* Domin (from Queensland) due to the prominently enlarged terminal leaflet, but *T. flagellaris* can be distinguished by the following characters: 5–9 linear-oblong leaflets per leaf; terminal leaflet up to 4 × longer than the adjacent laterals; larger flowers (8–9 mm long); and broader pods with a straight apex.

Specimens of *T.* sp. Northern from the Northern Territory have been misidentified as *T. insolens* there, presumably because of the enlarged terminal leaflet and very long, slender calyx lobes, but are readily distinguishable by their orange flowers and, if not flowering, by their straight, turgid pods with spongy to membranous tissue between the more-boldly mottled seeds, and the leaves having 7+ leaflets with no indication of reddening of the venation.

There is variation in the size of the terminal leaflet relative to the laterals, this related either to the age of the plant or to the different positions of the leaves throughout the mature plants. Herbarium specimens that are comprised of whole plant samples (i.e. including the taproot) show that the first leaves and those near the base of stems have the terminal leaflets greatly enlarged compared to the laterals, but that this relative enlargement diminishes along stems.

Tephrosia lithosperma R.Butcher & Cowie, *sp. nov.*

Type: Daguragu Land Trust area; near Hughie Creek *c.* 18.3 km south-west of Daguragu, Northern Territory, 28 March 2012, *I.D. Cowie* 12917 (*holo*: DNA-D0223830!; *iso*: BRI, CANB, LD, MEL 2380768A!, PERTH 08616884!).

Tephrosia sp. Magazine Hill (P. Jones 365), Queensland Herbarium, in Holland, A.E. & Pedley, L. in Bostock, P.D. & Holland, A.E. (eds.) (2010), Fabaceae. *Census of the Queensland Fl.,* 2010: 78.

Tephrosia sp. O.T. Station (S.T. Blake 17659), Cowie [Northern Territory Herbarium], in Albrecht, D.E., Dugiuid, A.W., Coulson, H., Harris, M.G. & Latz, P.K. (2007), *Vasc. Pl. Checkl. for the S. Bioreg. of the N. Territory: Nomencl., Distrib. and Cons. Stat.* 2nd Edn: 127; Short, P.S., Albrecht, D.E., Cowie, I.D., Lewis, D.L. & Stuckey, D.M. (eds.) (2011), *Checkl. of the Vasc. Pl. of the N. Territory*: 36.

Tephrosia 'D53770 OT Station', in Albrecht, D.E., Duguid, A.W., Latz, P.K., Coulson, H. & Barritt, M.J. (1997), *Vasc. Pl. Checkl. for the S. Bioreg. of the N. Territory: Nomencl., Distrib. and Cons. Stat.*: 113.

Tephrosia '*carpenteriae*', *in sched.* [BRI]

[*Tephrosia stipuligera auct. non* W.Fitzg.: J.R. Maconochie, *Fl. Central Austral.*: 156 (1981), as to NT and Qld material].

Low, spreading *woody herb* to *subshrub*, possibly annual, to 0.5 m tall, at least 0.3 m wide, with numerous slender stems arising from a narrow rootstock. *Branchlets*, *leaf and inflorescence rachides* with sparse to moderately dense indumentum of ascending to patent, straight, hyaline, white to pale stramineous hairs, 0.3–1.2 mm long. *Leaves* pinnate, up to 85 mm long including petiole; *stipules* persistent, prominent, divergent through patent to recurved with age, filiform to subulate, 4–9 mm long, red-brown darkening with age, 3-nerved, hairy; *petiole* 1.5–10 mm long, with the first leaves of small, post-fire plants having petioles 20–24 mm long and reducing thereafter; *ultrajugal rachis* 1–7.7 mm long; *stipellae* absent; *petiolules* 0.5–1.2 (to 2 mm on lowest leaves); *leaflets* 5–11(–17), increasing in size from base with the longest towards the centre or at the apex of leaf, most leaves with at least some of the leaflets attached in the proximal half, narrowly elliptic to obovate, flat to V-shaped in T.S., base cuneate, apex acute to obtuse to retuse, straight to gently recurved, mucro often minute (0.2–0.5 mm long), sometimes to 1.6 mm long; *lateral leaflets* 2.9–17 mm long, 1.4–6.9 mm wide, length 1.8–4.1 × width; *terminal leaflet* 0.9–1.5 × longer than adjacent laterals, 4.7–24 mm long, 2.1–8.4 mm wide, length 1.9–3.9 × width; lamina discolorous, light green above and mid-green to olive green below; secondary veins brochidodromous on larger leaflets, eucamptodromous becoming brochidodromous just at apex on smaller leaflets, in 7–14 pairs, intersecondary veins parallel, only reticulating towards margin; upper surface indumentum moderately dense, with inclined to patent, fine, straight, hyaline hairs (surface often appearing glabrous), sometimes with loosely appressed, white hairs, glabrescent; lower surface with prominent, thickened, raised, usually reddish to dark red primary and secondary veins, indumentum as for upper surface except longer and denser. *Inflorescence* pseudoracemose, leaf-opposed at apices of branches, often also with axillary flowers at base, 50–165 mm long, with 3 or 6 (or more) flowers in each cluster; *inflorescence bracts* persistent, recurved, filiform-subulate, reddish, 3.3–7 mm long; *floral bracts* commonly persistent with clusters of bracts remaining at inflorescence nodes after flowers and pods have fallen, antrorse, filiform-subulate, reddish, 1.1–2.7 mm long; *pedicel* 1.5–4 mm long; *bracteoles* absent. *Calyx* 3.3–5.3 mm long, moderately hairy with patent, white hairs; tube 1.5–2 mm long, 0.45–0.62(–0.9) × the length of lateral lobes; lobes attenuate to setose in appearance; vexillary lobes united slightly higher to evidently higher than lower three, free for 1.6–2.7 mm (divided to 80–87% length); lowest lobe 2.5–4.5 mm long, a little longer than the lateral lobes. *Corolla* pink-mauve-purple, 3.7–5.5 mm long; *standard* 4.6–6 mm long, 5.7–7.2 mm wide, with a tapering claw 1.7–2.1 mm long, the blade depressed-broadly ovate to flabelliform, scarcely to slightly linearly callused at base, with a rounded to shallowly emarginate apex; *wings* 5.6–7.5 mm long (incl. 1.8–2.5 mm long claw), 2.6–3.7 mm wide, longer than keel, the blade elliptic to broadly ovate, with a deeper curve on the lower edge and a short straight region in front of the spur on the upper edge, the apex rounded, oblique, sometimes with a few hairs on the lower edge towards the claw; *keel* 4.3–5.6 mm long (incl. 2–2.7 mm long claw), 2.1–2.8 mm wide, glabrous, the blade semi-circular, broadly and prominently pouched in front of spur to *c.* 1/2 blade depth. *Staminal tube* 3.8–4.4 mm long, glabrous, slightly callused on margins and at apex of fenestrae to having prominent, rounded calluses at the apex; vexillary filament slightly geniculate in lower half, with scattered hairs (occasionally only 1 or 2) in front of small callosities to extending much of the way along the filament; anthers oblong, ovate, to broadly elliptic, *c.* 0.5 mm long, 0.3–0.4 mm wide. *Ovary* densely hairy (short, inclined hairs); ovules 5–7 (on specimens seen, but number likely to be higher based on seed number in fruit). *Style*

flattened, almost uniform, glabrous; stigma with short hairs at base, linear. *Pods* linear, upturned at apex to curved along length, laterally compressed when immature, almost turgid at maturity but very slightly indented between seeds, 16–38 mm long, 2.5–3.3 mm wide (length 8.4–11.9 × width), tissue absent between seeds, pods stramineous to yellow-brown at maturity, indumentum sparse to moderately dense, hairs patent, white, shorter on the darkened sutures, often longer and finer on the pod faces; beak long, in line with upper suture, straight. *Seeds* (3–)6–9 per pod, 3.2–4.5 mm between centres of adjacent seeds, transversely obloid-reniform to pulvinate, laterally compressed, (1.1–)1.8–2.4 mm long, 2.5–3.8 mm wide, orange-brown to brown, flecked or patterned with darker brown to black and pale pinkish brown, orange around hilum, testa irregularly rugose, depressed in darker-coloured areas; hilum ±central to excentric (positioned *c.* 1/3 of the way along seed), with a small but distinct, whitish, rim aril (with double tongue) 0.1–0.2 mm long within the hilar fissure. (Figures 4, 5C)

Diagnostic features. Low, spreading woody herb to subshrub with an indumentum of ±patent pale hairs; pinnate leaves with persistent, recurved, red-brown stipules and 5–11(–17) narrowly elliptic to obovate leaflets 2.9–24 mm long, with the terminal leaflet not distinctly larger than adjacent laterals (0.9–1.5 × longer); small (3.7–5.5 mm long), pink to purple flowers with the calyx tube *c.* 1/2 length of the slender lateral lobes, held in short pseudoracemes (to 165 mm long) with persistent, recurved inflorescence bracts; the staminal tube glabrous and the vexillary filament with few to numerous hairs in front of the basal callosities; pods linear, with an upcurved apex or curved along length, 16–38 mm long, 2.5–3.3 mm wide, almost turgid at maturity but slightly depressed between seeds, with an indumentum of patent, white hairs; transversely obloid-reniform to pulvinate seeds that are laterally compressed and have a finely mottled and irregularly rugose testa with the hilum usually slightly excentric.

Selected specimens examined. WESTERN AUSTRALIA: [locality withheld for conservation reasons] 25 May 1997, *M.E. Trudgen* MET 18005 (PERTH). NORTHERN TERRITORY: O.T. Stn, *S.T. Blake* 17659 (AD, BRI, DNA, MEL); Savannah Way between Hi-Way Inn and Cape Crawford, 2 Apr. 2016, *K. Brennan* 10598 (DNA); Birrindudu Ra., 2 May 2004, *K. Brennan* 6295 *& P.K. Latz* (DNA); Timber Creek, 4 May 1969, *N. Byrnes* 1574 (DNA, NSW); 94 m[iles] E of Daly Waters, 18 Mar. 1972, *N. Byrnes* 2505 (CANB, DNA [2 sheets], NSW); 144 m[iles] E Stuart Hwy, Borroloola Rd, 4 June 1971, *N.M. Henry* 26 (BRI, CANB, DNA, K, NSW, NT); Newcastle Waters Stn, Ferguson Creek, 46 km S of Elliott, 14 Mar. 1979, *T.S. Henshall* 2599 (BRI, CBG, DNA, K); 8 km E of Bauhinia HS, 5 May 1995, *P.K. Latz* 14413 (BRI, DNA, MEL, NT); SE of Lajamanu, Winnecke Hills, Tanami Desert, 2 May 2004, *C.P. Mangion* 1639 *& D.L. Lewis* (DNA); Wave Hill, 17 Mar. 1997, *C.R. Michell* 629 *& C.P. Mangion* (DNA). QUEENSLAND: near Tonkoro Rd, W of Lochern N.P., SW of Longreach, 12 May 2010, *A.R. Bean* 29759 *& A.J. Emmott* (BRI, E); Tranby, 9 May 1936, *S.T. Blake* 11442 (AD, BRI, DNA, MEL); E of jump-up, 33.6 km (by road) E of Musselbrook mining camp, 175 km N of Camooweal-Lawn Hill N.P., 7 May 1995, *R.W. Johnson* MRS1037 *& M.B. Thomas* (BRI, CANB, DNA, K, NSW, PERTH); 0.7 km NW of Magazine Hill, 10 km N of Silver Star Mine, 18 Apr. 1991, *P. Jones* 365 (BRI); 69.2 km by road towards Julia Creek from Burke Development Rd, near Dugald River, 14 June 2004, *K.R. McDonald* KRM2779 (BRI); Burke and Wills Roadhouse, 198 km by road SW of Normanton, 14 Apr. 2007, *K.R. McDonald* KRM6570 (AD, BRI, DNA, PERTH); Musselbrook section, Lawn Hill N.P., 16 Apr. 2007, *K.R. McDonald* KRM6612 (BRI, CNS); Dugald River crossing, 64 km N of Cloncurry junction, 1 Apr. 2010, *K.R. McDonald & P.D. Dennis* KRM9077 (BRI); 40 km N of Glenariff, 8 Apr. 1997, *J. Milson* JM1250 (BRI); ridge W of Hilton, 20 km N of Mt Isa, 22 Apr. 1983, *A. Schmid* 612 (BRI); 32 km SW of Hells Gate Roadhouse on turn off to [Anthony] Lagoon Stn (Gulf site 335), 4 Apr. 2006, *E.J. Thompson* WES237 *& M. Edgington* (BISH, BRI, DNA, MEL).

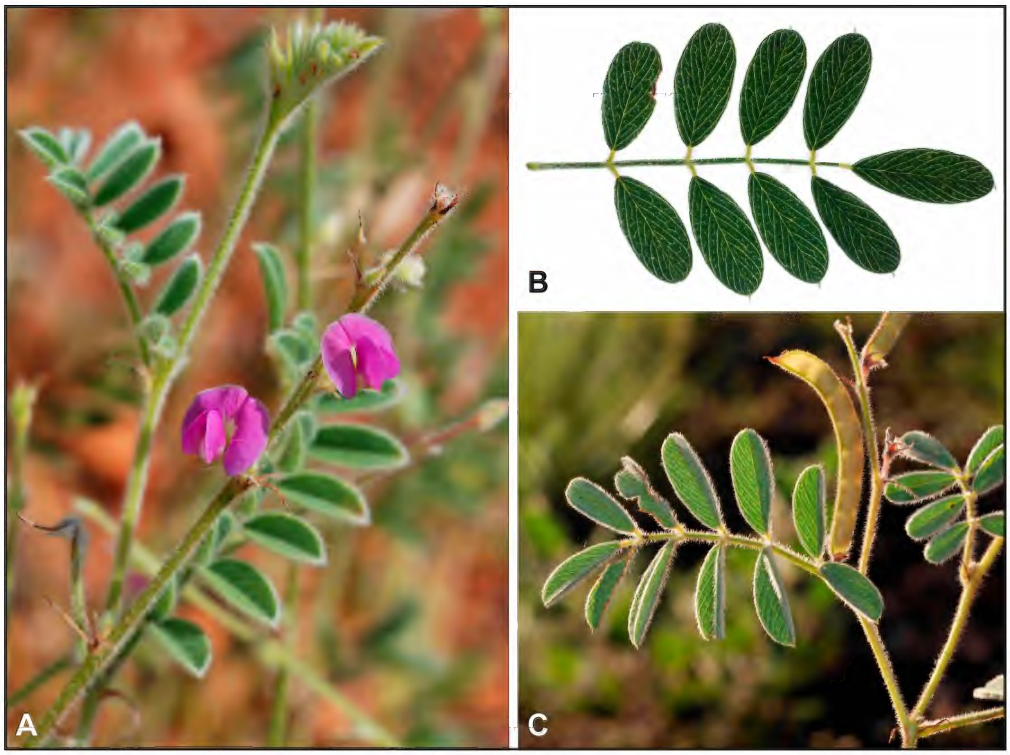

Figure 4. *Tephrosia lithosperma*. A – upper branches showing 11-foliolate leaves with the terminal leaflet not greatly enlarged, as well as persistent, subulate, inflorescence and floral bracts, and pink-purple flowers; B – single 9-foliolate leaf showing mucronate leaflets and venation; C – upper branches showing leaves and curved pod. Photographs by K. Brennan from *K. Brennan* 10598 (A), 8570 (B) & 9039 (C).

Phenology. Flowering and fruiting over a long period of the year, probably in response to rainfall events. Peak flowering from March to July and fruiting March to September, with mature seed present on plants collected in May to October; flowers and fruits also present on specimens collected in January, February, and August to November.

Distribution. Western Australia (PIL), Northern Territory (BRT, DMR, GFU, GSD, MAC, MGD, MII, OVP, STU, TAN, VIB) and Queensland (BK, GN, MI): known from only one collection, to date, in Western Australia, but likely to be found further east of existing localities with further surveys, given its widespread distribution in central Australia. *Tephrosia lithosperma* is found frequently in the area roughly bounded by Mistake Creek (NT) in the west, Timber Creek through to Limmen National Park (NT) in the north and Alice Springs (NT) in the south, extending to Aberfoyle and Longreach (Qld) in the east and south-east, with a Hamersley Range (WA) outlier to the far west (Figure 2).

Habitat. Most commonly collected from stony and rocky slopes of variable geology (limestone, sandstone, basalt, laterite, quartz), but also from clay soils on plains beneath slopes. Grows in open savanna woodland or shrubland, frequently among spinifex. Likely to be an annual or biennial species; frequently noted to occur in post-fire landscapes.

Conservation status. This species was recently listed as Priority One under Conservation Codes for Western Australian Flora (equivalent to IUCN category Data Deficient) under the name *T.* sp. Magazine

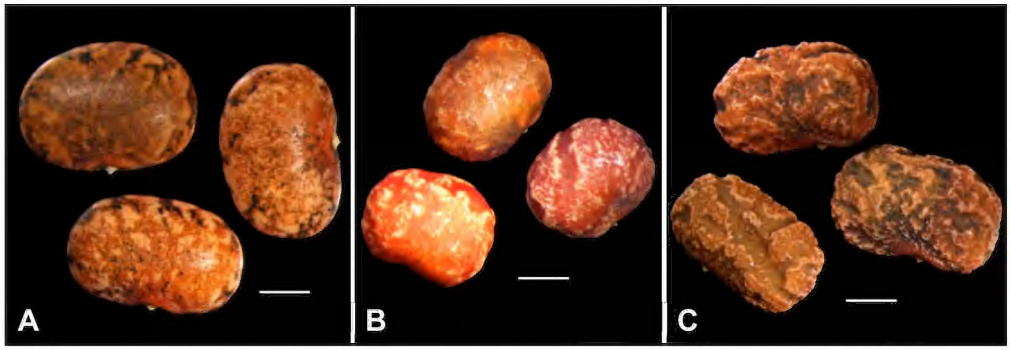

Figure 5. Comparative seed morphology of *Tephrosia supina* (A), *T. insolens* (B) and *T. lithosperma* (C), showing smooth testa and central hilum in *T. supina*, smooth to broadly dimpled testa and central hilum in the smaller seeds of *T. insolens*, and rugose testa and excentric hilum of *T. lithosperma* seeds, which are frequently more laterally compressed than in the other two species. Images taken at ×10 mag. from *M.E. Trudgen* MET 17759 (A), *P. Latz* 26785 (B), & *D.E. Albrecht* 9736 (C). Scale bars = 1 mm.

Hill (P. Jones 365) because it is presently only known from a single collection that is highly disjunct from the nearest known record (in NT). This status may be downgraded if additional populations are found in the intervening and notoriously under-collected area. Assessed in the Northern Territory as Least Concern under their TPWCA using IUCN guidelines, and not conservation-listed in Queensland.

Etymology. From the Greek words *lithos* (stone) and *sperma* (seed) in reference to the rough seeds, which resemble small stones.

Affinities and notes. *Tephrosia lithosperma* shares some characters with *T. supina* and others with *T. insolens*, but can be distinguished from both by the combination of its longer, more slender, distinctly inclined to recurved stipules; generally smaller leaflets with a more prominent mucro; slender, elongate calyx lobes that are *c.* 2–3 × longer than the tube; glabrous staminal tube and variably hairy upper filament; narrower pods with a more strongly upturned apex and a (generally) longer beak; and laterally compressed, reniform to transversely oblong seeds, which are finely rugose and uniformly red-brown or flecked with dark brown or black.

Tephrosia lithosperma is also similar to *T. stipuligera*, which can be distinguished by the following characters: narrowly obovate to spathulate leaflets with prominently recurved apices and longer mucros (0.7–1.2 mm long); eucamptodromous venation with the secondary veins more acutely angled and the intersecondary veins indistinct; flowers and pods barely exceeding the foliage; shorter, broader (frequently ±oblong) pods with the apices almost straight to only slightly upturned; smooth, transversely ellipsoid seeds (1.9–2.2 mm long, 2.6–3 mm wide) that are not compressed and are mottled shades of brown or dark purple-brown, with a more excentric hilum. *Tephrosia stipuligera* was recorded for central Australia by Maconochie (1981) but the misapplication of the name to *T. lithosperma* (as *Tephrosia* 'D53770 OT Station') was recognised by Albrecht *et al.* (1997) and the name was removed from checklists.

Possible annual or short-lived disturbance opportunist perennial. Noted to be abundant on recently burnt rocky slope (*D. Albrecht* 7649 *& P. Latz*), with collections from that habitat of extremely young plants, complete with taproot, already with mature fruit and seed (*D. Albrecht* 7646 *& P. Latz*).

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Corrigendum to: 50 years of botanical discovery: a golden anniversary edition of *Nuytsia*, the journal of the Western Australian Herbarium

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SHORT COMMUNICATION

See *Nuytsia* 31: 1–7 (2020).

p. 3. The orange bars in Figure 2 have been repositioned to correctly show the proportion of names published in *Nuytsia* (1970–2019).

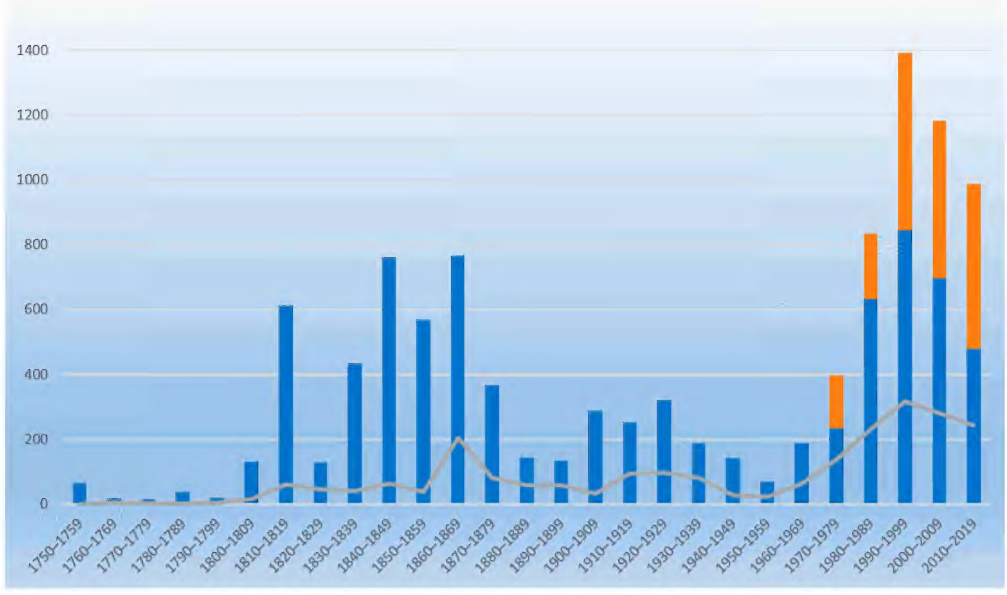

Figure 2. The number of Western Australian native vascular plant species according to the decade the current name was published. The proportion of names published in *Nuytsia* (1970–2019) are indicated by the orange bar, while the number of new combinations (regardless of publication outlet) are indicated by the grey line. Note that the past three decades have been the most prolific in terms of species discovery and description and, while there has been an overall decline in the number of species published since the 1990s, the outputs from *Nuytsia* have remained fairly consistent.

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Rubinoboletus phaseolisporus (Boletaceae) from Western Australia is a *Tylopilus* with bean-shaped spores

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Abstract

Osmundson, T.W., Bougher, N.L., Robinson, R.M. & Halling, R.E. *Rubinoboletus phaseolisporus* (Boletaceae) from Western Australia is a *Tylopilus* with bean-shaped spores. *Nuytsia* 32: 87–97 (2021). The bolete genus name *Rubinoboletus* Pilát & Dermek has been misapplied in the past to include taxa belonging to several genera including *Tylopilus* P.Karst. In this study, we provide morphological and molecular phylogenetic justification for alignment of *Rubinoboletus phaseolisporus* T.H.Li, R.N.Hilton & Watling in *Tylopilus* with the North American taxon *T. balloui* (Peck) Singer. Thus, a new combination, *Tylopilus phaseolisporus* (T.H.Li, R.N.Hilton & Watling) Osmundson, Bougher, R.Rob. & Halling, is proposed for this brightly-coloured species that is apparently endemic to bushland in south-west Western Australia.

Introduction

In one paper in a series on the Cooloola boletes of Queensland, Watling and Gregory (1989) stated, '*Tylopilus* is very well represented in Australasia and many more undescribed species occur there than in north temperate regions.' A brief diagnosis of the genus was followed by discussion of varying concepts employed by McNabb (1967), Smith and Thiers (1971), Corner (1972), and Pegler and Young (1981). Following Corner (1972), nine alliances were enumerated by Watling and Gregory (1989). These encompassed entities that are likely of restricted distribution in SE Asia (e.g. *Boletus longipes* Massee (=*Ionosporus* Khmeln.), *Boletus nanus* Massee and other seemingly obscure taxa recognized by Corner), some others that recall northern hemisphere species (e.g. *T. alboater* (Schwein.) Murrill), or ones that have been considered generic synonyms of *Tylopilus* P.Karst (*Boletochaete* Singer, *Porphyrellus* E.-J.Gilbert). More detailed evaluations and descriptions were given for taxa that would appear to be aligned morphologically with the type species, *T. felleus* (Bull.) P.Karst. Subsequently, Watling (2001a, b; 2008) has provided more refined discussions on the possible heterogeneous concepts of *Tylopilus*.

Of particular interest to the present study is the species alliance surrounding *Tylopilus balloui* (Peck) Singer, a distinctive bolete from northeastern North America with striking, bright orange pigments

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(Figure 1A). This species, described by Peck (1912) as a *Boletus* L. from southern New York state, has a combination of morphological features that has led to alternative classifications based on different character weighting judgments. *Tylopilus balloui* has been placed in *Gyrodon* Opat. (Snell 1941), *Tylopilus* (Singer 1947), *Rubinoboletus* Pilát & Dermek (Heinemann & Rammeloo 1983), *Chalciporus* Bataille (Klofac & Krisai-Greilhuber 2006), and *Gyroporus* Quél. (Horak 2011). Molecular data have recently proven useful in resolving this taxonomic quandary, and support placement in *Tylopilus* despite *T. balloui* having ellipsoid-ovoid basidiospores that are uncharacteristic for a genus in which the type species and most other species have longer, subfusiform spores (Singer 1947; Osmundson & Halling 2010; Halling *et al.* 2012; Trappe *et al.* 2013). Singer (1947) emphasized that short basidiospores occur in almost all groups of boletes, and *Tylopilus* appears to be no exception. Osmundson and Halling (2010) noted that recent field and laboratory studies in Australasia have revealed a number of taxa morphologically similar to *T. balloui*, though differing in several morphological features as shown by Halling (2018). These data suggest that the name *T. balloui* as commonly ascribed to field and herbarium collections represents a species complex rather than a single widespread species (Halling *et al.* 2008), an observation consistent with that of Watling (2001a, b). Previously, Watling and Gregory (1988), Watling and Li (1999) and Li and Watling (1999) identified specimens of the '*balloui*' group as *Rubinoboletus* species, following Heinemann and Rammeloo's (1983) placement of African species morphologically similar to *T. balloui*. Despite that generic assignment, Watling and Li (1999) nonetheless suggested that *Rubinoboletus* was an unnatural assemblage and that its relationships needed reassessment. Watling (2008) subsequently recommended that the complex around *T. balloui* should be maintained in *Tylopilus* despite some anomalies, and that *Rubinoboletus* should be restricted to its original circumscription (Pilát & Dermek 1969).

According to Singer (1973), the type species of *Rubinoboletus*, *R. rubinus* (W.G.Sm.) Pilát & Dermek, is a *Chalciporus*. In accordance with that placement, Grgurinovic (1997) and Klofac and Krisai-Greilhuber (2006) transferred a number of species of the '*balloui*' group from *Rubinoboletus* to *Chalciporus*, and the latter authors reduced *Rubinoboletus* to subgeneric status within *Chalciporus*. More recently, large molecular datasets also support placement of *R. rubinus* in *Chalciporus* (Binder & Hibbett 2006; Nuhn *et al.* 2013; Wu *et al.* 2014). In contrast, molecular studies place *T. balloui* in *Tylopilus s.s.* with the type species, *T. felleus* (Binder & Hibbett 2006 (Suppl. Fig. 1); Wu *et al.* 2014; Gelardi *et al.* 2019). These results suggest that other taxa morphologically more closely allied to *T. balloui* than to *C. rubinus* (W.G.Sm.) Singer should also be placed in *Tylopilus*. Furthermore, these results indicate that spore shape, when treated as an isolated character, is an unreliable indicator of phylogenetic relationships in boletes.

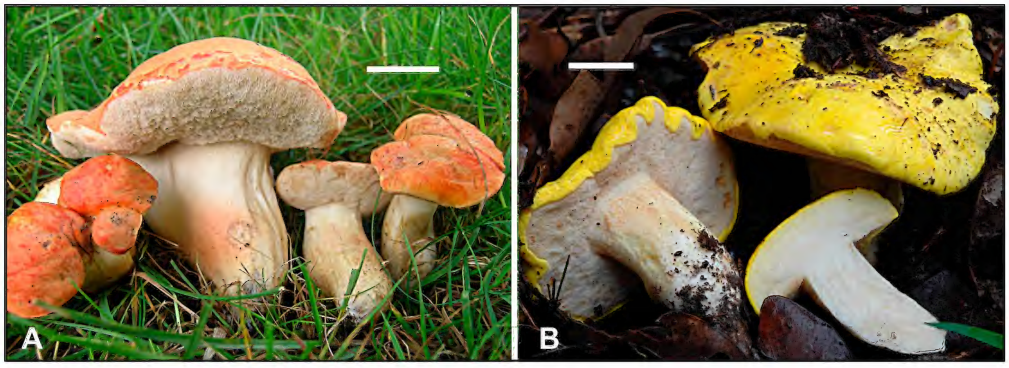

Figure 1. Basidiome habits. A – *Tylopilus balloui* (USA. New York: Bronx, New York Botanical Garden, 29 Sep 2008, *R.E. Halling* 9016, NY 1034441); B – *Tylopilus phaseolisporus* (PERTH 08166390). Scale bars = 2 cm.

Watling and Li (1999) provided an updated description of *R. phaseolisporus* citing two additional specimens (*K. Elson & B. Dell* UWA1835, *A. Saar* UWA2619 cited below), and stated that it is common under jarrah (*Eucalyptus marginata* Sm.) in Western Australia. While they noted that the spore deposit colour strongly suggested placement in *Tylopilus* (as originally suggested in a personal communication from R. Hilton to Watling), the spore shape did not match Corner's (1972) concept of the genus. Watling and Li (1999) further suggested that the bright yellow pileus colour and spore shape suggested affinity to *Gyroporus*; however, because the stipe lacked the circumferential hyphae characteristic of that genus, the authors opted for placement of the new taxon in *Rubinoboletus* as *Rubinoboletus phaseolisporus* T.H.Li, R.N.Hilton & Watling.

Based on extensive field and micromorphological documentation and a molecular analysis that incorporates the most comprehensive published phylogenetic framework for the family Boletaceae, we provide justification for the proper placement of this taxon – thus far known only to occur in south-west Western Australia – in *Tylopilus*. Accordingly, we propose the new taxonomic combination *Tylopilus phaseolisporus*.

Materials and Methods

Morphology

Macromorphological data were obtained from fresh specimens. General colour terms are approximations, and the colour codes (e.g. 7D8) are page, column and grid designations from Kornerup and Wanscher (1983). All microscopic structures were observed and measured with an Olympus BHS compound light microscope equipped with Nomarski Differential Interference Contrast (DIC) optics from dried material revived in 3% KOH. The abbreviation *Q* refers to the mean length/width ratio measured from *n* basidiospores, observed from *p* collections and *x* refers to the mean length × mean width. Light micrographs were obtained via Spot 5.3 Imaging software using a Spot Insight Gigabit digital camera from Diagnostic Instruments. Herbarium codes (Thiers 2021) are cited for all collections from which morphological features were examined. The new taxonomic combination is registered with MycoBank.

DNA isolation, PCR amplification and DNA sequencing

Genomic DNA was extracted from basidiomata tissues preserved in silica desiccant or from dried herbarium specimens for two collections of *T. phaseolisporus* (*R.E. Halling, N.L. Bougher & R.* Garvey 8823 and *R.E. Halling* 8827; see *Specimens examined*, below), a collection of *T. balloui* from the New York Botanical Garden (*Osmundson* 1030, NY 02072601), USA, the related species *T. oradivensis* Osmundson & Halling from Costa Rica (Osmundson & Halling 2010), and three collections from Queensland, Australia that we hypothesized to belong to the *T. balloui* group based on macro- and micromorphology (Table 1). Approximately 10 mg of dried tissue was ground using a Bio101/Savant Fast Prep FP120 tissue homogenizer (Qbiogene Inc., Carlsbad, CA, USA), and DNA was extracted using either the Qiagen DNeasy Plant Mini or DNeasy 96 extraction kit (Qiagen Inc., Valencia, CA, USA), following the manufacturer's instructions.

Partial sequences from two nuclear loci were obtained for this study: the nuclear ribosomal large subunit (LSU) and nuclear translation elongation factor 1α (*tef1* or EF-1α). PCR amplifications were performed in 25 µL volumes consisting of 2.5 µL 10X PCR buffer, 2.5 µL dNTP mix (0.2 mM each dNTP), 2.5 µL bovine serum albumin, 1 µl each primer (10 µM primer solution), 5 µL PCR additive (Q solution, Eppendorf), 1 unit Taq polymerase, and ddH_20 to reach 25 µL total volume. For *tef1*,

better results were obtained by eliminating Q solution and replacing the volume with ddH_20. PCR primers were LR0R (5'- ACC CGC TGA ACT TAA GC-3') / LR7 (5'- TAC TAC CAC CAA GAT CT -3') (Vilgalys & Hester 1990) for LSU and EF1-526F (5'- GTC GTY GTY ATY GGH CAY GT -3') (S. Rehner unpublished) / 1567R (5'- ACH GTR CCR ATA CCA CCR ATC TT -3') (Rehner & Buckley 2005) for *tef1*. Amplification conditions for LSU were (i) initial denaturation at 95° C for 2 min; (ii) 30 cycles of denaturation at 94° C for 60s, annealing at 50° C for 45s and extension at 72° C for 60s; (iii) final extension at 72° C for 7 min. Amplification of *tef1* was conducted using a modification of the touchdown PCR protocol by Rehner and Buckley (2005): (i) 95° C for 5 min; (ii) 94° C for 60s, 65° C for 60s, decreasing 1° C per cycle for the following 9 cycles, then 72° C for 60s; (iii) 25 additional cycles of 94° C for 60s, 56° C for 60s, and 72° C for 60s; (iv) final extension at 72° C for 5 min. PCR products were purified and sequenced at the High Throughput Genomics Facility, University of Washington (Seattle, WA, USA) using BigDye terminator chemistry (Applied Biosystems, Inc., Foster City, CA, USA). Sequencing primers were identical to the PCR primers, with the addition of internal sequencing primers LR3 (5'- CCG TGT TTC AAG ACG GG - 3') for LSU and EF-ir (5'- GCR TGY TCN CGR GTY TGN CCR TC '3') for *tef1*.

Portions of two additional loci were sequenced for collection *R.E. Halling* 8827: the mitochondrial ATPase subunit 6 (*atp6*) and mitochondrial ribosomal large subunit (mtLSU). These sequences were not used in the analysis for the current study, but previous analyses of *atp6* alone and in combination with LSU support placement of *T. phaseolisporus* in *Tylopilus* (Osmundson 2009). The mtLSU sequence has not been used in any analyses to-date. PCR conditions for *atp6* used the same reaction mixture specified above except for eliminating Q solution, tripling the volumes of the two degenerate primers, and adjusting the water volume accordingly. Amplification of *atp6* was conducted using the primers atp6-1 (5'- ATT AAT TSW CCW TTA GAW CAA TT -3') and atp6-2 (5'- TAA TTC TAN WGC ATC TTT AAT RTA -3'), and the cycling parameters of Kretzer and Bruns (1999). Amplification of mtLSU was conducted using the primers ML5 (5'- CTC GGC AAA TTA TCC TCA TAA G -3') and ML6 (5'- CAG TAG AAG CTG CAT AGG GTC -3') (White *et al*. 1990) and the reaction mixture and thermocycling conditions described for LSU above. A total of 10 new sequences were obtained. GenBank accession numbers for all newly generated sequences and previously-submitted sequences from these samples are listed in Table 1.

Alignment and phylogenetic analyses

Sequences generated for this study were end-trimmed and checked for errors using Geneious Prime 2019 (Biomatters Ltd., Auckland, New Zealand), then aligned with the two-locus LSU/tef1 Boletaceae dataset from Wu *et al*. (2014), representing the most comprehensive multilocus dataset for the family to-date. Alignments for each locus were conducted using MUSCLE 3.8.425 with the maximum number of iterations set to 20, implemented in Geneious Prime 2019. Alignments were curated using GBlocks 0.91b (Castresana 2000; Talavera *et al*. 2007), with the following parameter settings: minimum number of sequences for conserved position = default (50% of the number of sequences + 1); minimum number of sequences for a flank position = default (85% of the number of sequences); maximum number of contiguous nonconserved positions = 8; minimum block length = 10; allowed gap positions = with half. The two individual alignments were concatenated using Geneious Prime 2019, and four data partitions were specified corresponding to *tef1* first + second codon positions, *tef1* third codon positions, *tef1* introns, and LSU. Data were analysed under a maximum likelihood optimality criterion using RAxML 8.2.12 (Stamatakis 2014). A search for the maximum likelihood tree was conducted using the following parameter settings: rate categories = 25; random seed value 12345; estimate proportion of invariable sites = no; alternative runs on distinct starting trees = 100. Multiparametric bootstrapping was conducted with random seed value 12345 and 1000 replicates.

Table 1. Collections of *Tylopilus phaseolisporus* and additional *Tylopilus balloui s.l.* sequenced for this study, with GenBank accession numbers. Asterisks denote sequences submitted for previous studies (Halling *et al.* 2008; Osmundson & Halling 2010).

Taxon	Specimen	LSU	tef1	atp6	mtLSU
Tylopilus phaseolisporus	*R.E. Halling* 8823	MW620812	N/A	N/A	N/A
Tylopilus phaseolisporus	*R.E. Halling* 8827	MW620809	MW620810	MW620811	MW620808
Tylopilus balloui	*T.W. Osmundson* 1030	EU430737*	MW815570	N/A	N/A
Tylopilus oradivensis	*R.E. Halling* 8187	EU430732*	MW815572	N/A	N/A
Tylopilus aff. *balloui*	*T.W. Osmundson* 1105	EU430738*	MW815571	N/A	N/A
Tylopilus aff. *balloui*	*T.W. Osmundson* 1122	EU430742*	MW815573	N/A	N/A
Tylopilus aff. *balloui*	*T.W. Osmundson* 1132	EU430739*	MW815574	N/A	N/A

GBlocks and RAxML were implemented on the CIPRES Science Gateway (www.phylo.org; Miller *et al.* 2010).

An initial analysis was conducted using the full taxon set from Wu *et al.* (2014), with outgroup sequences *Suillus* aff. *luteus* HKAS 57748 and *Suillus* aff. *granulatus* HKAS 57622. Based on the results of this analysis (see Results) and in order to include additional characters that may clarify relationships, a second analysis included only the Boletoideae clade and outgroup sequences *Boletellus dissiliens* REH 9435 (Xerocomoideae), *Retiboletus* aff. *ornatipes* HKAS 63548 (Leccinoideae), and *Retiboletus griseus* HKAS 63590 (Leccinoideae). Tree figures were prepared using the Interactive Tree of Life (iTOL) website (Letunic & Bork 2019).

Results

Molecular analyses

The alignment for the initial analysis with the full taxon set from Wu *et al.* (2014) consisted of 297 sequences and 1076 alignment positions (484 bp tef1; 592 bp LSU), containing 613 distinct alignment patterns (*tef1* positions 1+2: 160; *tef1* position 3: 151; *tef1* introns: 16; LSU: 286). This analysis placed *T. phaseolisporus* and the other '*balloui*' taxa in the Boletoideae clade sensu Wu *et al.* (2014). Relationships within the clade received low bootstrap support (Figure 2), so a Boletoideae-only analysis was conducted to allow inclusion of additional characters that could not be unambiguously aligned with the full Boletaceae dataset.

The alignment for the Boletoideae-only analysis consisted of 79 sequences and 1248 alignment positions (558 bp *tef1*; 690 bp LSU) containing 604 distinct alignment patterns (*tef1* positions 1+2: 104; *tef1* position 3: 150; *tef1* introns: 86; LSU: 264). The results of this analysis placed *T. phaseolisporus* in a well-supported clade (91 percent bootstrap support) with the *T. balloui* specimen from New York, USA and other specimens morphologically allied in a *T. balloui* species complex (Figure 3). Within that clade, the two *T. phaseolisporus* specimens formed a moderately well supported (70 percent) clade with an Australian '*balloui*' collection. A sister group relationship with a North American clade (*T. balloui* from USA and *T. oradivensis* from Costa Rica) rather than to the other Australian collections is indicated in the maximum likelihood tree, though this relationship did not receive strong bootstrap support (35 percent).

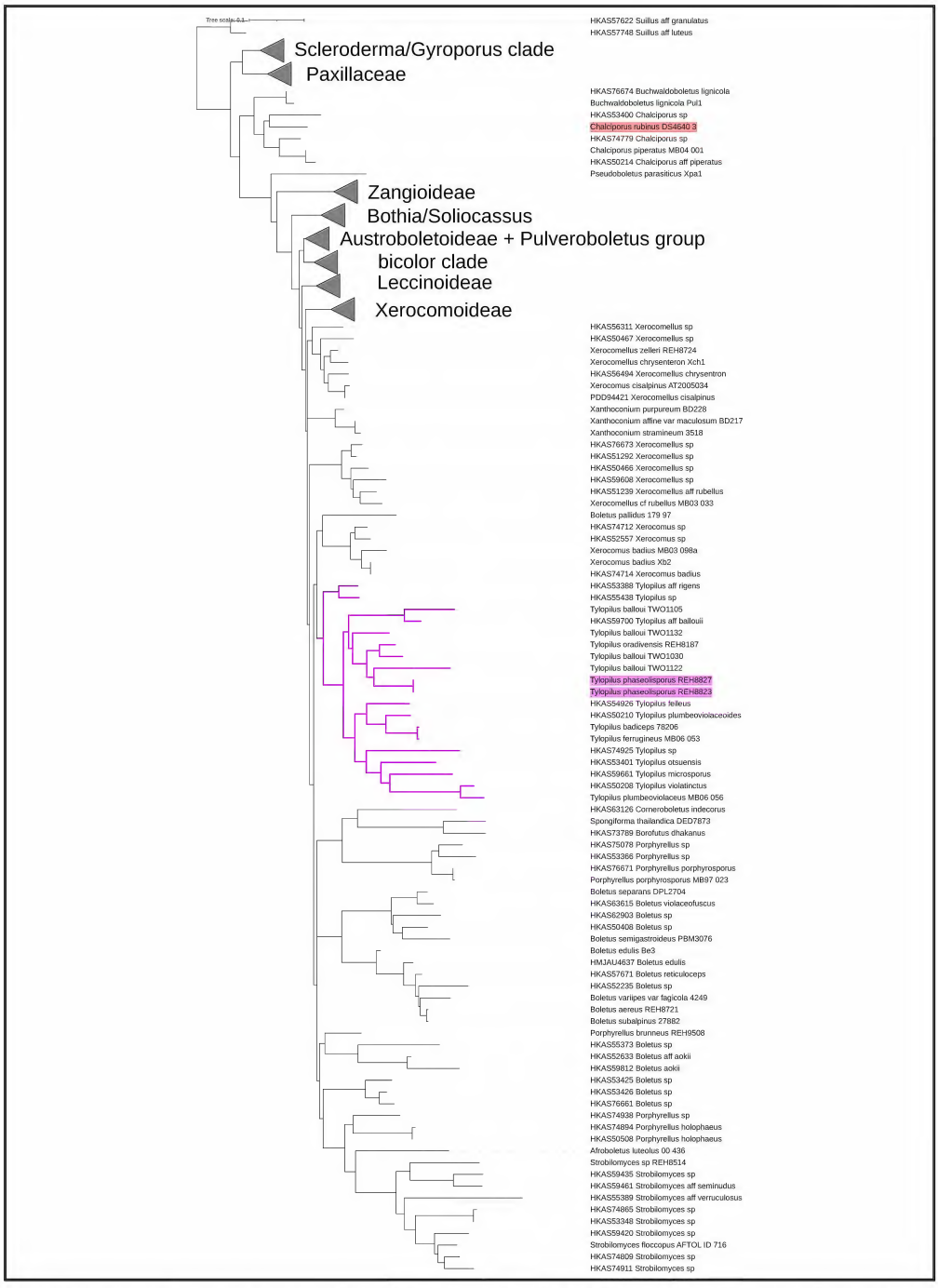

Figure 2. Maximum likelihood phylogram for combined LSU-*tef1* analysis of *Tylopilus phaseolisporus* and other *Tylopilus balloui s.l.* specimens with the full taxon sample of Wu *et al.* (2014). Clades, except for those containing *T. phaseolisporus* and *Chalciporus* (*Rubinoboletus*) *rubinus*, are collapsed, with labels corresponding to the names given to these clades in Wu *et al.* (2014). Purple branches denote *Tylopilus s.s.*, and purple-highlighted labels denote the two specimens of *T. phaseolisporus*; red label denotes *Chalciporus rubinus*, the type species of *Rubinoboletus* (as *Rubinoboletus rubinus*).

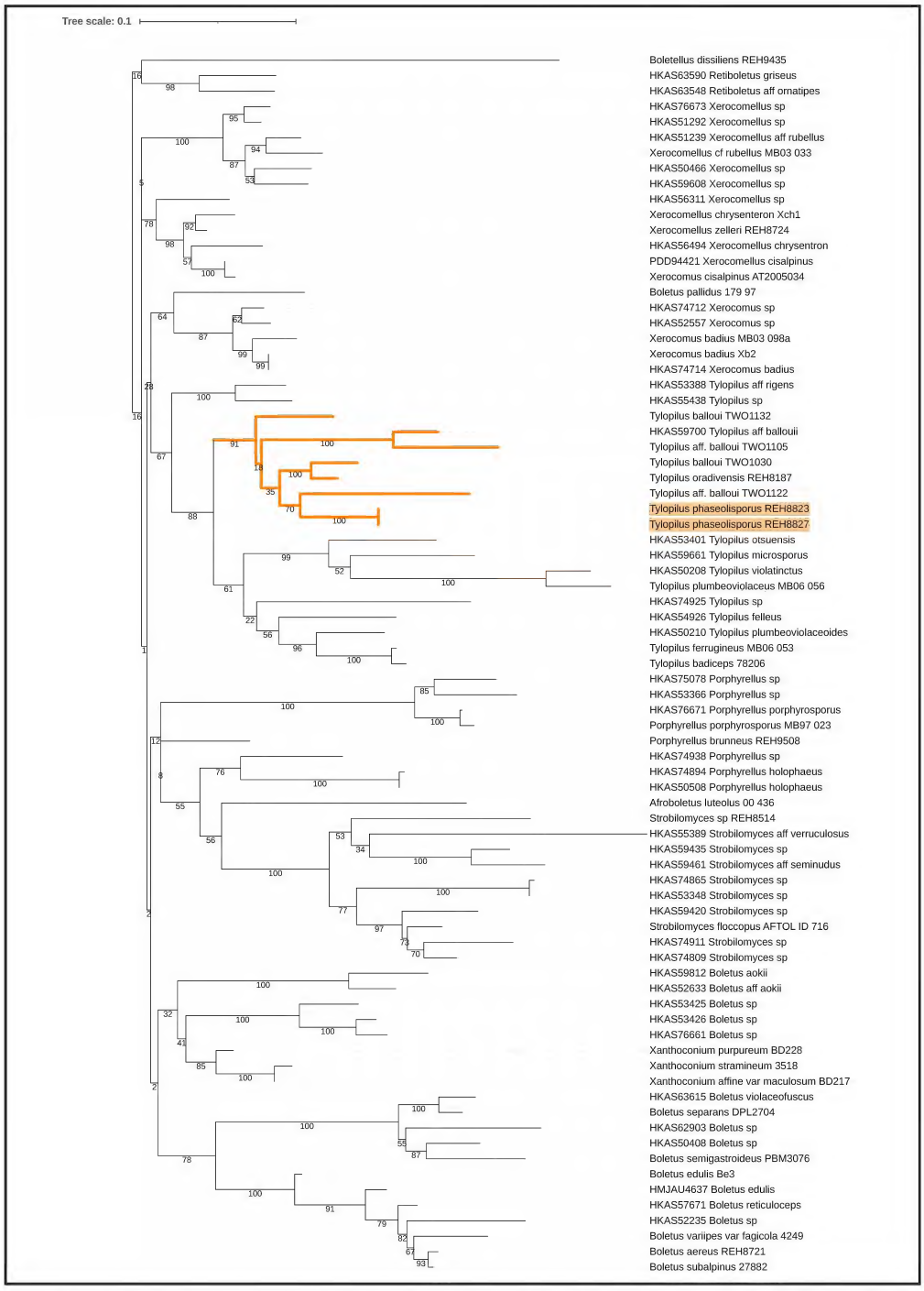

Figure 3. Maximum likelihood phylogram for combined LSU-*tef1* analysis of *Tylopilus phaseolisporus* and other *Tylopilus balloui s.l.* specimens with the reduced taxon sampling restricted to subfamily Boletoideae sensu Wu *et al.* (2014); orange branches denote the *T. balloui* species complex, and orange-highlighted taxon labels denote the two specimens of *T. phaseolisporus* included in the analysis.

Taxonomy

Tylopilus phaseolisporus (T.H.Li, R.N.Hilton & Watling) Osmundson, Bougher, R.Rob. & Halling, *comb. nov.*

Rubinoboletus phaseolisporus T.H.Li, R.N.Hilton & Watling in T.H. Li & R. Watling, *Edinburgh J. Bot.* 56: 146 (1999). *Chalciporus phaseolisporus* (T.H.Li, R.N.Hilton & Watling) Klofac & Krisai, *Österreich Zeit. Pilzk.* 15: 50 (2006). *Type*: Mundaring State Forest, Western Australia, 15 June 1975, *R.N. Hilton* UWA 1990 (*holo*: E00465106!; *iso*: PERTH 00770361!).

MycoBank: MB 839093.

Pileus (3.5–)5.5–8.5(–9) cm broad, convex to plano-convex, with irregular margin, viscid to subviscid, soon drying, glabrous to obscurely finely matted, yellow (3A5, 3A8, 4A7), then pale yellow, dulling to orange yellow (near 5A8), developing pale brownish tone with age; margin incurved, smooth, entire. *Flesh* white, unchanging, with mild odour and taste. *Tubes* adnexed to subdecurrent, pale cream (5A2) at first, becoming pale pinkish buff (5A3), staining cinnamon brown (near 7E8, 8E7), with pores pale pinkish buff staining cinnamon brown. *Stipe* (2–)6.5–8.5 cm long, (1–)1.5–3 cm broad, tapering downward or sometimes clavate, dry to moist, yellow when young, then white and covered with fine, scurfy pruinosity that is pale caramel coloured, stains cinnamon brown and is denser toward the base; context solid, white; basal mycelium white.

Basidiospores pinkish brown in deposit, 4.9–7 × 2.8–3.5 µm, (x = 5.95 × 3.36 µm, Q = 1.77, (n = 40, p = 2), smooth, phaseoliform in profile, subellipsoid in adaxial and abaxial views, hyaline in KOH and Melzer's reagent. *Basidia* clavate, 25–30 × 7–9 µm, hyaline, 4-sterigmate. *Pleurocystidia* common, 35–60 × 8–22 µm, narrowly to broadly fusiform, thin-walled, with oily to granular or coarse orange brown to brownish yellow content, rarely hyaline. *Tube trama* boletoid and divergent, hyaline in KOH and Melzer's reagent, with hyphae 3–7 µm broad. *Pileus trama* inamyloid, hyaline in KOH, with hyphae 3–7 µm broad. *Pileipellis* a collapsed trichodermium embedded in a gelatinous matrix, with elements 2.8–4.2 µm wide. *Stipitipellis* a disrupted hymeniform layer of clavate, subclavate or rarely short subfusiform elements, 20–40 µm long, hyaline, and thin-walled, often intermixed with amorphous golden brown pigment clusters. *Clamp connections* absent. (Figures 1B, 4)

Specimens examined. WESTERN AUSTRALIA: Nannup, Easter Forest Block, Dickson Road (Bridge Spot), 31 May 1983, *N.L. Bougher* E 349 (PERTH 07607113); Murray, Dwellingup, Alcoa Mine, Nettleton Road, 10 June 2002, *N.L. Bougher* E 7120 (PERTH 07649983); Denmark, Nornalup, Valley of the Giants, Old Valley Road, 7 June 1992, *N.L. Bougher & K. Syme* E 4773 (PERTH 07554583); between Jarrahdale and Gleneagle Forest, 1.25 miles along track which turns off opposite Rock, *K. Elson & B. Dell* UWA 1835 (E 00465107, PERTH 00770434); Alcoa Mine, Nettleton Road, Dwellingup, 11 June 2002, *M. Glen, R. Armstead, R. Daniels* E 7145 (PERTH 07650833); Manjimup, 21 June 2006, *R.E. Halling* 8827 (NY 1393472); Nannup, Easter Forest Block, Dickson Road, 21 June 2006, *R.E. Halling, N.L. Bougher & R. Garvey* 8823 (NY 1393466, PERTH 08019134); Manjimup, Grid FC55, Lewin Forest block, 100 m E of Arthur Road, access from Eastwin Road, 5 June 2013, *R.M. Robinson, P. Anderson, & S.J.M. McMullan-Fisher* FC 1880 (PERTH 08166390); Nannup, Layman Forest Block, Plot FC40, Crouch Road, 500 m E of junction with Cul De Sac Road, 15 June 2006, *R.M. Robinson & J.C. Fielder* FC 1015 (PERTH 06660622); Nannup, Barrabup Forest Block, Plot FC43, 1.4 km N off Keene Road on logging track, 21 June 2006, *R.M. Robinson & J. Fielder* FC 1045 (PERTH 06660991); Nannup, St John Forest Block, Plot FC39, 400 m N on boundary of St John Conservation

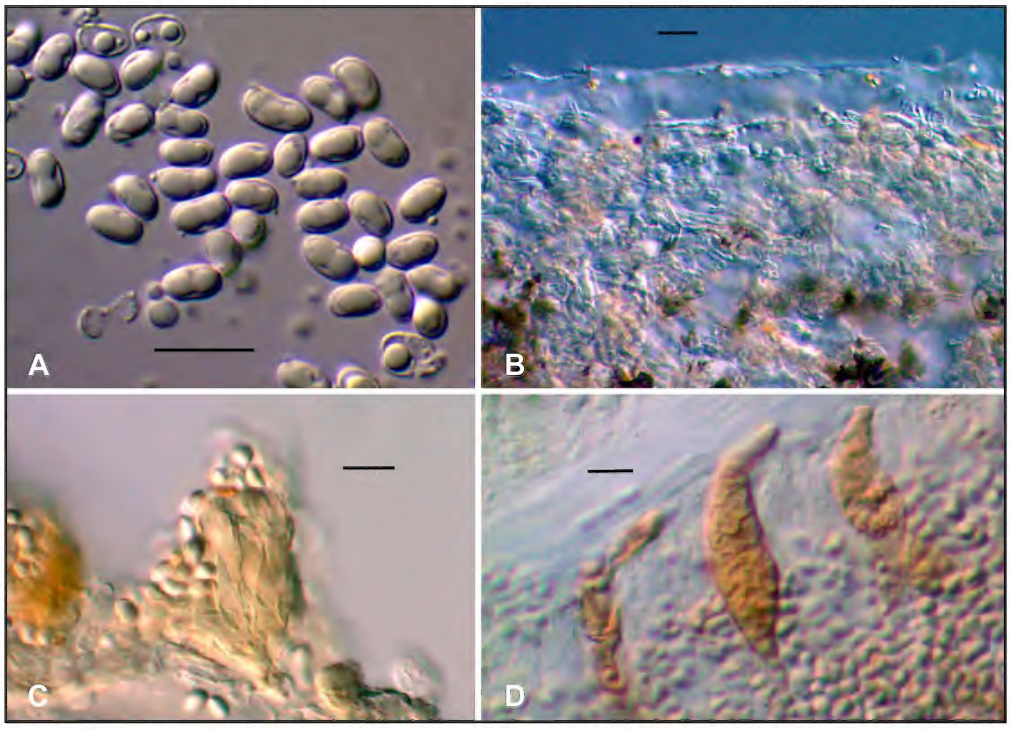

Figure 4. Micromorphology of *Tylopilus phaseolisporus*. A – Basidiospores (NY 1393466); B – Pileipellis (NY 1393472); C – Stipitipellis (NY 1393466); D – Pleurocystidia (NY 1393466). Scale bars = 10 µm (A, C, D); 20 µm (B).

Park off St John Road West, 400 m E of junction with St Luke Road, 21 June 2006, *R.M. Robinson & J. Fielder* FC 1053 (PERTH 06661076); Bridgetown-Greenbushes, Barrabup Forest Block, Plot FC38, St John Road East, 1 km N of junction with Mowen Road, 14 July 2006, *R.M. Robinson & J. Fielder* FC 1208 (PERTH 06662722); Nannup, Barrabup Forest Block, Plot FC46, 100 m N of Keene Road on logging track, 15 June 2012, *R.M. Robinson & C. Newland* FC 1771 (PERTH 08164541); FC19, Dooganally Road, Tumlo Forest Block, 38.4 km from Collie, 8 July 2003, *R.M. Robinson & K. Pearce* FC 589 (PERTH 06437664); Nannup, Forest Check Monitoring Plot 10, near Dickson Tower, Easter Forest Block, 16 June 2004, *R.M. Robinson & R.H. Smith* FC 623 (PERTH 06640532); Forest Check Monitoring Plot 10, near Dickson Tower, Easter Forest Block, 16 June 2004, *R.M. Robinson & R.H. Smith* FC 628 (PERTH 06640486); Boulter Road, Boranup, 26 June 1982, *A. Saar* UWA 2619 (E 00465108, PERTH 00909890).

Distribution and habitat. Scattered to gregarious in litter on soil or sand under a variety of dominant species including *Eucalyptus marginata*, *E. diversicolor*, *E. jacksonii*, *E. guilfoylei*, *Corymbia calophylla*, *Allocasuarina decussata*, *A. fraseriana*, and/or *Acacia pentadenia*. So far, known only from south-west Western Australia.

Discussion

Despite differing in pileus colouration, *T. phaseolisporus* bears a close resemblance both macroscopically (stature, hymenophore colour, and staining reactions) and microscopically (basidiospore shape and size, pleurocystidial shape and contents) to the North American species *T. balloui*. Originally described

by Peck in a formerly more heterogeneous and inclusive *Boletus*, *B. balloui* Peck was transferred to *Tylopilus* by Singer (1947). Although *T. balloui* resembles other *Tylopilus* in terms of spore deposit colour, hymenial colouration and staining, and pleurocystidial shape and contents, its short, phaseoliform basidiospores are unusual for *Tylopilus*. Subsequent placements in *Gyrodon* (Snell 1941) and *Rubinoboletus* (Heinemann & Rammeloo 1983) resulted from placing excessive weight on this character despite the other similarities with *Tylopilus* and the lack of other strong similarities between *T. balloui* and the type species of either *Gyrodon* or *Rubinoboletus*. As a result of *T. balloui* being transferred to *Rubinoboletus*, other species resembling this taxon – including *T. phaseolisporus* – were placed there as well, and some of these were transferred again to *Chalciporus* along with *R. rubinus*. The results of the present study confirm placement of both *T. balloui* and *T. phaseolisporus* in *Tylopilus*. In our analyses, *T. balloui* is represented by a specimen (*T.W. Osmundson* 1030, NY 02072601) collected in Bronx, New York, USA, on the grounds of the New York Botanical Garden in association with native *Fagus grandifolia* trees; this locality is ±67 km west of the type locality at Orient Point on eastern Long Island. The phylogenetic results presented here furthermore indicate that additional taxa resembling *T. balloui* should be described (or retained) in *Tylopilus*, not *Rubinoboletus* or *Chalciporus*.

Our field explorations suggest that Australia is rich in taxa similar to *T. balloui*, only some of which are included in the molecular analyses presented here. We are currently examining the taxonomy and systematics of the *Tylopilus balloui* complex in Australia and on a more global scale.

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Isotropis petrensis (Fabaceae: Mirbelieae), a new species from arid Western Australia

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SHORT COMMUNICATION

The new species described below was opportunistically collected by one of us [RD] in 2016 and immediately considered to be of taxonomic interest on account of its foliage, indumentum, and flower colour. Subsequent examination of the *Isotropis* Benth. holdings at the Western Australian Herbarium unearthed seven comparable collections, all from granite outcrops in the Yalgoo or Murchison bioregions. Type material of *I. atropurpurea* var. *alba* Ewart, collected in 1890 by Henry S. King and Courcy G. de Lefroy from near Lake Austin, was also found to be comparable. This varietal name has hitherto been of uncertain application (Council of Heads of Australasian Herbaria 2006–), perhaps in part due to Ewart's description of the standard petal as pale or white with striations (Ewart *et al.* 1908). Our field observations indicate that the standard is orange-yellow with dark red-brown striations and a yellow eye (Figure 1), although it fades to dark cream with dark purple striations when dried. We recognise this taxon at the species level (see *Notes* below) and, rather than making a new combination with a somewhat misleading epithet, we choose a more appropriate name based on a new type, placing Ewart's variety into synonymy.

Isotropis petrensis R.W.Davis & Wege, *sp. nov.*

Type: south-east of Murchison Settlement, Western Australia [precise locality withheld for conservation reasons], 7 August 2019, *R. Davis & A. Brown* RD 13011a (*holo*: PERTH 09316574; *iso*: CANB, MEL).

Isotropis atropurpurea var. *alba* Ewart, in A.J. Ewart, J. White & J.R. Tovey, *J. & Proc. Roy. Soc. New South Wales* 42: 190 (1908). *Type*: 'Near Lake Austin, W.A., King and Lefroy 1890' (*syn*: BM 000885505 image!, K 000278153 image!, K 000278154 image!, MEL 78150!, MEL 78151!, NSW 32662 image!, PERTH 01023144!).

Isotropis sp. Yalgoo (S. Patrick 2375), Western Australian Herbarium, in *FloraBase*, https://florabase.dpaw.wa.gov.au/ [accessed 14 May 2021].

Erect or spreading *subshrub* (20–)30–45 cm high. *Stems* terete, densely sericeous when young, glabrescent with age; hairs appressed, antrorse, golden brown on the new growth, becoming paler or white, *c.* 0.2–0.6 mm long. *Leaves* scattered, unifoliolate, sericeous as per the stems; petiole ascending to descending, 3–15 mm long; petiolule straight or more often geniculate at junction with petiole; leaflet

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spreading to ascending, oblong or narrowly lanceolate (rarely elliptic) with entire margins, (8–)12–50 mm long, 3–10 mm wide, apex obtuse with a deflexed mucro, base obtuse. *Stipules* recurved or sometimes spreading, narrowly triangular, 1.2–2.3 mm long, sericeous. *Inflorescence* a terminal (leaf-opposed) raceme, densely sericeous, rachis 10–14 cm long with widely-spaced flowers; pedicels mostly longer than the calyx, 8–14 mm long; bracts broadly ovate, 1.5–4.2 mm long; bracteoles toward summit of pedicel, ovate, 1.5–2.5 mm long. *Calyx* divided to near base into an upper lip and 3 lower lobes, densely hairy externally (the hairs appressed and antrorse to spreading and sometimes sinuous), glabrous internally except for a cluster of hairs at the tips of the lobes and towards the margins; tube 1.2–2 mm long; upper two lobes erect, united for most of their length, 7–10.3 mm long; lower lobes slightly spreading but not becoming reflexed, narrowly triangular, 4–7 mm long. *Corolla*: *standard* orange-yellow with dark red-brown striations and a yellow eye (drying orange-yellow and fading to dark cream with dark purple striations and a yellow eye), broadly ovate to transversely elliptic, 11–14 mm long including the 1.7–2.5 mm long claw, 9.5–14 mm wide, retuse, base cuneate; *wings* dark red-brown sometimes with orange-yellow markings apically (drying purple), narrow-obovate, 9–12 mm long including the 1.9–2.6 mm long claws, 3.5–4.8 mm wide, auriculate; *keel* dark red-brown (drying purple), obovate with the apex slightly upturned and the lower margin slightly curved, 9.5–10.7 (–13) mm long including the 2.3–2.5 mm long claws, 4.3–6 mm wide, auriculate. *Stamens* 10, ± uniform, free; anthers versatile, *c.* 0.9–1 mm long. *Ovary* shortly stipitate, fusiform, villose, ovules numerous; style slender, incurved, sparsely hairy towards the base. *Pods* narrow-obovoid, tapered at both ends, 17–24 mm long with a stipe 2–3 mm long, 6–7.5 mm wide, with dense, straight or sinuous to crispate hairs to 0.6 mm long. *Seeds* reniform, brown with prominent light yellow-brown reticulations, 3.1–3.5 mm long, 2.6–3 mm wide. (Figure 1)

Diagnostic features. Distinguished from other species in the genus by the following combination of characters: a golden brown or white and mostly sericeous indumentum (i.e. the hairs are usually silky, appressed and antrorse, although they can be sinuous and spreading on the calyces); spreading to ascending, oblong or narrowly lanceolate (rarely elliptic) leaflets with entire margins; erect or slightly spreading calyx lobes (never becoming reflexed); ovate bracts; an orange-yellow standard with red-brown striations and a yellow eye (pressed material fading to dark cream with dark purple striations and a yellow eye); wings and keel predominantly red-brown (drying dark purple).

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 26 Sep. 2000, *M.D. Crisp & L.G. Cook* MDC 9261 (CANB *n.v.*, PERTH); 4 Aug. 2016, *R. Davis & A. Brown* RD 12636 (PERTH); *R. Davis & A. Brown* RD 13011b (BRI, NSW, PERTH); 10 Sep. 1987, *J.W. Green* 5256 (PERTH); 6 July 2004, *G.J. Keighery* 16615 (PERTH); 3 Sep. 1967, *A.R. Main* 5 (PERTH); 2 Aug. 1995, *S. Patrick* 2375 (PERTH); 2 Aug. 1992, *S. Patrick & D. Edinger* SP 1114 (PERTH); 20 Sep. 1967, *E.M. Scrymgeour* 2118 (PERTH).

Phenology. Flowering from late July to mid-September; mature fruits have been collected in September.

Distribution and habitat. *Isotropis petrensis* occurs in the Yalgoo and southern Murchison bioregions where it grows in sandy loam in association with granite outcropping. It has been recorded in open shrubland of *Gastrolobium laytonii*, *Calycopeplus paucifolius*, *Acacia lasiocalyx* and *Eremophila serrulata*, high open shrubland of *Brachychiton gregorii*, *Calycopeplus paucifolius* and *Kunzea pulchella*, *Acacia* scrub or shrubland in association with *Grevillea pityophylla* or *Eremophila*, and shrubland among tussocks of *Cymbopogon*.

Conservation status. Recently listed as Priority One under Conservation Codes for Western Australian Flora, under the name *I.* sp. Yalgoo (S. Patrick 2375) (Western Australian Herbarium 1998–). This

Figure 1. *Isotropis petrensis*. A – shrubby and leafy habit; B – flowers, showing the orange-yellow standard with dark red-brown striations and a yellow eye, dark red-brown wings, and ovate bracts; C – flower, showing the dark red-brown keel; D – developing fruit with erect calyx lobes. Photographs by R.W. Davis from the type population.

species appears to be uncommon and may be susceptible to grazing by goats.

Etymology. The epithet is Greek (*petrensis* – among rocks) and refers to the occurrence of this species on or around granite outcrops.

Vernacular name. Granite Granny Bonnets.

Notes. Upon describing *I. atropurpurea* var. *alba*, Ewart noted that its indumentum was less prominently rusty tomentose than that of *I. atropurpurea* F.Muell. var. *atropurpurea* and that it had narrower and rather longer leaves, slightly longer calyx lobes and a pale or white standard with striations (Ewart *et al.* 1908). He did not consider these differences sufficient to establish a distinct species; however, with more material at our disposal, we have been able to obtain additional evidence in support of its recognition at species rank.

Indumentum is a key feature: it is sericeous in *I. petrensis*, consisting of appressed or antrorse hairs that are moderately dense (not obscuring the leaflet and stems), whereas in *I. atropurpurea* it is velvety, comprising crispate or sinuous hairs that are noticeably denser (obscuring the surface of the leaflet and stems). The colour of the standard is also diagnostic: orange-yellow with dark red-brown striations in *I. petrensis* (drying orange-yellow and fading to dark cream with dark purple striations) and orange to orange-red with dark red striations in *I. atropurpurea* (drying purple to pale mauve with dark purple striations). *Isotropis petrensis* also has an elliptic to lanceolate leaflet with an obtuse apex (*cf.* broadly elliptic to suborbicular or ovate with a rounded apex in *I. atropurpurea*), mostly longer pedicels (8–14 mm long *cf.* 4–8 mm) and mostly longer upper calyx lobes (7–10.3 mm long *cf.* 5–7 mm). *Isotropis atropurpurea* is widespread in arid areas but is not known from the Murchison and Yalgoo bioregions, occurring further north and extending into the Northern Territory.

Isotropis petrensis is morphologically more akin to *I. foliosa* Crisp (Crisp 1987), a species from north-eastern New South Wales and south-eastern Queensland with a similar indumentum. *Isotropis petrensis* has distinct leaflets that are spreading to ascending, oblong or narrowly lanceolate (rarely elliptic), and with entire margins and a mostly persistent indumentum. In *I. foliosa* they are deflexed, ovate (rarely elliptic), glabrescent and usually with undulate margins. *Isotropis petrensis* also has broadly ovate bracts (*cf.* narrowly triangular in *I. foliosa*), an orange-yellow standard that fades to dark cream with dark purple striations when dried (*cf.* orange drying mauve to pale brownish mauve in *I. foliosa*), and red-brown wings and a red-brown keel that dry dark purple (*cf.* wings orange-red drying mauve to pale brownish mauve, and keel dark red-brown apically drying purple apically and pale mauve to brownish mauve below).

Isotropis petrensis could be confused with *I. iophyta* Wege & R.W.Davis, a recently named species that is widespread in Western Australia's arid zone including the Murchison bioregion (Wege & Davis 2020), although the distributions of the two species are not known to overlap (Western Australian Herbarium 1998–). *Isotropis petrensis* can be separated from *I. iophyta* by its indumentum (hairs mostly appressed and antrorse *cf.* crispate or sinuous in *I. iophyta*), erect or slightly spreading calyx lobes (*cf.* becoming strongly reflexed), longer pedicels (8–14 mm long and mostly longer than calyx *cf.* 4–8 mm long and mostly shorter than the calyx), and predominantly orange-yellow standard (*cf.* orange, often drying purple).

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Styphelia undulata (Ericaceae: Epacridoideae: Styphelieae), a distinctive, short-range endemic from the Geraldton Sandplains

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SHORT COMMUNICATION

Styphelia undulata Hislop, *sp. nov.*

Typus: Badgingarra National Park, Western Australia [precise locality withheld for conservation reasons], 20 January 2007, *M. Hislop* 3688 (*holo*: PERTH 07703856; *iso*: CANB, CNS, HO, K, MEL, NSW 832208).

Leucopogon sp. Badgingarra (R. Davis 421), Western Australian Herbarium, in *Florabase*, https://florabase.dpaw.wa.gov.au/ [accessed 21 July 2021].

Erect, open, rather straggly *shrub*, to *c.*1.5 m high and 1.5 m wide, mostly single-stemmed at ground level, with a fire-sensitive rootstock. Young *branchlets* with a sparse to moderately dense indumentum of very short hairs < 0.05 mm long. *Leaves* spirally arranged, steeply antrorse; apex long-mucronate, pungent, the mucro ± straight, 0.7–1.1 mm long; base attenuate to cuneate; petiole conspicuous, 1.2–2.0 mm long, sparsely hairy on the adaxial surface, glabrous on abaxial surface, margins glabrous or very shortly hairy; lamina narrowly elliptic to narrowly ovate, 9–15 mm long, 1.8–3.2 mm wide, discolorous, concave adaxially; longitudinal axis usually ± straight or gently incurved, occasionally gently recurved; adaxial surface slightly shiny or not, usually sparsely hairy towards the base, venation not evident or very obscure towards the base only; abaxial surface paler, shiny, glabrous, with 5–7 primary veins, the midrib no broader than the others, shallowly grooved to ± flat between the veins; margins noticeably pale and hyaline in the first leaves produced during a growth flush, ± glabrous or with stiff, antrorse hairs < 0.05 mm long. *Inflorescence* axillary, erect; axis 2.5–5.5 mm long, (1)2–6-flowered, with a dense, spreading indumentum, ± terete below the lowest fertile bract, bluntly angular above, terminating in a bud-rudiment; flowers erect, sessile. *Fertile bracts* ovate to broadly ovate, 0.6–1.0 mm long, 0.6–1.0 mm wide, with 4–7 sterile bracts on the axis below. *Bracteoles* broadly ovate, 1.5–1.7 mm long, 1.3–1.7 mm wide, keeled, obtuse or acute; abaxial surface glabrous or with a few hairs about the keel, striate; margins ciliolate. *Sepals* ovate to elliptic, 2.6–3.0 mm long, 1.7–1.9 mm wide, acute or subacute, often ± apiculate, distinctly recurved; abaxial surface glabrous or very shortly and sparsely hairy, straw-coloured or pale green in central portion, becoming white and conspicuously undulate towards the margins, markedly striate; adaxial surface very shortly hairy; margins ciliolate, hairs < 0.05 mm long. *Corolla tube* white, depressed-obovoid, shorter than the sepals, 1.6–2.1 mm

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long, 2.0–2.3 mm wide, external and internal surfaces glabrous. *Corolla lobes* white, longer than the tube, 2.3–2.6 mm long, 1.0–1.2 mm wide at base, erect in basal 1/4–1/3 of length then spreading and recurved, external surface papillose, internal surface with a dense white indumentum of terete, straight, scarcely ornamented hairs, the basal hairs projecting into the top of the tube. *Anthers* partially exserted from the tube (by 1/4–1/3 of their length), 1.7–2.2 mm long, apex shallowly emarginate. *Filaments* terete, 0.3–0.5 mm long, attached to the anther *c.* 7/8 above the base, adnate to the tube just below the sinuses. *Nectary* annular, 0.2–0.3 mm long, ± truncate to shallowly lobed, the rim ciliolate. *Ovary* broadly ovoid to ± conical, 0.7–1.1 mm long, 0.8–1.0 mm wide, glabrous, 5-locular, pale green. *Style* 0.5–0.7 mm long, scabrous, slightly narrower than the raised ovary apex, included within the corolla tube; stigma not or scarcely expanded. *Fruit* ellipsoid, 3.7–5.5 mm long, 2.0–2.8 mm wide, much longer than the sepals, circular in section with a distinct gynophore; surface glabrous, ± dry, smooth (mesocarp poorly developed) or with obscure longitudinal ribs; apex truncate, but with the surface then raised slightly towards a central conical elevation; style usually shed at maturity (note the apical conical elevation may be mistaken for a style base at fruiting stage). (Figure 1)

Diagnostic characters. Distinguished from all other species of Western Australian *Styphelia* by the following character combination: leaves narrowly elliptic to narrowly ovate, adaxially concave, with a long-mucronate, pungent apex; inflorescences erect, (1)2–6-flowered; sepals markedly striate, with recurved apices and undulate margins; corolla tube shorter than the sepals; corolla lobes longer than the tube, papillose on external surfaces; style included within the corolla tube; fruit ellipsoid, ± dry with a distinct gynophore, apex truncate.

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 25 Oct. 2017, *D. Coultas* DC-OPP01 (PERTH); 10 Jan. 2008, *A. Crawford* ADC 1753 (K, PERTH); 18 Dec. 1995, *R. Davis* RD 421 (CANB, PERTH); 15 Mar. 2007, *K. Himbeck s.n.* (PERTH); 6 Dec. 1999, *M. Hislop* 1940 (MEL, NSW, PERTH); 26 July 2008, *M. Hislop* 3791 (CANB, CNS, PERTH); 7 Nov. 2013, *B. Phillips s.n.* (PERTH); 15 Mar. 2007, *B. Todd* 13 (PERTH).

Distribution and habitat. Known only from a small area near Badgingarra in the far south of the Geraldton Sandplains bioregion where it grows in white sand with laterite at depth, in species-rich heath or open woodland. Commonly associated species include *Eucalyptus todtiana*, *Banksia attenuata*, *B. menziesii*, *Adenanthos cygnorum* and *Hypocalymma xanthopetalum*.

Phenology. Flowers are produced through the summer months, at least between December and March. Collections with abundant mature fruit have been made in August and October although most of the flowering collections also have a few fruit present.

Etymology. From the Latin *undulatus* (wavy), a reference to the distinctly wavy sepal margins.

Conservation status. Listed as Priority Two (Smith & Jones 2018) under Conservation Codes for Western Australian Flora, under the name *Leucopogon* sp. Badgingarra (R. Davis 421). Apparently restricted to a single national park where it is highly localised but locally common.

Affinities. *Styphelia undulata* is a member of Group X and, in the phylogenetic analysis of Puente-Lelièvre *et. al* (2016), was placed in a polytomy with *S. kingiana* F.Muell., *S. crassiflora* F.Muell. and a group of eastern Australian species. Among Western Australian *Styphelia*, it only shows clear morphological affinity to *S. crassiflora* (Figure 2), a species with which it sometimes co-occurs (the pair key out at the first lead of couplet 14 (Group X) in Hislop (2021: 31). The two species share some

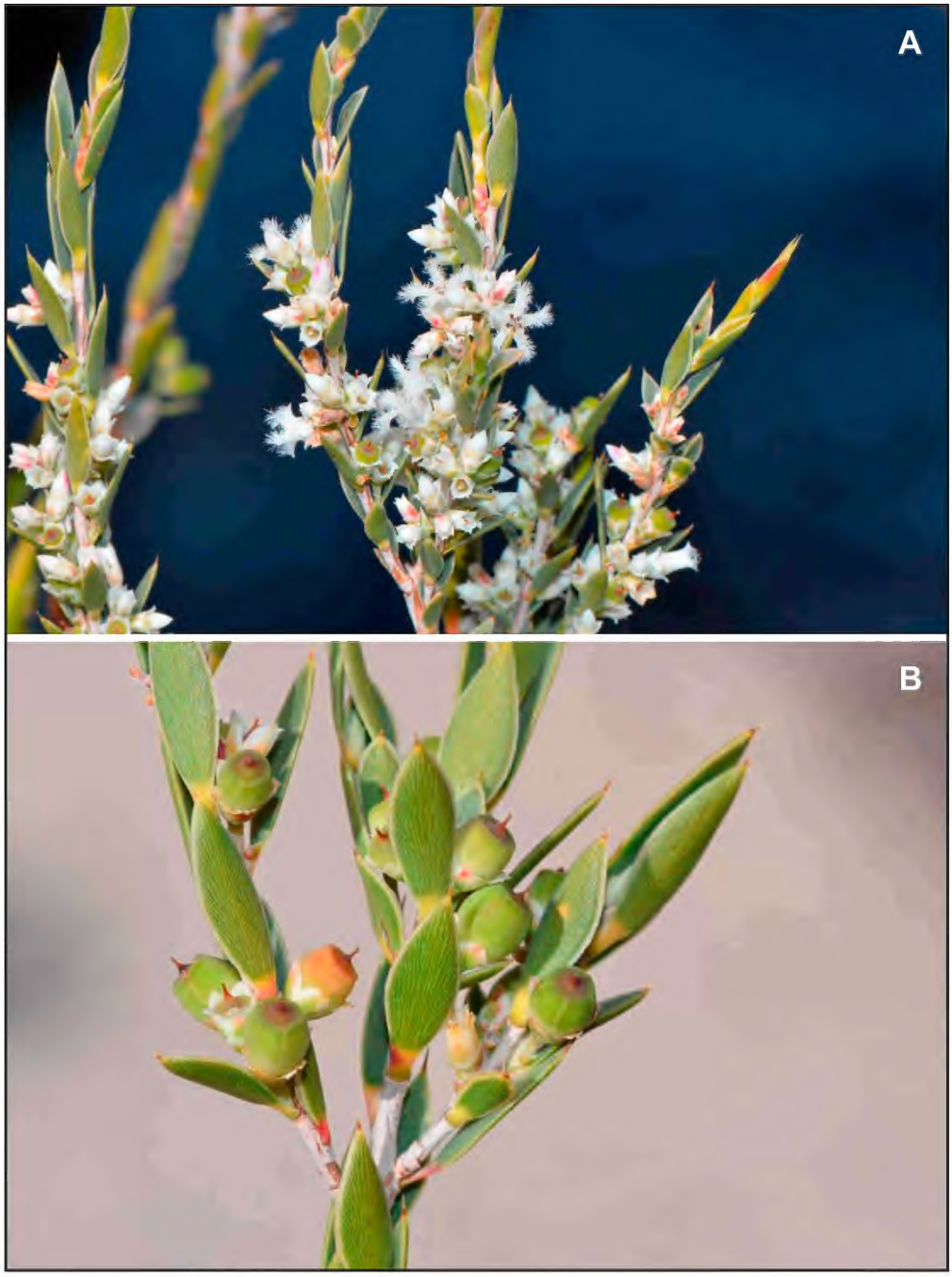

Figure 1. *Styphelia undulata*. A – flowering branchlets *in situ*; B – fruiting branchlet *in situ*. Photographs by Fred and Jean Hort from *F. & J. Hort* 4230.

Figure 2. *Styphelia crassiflora*. A – flowering branchlet *in situ*; B – branchlet with flowers and immature fruit *in situ*. Photographs by Fred and Jean Hort from *F. & J. Hort* 4233.

unusual features including a more or less dry drupe with a truncate apex (Figure 1B; 2B), and distinctly striate sepals with undulate margins. However, they can be easily distinguished by differences in their leaves, inflorescence and style length. Whereas *S. undulata* has narrowly elliptic to narrowly ovate leaves terminating in a pungent mucro, multi-flowered inflorescences, and a style that is included within the corolla tube, *S. crassiflora* has broadly elliptic to broadly obovate and obtuse leaves, single-flowered inflorescences, and a well-exserted style.

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Tephrosia sabulosa (Fabaceae: Millettieae), a new species from Australia's sandhill deserts

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Abstract

Butcher, R. (2021). *Tephrosia sabulosa* (Fabaceae: Millettieae), a new species from Australia's sandhill deserts. *Nuytsia* 32: 109–119. The new species described herein has been segregated from the complexes surrounding *T. rosea* Benth. and *T. brachyodon* Domin, both of which are extremely challenging taxonomically. *Tephrosia sabulosa* R.Butcher is distinctive; however, its relationship with the other members of these complexes is not yet known. It occurs in sandhill habitats on the crests and slopes of dunes and has a disjunct distribution in Australia, with all but one collection being made from the Simpson-Strzelecki Dunefields bioregion of the Northern Territory, South Australia and Queensland; nearly 900 km lies between these collections and that made from the Kiwirrkurra Indigenous Protected Area (Gibson Desert bioregion) in Western Australia. The new species is described and differentiated from similar taxa, and images and a distribution map are provided.

Introduction

The genus *Tephrosia* Pers. (Fabaceae: Millettieae) has not been revised nationally since Bentham (1864), when 24 species were recognised; there are now 82 named and 53 unnamed native taxa in Australia, based on the *Australian Plant Census* (APC), Butcher (2018a, 2018b, 2020, 2021), Butcher and Cowie (2021), and this publication. One of the key aims of current taxonomic research has been the reconciliation of informal names in use across Australia for undescribed *Tephrosia* taxa, names that have proliferated as increased collections have brought to light putatively new taxa, and because many superfluous names have arisen across the country's herbaria as a result of siloed research, different approaches to taxonomic practice, and evolving taxonomic concepts. The objectives of this reconciliation process are to eliminate overinflation of taxon numbers, to determine true taxon distributions and to aggregate information required for taxon resolution and conservation assessment.

Following Barker (2005) and APC protocols, the majority of *Tephrosia* manuscript names in use have been converted to phrase names, with the designation of a voucher specimen against which to compare other collections an integral part of achieving and maintaining taxonomic stability in lieu of formal description and publication. Unfortunately, some taxa have been given multiple manuscript or phrase names (or both) over time, with some names still to be converted to, or reconciled with, existing phrase names because the taxon spans geopolitical boundaries and has not been comprehensively studied across its range, the taxonomic expertise in the group lies outside the institution in which the specimens have been annotated, or the taxon itself occurs outside the State or Territory within which

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that institution operates. Where taxa have multiple phrase names their distributions may suspiciously stop at borders, but with so many phrase-named *Tephrosia* taxa in Australia this can be difficult to detect. Less frequently, a single informal name contains more than one taxon, but this hypothesis is only recognised and recorded in-house because research is ongoing. An unfortunate consequence of this is that it is not possible to distinguish the collections in *Australasian Virtual Herbarium* maps and records, which hampers the investigation and resolution of their taxonomic status. In very rare circumstances all of the above apply, and a new taxon has multiple historical informal names whilst also being concealed within an informal name to which it does not belong. The new species *T. sabulosa* R.Butcher, described herein, is one such rarity. The tortuous path of its taxonomic recognition, and associated informal nomenclature, is presented below as a case study of the importance of trans-Australian revisions.

Tephrosia sabulosa—*a case study*

During study of the *Tephrosia* collection at the Queensland Herbarium (BRI) in 2012, two tag-named forms were noted under the phrase name *T.* sp. Glenormiston (R.W. Purdie 1362): *T. 'deserti'*, a pink/purple-flowered entity usually with spreading to patent hairs, which included the voucher specimen for the phrase name, and *T. 'boylandii'*, a similar, shortly appressed-hairy entity. In Queensland, *T. 'deserti'* and *T. 'boylandii'* occur in close proximity in the interface between the Simpson-Strzelecki Dunefields (SSD) and Channel Country (CHC) bioregions (Department of Environment 2013); however, they have different habitat preferences and reasonably consistent morphological differences. Two collections from Cravens Peak Reserve made on the same day from sites less than 3 km apart are clearly different from one another and are the two different *T.* sp. Glenormiston forms, with *T. 'deserti'* (*P.I. Forster* PIF37482) collected from red sandplain (on the edge of claypan flats) and *T. 'boylandii'* (*P.I. Forster* PIF37501) from the crest of a sand ridge. The correlation between morphological differences (e.g. indumentum, leaflet shape, venation) and substrate differences (i.e. alluvial and clay flats to rocky sites *vs* deep sands to dune crests) is highly consistent across the collection; however, it was evident from the specimen determinations that these tag-names had been applied only semi-consistently over time, suggesting evolving taxonomic concepts.

Because many of the *T. 'boylandii'* specimens had also been annotated as '*T. rosea* 'desert form'' they were requested on loan from BRI to advance studies at the Western Australian Herbarium (PERTH) on the *T. rosea* Benth. complex. Familiarity with those specimens made it possible to recognise that a single '*T.* aff. *rosea* var. *clementii* Domin' collection from the Kiwirrkurra Indigenous Protected Area (spanning the Gibson Desert and Great Sandy Desert bioregions in northern Western Australia) needed to be critically compared with *T. 'boylandii'* rather than be shoe-horned into *T. rosea* as yet another atypical form. The extreme disjunction between this collection and those from Queensland was remarkable given the vast areas of seemingly suitable sandhill country between them, so it was pleasing to find a folder of *T. 'boylandii'* specimens at the Northern Territory Herbarium (DNA) during an extended visit in 2019; there, however, they had been identified as *T. brachyodon* var. *longifolia* (Benth.) Domin (a taxon needing lectotypification and splitting), '*T. brachyodon* var. indet.' and '*T. brachyodon* var. indet. (Simpson Desert dunes form)'. The Northern Territory specimens were from the Simpson Desert, as were two additional collections from north-east South Australia that were identified in 2020 from specimens on loan from the State Herbarium of South Australia (AD) and the Australian National Herbarium (CANB). Even with the discovery of these additional records, the large disjunction remains (Figure 1).

The species represented by the *T. 'boylandi'* form (≡ *T. sabulosa*), was first recognised as a distinct taxon in the early 1970s by J.R. Maconochie (Northern Territory Herbarium, Alice Springs) who determined

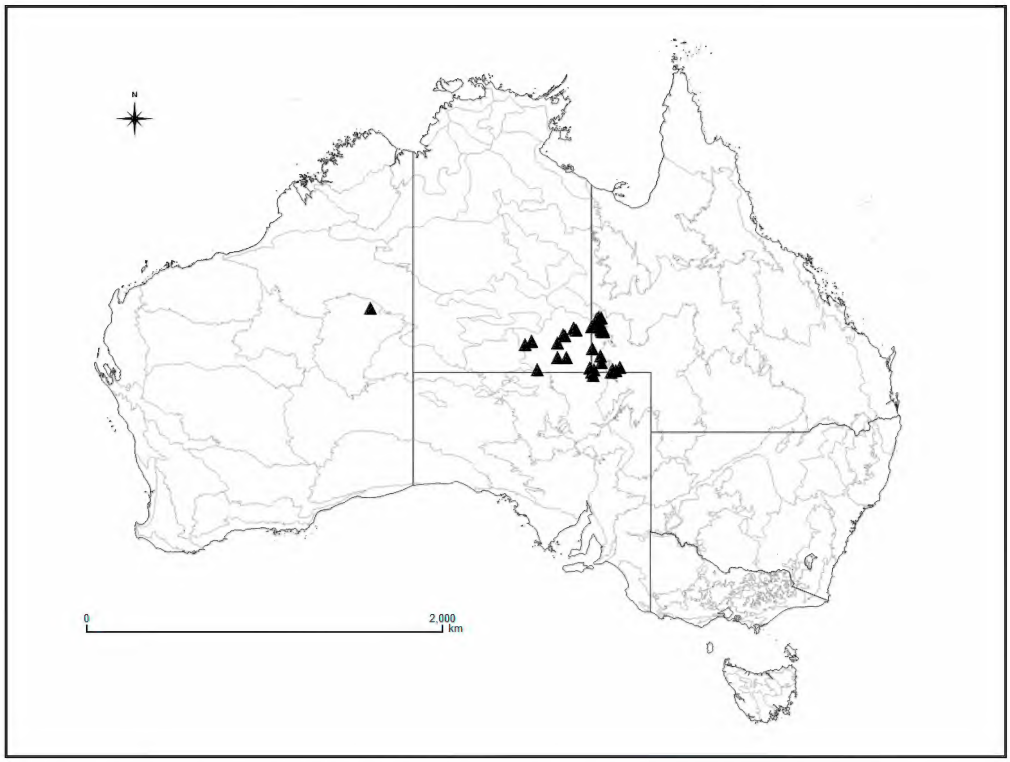

Figure 1. Distribution of *Tephrosia sabulosa* in the central deserts of Australia. The species is found on dunes in sandhill country, including the Gibson Desert (Western Australia) and the Simpson Desert (Northern Territory, Queensland and South Australia). *Interim Biogeographic Regionalisation for Australia* v. 7 regions (Department of the Environment 2013) shown in grey.

the specimen *N. Henry* 936 (collected 20th Sep. 1973) as '*T. rosea* var. *desertii*'; an orthographic variant of this name was taken up in a specimen determination by M. Crisp (Australian National Herbarium) in April 1978, as '*T. rosea* var. *deserti* J.R.Maconochie' (with 'ms' added to the label in pencil later). Les Pedley (dec.) must have seen this determination, and must have seen it in Canberra[1], because '*T. rosea* var. *deserti*' is written in his hand on the flimsy for *D.E. Symon* 4354 (AD 96715005), a specimen he determined in 1984 to be worth recognising at species rank (along with three other AD sheets) as '*T. eremaea* sp. nov. aff. *T. rosea* F.Muell ex Benth.'. The name '*T. eremaea* Pedley ms' was subsequently adopted at AD for these Northern Territory collections determined by Pedley and also applied de novo to duplicate sheets at AD in May 2003. The only South Australian collection of this species held at AD has until now been filed under *T. sphaerospora* F.Muell., a spreading, orange-flowered subshrub and the most commonly collected *Tephrosia* in the State.

[1]Although based at BRI, Pedley was in receipt of four loans to CANB in March 1984—two from AD and one each from DNA and PERTH—(S. Coffey, A. Serkan & H. Vonow, pers. comms), and his determinations on these specimens are nearly exclusively from December 1984 and on 'Australian National Herbarium (CANB)' or 'Herbarium Australiense' labels. He was present at CANB for all of June 1984, and from late November to early December 1984 (J. Palmer, pers. comm.) in order to attend a joint meeting of representatives from Australia's taxonomic journals, held at the Australian National Herbarium on Tuesday 27th Nov. 1984 (Barlow 1985).

It would appear, however, that by the time Pedley saw Queensland material of this new species at BRI, the concept of the new taxon had been remembered but the name '*T. eremaea*' forgotten or rejected in favour of Maconochie's unpublished varietal name, with Pedley annotating *D.E. Boyland* 282 with a note on the flimsy [*in adnot.*]:

'I intend making this the type of new species (*T. deserti*). *Crocker* s.n. (AD), *Latz* 8495 (AD, NT), *Symon* 3371 (AD, CANB), *Symon* 4354 (AD, CANB, NSW) also belong here. LP. 11.x.89'

Despite the note on the flimsy, this specimen was only determined as *T. 'deserti'* in 1994, on the same day that another collection — *L. Pedley* 4479, a good specimen with numerous duplicates for distribution — was also declared (*in adnot.*) to be the proposed type of *T. 'deserti'*. Unfortunately, even though it has more or less appressed hairs, similar to *D.E. Boyland* 282 and matching specimens (≡ *T. sabulosa*), *L. Pedley* 4479 was not the same taxon. When the phrase name *T.* sp. Glenormiston (R.W. Purdie 1362) was raised (Holland 1997) it was this second taxon to which the phrase name was now linked through its voucher specimen, *R.W. Purdie* 1362 being very similar to *L. Pedley* 4479 but with soft, spreading hairs. The phrase name and the tag name *T. 'deserti'* were then applied to both taxa for some time, and it has only been in the last decade that annotations such as '*T. 'deserti'* (Simpson Desert form)' and '*T. 'deserti'* (2) – *'boylandii'*" began to appear on BRI sheets and folders to recognise as new, ironically, the taxon first recognised as new and the first taxon proposed to be named *T. deserti*. With an overarching goal of nomenclatural stability in taxonomic work, it was deemed unwise to resurrect any of these manuscript or tag names, thus the new name *T. sabulosa*—reflective of its habitat preference—has been selected for the species represented by the *T. 'boylandii'* form.

The duplication of manuscript names (and phrase names) for the same taxon across different herbaria has been noted for many new species in *Tephrosia* (see e.g. Butcher 2018). These duplications in no way suggest poor taxonomy, they merely serve to highlight (1) just how many undescribed species there are across Australia, (2) the difficulty in keeping track of novel forms observed over many years across States when focussed primarily on the diversity in one's own, and (3) the unintended consequences of siloed taxonomic research in widespread groups. The importance of tackling taxonomic revisions across the entire (bioregional) range of a genus cannot be understated. It is only with comprehensive knowledge that taxon boundaries can be properly assessed, new species resolved and described accurately, and the proliferation of superfluous names prevented. There have been similar discoveries of new taxa for Western Australia recently, with highly disjunct collections of two other species (Butcher & Cowie 2021) made from the Pilbara bioregion, while the two new species are widespread across the Northern Territory and central Queensland; knowledge of the genus beyond Western Australia prevented new and superfluous phrase names being raised on the State's plant census to account for these collections. It is highly likely that we will see this scenario again, given the low number of collections from, and the inaccessibility of, Western Australia's arid interior.

Materials and methods

All *Tephrosia* specimens at AD, BRI, CANB, DNA, NSW, NT, MEL and PERTH have been viewed, as well as the Australian *Tephrosia* specimens (including types) housed at K, and types available through *GlobalPlants* (https://plants.jstor.org/) or as scanned specimens (i.e. from Domin's Herbarium at PR). Herbarium acronyms follow Thiers (continuously updated). Bioregions (and their standard abbreviations) referred to in distribution statements and maps follow *Interim Biogeographic Regionalisation for Australia* (IBRA) v. 7 (Department of the Environment 2013).

Taxonomy

Tephrosia sabulosa R.Butcher, *sp. nov.*

Type: north-east Simpson Desert, Tobermorey Station, Northern Territory, 25 October 2010, *P.K. Latz* 18198 (*holo*: BRI AQ649314; *iso*: DNA A0107084, NT A0107084).

Tephrosia rosea var. *desertii* [ined.] (*in sched.*), Northern Territory Herbarium (e.g. DNA A0049128); *T. rosea* var. *deserti* Maconochie ms (*in sched.*), Australian National Herbarium (e.g. CBG 7801597.1).

Tephrosia eremaea Pedley ms (*in sched.*), State Herbarium of South Australia (e.g. AD 98824116).

Tephrosia deserti [ined.] (*in sched.*), Queensland Herbarium (e.g. BRI AQ 238563).

Tephrosia 'boylandii' (*in adnot.*), Queensland Herbarium.

[*Tephrosia* sp. Glenormiston (R.W. Purdie 1362), Queensland Herbarium, *p.p.*, *auct. non R.W. Purdie* 1362.]

Rounded to erect, grey, *subshrub* to *shrub*, multi-stemmed, perennial, 0.3–1 m tall, to 1 m wide; corky at base of stems, rootstock not seen. *Branchlets*, *leaf and inflorescence rachides* with moderately dense to dense indumentum, the hairs appressed to loosely appressed, silver-white, straight to slightly wavy, 0.2–0.5 mm long, sometimes stramineous on young growth. *Leaves* pinnate, up to 136 mm long including petiole; *stipules* caducous or falling late, antrorse becoming patent with recurved apices, attenuate to deltoid, 1.1–3 mm long, yellow-brown [red-brown under hairs], dark red on mid-rib but obscured by hairs, 1- or 3-nerved, appressed-hairy; *petiole* 10–32 mm long; *ultrajugal rachis* 2.4–16 mm long; *stipellae* absent; *petiolules* 0.9–3.5 mm long; *leaflets* (3–)5–11, narrowly ovate through elliptic-oblong to slightly obovate, flat in T.S.; base rounded-broadly cuneate; apex rounded through truncate to retuse, straight with a minute, reflexed mucro 0.2–0.5 mm long; *lateral leaflets* 8.7–28.5 mm long, 3.3–14 mm wide, length 1.7–3.7 × width; *terminal leaflet* 1.05–2 × the length of adjacent laterals, 15–40 mm long, 4.5–12 mm wide, length 2.7–4.7 × width; lamina discolorous, the upper surface yellowish green to light lime green to mid-green, the lower surface dull green to grey-green; secondary veins in 7–14 pairs, venation craspedodromous with veins curving just before contacting margin, brochidodromous at apex, the intersecondary veins obscure or parallel at base then obscure in upper half; upper surface indumentum sparse to moderately dense, the hairs appressed to patent, straight to slightly wavy, hyaline-white; lower surface with raised veins, indumentum moderately dense, the hairs appressed to ascending, straight to slightly wavy, hyaline-white. *Inflorescence* pseudoracemose, usually also with a cluster of flowers at the base, leaf-opposed in terminal position or with a new branch arising from axil, to 420 mm long, fascicles reasonably crowded to well-spaced, 3–9-flowered; *inflorescence bracts* caducous or falling late, antrorse, attenuate to deltoid, acute, 0.8–2.3 mm long; *floral bracts* caducous, antrorse, subulate to narrowly deltoid, 0.3–1.5 mm long; *pedicels* 1.2–5.2 mm long (to 7.8 mm for pods); *bracteoles* absent. *Calyx* 2.7–4.7 mm long, indumentum moderately dense to dense, the hairs appressed to ascending, mostly white with some stramineous; tube 1.4–2.7 mm long, 0.7–1.6 × the length of lateral lobes; lobes narrowly deltoid to deltoid; vexillary lobes united higher than lower three, free for 0.6–1.7 mm; lowest lobe (1.2–)1.5–3 mm long, ±equal to a little longer than lateral lobes. *Corolla* 5.5–9 mm long, pink to purple, with a yellow eye at throat; *standard* 5.9–8.1 mm long, 7–10 mm wide, the claw 1.6–2.5 mm long, the blade depressed-broadly elliptic or -ovate to suborbicular, callused at base with a rounded to emarginate apex; *wings* 5.8–9 mm long

(incl. claw 1.6–2.8 mm long), 2.9–4.8 mm wide, longer than keel, few hairs present near upper edge to centre of blade, the blade ±straight-sided at base then broadly ovate to obliquely elliptic with the lower edge more deeply curved, pouched in front of twisted spur, deeply scalariform perpendicular to upper edge within the pouch, with a rounded apex; *keel* 5.3–7.2 mm long (incl. claw 2–2.8 mm long), 2.5–3.5 mm wide, glabrous, the blade semicircular, pouched in front of spur, obtuse at apex. *Staminal tube* 4–5.3 mm long, with antrorse hairs near fenestrae on and in front of callosities and sometimes on upper sides of the tube, fenestrae callused on margins and prominently at apex; vexillary filament geniculate beneath prominent calluses near base, with antrorse to patent hairs on callosities and along filament; anthers broadly oblong to quadrate to suborbicular, 0.5–0.6 mm long, 0.4–0.5 mm wide. *Ovary* densely appressed-hairy; ovules 3–5. *Style* broad and thick at base then flattened and tapering, glabrous; stigma villous, orbicular. *Pod* linear, straight and broader at apex to gently upcurved to upcurved at apex, compressed, (19–)23–42 mm long, 2.9–4.2 mm wide, tissue absent between seeds, yellow-brown or light to dark red-brown, appearing purplish brown under moderately dense, appressed, straight to slightly wavy, white to silver-white hairs; beak in line with upper suture, straight to slightly deflexed. *Seeds* 1–4 per pod, 5.5–7.5 mm between centres of adjacent seeds, transversely narrowly obloid to sub-cylindrical, not compressed, 2–2.6 mm long, 4.1–5.5 mm wide, testa smooth, bicoloured, greenish to tan/light brown with dark green to brown or purplish brown markings (especially around circumference), with orange to dark brown encircling hilum and raised lens; hilum central to slightly excentric, with a creamish, incomplete-annular rim aril (with tongue) 0.15–0.3 mm tall, 0.35–0.45 mm wide. (Figure 2)

Diagnostic features. Short, dense, ±appressed, silvery white indumentum; stipules short (to 3 mm) and caducous; petioles long relative to the leaf rachis; (3–)5–11, widely spaced, ovate-elliptic-obovate, pale green, discolorous leaflets with pale primary and secondary veins and ±obscure intersecondary veins; ultrajugal rachis present; elongate pseudoracemes bearing 6+-flowered fascicles of pink/purple flowers with the calyx tube usually a little longer than the lobes, the wings often sparsely hairy near apex, the vexillary stamen densely hairy at base, and 3–5 ovules; ±straight pods with a straight to slightly deflexed beak; transversely narrowly obloid to subcylindrical seeds, >2 × wider than long, with a smooth, bicoloured testa and usually central hilum.

Selected specimens examined. WESTERN AUSTRALIA: [locality withheld for conservation reasons] 13 Sep. 2015, *R. Butcher & R. Davis* RB 2062 (BRI, CANB, NT, PERTH). NORTHERN TERRITORY: *c.* 12 km SSE of Lake Caroline, N Simpson Desert, 8 July 2007, *D.E. Albrecht & A. Duguid* 12277 (DNA, NT); NW Simpson Desert, 20 Sep. 1973, *N. Henry* 936 (DNA); W of Colson Track, 81.6 km S of junction with Andado cross track, Simpson Desert, 17 Apr. 2013, *P.C. Jobson* 10421 *& C.E. Nano* (BRI, DNA, NT); NW Simpson Desert, 27 Aug. 1977, *P.K. Latz* 7479 (CBG, MO, NT); NW Simpson Desert, 21 Oct. 1980, *P.K. Latz* 8495 (AD, DNA); 3 km S of Magellan Bore, Allambi Stn, 17 Mar. 1995, *P.K. Latz* 14185 (DNA, NT); 24 km N Mt Dare HS, Andado Stn, 8 May 1997, *P.K. Latz* 15280 (DNA, NT); 105 km SSE of Atula Stn HS, Simpson Desert, 19 Sep. 2001, *P.K. Latz* 18011 (DNA, NT); between Lake Caroline and Plenty River, 8 Oct. 1986, *G. Leach* 1090 (AD, BRI, DNA, MEL, MO, NT); *c.* 24 km NNW of Poeppels Corner, 19 Sep. 1987, *G. Leach* 1462 (AD, BRI, DNA, NSW, NT); Simpson Desert, Amerada Petroleum Corporation No. 1 Hale River, 2 Nov. 1966, *D.E. Symon* 4354 (AD [2 sheets], NSW); *loc. cit.*, *D.E. Symon* 4371 (AD [2 sheets], CANB). QUEENSLAND: Cravens Peak, *c.* 4.7 km from Sand Hill Bore towards Plum Pudding, 14 Aug. 2008, *P. Foreman* CP155 (BRI); Cravens Peak, 21 km from Ocean Bore and 16 km S along Shotline track to southern boundary with Carlo, Simpson Desert, W of Boulia, 23 June 2010, *P.I. Forster* PIF37501 (BRI, DNA, MEL); Ethabuka Stn, 15.2 km SE of HS, 21 June 2011, *J.S. Gillen* JSG38 (BRI); Cravens Peak, 900 m SW of Pudding Bore on track to Ocean Bore, 135 km SW of Boulia, 22 June 2010, *D. Halford* Q9953 (BRI); Cravens Peak, 8.8 km SE of Ocean Bore on track to 12 Mile Bore, 135 km SW of

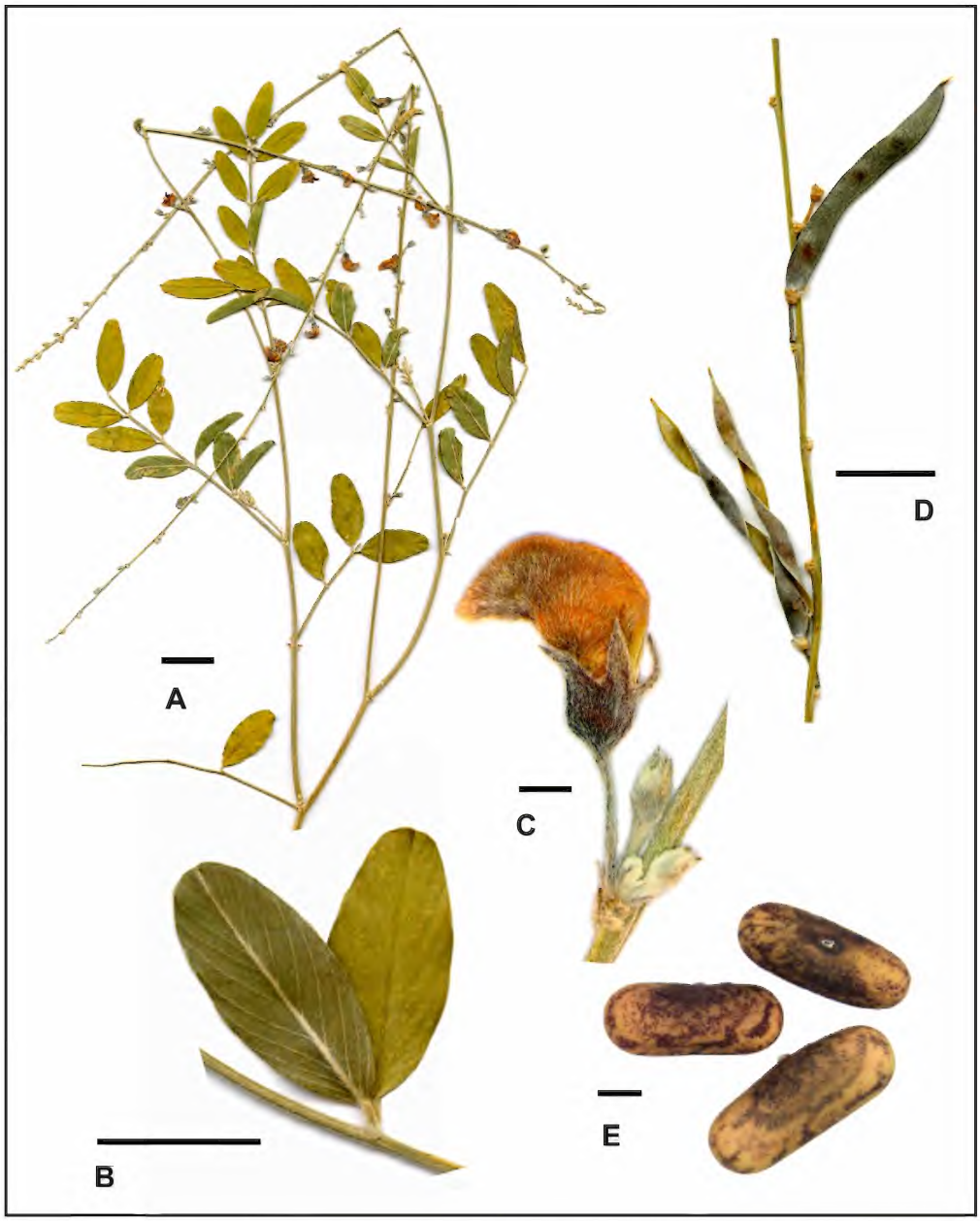

Figure 2. *Tephrosia sabulosa*. A – pressed specimen showing well-spaced, flat, narrowly ovate to elliptic leaflets, minute (caducous) stipules, and moderately long, leaf-opposed pseudoracemes of (pink to magenta) flowers; B – pair of discolorous leaflets showing pale green to yellowish green upper surface and mid-green lower surface with noticable secondary veins (at *c*. 45°) and obscure intersecondary veins; C – pressed fascicle of flowers and buds with short, subtending inflorescence bract, showing short appressed hairs on rachis and calyces, and calyx with the lateral and lower lobes *c*. equal in length to each other and to the tube; D – part of infructescence showing ±straight 3-seeded pod (1 aborted) with beak in line with the upper suture, and dehisced pod, with no white tissue on inner surface; E – bicoloured, transversely obloid to subcylindrical seeds with width greater than twice length, smooth testa and central hilum. Scale bars = 10 mm (A, B, D), 1 mm (C, E). Images taken by R. Butcher from *P.I. Forster* PIF37501 (A, C); *P.K. Latz* 14185 (B); *D.E. Albrecht & A. Duguid* 12277 (D, E).

Boulia, 24 June 2010, *D.A. Halford* QM22 (BRI); Ethabuka HS, 12 Oct. 2005, *P.K. Latz* 21383 (BRI, DNA, NT); Simpson Desert, Sep. 1986, *J. Mills s.n.* (BRI); 11 km W of Kuddaree Waterhole, Adria Downs, 6 Aug. 2015, *J.L. Silcock* JLS 1739 (BRI). SOUTH AUSTRALIA: KI Line Simpson Desert Conservation Park, *c.* 20 km [S] from Poeppel Corner, 13 June 1998, *M. Friebe* S-61 (AD); Simpson Desert, *c.* 3 km W of Poeppel Corner, 2 Aug. 1982, *R.W. Purdie* 2857 (CANB).

Phenology. Flowers and fruits April–November; seeds on specimens collected in June, July and October.

Distribution. Western Australia (GID), Northern Territory (MAC, SSD), Queensland (CHC, SSD in Gregory North and Gregory South districts) and South Australia (SSD): occurs in the area roughly bounded by Nyinmi outstation in Western Australia (*c.* 250 km W of the Northern Territory border), eastward to Cravens Peak Reserve and Birdsville in Queensland (Figure 1). Collection records are concentrated in the Simpson Desert (SA, NT and Qld) and the Kiwirrkurra IPA collection is *c.* 890 km west of the nearest collection in the Northern Territory; it is probable that *T. sabulosa* also occurs in suitable dune country in the intervening desert areas, but it is unusual that it has not been collected there given the significant regional collecting efforts of botanists such as David Albrecht, Peter Latz and John Maconochie.

Habitat. Grows in desert sandhill country on the slopes and crests of sand dunes in deep red sand. Associated with *Triodia basedowii* or *Zygochloa paradoxa* hummock grassland with sparse shrubs (e.g. *Acacia ligulata*, *Crotalaria cunninghamii*, *Goodenia connata*, *Grevillea stenobotrya*, *Lechenaultia divaricata*, *Newcastelia cladotricha*) and forbs (e.g. *Indigofera linnaei*), sometimes with scattered *Corymbia* in the overstorey.

Conservation status. To be listed as Priority One under Conservation Codes for Western Australian Flora in light of its single, and highly disjunct, collection from the State (C. Bourke, pers. comm.). Not conservation assessed in the Northern Territory or South Australia, and not conservation-listed in Queensland.

Etymology. From the Latin word *sabulosus*, 'sandy, growing in sandy places', in reference to its dune and deep sand habitats.

Affinities and notes. *Tephrosia sabulosa* was informally recognised as an inland variant of *T. rosea* by L. Pedley and of *T. brachyodon* Domin by I. Cowie (DNA), but it is unclear in the absence of molecular data to which it is most closely allied. It is similarly difficult to define these species (*s. lat.*) with robust sets of characters given the variation currently recognised in each. Like *T. rosea* and *T. brachyodon*, the pink/purple flowers of *T. sabulosa* have prominent callosities at the apex of the staminal tube fenestrae and at the base of the vexillary filament, which is also markedly hairy in all three species, as well as a pronounced scalariform region near the upper margin of each wing petal. This scalariform petal ornamentation is not unique to this taxon group, however, and has been observed in orange-flowered (e.g. *T. virens* Pedley) as well as pink/purple-flowered species. They also have similar calyces, with the vexillary lobes united higher than the lower three, the tube and lateral lobes of similar length, and the lower and lateral lobes narrowly deltoid. The seeds are superficially similar, being wider than long (length being measured from the point of attachment to the placenta to the opposite side; width at 90° to this) and darkly marked, but there are a number of differences (some overlapping) between them. In *T. sabulosa* the seeds are transversely narrowly obloid to sub-cylindrical (width >2 to 3 × length) and appear bicoloured (green to tan with dark brown markings), whereas the other species have seeds varying from transversely ellipsoid to transversely obloid (width rarely >2 × length) and are tricolored

and mottled. The testa is smooth in *T. sabulosa* and *T. rosea*, but in *T. brachyodon* it is slightly to strongly depressed in darker areas and raised in the palest areas (pinkish tan) where it appears to lift away from the seed. Leaflet venation differs between the three species with the intersecondary veins parallel to closely parallel in *T. rosea* (such that they can be difficult to distinguish from the secondary veins), but parallel just at the base then becoming diffuse or obscure in *T. sabulosa* and *T. brachyodon*; the intersecondary and tertiary venation can be quite red in some varieties and forms of *T. brachyodon*.

Among the formal and informal taxa within *T. rosea*, *T. sabulosa* is most like var. *rosea* and var. *clementii* but is readily distinguished from both by its leaflet venation. With var. *rosea* it shares its longer overall leaf length, longer petioles, higher leaflet number (usually 5 to 11, but up to 17 in *T. rosea* collections from Kimberley islands) and more similar leaflet shape, but var. *rosea* differs markedly in its higher number of secondary veins (15–22 pairs), 6–8 ovules and seeds, and longer pods that curve up at the apex. With var. *clementii* it shares its silver-white indumentum, lower ovule number and shorter, scarcely to slightly curved pods, but this differs in its longer, more persistent stipules, short petioles, lower number (usually 5 or 7) of narrower leaflets, usually with an obtuse apex, and stouter pedicels; var. *clementii* is extremely variable in morphology as well as habitat, with some Pilbara region collections (e.g. *R. Butcher & R. Davis* RB 1558; *H. Demarz* 2494; *R.D. Royce* 1518) from dune crests in deep red sand.

Similarly, the *T. rosea* segregate taxon *T.* sp. Kennedy Range (J.S. Beard 4392) also occurs on dune crests but is restricted to the eastern Carnarvon bioregion of Western Australia. It can be distinguished from *T. sabulosa* by the following combination of characters: a golden-bronze appearance to plants; leaves with short petioles and 5–9, closely spaced, densely hairy, obovate leaflets; long, persistent stipules; short, thick pedicels; calyx lobes that spread open away from the developing pods; golden brown to dark brown indumentum on buds and pods; pods that are curved up just at the apex and have 4–6 seeds. In Western Australia, *T. sabulosa* occurs in the same area as a widespread, inland, 'small, cuneate leaflet form' of *T. rosea*, which I observed in 2015 to be common on clayey sand flats around Kiwirrkurra. This taxon is a low-growing shrub with shortly petiolate, short, 5-foliolate leaves with small, cuneate leaflets that are V-shaped in T.S. and have retuse apices.

Many specimens of *T. sabulosa* were originally identified as *T. brachyodon* var. *longifolia*, *T. brachyodon* var. indet. and *T. brachyodon* var. indet. 'Simpson Desert form', identifications that give a small insight into the taxonomic complexities within and surrounding *T. brachyodon*. *Tephrosia brachyodon* var. *longifolia* needs lectotypification, with the syntypes of the basionym, *T. purpurea* var. *longifolia* Benth., representing three, possibly four different taxa. The status of *T. brachyodon* var. *cloncurriensis* Domin relative to var. *longifolia s. lat.* is also uncertain.

Among the informal taxa associated with *T. brachyodon*, *T. sabulosa* is most like *T.* sp. Granite (P.K. Latz 12116) and *T.* sp. Glenormiston (R.W. Purdie 1362) [*T. 'deserti'* form]; the boundaries between these central Australian taxa and *T. brachyodon* var. *longifolia s. lat*. and var. *cloncurriensis* require further study, with intermediate collections observed at BRI and DNA. *Tephrosia* sp. Granite can sometimes have similarly shaped and coloured leaflets to *T. sabulosa*, but it is a smaller, nearly glabrous to appressed hairy subshrub occupying rocky habitats, and has smaller leaves, often with a glabrous upper surface to leaflets, persistent, long-attenuate stipules, shorter inflorescences of smaller flowers with 6–8 ovules, and narrowly oblong, straight to slightly curved pods that are tan at maturity. *Tephrosia* sp. Glenormiston can be distinguished by its usually patent to spreading indumentum, long, attenuate, persistent stipules, narrowly elliptic to elliptic, mid-green leaflets with ±obtuse, mucronate apices and usually pink-red secondary veins with a red reticulum often visible, 5–7 ovules per flower,

and tan to light brown pods that are gently curved along their length. All of these taxa have their secondary veins more sharply angled from the midvein than in *T. sabulosa* (12–20° *vs c.* 30°).

Two *T. sabulosa* collections have very small leaflets—*D.E. Boyland* 282 (BRI; Poeppel Corner, sandy soil, inter-sand-ridge flat) and *G. Leach* 1462 (AD, BRI, DNA, NSW, NT; *c.* 24 km NNW of Poeppels Corner, dune slope, red sandy slope). The *Boyland* collection also has small flowers with short, thick pedicels and the sampled plant has the appearance of being stressed or perhaps flowering for a second time in the season; there are a number of elongate spent pseudoracemes, with a few young inflorescences emerging. The only collection from Western Australia (*R. Butcher & R. Davis* RB 2062) was from a population of plants (common on the dune crest) from which most leaves had fallen and the leaves that were present were small, 3- or 5- foliolate, with broadly lanceolate leaflets; it has similarly small flowers with short, thick pedicels, as well as short calyx lobes and a bicoloured (white and stramineous) indumentum on the calyces. While unusual to see these characters in combination, none of them are unique to the Western Australian material (e.g. *M.J. Laidlaw, N. Cuff & V.J. Nelder s.n.*, BRIAQ872969, also has small flowers with short calyx lobes; *P. Foreman* CP155 also has stramineous hairs on the calyces), and the caducous stipules, appressed indumentum, 3-ovulate ovary, and the size and shape of the pods and seeds place this collection in *T. sabulosa* above any other taxon.

The collection *V.T. Garbin* 20 (DNA) is very similar to *T. sabulosa* specimens in having caducous stipules and leaflets of the same shape, size and colour; however, it has a patent to spreading indumentum, reddening primary and secondary veins, a small calyx (2.7–3.2 mm long; at the lower end of the range for *T. sabulosa* with the lower lobe longer than the laterals), glabrous wing petals, sparser and shorter hairs on stamens, and 7 ovules (observation from one flower). This specimen remains of uncertain placement.

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A revision of *Lasiopetalum* (Malvaceae: Byttnerioideae) from the northern sandplains of Western Australia, including two new species

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Abstract

Shepherd, K.A. & Wilkins, C.F. A revision of *Lasiopetalum* (Malvaceae: Byttnerioideae) from the northern sandplains of Western Australia, including two new species. *Nuytsia* 32: 121–149 (2021). Taxonomic descriptions are provided for eight species of *Lasiopetalum* Sm. with a centre of diversity in the Geraldton Sandplains bioregion. Circumscriptions are updated for six species, namely *L. angustifolium* W.Fitzg., *L. drummondii* Benth., *L. lineare* Paust, *L. ogilvieanum* F.Muell., *L. oldfieldii* F.Muell., and *L. oppositifolium* F.Muell. Lectotypes are designated for *L. angustifolium*, *L. ogilvieanum*, *L. oldfieldii*, and *L. oppositifolium*, while the holotype for *L. drummondii* is clarified. In addition, two new species from the region are recognised and named here as *L. biloculatum* K.A.Sheph. & C.F.Wilkins and *L. erectifolium* K.A.Sheph. & C.F.Wilkins. Images and distribution maps are provided for all species.

Introduction

In Western Australia the genus *Lasiopetalum* Sm. (Malvaceae Juss.) is largely confined to the South-West Botanical Province with the distribution of the northern-most species *L. angustifolium* extending to Shark Bay in the Geraldton Sandplains bioregion (Department of the Environment 2013). The Geraldton Sandplains are notable for high levels of vascular plant endemism, particularly within the 'Lesueur' and 'Nanda' districts as recognised by Gioa and Hopper (2017). This paper revises a small group of *Lasiopetalum* centred around this region, which have not already been treated in our ongoing revision of this genus. These species have non-petaloid epicalyx bracts (e.g. Figure 1C), scale-like petals (e.g. Figure 1E), and non-rostrate anthers. Other species that may occur in the Geraldton Sandplains, or near the Swan Coastal Plain bioregion to the south or the Avon Wheatbelt and Yalgoo boundaries to the east, have been included with allied species in previous treatments along that focused on shared morphology, such as the presence of rostrate anthers (e.g. *L. glutinosum* subsp. *latifolium* (Benth.) K.A.Sheph. & C.F.Wilkins in Shepherd & Wilkins 2015), petaloid epicalyx bracts (e.g. *L. decoratum* K.A.Sheph. & C.F.Wilkins and *L. rupicola* K.A.Sheph. & C.F.Wilkins in Shepherd & Wilkins 2018) or an absence of scale-like petals (e.g. *L. rutilans* K.A.Sheph. & C.F.Wilkins in Shepherd & Wilkins 2017).

Updated descriptions are provided for *Lasiopetalum angustifolium* W.Fitzg., *L. drummondii* Benth., *L. lineare* Paust, *L. ogilvieanum* F.Muell., *L. oldfieldii* F.Muell., and *L. oppositifolium* F.Muell., the latter three being currently recognised as species of conservation concern (Smith & Jones 2018). All

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but *L. lineare* and *L. drummondii* are also lectotypified. The phrase-named taxon *Lasiopetalum* sp. Coorow (E. Ried 101) is supported as distinct and recognised here as *L. biloculatum* K.A.Sheph. & C.F.Wilkins *sp. nov.*, while *L.* sp. Watheroo (K. Shepherd & C. Wilkins KS 220) is similarly recognised and named as *L. erectifolium* K.A.Sheph. & C.F.Wilkins *sp. nov.*

Methods

This study was based on the examination of field collections and herbarium specimens held at AD, BM, CANB, CGE, K, LD, MEL, NSW, PERTH, P and W (viewed on loan or while visiting institutions). Supplementary material including types were also viewed via JSTOR *Global Plants* (https:// plants.jstor.org/) or the Museum National d'Histoire Naturelle (P) online database (https://science.mnhn.fr/institution/mnhn/search).

The description of the indumentum and density of hairs follows Shepherd and Wilkins (2017). Leaf descriptions and measurements are based on mature leaves unless otherwise stated. Flower measurements were drawn from spirit material or from specimen fragments rehydrated in hot water and detergent.

Maps for species that are not currently conservation listed were created using QGIS version 2.18.16 based on all specimens lodged at PERTH and include Interim Biogeographic Regionalisation for Australia (IBRA) version 7 bioregions (Department of the Environment 2013).

Taxonomy

Key to northern sandplains species of *Lasiopetalum* with non-petaloid epicalyx bracts, scale-like petals, and non-rostrate anthers

*occurs more than once in the key

1. Style with stalked reflexed fan-like hairs scattered in the upper half or forming a dense cone along most of the length

2. Leaves appearing opposite near the first four nodes from the apex, then alternate; style < 3 mm long and consistently *c.* 0.15 mm wide.

3. Calyx lobes narrow (< 2 mm wide); flowers 2.3–3.5 mm long; ovary with antrorse fan-shaped silky hairs to 1.1 mm long; epicalyx bracts narrowly ovate ..... **L. oppositifolium***

3: Calyx lobes broad (> 3 mm wide); flowers (4–)5.4–6 mm long; ovary with multi-angulate stellate hairs 0.3–0.6 mm long; epicalyx bracts narrowly obovate..... **L. angustifolium**

2: Leaves alternate throughout; style > 3 mm long and thickening to *c.* 0.5 mm wide at the middle of its length.

4. Mature leaves linear, 1.3–2 (–3) mm wide, with revolute to strongly recurved margins; peduncles *c.* 0.5 mm wide at base ..... **L. lineare**

4: Mature leaves narrowly elliptic, narrowly ovate to ovate or oblong, (2–)3–18 mm wide, with scarcely to strongly recurved margins; peduncles *c.* 1 mm wide at base

5. Mature apical leaves spreading and usually ovate to narrowly ovate or oblong; adaxial surface with stellate hairs with *c.* 6 arms, each to 0.15 mm long, early glabrescent; outer calyx lobes with an indumentum of short-stalked (to 0.3 mm long) stellate hairs with arms to 0.2 mm long..... **L. drummondii**

5: Mature apical leaves erect and usually narrowly ovate to narrowly elliptic; adaxial surface with stellate hairs with 12–16 arms, each to 0.3 mm long, late glabrescent; outer calyx lobes with a woolly indumentum of long-stalked (to 1 mm long) stellate hairs with arms to 0.8 mm long ..... **L. erectifolium**

1: Style glabrous or with sessile stellate hairs at the base only

6. Apical leaves appearing opposite near the first four nodes from the apex then alternate; flowers with narrow calyx lobes (0.7–1.3 mm wide); inflorescence a compact, capitulum-like dichasium ..... **L. oppositifolium***

6: Apical leaves alternate throughout; flowers with broad calyx lobes (2.3–4.3 mm wide); inflorescence a loosely-branched dichasium

7. Reduced petals glabrous or with occasional stellate hairs; leaves narrowly elliptic or narrowly ovate; calyx 7–8.1 mm long ..... **L. ogilvieanum**

7: Reduced petals densely hairy; leaves usually ovate or narrowly ovate; calyx 4.5–6 mm long

8. Ovary with 3 locules; inflorescence 21–53 mm long with 6–18 flowers; epicalyx bracts 3.1–6.6 mm long; outer calyx stellate hairs with stalks up to 0.3 mm long, and usually with 9–12 arms, each 0.5–0.8 mm long..... **L. oldfieldii**

8: Ovary with 2 locules; inflorescence 43–71 mm long with 9–29(–34) flowers; epicalyx bracts (3)4–9 mm long; outer calyx stellate hairs with stalks up to 0.8 mm long, and usually with 12–20 arms, each up to 1.3 mm long ..... **L. biloculatum**

Lasiopetalum angustifolium W.Fitzg., *W. Austral. Naturalist* 2(1): 3–4 (1904). *Type citation*: 'Geraldton, Sept. 1903. – W.V.F.' *Type specimen*: Geraldton, [Western Australia], September 1903, *W.V. Fitzgerald s.n.* (*lecto*, here designated: PERTH 01625497!; *isolecto*: NSW 366860!, NSW 366864!).

Dense, spreading *shrub* 0.15–1.5 m high, 0.4–1.5 m wide. *Young stems* with a close tomentum of ferruginous-centred white, sessile or stalked (to 0.15 mm long), appressed-stellate hairs with *c.* 12 arms, each to 0.2 mm long, over dense, smaller, white stellate hairs, glandular hairs absent; glabrescent. *Petioles* 2–8 mm long. *Leaves* with apical nodes opposite then shortly alternate, spreading, narrowly ovate, narrowly elliptic to linear (if revolute), 22–100 mm long, 2–10 mm wide, base scarcely cordate, apex obtuse or sub-acute; margins entire, flat, strongly recurved or revolute; abaxial surface with a close tomentum of ferruginous-centred white or white and occasionally ferruginous, sessile or stalked (to 0.2 mm long), multi-angulate and appressed-stellate hairs, with 12–18 arms, each to 0.25 mm long, over dense, smaller, white stellate hairs; adaxial surface dull, not mucilaginous, with dense, ferruginous-centred white, sessile, appressed-stellate hairs with *c.* 12 arms, each to 0.25 mm long; early glabrescent. *Inflorescence* a compact, simple or compound dichasium, 22–37 mm long, with 5–18 flowers. *Peduncles* 11–28 mm long with a tomentose indumentum of scattered, ferruginous or ferruginous-centred white, sessile or stalked (to 0.15 mm long), multi-angulate or appressed-stellate hairs with 12–14 arms, each to 0.2 mm long, over dense smaller, white, stellate hairs. *Pedicels* 1.8–3.2 mm long, indumentum as for peduncles but with fewer ferruginous stellate hairs. *Bract* narrowly ovate, 0.9–2.5 mm long, 0.3–0.5 mm wide. *Epicalyx bracts* 3, directly below the calyx, narrowly obovate, 4.7–9.8 mm long, 0.8–1.5 mm wide. *Calyx* outer surface pale brown, internally pink with a green base, (*c.* 4–)5.4–6 mm long, with a tube 0.7–1.2 mm long; lobes ovate, 4.4–5.3 mm long, 3.4–3.5 mm wide; outer surface of multi-layered hairs, with a moderately dense to dense indumentum of ferruginous-centred white, sessile or stalked (to 0.2 mm long), multi-angulate, stellate hairs with *c.* 12 arms, each to 0.4 mm long (longest at base and ferruginous at apex), over smaller white stellate

hairs, glandular hairs absent; inner surface base glabrous, remainder with scattered, white, mostly simple hairs to 0.15 mm long. *Petals* dark red, obovate, flat, 1.2–1.9 mm long, 1.2–1.5 mm wide, glabrous or outer surface with occasional to moderately dense stellate hairs. *Staminal filaments* 1.1–1.7 mm long, 0.1–0.3 mm wide. *Anthers* dark red, ovate, 1.8–2.5 mm long, 0.7–1.1 mm wide, glabrous. *Ovary* 3- or 4-locular (with 2 ovules per locule), 1.2–1.5 mm long, 1.4–1.5 mm wide; outer surface with a tomentum of white, multi-angulate stellate hairs, each arm to 0.3–0.6 mm long. *Style* 1.5–2.7 mm long, consistently *c*. 0.15 mm wide, basal third with sessile, appressed-stellate hairs, apical 2/3 with dense, white, stalked, reflexed fan-like stellate hairs. *Fruit* ovoid, 2.5–3 mm long, 3–3.3 mm wide, outer surface with scattered, white, multi-angulate stellate hairs. *Seed* ellipsoid, dark brown, *c.* 2 mm long, 1.4 mm wide, glabrous or with scattered stellate hairs; aril a cap with 3 long and 2 short lobes, *c*. 0.7 mm long, *c*. 0.7 mm wide. (Figure 1)

Diagnostic features. *Lasiopetalum angustifolium* can be distinguished from other members of the genus by the combination of narrowly ovate to linear leaves 2–10 mm wide, which appear opposite rather than alternate at the apical nodes, and flowers (4–)5.4–6 mm long, subtended by three narrowly obovate epicalyx bracts 4.7–9.8 mm long, a style with reflexed, fan-like hairs in the upper two thirds and dense stellate hairs at the base, and multi-angulate stellate hairs covering the ovary.

Selected specimens. WESTERN AUSTRALIA: Goat Gulch, Kalbarri coastal gorges, 26 Aug. 1995, *D. & B. Bellairs* 2067 (PERTH); E of Grey Rd, SW of Ajana Rd on southern boundary of Kalbarri NP, 23 Oct. 2004, *G. Cassis, M. Wall, C. Symonds & C. Weirauch* 5-47 (PERTH); Quoin Bluff, Dorre Is, Shark Bay, 30 Aug. 1998, *S.J. Claymore & A.S. Weston* 262 (PERTH); S along Management Access track to Eagle Rock, Kalbarri, 29 Aug. 2001, *R. Davis* 9978 (PERTH); Yerina Springs NR, 3 Nov. 2005, *A. Franks, S. Branigan & B. Smith* BS 134 (PERTH); S of Bottom Ten Mile Well, Dirk Hartog Is, 3 Sep. 1972, *A.S. George* 114546 (CANB, K, MEL, PERTH); W end of State Barrier fence near Zuytdorp Cliffs, 30 July 1996, *G.J. Keighery & N. Gibson* 2039 (BRI, PERTH); Mt Fairfax, Moresby Range, 25 Aug. 1983, *C.M. Lynch* 124 (PERTH); northern end of Mt Tarcoola plateau, Geraldton, 17 Oct. 1997, *M.H. O'Connor* MOC 0068 (PERTH); T junction 0.3 km along Cliff Head Rd from Indian Ocean Drive, S of Dongara, 18 Aug. 2020, *K.A. Shepherd & C.F. Wilkins* KS 1718 (PERTH); East Walabi [Wallabi] Island, 8 Sep. 1959, *G.M. Storr s.n.* (PERTH 02759381); N of Ranger Cottage, Garden Island, 12 Aug. 1994, *C. Wilkins, K. Shepherd & W. MacArthur* CW 684 (CANB, MEL, NSW, PERTH); SE of Tamala Homestead, Shark Bay, 29 Sep. 1989, *M.E. Trudgen* 7289 (PERTH); N of Knobby Head North, 1 Aug. 2003, *C.F. Wilkins, M. Trudgen, & B. Moyle* CW 1693 (PERTH).

Phenology. Recorded as flowering from July to October and fruiting from October.

Distribution and habitat. *Lasiopetalum angustifolium* is generally found near the Western Australian coast, extending from Shark Bay to south of Perth, with some populations occurring near Eneabba in the Geraldton Sandplains and Yalgoo bioregions. It is also found on several offshore islands such as Dorre, Dirk Hartog, and East Wallabi of the Abrolhos (Figure 2). One population has also been recorded from the Swan Coastal Plain on Garden Island. This species can be found in yellow-grey, grey-brown or brown (rarely black) sand over limestone or sandstone, in tall open shrubland, scrub or coastal heath with *Acacia rostellifera* and *Melaleuca cardiophylla*.

Conservation status. This species is not considered to be under conservation threat as it has a relatively widespread distribution.

Figure 1. *Lasiopetalum angustifolium*. A – coastal habitat showing large greyish green shrubs of this species in the foreground; B – flowering branchlet with narrow leaves that become dark green and glabrescent with age; C – compact dichasial inflorescence showing three greyish, narrow epicalyx bracts subtending each flower; D – leaves opposite at the apical node; E – pink flowers with a green base and small, deep burgundy, glabrous petals (yellow arrow) below each anther. Voucher: *K.A. Shepherd & C.F. Wilkins* KS 1718. Images: K.A. Shepherd.

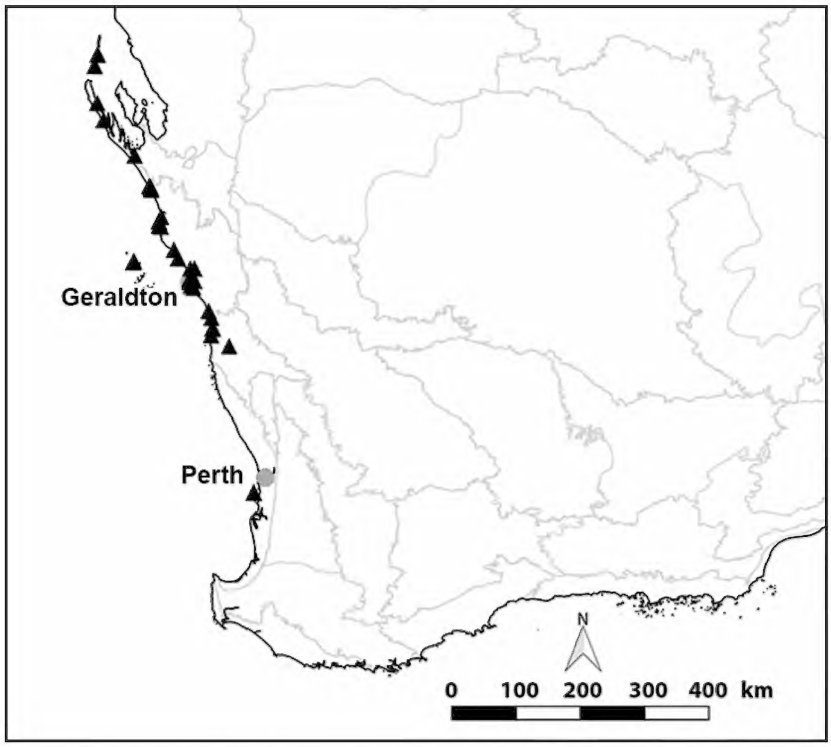

Figure 2. Distribution of *Lasiopetalum angustifolium* with IBRA subregions (Department of the Environment 2013) in pale grey.

Affinities. *Lasiopetalum angustifolium* is morphologically most similar to *L. oppositifolium* in having narrow to linear leaves (appearing opposite at apical nodes) only 2–10 mm wide, and appressed, disc-like stellate hairs on stems. However, it differs from *L. oppositifolium* in having larger flowers with a calyx (4–)5.4–6 mm long (vs 2.3–3.5 mm long) and *c*. 3.5 mm wide (vs 0.7–1.3 mm wide) with narrowly obovate epicalyx bracts (vs narrowly ovate epicalyx bracts), cream-coloured multi-angulate stellate hairs with arms 0.3–0.6 mm long covering the ovary (vs white, silky upwardly appressed fan hairs to 1.1 mm long), and the style with dense, white, stalked and reflexed hairs for apical 2/3 and sessile, appressed-stellate hairs in the basal third (vs the style being glabrous or with occasional to dense, reflexed, fan-like hairs in the apical 2/3 and glabrous at the base). Finally, the epicalyx bracts and pedicels in *L. oppositifolium* mainly have conspicuous long red clavate glandular hairs (intermixed with the stellate hairs) that are absent in *L. angustifolium*.

Typification. The PERTH 01625497 sheet is a match for Fitzgerald's (1904) description of this Western Australian species and so is designated as the lectotype, and the two sheets at the National Herbarium of New South Wales (NSW 366860, NSW 366864) are recognised as isolectotypes. The flowers on material housed at PERTH and elsewhere, are slightly larger than that observed on the type, being 5.4–6 mm long rather than *c.* 4 mm long; however, in all other respects specimens are consistent with the type.

Lasiopetalum biloculatum K.A.Sheph. & C.F.Wilkins, *sp. nov.*

Type: 4.1 km E of Coalara Road on Watheroo Road, NW of Moora, Western Australia, 22 August 2016, *K.A. Shepherd & C.F. Wilkins* KS 1599 (*holo*: PERTH 09101802; *iso*: AD, BRI, CANB, K, MEL, NSW).

Lasiopetalum sp. Coorow (E. Ried 101), Western Australian Herbarium, in *FloraBase*, https://florabase.dpaw.wa.gov.au/ [accessed 3 June 2021].

Lasiopetalum oldfieldii subsp. *biloculatum* E.M.Benn. & K.Shepherd ms, in Paczk. & A.R.Chapm., *West. Austral. Fl.: Descr. Cat.* p. 544 (2000), *nom. inval.*

Low spreading *shrub* 0.2–1.5 m high, 0.5–1.5(–3) m wide. *Young stems* with a ferruginous, tomentose indumentum of ferruginous or ferruginous-centred white, sessile or stalked (to 0.5 mm long), multi-angulate stellate hairs with 10–16 arms, each to 0.7 mm long, over smaller, white stellate hairs, glandular hairs absent; glabrescent. *Petioles* 6–24 mm long. *Leaves* alternate, apical leaves spreading, ovate, 11–52 mm long, 6–33 mm wide, base cordate, apex obtuse or sub-acute; margins entire, moderately recurved; abaxial surface with dense ferruginous stellate hairs on the midrib, becoming scattered on blade, these sessile or shortly stalked (to 0.6 mm long), with 6–16 arms, each to 0.4 mm long, over moderately dense, smaller, white stellate hairs; adaxial surface glossy, mucilaginous, with scattered sessile or shortly stalked (to 0.2 mm long), stellate hairs with *c*. 6 arms, each to 0.5 mm long, with or without scattered glandular hairs to 0.1 mm long; early glabrescent. *Inflorescence* a loose, simple or compound dichasium, 43–71 mm long, with 9–29(–34) flowers. *Peduncles* 11–44 mm long with dense, ferruginous, sessile and stalked (to 0.3 mm long), multi-angulate stellate hairs with *c*. 16 arms, each to 0.9 mm long, over dense smaller, white, stellate hairs. *Pedicels* 1.7–3.8 mm long, indumentum as for peduncles. *Bract* narrowly ovate to filiform, 2.1–4 mm long, 0.15–0.7 mm wide. *Epicalyx bracts* 3, attached directly below the calyx, narrowly ovate to filiform, (3–)4.5–9 mm long, 0.15–0.4 mm wide. *Calyx* white externally sometimes with brown tips in bud, internally bright pink, pale pink or white with a green or darker pink base, 4.8–6 mm long, with a tube 0.8–1 mm long; lobes ovate, 4.3–5 mm long, 2.3–2.6 mm wide; outer surface with a multi-layered woolly indumentum of white, stalked (to 0.8 mm long), multi-angulate, stellate hairs with 12–20 arms, each to 1.3 mm long, over smaller, white stellate hairs, glandular hairs absent; inner surface base glabrous, remainder with dense to moderately dense, white, stellate hairs with 1–6 arms, each to 0.15 mm long, mainly towards the apex and margins, sometimes with scattered larger hairs centrally. *Petals* dark red, obovate, cupped, 0.5–1.3 mm long, 0.4–1.5 mm wide, outer surface densely stellate hairy. *Staminal filaments* 0.8–1.6 mm long, 0.2–0.5 mm wide. *Anthers* dark red, ovate, 1.5–2.5 mm long, 0.7–1 mm wide, glabrous. *Ovary* 2-locular (with 2 ovules per locule), 0.8–1.2 mm long, 0.8–1 mm wide; outer surface with a tomentum of white, multi-angulate, stellate hairs, each arm 0.6–1 mm long. *Style* 1.5–2.4 mm long, consistently *c*. 0.15 mm wide, glabrous. *Fruit* ellipsoid, 3.5–4.5 mm long, 3–4.5 mm wide, outer surface with moderately dense stellate hairs. *Seed* ellipsoid, brown, 2.5–3.3 mm long, 1–1.4 mm wide, stellate hairy; aril a cream cap with two long lobes, 2–2.7 mm long, 1–1.3 mm wide. (Figure 3)

Diagnostic features. *Lasiopetalum biloculatum* can be distinguished from all other members of the genus by its two-locular ovary in combination with its densely hairy petals, a glabrous style, three narrowly ovate to filiform epicalyx bracts, ovate leaves with new growth having a glossy and mucilaginous upper surface, and a loose, dichasial inflorescence with 9–29(–34) flowers.

Selected specimens. WESTERN AUSTRALIA: N of Eneabba, 17 Oct. 2000, *J.A. Cochrane* JAC 3705 (PERTH); N along Brand Mudge Rd (39) from the intersection of Carnamah–Eneabba Rd, SW of Carnamah, 4 Oct. 1990, *R.J. Cranfield & P.J. Spencer* 7964 (CANB, PERTH); Crown Land S of

Figure 3. *Lasiopetalum biloculatum*. A – habit; B – shrub with ovate and dark green glossy leaves (on the adaxial surface) with white, woolly inflorescences; C – flowering branchlet showing the tomentose indumentum of mainly white stellate hairs on the abaxial surface of the leaf; D – a loosely-branched, compound dichasial inflorescence showing linear epicalyx bracts exceeding the length of each flower (yellow arrow); E – inflorescence highlighting the contrast in flower colour showing a deep pink flower form; F – variant with pale pink flowers with a green base and small, hairy, petals (yellow arrow) at the base of each anther and a glabrous style. Voucher: *K.A. Shepherd & C.F. Wilkins* KS 1599 (A, B, D, F) and *C. Wilkins & J.A. Wege* CW 2374 (C, E). Images: K.A. Shepherd (A, B, D, F) and J.A. Wege (C, E).

Arrowsmith River on Brand Hwy, 11 Oct. 1989, *E.A. Griffin* 5543 (PERTH); Quadrat WMA53, Watheroo NP, A 24491, Shire of Dandaragan, 24 Sep. 1999, *M.A. Langley & P.M. Smith* MAL 2114 (PERTH); N of Eneabba–Carnamah Rd on Brand Mudge Rd, WSW of Winchester, 22 Oct. 2000, *B.J. Lepschi, L.A. Craven & A. Tinker* 4317 (CANB, PERTH); S of Winchester West Rd on the Carnamah–Eneabba

Rd, 18 Aug. 1995, *K. Shepherd, C. Wilkins & E. Bennett* KS 194 (PERTH); E of Coalara Rd on Watheroo West Rd, 11 Oct. 1998, *C.F. Wilkins, J. Chappill & R. Butcher* CW 1417 (PERTH); N of Coalara Rd on Watheroo Rd, 23 Sep. 2002, *C.F. Wilkins & J.A. Wege* CW 1573 (PERTH); on Station Valentine Rd, NE of Durawah, 31 July 2003, *C. Wilkins, M. Trudgen & B. Moyle* CW 1678 (PERTH); N of Eneabba–Carnamah Rd on Lucas Rd, 17 Sep. 2003, *C. Wilkins & J. Wege* CW 1762 (PERTH).

Phenology. Recorded as flowering from mid-winter in July through to late spring in November. Fruits observed on specimens collected in October.

Distribution and habitat. *Lasiopetalum biloculatum* is largely confined to the Geraldton Sandplains bioregion from north-east of Eneabba to the Watheroo National Park near Badgingarra; however, there is a single November 1985 collection from '[b]etween Wickepin and Jitarning' (*D.B. Foreman* 1106) that is also a match for this species (Figure 4). There have been no other collections of *L. biloculatum* from this area, so it is uncertain if the given locality is a label error, specimen mix up, or there is a disjunct population to the south, which seems unlikely given no further collections have been made of this distinct species in this vicinity. It should be noted that the next six herbarium specimens by the same collector (*D.B. Foreman* 1107–1112) give the same locality statement, while the preceding collection is from the same region near the Dryandra State Forest (*D.B. Foreman* 1105). In the Geraldton Sandplains, *L. biloculatum* is generally found in low open mallee, wandoo or *Banksia* woodland or in scrub over heath with *Allocasuarina*, *Acacia*, *Xylomelum* or *Hakea* in white, grey, yellow or orange-brown sand or sandy clay, with or without lateritic gravel.

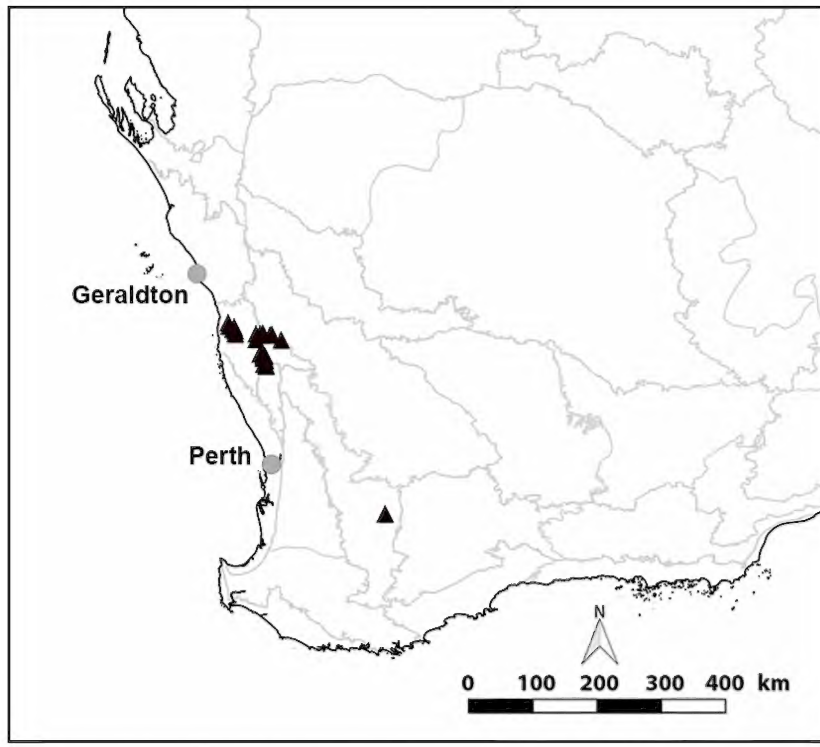

Figure 4. Distribution of *Lasiopetalum biloculatum* with IBRA subregions (Department of the Environment 2013) in pale grey.

Conservation status. This species is relatively widespread and not currently considered to be under any conservation threat.

Etymology. From the Latin *bi* (two) *-loculatus* (having locules), in reference to the ovary which is unique in the genus for having two rather than the more typical three locules.

Affinities. *Lasiopetalum biloculatum* is morphologically most similar to *L. oldfieldii*, which also has ovate leaves (where the new growth appears glossy and mucilaginous on the adaxial surface), a glabrous style, and densely hairy petals. It is distinguished from that species by its 2- rather than 3-locular ovary and having generally longer inflorescences (43–71 mm vs 21–53 mm long) with longer peduncles (11–44 mm vs 13–26(–38) mm) and usually more flowers (9–29(–34) vs 6–18), with longer stalked stellate hairs on the outer calyx (1.3 mm long vs 0.5–0.8 mm long).

Lasiopetalum biloculatum also somewhat resembles *L. ogilvieanum* in having a glabrous style, three linear epicalyx bracts, and a loose inflorescence with pink flowers but differs in having densely hairy rather than glabrous petals (rarely with a few stellate hairs), smaller flowers 4.8–6 mm long (vs > 7–8.1 mm long), and ovate rather than narrowly ovate or narrowly elliptic leaves.

Lasiopetalum drummondii Benth., *Fl. Austral.* 1: 264 (1863). *Type citation*: 'W. Australia, *Drummond*, a single specimen.' *Type specimen*: Swan River, [Western Australia], 1851, *J. Drummond s.n.* (*holo*: K 000686572!).

Erect multi-stemmed or slender *shrub* 0.1–1 m high, 0.1–1 m wide. *Young stems* with a close tomentum of ferruginous or ferruginous-centred beige, sessile or stalked (to 0.3 mm long), multi-angulate, stellate hairs with *c*. 12 arms, each to 0.3 mm long, over smaller, dense tan stellate hairs, sometimes also with moderately dense golden, clavate glandular hairs to 0.2 mm long, glabrescent. *Petioles* 4–21 mm long. *Leaves* alternate, apical leaves spreading, narrowly ovate to ovate, or oblong, 15–37 mm long, 6–18 mm wide, base slightly to strongly cordate, apex obtuse to sub-acute; margins entire, moderately to strongly recurved; abaxial surface with a close tomentum of dense ferruginous hairs on midrib scattered on blade, with dense ferruginous-centred white, sessile or shortly stalked (to 0.2 mm long), multi-angulate, stellate hairs with 12–24 arms, each to 0.2 mm long, over dense, smaller, white stellate hairs; adaxial surface dull, not mucilaginous, with moderately dense, brown-centred white, stellate hairs with *c*. 6 arms, each to 0.15 mm long, early glabrescent. *Inflorescence* a compact, simple or compound dichasium, 19–47 mm long with 13–31 flowers. *Peduncles* 9–21 mm long with tomentose indumentum of white or ferruginous, sessile and stalked (to 0.3 mm long), multi-angulate, stellate hairs with 12–24 arms, each to 0.3 mm long, over dense, smaller, white stellate hairs. *Pedicels* 0.7–2.5 mm long, indumentum as for peduncles. *Bract* narrowly ovate, 2.5–6.5 mm long, 0.3–1 mm wide. *Epicalyx bracts* 1–3, attached directly below the calyx, narrowly ovate to filiform, (3–)5–8.5 mm long, 0.3–0.7 mm wide. *Calyx* outer surface white, inner surface pink with a green base 6.6–10.4 mm long, with a tube 0.3–1 mm long; lobes narrowly ovate, 6.3–10.3 mm long, 1–2 mm wide; outer surface with a multi-layered woolly indumentum of white, stalked (to 0.3 mm long), multi-angulate, stellate hairs with 10–24 arms, each to 0.2 mm long, over dense smaller, white stellate hairs, glandular hairs absent; inner surface base glabrous, remainder with scattered to moderately dense white stellate hairs with 1–6 arms, each to 0.2 mm long. *Petals* red, obovate, flat, 0.7–1.7 mm long, 0.4–1.3 mm wide, glabrous. *Staminal filaments* 0.5–1.5 mm long, 0.15–0.3 mm wide. *Anthers* dark red throughout or apex white, oblong, 1.8–2.7 mm long, 0.6–1 mm wide, glabrous. *Ovary* 3-locular (with 2 ovules per locule), 0.7–1.4 mm long, 0.7–1.4 mm wide; outer surface with a tomentum of white, multi-angulate, stellate hairs, with each arm to 0.4 mm long. *Style* 3.6–4.5 mm long, centrally thickened to 0.5 mm wide, with dense reflexed, stalked fan-like hairs along most of length. *Fruit* ellipsoid, 3.7–4.3 mm

long, 3–3.8 mm wide, outer surface with dense, white, stellate hairs. *Seed* ellipsoid, brown, *c*. 3.3 mm long *c*. 1.4 mm wide, densely stellate hairy; aril a cream cap with two long lobes *c*. 2.7 mm long, *c*. 1 mm wide. (Figure 5)

Diagnostic features. *Lasiopetalum drummondii* can be distinguished from all other members of the genus that have 1–3 very narrow to filiform epicalyx bracts and stalked reflexed fan-like hairs along the style by the following combination of characters: leaves mainly ovate or narrowly ovate; inflorescence a compact head; flowers with narrow calyx lobes < 2 mm wide; petals glabrous and ovary with three locules.

Selected specimens. WESTERN AUSTRALIA: ENE of Jurien, along Jurien Rd from Brand Hwy, 8 Sep. 2004, *R.K. Brummitt, A.S. George & E.G.H. Oliver* 21175 (PERTH); near Arrowsmith River towards Three Springs on Dongara–Three Springs Rd, 22 Sep. 1968, *E.M. Canning* 037283 (CANB, PERTH); near Diamond of the Desert Spring, 16 Oct. 1946, *C.A. Gardner* 8472 (CANB, PERTH); N of Lake Indoon, W of Eneabba, 26 Feb. 1981, *E.A. Griffin & M.I. Blackwell* EAG 2983 (CANB, PERTH); Hi Vallee property (D. & J. Williams) Warradarge, W slopes towards southern end of main valley, 15 Sep. 1999, *M. Hislop* 1576 (PERTH); S side of Jurien Rd East, W of junction with Brand Hwy, 9 Sep. 1999, *J.W. Horn* 2324 (DUKE, P, PERTH); S of Cataby on W side of the road opposite a

Figure 5. *Lasiopetalum drummondii*. A – habit; B – ovate to narrowly ovate, spreading leaves that are early glabrescent; C – compact dichasial inflorescence with narrowly ovate to filiform epicalyx bracts subtending each flower; D – pale pink flowers with a greenish pink base and dark red, glabrous, scale-like petals (yellow arrow) and a cone of white, reflexed, fan-like stellate hairs on the style. Voucher: *K.A. Shepherd & C.F. Wilkins* KS 1605. Images: K.A. Shepherd.

gravel track, 16 Aug. 1995, *K. Shepherd, C. Wilkins & E. Bennett* KS 157 (MEL, PERTH); Mt Lesueur NP, along Blackbutt buffer road from the Coorow–Green Head Rd, 23 Aug. 2016, *K.A. Shepherd & C.F. Wilkins* KS 1605 (PERTH); Three Springs Rd, NE of Cockleshell Gully Farm turnoff, NNE of Jurien Bay, 1 Sep.1966, *R.V. Smith* 66/194 (AD, CANB, HO, MEL, PERTH); Mt Lesueur NP, 14 Sep. 2011, *K.R. Thiele* 4247 (PERTH); S of Allanooka Springs Rd on Tabletop Rd, 1 Aug. 2003 , *C. Wilkins, M. Trudgen & B. Moyle* CW1683 (PERTH); NW of Badgingarra which is 175 km N of Perth, 1 Nov. 1965, *P.G. Wilson* 3892 (K, PERTH).

Phenology. Recorded as flowering from May to November. Fruiting from October.

Distribution and habitat. *Lasiopetalum drummondii* extends southwards from near Dongara and Mount Lesueur National Park to south of Cataby in the Geraldton Sandplains and northern part of the Avon Wheatbelt bioregions (Figure 6). This species grows in white or yellow sand, or brown sand with laterite, rarely over limestone, in low open eucalypt woodlands, low shrublands or open heath with *Hakea*, *Banksia*, *Allocasuarina* and *Acacia*.

Conservation status. This species is currently not considered to be under conservation threat.

Affinities. *Lasiopetalum drummondii* is morphologically most similar to *L. erectifolium* and *L. lineare* in having a compact inflorescence, flowers with 1–3 filiform epicalyx bracts, a style with reflexed fan-like hairs, and narrow calyx lobes < 2 mm wide. This species is distinct from *L. lineare* in having

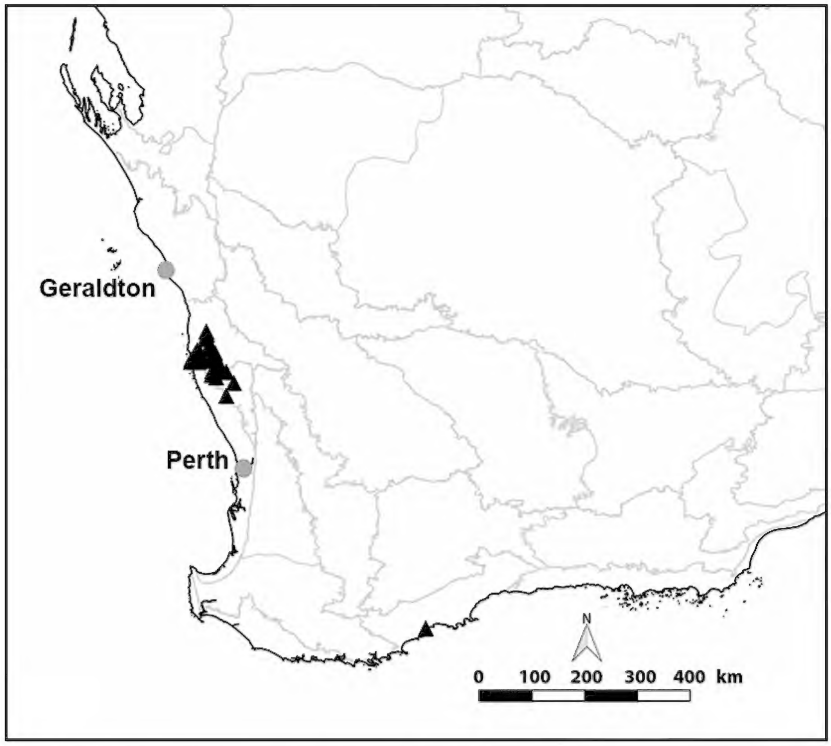

Figure 6. Distribution of *Lasiopetalum drummondii* with IBRA subregions (Department of the Environment 2013) in pale grey.

narrowly ovate to ovate leaves (6–18 mm wide) rather than linear leaves (1.5–2(–3) mm wide) and broader peduncles to 1 mm at the base (vs 0.5 mm at the base).

In contrast to *L. erectifolium*, *L. drummondii* has apical leaves that are ovate and spreading (vs narrowly ovate to narrowly elliptic and erect) initially with shorter pale brown to ferruginous stellate hairs to 0.15 mm long on the adaxial surface that are soon lost (vs late glabrescent ferruginous -coloured hairs to 0.3 mm long). The outer surface of the calyx has shorter stellate hairs with stalks *c*. 0.3 mm long and arms *c*. 0.5 mm long, whereas *L. erectifolium* has stellate hairs with stalks to 1 mm long and arms to 0.8 mm long, and as a result, appears more woolly than the calyx of *L. drummondii* (Figure 7D). *Lasiopetalum drummondii* also generally has more flowers than *L. erectifolium* (13–31 vs 7–18).

Typification. To date only one sheet at Kew (K 000686572) stamped 'Herbarium Hookerianum 1867' with a label in Bentham's hand 'Swan River Drummond 1857' has been located. As Bentham (1863) noted that his description of *L. drummondii* was based on a single collection by James Drummond this specimen is designated as the holotype.

Lasiopetalum erectifolium K.A.Sheph. & C.F.Wilkins, *sp. nov.*

Type: Boothendarra Nature Reserve, W along track from Wilcocks Road, NE of Badgingarra, Western Australia, 22 August 2016, *K.A. Shepherd & C.F. Wilkins* KS 1600 (*holo*: PERTH 09101810; *iso*: AD, CANB, K, MEL, NSW).

Lasiopetalum sp. Watheroo (K. Shepherd & C. Wilkins KS 220), Western Australian Herbarium, in *FloraBase*, https://florabase.dpaw.wa.gov.au/ [accessed 3 June 2021].

Lasiopetalum erectifolium E.M.Benn. & K.Shepherd ms in Paczk. & A.R.Chapm., *West. Austral. Fl.: Descr. Cat.* p. 543 (2000), *nom. inval.*

Erect spreading or slender *shrub* 0.1–1 m high, 0.1–1 m wide. *Young stems* with a close tomentum of dense orange-brown, sessile or stalked (to 0.8 mm long), multi-angulate, stellate hairs with 12–24 arms, each to 0.7 mm long, over smaller, stellate orange-brown hairs, and rarely with moderately dense golden, clavate glandular hairs to 0.25 mm long; glabrescent. *Petioles* 2–7 mm long. *Leaves* alternate, apical leaves are erect, then spreading below, narrowly ovate, narrowly elliptic to narrowly oblong, (14–)22–53 mm long, 2–10 mm wide, base petiolate to slightly cordate, apex obtuse to sub-acute; margins entire, moderately to strongly recurved; abaxial surface with a multi-layered tomentum of dense orange-brown hairs on the midrib becoming scattered on the blade, or with dense orange-brown-centred white, sessile or shortly stalked (to 0.4 mm long), multi-angulate, stellate hairs throughout, with 12–24 arms, each to 0.6 mm long, over dense, smaller, white stellate hairs; adaxial surface, dull not mucilaginous, with moderately dense, orange-brown-centred white, stellate hairs with 12–16 arms, each to 0.3 mm long, late glabrescent. *Inflorescence* a compact, compound dichasium, 12–35 mm long with 7–18 flowers. *Peduncles* 6–25 mm long with tomentose white, orange-brown or ferruginous, sessile and stalked (to 0.5 mm long), multi-angulate, stellate hairs with 12–24 arms, each to 0.9 mm long, over smaller, white stellate hairs, sometimes with occasional, white, clavate, glandular hairs to 0.1 mm long. *Pedicels* 1.1–5 mm long, indumentum as for peduncles. *Bract* narrowly ovate, 4.3–6.3 mm long, 0.4–1 mm wide. *Epicalyx bracts* 1–3 below the calyx, narrowly ovate to filiform, 3.8–7.5 mm long, 0.15–0.6(–1.6) mm wide. *Calyx* outer surface white, inner surface bright to pale pink with a base green, 4.8–9 mm long, tube 0.3–1.3 mm long; lobes narrowly ovate, 5–8.8 mm long, 0.3–1.3 mm wide; outer surface with a woolly indumentum of white, stalked (to 1 mm long), multi-angulate, stellate hairs with 10–24 arms, each to 0.8 mm long, over smaller, white stellate hairs, glandular hairs

absent; inner surface base glabrous, remainder with scattered to moderately dense white stellate hairs with 1–6 arms, each to 0.2 mm long. *Petals* red, obovate, flat, 0.7–1.4 mm long, 0.4–1.3 mm wide, glabrous. *Staminal filaments* 0.8–1.8 mm long, 0.15–0.3 mm wide. *Anthers* dark red throughout or apex white, oblong, 1.7–2.1 mm long, 0.6–0.8 mm wide, glabrous. *Ovary* 3-locular (with 2 ovules per locule), 0.7–1.4 mm long, 0.7–1.4 mm wide; outer surface with a tomentum of white, multi-angulate, stellate hairs, with each arm to 0.7 mm long. *Style* 2.8–5 mm long, centrally thickened to 0.5 mm wide, with reflexed, stalked fan-like hairs along most of length. *Fruit* ellipsoid, 3.7–4.3 mm long, 3–3.8 mm wide, outer surface with dense, white, stellate hairs. *Seed* ellipsoid, brown, *c*. 3.3 mm long, *c*. 1.4 mm wide, densely stellate hairy; aril a cream-coloured cap with two long lobes *c*. 2.7 mm long, *c*. 1 mm wide. (Figure 7, 8)

Diagnostic features. *Lasiopetalum erectifolium* can be distinguished from other members of the genus that have reflexed fan-like hairs along the centrally thickened style, 1–3 filiform epicalyx bracts, and narrow calyx lobes < 2 mm wide, by the following combination of characters: narrowly ovate to narrowly elliptic, late glabrescent, apical leaves that are erect and covered in a woolly tomentum of orange-brown stellate hairs, with each inflorescence being a compact, compound dichasium of 7–18 flowers, 12–35 mm long.

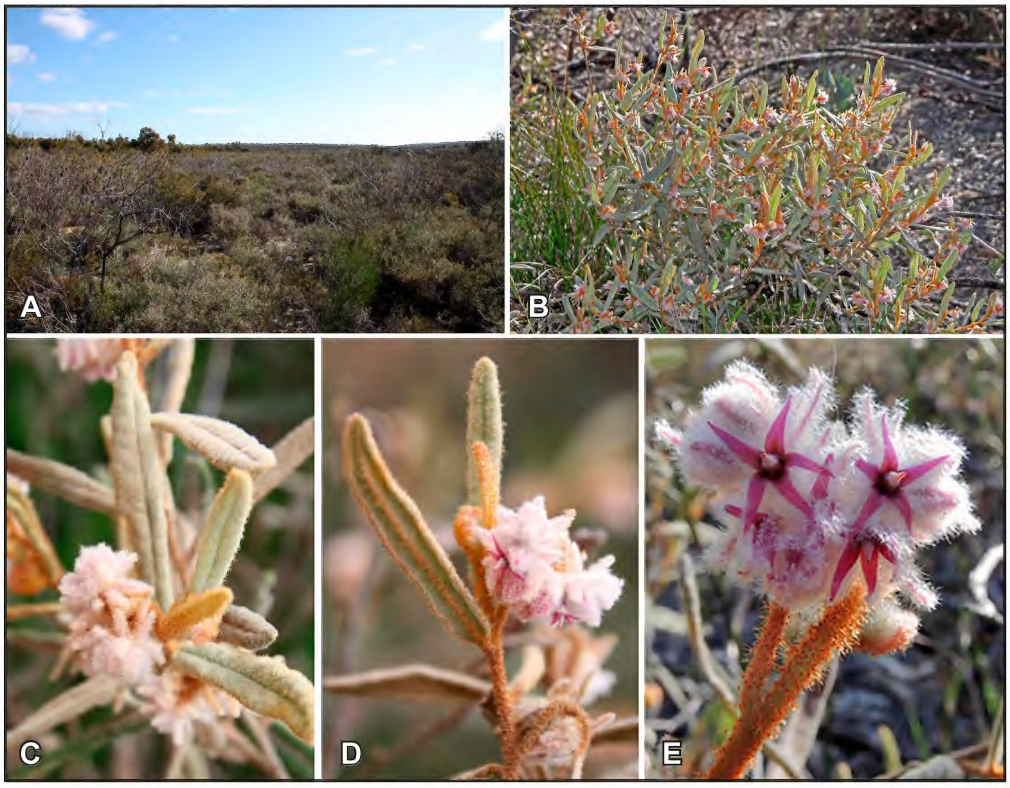

Figure 7. *Lasiopetalum erectifolium*. A – habitat; B – habit; C – branchlet showing late glabrescent, narrowly elliptic leaves and compact dichasial inflorescences; D – apically erect leaves and orange-brown stems; E – compact dichasial inflorescence showing narrow, bright pink calyx lobes with a woolly indumentum of white stellate hairs on the outer surface, and styles with a cone of white, dense fan-like, reflexed stellate hairs. Vouchers: *K.A. Shepherd & C.F. Wilkins* KS 1720 (C, D); *K.A. Shepherd & C.F. Wilkins* KS 1600 (A, B, E). Images: K.A. Shepherd.

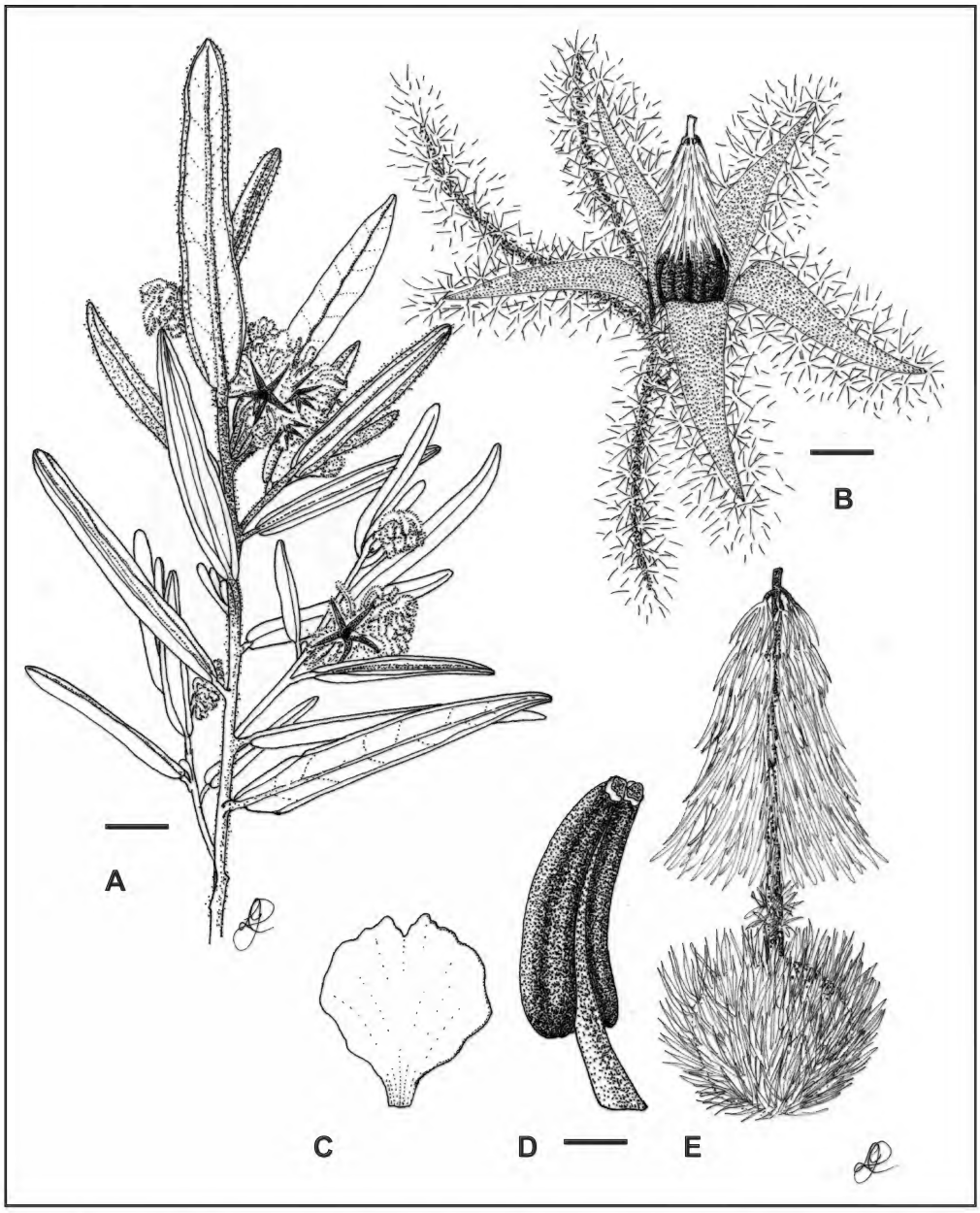

Figure 8. *Lasiopetalum erectifolium*. A – branchlet showing leaves with revolute margins and inflorescences; B – flower highlighting the outer calyx lobes and pedicel covered in a woolly indumentum of stellate hairs; C – glabrous scale-like petal; D – anther showing apical pores; E – ovary with stellate hairs and style with dense fan-like, reflexed stellate hairs along most of the length. Scale bars = 1 cm (A), 0.125 cm (B) and 0.05 cm (C–E). Voucher: *K.A. Shepherd & C.F. Wilkins* KS 220 (C, D). Illustration: Lorraine Cobb.

Selected specimens. WESTERN AUSTRALIA: N on Brand Mudge Rd, from intersection of Carnamah-Eneabba Rd, SW of Carnamah, 4 Oct. 1990, *R.J. Cranfield & P.J. Spencer* 7967 (PERTH); AMG-Zone 50 378336mE 6657792mN; E side of Coalara Rd, Watheroo NP (Reserve 24491), NE of Badgingarra, 6 Dec. 1992, *E.A. Griffin* 8268 (PERTH); Watheroo NP, 4 Oct. 1971, *R.D. Royce* 9573 (PERTH); S of Geraldton–Mullewa Rd on the Casuarinas Rd, 22 Aug. 1995, *K. Shepherd & C. Wilkins* KS 220 (PERTH); S of the Geraldton–Mt Magnet Rd, on Casuarinas Rd, SW of Mullewa, 19 Aug. 2020, *K.A. Shepherd & C.F. Wilkins* KS 1720 (PERTH); E of Tompkins Rd on Yandanooka Rd, N side of road, 26 Sep. 2002, *C.F. Wilkins & J.A. Wege* CW 1603 (PERTH); On Casuarina Rd, S of Mullewa–Geraldton Rd, 10 Oct. 2004, *C.F. Wilkins & J.A. Wilkins* CW 1982 (PERTH); Track N of Skipper Rd, Eneabba, 12 Oct. 2004, *C.F. Wilkins, J. Wilkins & A. Tinker* CW 1997 (PERTH); S of Dongara, E of Brand Hwy. In central section of the Yardanogo NR, 25 Aug. 2004, *G. Woodman, C. Godden, A. Harris & F. Obbens* ARC 159.11 (PERTH).

Phenology. Recorded as flowering from August to October. Fruiting from October.

Distribution and habitat. This species is distributed northwards from Badgingarra towards Geraldton in the Geraldton Sandplain bioregion (Figure 9), growing in tall *Acacia* shrubland, *Banksia* woodland, open mallee woodland or rarely in seasonally damp claypans in white, yellow, grey or brown sand and gravel.

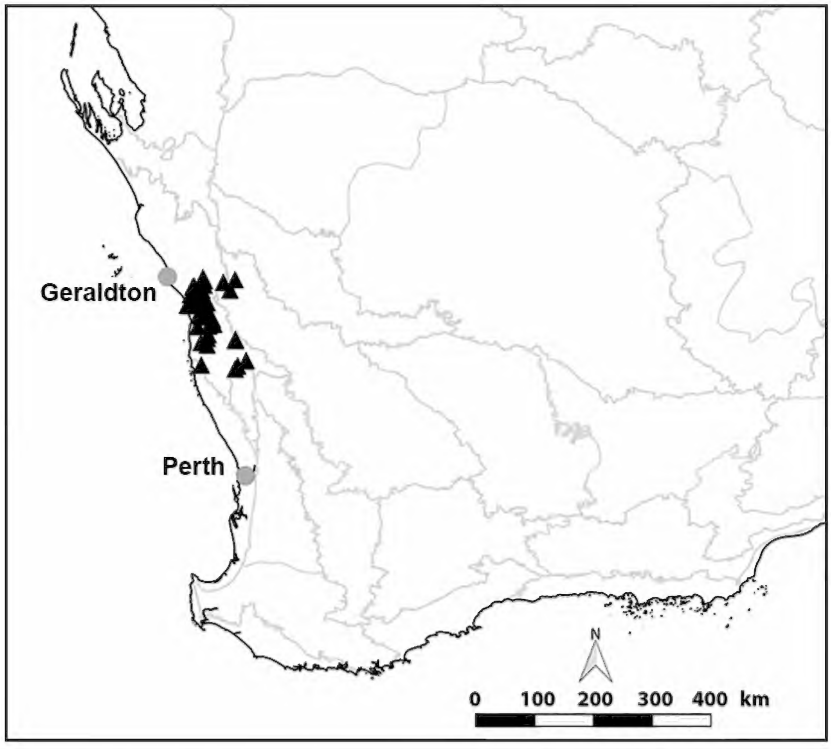

Figure 9. Distribution of *Lasiopetalum erectifolium* with IBRA subregions (Department of the Environment 2013) in pale grey.

Conservation status. Currently this species is relatively widespread and not considered to be under any current conservation threat; however, as recent road widening and verge clearing has removed some populations, this species should continue to be monitored for changes in threat levels.

Etymology. From the Latin *erecti* (erect) *-folium* (leaved), in reference to the distinctive upright orientation of the leaves.

Affinities. Refer to this section under *Lasiopetalum drummondii.*

Lasiopetalum lineare Paust, *Nuytsia* 1(4): 353, 356 figs 5, 12 (1974). *Type*: Watheroo West, Western Australia, 4 November 1954, *R.D. Royce* 4965 (*holo*: PERTH 01625535!; *iso*: K 000686563!).

Open or domed, multi- or single-stemmed *shrub* 0.1–0.5 m high, 0.2–0.35 m wide. *Young stems* with an indumentum of tomentose ferruginous-centred white, sessile or sessile and stalked (to 0.3 mm long), multi-angulate, stellate hairs with 12–24 arms, each to 0.35 mm long, over dense smaller, brown-centred white stellate hairs, glandular hairs absent; glabrescent. *Petioles* 1–3 mm long. *Leaves* alternate, apical leaves spreading, linear, 24–78 mm long, 1.3–2(–3) mm wide, base petiolate, apex obtuse; margins entire, mainly revolute to strongly recurved; abaxial surface with scattered to dense ferruginous-centred white, sessile or stalked (to 0.2 mm long), multi-angulate, stellate hairs with 12–16 arms, each to 0.3 mm long, over dense, smaller white stellate hairs; adaxial surface dull not mucilaginous, with moderately dense to dense white brown-centred stellate hairs with *c*. 12 arms, each to 0.4 mm long, early glabrescent. *Inflorescence* a compact compound or simple dichasium, 25–53 mm long, with 7–15 flowers. *Peduncles* 15–32 mm long with a tomentose ferruginous-centred white, sessile or sessile and stalked (to 0.35 mm long), multi-angulate, stellate hairs with *c*. 12 arms, each to 0.4 mm long, over smaller, white stellate hairs. *Pedicels* 1–4.5 mm long, indumentum as for peduncles but with more numerous white stellate hairs. *Bract* narrowly ovate to filiform, 2.5–5.3 mm long, 0.15–0.3 mm wide. *Epicalyx bracts* 1–3, directly below or to 1.3 mm below the calyx, narrowly ovate to filiform, 3.5–7.2 mm long, 0.2–0.4 mm wide. *Calyx* outer surface white, inner surface bright pink with a slightly darker pink base, (4.5–)5–9.1 mm long, with a tube 0.3–0.4 mm long; lobes narrowly ovate, 6.1–8.6 mm long, 0.7–1 mm wide; outer surface with a dense to tomentose woolly indumentum of white, stalked (to 0.3 mm long), multi-angulate, stellate hairs with *c*. 12 arms, each to 0.6 mm long, over smaller, white stellate hairs, glandular hairs absent; inner surface base sometime glabrous, or with moderately dense to dense, white, stellate hairs with 1–6 arms, each to 0.3 mm long throughout. *Petals* dark red, obovate, flat, 0.4–0.6 mm long, 0.35–0.6 mm wide, glabrous. *Staminal filaments* 0.7–1 mm long, 0.25–0.3 mm wide. *Anthers* dark red, oblong, 1.1–1.5 mm long, *c*. 0.6 mm wide, glabrous. *Ovary* 3-locular (with 2 ovules per locule), 0.7–1 mm long, 0.7–1 mm wide; outer surface with a tomentum of white, multi-angulate, stellate hairs, each arm 0.4–0.6 mm long. *Style* 3–4.1 mm long, centrally thickened to 0.5 mm wide, with stalked reflexed, fan-like hairs throughout. *Fruit* ovoid to ellipsoid, 3.8–4.5 mm long, 3.4–4 mm wide, with scattered to dense, white, multi-angulate, stellate hairs. *Seed* ellipsoid, brown, *c*. 2.5 mm long, *c*. 1.3 mm wide, densely stellate hairy; aril a multilobed (two long, four short) cream-coloured cap, *c*. 1.8 mm long, *c*. 0.9 mm wide. (Figure 10)

Diagnostic features. *Lasiopetalum lineare* can be distinguished from all other members of the genus that have reflexed, fan-like hairs along a centrally thickened style and 1–3 narrowly ovate to filiform epicalyx bracts, by its revolute linear leaves (1.5–2 mm wide), a compact, woolly inflorescence 25–53 mm long, narrow peduncles (*c*. 0.5 mm wide at base), and narrowly ovate calyx lobes < 1 mm wide.

Selected specimens. WESTERN AUSTRALIA: SSE of Yeal Swamp in Wanneroo Forestry Reserve, 28 Oct.1964, *Y. Chadwick* 2554 (PERTH); W of Brand Mudge Rd, Alexander Morrison NP, 5 Nov. 1992,

Figure 10. *Lasiopetalum lineare*. A – habitat; B – habit; C – branchlet showing erect, glabrescent and narrowly elliptic leaves and pendulous flower heads; D – compact, compound dichasial inflorescence showing the long bracts and narrow epicalyx bracts subtending the flowers; E – pale pink flowers that have a greenish base, with glabrous scale-like dark red petals subtending each anther, and a cone of white, dense, fan-like reflexed hairs on the style. Voucher: *K.A. Shepherd & C.F. Wilkins* KS 1713. Images: K.A. Shepherd.

R. Cranfield & P. Spencer 8403 (PERTH); Wongonderrah Rd, E of Yerramullah Rd (SE of Cervantes), 9 Jan. 2008, *A. Crawford* 1749 (PERTH); S along Reserve Rd from junction Yalyal Rd, 8 Nov. 2015, *R. Davis, K. Thiele & T. Hammer* RD 12567 (DNA, MEL, PERTH); W margin Badgingarra NP where Bibby Creek meets road, 14 Oct. 1978, *J. Dodd* 25 (CANB, PERTH); S of Badgingarra, Brand Hwy

[Near Mt Hamersley], 17 Oct. 1969, *A.S. George* 9799 (BRI, PERTH); Barracca NR, Great Northern Hwy, Muchea, on edge of firebreak at NW corner of reserve, 23 Oct. 2004, *F. & J. Hort* 2386 (PERTH); W of Chatfield Clarke Rd, N of Coorow–Greenhead Rd, 19 Nov. 1997, *S. Patrick* 2998 (PERTH); S of Eneabba Drive on the Brand Hwy, E side of road, S of Eneabba, 17 Aug. 2020, *K.A. Shepherd & C.F. Wilkins* KS 1714 (PERTH); W of Midlands Rd on the Marchagee track, 4 Nov. 1993, *C. Wilkins, K.A. Shepherd, J.A. Wege & J.A. Chappill* CW 325 (PERTH); NW corner of Cadda and Yerramullah Rd in Badgingarra NP, 11 Oct. 1998, *C.F. Wilkins, J. Chappill & R. Butcher* CW 1416 (PERTH), Corner Tootbardie and Coorow–Greenhead Rds, 8 Nov. 1999, *C.F. Wilkins & J. Chappill* CW 1448 (PERTH).

Phenology. Recorded as flowering from October to December with one record in January. Fruiting specimens collected in November.

Distribution and habitat. Found around Gingin and northwards towards Eneabba in the Swan Coastal Plain and Geraldton Sandplains bioregions (Figure 11). This species grows in white, yellow or brown sand and laterite in low *Banksia* or *Eucalyptus todtiana* open woodlands, or in heath associated with *Allocasuarina*, *Adenanthos, Jacksonia* and *Conospermum*.

Conservation status. *Lasiopetalum lineare* is currently not considered to be a species of conservation concern as it is known from numerous locations and is not under imminent threat, although it is never found in high numbers, with populations tending to consist of a few scattered plants.

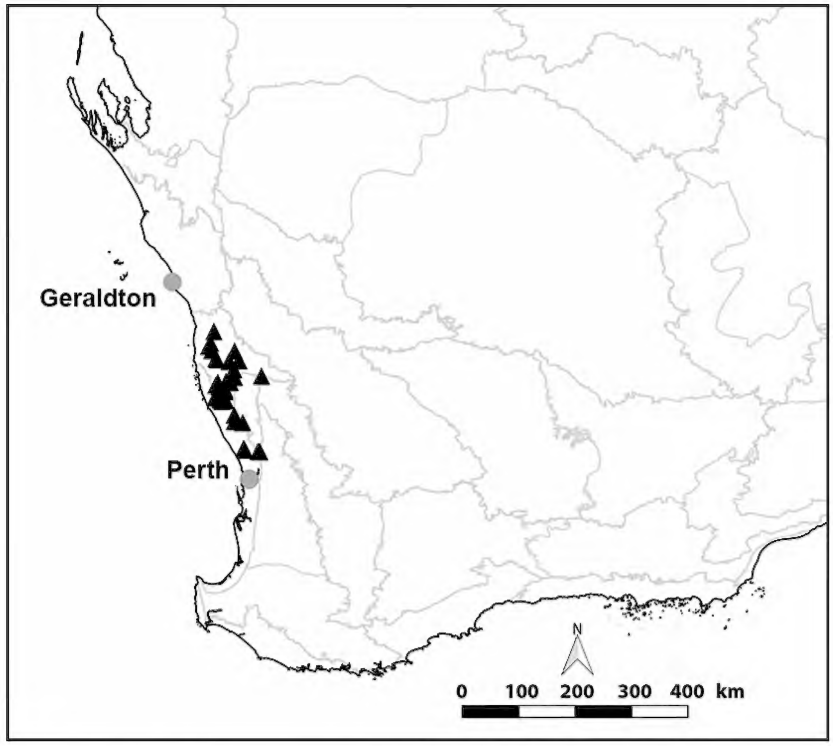

Figure 11. Distribution of *Lasiopetalum lineare* with IBRA subregions (Department of the Environment 2013) in pale grey.

Affinities. *Lasiopetalum lineare* is morphologically most similar to *L. drummondii* (refer to the affinities section under that species) and *L. erectifolium*. It is distinguished from the latter by its early glabrescent, linear leaves 1.3–2 (–3) mm wide (vs late glabrescent, narrowly ovate, narrowly elliptic to narrowly oblong leaves 2–10 mm wide), shorter stellate hairs with 12–16 arms, each to 0.3 mm long on the adaxial surface of leaves (vs stellate hairs with 12–24 arms, each to 0.6 mm long), and outer calyx with short stellate hairs each with *c*. 12 arms to 0.6 mm long (vs stellate hairs each with 10–24 arms to 0.8 mm long).

While *L. angustifolium* and *L. oppositifolium* also have narrow leaves like *L. lineare*, the apical leaves in these two species are alternate rather than opposite and the stellate stem hairs of the latter are multi-angulate rather than disc-like. Moreover, the styles in *L. angustifolium* and *L. oppositifolium* are shorter (< 3 mm long vs > 3 mm long) and narrow throughout (*c*. 0.15 mm wide) rather than thickened at their midpoint (to *c*. 0.5 mm wide) as observed in *L. lineare*.

Lasiopetalum fitzgibbonii F.Muell, a species with a more southern distribution centred around the Esperance Plains and Mallee bioregions, also has relatively linear leaves. However, it can readily be distinguished from *L. lineare* by its shorter leaves (8–17(–40) mm long vs 24–78 mm long), loose inflorescences (vs compact) and flowers subtended by only one epicalyx bract (vs 1–3).

Lasiopetalum ogilvieanum F.Muell., *Fragm.* 11(93): 107–108 (1881). *Type citation*: 'In locis sabulosis inter fluvios Greenough– et Irwin-River; F.M.' *Type specimen*: Irwin's [= Irwin] and Greenough's [= Greenough] River, [Western Australia], November 1877, *F. Mueller s.n.* (*lecto*, here designated: MEL 52370!; *isolecto*: MEL 52369!; *possible isolecto*: K 000686566!).

Open spindly or rounded *shrub* 0.5–1.5 m high, *c*. 0.8 m wide. *Young stems* with an indumentum of tomentose ferruginous, sessile and stalked (to 0.6 mm long), multi-angulate, stellate hairs with 6–16 arms, each to 0.6 mm long, over smaller, white or ferruginous stellate hairs, glandular hairs absent; glabrescent. *Petioles* 3–12 mm long. *Leaves* alternate, apical leaves spreading, narrowly ovate to narrowly elliptic, (11–)31–68 mm long, 4–18 mm wide, base petiolate or rarely slightly cordate, apex obtuse or sub-acute; margins entire to slightly irregular, moderately recurved; abaxial surface with dense ferruginous hairs on midrib becoming scattered on blade with dense ferruginous -centred white stalked (to 0.3 mm long), multi-angulate, stellate hairs with 6–12 arms, each to 0.5 mm long, over smaller dense white stellate hairs; adaxial surface can be glossy but not viscid, with scattered to dense white or ferruginous -centred white stellate hairs with *c*. 6–12 arms, each to 0.8 mm long, early glabrescent. *Inflorescence* a loose, simple or compound dichasium, 52–98 mm long, with (4–)8–21 flowers. *Peduncles* 18–39 mm long with an indumentum of scattered ferruginous-centred white, sessile and stalked (to 0.5 mm long), multi-angulate, stellate hairs with 8–14 arms, each to 0.8 mm long, over smaller, dense white stellate hairs. *Pedicels* 3–6.5 mm long, indumentum as for peduncles but without scattered ferruginous stellate hairs. *Bract* narrowly ovate to linear, 1.6–4 mm long, 0.2–0.4 mm wide. *Epicalyx bracts* 3, directly below the calyx, narrowly ovate to filiform, 4–8 mm long, 0.2–0.9 mm wide. *Calyx* outer surface white or pale pink, with ferruginous hairs towards apex in bud (and on lobe margin near Three Springs), inner surface bright pink with a dark pink base, 7–8.1 mm long, with a tube 1.1–2.8 mm long; lobes ovate, 4.8–6.2 mm long, 3.3–4.3 mm wide; outer surface with dense to tomentose white, stalked (to 0.2 mm long), multi-angulate, stellate hairs with 12–24 arms, each to 1 mm long (with ferruginous hairs at apex), over smaller, white stellate hairs, glandular hairs absent; inner surface base glabrous, remainder with scattered to moderately dense, white, stellate hairs with 1–2(6) arms, each to 0.2 mm long. *Petals* dark red, obovate, cupped, 0.7–0.9 mm long, 0.45–0.9 mm wide, glabrous or with occasional stellate hairs. *Staminal filaments* 1.3–2.2 mm long, 0.3–0.4 mm wide. *Anthers* dark red, narrowly ovate to ovate, 2.3–3.5 mm long, 0.6–1.1 mm wide,

glabrous. *Ovary* 3-locular (with 2 ovules per locule), 1.2–2 mm long, 1.4–2.3 mm wide; outer surface with a tomentum of white, multi-angulate, stellate hairs, each arm to 0.5 mm long. *Style* 2.5–2.8 mm long, consistently *c*. 0.15 mm wide, glabrous or with a few basal hairs. *Fruit* ovoid, 3.8–4.1 mm long, 3.4–3.5 mm wide, with scattered to moderately dense, white multi-angulate stellate hairs. *Seed* brown, ellipsoid, *c*. 2.5 mm long, 1.4 mm wide, with occasional stellate hairs; aril a cream-coloured cap with two short lobes *c*. 0.8 mm wide, *c*. 1 mm long. (Figure 12)

Diagnostic features. *Lasiopetalum ogilvieanum* can be distinguished from all other members of the genus that have a glabrous style, by the following combination of characters: a loose inflorescence

Figure 12. *Lasiopetalum ogilvieanum*. A – habitat; B – habit; C – early glabrescent narrowly ovate to elliptic leaves; D – a loose dichasial inflorescence; E – abaxial surface of leaf showing scattered ferruginous hairs over dense white stellate hairs, and bright pink flowers with a deep reddish-pink base; F – flowers showing the three filiform epicalyx bracts at the base of each petaloid calyx, broader calyx lobes, deep red scale-like petals (yellow arrow) subtending each anther, and glabrous style. Voucher: *K.A. Shepherd & C.F. Wilkins* KS 1606. Images: K.A. Shepherd.

52–98 mm long, 3 filiform epicalyx bracts, flowers 7–8.1 mm long with ovate calyx lobes 3.3–4.3 mm wide, glabrous petals (rarely with occasional stellate hairs), and 3-locular ovary.

Selected specimens. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 25 Oct. 2006, *C. Anderson* D18 5 (PERTH); 20 Aug. 1993, *B. & B. Backhouse* NS 101 (PERTH); 30 Sep.1966, *E.M. Bennett* 1411 (PERTH); 24 Sep. 1931, *W.E. Blackall* 4904 (PERTH); 25 Oct. 1993, *R. Cranfield & D. Kabay* 8950 (PERTH); 1976, *Hj. Eichler* 22000 (CANB, PERTH); 15 Nov. 2011, *L. Guja* LKG 073 (PERTH); 22 July 1980, *R. Hnatiuk* 800005 (PERTH); 28 Sep. 1976, *R.W. Johnson* 3358 (BRI, PERTH); 24 Aug. 2016, *K.A. Shepherd & C.F. Wilkins* KS 1606 (CANB, MEL, NSW, PERTH); 10 Nov. 2011, *B. Taylor & L. McFarlane* BT 10 (PERTH); 11 Oct. 2004, *C.F. Wilkins & J.A. Wilkins* CW 1987 (CANB, PERTH).

Phenology. Flowering recorded from September to November. Fruiting material was collected in November.

Distribution and habitat. This species has a relatively narrow range centred in the Geraldton Sandplains bioregion southeast of Dongara to north of Eneabba, with a few populations also occurring on the boundary with the Avon Wheatbelt bioregion (Figure 13). Associated with low open *Eucalyptus todtiana* woodland over heath with *Hakea*, *Allocasuarina*, or *Melaleuca* and *Beaufortia* growing in white, grey, yellow or yellow-brown sand over granite or with laterite. Often recorded as occurring under isolated trees in heathland.

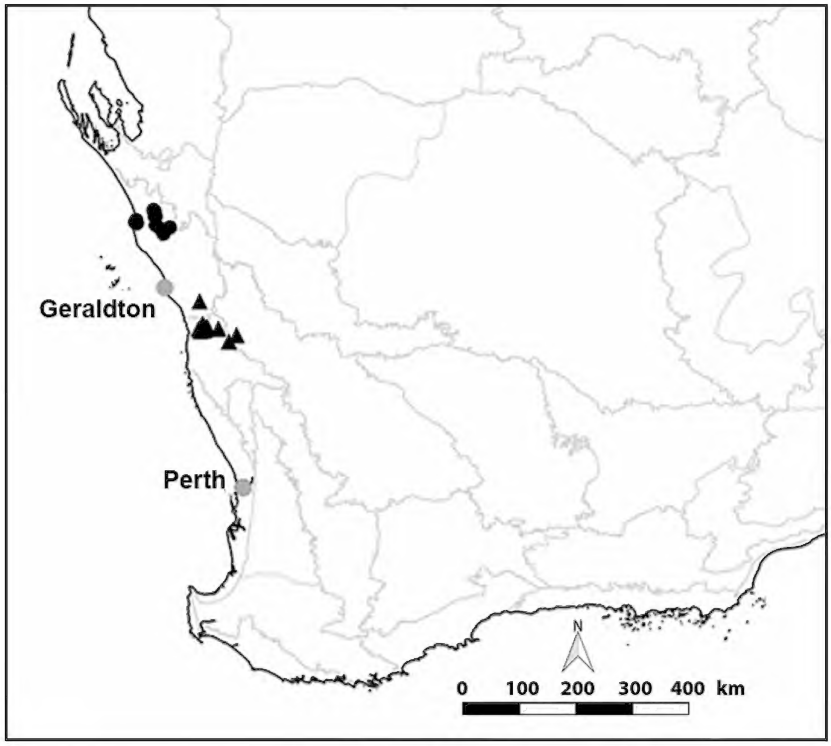

Figure 13. Distribution of *Lasiopetalum ogilvieanum* (▲) and *L. oppositifolium* (●) with IBRA subregions (Department of the Environment 2013) in pale grey.

Conservation status. *Lasiopetalum ogilvieanum* is uncommon and is currently listed as a Priority One species under the Conservation Codes for Western Australian Flora (Smith & Jones 2018).

Affinities. *Lasiopetalum ogilvieanum* is morphologically most similar *L. biloculatum* and *L. oldfieldii* in having a glabrous style, three filiform epicalyx bracts and a loose inflorescence but has glabrous petals (rarely with occasional stellate hairs) rather than densely hairy petals, and larger flowers (calyx 7–8.1 mm long vs 4–6 mm long).

Typification. There are two sheets of *L. ogilvieanum* collected by Mueller and housed at the National Herbarium of Victoria that could equally serve as the lectotype, but MEL 52370 is selected over MEL 52369 (which is designated as an isolectotype), as it better shows the diagnostic features for this species. The Kew specimen (K 000686566) is only tentatively designated as an isolectotype, as even though it has Mueller's distinctive blue label, the writing is not in his hand. The location is given as 'Irwin and Greenoughs R., Western Australia' but there is no collection date (only the date received 7/1884).

Lasiopetalum oldfieldii F.Muell., *Fragm.* 2(11): 6 (1860); *Lasiopetalum acutiflorum* var. *oldfieldii* (F.Muell.) Benth., *Fl. Austral.* 1: 264 (1863). *Type citation*: 'In planitiebus arenosis ad flumen Murchison. Walcott et Oldfield.' *Type specimen*: 'Murchison R[iver]. W.A.', [*P. Walcott* &] *A.F. Oldfield s.n.* (*lecto*, here designated: MEL 52368!; *isolecto*: K 000686570!, G 00358437 image!, MEL 52367!; W!).

Low, spreading *shrub* 0.3–1.5 m high, 0.3–1.5 m wide. *Young stems* with tomentose ferruginous, sessile or stalked (to 0.4 mm long), multi-angulate, stellate hairs with 12–16 arms, each to 0.5 mm long, over smaller, dense white or brown-centred white, stellate hairs, glandular hairs absent; glabrescent. *Petioles* 5–17 mm long. *Leaves* alternate, apical leaves spreading, mainly ovate or narrowly ovate, 15–52 mm long, 8–21 mm wide, base cordate, apex obtuse to sub-acute; margins entire, moderately recurved; abaxial surface with an indumentum of dense ferruginous hairs on midrib becoming scattered on blade with dense ferruginous-centred white sessile or stalked (to 0.3 mm long), multi-angulate, stellate hairs with 6–16 arms, each to 0.4 mm long, over smaller, dense white stellate hairs; adaxial surface new growth glossy mucilaginous, with scattered, sessile or shortly stalked (to 0.1 mm long), stellate hairs with *c*. 6 arms, each to 0.8 mm long, early glabrescent. *Inflorescence* a loose, simple or compound dichasium, 21–53 mm long, with 6–18 flowers. *Peduncles* 13–26(–38) mm long with tomentose indumentum of dense, ferruginous or ferruginous-centred white, sessile and stalked (to 0.3 mm long), multi-angulate, stellate hairs with *c*. 12 arms, each to 0.9 mm long, over smaller, dense white stellate hairs. *Pedicels* 0.8–2.3 mm long, indumentum as for peduncles but with less ferruginous hairs. *Bract* narrowly ovate, 1.1–5 mm long, 0.25–0.7 mm wide. *Epicalyx bracts* 3, below the calyx, narrowly ovate to filiform, 3.1–9.5 mm long, 0.2–1 mm wide. *Calyx* outer surface white or with brown tips in bud, inner surface bright pink throughout, or with a green base, 4.5–5.5 mm long, with a tube 0.8–1.2 mm long; lobes ovate, 3.3–4.9 mm long, 2.5–3.3 mm wide; outer surface with a woolly indumentum of scattered ferruginous and white, sessile and stalked (to 0.3 mm long), stellate hairs with 9–12 arms, each 0.5–0.8 mm long, over smaller, dense white stellate hairs, glandular hairs absent; inner surface base glabrous, remainder with scattered to moderately dense, white, stellate hairs with 1–6 arms, each to 0.2 mm long. *Petals* dark red, obovate, cupped, 0.7–1 mm long, 0.7–1.1 mm wide, outer surface densely stellate hairy. *Staminal filaments* 0.8–1.4 mm long, 0.15–0.3 mm wide. *Anthers* dark red with white apices, narrowly ovate, 2–2.8 mm long, 0.6–0.9 mm wide, glabrous. *Ovary* 3-locular (with 2 ovules per locule), 0.7–1.1 mm long, 0.7–1 mm wide; outer surface with a tomentum of white, appressed-stellate hairs, each arm to 0.3 mm long. *Style* 2–2.4 mm long, consistently 0.15 mm wide, glabrous or base with few multi-angulate stellate hairs. *Fruit* ellipsoid, 4–4.2 mm long, *c*. 3.1 mm wide, outer surface with scattered, multi-angulate, stellate hairs. *Seed* ellipsoid, brown, *c*. 1.8 mm long, *c*. 0.8 mm wide (immature), hair presence unknown; *aril* a cream cap with two long lobes *c*. 1.7 mm long, *c*. 0.8 mm wide. (Figure 14)

Figure 14. *Lasiopetalum oldfieldii*. A – habit; B – young leaves with scattered stellate hairs on the adaxial surface and a loose compound dichasial inflorescence; C – leaves with scattered hairs on the glossy adaxial surface and flowers with three linear epicalyx bracts generally shorter than the length of the calyx (yellow arrow); D – bright pink flowers with a deep reddish-pink base, scale-like petals covered in stellate hairs (yellow arrow) subtending each anther, and glabrous style. Voucher: *K.A. Shepherd & C.F. Wilkins* KS 1724. Images: K.A. Shepherd.

Diagnostic features. *Lasiopetalum oldfieldii* can be distinguished from all other members of the genus with three non-petaloid epicalyx bracts and a glabrous style by the following combination of characters: inflorescence a loose dichasium 21–53 mm long with long peduncles (13–26(–38)) mm long) and 6–18 flowers, each with densely hairy petals and an ovary with three locules.

Selected specimens. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 18 Nov. 2003, *G. Byrne* 783 (PERTH); 10 Oct. 1996, *M.G. Corrick & B.A. Fuhrer* MGC 11357 (AD, CANB, MEL PERTH); 18 Aug. 1993, *R. Cranfield & D. Kabay* 8758 (PERTH); 29 Nov. 2007, *A. Crawford* 1617 (PERTH); 9 July 1997, *R. Davis* 3670 (PERTH); 28 Nov. 1901, *L. Diels* 5680 (BM, PERTH); 27 Aug. 2000, *H. & B. Henderson* 7 (PERTH); 21 Mar. 2001, *S. Patrick* 3770A (PERTH); 6 Oct. 1972, *S. Paust* 1271 (BRI, CANB, K, PERTH); 6 Oct. 1972, *S. Paust* 1272 (AD, NY, PERTH); 21 Aug. 1995, *K. Shepherd, C. Wilkins & E. Bennett* KS 217 (PERTH); 22 Aug. 1995, *K. Shepherd & C. Wilkins* KS 221 (PERTH); 20 Aug. 2020, *K.A. Shepherd & C.F. Wilkins* KS1724 (PERTH); 16 Oct. 2011, *R. Simkin* RS 006 (PERTH); 26 Sep. 2002, *C. Wilkins & J. Wege* CW 1595 (MEL, PERTH); 10 Oct. 2004, *C.F. & J.A. Wilkins* CW 1980 (NSW, PERTH).

Phenology. Flowering recorded from August to November. Fruits appear from October.

Distribution and habitat. This species is confined to the northern part of the Geraldton Sandplains bioregion extending from northeast of Port Gregory to south of Mullewa (Figure 15). It is found growing in white, yellow or grey sand, or red brown clayey sand and laterite, in open mallee woodland, tall scrub, or dense shrubland with *Acacia*, *Banksia*, *Grevillea*, or *Allocasuarina*.

Conservation status. Currently listed as a Priority Three species under the Conservation Codes for Western Australian Flora (Smith & Jones 2018). Plant numbers in populations are recorded as being either occasional or abundant, the latter most likely post-fire.

Affinities. Refer to this section under *Lasiopetalum biloculatum* and *L. ogilvieanum*.

Typification. While Mueller cites 'Walcott et Oldfield' in the protologue, it is not evident if he is referencing two collectors working together or two different collections. No Walcott or Walcott and Oldfield material representing a type gathering has been found for this species to date, but we here assume it was a joint collection based on the account of their trip together by Henderson and Henderson (2018). The MEL 52368 sheet has multiple mounted branchlets and two packets of fragments with two separate labels (in the same hand), stating they are Oldfield collections. This material is treated as the same gathering and designated here as the lectotype. The left-hand label gives the identification as '*Lasiopetalum oldfieldii* F. Muell.' while the right-hand label has the updated name (with a slightly different coloured ink) '*Lasiopetalum* [*acutiflorum* Tz. var] *oldfieldii* F.Muell.' reflecting Bentham's (1863) later concept of this species. Remaining material held at the National Herbarium of Victoria (MEL 52367), Kew (K 000686570) and Genève (G 00358437) all have a similar label and are designated as isolectotypes.

Notes. Due to the inclusion of the informal name *Lasiopetalum oldfieldii* subsp. *biloculatum* E.M.Benn. & K.Shepherd ms in Paczkowska and Chapman (2000), the autonym *L. oldfieldii* F.Muell. var. *oldfieldii* was generated and subsequently listed in that publication and on *FloraBase* (Western Australian Herbarium 1988–). However, since the subspecies had not been validly published at that time, the autonym in effect was not established and so should not be formally recognised in the listed synonyms.

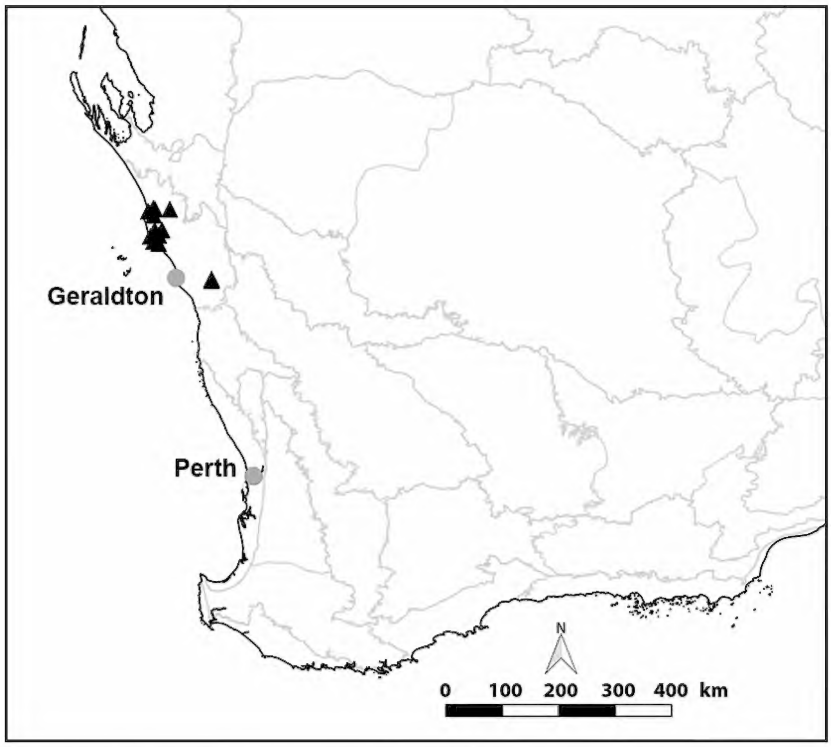

Figure 15. Distribution of *Lasiopetalum oldfieldii* with IBRA subregions (Department of the Environment 2013) in pale grey.

Lasiopetalum oppositifolium F.Muell., *Fragm.* 2(11): 5 (1860). *Type citation*: 'In locis rupestribus ad flumen Murchison. A. Oldfield'. *Type specimen*: Murchison R[iver], [Western Australia], *s. dat.*, *A.F. Oldfield s.n.* (*lecto*, here designated: MEL 52371!; *isolecto*: K 000686592!, K 000686593!).

Open erect multi-stemmed *shrub* 0.3–1 m high, 0.5–1 m wide. *Young stems* with a close tomentum of dense ferruginous-centred, pale-brown, sessile and stalked (to 0.1 mm long), appressed-stellate hairs with *c.* 12 arms, each to 0.1 mm long, over smaller, dense white stellate hairs, glandular hairs absent; early glabrescent. *Petioles* 1–4 mm long. *Leaves* opposite and spreading at apical nodes then alternating basipetally, linear or narrowly elliptic or narrowly ovate, (23–)41–80 mm long, 2.5–7(–9) mm wide, base petiolate, apex obtuse or rounded; margins entire, revolute to strongly recurved; abaxial surface with a tomentose indumentum of scattered ferruginous hairs on the blade becoming dense on the midrib, and stalked (to 0.1 mm long), appressed-stellate hairs with *c.* 12 arms, each to 0.15 mm long, over dense, smaller white stellate hairs; adaxial surface dull not mucilaginous, with dense, white, sessile, disc-like stellate hairs with *c.* 10 arms, each to 0.15 mm long, early glabrescent. *Inflorescence* a compact, simple or compound dichasium, 10–24 mm long, with 4–7(–12) flowers. *Peduncles* 5–15 mm long, indumentum as for stems, with or without red clavate glandular hairs to 0.4 mm long. *Pedicels* 0.8–1.6 mm long, indumentum as for stems but without scattered, ferruginous, stellate hairs. *Bract* narrowly ovate, 1.7–2.7 mm long, 0.3–0.5 mm wide. *Epicalyx bracts* 3, directly below the calyx, narrowly ovate, 2.7–4.7 mm long, 0.4–1.4 mm wide, with or without red clavate glandular hairs to 0.6 mm long. *Calyx* outer surface white, inner surface white or pale pink with a darker

pink base, 2.3–3.5 mm long, with a tube 0.3–0.7 mm long; lobes ovate, 2.1–3.1 mm long, 0.7–1.3 mm wide; outer surface with a dense indumentum of white, sessile, multi-angulate stellate hairs with *c*. 12 arms, each to 0.15 mm long, with or without occasional glandular hairs to 0.15 mm long; inner surface base glabrous, margin and apex of lobes with scattered to moderately dense, white, stellate hairs with 1–4 arms, each to 0.1 mm long. *Petals* dark red, obovate, flat, 0.4–0.8 mm long, 0.3–0.7 mm wide, glabrous or with occasional stellate hairs. *Staminal filaments* 0.5–0.9 mm long, 0.1–0.3 mm wide. *Anthers* dark red, oblong, 1–1.5 mm long, 0.6–0.8 mm wide, glabrous. *Ovary* 3-locular (with 2 ovules per locule), 1.1–1.3 mm long, 1.1–1.3 mm wide; outer surface with a tomentum of white, silky, upwardly appressed fan-like stellate hairs, to 1.1 mm long. *Style* 1.7–2.4 mm long, glabrous or with occasional to dense, reflexed, fan-like hairs, consistently 0.15 mm wide. *Fruit* ovoid, 3–3.8 mm long, 2.4–3.3 mm wide with dense, silky, white stellate hairs. *Seed* ellipsoid, brown, 2.1–2.5 mm long, 0.8–1.4 mm wide, glabrous or with moderately dense stellate hairs; aril a cream-coloured cap with two long lobes *c*. 2.7 mm long, *c*. 1 mm wide. (Figure 16)

Figure 16. *Lasiopetalum oppositifolium*. A – habitat; B – habit; C – young grey green leaves becoming glabrescent and dark green with age; D – compact dichasial inflorescence of young buds; E – apical opposite leaves. Voucher: *K.A. Shepherd & C.F. Wilkins* KS 1731 (A, B, E) and *K.A. Shepherd & C.F. Wilkins* KS 1740 (C, D). Images: K.A. Shepherd.

Diagnostic features. *Lasiopetalum oppositifolium* can be uniquely distinguished from other species in the genus in having leaves opposite at the apical nodes then alternate, a compact inflorescence, three non-petaloid epicalyx bracts, small flowers 2.3–3.5 mm long, glabrous petals, and the style glabrous or with scattered to dense reflexed fan hairs only in the apical two thirds.

Selected specimens. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 23 Oct. 2001, *P.G. Armstrong* PA 01/23G (PERTH); 28 Sep. 1995, *D. & B. Bellairs* 8 (PERTH); 10 Oct. 1995, *D.R. Bellairs s.n.* (PERTH 04367502); 5 Sep. 1963, *A.R. Fairall* 1243 (PERTH); 27 Sep. 1995, *S. Patrick* SP 2437 (PERTH); 21 Aug. 1995, *K. Shepherd, E. Bennett & C. Wilkins* KS 212 (PERTH); 13 Sep. 1996, *K. Shepherd & J. Wege* KS 387 (PERTH); 20 Aug. 2020, *K.A. Shepherd & C.F. Wilkins* KS 1731 (PERTH); 22 Aug. 2020, *K.A. Shepherd & C.F. Wilkins* KS 1740 (PERTH); 27 Aug. 1981, *Wemm* 2067 B, (PERTH); 2 Oct. 2002, *C.F. & J.A. Wilkins* CW 1614 (PERTH); 5 Oct. 2002, *C.F. & J.A. Wilkins* CW 1617 (PERTH).

Phenology. Flowering material has been collected in spring from August to October and fruiting collections were made in November.

Distribution and habitat. *Lasiopetalum oppositifolium* is only known from a few populations around Kalbarri in the Geraldton Sandplains bioregion (Figure 13). It is found on hilltop cliffs, gorge slopes or rocky breakaway areas and exposed sandstone sheets, in red or white-grey sand or yellow sandy loam and is associated with shrubland or open scrub with *Acacia*, *Allocasuarina*, *Melaleuca*, *Grevillea* or *Callitris*.

Conservation status. This species is confined to breakaways and other rocky habitats and is usually not common in the landscape. It is currently listed as a Priority Three species under the Conservation Codes for Western Australian Flora (Smith & Jones 2018).

Affinities. Refer to this section under *L. angustifolium*.

Typification. The specimen collected by Oldfield from the Murchison River (MEL 52371), housed at Mueller's home institution at the National Herbarium of Victoria and annotated by him, is designated here as the lectotype. Two sheets housed at Kew (K 000686592 and K 000686593) are a good match for the type with the labels in the same hand, and so are designated as isolectotypes. It should be noted that while the lectotype has a glabrous style and obvious red glandular hairs on the outer surface of the calyx, other collections may have either a glabrous style without glandular hairs on the outer calyx or few to many reflexed fan-like stellate hairs on the style with or without the glandular hairs on the outer calyx.

Acknowledgements

Brendan Lepschi (CANB) is sincerely thanked for providing important nomenclatural advice as is Alex George for confirming the epithet as being correctly formed for *Lasiopetalum biloculatum*. Early stages of this study were undertaken by the lead author at the University of Western Australia, funded through an Australian Biological Resources Study grant awarded to the late Jenny Chappill and Eleanor Bennett and their contribution to early aspects of this research is gratefully acknowledged. The late Lorraine Cobb is also acknowledged for her wonderful illustration of *L. erectifolium.* KAS received a Winston Churchill Memorial Trust Fellowship sponsored by the Australian Biological Resources Study, to facilitate travel to Europe to examine specimens lodged at BM, CGE, K, LD and W and these

institutions and their staff are also gratefully acknowledged as are all the staff at Australian Herbaria particulalry at PERTH. Trevor Wilson is thanked for his thoughtful and thorough review as is Terry Macfarlane for his helpful editorial comments including clarification of Walcott collections. CFW was partially funded by a Biodiversity & Conservation Science (DBCA) Terrestrial conservation science project grant to undertake aspects of this work.

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Eucalyptus merleae (Myrtaceae), a new rare species endemic to Ravensthorpe Shire in south-west Australia

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Abstract

McQuoid, N.K. & French, M.E., *Eucalyptus merleae* (Myrtaceae) a new rare species endemic to Ravensthorpe Shire in south-west Australia. *Nuytsia* 32: 151–158 (2021). *Eucalyptus merleae* McQuoid & M.E.French, first collected by Ian Brooker in 1985, is described and illustrated. It is related to *Eucalyptus astringens* Maiden. The new species has a scattered distribution in the Ravensthorpe to Hopetoun area on the central south coast of Western Australia, is at risk from frequent fire, climate change and potential mining activity, and is in need of further survey and monitoring.

Introduction

Eucalyptus merleae McQuoid & M.E.French was first collected north of Ravensthorpe by Ian Brooker in 1985 (*M.I.H. Brooker* 8804), as *E. astringens* Maiden (Brooker & Kleinig 1990). In 1995, Brooker collected from a population south of Ravensthorpe (*M.I.H. Brooker* 12200), which he determined as having affinity to *E. astringens*. Brooker later included the Ravensthorpe populations in *E. astringens* subsp. *astringens* Brooker & Hopper (Brooker & Kleinig 2001; Brooker & Hopper 2002).

Flora and vegetation surveys in the Ravensthorpe area collected and recognised the mallet described herein as *Eucalyptus merleae,* variously as *Eucalyptus astringens* (Craig pers. comm.; Craig *et al.* 2008; Hickman 2008), *E. astringens* subsp. *astringens* and *E. astringens* subsp. *redacta* Brooker & Hopper (Kern *et al.* 2008), or *E. astringens* subsp. 'Kundip' (McQuoid 2009). Craig *et al.* (2008), in their publication on the vegetation of the Ravensthorpe Range, stated that the '*E. astringens* variant' appears to differ from both *E. astringens* subsp. *astringens* and *E. astringens* subsp. *redacta*, and may warrant recognition as a separate taxon.

Since 2008 more populations of the taxon described herein as *E. merleae* have been discovered and collected across the Ravensthorpe area (French 2012; French & Nicolle 2019; RAIN 2021). From these it has become clear that *E. merleae* inflorescences, buds and fruits are uniform and distinct from both subspecies of *E. astringens*; differences being notably longer and strongly pendulous peduncles, longer pedicels, campanulate and slightly to moderately ribbed hypanthia and fruits with ribs partially spirally arranged. Further, populations with consistently pink to red flowers have added to the uniqueness of *E. merleae* within the *E. astringens* group, and from its closest relatives that form *Eucalyptus* subser. *Pedicellatae* Blakely (Nicolle 2019). The distributions of these three taxa are distinct (Figure 1), with *E. astringens* subsp. *astringens* occurring west, north-west and north of a line from Cranbrook to west

https://florabase.dpaw.wa.gov.au/nuytsia/
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of Lake King; *E. astringens* subsp. *redacta* south-east and east of a line from Mt Barker to north of Jerramungup including near the coast; and *E. merleae* separated to the east and restricted to an area from near Ravensthorpe to west of Hopetoun. Intergrades of *E. merleae* and *E. astringens* subsp. *redacta* occur between the distributions of these taxa (see Figure 1).

Eucalyptus merleae is part of the *Eucalyptus* subg. *Symphyomyrtus* (Schauer) Brooker sect. *Glanduloseae* ms Nicolle, ser. *Erectae* Brooker subser. *Pedicellatae* Blakely (Nicolle 2019).

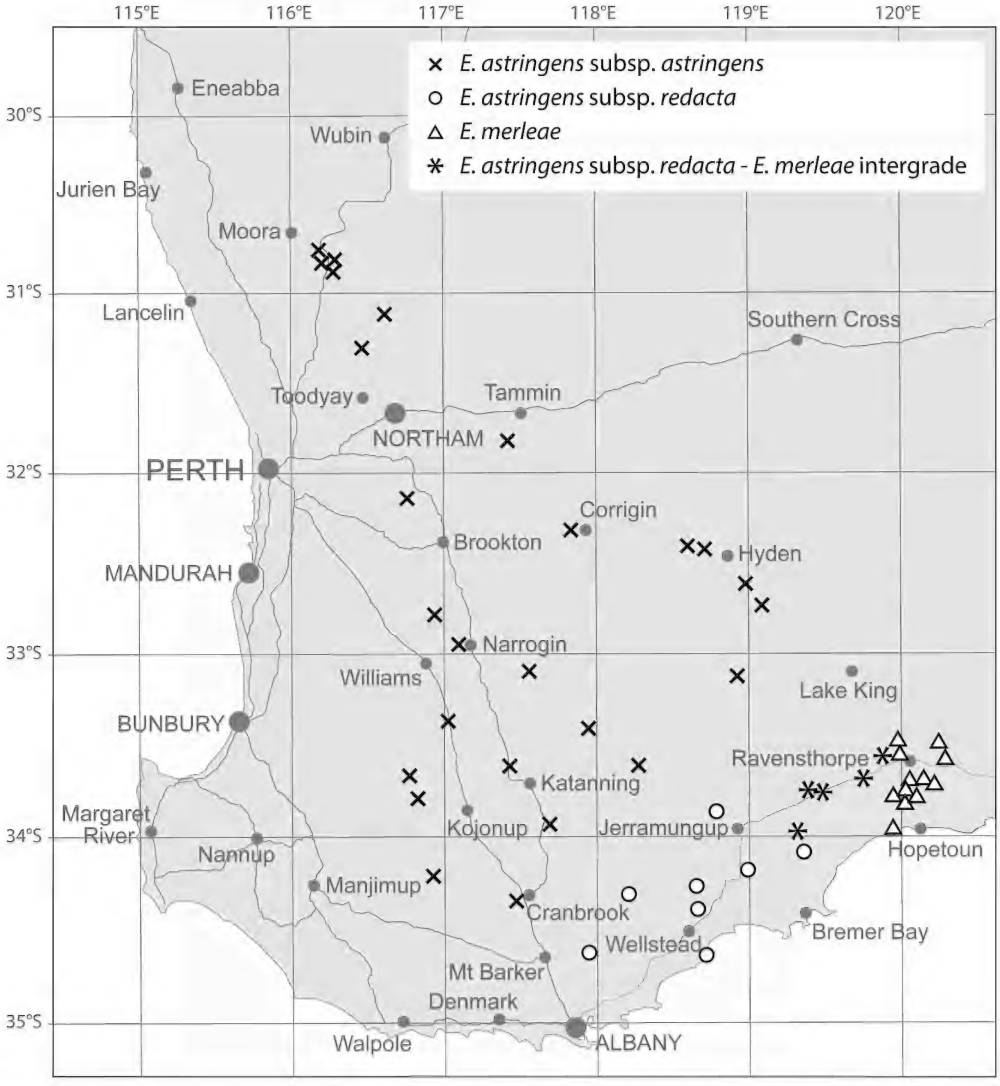

Figure 1. Distribution of *Eucalyptus merleae*, *E. astringens* subsp. *astringens*, *E. astringens* subsp. *redacta* and *E. merleae* – *E. astringens* subsp. *redacta* intergrades.

Key to closely related species from *Eucalyptus* series *Erectae* subseries *Pedicellatae* based on field habit and adult material

1. Mallee or tree, lignotuberous

2. Bark rough at base and lower trunk

3. Fruit campanulate ..... **E. occidentalis**

3: Fruit cylindrical to broadly obconical ..... **E. aspratilis**

2: Bark smooth

4. Buds and fruit prominently ribbed ..... **E. stowardii**

4: Buds and fruit smooth

5. Peduncles terete

6. Erect habit to 8 m tall; adult leaves lanceolate (mean width 18 mm, maximum width 28 mm), glossy green ..... **E. sporadica**

6: Bushy habit to 4 m tall; adult leaves narrow-lanceolate (mean width 10 mm, maximum width 15 mm), slightly glossy, grey-green to green ..... **E. sargentii** subsp. **onesia**

5: Peduncles flattened

7. Buds 20–26 mm long; operculum to three times as long as hypanthium, smooth to rarely ribbed, apex apiculate to rarely blunt ..... **E. diminuta**

7: Buds 12–20 mm long; operculum to twice as long as hypanthium, smooth, apex blunt ..... **E. thamnoides**

1: Mallet, non-lignotuberous

8. Seedling leaves narrow-lanceolate; adult leaves narrow-lanceolate, rarely to 14 mm wide, slightly glossy blue-green to green; buds elongated ..... **E. sargentii** subsp. **sargentii.**

8: Seedling leaves ovate; adult leaves lanceolate to 22 mm wide, glossy green; buds cylindrical

9. Peduncles strongly pendulous, to 30 mm long; fruit campanulate, faintly to moderately ribbed, ribbing partially spirally arranged ..... **E. merleae**

9: Peduncles erect or somewhat pendulous, to 18 mm long; fruit cylindrical or obconical to slightly campanulate, smooth

10. Peduncles to 18 mm long; fruit 8–12 mm long × 7–10 mm wide ..... **E. astringens** subsp. **astringens**

10: Peduncles to 15 mm long; fruit 5–9 mm long × 5–7 mm wide ..... **E. astringens** subsp. **redacta**

Description

Eucalyptus merleae McQuoid & M.E.French, *sp. nov.*

Typus: south-west of Ravensthorpe, Western Australia [precise locality withheld for conservation reasons], 3 March 2018, *M. French* 2986 (*holo*: PERTH 09247726; *iso*: AD, CANB, MEL).

Illustrations: G. Craig *et al.*, *Vegetation of the Ravensthorpe Range, Western Australia: Mt Short to Kundip*: 101 Photo 004 (2008); M. French. *Eucalypts of Western Australia's Wheatbelt*: 91, pink to

red flower image (2012); M. French & D. Nicolle. *Eucalypts of Western Australia, the South-west Coast and Ranges*: 81, Figure 5 (2019).

Mallet erect, 6–10 m tall, without a lignotuber. *Bark* smooth, decorticating in autumn, bronze-brown. *Pith glands* present. *Cotyledons* Y shaped (bisected). *Seedling leaves* petiolate, ovate opposite for 1 to 3 pairs then alternate, dull, green. *Adult leaves* with a petiole 10–20 mm long; blade lanceolate to broad-lanceolate, 60–110 mm long, 10–22 mm wide, glossy, green; venation moderate, clear, secondary veins about 45% to the midrib, intramarginal vein remote from leaf edge, oil glands numerous, island and intersectional. *Inflorescences* axillary, unbranched, 7-flowered, peduncles flattened, conspicuously down-curved, pendulous, 10–30 mm long; pedicels terete, 5–11 mm long. *Buds* cylindrical, 15–20 mm long; hypanthium slightly ribbed, 5–10 mm long, 5–7 mm wide, swelling at top below operculum scar; operculum rarely blunt to pointed, 10–12 mm long. *Flowers* cream to pale yellow, occasionally pink or red. *Stamens* erect, ascending from narrow staminophore, bent radially then ascending, all fertile; anthers oblong, dorsifixed, opening by slits. *Style* long and straight. *Fruit* 4-locular, campanulate, faintly to moderately ribbed, ribbing usually partially spirally arranged, 8–14 mm long, 6–11 mm wide; rim thick, disc level to descending, valves 4 at rim level or slightly exserted. *Seed* grey-brown with distinct reticulum, 2–3 mm long. (Figure 2)

Diagnostic characters. Distinguished within *Eucalyptus* subser. *Pedicellatae* by the following combination of characters: mallet, obligate seeder; long pendulous peduncles; hypanthia slightly ribbed with conspicuous swelling at the top below operculum scar; rarely blunt to pointed opercula, cream or pale yellow to pink or red flower filaments; fruit consistently campanulate, faintly to moderately ribbed, with ribbing mostly partially spirally arranged.

Specimens examined of E. merleae. WESTERN AUSTRALIA [localities withheld for conservation reasons]: 8 Feb. 2004, *M. Bennett* 898 (PERTH): 18 Jan. 1985, *M.I.H. Brooker* 8804 (AD *n.v.*, CANB, MEL *n.v.*, NSW *n.v.*, PERTH); 7 Apr. 1995, *M.I.H. Brooker* 12199 W (AD *n.v.*, CANB, NSW *n.v.*, PERTH); 6 Apr. 1995, *M.I.H. Brooker* 12200 W (CANB, NSW, PERTH); 21 Nov. 1999, *G.F. Craig* GFC 5152 (PERTH); 21 Nov. 1999, *G.F. Craig* 5154 (PERTH); 21 Nov. 1999, *G.F. Craig GFC* 5155 (PERTH); 21 Nov. 1999, *G.F. Craig* GFC 5156, (PERTH); 5 Dec. 2003, *G.F. Craig* GFC 5986 (PERTH); 23 Nov. 1999, *M. French* 1106 (AD *n.v.*, PERTH);12 Mar. 2018, *M. French* 2991 (BRI, MEL, PERTH); 12 Mar. 2018, *M. French* 2993 (CANB, PERTH); 12 Mar. 2018, *M. French* 2994 (PERTH 2 sheets); 1 Oct. 2007, *S. Kern, R. Jasper & H. Hughes* LCH 17924 (PERTH 2 sheets); 22 Jun. 2019, *N. McQuoid, R. Jasper*, *K. Douthie & J. Brampton* RJ 49 (NT, NSW, PERTH); 16 Oct. 2019, *D. Nicolle* 7740 (PERTH); 5 Nov. 2000, *D. Nicolle & M. French* DN 3585 (CANB, PERTH); 20 July 2001, *D. Nicolle & M. French* DN 3971 (PERTH).

Selected specimens of E. merleae – E. astringens subsp. *redacta intergrades examined*. WESTERN AUSTRALIA: 7 Apr. 1995, *M.I.H. Brooker* 12209 (AD *n.v.*, CANB, NSW *n.v.*, PERTH), 13 May 1988, *L.A.S. Johnson* 9059 *& M. Johnson* (NSW, PERTH); May 2001, *A.E. Raudino* AER 586, (PERTH), 16 Jan. 2015, *L.S.J. Sweedman* 8810 (K, PERTH).

Distribution and habitat. Occurs as almost pure stands on breakaways and slopes of Ravensthorpe Range north-west, north-east and south-east of Ravensthorpe (Figure 1). Also occurs in similar habitats on decomposing breakaways of unnamed low hills and rises south of Ravensthorpe, including a single stand west of Hopetoun in Fitzgerald River National Park. Mostly occurs in heavy mica-rich clay, usually white to pale grey and occasionally shiny pale orange to pink. Associated mallet eucalypts include *Eucalyptus cernua* Brooker & Hopper, *E. clivicola* Brooker & Hopper and *E. platypus* Hook. subsp. *platypus*.

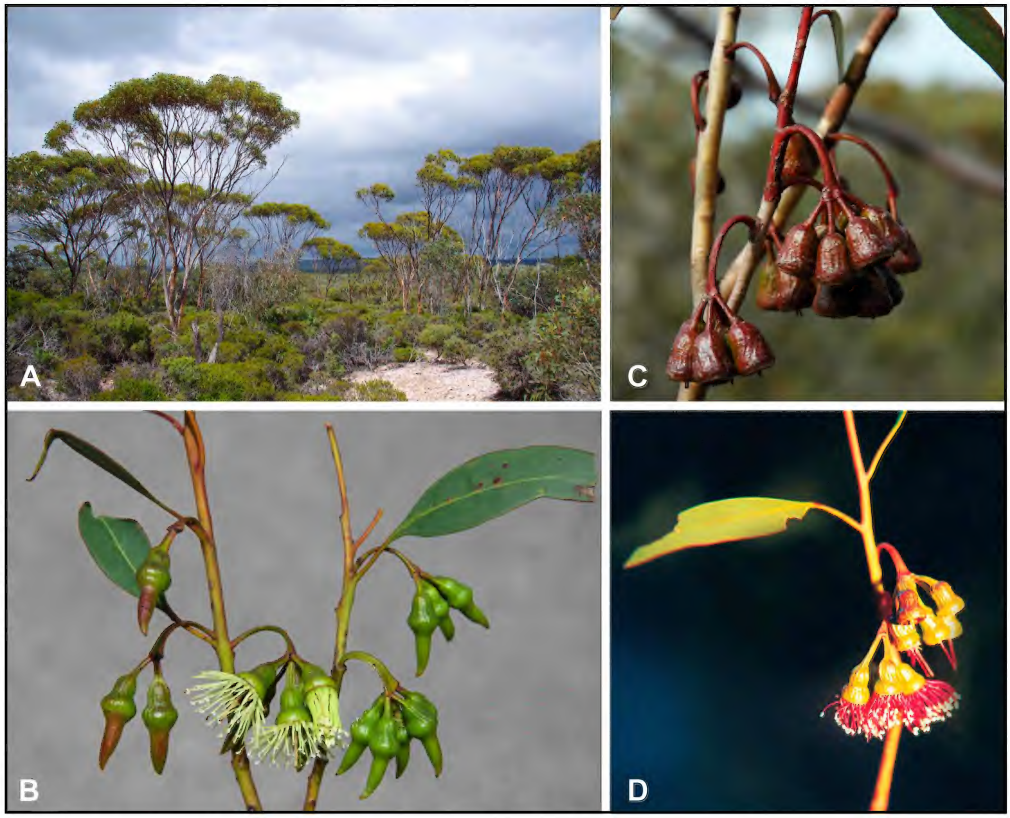

Figure 2. *Eucalyptus merleae* from south of Ravensthorpe. A – habit, showing bark, stature. Image M. French from *M. French* 2986; B – buds and cream flowers, showing acute opercula, and campanulate, slightly ribbed hypanthia. Image M. French from *M. French* 2986; C – fruit, showing downcurved pendulous peduncles, long pedicels, moderately ribbed (partially spirally arranged) campanulate hypanthia. Image N. McQuoid from *N. McQuoid, R. Jasper, K. Douthie & J. Brampton* RJ 49; D – pink-red flowers. Image M. French, scan of a 2004 photograph.

Flowering period. July to March.

Etymology. Named for Mrs (Violet) Merle Bennett OAM of Hopetoun WA, born 23 June 1929, for her outstanding and enduring contribution to the appreciation, celebration and exploration of the Ravensthorpe flora and landscape. Her contribution includes 50 years of observation towards understanding the diversity of the district's remarkable flora; collection of significant herbarium material (including *Eucalyptus merleae* in 2004 as cited above); discovery of new occurrences of rare plant taxa; helping community members and visitors enjoy and explore the complex and often cryptic flora; membership of conservation organisations and committees; considerate and skilful advocacy and counsel on nature conservation matters; and, longstanding and award winning involvement with the Ravensthorpe Wildflower Show and Festival.

Conservation status. To be listed as Priority Two under Conservation Codes for Western Australian Flora (C. Bourke pers. comm.). Comprises approximately twelve broadly scattered populations, mostly on unallocated Crown land over much of which mineral exploration leases and mining tenements occur; also, on road reserves, private land, and one small population in Fitzgerald River National Park. The unallocated Crown land south of Ravensthorpe, where the largest populations of *E. merleae* are

known to occur, form part of the proposed Cocanarup-Kundip Conservation Reserve. Further searches may find it between known populations.

Threats to *Eucalyptus merleae* are fire frequency intervals less than approximately 50 years, as it is a long-lived, serotinous obligate seeder (Barrett *et al.* 2009); drying trends from climate change and its potential relationships with other environmental stresses, such as altered fire regimes (Gilfillan *et al.* 2009; DEC 2012) and reduced opportunities for successful recruitment (Barrett *et al.* 2009); and clearing for mineral exploration and mining (DEC 2012). A wildfire south of Ravensthorpe in February 2020 burnt approximately 1,000 ha, including several stands of *E. merleae* and associated mallet eucalypts. Very dry conditions following have seen limited recruitment, which may impact the composition, integrity and size of the stands (RAIN 2021). Further, another wildfire in January 2021 burnt approximately 800 ha adjacent to the west of the February 2020 fire, which may have impacted stands of *E. merleae.* Monitoring to gauge recent fire impacts, seed production and recruitment patterns, and further survey to determine accurate distribution and population dimensions are recommended.

Affinities. *Eucalyptus merleae* (Figure 2) differs distinctly from its closest relative *E. astringens* (Figure 3) by its often longer (10–30 mm vs 10–18 mm long) and consistently downcurved to pendulous peduncles (*cf.* mostly erect to occasionally down-curved); pedicels 5–11 mm long (*cf.* 2–8 mm in *E. astringens*); slightly more acute opercula; buds 15–20 mm long and with a pronounced swelling below the join on the upper hypanthia (*cf.* 12–17 mm and lacking a swelling), hypanthia slightly ribbed (*cf.* smooth); flowers cream or pale yellow to pink or red (*cf.* cream to white); and consistently campanulate fruits 8–14 mm long × 6–11 mm wide (*cf.* cylindrical or obconical to slightly campanulate and 5–12 mm long × 5–10 mm wide), with faint to moderate and partially spirally arranged ribbing (*cf.* smooth). Its occasional pink or red flowers, which we know to be annually consistent in cultivation (Currency Creek Arboretum, South Australia, planted 2004), are unknown in close relatives in *E.* subser. *Pedicellatae* (Figure 2D). The partially spirally arranged fruit ribbing is otherwise unknown in the genus (Figure 2C). It also differs from *E. astringens* subsp. *astringens* by its smaller stature of 6–10 m (*cf.* to 24 m) and seed 2–3 mm long (*cf.* 1.5–2 mm).

Intergrades are known with *Eucalyptus astringens* subsp. *redacta* west of the distribution of *E. merleae* (Figure 1). These plants occur as a number of small stands that lie between the distribution of *E. astringens* subsp. *redacta* and *E. merleae*, exhibiting intermediate bud and fruit morphology.

Eucalyptus merleae is known to hybridise with *E. cernua* and *E. platypus* subsp. *platypus* south-east of Ravensthorpe, where parent plants converge (N. McQuoid pers. obs.).

Notes. The area covered by Ravensthorpe Shire is well known for its botanical diversity (Craig *et al.* 2008; Craig 2011; McQuoid 2017), including many endemic and otherwise rare taxa (Wilkins *et al.* 2011). Ravensthorpe Shire is considered to be the richest place on earth for eucalypt diversity (S. Hopper pers. comm.), a complexity that includes a number of endemic taxa: *Eucalyptus burdettiana* Blakely & Steedman, *E. cernua*, *E. coronata* C.A.Gardner, *E. desmondensis* Maiden & Blakely, *E. mcquoidii* Brooker & Hopper, *E. megacornuta* C.A.Gardner, *E. oleosa* Miq. subsp. *corvina* Johnson & Hill, *E. proxima* D.Nicolle & Brooker, *E. purpurata* D.Nicolle, *E. ravensthorpensis* Gosper ex Brooker & Hopper and *E. sepulcralis* F.Muell.

Since the recognition of two subspecies within *Eucalyptus astringens*, new discoveries and further research have improved the understanding of the distribution patterns of these two taxa (Figure 1). The known distribution of *E. astringens* subsp. *astringens* has been extended northwards in a narrow band

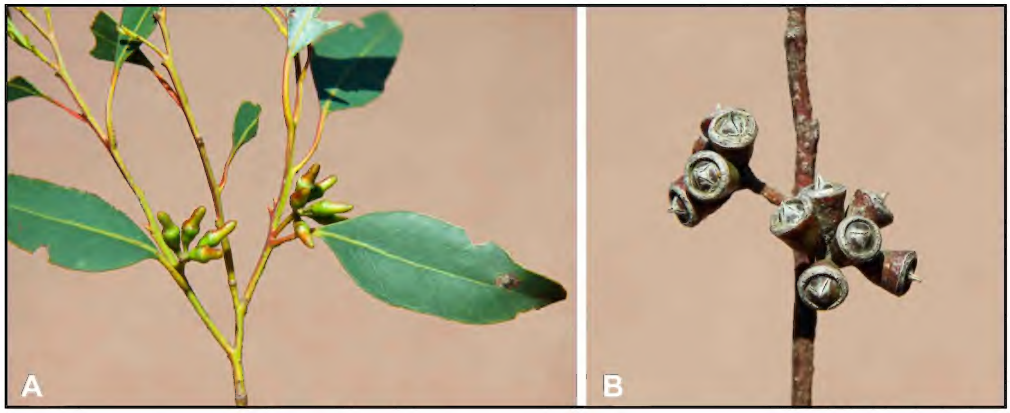

Figure 3. *Eucalyptus astringens* subsp. *redacta* from Kamballup West. A – buds, showing erect peduncles, blunt opercula, slightly campanulate hypanthia. Image M. French; B – fruit, showing erect peduncles, short pedicels, smooth obconical fruit. Image M. French.

from near Northam to the Walebing area, south-east of Moora, and eastwards from Hyden north-west to near Tammin (French 2012). *Eucalyptus astringens* subsp. *redacta* has been found to be confined to the far south, extending from west of Kamballup eastwards through the Boxwood Hill and Cape Riche area to south of Jerramungup and western Fitzgerald River National Park; it is not known to occur in the Stirling Range National Park, having previously been confused with *E. thamnoides* Brooker & Hopper in that area (French & Nicolle 2019).

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Convolvulus pyrophilus (Convolvulaceae), a new post-fire ephemeral, and an updated illustrated key to the Western Australian species

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SHORT COMMUNICATION

Convolvulus L. is a cosmopolitan genus of nearly 200 species (Wood *et al.* 2015; POWO 2021), with 14 currently recognised in Australia (CHAH 2021). The new species described here brings to seven the number occurring in Western Australia, two of which are introduced. Although neither of the introductions is apparently posing a problem at this stage, monitoring is recommended since *C. arvensis* L. is an agricultural weed in many parts of the world, including some parts of Australia, and *C. sabatius* Viv., which is available on the horticultural market, is noted as a naturalised alien in some parts of Europe (Randall 2007; Arianoutsou *et al.* 2010; Hrusevar *et al.* 2017). It had been accepted that all Australian native species were perennial herbs (Wood *et al.* 2015; Johnson 2001) but the recently discovered species described below has proven to be an annual, post-fire ephemeral plant. The new species germinates in depressions of mallee shrublands after winter rainfalls only following bushfires, and it dies off in the following autumn after producing numerous seeds that lay dormant until there is another fire.

Convolvulus pyrophilus O.Nazarova & Hislop, *sp. nov.*

Type: north side of the Lake King-Norseman Road, Western Australia [precise locality withheld for conservation reasons], 22 November 2020, *O. Nazarova* 120 (*holo*: PERTH 09379975; *iso*: AD, CANB, MEL).

Convolvulus sp. Cascades (W. Archer 1110161), Western Australian Herbarium, in *Florabase*, https://florabase.dpaw.wa.gov.au/ [accessed 5 August 2021].

Annual, post-fire ephemeral, prostrate *herb*, often mat-forming, and up to at least 2.5 m across, or occasionally twining where support is present. Primary *roots* are shallow, thin, with a few slender lateral roots. *Stems* terete, with sparse appressed hairs, 0.2–0.35 mm long. *Leaves* petiolate, alternate, bright green with a glossy adaxial surface. *Petioles* up to 30 mm long, with sparse, appressed hairs, 0.2–0.25 mm long; basal leaf petioles often longer than the blade then becoming progressively shorter on stem leaves. *Leaf blade* broadly ovate to deltate, 6–27 mm long, 4–24 mm wide, with sparse appressed hairs, 0.18–0.32 mm long; venation prominent; margins more or less regularly crenate or undulate; apex often emarginate, mucronate, occasionally retuse or rarely attenuate; base truncate and

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slightly decurrent onto the petiole, sometimes slightly sagittate. *Inflorescence* axillary, cymose, one or two per axil, up to 5-flowered. *Peduncle* filiform, 4–55 mm long, with sparse, appressed hairs; *pedicel* 5–10 mm long, hairs as for peduncle, erect in fruit. *Bracteoles* sub-opposite to opposite, subulate to linear, 0.8–1.2 mm long, 0.25–0.4 mm wide, apex acute, moderately to densely hairy on adaxial surface, sparingly hairy or glabrous on abaxial surface. *Sepals* mostly light green, paler towards the margins; broadly elliptic to obovate; apex obtuse to rounded, emarginate and shortly mucronate or apiculate, with hyaline margins *c*. 0.5–1 mm wide; outer sepals 4–5 mm long, 3–3.5 mm wide, sparsely appressed-hairy, slightly more densely towards the apex; inner sepals 3.7–4 mm long, 2.5–2.9 mm wide, glabrous or with rare hairs. *Corolla* funnelform, 6.5–7 mm long, apparently not fully opening at anthesis, light pink with five paler longitudinal bands, weakly lobed, lobes 2.6–3 mm long, glabrous except for hairs on the upper, outer portion of the longitudinal bands; throat light greenish cream, 2.2–2.5 mm diameter. *Stamens* five, slightly unequal in length; *filaments* adnate to the corolla tube for 1.8–2 mm above the base, free for 1.6–2 mm, with short tubercles on the adnate part and lower part of the free portion of the filaments; *anthers* closely surrounding the stigmas (*c*. ½ way from the stigmas base), oblong, becoming deltate at dehiscence, *c*. 0.4–0.7 mm long, 0.3–0.42 mm wide; apex obtuse, becoming emarginate at dehiscence, base sagittate; *pollen* grains three-colpate. *Ovary* ovoid, 0.8–1.0 mm long, on a prominent disk, 0.2–0.3 mm high, mostly glabrous, but with a very occasional long hair; *style* glabrous 2–2.2 mm long, tapering gradually from ovary apex, with two cylindrical obtuse stigmas, 1–1.5 mm long. *Capsule* globular to globular-obovoid 5.3–7 mm long, 5.5–6.5 mm diameter, glabrous. *Seeds* 4, ¼-globose, slightly concave in the middle of outer and both inner surfaces, 2.6–3 mm long, 1.9–2.5 mm wide, black or dark brown, somewhat glossy, obtuse at the base; surface finely punctate, bearing sparse low, irregular, flat tubercles and +/– anastomosing ridges; outer margin a narrow, irregular, discontinuous wing. (Figure 1, 2 A)

Diagnostic features. Distinguished from other species within the genus by its post-fire ephemeral biology, small flowers, and shiny, bright green, relatively uniform, broadly ovate or deltate leaves with more or less regularly crenate or undulate margins and the absence of basal lobes. The consistently sparsely appressed-hairy vegetative parts and mostly prostrate habit are also notable.

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 11 Oct. 2016, *W. Archer* 1110161 (PERTH); 31 Oct. 2016, *W. Archer* 3110161 (AD, CANB, PERTH); 29 Oct. 1997, *B.J. Lepschi* & *B.A. Fuhrer* BJL 3805 (AD, BRI, CANB, PERTH); 22 Dec. 2020, *E. Massenbauer* EM 926 (PERTH 2 sheets).

Phenology. All collections have both flowers and fruit present and were made between October and December. Observations by the first author at the type location and that of *E. Massenbauer* 926, showed that all plants had died by April of 2021, i.e. four or five months after the collection dates and 13–14 months after the fire event. This corresponds with the observations made earlier by William Archer at the site of another population where no plants were evident a year after the collecting date.

Distribution and habitat. Currently known from three disjunct localities: east of Lake King and north and south of Cascade, in the Eastern Mallee and Recherche IBRA Subregions. Occurs on gravelly brown, yellow or reddish sandy loam in depressions or shallow drainage lines in recently burnt mallee woodlands. Associated species include others that are often prominent in the aftermath of recent fire such as *Trachymene anisocarpa*, *Austrostipa* sp., *Bulbine* sp. and *Haloragis digyna*.

Conservation status. Currently listed as Priority One under the Conservation Codes for Western Australian Flora (Western Australian Herbarium 1998–), under the name *C.* sp. Cascades (W. Archer 1110161). Because of its post-fire ephemeral biology, the true extent of its distribution and hence the

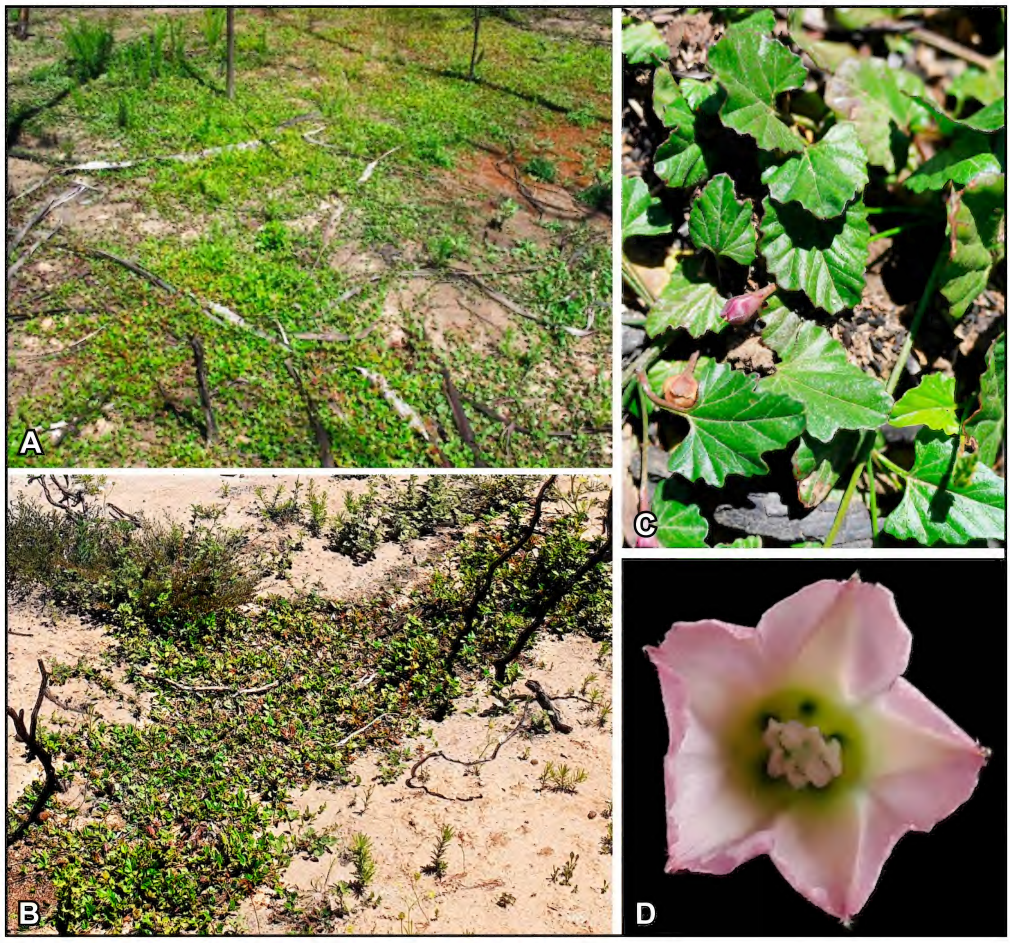

Figure 1. *Convolvulus pyrophilus*. A and B – mat-forming habit in depressions (A) and shallow drainage lines (B) in recently burnt open mallee woodlands; C – leaves *in situ*; D – flower, showing characteristic half-opened appearance with the anthers crowded around stigmas. Voucher: *O. Nazarova* 120. Images: W. Archer (A) and O. Nazarova (B–D).

most appropriate conservation rank will always be problematic to some extent. It seems worth noting, however, that only two small populations were located by the first author and local Flora Conservation Officer, Emma Adams (formerly E. Massenbauer), during searches of a number of similar post-fire habitats.

Etymology. The epithet is from the Greek *pyros* (fire) and *phileo* (to love) and refers to the germination of this species after fire.

Affinities. The only species likely to be confused with *Convolvulus pyrophilus* is *C. remotus* R.Br., Aside from its different biology *C. pyrophilus* differs from that species in having broadly ovate or deltate leaves without basal lobes (*cf.* narrowly ovate, oblong, narrowly triangular to linear, with prominent basal lobes present), glossy green foliage (*cf.* dull green), leaf margins that are crenate or undulate (*cf.* entire) and smaller corollas, 6.5–7 mm long (*cf.* 8–18 mm).

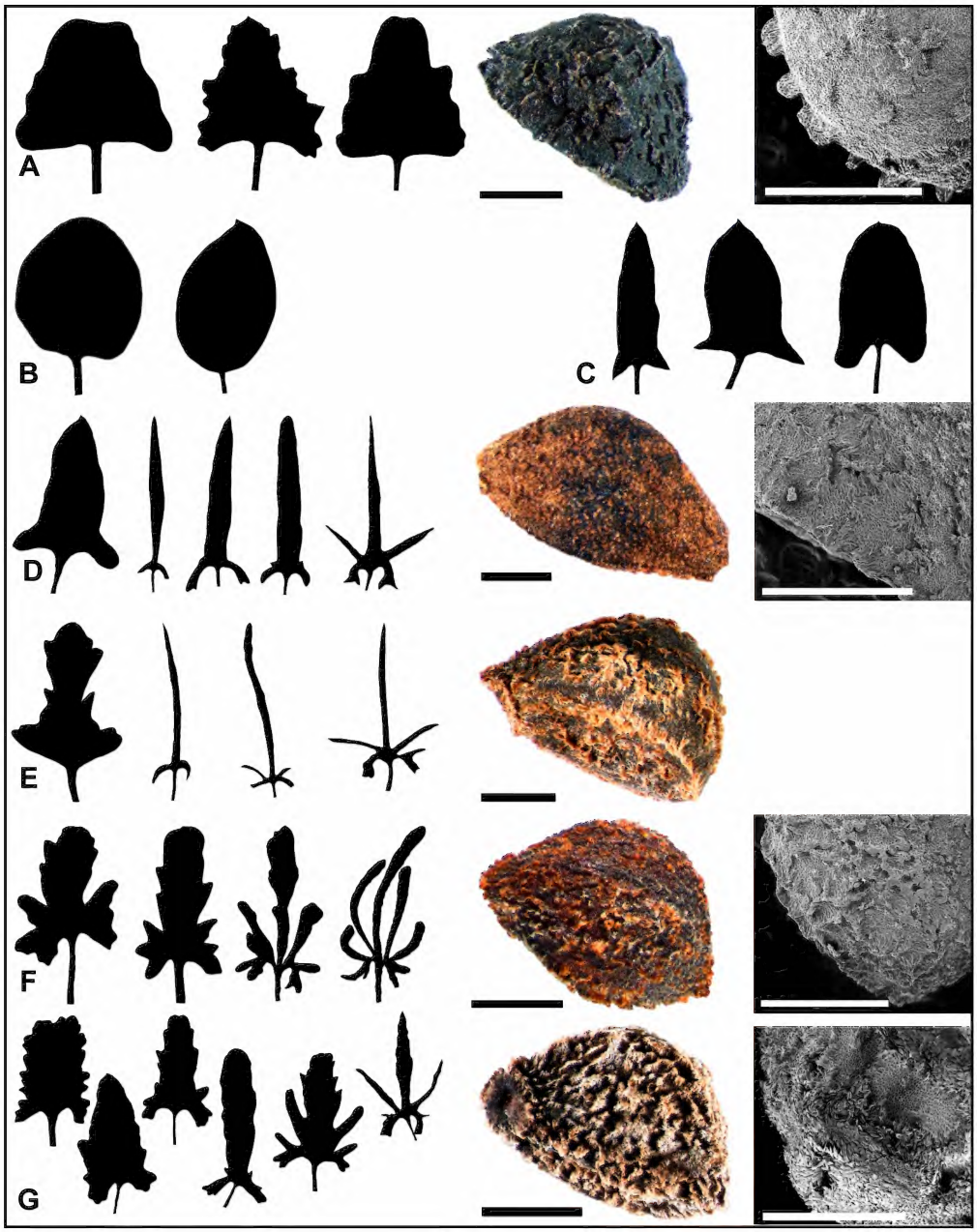

Figure 2. Comparative stem leaf and seed morphology of *Convolvulus pyrophilus* (A), **C. sabatius* subsp. *mauritanicus* (B), **C. arvensis* (C), *C. remotus* (D), *C. angustissimus* (E), *C. recurvatus* subsp. *nullarborensis* (F) and *C. clementii* (G). Leaf images represent composites of stem leaves from the following specimens: *O. Nazarova* 120 (A); *G.J. Keighery* 14041 (B); *G.J. Keighery* 9396, *J.P. Simpson s.n.* (PERTH 05825946) (C); *A.S. George* 11317, *K.R. Newbey* 7492, *R.D. Royce* 5231, *I.B. Shepherd* 181, (D); *C. Andrews s.n.* (PERTH 05826373), *G.J. Keighery* 5655, *J.A.L. Preiss* 1925 (MEL 0689916A_ISOTYPE) (E); *T.E.H. Aplin* 1671, *E.R.LJohnson* 12, *D. Lynch* DL 56 (F); *K.A. Atkins* 650, *B.J. Lepschi* 2065, *M.N. Lyons* & *R.A. Coppen*, FV 0706, *K. McCreery* GIR 16-37, *P. de Rebeira* 81 (G). Seed images taken at × 3 mag by O. Nazarova and scanning electron microscopy images taken by S. Dillon from: *O. Nazarova* 120 (A), *T.E.H. Aplin* & *M.E. Trudgen* 5762 (D), *C. Andrews s.n.* (PERTH 05826373) (E), *E.R.L. Johnson* 12 (F), *P.G. Wilson* 9920 (G). Seeds scale bars = 1 mm.

Notes. An interesting feature of *C. pyrophilus* noted by the first author and two other collectors of the species, is that the flowers may not open fully at anthesis. This raises the possibility that they are self-pollinating, which is a strategy that may have advantages in plants that produce flowers quickly in the months after major fire events when potential pollinators are likely to be scarce.

The seeds of *C. pyrophilus* germinate well after smoke-water treatment. It is noteworthy that potted plants were able to twine at least to 30 cm because *in situ* plants usually appear as dense mats, due to the absence of suitable support in the postfire environment.

Other morphological variations to note include: Leaf shape and indumentum does not depend on leaf position (base or stem) but rather on maturity. Petioles, leaves, peduncles and pedicels often become progressively shorter from the base upwards. Blades of juvenile leaves are more deltate in shape. Young leaves, petioles, pedicels and buds are hairier, becoming sparser with age. Surfaces of vegetative parts (stem, leaves and sepals) exposed to sun are often tinted purple.

Key to Western Australian species of *Convolvulus*

* alien to Western Australia
⁜ occurs more than once in the key

1. Leaves on individual plants relatively uniform in shape, basal lobes absent or if present then usually entire, the central lobe always without further divisions

2. Corolla 6.5–7 mm long; leaf margins crenate and often undulate, never entire (Figure 2A); post-fire ephemeral ..... **C. pyrophilus**

2: Corolla 8–30 mm long; leaf margins entire, apart from basal lobes in *C. remotus* and *C. arvensis*; perennial herbs

3. Corolla blue or violet; leaves broadly ovate to suborbicular, basal lobes absent (Figure 2B)..... ***C. sabatius** subsp. **mauritanicus**

3: Corolla pink or white; leaves broadly to narrowly ovate, oblong, narrowly triangular to linear, basal lobes present

4. Stems ±quadrangular, or rare narrowly winged, ± glabrous or with an indumentum ± spreading hairs; outer sepals distinctly narrower then inner, corolla 15–30 mm; basal leaf lobes always entire (Figure 2C)..... ***C. arvensis**

4: Stems terete, with an indumentum of mostly appressed hairs; outer sepals not distinctly narrower then inner, corolla 8–18 mm long; basal leaf lobes not always entire, may possess ascending secondary lobes (Figure 2D)..... **C. remotus**⁜

1: Leaves on individual plants usually variously shaped, basal lobes often further divided into secondary lobes, sometimes the central lobe itself with secondary lobes

5. Fruiting pedicel recurved

6. Leaves 10–65 mm long, central lobe margin mostly entire, ascending secondary lobes when present usually do not exceed ½ length of the central lobe; petioles 2–20 mm long; pedicels 3–23 mm long; corolla 8–21 mm long; sepals 3.5–6.5 mm; seeds 2.9–4 mm long, brown, with wavy, ± anastomosing ridges and ± continuous narrow wings (Figure 2E)..... **C. angustissimus**[1]

6: Leaves up to 25 mm, though most less than 15 mm, central lobe margin often coarsely crenate, shallow to deeply lobed, ascending secondary lobes when present more than ½ length of the central lobe; petioles 2–10(–12) mm; pedicels 2–6 mm long; corolla 5–7 mm long; sepals 3–4 mm; seeds 2.5–3.5 mm long, brown to dark brown, with fine dense anastomosing ridges and a discontinuous wing (Figure 2F)..... **C. recurvatus** subsp. **nullarborensis**

5: Fruiting pedicel not recurved

7. Leaves of the same plant often strongly dimorphic, leaf margin coarsely crenate, laciniate to deeply lobed, ascending secondary lobes often exceed ½ length of central lobes; sepals 3.5–5.5 mm with mostly spreading or ascending hairs; corolla 6–9(–10) mm long; seeds 2.5–3.5 mm long, chubby, less 1.5 long as wide, with ridges and tubercles of unevenly distributed tufts of dense partly fused hair-like structures (Figure 2G) ..... **C. clementii**

7: Leaves generally not strongly dimorphic, central lobe margin mostly entire, when present ascending secondary lobes rarely exceed ⅓of the central lobe length; sepals 4–7 mm with mostly appressed hairs, rarely spreading; corolla 8–18 mm long; seeds 3–4.8 mm long, elongated, more 1.5 long as wide, with a fine to nearly smooth pattern of low irregular tubercles and ridges (rarely with spongy outgrowth towards outer margins) (Figure 2D)..... **C. remotus**

[1]*Convolvulus angustissimus* R.Br. is very poorly known in Western Australia. Only five of the ten specimens currently lodged at PERTH have been determined by a specialist, the late R.W. Johnson. Moreover, three of these, including the most recent collection from 1982 (*G.J. Keighery* 5655), are tentative identifications of poor-quality specimens as indicated by the use of question marks on his determinavit slips. The status of the species in Western Australia is therefore somewhat problematic and in need of clarification. The distinguishing features used in the key above for *C. angustissimus* were mostly based on Johnson's descriptions (2001) of this species.

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Taxonomic notes on *Calandrinia remota* (Montiaceae) and a reassessment of the status of *C. polyandra* var. *leptophylla* and *C. polyandra* var. *monantha*

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SHORT COMMUNICATION

Calandrinia remota J.M.Black (Montiaceae) is an annual, erect to semi-erect species with smooth, tan, orbicular seeds (elliptic in cross-section) and a widespread, but very disjunct distribution. In Western Australia it occurs over a relatively wide area of the Mid-West region, while interstate populations are found across the arid central and eastern parts of South Australia, just extending into far north-western New South Wales and far south-western Queensland (i.e., a disjunction of ~1400 kms between the closest western and eastern populations).

The species was first described by Black (1923, p. 369) from collections gathered at Gawler Range and northern parts of the Flinders Range to Cooper's Creek in South Australia. I have seen high-quality images of these syntypes (including seed) which are listed in the appendix. In a later publication Black (1932, pp. 41–42) added supplementary information to the protologue for *C. remota* saying he originally described the species from small, dried specimens collected near Mount Gunson and Tarcoola (omitting the Cooper's Creek syntype locality), but goes on to cite other locations from which he believed it occurred including Wynbring, Ooldea, Lake Callabonna, Strzelecki and Cooper's Creeks, and also Central Australia and Victoria Desert, Western Australia. He concluded by stating, "*C. polyandra* (Hook.) Benth. var. *leptophylla*, Benth., quoted for the "W. coast" of Western Australia, is perhaps the same as *C. remota*." Black (1948), later confirmed this view by placing *C. polyandra* var. *leptophylla* in synonymy under *C. remota* and, in so doing, established the usage of the latter name for the Western Australian flora.

Since Black's time numerous Western Australian collections have been referred to *C. remota*, and there are certainly good morphological reasons for doing so. Despite their disjunct distribution, the Western Australian collections are broadly similar to interstate ones seen. In particular, there is generally a close similarity in the seed morphology, which is always an important character in the taxonomy of the genus (Carolin 1987; Syeda & Carolin 1989). This disjunction is very similar to that also seen in *C. disperma* J.M.Black demonstrating that a large separation between populations of a species does not always result in morphological differentiation, but one should also not discount this possibility.

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Collections of *C. remota* on loan from AD (26 specimens), BRI (20 specimens) and DNA (6 specimens) were examined and of these only nineteen collections were determined as *C. remota*. This included fifteen specimens from across much of central and north-eastern South Australia, two from far south-western Queensland and two from far north-western New South Wales that I had determined at NSW in 2006 – see appendix. Two of the six Northern Territory collections, like many of the Queensland and some of the South Australian collections, were confused with and thus redetermined as *Calandrinia* sp. Lumeah (R.W. Purdie 2168), a mostly prostrate to decumbent species with smooth, brown, globular seeds found growing on heavier soils that are often stony or rocky. A further two Northern Territory collections were *C. polyandra* while the remaining two sterile specimens were possibly *C. reticulata*, but definitely not *C. remota*. All the true *C. remota* collections above were relatively homogeneous morphologically, with populations restricted to sand dune habitats or undulating sandplains that are extensive throughout its eastern distribution. While the Northern Territory loan did not include a single *C. remota* specimen, there appears to be abundant suitable habitat, especially in the far south-east where the Simpson Desert occurs in all three states. Deep sand habitat thus might serve as a spotting feature for *C. remota* as collections made from other habitats should be considered doubtful for this species, keeping in mind that *C. balonensis* Lindl., *C. polyandra* and others may also occur on deep sands.

By comparison, Western Australian specimens of *C. remota* are much more diverse in habitat and display a more variable habit and basal leaf morphology. Amongst the above Western Australian collections there are several specimens that appear morphologically very similar to *C. remota sens. str.* and some of these even occur on sand dunes. Beside these, as previously indicated, many more specimens have characters with varying degrees of similarity and sometimes rather dissimilar. For these reasons two entities were segregated from Western Australian *C. remota* as potentially new taxa. The first, *C.* sp. Shark Bay (A. Markey 1405), is an annual species with black, smooth seeds (rather than tan, smooth seeds as seen in *C. remota sens. str.*) and is confined to coastal or near coastal calcareous habitat. A subspecies ranking is probably most appropriate for this entity. The other segregate, *C.* sp. Cape Range (F. Obbens FO 10/18), is a scrambling perennial often found growing through *Triodia* sp., on hard, limestone habitats in the Cape Range area and on Barrow Island. *Calandrinia* sp. Cape Range (F. Obbens FO 10/18) was included in a recent phylogeny of Australian *Calandrinia* (Hancock *et al.* 2018) and placed in the bottom branch of clade 2 (i.e., aligns mostly with section *Pseudodianthodiae*) well separated from other Western Australian accessions of *C. remota* (labelled as *sens. str.*). Although it should be noted the bootstrap values are relatively poor for the lower half of this clade, this result supports the recognition of *C.* sp. Cape Range (F. Obbens FO 10/18) as a distinct taxon. Unfortunately, genetic sampling of *C. remota* from other states was not included in this research. Following removal of the phrase name specimens, the remaining collections of *C. remota* at PERTH are still quite variable in morphology and habitat.

Apart from the presence of the above-mentioned segregates within Western Australian *C. remota*, the overarching question is whether any of the remaining western collections of the species should be truly regarded as conspecific with the syntypes. Currently, this is an open question that would require a dedicated study to resolve, and at the very least, an examination of spirit material from across its range. Even then, these plants are quite variable on a population basis and also within populations so finding several minor differences will not necessarily resolve this matter. It would seem that the most effective solution should be a combination of the above with a wider molecular-genetic study. Consequently, *C. remota* is currently considered to occur in Western Australia.

The name *C. polyandra* var. *leptophylla* was first published in *Flora Australiensis* (Bentham 1863). The type specimen, from Western Australia, was cited as, 'W. coast, with the commoner form, *Bynoe*'. Benjamin Bynoe was a surgeon with the English navy who sailed extensively around Australia and

nearby. He collected from several areas all around Australia, but in Western Australia he collected predominantly from coastal and near coastal mainland sites and on islands of the Kimberley and Pilbara, with the majority of his collections originating from northern Australia.

Bynoe's type is a K collection previously on loan to CANB at the time of this study, but now has been returned. I have seen a high-quality image of this type and also had communicated with staff at CANB regarding this collection while it was still on loan. Six stems of early flowering material are attached to the type sheet with no fruiting/seeding material being available for examination. Rather than coming from the west coast as indicated in Bentham's protologue, the specimen is clearly labelled as 'N.W. Coast of Australia, Bynoe'. My assessment is that the specimen actually represents *C. strophiolata* (F.Muell.) B.D.Jacks. and is likely to have been collected from either the Kimberley coast or north-eastern Pilbara coast or nearby islands. Neither *C. polyandra* nor *C. remota* occur that far north. It is known that Bynoe once landed at Champion Bay (now Geraldton, Western Australia) where the above two species could have been collected in the wider area, but that trip was in mid-December, a time when these annual species are well past flowering or fruiting. Additionally, some of the more opened flowers of the Bynoe type specimen appear to have more than five petals, which definitely precludes the consistently five-petalled species *C. polyandra* and *C. remota*. On the other hand, *C. strophiolata* usually has ten to twelve petals. *Calandrinia polyandra* var. *leptophylla* is therefore considered to be a synonym of *C. strophiolata*.

The name *C. polyandra* var. *monantha* is a *nomen nudum* (Mueller & Tate 1896) and is accredited to a collection made by R. Helms near camp 49 on 12th September 1891 from the Great Victoria Desert, Western Australia (i.e., AD97601320A). It is probably this specimen that Black referred to when he stated that *C. remota* occurred in that Western Australian region. It is also possible that Black confused this with another collection Helms made from the Great Victoria Desert in South Australia near the Musgrave Range. Both collections are from the Elder Exploring Expedition of which Helms was the botanist. These two collections are relatively poor (particularly the latter one) and there are no seeds available on either. The former is vaguely similar to a small specimen of *Calandrinia* sp. Lumeah (R.W. Purdie 2168) which often has scapes terminating with a single flower (sometimes more) or more likely is a stunted specimen of *C. polyandra* due to poor seasonal conditions. Both these species can occur in this region, but without seed a positive determination is difficult, if not impossible. However, it is clear that Helms' Western Australian collection is not *C. remota* as Black indicated as no other collection of *C. remota* has ever been made in this region since.

Appendix

Calandrinia remota J.M.Black, *Trans. & Proc. Roy. Soc. South Australia* 47: 369 (1923). *Type*: South Australia, Lake Eyre Basin, east. Cooper's Creek, on Birdsville Track, no date or collector given (*syn*: AD 96415069); West of Lake Torrens. Mt. Gunson, *c.* 135 km north-north-west of Port Augusta, September 1913, *Mrs Beckwith* (*syn*: AD 96416001; *isosyn*: K001097823, image seen); Kanowarra (probably now Kanowana, ca. 110 km west of Innamincka), 10 October 1916, *S.A. White* (*syn*: AD 96416002).

Other specimens examined. WESTERN AUSTRALIA (selection; all in PERTH except where indicated): S of Carnarvon Tracking Stn, 17 Aug. 1969, *A.M. Ashby* 2970 (CANB *n.v.*, PERTH); Transect RB, Red Bluff, Kalbarri NP, 9 Sep. 2003, *D. & B. Bellairs* 6324; Dalgaranga Well, *c.* 5 km SE of Dalgaranga Stn HS, which is situated *c.* 80 km NE of Yalgoo, 17 Sep. 2011, *B. & H. Bennetts, M. & R. Skeet, G. Marsh* GM 146; Camel Soak on Number 2 Rabbit Proof Fence Rd, Perenjori, 8 Oct. 2003, *G. Byrne* 546A; on a granite outcrop 200 m to the E of the S Entrance Rd approximately

3.2 km from the Barnong Stn HS, 16 Aug. 2008, *G. Byrne* 3598; 72 km S of Carnarvon, 27 Oct. 1978, *H. Demarz* 7135 (CANB *n.v.*, PERTH); breakaway opposite Waterloo Reserve, NNW of Woolgorong Stn HS, 11 Sep. 2007, *D.J. Edinger* 6420; Quadrat 7, on Burnerbinmah – Nalbarra Rd, just N of Clinche's Bore, in Thundelarra Stn, 14 Sep. 2008, *D.J. Edinger* 6888 C; Gabyon Station/Cue Rd, Shire of Yalgoo, 19.4 km NE of Courin Hill, 8 Oct. 2004, *F. Hort, J. Hort & J. Shanks* 2365B; Barloo Well, *c.* 11 km WSW of Lakeside Stn HS, which is *c.* 53 km WSW of Cue, 22 Sep. 2012, *G.J. Marsh* GM 342; Jack Hills, survey site JACK 04, *c.* 8 km WSW of spot-height 514 m, and approximately 5 km from the junction of Berringarra – Cue Rd and the main track running adjacent and parallel N of the Jack Hills Range, 23 Aug. 2005, *R. Meissner & Y. Caruso* 703; 13 km SW of Coodardy HS, 15 Sep. 1986, *A.A. Mitchell* 1561; *c.* 3.9 km upstream of the Greenough River where it crosses the Yuna – Tenindewa Rd (i.e. Noondamurra Crossing), 14 Oct. 2003, *F. Obbens* FO 73/03; *c.* 100 m S down track to Karara HS from junction with Mungada Rd, *c.* 50 km directly NE of Perenjori, 10 Sep. 2007, *F. Obbens* FO 7/07; on access track to Red Bluff, Quobba Stn, just off track before descent into beachfront and campgrounds, *c.* 2 km N of Red Bluff, 2 Sep. 2020, *F. Obbens* FO 03/20; along Butchers Track, 25.7 km E of where gas pipeline crosses track and also *c.* 93 km E of the North West Coastal Hwy, 19 Aug. 2008, *F. Obbens, F. Hort & J. Hort* FO 11/08; 12.7 km N along Twin Peaks-Wooleen Rd from Twin Peaks Stn turnoff (i.e. vicinity of Mt Hope), 17 Sep. 2008, *F. Obbens, F. Hort & J. Hort* FO 37/08; 21.2 km N of Gascoyne Junction townsite on the Ullawarra Rd (E side of Rd), 13 Oct. 2011, *F. Obbens & G. Marsh* FO 16/11; *c.* 22 km WNW of Mingenew townsite, 1 Oct. 2008, *B. Taylor & K. Greenacre* MING 68-01; adjacent to Quadrat WUN1 on Eurardy Stn, which is *c.* 43 km N of Kalbarri turnoff on the North West Coastal Hwy and N of the Murchison River in the Shire of Northampton, 29 Aug. 2003, *Wildflower Society of WA* EURA 57. SOUTH AUSTRALIA: Uro Bluff, Yudnapinna locality, Sep. 1939, *Anon. s.n.* (AD 98590874, AD 98590882); Gawler Ranges, Kolendo Stn, 18 Oct. 1985, *Anon. s.n.* (AD 98649124); 13 km ESE of Billa Kalina HS, 21 Dec. 1984, *F.J. Badman* 1602 (AD); 8 km NE of Bulgunnia HS, 13 Nov. 1992, *F.J. Badman* 6456 (AD); 12 km S of Innamincka No. 3 Bore, Innamincka Regional Reserve, 14 Oct. 1996, *F.J. Badman* 9996 (AD); 32.2 km direct SSE of King Lookout, Innamincka Regional Reserve, 18 Sep. 2008, *M. Barnett* BS612-323 (AD); 100 m S of creek crossing by Cadnawatina Dam, Coronation paddock, Witchelina, [4.2 km direct ESE of The Bend], 13 Oct. 2010, *P.J. Lang & N.R. Neagle* BS719-207 (AD); Drive N from Marqualpie Bore to boundary with Cordillo Downs, then turn W and drive 11.5 km, [10.8 km direct ESE of Ootadoola Hill], Innamincka Regional Reserve, 19 Sep. 2008, *N.R. Neagle & M. Thomas* BS612-787 (AD); 21.6 km direct SSW of Arrabury, Innamincka Regional Reserve, 25 Sep. 2008, *N.R. Neagle & G.M. Kluske* BS612-1062 (AD); NE Andamooka Mine, Town Dam track, 22 Oct. 2004, *M.C. O'Leary* 4554 (AD); 9.3 km WNW from May Hill, property: Wirraminna, 8 Nov. 1996, *G.A. Pickerell & T.M. Celebrezze* BS69-31199 (AD); 3.6 km S from Marsella Hill, [1.5 km direct WSW of The Pines], property: Arcoona, 12 Nov. 1996, *S.J. Pillman & T.S. Goodman* BS69-30663 (AD). QUEENSLAND: 23 miles WNW of Thargomindah on loose red sandhill, 12 Sep. 1967, *L. Pedley* 2471 (AD, BRI); QNC Trip, Site 5, 30 km ENE of Rosebirth [roughly halfway along Rd between Birdsville and Betoota], 22 Aug. 1978, *R.W. Purdie* 1282 (BRI). NEW SOUTH WALES: Camerons Corner, 9 Sep. 1981, *S.W.L. Jacobs* 4148 (NSW 679874); 18 km E of Cameron Corner, near Olive Downs HS, 29 Oct. 1986, *A.N. Rodd, J. Gentle & Peter G. Wilson* 5779 (NSW 196383).

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Austrobaeckea, a new south-western Australian genus of Myrtaceae (Chamelaucieae: Hysterobaeckeinae)

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Abstract

Austrobaeckea, a new south-western Australian genus of Myrtaceae (Chamelaucieae: Hysterobaeckeinae). *Nuytsia* 32: 173–197 (2021). The new Myrtaceous genus *Austrobaeckea* Rye is described, with eight species recognised. It is a member of tribe Chamelaucieae DC. subtribe Hysterobaeckeinae Rye & Peter G.Wilson and is restricted to the southern part of the South West Botanical Province of Western Australia. Three new species are named as *A. columnaris* Rye, *A. fascifolia* Rye and *A. narembeen* Rye, and the following new combinations are made: *A. latens* (C.R.P.Andrews) Rye, *A. pygmaea* (R.Br. ex Benth.) Rye, *A. pachyphylla* (Benth.) Rye, *A. uncinella* (Benth.) Rye and *A. verrucosa* (Turcz.) Rye. A lectotype is selected for *A. uncinella*. Three species have conservation priority.

Introduction

A new genus of Myrtaceae tribe Chamelaucieae DC. is described here as *Austrobaeckea* Rye. It is one of many diverse species groups that were previously included in a large and indefinable, polyphyletic *Baeckea* L. *s. lat.* Since 1985, ten genera have been reinstated from synonymy, two infrageneric taxa raised to generic level, six new genera named and all 18 genera assigned to new subtribes (see Table 1), leaving *Baeckea s. str.* as the only genus of subtribe Baeckeinae Schauer. A few species of *Baeckea s. lat.* have also been transferred into *Astartea* DC. and *Malleostemon* J.W.Green.

Ten of the reassigned genera are now included in the large subtribe Hysterobaeckeinae Rye & Peter G.Wilson and all remaining unassigned species of *Baeckea s. lat.* also belong in this subtribe. All of these unassigned '*Baeckea*' species occur in south-western Australia; some await new combinations or names to transfer them into existing genera while others, like the species assigned here to *Austrobaeckea*, are not a good match for any existing genus.

Austrobaeckea is restricted to the South West Botanical Province (*sensu* Beard 1980) of Western Australia and occurs primarily near the south coast between Walpole and Israelite Bay, a distribution favourable to the early discovery of its species by visiting naturalists and new colonists. Five of the eight species treated here were named within 80 years of the time of European settlement of Western Australia and one of the three new species was also collected within that period.

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Table 1. Progressive publication from 1986 onwards of new or reinstated groups from *Baeckea s. lat*, and the new subtribes assigned to them by Rye *et al.* (2020).

Publication	Genus	Action taken	Subtribe
Trudgen (1986)	*Rinzia* Schauer	reinstatement	Rinziinae
Trudgen (1987)	*Ochrosperma* Trudgen	new genus previously known as *Baeckea* sect. *Pausomyrtus* Radlk.	Ochrospermatinae
Bean (1995)	*Triplarina* Raf.	reinstatement	Rinziinae
Trudgen (2001)	*Euryomyrtus* Schauer	reinstatement	Rinziinae
Trudgen & Rye (2005)	*Astus* Trudgen & Rye	new genus	Rinziinae
Wilson *et al.* (2007)	*Harmogia* Schauer *Kardomia* Peter G.Wilson *Sannantha* Peter G.Wilson	reinstatement new genus new genus	Hysterobaeckeinae Hysterobaeckeinae Hysterobaeckeinae
Rye & Trudgen (2008)	*Seorsus* Rye & Trudgen	new genus	Astarteinae
Rye (2009a)	*Cheyniana* Rye	new genus	Hysterobaeckeinae
Rye (2009b)	*Oxymyrrhine* Rye	reinstatement	Hysterobaeckeinae
Trudgen & Rye (2010)	*Enekbatus* Trudgen & Rye	new genus	Rinziinae
Rye & Trudgen (2012)	*Anticoryne* Turcz. *Cyathostemon* Turcz. *Tetrapora* Schauer	reinstatement reinstatement reinstatement	Hysterobaeckeinae Astarteinae Hysterobaeckeinae
Rye (2015a)	*Ericomyrtus* Turcz.	reinstatement	Hysterobaeckeinae
Rye (2015b)	*Hysterobaeckea* (Nied.) Rye	new combination for *Baeckea* subg. *Hysterobaeckea* Nied.	Hysterobaeckeinae
Rye (2015c)	*Babingtonia* Lindl.	reinstatement	Hysterobaeckeinae

History of recognition of the species

Robert Brown collected a swampland species of *Austrobaeckea* at King George Sound in December 1801 and gave it a manuscript name, but more than sixty years were to pass before Bentham (1867) formally described it as *Baeckea pygmaea* R.Br. ex Benth. By then, specimens collected by James Drummond and George Maxwell had been used to describe a related species, first as *Tetrapora verrucosa* Turcz. (Turczaninow 1852), then as *Harmogia corynophylla* F.Muell. (Mueller 1860). In a later publication, Mueller (1864) simultaneously published the names *Baeckea corynophylla* (F.Muell.) F.Muell. and *Babingtonia corynophylla* (F.Muell.) F.Muell.; hence, this species had been placed in four genera before Bentham (1867) combined all these genera under *Baeckea s. lat.* in *Flora Australiensis*.

Bentham (1867) increased the number of named species now recognised as *Austrobaeckea* by also describing *Baeckea pachyphylla* Benth. and *B. uncinella* Benth. He included those two species with *B. corynophylla* in *Baeckea* sect. *Oxymyrrhine* (Schauer) Benth. together with the type species of *Oxymyrrhine* Schauer and one species of *Ericomyrtus* Turcz.; hence, more than half of the species placed in sect. *Oxymyrrhine* were of *Austrobaeckea*. However, Bentham placed one species of *Austrobaeckea* [as *B. pygmaea*] in sect. *Babingtonia* (Lindl.) Benth., together with two species of *Ericomyrtus* [as *B. corymbulosa* Benth. and *B. pulchella* DC.] and species of *Anticoryne* Turcz., *Babingtonia* Lindl. and *Tetrapora* Schauer, as well as several currently unplaced species.

The final species to be named was *B. latens* C.R.P.Andrews, which Andrews (1904) placed in sect. *Oxymyrrhine* and considered to be closely allied to *B. uncinella*.

During the early 1990s, unpublished measurements and descriptions were prepared by Sandra Maley and Bronwen Keighery for all but one of the eight species recognised here for *Austrobaeckea*, as part of

an Australian Biological Resources Study project supervised by Malcolm Trudgen. Following the discovery of the eighth species, collected for the first time in 1999, Trudgen allocated phrase names under *Baeckea s. lat.* in 2004 and 2005 to the three undescribed taxa now included in *Austrobaeckea*.

Molecular evidence

Two members of the genus formed a strongly supported clade in molecular analyses based on several chloroplast DNA sequences (Lam *et al.* 2002; Wilson *et al.* 2004). The two species sampled were *A. verrucosa* (Turcz.) Rye and *A. uncinella* (Benth.) Rye [as *Baeckea corynophylla* and *B. uncinella*]. The same two species of *Austrobaeckea* were included among DNA samples used to produce Figure 1 in Rye *et al.* (2020: 196), where they formed the strongly supported clade labelled '*Baeckea* 7/2' within subtribe Hysterobaeckeinae. In this case a nuclear DNA region (ETS) was also used. Previously, a third member of the new genus, *A. latens* (C.R.P.Andrews) Rye, had also been sequenced for DNA and shown to belong to the same clade (P. Wilson, pers. comm. 2015).

It was not clear from these publications which genus of Hysterobaeckeinae is most closely related to *Austrobaeckea* but a clade of genera with reduced anthers was strongly supported in an unpublished study based on chloroplast and nuclear regions (P. Wilson, pers. comm. 2015). This clade had *Austrobaeckea* as sister to a subclade comprising *Cheyniana, Ericomyrtus* and *'Baeckea' elderiana* E.Pritz., while *Oxymyrrhine* formed a separate clade.

Need for further studies

This is a taxonomically difficult species group in which separation of its members relies heavily on differences in leaf characters. The only species that can be readily identified from floral characters is *A. pygmaea* (R.Br. ex Benth.) Rye. The five previously named species are accepted here as being good species but further studies of them, and of the three new species, are needed in view of the great variability within most of them and the presence of a few specimens that are hard to place. There may be some hybridisation between taxa with greatly overlapping ranges; if so, it could account for a few apparently intermediate specimens.

Further molecular data are needed to investigate the placement of all the taxa listed above as possible relatives of *Austrobaeckea* and the relationships between all eight species included here within *Austrobaeckea*.

No chromosome numbers are known for the new genus.

Methods

Sharr (2019) was consulted for the derivations of epithets. Type material housed at PERTH, or borrowed from MEL, was examined and images of types housed elsewhere were examined through *Global Plants* (https://plants.jstor.org/). Some additional specimens on loan from AD, CANB and MEL were also examined.

Measurements were made from dry herbarium material, using the largest leaves and stalks available and being careful to avoid immature floral organs, fruits and seeds when taking measurements of those items. Stamen and ovule numbers recorded earlier by Sandra Maley and Bronwen Keighery were written onto the PERTH sheets they examined, as were some of their style measurements. Their

measurements of other organs were obtained by different methods so were not strictly comparable to those obtained in the current study, but were still useful to check the accuracy of the new measurements, and for the most part there was a good agreement in the measurements obtained in the two studies.

Characteristics of the genus

Vegetative characters

Austrobaeckea species are small or medium-sized shrubs, either single-stemmed or multi-branched at the base. They commonly have galls on or within the young stems. One kind of gall is a long swelling of the stem well below its apex, with the mature insect eventually emerging via a circular hole. A more common kind of gall is a woody structure that usually terminates a branchlet. Terminal galls have a bulbous base and narrower flattened apex and appear to be empty once fully formed; they tend to split longitudinally into two halves.

The leaves in *Austrobaeckea* are small and entire. In most species they are about as thick as wide; however, they range from being markedly bilaterally compressed in *A. verrucosa* to dorsiventrally compressed, although always still quite thick, on many specimens of *A. pygmaea*.

Separation of the species relies primarily on leaf morphology and whether the leaves are clustered. Apart from the differences in leaf thickness noted above, important characters include the petiole length, the curvature of the adaxial surface and the length of the apical point, if present.

Inflorescence characters

Most species of *Austrobaeckea* produce fewer than five pairs of peduncles on each flowering branchlet, but *A. verrucosa* produces up to nine pairs of peduncles. Peduncles are not uniformly 1-flowered in any species; the most common multiple number of flowers per peduncle is three and *A. uncinella* has up to nine flowers. When there is a triad, the central flower normally matures earlier than the two lateral flowers and sometimes differs in the length of its pedicel. All pedicels usually arise directly at the summit of the peduncle, regardless of how many flowers there are, but in some species there is very rarely a short stalk (secondary axis) arising at the summit such that not all pedicels are directly attached to the peduncle. All occurrences of a secondary axis appear to be anomalies.

For distinguishing species, the inflorescence characters of greatest importance are the length of the peduncle and the relative length of the peduncles and pedicels. At 0.2–0.6 mm long, peduncles are particularly short in *A. columnaris*, with the pedicels up to about five times longer, while at the other extreme *A. pygmaea* has 4–11 mm long peduncles that are up to four times longer than the pedicels. There is a tendency within each species for peduncles that subtend just one flower to be shorter than those subtending multiple flowers as well as a tendency for fast-growing shoots to have longer peduncles and pedicels.

Floral characters and pollination

Like many other groups of species within *Baeckea s. lat.*, *Austrobaeckea* has small, white flowers that would attract a variety of small insects to their readily accessible nectar. One characteristic feature of *Austrobaeckea* is the presence of prominent oil glands on the ovary summit. Rather prominent

glands are also found on the adnate part of the hypanthium and the sepals. The sepals are incurved and have a thickened or keeled herbaceous centre. The inner sepals usually have a broadly obtuse herbaceous portion within a petaline margin, while the outer sepals are more prominently keeled and the herbaceous part often extends well beyond the petaline margin, resulting in a more acute apex. The ridging of sepals is most extreme in *A. verrucosa*, in which the outer sepals appear to be horned, with the horn up to about 1 mm long.

The petals are white in all species and are broadly ovate to broadly obovate and narrowly attached at the base. They are piled up in bud, with each petal extending over the entire summit of the ovary, and must therefore open one at a time starting with the outermost, i.e. the topmost, petal. The innermost petal at the bottom of the pile lies directly over the stamens, causing it to be crinkled when it opens. Sepals are shorter than the petals but more broadly attached at the base.

Stamen number is variable within each species, especially in *A. pygmaea*, which has 10–25 stamens per flower. *Austromyrtus pygmaea* is the only species to sometimes have numerous stamens arranged opposite both the petals and the sepals in a more or less continuous circle. In the remainder of the genus there are 2–13 stamens that are all antisepalous with usually variable numbers of stamens opposite the sepals of a single flower. Note that stamens are only considered to be antipetalous if they are attached within the rather narrow attachment area of a petal.

In most species the stamens are ten or fewer, with the number of stamens opposite each sepal usually not exceeding two. What all species except *A. pygmaea* have in common is that a few or many of their flowers have eight stamens in the arrangement 2,2,1,2,1. In flowers with five stamens there is often one stamen opposite each sepal, i.e. 1,1,1,1,1.

Filaments are more or less terete and anthers are broad in comparison with the height of the thecae, which are 2-lobed. The connective gland protrudes slightly to fairly distinctly from between the base of the thecae and its exposed surface becomes hollowed after the pollen is released.

The ovary is fully inferior and has a shallowly concave summit. The small-flowered *A. pygmaea* is again the odd species out in having a 2-locular ovary, all other species having it 3-locular. Placentas are peltate, being more or less elliptic with a stalk towards the centre, and have ovules inserted around the full margin. The style length tends to be quite variable within species, reducing its value as a character in distinguishing species.

Fruiting characters

Austrobaeckea species have a small, largely inferior capsule, which releases its seeds from two or usually three radial valves on its summit. Each valve extends along the centre of a loculus from the circumference of the fruit summit to the central cylinder, which houses the sunken base of the style. The summit of the fruit has the centre of each loculus shallowly convex so as to be shortly above its junctions with adjacent loculi. The persistent sepals are fairly erect.

Seeds are small and have a thin, crustaceous testa, which usually becomes dark red-brown when fully mature. They are only slightly facetted in *A. pygmaea* but distinctly facetted in all other species. The seeds produced at one end of the placenta may be of a somewhat different shape from most seeds. Such seeds can be wider than thick rather than the usual wedge shape that is thicker than wide.

Descriptions and key

Austrobaeckea Rye, *gen. nov.*

Typus: *Austrobaeckea verrucosa* (Turcz.) Rye.

Shrubs erect or rarely low-growing, 0.1–1.5(–2.6) m high, glabrous. *Young stems* with a loose, pale grey or brownish epidermis that splits into strips when shed. *Leaves* opposite, decussate, small, shortly petiolate; blade dorsiventrally compressed to bilaterally compressed but commonly about as thick as wide, entire. *Peduncles* usually very short to about as long as the pedicels, but in one species usually distinctly longer than the pedicels, 1–3(–9)-flowered, never consistently 1-flowered; secondary axes absent from all or most peduncles. *Bracts and bracteoles* shed early or at least shed prior to the fruiting stage in most species, narrow, with margins incurved. *Buds* with a convex or shallowly convex apex. *Hypanthium* broad, usually shallowly cup-shaped, dotted with oil glands; adnate portion broadly obconic to depressed hemispheric; free portion short, erect or spreading. *Sepals* 5, persistent in fruit, shorter than the petals but with a broader base, the outer ones dorsally ridged or appearing horned. *Petals* 5, shed before the fruit matures, very shortly narrowed at base, broadly obovate to broadly ovate to ± circular, 1.2–4 mm long, white inside, with the portion of the outermost petal that is exposed in late bud sometimes deep pink. *Antipetalous colleters* usually inconspicuous. *Staminodes* rare or absent. *Stamens* 2–25 but mostly in the range 5–13, in antisepalous groups of 0–5 (rarely also opposite petals), free, geniculate, mostly widely spaced, those closest to the centre of a sepal usually shortest. *Filaments* slender, ± terete, white or pale pink. *Anthers* introrse, small, broader than the height of the thecae, dehiscent by 2 pores or short slits that tend to diverge basally, brown to maroon; thecae short, closely connate, their junction marked by a groove; connective gland fused over its full length, shortly protruding at the rear of the thecae where the filament attaches but sometimes inconspicuous, becoming hollowed on the exposed surface. *Ovary* usually 3-locular but 2-locular in one species, inferior; summit green at first, becoming deep pink to red in fruit, with rather large oil glands; placentas axile, ± elliptic, distinctly stalked at the centre; ovules 5–14 per loculus. *Style* terete, 0.6–1.8(–2.2) mm long, with the base inset in a long cylindrical depression; stigma scarcely enlarged to somewhat peltate, circular from top view. *Fruit* 2/3 to fully inferior, few- or many-seeded, dehiscent by terminal valves; summit fairly level at first, becoming expanded upwards and 2- or 3-lobed in fruit, small, enclosed by the glandular, adnate part of the hypanthium, with the free hypanthium spreading outwards from the fruit summit. *Seeds* facetted, mostly wedge-shaped, with a large, curved outer surface, two equal lateral surfaces and usually a small inner surface, 0.45–1 mm long, with a small hilum; testa crustaceous, uniformly coloured or with some cells dark-coloured, usually becoming dark red-brown, colliculate on the lateral surfaces, somewhat smoother on the outer surface. *Chaff pieces* strongly facetted, more flattened and usually more numerous than the seeds, uniformly coloured and mostly darker or paler than the seeds.

Diagnostic features. Distinguished from other genera in subtribe Hysterobaeckeinae by the following combination of characters: peduncles 1–9-flowered (never consistently 1-flowered); anthers small, broader than the length of the thecae; connective gland fused, scarcely to noticeably protruding, becoming hollowed; ovules 5–14 per loculus; fruits dehiscent by 2 or 3 terminal valves; and seeds facetted.

Size and distribution. A genus of eight species, endemic to the south-west of Western Australia and concentrated near the south coast, mainly occupying the Esperance and Mallee bioregions but also recorded in the Jarrah, Warren and Avon Wheatbelt bioregions (Figure 1). It extends from north of Lake Muir east to Cape Arid National Park and inland to the Merredin area.

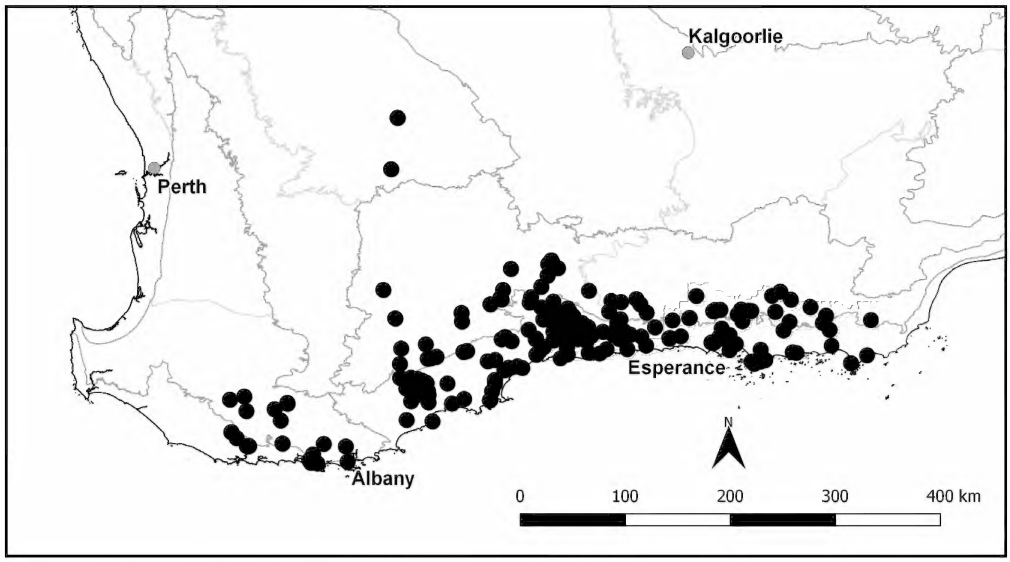

Figure 1. Distribution of the genus *Austrobaeckea*.

Etymology. From the Latin *austro-* (southern) and the generic name *Baeckea*, in which members of the new genus were previously placed, as *Austrobaeckea* is distributed primarily along the south coast. Its distribution is more consistently southern than that of any other genus that has previously been included in *Baeckea s. lat.*

Co-occurring species. Two of the *Austrobaeckea* species do not overlap in distribution with any other members of this genus. Among the other six taxa, there are very few records of two taxa co-occurring. Further field studies are needed to determine how frequently taxa co-occur and whether this results in hybridisation in the genus.

Affinities. Generic relationships within subtribe Hysterobaeckeinae have yet to be fully determined. *Austrobaeckea* is most likely to be confused with *Ericomyrtus*, *Oxymyrrhine* and *Tetrapora*, all of which have small anthers with the connective gland either fully incorporated within the structure housing the thecae or not greatly protruding. Both *Ericomyrtus* and *Oxymyrrhine* differ from *Austrobaeckea* in having consistently 1-flowered peduncles. *Ericomyrtus* also has longer and more persistent bracteoles. *Oxymyrrhine* has a continuous circle of numerous stamens, a character absent in *Austrobaeckea* except rarely in *A. pygmaea*, and also differs in having a broadly hollowed top to its ovary. *Tetrapora* matches *Austrobaeckea* in having usually multi-flowered peduncles but does not appear to be particularly closely related on the basis of the molecular evidence presented above, as it falls into a clade that includes *Anticoryne*, *Babingtonia*, *Malleostemon* and *Scholtzia* Schauer. *Tetrapora* differs from *Austrobaeckea* in having almost spherical to broadly ellipsoid anthers fully incorporating the connective gland, which does not become hollowed, and some differences in its stamen arrangement. More comprehensive molecular data could be valuable in determining the affinities of *Austrobaeckea* more precisely.

Notes. Among the genera of subtribe Hysterobaeckeinae, *Austrobaeckea* is unusual in having a concentration of species near the south coast between Walpole and Israelite Bay, with only one of its eight species being restricted to an area well inland. Four other small genera, *Anticoryne*, *Ericomyrtus*, *Oxymyrrhine* and *Tetrapora*, have at least one species occurring near the south coast. There is also a

single member of the *Baeckea muricata* C.A.Gardner group, *B.* sp. Gibson (K.R. Newbey 11084), but that differs from all other species in the region in having a very prominent connective gland.

Key to species of *Austrobaeckea*

1. Leaves noticeably to markedly bilaterally compressed

2. Leaves distinctly bilaterally compressed, 1.2–1.8 mm thick, about twice as thick as wide; adaxial surface convex, grading into the lateral surfaces, usually narrower than abaxial surface. Outer sepals 1–1.5 mm long (Jerrumungup area–near Munglinup) ..... **A. verrucosa**

2: Leaves somewhat compressed, 0.8–1.3 mm thick, up to about 1.5 times thicker than wide; adaxial surface concave to shallowly convex, often distinctly demarcated from the lateral surfaces, broader than abaxial surface. Outer sepals 0.4–1.1 mm long (near Ongerup–SE of Mt Ney) ..... **A. pachyphylla**

1: Leaves about as thick as broad or dorsiventrally compressed

3. Petals 1.2–1.8 mm long. Stamens (10–)12–25. Ovary 2-locular in all or most flowers (N of Lake Muir–near Albany) ..... **A. pygmaea**

3: Petals 1.8–4 mm long. Stamens 3–10(–13). Ovary 3-locular in all or most flowers

4. Peduncles up to 1.3 mm long when multi-flowered, down to 0.2 mm long when single-flowered

5. Branches with a column-like appearance. Petioles 0.5–0.7 mm long. Leaf blades flattened on adaxial surface, 2.5–4.5 mm long (S & SE of Ongerup) ..... **A. columnaris**

5: Branches not column-like. Petioles 0.7–1.2 mm long. Leaf blades subterete, 4–6.5 mm long (Lake Mortijinup–Cape Arid NP) ..... **A. fascifolia**

4: Peduncles 1.5–6.5 mm long when multi-flowered, down to 1 mm long when single-flowered

6. Leaves terminating in a recurved point 0.2–0.5 mm long. Stamens 7–13 (Young River–near Mt Heywood) ..... **A. uncinella**

6: Leaves with apical point absent or up to 0.1 mm long. Stamens 3–10

7. Shrubs up to *c.* 2.6 m high, with subterete leaves. Sepals 0.5–0.8 mm long, at least five times shorter than the 3–4 mm long petals (Merredin area–Narembeen area) ..... **A. narembeen**

7: Shrubs up to *c.* 1.8 m high, with all or most leaves of flowering stems having the adaxial surface ± flat. Sepals 0.8–1.3 mm long, about three times shorter than the 2.5–3.5 mm long petals (Merilup NR–near Mt Ragged) ..... **A. latens**

1. **Austrobaeckea columnaris** Rye, *sp. nov.*

Typus: Corackerup, south-east of Ongerup [precise locality withheld for conservation reasons], Western Australia, 6 August 1977, *K.R. Newbey* 5048 (*holo*: PERTH 06707203; *iso*: CANB, K, MEL, NSW, PERTH 06266657).

Baeckea sp. Corackerup (K.R. Newbey 5048), Western Australian Herbarium, in *Florabase*, https://florabase.dpaw.wa.gov.au/ [accessed 24 July 2017].

Shrub 0.4–0.8 m high, 0.1–0.6 m wide, single-stemmed at base and usually with 2 or 3 major branches 20–150 mm above the base and with secondary branches few and short, giving the branches a column-

like appearance; flowering branchlets with 1–3 pairs of peduncles and with the flowers borne on them combining to produce a many-flowered cluster. *Leaves* widely antrorse or patent when clustered but shallowly antrorse when widely spaced, often clustered. *Petioles* 0.5–0.7 mm long. *Leaf blades* often recurved, commonly narrowly or very narrowly obovate in outline, 2.5–4.5 mm long, *c.* 0.6 mm wide, *c.* 0.6 mm thick, obtuse, without any obvious apical point but often recurved; abaxial surface deeply convex, with usually few oil glands in 2 or 3 main rows on each side of midvein; adaxial surface almost flat (rather than concave or convex), with less obvious oil glands. *Peduncles* 0.2–0.6 long, 1–3-flowered. *Largest bracts or bracteoles* 0.6–1.1 mm long. *Pedicels* 1–2 mm long, 3–5 times longer than the peduncles. *Flowers* 5–5.5 mm diam. *Hypanthium* hemispheric or shallowly cup-shaped, 1–1.5 mm long, 1.5–2 mm wide; free portion *c.* 0.4 mm long. *Sepals* very broadly ovate, 0.4–0.5 mm long, *c.* 0.6 mm wide, broadly obtuse, the outer ones prominently ridged. *Petals* 1.8–2.2 mm long, white. *Stamens* 7–10, with 1 or 2 opposite each sepal, most commonly 8 in the arrangement 2,2,1,2,1. *Longest filaments* 0.3–0.6 mm long. *Anthers* 0.25–0.3 mm wide; thecae up to 0.2 mm high, maroon; connective gland protruding by *c.* 0.1 mm, paler than the thecae. *Ovary* 3-locular; ovules 8–11 per loculus. *Style* 0.7–1.2 mm long; stigma somewhat peltate, 0.15–0.2 mm diam. *Fruits c.* 2/3 inferior, *c.* 1 mm long, 1.5–2 mm wide; summit prominently glandular; hypanthium glandular-rugose on adnate part. *Seeds* 0.5–0.55 mm long, *c.* 0.35 mm wide, *c.* 0.4 mm deep, facetted, golden brown, colliculate on lateral surfaces.

Diagnostic features. Distinguished from other species of *Austrobaeckea* in having branches with a column-like appearance. Other important characters: leaves tending to be clustered; petioles 0.5–0.7 mm long; leaf blades 2.5–4.5 mm long, *c.* 0.6 mm thick, about as thick as wide, flattened on adaxial surface; peduncles 0.2–0.6 long, up to five times shorter than the pedicels.

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 15 Jan. 1979, *B. Barnsley* 637 (PERTH); 15 Apr. 2017, *G. Byrne* 6236 (PERTH); *s. dat.*, *J. Drummond s.n.* (MEL 76447, 76509 & 76511); 3 May 1974, *K.R. Newbey* 4126 (PERTH), 20 Apr. 2005, *S. Oborne* 63 (PERTH).

Distribution and habitat. Occurs south and south-east of Ongerup, such as in the vicinity of Corackerup Creek (Figure 2A). Recorded on flats, at the type locality with shallow, loamy sand with clay and spongolite, at another locality with clay sand on laterite and a low heath with *Eucalyptus uncinata*.

Phenology and insect associations. Flowers recorded from January to August and mature fruits recorded in April and May. According to Ken Newbey's field notes, the type population flowered from early July to late August with individual plants flowering for long periods. Terminal galls are common on one (*B. Barnsley* 637) of the few collections of this species.

Etymology. From the Latin *columnaris* (columnar), referring to the column-like branches. This habit is shown in a colour photograph attached to one of the specimens (*S. Oborne* 63).

Conservation status. Recently listed as Priority Two under the Conservation Codes for Western Australian Flora (Western Australian Herbarium 1998–) under the name *Baeckea* sp. Corackerup (K.R. Newbey 5048). This species has a restricted distribution and few populations are known.

Affinities. Possibly closest to *A. fascifolia*, as both species have short peduncles, clustered leaves and the smallest flowers apart from those of *A. pygmaea*, but differing from *A. fascifolia* in its habit and leaf morphology as indicated in the key.

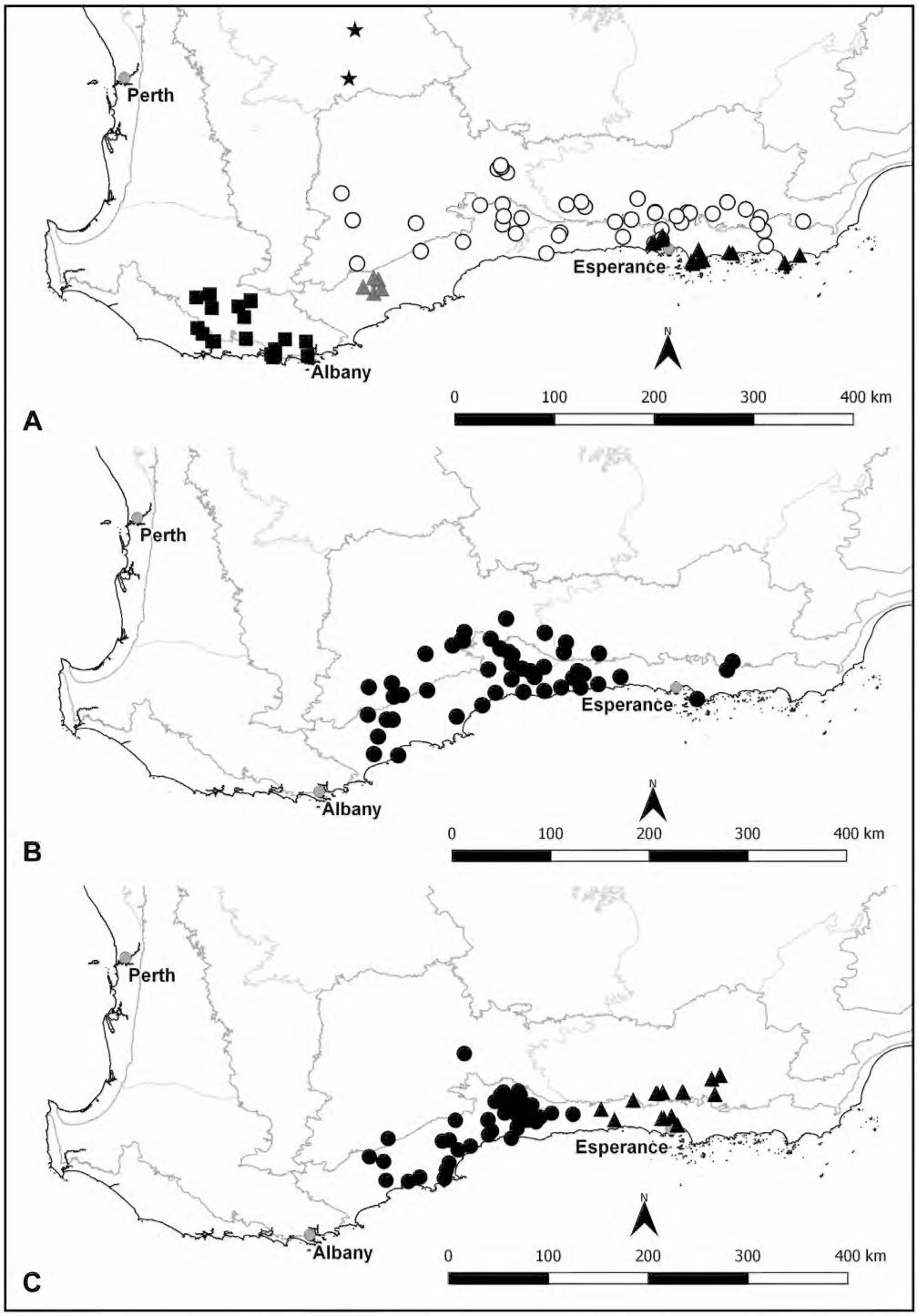

Figure 2. Distribution of *Austrobaeckea* species. A – *A. columnaris* (▲), *A. fascifolia* (▲), *A. latens* (○), *A. narembeen* (★) and *A. pygmaea* (■); B – *A. pachyphylla* (●); C – *A. uncinella* (▲) and *A. verrucosa* (●).

Notes. This species was collected by James Drummond (see MEL collections listed above) probably in 1843–1844 on his third or 1848–1849 on his fifth collecting trip but no details are given on the specimens. Fortunately, Ken Newbey's very detailed field notes have been attached to the type specimen. His description records ten stamens, with one stamen located on each side of the base of each petal, i.e. with two stamens opposite every sepal. However, most flowers on the type have fewer stamens than this.

2. Austrobaeckea fascifolia Rye, *sp. nov.*

Typus: inland from western side of road to Le Grand Beach, approximately 0.5 kilometres south from its junction with Frenchman's Peak turnoff, Cape Le Grand National Park, Western Australia, 22 December 1994, *A.G. Gunness* AG 2435 (*holo*: PERTH 06707343; *iso*: CANB, K, MEL).

Baeckea sp. Esperance (A.G. Gunness AG 2435), Western Australian Herbarium, in *Florabase*, https://florabase.dpaw.wa.gov.au/ [accessed 24 July 2017].

Shrub usually widely spreading, 0.3–1.2 m high, 0.4–1.2 m wide, with a single stem commonly *c.* 10–70 mm diam. at base; flowering branchlets with 1–3 pairs of peduncles. *Leaves* antrorse or patent, often clustered. *Petioles* 0.7–1.2 mm long. *Leaf blades* often incurved, appearing ± terete but with adaxial surface somewhat less curved than the deeply convex abaxial surface, narrowly or very narrowly obovate in outline, 4–6.5 mm long, 0.7–1.1 mm wide, 0.6–1 mm thick, obtuse, sometimes with a slight mucro, dotted with oil glands that are often prominent. *Peduncles* 0.4–1.3 mm long, 1–3-flowered. *Largest bracts or bracteoles* 0.6–1.3 mm long. *Pedicels* (1.5–)2–3.5 mm long, 3–4 times longer than the peduncles. *Flowers* 5–7 mm diam. *Hypanthium* almost cup-shaped in bud but becoming more flared at anthesis, 1–1.9 mm long, 1.5–2 mm wide; free portion 0.2–0.35 mm long. *Sepals* very broadly or depressed ovate, 0.4–0.7 mm long, 0.7–1.4 mm wide, broadly obtuse, with oil glands on the thickened keel and often with narrow petaline borders. *Petals* 1.8–2.8 mm long, white. *Stamens* 5–9, 0–2 opposite each sepal, commonly 8 in the arrangement 2,2,1,2,1. *Longest filaments* 0.35–0.6 mm long. *Anthers c.* 0.3 mm wide; thecae *c.* 0.2 mm high; connective gland protruding by *c.* 0.1 mm. *Ovary* 3-locular; ovules 7–11 per loculus. *Style* 0.7–1.5 mm long; stigma scarcely enlarged, up to *c.* 0.1 mm diam. *Fruits* usually *c.* 2/3 inferior, 1.2–1.5 mm long, *c.* 2 mm wide; summit prominently glandular; hypanthium glandular-rugose on adnate part. *Seeds* strongly facetted, 0.5–0.7 mm long, 0.4–0.5 mm wide, 0.4–0.5 mm deep, pale or golden brown with dark reddish markings, shallowly colliculate on lateral surfaces. (Figure 3A)

Diagnostic features. Distinguished from other species of *Austrobaeckea* by the following combination of characters: leaves tending to be clustered; petioles 0.7–1.2 mm long; leaf blades subterete, 4–6.5 mm long, 0.6–1 mm thick; peduncles 0.4–1.3 mm long, much shorter than the pedicels.

Selected specimens examined. WESTERN AUSTRALIA: Rossiter Bay, Cape Le Grand National Park, 27 Nov. 1985, *D.B. Foreman* 1274 (AD *n.v.,* CANB *n.*. MEL *n.v.*, NSW *n.v.*, PERTH); S of farm land on E of Duke of Orleans Bay Rd, 9.5 km S of Merivale Rd crossing, Duke of Orleans Bay, 21 Dec. 2005, *R.M. Hoggart* 1/1205 (PERTH); 1.9 km W of Hellfire Bay carpark, 2.0 km SE of Mt Le Grand summit, 6.7 km WSW of Lucky Bay campsite, Cape Le Grand National Park, 29 km SE of Esperance township, 26 Nov. 2011, *A. Markey & B. Bayliss* NIB 9533 (PERTH); Cape Arid National Park, 29 Nov. 1971, *R.D. Royce* 9830 (PERTH); maintenance track, Helms Arboretum, 10 Dec. 2003, *B.L. Rye* 231234 *& C.D. Turley* (NSW, PERTH); Telegraph Rd, Lake Mortijinup, 9 Jan. 2004, *C.D. Turley* 2/104 (PERTH); Cape Le Grand National Park, gravel pit up slope from general camp site, Lucky Bay, 13 Jan. 2004, *C.D. Turley* 10/104 & 11/104 (PERTH).

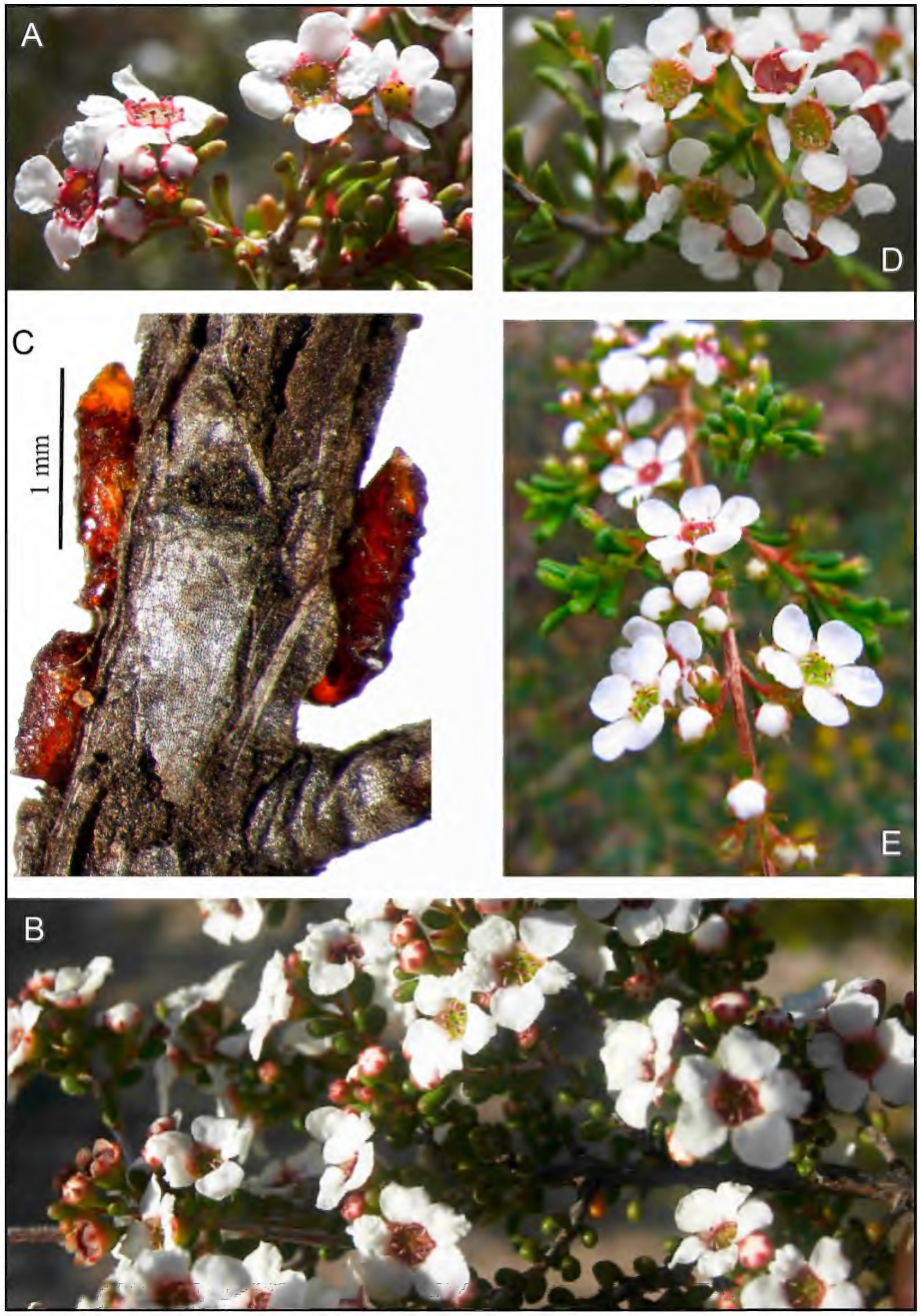

Figure 3. Images of *Austrobaeckea* species, most showing a change in the ovary summit from green glistening with nectar at anthesis to red in old flowers or young fruits. A – *A. fascifolia* in bud and flower, showing almost terete leaves; B – *A. pachyphylla* branch in bud, flower and fruit, showing short, thick leaves; C – stem of *A. pygmaea* infested with lac insects; D – *A. uncinella* flower cluster and leaves with a small apical point; E – *A. verrucosa* branch with buds, flowers and fruits, showing bilaterally compressed leaves and with horned sepals visible on some of the buds. Images taken by Peter Rye (A, B, D & E) and Alex Williams (C). Vouchers: *B.L. Rye* 231234 & *C.D. Turley* (A), *B.L. Rye* 231203 (B), *A.R. Annels* & *R.W. Hearn* 5102 (C) and *B.L. Rye* 231215 (D). The *A. verrucosa* photograph (E) was taken between Ravensthorpe and Hopetoun, and is unvouchered.

Distribution and habitat. Extends from Lake Mortijinup, west of Esperance, east to the southern part of Cape Arid National Park (Figure 2A), apparently in sandy soils in seasonally damp habitats close to the coast, sometimes associated with granite.

Phenology and insect associations. There is probably a long flowering season but all flowering specimens have been collected from November to February. Mature fruits have been recorded in January, February and September. Seed predation by weevils is suggested by the presence of a weevil within an old fruit from the September collection (*G. Byrne* 2618). Terminal galls appear to be rare in this species.

Etymology. From the Latin *fascis* (bundle) and *-folius* (-leaved), referring to the clustered leaves.

Conservation status. This species is not currently considered to be at risk. It probably extends along the coast for a distance of *c.* 150 km but does not extend very far inland.

Co-occurring species. Known to co-occur with *A. uncinella*, as discussed under that species.

Affinities. *Austrobaeckea fascifolia* shows some morphological similarities to *A. columnaris* as discussed under that species. It has previously been identified as *A. latens* but differs in its shorter peduncles, its clustered leaves on flowering shoots, its usually longer petioles and leaf blades that are subterete (*cf.* mostly flattened on adaxial surface). It tends to have the longest petioles in the genus although there is some overlap in length with *A. uncinella* (0.7–1.2 *vs.* 0.5–1 mm long).

Notes. This species was apparently collected for the first time in 1960 by Alex George (*A.S. George* 2231). Many of the subsequent collections were made by Coral Turley, whose botanical expertise and commitment in the Esperance region have been acknowledged by three species having been named after her, including *Hibbertia turleyana* J.R.Wheeler.

One specimen (*A. Strid* 21211) gives the flower colour as white or pale pink but the pink might refer to the buds, which may have a pink flush.

3. Austrobaeckea latens (C.R.P.Andrews) Rye, *comb. nov.*

Baeckea latens C.R.P.Andrews, *J. Western Australia Nat. Hist. Soc.* 2(1): 41 (1904). *Type*: sandplains north of Esperance, Western Australia, October 1903, *C.R.P. Andrews s.n.* (*holo*: PERTH 01605577).

Illustration. W.E. Blackall & B.J. Grieve, *How Know W. Austral. Wildfl.* 3A: 77 (1980) as *Baeckea latens*.

Shrub 0.3–1.8 m high, 0.4–1.5 m wide, one specimen multi-branched from a thick base 70 mm wide; flowering branchlets with 1–3(–6) pairs of peduncles. *Leaves* mostly antrorse, sometimes a few patent, sometimes almost appressed on rapidly growing shoots, not clustered on flowering shoots but sometimes clustered on lower vegetative branches. *Petioles* 0.5–0.8 mm long. *Leaf blades* very narrowly obovate to linear in outline, 4.5–8.5 mm long, 0.5–0.7 mm wide, 0.4–0.7 mm thick, dotted with small but sometimes prominent oil glands, sometimes with a slight mucro; abaxial surface deeply convex; adaxial surface shallowly concave to flat on flowering stems and when leaves widely spaced on vegetative branches. *Peduncles* mostly 1–1.5 mm long if 1-flowered and 1.5–6 mm long if multi-flowered, 1–3(–6)-flowered, never all 1-flowered. *Largest bracts or bracteoles* 1.2–2 mm long, rarely with a longer more leaf-like bract present, sometimes retained in late flower. *Pedicels* 2.5–4.5 mm long, mostly 0.75–2 times as long as the multi-flowered peduncles. *Flowers* 6.5–9 mm diam. *Hypanthium*

cup-shaped, 1.7–2.2 mm long, 2–2.5 mm wide; free portion 0.3–0.4 mm long. *Sepals* ovate or broadly ovate, 0.8–1.3 mm long, 1–1.6 mm wide, the outer ones strongly ridged or shortly horned. *Petals* 2.5–3.5 mm long, white. *Stamens* 3–10, with 0–3 opposite each sepal, commonly 8 in the arrangement 2,2,1,2,1, rarely with the stamen number reduced to 3. *Longest filaments* 0.5–0.7 mm long. *Anthers* pink, 0.2–0.25 mm wide; thecae 0.15–0.2 mm high; connective gland protruding by up to 0.1 mm. *Ovary* 3-locular; ovules 9–13 per loculus. *Style* 1.3–1.8 mm long; stigma 0.1–0.15 mm diam. *Fruits* inferior, 1.5–2.2 mm long, 2.5–2.75 mm wide. *Seeds* facetted, 0.7–0.8 mm long, 0.35–0.5 mm wide, 0.4–0.5 mm thick, brown, becoming dark red-brown, shallowly colliculate on lateral surfaces.

Diagnostic features. Distinguished from other species of *Austrobaeckea* by the following combination of characters: leaf blades about as wide as thick, with adaxial surface flattened on flowering stems; pedicels about as long as multi-flowered peduncles but often much longer than 1-flowered peduncles; sepals 0.8–1.3 mm long, about three times shorter than the 2.5–3.5 mm long petals.

Selected specimens examined. WESTERN AUSTRALIA: Hamersley River, SW of Ravensthorpe, Oct. 1903, *C. Andrews s.n.* (PERTH); 9 miles SE of Mt Ragged, 19 Oct. 1970, *T.E.H. Aplin* 4301 (PERTH); 5.3 km SE of Mt Gibbs, 9 Nov. 2005, *G.F. Craig* 7015 (PERTH); Merilup Nature Reserve, SE of Kukerin, N boundary of E block, *c.* 200 m E of NW corner, 9 Nov. 2015, *M. Hislop* 4569 (PERTH); Speddingup Reserve, SE boundary on Robins Rd, 580 m SW of Speddingup Rd, 11 Oct. 2016, *E. Massenbauer* 755 (PERTH); near Twertup Creek, Fitzgerald River National Park, 19 Oct. 1968, *K.R. Newbey* 2790 (PERTH); *c.* 32 km NNE of coast at Stokes Inlet, 18 Oct. 1968, *E.A. Orchard* 1640 (AD, PERTH); W of Salmon Gums, Frank Hann National Park, 10 Dec. 1971, *R.D. Royce* 10218 (PERTH); 2.2 km NW of the Gibson Soak Hotel, 8 Aug. 2003, *P.G. Wilson* 1630 *& N. Lam* (PERTH).

Distribution and habitat. Extends from Merilup Nature Reserve, south-east of Kukerin, east to near Mt Ragged (Figure 2A), in varied habitats including sandy soils with mallees and low-lying, winter-wet sites.

Phenology and insect associations. Flowers from late August to November, with mature fruits recorded from late August to December. Terminal galls occur on some specimens.

Etymology. From the Latin *latens* (hidden, secret), perhaps because the type specimen was referred to as 'a small fragment of this species among flowers gathered on the sand plain north of Esperance' (Andrews 1904: 41).

Conservation status. This is the most widespread species in the genus and is not at risk.

Co-occurring species. See notes under *A. uncinella*.

Affinities. See notes under *A. fascifolia*, *A. narembeen* and *A. pachyphylla*.

Notes. *Austrobaeckea latens* is typical of the genus in all characters scored, with no unique features, and therefore its identification relies on the absence of unusual characters. The type specimen is a fragment which has only the uppermost leaves and young flowers; its leaves are not clustered and they have a flattened adaxial surface. Its peduncles and pedicels are of about the same length.

A specimen that has been bent towards the base to allow a particularly long piece to be mounted (*M.E. & M.E. Trudgen* 1478) has similar leaves at the top where the flowers are borne but has densely clustered

leaves that are closer to terete on sterile branches nearer the base. This suggests that mature leaves may tend to be clustered and subterete but are usually not present on the specimens. *Austrobaeckea fascifolia* differs in having subterete leaves in dense clusters apparently throughout the plant, including its flowering stems, which gives it a different overall appearance.

One specimen (*E. Massenbauer* 755) is unusual in having a few flowers with ten stamens in the arrangement 3,2,1,3,1, which is very rare in *Austrobaeckea*, although it also has the typical eight stamens in the 2,2,1,2,1 arrangement and at least two other stamen numbers present.

4. Austrobaeckea narembeen Rye, *sp. nov.*

Typus: north-west of Narembeen, Western Australia [precise locality withheld for conservation reasons], 2 October 1997, *G.J. Keighery & N. Gibson* 3010 (*holo*: PERTH 06776515; *iso*: CANB, K, MEL, NSW).

Baeckea sp. Narembeen (G.J. Keighery & N. Gibson 3010), Western Australian Herbarium, in *Florabase*, https://florabase.dpaw.wa.gov.au/ [accessed 24 July 2017].

Shrub tall, 1.3–2.6 m high, up to 4.5 m wide, with numerous spreading branches from the base; flowering branchlets with 1 or 2 pairs of peduncles. *Leaves* mostly antrorse, sometimes almost appressed on rapidly growing shoots, not clustered. *Petioles* 0.4–0.6 mm long. *Leaf blades* very narrowly obovate to linear in outline, subterete, 4.5–5.5 mm long, 0.4–0.7 mm wide, 0.4–0.6 mm thick, dotted with small but often prominent oil glands, without any obvious apical point but occasionally with a minute mucro; abaxial surface deeply convex; adaxial surface shallowly convex throughout or only flattened near the base. *Peduncles* 2–5 mm long, 1–3-flowered. *Largest bracts or bracteoles* 0.9–1.3 mm long. *Pedicels* 3–4.5 mm long, 0.7–1.5 times as long as the peduncles. *Flowers* 8–9 mm diam. *Hypanthium* cup-shaped in bud, becoming more flared, 1.5–2 mm long, 2–2.5 mm wide, often 5-angled to somewhat 5-ribbed; free portion *c.* 0.5 mm long. *Sepals* broadly to depressed ovate, 0.5–0.8 mm long, 1.2–1.5 mm wide, the outer ones often strongly ridged. *Petals* 3–4 mm long, white. *Stamens* 8–10, 1–3 opposite each sepal, most commonly 8 in the arrangement 2,2,1,2,1 but 10 in the arrangement 3,2,2,2,1 also observed. *Longest filaments* 0.7–0.9 mm long. *Anthers* 0.25–0.3 mm wide; thecae 0.15–0.2 mm high, darker than the connective gland; connective gland protruding by 0.15–0.2 mm. *Ovary* 3-locular; ovules 10–13 per loculus. *Style* 1.3–1.7 mm long; stigma somewhat peltate, 0.15–0.2 mm diam. *Fruits* 4/5 to fully inferior, 1.6–2 mm long, 2.3–2.5 mm wide, rugose-glandular. *Seeds* facetted, 0.45–0.5 mm long, 0.35–0.4 mm wide, 0.3–0.35 mm deep, golden brown, shallowly colliculate on lateral surfaces.

Diagnostic features. Distinguished from other species of *Austrobaeckea* in its larger habit and more northern distribution. Other important characters: leaves subterete; petals 3–4 mm long, at least five times longer than the sepals.

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 8 Sep. 1999, *G.J. Keighery & N. Gibson* 7024 (PERTH); 9 Nov. 2008, *M.E. Trudgen & P. Jobson* MET 23134 A & MET 23134 B–E (PERTH); 31 Aug. 2006, *M.E. Trudgen & B. Moyle* MET 22542 (PERTH).

Distribution and habitat. Occurs near Merredin and Narembeen (Figure 2A), one of the localities on a breakaway with *Callitris canescens* and *Melaleuca hamata* and another with granite outcropping in places.

Phenology and insect associations. Flowers from late September to November, with fruits recorded in November. Specimens often have terminal galls or non-terminal stem galls, but the terminal galls observed are more elongated than those seen in other members of the genus and lack the longitudinal seam.

Etymology. Refers to the Narembeen area where this species was collected for the first time. The name of the town comes from a Noongar word for 'place of female emus'.

Conservation status. Listed by Smith and Jones (2018) as Priority Two under the Conservation Codes for Western Australian Flora under the name *Baeckea* sp. Narembeen (G.J. Keighery & N. Gibson 3010). Only two populations are known for this species.

Affinities. Apparently closest to *A. latens*, differing in its larger habit and uniformly subterete leaves. It also has shorter sepals but longer petals on average and hence its petals are at least five times longer than the sepals (*cf. c.* three times longer).

Notes. This is the most recently discovered species in the genus and was collected for the first time in September 1999 by Greg Keighery and Neil Gibson. It is odd in its occurrence on rocky habitats well north of the distribution of the other species of *Austrobaeckea*. Perhaps it benefits from increased moisture caused by runoff from the rock outcrops.

Most specimens now available are in immature fruit, limiting the opportunities to record stamen numbers and arrangement as well as seed measurements. Only one mature fruit with seeds was found amongst the specimens; this had the smallest seeds recorded so far for the genus.

Stamen filaments were recorded as red on one specimen 1.3 m high (*M.E. Trudgen & P. Jobson* MET 23134A) and white on a specimen 2.6 m high from the same population. As both plants were primarily in young fruit, the red filament colour may have been a sign of aging or stress. More collections in both flower and mature fruit are needed to check the description provided here.

5. Austrobaeckea pachyphylla (Benth.) Rye, *comb. nov.*

Baeckea pachyphylla Benth., *Fl. Austral.* 3: 85 (1867). *Type citation*: 'in the interior from the south coast, Maxwell. A single specimen in Herb. F. Mueller'. *Type*: south-west coast and interior of Western Australia, 1858–1866, *G. Maxwell s.n.* (*holo*: MEL 72895; *iso*: K 000821682, possibly also K 000821681 & PERTH 01606107).

Illustration. W.E. Blackall & B.J. Grieve, *How Know W. Austral. Wildfl.* 3A: 74 (1980) as *Baeckea pachyphylla*.

Shrub 0.4–1.5(–2) m high, 0.3–1.2(–2.5) m wide; flowering branchlets with 1–4 pairs of peduncles. *Leaves* antrorse or patent, not clustered. *Petioles* 0.3–0.6 mm long. *Leaf blades* somewhat bilaterally compressed (up to 1.5 times thicker than wide), irregularly obovate or narrowly so from side view, 2.5–4.5 mm long, 0.7–1.1 mm wide, 0.8–1.3 mm thick, dotted with oil glands, which are sometimes prominent, without any apical point or with a point less than 0.1 mm long; abaxial surface deeply convex; adaxial surface slightly convex to flat. *Peduncles* 0.4–1.2 mm long if 1-flowered, 1–2(–3) mm long if multi-flowered, up to 3(4)-flowered but often all or mostly 1-flowered. *Largest bracts or bracteoles* 0.6–0.8 mm long. *Pedicels* 1.5–3.3 mm long, *c.* 3 times longer than the peduncles. *Flowers* 5–7.5 mm

diam. *Hypanthium* cup-shaped, 1.4–1.5 mm long, 2–2.2 mm wide; free portion *c.* 0.3 mm long. *Sepals* broadly to depressed ovate, 0.6–1.1 mm long, 1.1–1.5 mm wide, the outer ones strongly ridged or somewhat horned. *Petals* 2.2–3.5 mm long, white. *Stamens* 2–8, 0–2 opposite each sepal, commonly 8 in the arrangement 2,2,1,2,1 but ranging down to just 2 in the arrangement 1,0,1,0,0. *Longest filaments* 0.4–0.6 mm long. *Anthers c.* 0.3 mm wide; thecae *c.* 0.2 mm high, dark-coloured; connective gland protruding by *c.* 0.1 mm, usually paler than the thecae. *Ovary* 3-locular; ovules 8–12 per loculus. *Style* 0.8–1.3 mm long; stigma capitate or somewhat peltate, up to 0.1 mm diam. *Fruits* inferior, 1.5–1.7 mm long, 2–2.5 mm wide; prominently rugose-pitted. *Seeds* facetted, 0.55–0.85 mm long, 0.3–0.45 mm wide, 0.35–0.5 mm deep, brown, becoming dark red-brown, shallowly colliculate or colliculate on lateral surfaces. (Figures 3B, 4)

Diagnostic features. Distinguished primarily by having bilaterally compressed leaf blades that are up to *c.* 1.5 times thicker than wide. Other important characters: petioles 0.3–0.6 mm long; blade 0.9–1.3 mm thick; peduncles 0.4–1.2 mm long if 1-flowered, 1–2(–3) mm long if multi-flowered, usually much shorter than the pedicels.

Selected specimens examined. WESTERN AUSTRALIA: Corackerup Nature Reserve, corner of Corackerup and Moojebup Rds, 7 Apr. 2015, *G. Byrne* 5453 (PERTH); 6.3 km along track from Melaleuca Rd, 43 km NNW of Munglinup, 12 Dec. 2005, *R. Davis* 10965 (PERTH); ranger's residence, Quiss Rd, Fitzgerald River National Park, *C.R. Hart* 28 (PERTH); Lake Shaster Nature Reserve, northern firebreak, 1 May 2009, *M. Hoggart & E. Adams* EA 545 (PERTH); Springdale Rd, 3.9 km W of Bedford Harbour Rd and 17.9 km E of Mason Bay Rd, 9 Dec. 2003, *B.L. Rye* 231201 (PERTH); near

Figure 4. A large spreading shrub, *c.* 2 m high, of *A. pachyphylla* in full flower, south of Ravensthorpe. Image taken by Peter Rye, voucher: *B.L. Rye* 231214.

crossing of Yallobup Creek on Mason Bay Rd, 1.0 km S of the Springdale Rd, 9 Dec. 2003, *B.L. Rye* 231223 (PERTH); Mt Le Grand, 11 Dec. 2003, *B.L. Rye* 231249 (PERTH); 12 km NNW of Ongerup, adjacent to Foster Rd, 5 Nov. 2003, *L.M. Strahan* 128 (CANB, PERTH); 6 km from Munglinup on the road to Ravensthorpe, 5 Nov. 1982, *A. Strid* 21165 (AD, BRI, K, NSW, MEL, PERTH); 10 km W of Jerramungup, 10 Nov. 1974, *D.J. Whibley* 5250 (AD, PERTH).

Distribution and habitat. Extends from near Ongerup east to near Mt Ney (Figure 2B), in varied habitats with sandy soils, sometimes in relatively damp situations, often with mallees or other eucalypts dominant.

Phenology and insect associations. Flowers and fruits have been recorded through most of the year, with flowering especially common from October to January. Terminal galls are often present.

Etymology. From the Greek *pachys* (thick) and *-phyllus* (-leaved), an appropriate name as the leaves are thicker than wide.

Conservation status. This species has many populations extending over an area *c.* 400 km long and is not at risk.

Co-occurring species. The distribution of *A. pachyphylla* greatly overlaps the ranges of both *A. latens* and *A. verrucosa* and there appear to be at least two cases of co-occurrence with the latter species. For example, *A. pachyphylla* (*A. Strid* 22429) was recorded growing with a specimen of *A. verrucosa* (*A. Strid* 22435), with both taxa in full flower.

Typification. Since Bentham (1867: 85) indicated that he was basing his new species on a single specimen 'in Herb. F. Mueller, which I am unable to refer to any other species', MEL 72895 is evidently the holotype. One specimen from Kew (K 000821682) is probably an isotype. Two other possible isotypes are a fragment with the locality given as 'Oldfield Range' (PERTH 01606107) and K 000821681.

Affinities. This species is like *A. verrucosa* in having very thick leaves although they are not markedly bilaterally compressed as in *A. verrucosa*. Many specimens included here under *A. pachyphylla* were previously identified as *A. verrucosa* or less commonly as *A. latens*, which differs in having leaves about as wide as thick and usually longer peduncles with the pedicels and peduncles tending to be of about the same length. As currently delimited *A. pachyphylla* is widespread and very variable. More study is needed of its variants and its relationships with other members of the genus.

Notes. On pressed specimens a few leaves may appear to be broader than long if their abaxial surface has been strongly pressed towards the adaxial surface, whereas leaves that have been pressed side on may appear more highly bilaterally compressed than they actually are.

The lowest stamen number recorded for the genus, of two stamens per flower, is known from *B.L. Rye* 231201, which also has flowers with three to five stamens.

6. Austrobaeckea pygmaea (R.Br. ex Benth.) Rye, *comb. nov.*

Baeckea pygmaea R.Br. ex Benth., *Fl. Austral.* 3: 89 (1867). *Type*: King George Sound, Western Australia, December 1801, *R. Brown s.n.* (*holo*: K 000821686; *iso*: BM 000889768, K 000821687, possibly also CANB 278743).

Illustrations. W.E. Blackall & B.J. Grieve, *How Know W. Austral. Wildfl.* 3A: 75 (1980); drawings on *C. Andrews s.n.* Dec. 1903.

Shrub low-growing and 0.1–0.5 m high or erect and 0.6–1(–1.5) m high, 0.2–1 m wide; flowering branchlets with 2–6 pairs of peduncles. *Leaves* antrorse, sometimes almost appressed on fast-growing branchlets, not clustered. *Petioles* 0.2–0.4 mm long. *Leaf blades* narrowly obovate to almost linear in outline, 3.5–8 mm long, 0.5–1.1 mm wide, 0.4–0.7 mm thick, usually somewhat dorsiventrally compressed but sometimes slightly thicker than wide, with a minute recurved apical point up to 0.1 mm long; abaxial surface convex, with the larger oil glands often in 2 main rows on each side of midvein; adaxial surface concave to flat. *Peduncles* 4–11 mm long, 1–3-flowered. *Largest bracts or bracteoles* 0.7–1.5 mm long. *Pedicels* 1.5–2.5 mm long, 0.25–0.5 times as long as the peduncles. *Flowers* 3–5 mm diam. *Hypanthium* cup-shaped in bud, sometimes becoming more flared, 0.9–1.6 mm long, 1.3–2.2 mm wide, often 5-angled to somewhat 5-ribbed; free portion 0.2–0.3 mm long. *Sepals* broadly triangular-ovate, 0.4–0.8 mm long, 0.5–1.1 mm wide, slightly keeled or ridged, largely herbaceous, with a narrow whitish entire margin, keel incurved at apex. *Petals* 1.2–1.8 mm long, white, with a few large glands towards the base. *Stamens* (10–)12–25, with up to 5 opposite each sepal or (when numerous) with a complete circle of stamens opposite the petals and sepals. *Longest filaments* 0.3–0.4 mm long. *Anthers c.* 0.2 mm wide; thecae *c.* 0.15 mm high; connective gland protruding by less than 0.1 mm. *Ovary* 2-locular in all or most flowers (occasionally a few flowers with a 3-locular ovary); ovules 6–12 per loculus. *Style* 0.7–0.8 mm long; stigma small. *Fruits* inferior, 1.3–1.5 mm long, 1.5–1.75 mm wide. *Seeds* facetted, 0.55–0.7 mm long, 0.35–0.5 mm wide, 0.4–0.5 mm deep, with many or all cells dark maroon, colliculate on lateral surfaces. (Figure 3C)

Diagnostic features. Distinguished from other species of *Austrobaeckea* by its smaller petals, usually more numerous stamens, which sometimes form a complete circle rather than being all antisepalous, and its occurrence in the near-coastal region west of Albany. It is the only species in which the ovary is normally 2-locular.

Selected specimens examined. WESTERN AUSTRALIA: near Albany, Dec. 1903, *C.R.P. Andrews s.n.* (PERTH); Weld Rd, *c.* 3.5 km W of Thompson Rd, 24 Jan. 1995, *R.W. Hearn* 5670 (CANB, K, MEL, PERTH); Tootanellup Nature Reserve, SE of Frankland, 6 Jan. 2012, *G.J. & B.J. Keighery* 2010 (PERTH); Kodjinup Nature Reserve, 22 Mar. 1997, *G.J. Keighery & N. Gibson* 2800 (PERTH); 1.1 km in along track into water reserve from Poorrarecup Rd, 21 Jan. 2003, *B.L. Rye* 230188 *& R.W. Hearn* (PERTH); lower Denmark Rd near Bornholm, 19 Dec. 1982, *A. Strid* 21816 (AD, BRI, CANB, HO, MEL, NSW, NT, PERTH).

Distribution and habitat. Extends from north of Lake Muir eastwards to near Albany (Figure 2A), in winter-wet depressions with other wetland species such as species of *Astartea* and *Pericalymma*.

Etymology. From the Latin *pygmaeus* (dwarf), referring to the small habit.

Phenology and insect associations. Flowers from December to March, with mature fruits recorded in March. This species appears to be unique in having red-brown scales of a lac insect (family Kerridae) attached to the stems of some specimens (e.g. *A.R. Annels & R.W. Hearn* 5102, *R.W. Hearn* 5670, both also with terminal stem galls). Figure 3C shows a stem infested with the lac insects. As well as terminal galls, there are also galls in the form of long narrow stem swellings on *A. Strid* 21816. Terminal galls are commonly 3–4.5 by 2–3.5 mm.

Conservation status. This species has many populations extending over an area *c.* 130 km long and is not at risk.

Typification. Of the three confirmed type specimens, K 000821686 was the only one annotated by Bentham; this specimen has been annotated by David Mabberley as 'Holotype'. K 000821687 came via J.J. Bennett at too late a date to be available to Bentham at the time he wrote up the species for *Flora Australiensis*.

Affinities. This very distinctive species is readily distinguished from all other members of the genus and its closest affinities are unclear. Its leaves have a recurved apical point as in *A. uncinella* but much shorter. The seeds are less strongly facetted than in other *Austrobaeckea* species but with more pronounced colliculae than in most other species.

Notes. Being restricted to winter-wet habitats within a high rainfall region of the south-west, this species occurs in more humid conditions than the other members of the genus. Its largest habit was recorded as 1–1.5 m high from *G.J. & B.J. Keighery* 2010, and some collections (e.g. *B.L. Rye* 230181 *& R.W. Hearn*) record the presence within populations of both multi-stemmed plants from a lignotuber and many single-stemmed plants. Evidently there is considerable variation in habit within *A. pygmaea*.

The species is particularly variable in stamen numbers with specimens from near the coast in the Denmark to Albany area often having few stamens down to ten but specimens from other areas having up to 25 stamens, the highest number recorded for the genus. Although the lowest stamen number recorded for *A. pygmaea* is ten, most flowers on each plant have more numerous stamens and many specimens regularly have stamen numbers of 15 or more. The stamen number is given as 'about 10' in the protologue and this led Blackall and Grieve (1980: 75) to key '*Baeckea' pygmaea* out in Section 3 (stamens 10 or fewer) rather than in Section 4 (stamens more than 10) where it should predominantly belong. The species was also incorrectly described as having precisely ten stamens in Wheeler *et al.* (2002).

7. Austrobaeckea uncinella (Benth.) Rye, *comb. nov.*

Baeckea uncinella Benth., *Fl. Austral.* 3: 84 (1867). *Type citation*: 'Plains E. of Stokes Inlet, Maxwell'. *Type*: plains east of Stokes Inlet, Western Australia, 1858–1866, *G. Maxwell s.n.* (*lecto*: MEL 73062, here selected; possible *isolecto*: PERTH 07244789); south west coast and interior, *G. Maxwell s.n.* (*syn*: K 000821676, PERTH 07244770).

Illustration. W.E. Blackall & B.J. Grieve, *How Know W. Austral. Wildfl.* 3A: 77 (1980) as *Baeckea uncinella*.

Shrub 1–2 m high, 1–1.5 m wide, single-stemmed at base; flowering branchlets with 1–4 pairs of peduncles. *Leaves* antrorse to patent, sometimes appressed on fast-growing shoots, not clustered. *Petioles* 0.5–1 mm long. *Leaf blades* recurved, narrowly obovate to linear in outline, 3.5–6.5 mm long, 0.5–1.1 mm wide, 0.5–1.1 mm thick, with an apical point 0.2–0.5 mm long, the point usually obviously recurved; abaxial surface deeply convex, dotted with numerous oil glands, which are sometimes somewhat prominent; adaxial surface concave to flat. *Peduncles* 2.5–6.5 mm long, 1–9-flowered. *Largest bracts or bracteoles* 0.8–1.3 mm long. *Pedicels* 2.5–4.5 mm long, mostly 0.6–1 times as long as the peduncles. *Flowers* 5–8 mm diam. *Hypanthium* cup-shaped, 1.5–2 mm long, 2–2.5 mm wide; free portion 0.3–0.5 mm long. *Sepals* broadly or depressed ovate, 0.5–1.1 mm long, 0.8–1.5 mm wide,

the outer ones prominently ridged. *Petals* 2–3 mm long, white. *Stamens* 7–13, 1–4 opposite each sepal, when 13 then recorded in the arrangements 4,2,3,3,2 or 3,3,3,3,2. *Longest filaments* 0.5–0.8 mm long. *Anthers* 0.25–0.3 mm wide; thecae *c.* 0.2 mm high; connective gland protruding by *c.* 0.2 mm. *Ovary* 3-locular; ovules 8–14 per loculus. *Style* 0.8–1(–1.3) mm long; stigma small. *Fruits* largely inferior, 1.3–1.5 mm long, 1.8–2 mm wide. *Seeds* facetted, 0.6–0.8 mm long, 0.3–0.5 mm wide, 0.4–0.5 mm deep, golden brown, often with a few dark cells, shallowly colliculate on lateral surfaces. (Figure 3D)

Diagnostic features. Distinguished from other species of *Austrobaeckea* by its more prominently pointed leaves, with the point usually distinctly recurved. It also tends to have more flowers per peduncle than other species and a more prominently protruding connective gland.

Selected specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 18 Oct. 1968, *N.N. Donner* 3067 (CANB *n.v.*, PERTH); 20 Nov. 19983, *M. Hislop* 1257 (MEL, NSW, PERTH); 9 May 2012, *M. Hislop* 4192 (PERTH); 10 Dec. 2003, *B.L. Rye & C.D. Turley* 231232 (PERTH); 12 Dec. 2003, *B.L. Rye* 231252 (NSW, PERTH); 23 Nov. 1999, *R.T. Schuh, G. Cassis & R. Silveira* 102 (PERTH); 6 Nov. 1982, *A. Strid* 21180 (AD, BRI, CANB, HO, MEL, NT, PERTH); 17 Oct. 2007, *B. Taylor & C. Anderson* Opp 113 (PERTH); 21 Oct. 1997, *P.G. Wilson, N. Lam & E.A. Brown* PGW 1423 (PERTH); 2 Nov. 1968, *J.W. Wrigley s.n.* (CBG).

Distribution and habitat. Extends from Young River east to near Mt Heywood, which is *c.* 80 km north-east of Esperance (Figure 2C), associated with salt lakes and watercourses.

Etymology. From the Latin *uncinus* (hook) and diminutive *-ellus*, referring to the uncinate leaf tip.

Phenology and insect associations. Flowers recorded from September to January, especially from October to December. Mature fruits recorded in April, May and November. Non-terminal stem swellings (galls) and terminal galls are present on many specimens, such as *B.L. Rye* 231252 and *R.T. Schuh, G. Cassis & R. Silveira* 102.

Conservation status. Recently listed as Priority Three under the Conservation Codes for Western Australian Flora (Western Australian Herbarium 1998–) under the name *Baeckea uncinella* Benth. Of the five previously named species, *A. uncinella* has the fewest populations, but still extends for *c.* 130 km.

Co-occurring species. This species (*B.L. Rye & C.D. Turley* 231232) has been recorded growing with *A. fascifolia* (*B.L. Rye & C.D. Turley* 231234) in natural vegetation in Helms Arboretum, both species in full flower in December.

Typification. Bentham (1867: 84) cited a single collector and locality, 'Plains E. of Stokes Inlet, Maxwell', but stated that he had 'seen two specimens'. One specimen he certainly examined was MEL 73062, which gives the identical locality and indicates on the label that it was seen by Bentham. The second sheet Bentham examined was K 000821676, which gives the locality as 'south west coast and interior' and has a much more densely leafy appearance so is considered to represent a different collection. Two PERTH specimens are fragments obtained by C.A. Gardner; both give the same locality as the Kew specimen but PERTH 07244789 also gives the protologue location below on its label, although that locality is given with a question mark. MEL 73062 is selected here as the lectotype because it is a good match for both the description and locality given in the protologue. It is difficult to tell from the fragments at PERTH whether they match the lectotype or K 000821676, but the fragment labelled

with the protologue locality is a possible isolectotype and has been identified by M.E. Trudgen as being a good match for MEL 73062.

Affinities. A distinctive species that is unlikely to be confused with any other members of the genus because its leaves have a recurved point. A shorter recurved point is often present on *A. pygmaea* but that species is readily distinguished by its smaller flowers.

Notes. Mueller (1864) tentatively included this species as a western variant under the south-eastern Australian species *Baeckea behrii* (Schltdl.) F.Muell. [= *Hysterobaeckea behrii* (Schltdl.) Rye] but noted that it differed in its almost blunt leaves, always multi-pedicellate peduncles, slightly longer sepals and differently shaped filaments. Bentham (1867) described further differences in its inflorescence, stamens, etc. and reported higher ovule numbers of 15–20 per loculus. However, the ovule numbers recorded here for *A. uncinella* are all lower than this, with only 8–14 per loculus, very similar to the numbers of ovules present in *H. behrii*.

Specimens of *A. uncinella* that have a straighter point on the leaves than usual include *J.S. Beard* 5312, which also has a longer style than usual, *c.* 1.3 mm long, and comes from the far east of the species' range.

8. Austrobaeckea verrucosa (Turcz.) Rye, *comb. nov.*

Tetrapora verrucosa Turcz., *Bull. Cl. Phys.-Math. Acad. Imp. Sci. Saint-Pétersburg* 10: 329–330 (1852). *Type*: Swan River colony [Stirling Range to Cape Riche to Mt Barren Range], Western Australia, 1848–1849, *J. Drummond* 5: 127 [as 137] (*holo*: KW 001001270; *iso*: PERTH 03350649).

Harmogia corynophylla F.Muell., *Fragm.* 2: 30 (1860); *Baeckea corynophylla* (F.Muell.) F.Muell., *Fragm.* 4: 72 (1864); *Babingtonia corynophylla* (F.Muell.) F.Muell., *Fragm.* 4: 74 (1864). *Type*: Fitzgerald Range, Western Australia, 1858–1860, *G. Maxwell s.n.* (*holo*: MEL 72574).

Illustration. W.E. Blackall & B.J. Grieve, *How Know W. Austral. Wildfl.* 3A: 78 (1980) as *Baeckea corynophylla*.

Shrub 0.4–1.5(–1.8) m high, 0.45–1.5 m wide; flowering branchlets with 1–9 pairs of peduncles. *Leaves* antrorse or patent, not clustered. *Petioles* 0.3–0.6 mm long. *Leaf blades* markedly bilaterally compressed, thickest towards apex so that from side view the shape is almost obovate but with the adaxial margin straight, 2.5–6 mm long, 0.5–0.7 mm wide, 1.2–1.8 mm thick, without an apical point or rarely with a short one to 0.15 mm long, often verrucose with very prominent oil glands; abaxial and adaxial surfaces convex, grading into the broad, flat, lateral surfaces, the adaxial surface narrower than the abaxial surface or rarely ± as broad. *Peduncles* 0.3–1 mm long if 1-flowered, 0.6–5.5 mm long if multi-flowered, 1–4-flowered but mostly 1- or 3-flowered. *Bracts and bracteoles* often deciduous, the largest ones 1.1–1.8 mm long. *Pedicels* 0.7–4(–7) mm long, 0.7–2 times as long as the peduncles. *Flowers* 5–9 mm diam. *Hypanthium* cup-shaped, 1.1–2 mm long, 1.5–2.5 mm wide; free portion 0.2–0.3 mm long. *Sepals* ovate or broadly ovate, 1–1.5 mm long, 0.8–1.5 mm wide, acute, the outer ones often with keel extended into a horn-like point, with a narrow petaline border on each side; longest horn 0.4–1 mm long. *Petals* 2–3.2 mm long, white. *Stamens* 3–9, 0–3 opposite each sepal, commonly 8 in the arrangement 2,2,1,2,1 but down to 3 arranged as 1,1,0,1,0. *Longest filaments* 0.4–0.7 mm long. *Anthers c.* 0.3 mm wide; thecae *c.* 0.2 mm high, commonly dark reddish or reddish brown; connective gland protruding by *c.* 0.1 mm, usually pale. *Ovary* 3-locular; ovules 5–11 per

loculus. *Style* 0.9–1.3 mm long; stigma 0.1–0.15 mm diam. *Fruits* largely inferior, 1.5–1.8 mm long, 2.5–2.7 mm wide. *Seeds* facetted, 0.7–1 mm long, 0.4–0.5 mm wide, 0.5–0.6 mm deep, golden brown at first, often developing dark reddish cells, colliculate on lateral surfaces. (Figure 4E)

Diagnostic features. Unique in having markedly bilaterally compressed leaves, which are up to 1.8 mm thick. Other important characters: outer sepals 1–1.5 mm long, with a horn 0.4–1 mm long; seeds 0.7–1 mm long.

Selected specimens examined. WESTERN AUSTRALIA: 10 km SW of Mukinwobert Rock on Nindilbillup Rd, 25 Mar. 1983, *M.A. Burgman & S. McNee s.n.* (PERTH); a firebreak along a fence line E of the South Coast Hwy and S of the Pallinup River, 29 Aug. 2017, *G. Byrne* 6426 (PERTH); 50 km N of South Coast Hwy, on Old Ravensthorpe Rd, 23 Nov. 1985, *D.B. Foreman* 1194 (AD *n.v.*, CANB *n.v.*, MEL *n.v.*, NSW *n.v.,* PERTH); 28.8 km S of Varley, 1991, *S. Gourley* 91/274 (PERTH); 1 km S of Bandalup Hill, 20 Jan. 1981, *G.J. Keighery* 3718 (PERTH); on Norman Rd, 5 km N of Boxwood Hill–Ongerup Rd, 13 Jan. 2005, *B.L. Rye* 250118 *& M.E. Trudgen* (AD, BRI, PERTH); 20 km S of Ravensthorpe on Hopetoun Rd, Eyre district, 9 Aug. 2003, *P.G. Wilson & G.M. Towler* PGW 1638 (NSW *n.v.*, PERTH); *c.* 27.7 km E of Ravensthorpe, Eyre District, 22 Oct. 1997, *P.G. Wilson & N. Lam* PGW 1433 (NSW *n.v.*, PERTH).

Distribution and habitat. Extends from south-east of Jerramungup east to the Jerdacuttup River, with an isolated record from the Lake King area (Figure 2C), in varied soil types, sometimes associated with laterite, granite or other rock outcrops, often in mallee-dominated vegetation.

Etymology. From the Latin *verrucosus* (covered with warts), referring to the warty appearance of dried leaves that have very prominent oil glands. Other members of the genus often have prominent glands on the leaves too but not to the same degree.

Phenology and insect associations. Flowers recorded all year but primarily from August to November. Mature fruits have been recorded in many months, possibly primarily from October to May. Terminal or lateral galls are often present.

Conservation status. *Austrobaeckea verrucosa* is known from numerous populations over an area more than 160 km long and is not at risk.

Co-occurring species. Appears to co-occur occasionally with *A. pachyphylla*, as noted under that species. *Austrobaeckea verrucosa* has a quite similar distribution to *A. pachyphylla* except that it does not extend as far east (see Figure 2B,C).

Affinities. Molecular data (see *Molecular evidence* section above) indicate that *A. verrucosa* is more closely related to *A. latens* than it is to *A. uncinella*. In leaf morphology *A. verrucosa* is closest to *A. pachyphylla* (see notes under that taxon).

Notes. An isolated specimen from the far north of the distribution (*S. Gourley* 91/274) with spindly fast-growing stems and very compressed leaves has exceptionally long peduncles and pedicels up to 5.5 mm and 7 mm long respectively. This specimen is quite similar in these characters to the type specimen, which has very compressed leaves and old bare peduncles up to 4.5 mm long, although its pedicels are only up to about 4 mm long on the younger peduncles. The type collection is very verrucose and has particularly long horns on the outer sepals.

At the other extreme, specimens from the Ravensthorpe area often have very short peduncles and pedicels. Some specimens from the far west of the distribution (e.g. *S. Oborne* 95) have less than five stamens in most flowers and low stamen numbers are occasionally found elsewhere. Apart from those, most specimens include flowers with the most common stamen number of eight in its usual arrangement of 2,2,1,2,1.

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New species of Western Australian *Styphelia* (Ericaceae: Epacridoideae: Styphelieae) from the *S. pendula* and *S. conostephioides* groups

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Abstract

Hislop, M. New species of Western Australian *Styphelia* (Ericaceae: Epacridoideae: Styphelieae) from the *S. pendula* and *S. conostephioides* groups. *Nuytsia* 32: 199–238 (2021). Eight new species and one new subspecies are described and illustrated. Six of these, *S. caudata* Hislop, *S. globosa* Hislop, *S. graniticola* Hislop, *S. intermediana* Hislop, *S. intricata* Hislop and *S. madida* Hislop belong to the *S. pendula* (R.Br.) Spreng. group (also known as Group V), and the other two, *S. carolineae* Hislop and *S. exarata* Hislop, are from the *S. conostephioides* (DC.) F.Muell. group (also known as Group VIII). *Styphelia madida* includes the subspecies *hirtigera* Hislop. A key is provided to species of the *S. pendula* group occurring in the south-west corner of Western Australia (i.e. west of a line between Perth and Albany), this being the main region of diversity for the group. Five of the new species have conservation coding.

Introduction

Recent publications have added 18 new species of *Styphelia* Sm. to the epacrid flora of Australia: 14 for Western Australia (Hislop & Puente-Lelièvre 2017, 2019; Hislop 2019, 2020a, 2020b) and four for Queensland (Crayn *et al.* 2019; Bean 2020). However, much taxonomic work remains to be done in the genus, especially in Western Australia, where several dozen phrase-named taxa are listed on *Florabase* (Western Australian Herbarium 1998–), most of these still formulated in *Leucopogon* R.Br. (refer to Hislop 2021 for details). A significant proportion of these undescribed taxa either already have conservation coding or are of restricted distribution and in need of conservation assessment. The current paper provides formal names for eight species and one subspecies, with an emphasis on those of conservation significance.

Of the 12 phylogenetic groups resolved in *Styphelia* by Puente-Lelièvre *et al.* (2016), nine occur in Western Australia. Most species of Western Australian *Styphelia* have been placed in one of these nine groups either because of their inclusion in the published phylogeny, or by extrapolation of critical morphological features. Six of the species described below belong to the *S. pendula* (R.Br.) Spreng. group (or Group V) and the other two are from the *S. conostephioides* (DC.) F.Muell. group (or Group VIII). A recent short paper (Hislop 2021) provided an interim key to the infrageneric groups in Western Australia together with lists of their included taxa, including those with phrase names.

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While the morphological circumscription of two of the small, exclusively Western Australian groups has now been documented (i.e. Hislop & Puente-Lelièvre 2019; Hislop 2020a), this is not the case for those larger groups, including Group V and Group VIII, that are known to have, or considered likely to have, trans-Australian distributions. Further research into the affinities of some eastern Australian species is required before the morphological boundaries of these groups can be defined.

Methods

This study was based on an examination of dried specimens housed at the Western Australian Herbarium, together with field observations of the species described (excluding *S. exarata* Hislop) and their relatives in Western Australia.

Foliar measurements and observations were taken from dried specimens in natural posture. Care was taken to confine observations to mature leaves. Leaf lamina length is inclusive of the mucro. A separate measurement for the mucro is also given. Inflorescence length was measured from the point of attachment in the axil to the tip of the bud-rudiment. Floral measurements were taken from rehydrated flowers in natural posture, with the exception of the corolla lobes, which were uncurled to their fullest length before measuring. Observations of the floral indumentum were taken from dried material at x 50 magnification. Fruit length is inclusive of a gynophore, if present.

Bioregions referred to in the text and shown on distribution maps follow *Interim Biogeographic Regionalisation for Australia* (IBRA) v. 7 (Department of the Environment 2013).

Taxonomy

Notes relating to inflorescence orientation in Group V

Inflorescence orientation is an important character in the taxonomy of Group V. There are three basic character states in the Group: inflorescences erect (to about 45°), spreading (from about 45°–120°) or strictly pendulous. The differences between the erect (Figure 1) and spreading (Figure 2) states is to some extent arbitrary with some potential overlap between them. Pendulous inflorescences (Figure 3) are qualitatively different however, even from those spreading inflorescences that are held at angles greater than 90°. This is because, as the descriptor suggests, at maturity pendulous inflorescences apparently hang under the influence of gravity alone, and so regardless of their whereabouts on the plant the flowers will be directed downwards. Those with spreading inflorescences, on the other hand, are held by the plant at wide angles against the influence of gravity. These differences are best observed in live plants, and it is on more or less erect branchlets where they are most obvious. Where branchlets are widely spreading however the differences may no longer be evident because both the spreading and pendulous inflorescences will then appear to be held at a wide angle relative to the axis. For this reason, the character is sometimes not easily interpreted on dried specimens. Ideally therefore collectors should carefully record the inflorescence orientation at the time of collection.

Presumably, these differences in inflorescence orientation are an adaptation to different pollen vectors, and this may also be implicated in a substantially correlating difference in the stigma and upper style. With very few exceptions those species with a strictly pendulous inflorescence also have a stigma that is not, or barely, enlarged at anthesis (sometimes the stigma is more noticeably enlarged post-anthesis) and a completely smooth style. In those with erect or spreading inflorescences the stigmas are always distinctly enlarged and the upper portion of the style is usually more or less scabrous.

Figure 1. *Styphelia stricta*. Showing erect inflorescences. Photograph by Fred and Jean Hort.

Figure 2. *Styphelia erubescens*. Showing spreading inflorescences. Photograph by Fred and Jean Hort.

Figure 3. *Styphelia nitens*. Showing pendulous inflorescences. Photograph by Rob Davis.

Key to *Styphelia* species belonging to Group V (the *S. pendula* group) from the south-west corner of Western Australia[1]

[1] The key includes all taxa occurring west of a line between Perth and Albany as well as two (*S. woodsii* and *S. madida* subsp. *hirtigera*) that are known to occur close to the eastern boundary of that region and may also occur just inside it. The area encompasses the main centre of diversity for Group V in Western Australia and with this publication all currently recognised members of the group occurring there are now formally described.

1. Inflorescences strictly pendulous (see notes on inflorescence orientation above); stigma usually not, or barely expanded at anthesis (distinctly expanded only in *S. filifolia*); style usually smooth throughout

2. Leaves adaxially concave, the margins not recurved; leaf apex a broad, innocuous callus tip (Porongurup and Stirling Range–Israelite Bay)..... **S. woodsii**

2: Leaves adaxially convex, the margins recurved to revolute (occasionally ± flat in *S. inframediana*); leaf apex usually strongly mucronate, often pungent (sometimes with an innocuous callus tip in *S. concinna*)

3. Corolla lobes shorter than the tube

4. Longest leaves per specimen to 5 mm long (very rarely to 6 mm), leaf margins usually gently recurved, longitudinal axis of leaves usually variously recurved; ovary 3- or 4-locular; fruit cylindrical or very narrowly ellipsoid (widespread; New Norcia–Lake Muir–Gibson, and inland in the south of its range to Kojonup and Lake Magenta)..... **S. concinna**

4: Longest leaves per specimen > 5 mm long, or if occasionally no more than 5 mm then leaf margins strongly recurved to revolute, longitudinal axis of leaves usually ± straight; ovary 5-locular; fruit variously shaped, never as above

5. Leaf margins strongly recurved to revolute, the leaf apical mucro usually innocuous, occasionally sharply pungent; fruit narrowly obovoid (widespread; SE of Armadale–Augusta–Mount Manypeaks, and inland in the south of its range to Boyup Brook and Mount Barker)..... **S. pendula** (typical variant)

5: Leaf margins usually gently recurved, very occasionally moderately recurved in *S. graniticola*, the leaf apical mucro always sharply pungent; fruit ovoid, ellipsoid, narrowly ovoid, narrowly ellipsoid or occasionally (*S. graniticola*) narrowly obovoid

6. All, or at least some leaves retrorse; style 6.5–9.0 mm long; filaments attached to anthers 1/3–1/2 above anther base; fruit usually ovoid or narrowly ovoid, occasionally ellipsoid or narrowly ellipsoid, at least 3 mm wide (mostly Darling Range; N of Bindoon–Boyup Brook..... **S. nitens**

6: Leaves variously antrorse; style 3.5–5.3 mm long; filaments attached to anthers 2/3–3/4 above anther base; fruit narrowly ellipsoid to narrowly obovoid, 1.7–2.0 mm wide (restricted; SW to NE of Walpole)..... **S. graniticola**

3: Corolla lobes longer than the tube

7. Longest leaves per specimen to 5 mm long (very rarely to 6 mm), leaf margins usually gently recurved, longitudinal axis of leaves usually variously recurved; ovary 3- or 4-locular; fruit cylindrical or very narrowly ellipsoid (widespread; New Norcia–Lake Muir–Gibson, and inland in the south of its range to Kojonup and Lake Magenta)..... **S. concinna**

7: Longest leaves per specimen > 5 mm long, or if occasionally no more than 5 mm then leaf margins strongly recurved to revolute, longitudinal axis of leaves usually ± straight; ovary 5-locular; fruit variously shaped, never as above

8. Leaf apices shortly mucronate (the mucros 0.1–0.6 mm long) and innocuous, or very occasionally sub-pungent

9. Sepals and bracteoles shortly and densely hairy; fruit actinomorphic, globose or occasionally broadly ellipsoid (Busselton–Scott River–Donnybrook, with an apparent outlier in the Yarloop area)..... **S. globosa**

9: Sepals and bracteoles glabrous; fruit strongly zygomorphic or if actinomorphic, narrowly obovoid

10. Adaxial leaf surfaces with 3–5 sunken longitudinal lines evident; stigma distinctly expanded; fruit strongly zygomorphic, bilaterally compressed (sporadically from N of Eneabba–Harvey)..... **S. filifolia**

10: Adaxial leaf surfaces smooth, lacking sunken lines; stigma not, or barely, expanded; fruit actinomorphic, circular in transverse section, narrowly obovoid (Walpole–Albany–Stirling Range)..... **S. pendula** (short-tube variant)

8: Leaf apices long-mucronate (the mucros 0.4–2.0 mm long) and sharply pungent

11. Tangled, spreading shrubs; leaves linear or very narrowly ovate, 0.5–1.7 mm wide, ± patent to strongly retrorse; inflorescence axes glabrous; filaments 0.3–0.6 mm long; fruit ellipsoid to obovoid (SE of Margaret River–E of Augusta)..... **S. intricata**

11: Erect shrubs, never tangled; leaves variously shaped, but if linear or very narrowly ovate, then wider leaves > 1.7 mm wide, mostly variously antrorse (sometimes retrorse in *S. inframediana*); inflorescence axes hairy (sometimes ± glabrous in *S. madida* subsp. *madida*); filaments 0.5–1 mm long; fruit globose, broadly ellipsoid, broadly obovoid or (sometimes in *S. inframediana*) ellipsoid

12. Leaves 3.5–9.0 mm long, including a mucro 0.4–0.8 mm long; bracteoles 0.8–1.0 mm long, including a mucro 0.1–0.2 mm long; inflorescence axes 2.0–5.2 mm long; fruit broadly obovoid to ellipsoid (Denmark–Albany–Stirling Range)..... **S. inframediana**

12: Leaves 8.0–21 mm long, including a mucro 0.7–2.0 mm long; bracteoles 1.0–1.6 mm long, including a mucro 0.2–0.7 mm long; inflorescence axes 3.0–10 mm long; fruit globose or broadly ellipsoid

13. Young branchlets with sparse to moderately dense indumentum of short, straight hairs to *c.* 0.1 mm long; leaves 0.8–2.0 mm wide, the widest usually 1.8 mm or less; bracteole mucros 0.2–0.4 mm long; sepals 1.8–2.7 mm long (NW of Walpole–William Bay)..... **S. madida** subsp. **madida**

13: Young branchlets with a dense indumentum of straight or wavy hairs 0.1–0.4 mm long; leaves 1.5–3.8 mm wide, the widest usually at least 2.2 mm; bracteole mucros 0.4–0.7 mm long; sepals 2.5–3.0 mm long (just E of Albany–Bald Island)..... **S. madida** subsp. **hirtigera**

1: Inflorescences erect to spreading (see notes on inflorescence orientation above); stigma distinctly expanded at anthesis; style usually scabrous in the upper half

14. Sepals equal to, or longer than, the corolla tube

15. Sepals acute, prominently mucronate; leaves strongly antrorse, very narrowly elliptic, very narrowly obovate or linear, longest leaves per specimen, 16–30 mm long (widespread; Warradarge–Augusta–Cape Riche, and inland to Narrogin and the Stirling Range) ..... **S. propinqua**

15: Sepals obtuse, not mucronate; leaves spreading, varying from shallowly antrorse to shallowly retrorse, narrowly elliptic to narrowly ovate, if linear-oblong then longest leaves per specimen 9–16 mm long (near-coastal and islands; Dongara–Mandurah) ..... **S. insularis**

14: Sepals shorter than the corolla tube

16. Leaves strongly glaucous, margins obviously ciliate with stiff, spreading hairs, 0.1–0.2 mm long; inflorescences erect (mostly Darling Range; John Forrest N.P. –Darkan area) ..... **S. stricta**

16: Leaves not glaucous, margins glabrous or minutely ciliolate with hairs < 0.05 mm long; inflorescences spreading

17. Inflorescence axis glabrous; leaves mostly long-linear or less often very narrowly ovate, very narrowly elliptic or very narrowly obovate, longest leaves per specimen 15–35 mm long; fruit strongly zygomorphic, bilaterally compressed (somewhat disjunct; Lancelin–Yalgorup; Margaret River–Two Peoples Bay) ..... **S. racemulosa**

17: Inflorescence axis hairy; leaves usually wider than above, ovate to narrowly ovate, elliptic to narrowly elliptic or obovate to narrowly obovate, if linear-oblong the longest leaves per specimen 7–16 mm long; fruit actinomorphic, circular in transverse section

18. Corollas white or pink to red; corolla tube hairy on internal surfaces; sepal margins ciliolate not obviously translucent; fruit ellipsoid, narrowly ellipsoid, obovoid or narrowly obovoid, mesocarp not, or poorly, developed (widespread; Moore River N.P.–Augusta–W of Bremer Bay, and inland to York and the Stirling Range) ..... **S. erubescens**

18: Corollas always white; corolla tube glabrous below the lobes on internal surfaces; sepal margins glabrous, translucent; fruit globose or broadly ovoid, mesocarp well developed, obviously fleshy (near-coastal and islands; Dongara–Mandurah) ..... **S. insularis**

New species from Group V

Styphelia caudata Hislop, *sp. nov.*

Typus: south of Wongan Hills, Western Australia [precise locality withheld for conservation reasons], 2 April 2000, *M. Hislop* 1984 (*holo*: PERTH 05556333; *iso*: CANB, CNS, HO, K, MEL, NSW).

Leucopogon sp. Bungulla (R.D. Royce 3435), Western Australian Herbarium, in *Florabase*, https://florabase.dpaw.wa.gov.au/ [accessed 30 July 2021]

Spreading *shrubs*, to *c.* 100 cm high and 100 cm wide, single-stemmed at ground level, with a fire-sensitive rootstock. Young *branchlets* with sparse indumentum of short hairs, < 0.05 mm long. *Leaves* spirally arranged, antrorse, usually steeply so, the first leaves produced during a growth flush with noticeably paler margins than later leaves; apex obtuse to acute, with a blunt, callus tip to *c.* 0.1 mm long; base cuneate; petiole conspicuous, 0.5–1.0 mm long, adaxial surface hairy, abaxial surface

glabrous, margins glabrous or ciliolate; lamina elliptic to obovate, or narrowly so, 2.4–4.3 mm long, 1.1–2.4 mm wide, concave adaxially, longitudinal axis gently incurved throughout or sometimes tending to recurve slightly towards the apex; surfaces ± concolorous, matt or slightly shiny; adaxial surface mostly glabrous, but with some hairs towards the base, venation not, or barely, evident; abaxial surface glabrous, with 5–7 raised primary veins (the midrib slightly broader than the others); margins often irregularly ciliate, at least when young, but usually glabrescent on older leaves, sometimes ± erose or crenulate. *Inflorescence* axillary, spreading at *c.* 45°–90°, but often ± erect in early flower; axis 1.3–1.8 mm long, 1- or occasionally 2-flowered, densely hairy, ± terete below the uppermost fertile bract, compressed and ± narrowly winged above, terminating in a bud-rudiment; flowers spreading, subsessile or very shortly pedicellate below the bracteoles with a pedicel to *c.* 0.3 mm long. *Fertile bracts* ovate to broadly ovate, 0.5–0.8 mm long, 0.4–0.8 mm wide, and with usually 2(3) sterile bracts below the lowest fertile bract. *Bracteoles* depressed-ovate to ± orbicular, 0.8–1.2 mm long, 0.8–1.2 mm wide, not keeled, obtuse, mucronate (the mucro 0.05–0.2 mm long); abaxial surface glabrous, not striate; margins ciliolate. *Sepals* narrowly ovate, (1.5–)1.7–2.3 mm long, (0.7–)0.8–1.0 mm wide, obtuse to acute, and usually with a prominent, often recurved, flexible mucro (very occasionally absent); abaxial surface glabrous, straw-coloured, venation obscure, only the mid-vein evident; adaxial surface glabrous or with a few hairs towards the apex; margins densely ciliolate, with hairs to *c.* 0.1 mm long. *Corolla tube* white, narrowly ellipsoid to cylindrical, longer than the sepals, 2.5–3.5 mm long, 1.6–2.0 mm wide, glabrous on both surfaces. *Corolla lobes* white, shorter than, or rarely ± equal to the tube, (1.8–)2.0–2.5 mm long, (0.6–)0.7–1.0 mm wide at base, erect in basal 1/2–2/3 of their length, and then spreading and recurved to revolute, external surface glabrous, internal surface with a dense, white indumentum of flattened, twisted and ornamented hairs. *Anthers* partially exserted (by 7/8 of their length) or fully exserted from the tube, but not exserted beyond the erect basal portion of the corolla lobes, 0.8–1.5 mm long, apex emarginate. *Filaments* terete, 0.7–1.1 mm long, attached to the anther 2/3–3/4 above base or occasionally a little higher, adnate to the tube just below the sinuses. *Nectary* annular, 0.3–0.4 mm long, glabrous, ± truncate to shallowly lobed. *Ovary* narrowly ellipsoid or occasionally ellipsoid, 0.6–1.0 mm long, 0.4–0.5 mm wide, glabrous, 5-locular, dark green. *Style* usually glabrous and smooth or occasionally faintly scabrous towards the apex, 3.4–4.9 mm long, exserted from the corolla tube to a point just beyond the erect corolla lobe bases, tapering smoothly from ovary apex; stigma distinctly expanded. *Fruit* narrowly ellipsoid, *c.* 2.2–2.3 mm long and 1.3–1.4 mm wide (but see comment under *Notes* below), much longer than the sepals, circular in transverse section, gynophore absent; surface glabrous, shallowly rugose at maturity; apex rounded to subacute; style shed before maturity. (Figures 4, 5)

Diagnostic characters. Within Group V, *S. caudata* is distinguished by the following character combination: leaves elliptic to obovate, or narrowly so, adaxially concave, terminating in a blunt callus tip to *c.* 0.1 mm long; inflorescences spreading at *c.* 45°–90°, 1- or 2-flowered; sepals glabrous, obtuse to acute, usually terminating in a prominent, often recurved, flexible mucro (very occasionally absent); corolla tube longer than the sepals and corolla lobes; ovary 5-locular, glabrous; style usually glabrous and smooth or occasionally faintly scabrous towards the apex; stigma distinctly expanded; fruit narrowly ellipsoid, circular in transverse section, shallowly rugose, gynophore absent.

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 21 May 1970, *K.M. Allan* 248 (CANB, MEL, PERTH); 30 Apr. 2008, *J.M. Collins* 456 (PERTH); 12 June 2008, *J.M. Collins* 461 (PERTH); 3 July 2008, *J.M. Collins* 466 (PERTH); 25 May 1922, *C.A. Gardner* 1711 (PERTH); 7 May 2005, *M. Hislop* 3441 (CANB, CNS, NSW, PERTH); 8 May 2005, *M. Hislop* 3442 (CNS, NSW, PERTH); 8 May 2005, *M. Hislop* 3443 (CNS, PERTH); 24 Sep. 2005, *M. Hislop* 3523 (PERTH); 22 June 1996, *B.J. Lepschi & T.R. Lally* BLJ 2629 (CANB, PERTH); 2 June 1986, *S. Patrick* 258 (PERTH); 2 July 2002, *S. Patrick* 4116 (PERTH); 23 July 2001, *S. Patrick*

Figure 4. *Styphelia caudata* – flowering plant *in situ*. Voucher *M. Hislop* 3442. Photograph by Michael Hislop.

SP 3920A (PERTH); 1 May 1951, *R.D. Royce* 3435 (PERTH); 23 June 1983, *B.H. Smith* 221 (CANB, MEL, NSW, PERTH); 4 July 2007, *S. Thomas* 5 (PERTH).

Distribution and habitat. Recent collections of this species are all from a restricted part of the Avon Wheatbelt bioregion from Wongan Hills and Cadoux in the north, southwards to Dowerin. There is also a 50-year-old record from the Yerecoin area, to the west of the above distribution, and several

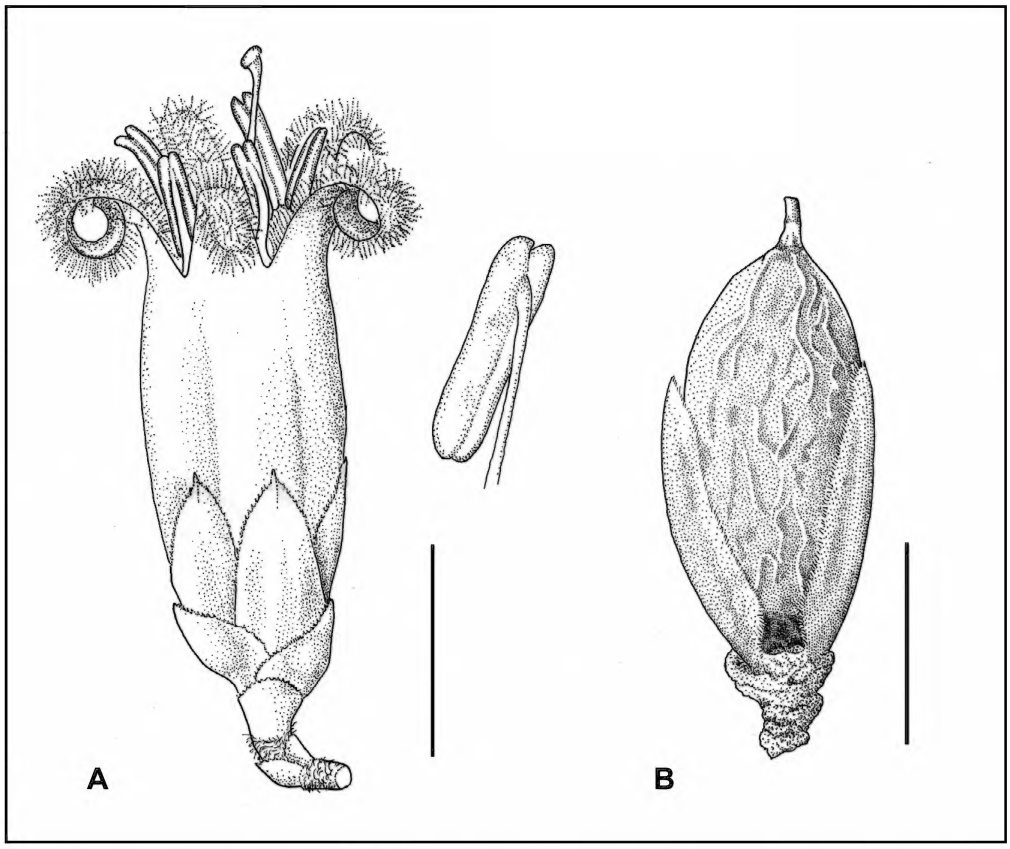

Figure 5. *Styphelia caudata*. A – 1-flowered inflorescence, stamen; B – fruit. Scale bars = 1 mm. Vouchers *M. Hislop* 3442 (A), *M. Hislop* 3523 (B). Drawings by Skye Coffey.

even older collections made in the Kellerberrin–Yorkrakine area to the east. The species grows in sand or light loamy soils, sometimes over laterite, in heath or open mallee woodland. Commonly associated species include *Eucalyptus pyriformis*, *Allocasuarina campestris*, *Hakea scoparia*, *Styphelia serratifolia* and *Ecdeiocolea monostachya*.

Phenology. Flowers between April and July, with the onset of flowering probably determined by the first significant rains of autumn. The only specimen with mature fruit present was collected in late September.

Etymology. From the Latin *caudatus* (ending with a narrow, tail-like appendage), a reference to the usually prominent and often recurved sepal mucros.

Conservation status. Listed as Priority Three (Smith & Jones 2018) under Conservation Codes for Western Australian Flora under the name *Leucopogon* sp. Bungulla (R.D. Royce 3435). *Styphelia caudata* has a restricted distribution in a heavily cleared part of the wheatbelt. As indicated under the distribution heading above it seems likely that it was formerly more widespread, but with no collections from the east of its range in the last 70 years it may no longer be extant in that area.

Affinities. *Styphelia caudata* was not included in the phylogeny of Puente-Lelièvre *et al.* (2016) but critical morphological attributes strongly indicate that it belongs in Group V (or the *S. pendula* group). The combination of widely spreading inflorescences, annular nectaries, dark green ovaries and anthers that are either partially exserted from the corolla tube or if fully exserted, then not exserted beyond the erect corolla lobe bases, would see the species key out at the second lead of couplet 11 in the key to infrageneric groups (Hislop 2021).

Before the species was recognised by the phrase name *L.* sp. Bungulla, older collections had mostly been assigned to either *S. woodsii* (F.Muell.) F.Muell. or *S. leptantha* (Benth.) F.Muell. This is understandable because, like *S. caudata*, those species have adaxially concave leaves with non-pungent apices, while by far the majority of species in Group V have convex leaves with pungent apices.

Styphelia woodsii is restricted to the south coast of Western Australia, but in any case, it can be readily distinguished from *S. caudata* by its strictly pendulous inflorescence (*cf.* spreading at *c.* 45°–90° in *S. caudata*), glabrous inflorescence axis (*cf.* hairy), eciliate sepal margins (*cf.* ciliate) and sepals equal to, or longer than, the corolla tubes (*cf.* shorter than the tubes).

Styphelia leptantha, from the Geraldton Sandplains and far north of the Swan Coastal Plains bioregion, could certainly be confused with *S. caudata*, at least when fruit is not available. A useful macroscopic distinguishing feature is that the leaves of *S. leptantha* are always distinctly glaucous compared to the mid-green aspect of *S. caudata*. Other differences observable on flowering specimens are associated with the style surfaces (more or less smooth or occasionally very faintly scabrous towards the apex in *S. caudata*, strongly scabrous in *S. leptantha*) and sepal apex (usually with a prominent mucro in *S. caudata*, smoothly rounded in *S. leptantha*). The most significant difference between the two species however is in their fruit: circular in section, shallowly rugose (i.e. with a well-developed mesocarp) and lacking a gynophore in *S. caudata*; strongly angular, smooth (mesocarp not, or barely developed), with gynophore present in *S. leptantha*.

Notes. Note that this species is not included in the key above because its distribution lies well outside of the area covered by that key.

The fruit measurements are based on a single fruiting collection and therefore cannot be regarded as definitive.

While there is little doubt that the Yerecoin specimen (*K.M. Allan* 248) mentioned above is referrable to this species it differs from all other collections in its relatively longer and narrower leaves. It is also one of very few specimens in which the sepal mucro is very obscure or absent.

In the Marchagee district of the Geraldton Sandplains bioregion, to the north-west of the known distribution of *S. caudata*, there occurs a plant with a similar morphology, but which differs in ways that are likely to be taxonomically significant. This morphotype has a consistently erect inflorescence axis that is a little shorter than in typical *S. caudata*. Its leaves tend to be wider (to at least 3 mm) and the leaf tips may either be very shortly mucronate with a blunt mucro *c.* 0.2 mm long (e.g. *M. Hislop* 4325a) or long-mucronate and sharply pungent with mucros *c.* 0.5 mm long (e.g. *M. Hislop* 4325b). It is known only from two populations a few kilometres apart, one of which is apparently no longer extant. Further research is desirable before a decision is taken regarding its taxonomic status; in particular, it would be especially valuable to see fruiting material. Because the only known, extant population co-occurs with Threatened Flora at its roadside habitat it is at least afforded some protection, whether or

not it is ultimately assessed to be a distinct taxon. In the meantime, these specimens will be referred to *S. aff. caudata* and are excluded from the above description of *S. caudata*.

Styphelia globosa Hislop, *sp. nov.*

Typus: Mowen Nature Reserve, Great North Road, 3 km south of Mowen Road, west of Nannup, Western Australia, 20 May 2006, *M. Hislop* 3597 (*holo*: PERTH 07515987; *iso*: CANB, CNS, MEL, NSW).

Leucopogon sp. Margaret River (J. Scott 207), Western Australian Herbarium, in *Florabase*, https://florabase.dpaw.wa.gov.au/ [accessed 30 July 2021]

Erect, open *shrubs*, to *c.* 1.5 m high and 1.2 m wide, single-stemmed at ground level, with a fire-sensitive rootstock. Young *branchlets* with a moderately dense indumentum of short hairs, to *c.* 0.1 mm long. *Leaves* spirally arranged, mostly steeply antrorse; apex mucronate, innocuous or rarely sub-pungent, the mucro usually ± straight, occasionally slightly deflexed or slightly inflexed, 0.2–0.6 mm long; base attenuate to cuneate; petiole 0.4–1.2 mm long, the adaxial surface hairy and the margins either glabrous throughout or with a few hairs towards the base, the abaxial surface glabrous; lamina linear, very narrowly elliptic or very narrowly obovate, 6–20 mm long, 1.0–2.7 mm wide, convex adaxially with the margins varying from slightly recurved to revolute, longitudinal axis ± straight, usually slightly twisted; surfaces ± concolorous or the abaxial surface slightly paler; adaxial surface shiny, glabrous, apart from a few hairs towards the base, with 3–5 obscure veins evident, at least towards the base; abaxial surface matt or slightly shiny, glabrous, with 5–7 primary veins (the midrib slightly broader than the others, at least towards the apex), ± flat or shallowly and broadly grooved between the veins; margins glabrous, except sometimes for a few short, antrorse hairs towards the apex. *Inflorescence* axillary, pendulous; axis 4.0–9.5 mm long, 1- or 2(3)-flowered, with a sparse to moderately dense indumentum, terete below the uppermost fertile bract, plano-convex and often shortly winged above, terminating in a bud-rudiment; flowers pendulous, pedicellate below the bracteoles, with a pedicel 0.6–1.5(–2.0) mm long. *Fertile bracts* ovate to broadly ovate, 0.7–0.9(–1.5) mm long, 0.5–0.7 mm wide, with 2–5 sterile bracts below the lowest fertile bract. *Bracteoles* depressed-ovate, 0.9–1.5 mm long, 1.2–1.6 mm wide, keeled, though often rather obscurely, obtuse, shortly mucronate (the mucro 0.1–0.2 mm long); abaxial surface shortly and densely hairy, not or scarcely striate; margins minutely ciliolate. *Sepals* ovate to narrowly ovate, 2.0–2.8 mm long, 1.2–1.5 mm wide, subacute to acute, sometimes shortly mucronate; abaxial surface shortly and densely hairy, straw-coloured, venation very obscure; adaxial surface hairy in the upper half; margins minutely ciliolate with hairs < 0.05 mm long. *Corolla tube* white, obovoid to depressed-obovoid, usually *c.* equal to the sepals, occasionally slightly longer, 1.5–2.2 mm long, 1.8–2.3 mm wide, external surface glabrous, internal surface glabrous. *Corolla lobes* white, longer than the tube, 4.0–4.8 mm long, 1.0–1.3 mm wide at base, erect in basal 2/3–3/4 of their length, and then spreading and revolute to ± coiled abaxially, external surface glabrous, internal surface with a dense, white indumentum of flattened to ± terete, twisted and ornamented hairs. *Anthers* fully exserted from the corolla tube, but not exserted beyond the erect basal portion of the corolla lobes, 2.5–3.5 mm long, distinctly narrowed towards apex and often ± filiform, ± entire to shortly emarginate. *Filaments* terete, 1.2–1.8 mm long, attached to anther 1/3–1/2 above anther base, adnate to the tube just below the sinuses. *Nectary* annular, 0.3–0.5 mm long, glabrous, ± truncate to very shallowly lobed. *Ovary* ovoid to ellipsoid, 0.8–1.1 mm long, 0.6–0.8 mm wide, glabrous, 5-locular, dark green to almost black. *Style* 5.2–6.2 mm long, glabrous and smooth, exserted from the corolla tube well beyond the erect corolla lobe bases, tapering smoothly from ovary apex; stigma not, or barely, expanded. *Fruit* globose or occasionally broadly ellipsoid, 3.8–5.5 mm long, 3.8–5.5 mm wide, much longer than the sepals, circular in transverse section, gynophore absent; surface glabrous, strongly rugose at maturity; apex rounded; style shed before maturity. (Figures 6, 7)

Figure 6. *Styphelia globosa*. A – flowering plant *in situ*; B – flowering branchlet. Vouchers *M. Hislop* 1292 (A), *K.R. Thiele* 3521 (B). Photographs by Michael Hislop (A), Kevin Thiele (B).

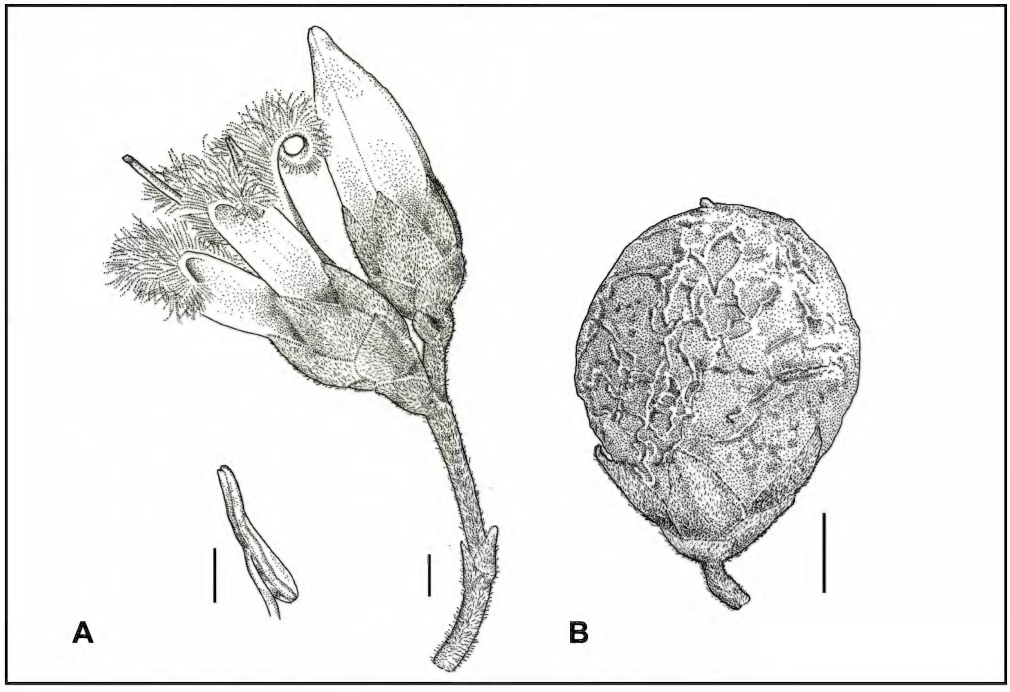

Figure 7. *Styphelia globosa*. A – 2-flowered inflorescence, stamen; B – fruit. Scale bars = 1 mm. Vouchers *M. Hislop* 3596 (A), *R. Davis* 4343 (B). Drawings by Skye Coffey.

Diagnostic characters. Within Group V, *S. globosa* is distinguished by the following character combination: leaves linear, very narrowly elliptic or very narrowly obovate, usually steeply antrorse, 1.0–2.7 mm wide, adaxially convex, the margins slightly recurved to revolute, leaf apices mucronate, usually innocuous and 0.2–0.4 mm long (occasionally sub-pungent and to 0.6 mm); inflorescences pendulous, 1- or 2(3)-flowered; sepals densely and shortly hairy, subacute to acute, sometimes shortly mucronate; corolla tube about equal to the sepals or occasionally slightly longer, shorter than the corolla lobes; ovary 5-locular, glabrous; style glabrous and smooth; stigma not, or barely, expanded; fruit globose or occasionally broadly ellipsoid, circular in transverse section, strongly rugose, gynophore absent.

Other specimens examined. WESTERN AUSTRALIA: 500 m S of Williamson Rd on Quilergup Rd [SE of Busselton], 23 May 2001, *R.J. Cranfield* 16407 (PERTH); 5 km WNW of Bibilup [NW of Nannup], 11 June 1996, *R. Davis* 1189 (PERTH); corner of Capel–Donnybrook Rd and Camp Gully Rd, SW of Donnybrook, 21 Oct. 1997, *R. Davis* 4343 (CNS, PERTH); Cell 7, Site 167, corner Blackwood Rd and Great North Rd, 50 m E on Blackwood Rd, bearing N [NE of Augusta], 21 Oct. 1998, *R. Davis* 7660 (PERTH); 4 miles [6.4 km] SW of Donnybrook, 20 Apr. 1966, *A.S. George* 7715 (CANB, CNS, PERTH); State forest near corner of Mowen Rd and Jalbarragup Rd, W of Nannup, 24 May 1998, *M. Hislop* 1052 (CANB, NSW, PERTH); *c.* 8 km NW of Nannup on W side of Vasse Hwy, 23 May 1999, *M. Hislop* 1292 (NSW, PERTH); corner Vasse Hwy and Cundinup South Rd, N of Nannup, 20 May 2006, *M. Hislop* 3596 (CANB, CNS, MEL, NSW, PERTH); Blackwood Conservation Park, Sues Rd, at intersection with Blackwood Rd, W of Nannup, 29 Apr. 2021, *M. Hislop* 4852 (CNS, K, MEL, PERTH); Site 92, 14 km NE of Margaret River, 19 Sep. 1997, *P.A. Jurjevich* 46 (PERTH); Ambergate Reserve [SW of Busselton], 11 Apr. 1992, *B.J. Keighery & N. Gibson* 1082 (PERTH); Whicher Range, Sabina Rd, just past St. Josephs Rd, 17 May 1991, *G.J. Keighery* 14179 (PERTH); Bancell Road reserve, 2 km N of Yarloop, 23 Nov. 2004, *G.J. Keighery & B.J. Keighery* 755 (PERTH); Bramley National Park [E of Margaret River], 12 May 2007, *G.J. Keighery & B.J. Keighery* 998 (PERTH); Acton Park Hall, Reserve 18918, Acton Park Rd [S of Busselton], 11 May 2007, *G.J. Keighery & B.J. Keighery* 1000 (K, MEL, PERTH); Site: MTC_RO50, Milyeannup Coast Rd, near powerline, close to intersection with South Coast Rd [E of Augusta], 24 Nov. 2008, *R. Orifici, R. Butler & P. Anderson* RO 253 (PERTH); Scott River National Park, 23 Oct. 1990, *C.J. Robinson* 253 (PERTH); Boronia State Forest, near corner of Baker Rd and Mowen Rd, 9 May 2000, *L.W. Sage* 2363 (PERTH); Davis Rd/McLean Rd, 5 km E of Witchcliffe, 19 Mar. 2000, *J. Scott* 207 (PERTH); Davis Rd, 4.2 km E of Bussell Hwy, 1 km S of Witchcliffe, 14 Oct. 2000, *J. Scott* 260 (PERTH).

Distribution and habitat. Occurs from Busselton south to the Scott River area and east to near Donnybrook, in the far west of the Warren, far south of the Swan Coastal Plain and far south-west of the Jarrah Forest bioregions. There is also an apparently outlying population further north, near Yarloop. The species is mostly recorded from sandy soils, often over laterite and most frequently in Jarrah-Marri woodland. Other commonly associated species are *Banksia grandis*, *Allocasuarina fraseriana*, *Podocarpus drouynianus*, *Taxandria parviceps*, *Acacia extensa*, *Hovea elliptica* and *Xanthorrhoea preissii*.

Phenology. Peak flowering is between April and June and most collections with mature fruit have been made in October and November. In regard to flowering time, the outlying collection from near Yarloop (*G.J. Keighery & B.J. Keighery* 755) is an interesting exception in that it is in full flower in late November. Despite the geographical disjunction and anomalous flowering time this specimen is morphologically typical for the species in all respects.

Etymology. From the Latin *globosus* (spherical), a reference to the usual shape of the fruit.

Conservation status. Although the distribution of this species is not extensive, it is locally common and well represented on the conservation estate, as well as in state forest. No conservation coding is recommended.

Affinities. *Styphelia globosa* belongs in Group V of Puente-Lelièvre *et al.* (2016). In the published phylogenetic tree, it was placed (as *Leucopogon* sp. Margaret River) in the same polytomy as *S. graniticola* Hislop (refer affinities heading under that species for details).

Styphelia globosa is broadly sympatric with two related species, *S. pendula* and *S. intricata* Hislop. It can be distinguished from the former by its densely, shortly hairy sepals and bracteoles (*cf.* glabrous in *S. pendula*) and, at least across the part of the far south west where the two co-occur, by the corolla tubes of *S. globosa* being distinctly shorter than the corolla lobes (*cf.* usually distinctly longer, occasionally ± equal to) and about equal to or slightly longer than the sepals (*cf.* distinctly longer). As noted under *S. inframediana* Hislop there is a variant of *S. pendula* that has proportionally shorter corolla tubes, about the same length as the sepals, but this plant occurs to the east of the range of *S. globosa*.

In addition to the hairy rather than glabrous sepals and bracteoles, *S. globosa* is distinguished from *S. intricata* by its wider, consistently antrorse leaves (*cf.* more or less patent to strongly retrorse in *S. intricata*) with innocuous or scarcely pungent leaf tips to 0.6 mm long, but usually 0.2–0.4 (*cf.* sharply pungent 0.6–1.0 mm long). The large, globose or occasionally broadly ellipsoid fruit of *S. globosa* provides a further distinction from both *S. pendula* (narrowly obovoid fruits) and *S. intricata* (ellipsoid to obovoid).

Another somewhat similar taxon, *Styphelia madida* Hislop subsp. *madida*, occurs in forest country to the east of the distribution of *S. globosa* in the Walpole–Denmark area. It differs from *S. globosa* in having glabrous rather than hairy sepals, longer and sharply pungent leaf mucros (*cf.* innocuous or rarely sub-pungent in *S. globosa*) and shorter anthers (1.8–2.6 mm long *cf.* 2.5–3.5).

Notes. Although *S. globosa* typically has innocuous leaf mucros, 0.2–0.4 mm long, there are a very few collections in which the mucro is longer (to 0.6 mm) and sub-pungent. In all other respects these specimens match the typical form of the species. It is noteworthy that a similar pattern of variation also occurs in *S. pendula*, which like *S. globosa* usually has short, innocuous leaf mucros, but in which they are occasionally longer and pungent or sub-pungent.

Two specimens from the south-eastern edge of the species range (*J.M. Powell* 2634 and *A.R. Chapman* 361 *& J.M. Powell*) suggest the possibility of hybridisation between *S. globosa* and another member of Group V, with *S. pendula* maybe the most likely candidate. Both specimens have the bracteole and sepal hairs of *S. globosa* (although these somewhat sparser than in that species), in combination with corolla tubes that are longer than the lobes. In *Powell* 2634 the leaf margins are barely recurved and the apices are strongly pungent, whereas *Chapman* 361 has strongly recurved margins and shorter sub-pungent apices.

Styphelia graniticola Hislop, *sp. nov.*

Typus: north of Walpole, Western Australia [precise locality withheld for conservation reasons], 1 September 2005, *M. Hislop* 3503 (*holo*: PERTH 07357877; *iso*: CANB, CNS, MEL, NSW 832203).

Leucopogon sp. Southern Granite (E.D. Middleton EDM 266), Western Australian Herbarium, in *Florabase*, https://florabase.dpaw.wa.gov.au/ [accessed 30 July 2021]

Spreading *shrubs*, to *c.* 80 cm high and 80 cm wide, single-stemmed at ground level, with a fire-sensitive rootstock. Young *branchlets* with a sparse to moderately dense indumentum of short hairs, < 0.05 mm long. *Leaves* spirally arranged, shallowly to steeply antrorse; apex long-mucronate, pungent, the mucro ± straight, 0.7–1.2 mm long; base cuneate to attenuate; petiole 0.7–1.2 mm long, glabrous, apart from a few hairs on the adaxial surface; lamina narrowly elliptic to narrowly obovate, 7–12 mm long, 1.9–3.6 mm wide, convex adaxially with the margins usually barely recurved, very occasionally moderately recurved, longitudinal axis ± straight (gently incurved to gently recurved), usually slightly twisted; surfaces slightly discolorous; adaxial surface shiny, glabrous, apart from a few hairs towards the base, with 3–5 obscure veins usually evident, at least towards the base; abaxial surface slightly paler, matt, glabrous, with 5–7 primary veins (the midrib slightly broader than the others, at least towards the apex), ± flat to very shallowly and broadly grooved between the veins; margins glabrous. *Inflorescence* axillary, pendulous; axis 1.5–5.5 mm long, 1- or 2-flowered, with a sparse to moderately dense indumentum, terete below the uppermost fertile bract, plano-convex and narrowly winged above, terminating in a bud-rudiment; flowers pendulous, pedicellate below the bracteoles, with a pedicel 0.4–0.8 mm long. *Fertile bracts* broadly ovate to depressed-ovate, 0.3–0.6 mm long, 0.5–0.7 mm wide, and with (3)4–5 sterile bracts below the lowest fertile bract. *Bracteoles* depressed ovate to ± orbicular, 1.0–1.2 mm long, 1.2–1.3 mm wide, obscurely keeled in the upper half, obtuse, shortly mucronate (the mucro to *c.* 0.1 mm long); abaxial surface glabrous, not or scarcely striate; margins minutely ciliolate. *Sepals* ovate or narrowly ovate, 1.8–2.2 mm long, 1.2–1.4 mm wide, obtuse to acute, often shortly mucronate; abaxial surface glabrous, straw-coloured, sometimes with pink tinges, venation very obscure; adaxial surface sparsely hairy in the distal half; margins minutely ciliolate, with hairs < 0.05 mm long. *Corolla tube* white, obovoid to broadly obovoid, longer than the sepals, 3.0–4.1 mm long, 2.2–3.0 mm wide, external surface glabrous, internal surface glabrous. *Corolla lobes* white, shorter than the tube, 2.0–2.8 mm long, 1.2–1.8 mm wide at base, erect in basal 2/3–3/4 of their length, and then spreading and recurved to revolute, external surface glabrous, internal surface with a dense, white indumentum of flattened, twisted and ornamented hairs. *Anthers* partially exserted (by at least 7/8 of their length), or fully exserted from the corolla tube, but not exserted beyond the erect basal portion of the corolla lobes, 1.0–1.5 mm long, apex emarginate. *Filaments* terete, 0.9–1.2 mm long, attached to the anther 2/3–3/4 above base, adnate to the tube just below the sinuses. *Nectary* annular, 0.3–0.5 mm long, glabrous, variably lobed. *Ovary* ellipsoid or broadly ellipsoid, 0.9–1.1 mm long, 0.7–0.8 mm wide, glabrous, 5-locular, dark green to almost black. *Style* glabrous and smooth, 3.5–5.3 mm long, exserted from the corolla tube to a point just beyond the erect corolla lobe bases, tapering smoothly from ovary apex; stigma not, or barely, expanded. *Fruit* narrowly ellipsoid to narrowly obovoid, 3.4–4.3 mm long, 1.7–2.0 mm wide, much longer than the sepals, circular in transverse section, gynophore absent; surface glabrous, mostly ± smooth or shallowly rugose, but more deeply rugose towards the base at maturity; apex rounded; style shed before maturity. (Figures 8, 9)

Diagnostic characters. Within Group V, *S. graniticola* is distinguished by the following character combination: leaves narrowly elliptic to narrowly obovate, variably antrorse, 1.9–3.6 mm wide, adaxially convex, the margins usually barely recurved, leaf apices long-mucronate, pungent, the mucro 0.7–1.2 mm long; inflorescences pendulous, 1- or 2-flowered; sepals glabrous, obtuse to acute, often shortly mucronate; corolla tube longer than the sepals and corolla lobes; ovary 5-locular, glabrous; style glabrous and smooth; stigma not or barely expanded; fruit narrowly ellipsoid to narrowly obovoid, circular in section, mostly ± smooth or shallowly rugose, but more deeply rugose towards the base at maturity, gynophore absent.

Figure 8. *Styphelia graniticola* – flowering plant *in situ*. Voucher *M. Hislop* 3507. Photograph by Michael Hislop.

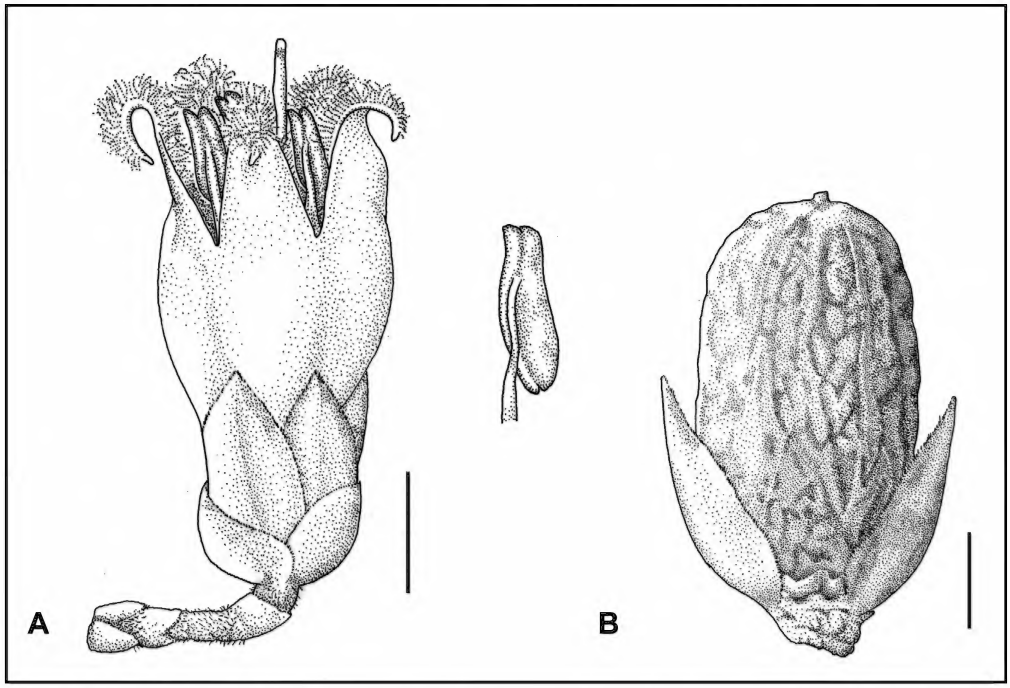

Figure 9. *Styphelia graniticola*. A – 1-flowered inflorescence, stamen; B – fruit. Scale bars = 1 mm. Vouchers *M. Hislop* 3507 (A), *M. Hislop* 3563 (B). Drawings by Skye Coffey.

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 18 Sep. 1966, *E.M. Bennett* 1173 (PERTH); 2 Sep. 2005, *M. Hislop* 3507 (CANB, CNS, PERTH); 29 Dec. 2005, *M. Hislop* 3563 (CANB, CNS, PERTH); 27 Aug. 2000, *E.D. Middleton* EDM 266 (PERTH); 10 Oct. 2000, *E.D. Middleton* EDM 304 (PERTH); 28 Aug. 2002, *E.D. Middleton* EDM 505 (PERTH); 15 Aug. 1979, *J.M. Powell* 1173 (CANB, H, K, L, NSW, PERTH); 13 Nov. 1985, *A.N. Rodd* 4955 & *G. Fenson* (NSW, PERTH); 22 Sep. 1992, *J.R. Wheeler* 3247 (PERTH).

Distribution and habitat. *Styphelia graniticola* has an apparently restricted distribution, extending from south-west to north-east of Walpole, in the Warren bioregion. It is restricted to shallow, sandy loam soils, in heathland communities, on the slopes of granitic hills. Associated species include *Dodonaea ceratocarpa*, *Eutaxia myrtifolia*, *Taxandria conspicua*, *Acacia myrtifolia* and *Melaleuca croxfordiae*.

Phenology. The main flowering period is between August and October. Collections with mature fruit have been made in November and December.

Etymology. From the Latin *graniticus* (granitic) and *-cola* (inhabiting), in reference to the species' habitat preference.

Conservation status. Currently known from just four populations, all on the conservation estate. Recently listed as Priority Two (Western Australian Herbarium 1998–) under Conservation Codes for Western Australian Flora under the name *Leucopogon* sp. Southern Granite (E.D. Middleton EDM 266).

Affinities. *Styphelia graniticola* belongs in Group V of Puente-Lelièvre *et al.* (2016). In the published phylogenetic tree, as *Leucopogon* sp. Southern Granite, it was one of sixteen species (including another three described in this paper: *S. inframediana*, *S. intricata* and *S. madida*) that were placed in a well-supported subclade of Group V.

Most older collections of *S. graniticola* had been referred to *S. erubescens* F.Muell., a species to which it bears a strong similarity in its vegetative morphology. The two can be distinguished by the following character differences: inflorescence pendulous in *S. graniticola* (*cf.* widely spreading in *S. erubescens*); inner corolla tube glabrous (*cf.* hairy); style glabrous and smooth, with a more or less filiform stigma (*cf.* style scabrous in the upper half, with a greatly expanded stigma).

Styphelia graniticola is usually readily distinguished from other members of Group V that occur in the Warren bioregion because of a different foliar morphology. In comparison to the relatively broad, convex (the margins usually barely recurved) leaves of *S. graniticola*, those of the widespread *S. pendula* are always noticeably narrower (0.5–1.6 mm wide, *cf.* 1.9–3.6 mm in *S. graniticola*) with strongly recurved to revolute margins. There is also a difference in leaf apex. In *S. graniticola* the mucro is always long (0.7–1.2 mm long) and sharply pungent whereas in *S. pendula* it is usually much shorter (mostly 0.1–0.5 mm long) and non-pungent. Occasionally however, *S. pendula* may have a longer (to 0.8 mm long), sharply pungent mucro. One such population is known to occur in close proximity to *S. graniticola* (refer *M. Hislop* 3508 and 3507 respectively), but with the two species always readily distinguishable. Indeed because *S. pendula* is such a common species in the Walpole area it is likely to be present within a short distance of all populations of *S. graniticola*, giving ample opportunity for potential hybridisation. Whether past hybridisation with one of the related pungent-leaved species, *S. graniticola*, *S. madida* or *S. inframediana* Hislop, is the reason for occasional atypical populations of *S. pendula* is a question worthy of further exploration.

Another member of Group V with pendulous inflorescences that is common in the Walpole area is *S. madida* subsp. *madida*. That taxon differs from *S. graniticola* in its narrower leaves (0.8–2.0 mm wide *cf.* 1.9–3.6 mm in *S. graniticola*), corolla lobes that are longer than, rather than shorter than, the tube and in having globose or broadly ellipsoid fruit (*cf.* narrowly ellipsoid to narrowly obovoid fruit).

Styphelia inframediana Hislop, *sp. nov.*

Typus: Stirling Range National Park, close to corner of Chester Pass Road and Formby Road South, Western Australia, 23 May 2017, *M. Hislop* 4707 (*holo*: PERTH 09092986; *iso*: CANB, CNS, MEL).

Styphelia sp. Albany (M. Hislop 2218), Western Australian Herbarium, in *Florabase*, https://florabase.dpaw.wa.gov.au/ [accessed 30 July 2021]

Leucopogon ovalifolius auct. non Sond.: Western Australian Herbarium, in *Florabase,* https://florabase.dpaw.wa.gov.au/ [before March 2018].

Erect *shrubs*, to *c.* 90 cm high and 70 cm wide, single-stemmed at ground level, with a fire-sensitive rootstock. Young *branchlets* with a sparse to moderately dense indumentum of short hairs, < 0.05 mm long. *Leaves* spirally arranged, variously antrorse to strongly retrorse; apex long-mucronate, pungent, the mucro ± straight, to slightly inflexed, 0.4–0.8 mm long; base cuneate; petiole 0.4–0.6 mm long, the adaxial surface hairy, the abaxial surface glabrous and the margins either glabrous or very sparsely hairy; lamina narrowly obovate to narrowly elliptic or occasionally narrowly ovate, 3.5–9.0 mm long, 1.0–2.5 mm wide, convex adaxially, the margins slightly recurved, or occasionally ± flat, longitudinal axis ± straight to distinctly recurved; surfaces slightly discolorous; adaxial surface shiny, glabrous apart from a few hairs towards the base, with 3–5 obscure veins usually evident, at least towards the base; abaxial surface slightly paler, ± matt, glabrous, with 5–7 primary veins (the midrib slightly broader than the others, at least towards the apex), ± flat to very shallowly and broadly grooved between the veins; margins coarsely and minutely ciliolate with antrorse hairs, < 0.05 mm long. *Inflorescence* axillary, pendulous; axis 2.0–5.2 mm long, 1- or 2(3)-flowered, with a very short, sparse indumentum, terete below the uppermost fertile bract, plano-convex and narrowly winged above, terminating in a bud rudiment; flowers pendulous, pedicellate below the bracteoles, with a pedicel 0.4–0.8 mm long. *Fertile bracts* ovate, 0.5–0.8 mm long, 0.5–0.6 mm wide, with 2–4(6) sterile bracts below the lowest fertile bract. *Bracteoles* broadly ovate to depressed ovate, 0.8–1.0 mm long, 0.8–1.2 mm wide, obscurely keeled in the upper half, obtuse to acute, mucronate (the mucro 0.1–0.2 mm long); abaxial surface glabrous, ± striate; margins minutely ciliolate. *Sepals* ovate or narrowly ovate, 1.8–2.4 mm long, 0.7–1.0 mm wide, acute, often shortly mucronate (the mucros sometimes recurved or incurved); abaxial surface glabrous, straw-coloured, venation very obscure; adaxial surface hairy in the distal half; margins ciliolate, with hairs < 0.05 mm long. *Corolla tube* white, obovoid or broadly obovoid, slightly shorter to distinctly longer than the sepals, 1.6–2.2(–2.5) mm long, 1.5–2.0 mm wide, external surface glabrous, internal surface glabrous or with a few hairs immediately below the lobes. *Corolla lobes* white, longer than the tube, 2.5–4.0 mm long, 0.8–1.0 mm wide at base, erect in the basal 1/2–3/4 of their length, and then spreading and revolute to partially coiled, external surface glabrous, internal surface with a dense, white indumentum of flattened, twisted hairs and ± ornamented hairs. *Anthers* partially exserted (by at least 7/8 of their length), or fully exserted from the corolla tube, but not exserted beyond the erect basal portion of the corolla lobes, 1.8–3.2 mm long, distinctly narrowed towards the apex and often ± filiform, variously emarginate or sometimes ± entire. *Filaments* terete, 0.5–1.0 mm long, attached to the anther 1/3–1/2 above the anther base, adnate to the tube just below the sinuses. *Nectary* annular, 0.3–0.5 mm long, glabrous, very shallowly to deeply lobed. *Ovary* ovoid to ellipsoid, 0.7–1.0 mm long, 0.4–0.6 mm long, glabrous, 5-locular, dark green to almost black.

Style 3.5–5.4 mm long, glabrous and smooth, exserted from the corolla tube well beyond the erect corolla lobe bases, tapering smoothly from ovary apex; stigma not, or barely, expanded. *Fruit* broadly obovoid to ellipsoid, 3.0–3.3 mm long, 2.2–2.5 mm wide, much longer than the sepals, circular in transverse section, gynophore absent; surface glabrous, rugose at maturity; apex rounded; style shed before maturity. (Figures 10, 11)

Diagnostic characters. Within Group V, *S. inframediana* may be distinguished by the following character combination: leaves narrowly obovate to narrowly elliptic (occasionally narrowly ovate), 1.0–2.5 mm wide, adaxially convex, the margins slightly recurved or occasionally ± flat, leaf apices long-mucronate, pungent, the mucro 0.4–0.8 mm long; inflorescences pendulous, 1- or 2(3)-flowered; sepals glabrous, acute, often shortly mucronate; corolla tube slightly shorter than to distinctly longer than the sepals, shorter than the corolla lobes; ovary 5-locular, glabrous; style glabrous and smooth; stigma not, or barely expanded; fruit broadly obovoid to ellipsoid, circular in transverse section, rugose, gynophore absent.

Other specimens examined. WESTERN AUSTRALIA: 28 km W along Stirling Range Drive from junction with Chester Pass Rd, Stirling Range National Park, 25 Oct. 1997, *E.A. Brown* 97/417, *P.G. Wilson & N. Lam* (NSW, NY, PERTH); King George's Sound, Sep. 1900, *B.T. Goadby* 131 (PERTH); E slope of Little Lindesay on track W from Stan Rd [N of Denmark], 19 Apr. 1995, *B.G. Hammersley* 1340 (PERTH); E side Red Gum Pass, 5.4 km S of Salt River Rd, Stirling Range National Park, 3 June 2001, *M. Hislop* 2218 (PERTH); Millbrook Rd, 3.6 km E of Albany Hwy, N of Albany, 9 May 2009, *M. Hislop* 3877 (CANB, PERTH); Stirling Range National Park, Mount Trio walk trail, 23 May 2017, *M. Hislop* 4705 (PERTH); Down Road Nature Reserve, E central part of reserve, 31 Aug. 2017, *M. Hislop* 4719 (PERTH); Mt Lindesay National Park, walk trail to Mt Lindesay, N of Denmark, 19 Oct. 2017, *M. Hislop* 4729 (CNS, PERTH); Red Gum Springs, Stirling Range, 13 May 1967, *F.W. Humphreys s.n.* (PERTH); 600 m, ridgeline hill, SW slopes of Ellen Peak [Stirling Range], 11 May 1982, *G.J. Keighery* 4941 (PERTH); lookout area on Baby Barnett Hill, off Stirling Range Drive, 9 Feb. 1980, *J.M. Powell* 1468 (CANB, NSW, PERTH); Yungemere track, *c.* 1.5 km E from Chester Pass Rd, Stirling Range National Park, 30 Aug. 1986, *J.M. Powell* 2738 (NSW, PERTH); ARVS Site L192. Down Road Nature Reserve, NW of Albany, 30 Apr. 2008, *E.M. Sandiford & D.A. Rathbone* 1616 (PERTH); site SRNP d26JAN, Murray Site, 1.39 km N of West Pillenorup Track on Hostellers Track, N from road [Stirling Range National Park], 26 Jan. 1989, *R.T. Wills* 1171 (PERTH); 16 km N of Albany on road to Borden, 9 May 1969, *P.G. Wilson* 8302 (CANB, K, NSW, PERTH).

Distribution and habitat. *Styphelia inframediana* is distributed rather sporadically between Denmark and Albany and north to the Stirling Range, in the far south of the Jarrah Forest and far west of the Esperance Plains bioregions. It grows in sandy or light loam soils, usually high in the landscape, over quartzite, laterite or granite and in species-rich heath or open woodland. Commonly associated species include *Eucalyptus marginata*, *E. staeri*, *Agonis theiformis*, *Taxandria spathulata*, *Hakea trifurcata*, *H. cucullata* and *H. ambigua*.

Phenology. The main flowering period is between April and June. Mature fruit has been collected in October and November.

Etymology. From the Latin *infra* (below) and *medianus* (the middle), a reference to the usual point of attachment of the anther to the filament. The name is intended to highlight a difference between the new species and *S. retrorsa* Hislop, Crayn & Puente-Lel. (formerly *Leucopogon ovalifolius* Sond.), the species with which it had until recently been confused. In the latter, the usual point of attachment is above the middle.

Figure 10. *Styphelia inframediana* – flowering plant *in situ*. Voucher *M. Hislop* 2218. Photograph by Michael Hislop.

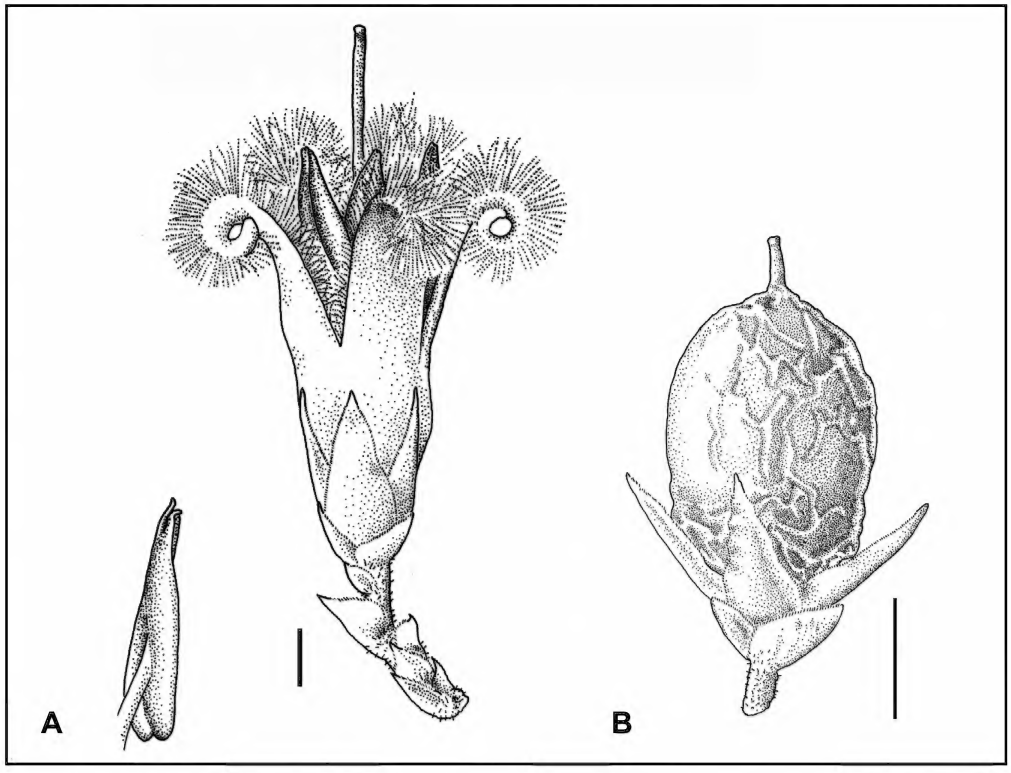

Figure 11. *Styphelia inframediana*. A – 1-flowered inflorescence, stamen; B – fruit. Scale bars = 1 mm. Vouchers *M. Hislop* 4707 (A), *E.A. Brown* 97/417, *P.G. Wilson & N. Lam* (B). Drawings by Skye Coffey.

Conservation status. Most of the known populations of this species occur on the conservation estate where it is often locally common. No conservation coding is recommended here.

Affinities. *Styphelia inframediana* belongs in Group V of Puente-Lelièvre *et al.* (2016). In the published phylogenetic tree, it was placed (as *Leucopogon ovalifolius*) in the same polytomy as *S. graniticola* (refer affinities heading under that species for details).

Styphelia inframediana was for a number of years treated as *Leucopogon ovalifolius* (now *S. retrorsa*) at the Western Australian Herbarium. However, that species occurs north and east of Perth, well to the north of the range of *S. inframediana*, from Cataby and Moora south to Bindoon, and east to Clackline. It differs from *S. inframediana* in at least the following ways: inflorescences 2–4-flowered (*cf.* 1- or 2-flowered in *S. inframediana*); corolla tube always longer than the sepals and usually longer than, or occasionally equal to the lobes (*cf.* tube shorter than, to longer than the sepals and always shorter than the corolla lobes); filaments usually attached to the anthers above the middle (*cf.* usually below the middle). In addition, the leaves of *S. retrorsa* are noticeably larger (e.g. widest leaves per specimen 2.5–4.5 mm wide, usually at least 3 mm *cf.* 1.5–2.5 mm wide, usually less than 2.2 mm in *S. inframediana*).

Within its geographical range *S. inframediana* is most likely to be mistaken for either *S. concinna* (Benth.) F.Muell. or *S. pendula*, two of the most variable species in Group V. *Styphelia concinna* is sympatric with *S. inframediana* in the Stirling Range, where the two have often been confused. It can be distinguished from *S. inframediana* by its shorter leaves, rarely more than 5 mm long, that are usually non-pungent, by its 3- or 4-locular ovary (*cf.* 5-locular in *S. inframediana*), obtuse or occasionally subacute sepals (*cf.* acute) and in having fruit that are cylindrical to very narrowly ellipsoid, to about 1.4 mm wide (*cf.* broadly obovoid to ellipsoid and 2.2–2.5 mm wide in *S. inframediana*).

Styphelia pendula always differs from *S. inframediana* in having strongly recurved or revolute leaf margins (*cf.* slightly recurved or occasionally ± flat) and narrowly obovoid fruit (*cf.* broadly obovoid to ellipsoid). Typical *S. pendula* also differs in having non-pungent leaf tips, but as noted under *S. graniticola*, occasionally they may be sharply pungent.

A distinctive variant of *S. pendula* with short corolla tubes (referred to as the 'short-tube variant' in the above key), about as long as the sepals and distinctly shorter than the corolla lobes (e.g. *M. Hislop* 3428), is distributed sporadically between Walpole, Albany and the Stirling Range. This character clearly puts it at variance with the typical form of *S. pendula*, in which the tube is always longer than the sepals and usually longer than (or occasionally ± equal to) the lobes. This variant may be more likely to be confused with *S. inframediana*. Apart from the distinguishing characters given in the preceding paragraph the short-tube variant of *S. pendula* also differs from *S. inframediana* in always having strongly antrorse leaves and apparently also in never having pungent leaf tips.

The case for a taxonomic recognition of the short-tube variant of *S. pendula* appears quite strong and is given support by a substantially different, although apparently overlapping flowering period, with the short-tube variant coming into flower well before the typical variant. However, given that there is apparently no difference in fruit shape (frequently a useful distinguishing character in Group V) further research seems advisable. Field observations would be particularly valuable to ascertain whether the difference in corolla proportions is consistent within populations. It would also be relevant to study the detail of the relative distributions of the two forms given that typical *S. pendulus* is broadly sympatric with the short-tube variant across the latter's geographical range, excluding the Stirling Range, where apparently only the short-tube variant occurs.

Styphelia intricata Hislop, *sp. nov.*

Typus: east of Augusta, Western Australia [precise locality withheld for conservation reasons], 21May 2006, *M. Hislop* 3599 (*holo*: PERTH 07441045; *iso*: CANB, CNS, H, K, MEL, NSW 832194).

Leucopogon sp. Gingilup (N. Gibson & M. Lyons 590), Western Australian Herbarium, in *Florabase*, https://florabase.dpaw.wa.gov.au/ [accessed 30 July 2021]

Tangled, spreading *shrubs*, to *c.* 80 cm high and 150 cm wide, single-stemmed at ground level, with a fire-sensitive rootstock. Young *branchlets* with a sparse indumentum of short hairs, < 0.05 mm long, or ± glabrous. *Leaves* spirally arranged, ± patent to strongly retrorse; apex long-mucronate, pungent, the mucro ± straight or slightly inflexed, 0.6–1.0 mm long; base cuneate to rounded; petiole rather indistinct, to *c.* 0.5 mm long, glabrous, apart from a few hairs on the adaxial surface; lamina linear to very narrowly ovate, 6–12 mm long, 0.5–1.7 mm wide, convex adaxially with the margins strongly recurved to revolute, longitudinal axis ± straight to distinctly recurved; surfaces ± concolorous; adaxial surface shiny, glabrous, apart sometimes for a few hairs towards the base, with 3–5 obscure veins usually evident, at least towards the base; abaxial surface matt or slightly shiny, glabrous, with 5–7 primary veins (the midrib slightly broader than the others, at least towards the apex), shallowly and broadly grooved between the veins; margins glabrous. *Inflorescence* axillary, pendulous; axis 2.8–7.5 mm long, 1- or 2-flowered, glabrous, terete below the uppermost fertile bract, plano-convex above, terminating in a bud-rudiment; flowers pendulous, pedicellate below the bracteoles, with a pedicel 0.7–1.5 mm long. *Fertile bracts* ovate to broadly ovate, 0.3–0.7 mm long, 0.3–0.5 mm wide, with 2–4 sterile bracts below the lowest fertile bract. *Bracteoles* ± orbicular to depressed-ovate, 0.7–1.0 mm long, 0.8–1.0 mm wide, obscurely keeled in the upper half, obtuse to subacute, mucronate (the mucro 0.1–0.3 mm long); abaxial surface glabrous, not or scarcely striate; margins minutely ciliolate. *Sepals* ovate or narrowly ovate, 1.6–2.3 mm long, 0.8–1.0 mm wide, acute, often shortly mucronate; abaxial surface glabrous, or sometimes very shortly and sparsely hairy, straw-coloured, sometimes with pink tinges, venation very obscure; adaxial surface sparsely hairy in the distal half; margins minutely ciliolate, with hairs < 0.05 mm long. *Corolla tube* white, obovoid to depressed-obovoid, a little longer than the sepals, 1.6–2.2 mm long, 1.7–2.3 mm wide, external surface glabrous, internal surface glabrous. *Corolla lobes* white, longer than the tube, 2.3–2.8 mm long, 1.0–1.2 mm wide at base, erect in basal 1/3–1/2 of their length, and then spreading and revolute to ± coiled, external surface glabrous, internal surface with a dense, white indumentum of flattened, twisted and ± ornamented hairs. *Anthers* partially exserted (by 3/4–7/8 of their length) from the corolla tube, 1.5–2.2 mm long, emarginate. *Filaments* terete, 0.3–0.6 mm long, attached to the anther 1/3–1/2 above the base, adnate to the tube just below the sinuses. *Nectary* annular, 0.4–0.5 mm long, glabrous, very shallowly lobed. *Ovary* ovoid or ellipsoid, 0.7–0.9 mm long, 0.5–0.6 mm wide, glabrous, 5-locular, dark green to almost black. *Style* glabrous and smooth, 3.0–4.2 mm long, exserted from the corolla tube well beyond the erect corolla lobe bases, tapering smoothly from the ovary apex; stigma not, or barely, expanded. *Fruit* ellipsoid to obovoid, 4.0–4.8 mm long, 2.0–2.8 mm wide, much longer than the sepals, circular in transverse section, gynophore absent; surface glabrous, ± dry and smooth (mesocarp apparently not, or poorly developed); apex rounded; style shed before maturity. (Figures 12, 13)

Diagnostic characters. Within Group V, *S. intricata* is distinguished by the following character combination: leaves linear to very narrowly ovate, ± patent to strongly retrorse, 0.5–1.7 mm wide, adaxially convex, the margins strongly recurved to revolute, leaf apices long mucronate, pungent, the mucro 0.6–1.0 mm long; inflorescences pendulous, 1- or 2-flowered; sepals glabrous, acute, often shortly mucronate; corolla tube slightly longer than the sepals, shorter than the corolla lobes;

Figure 12. *Styphelia intricata* – scanned image of flowering branchlets. Voucher *M. Hislop* 3599.

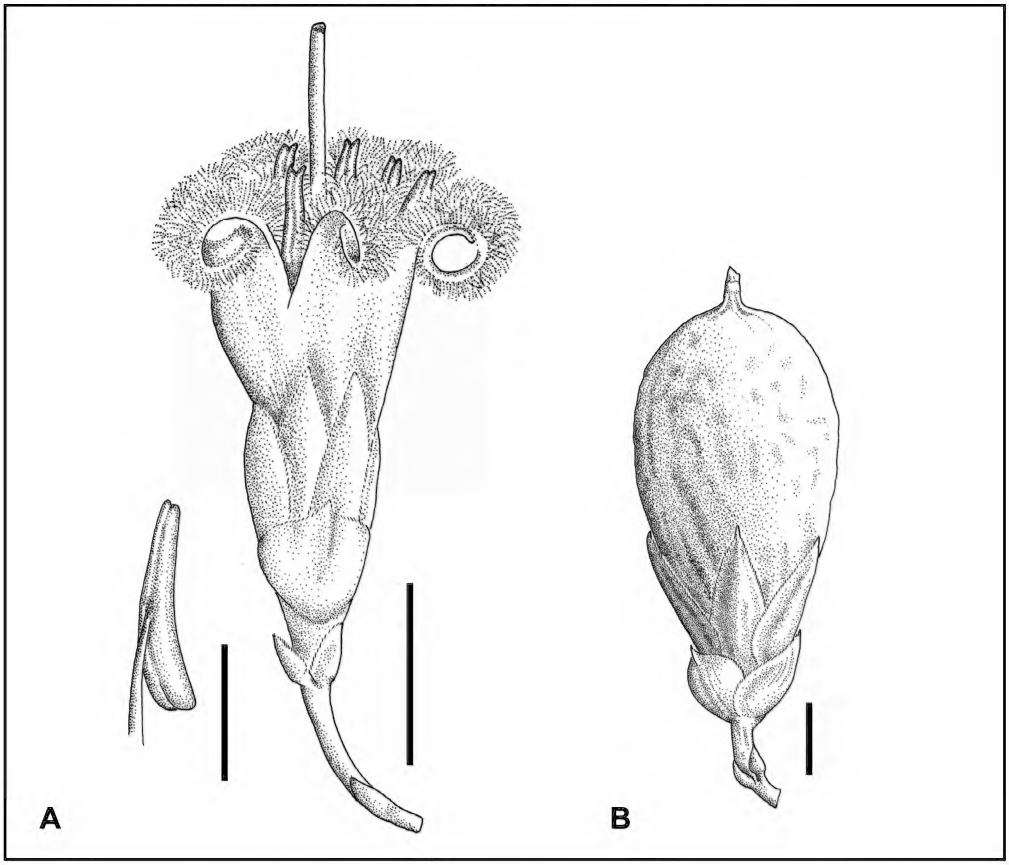

Figure 13. *Styphelia intricata*. A – 1-flowered inflorescence, stamen; B – fruit. Scale bars = 1 mm. Vouchers *M. Hislop* 3599 (A), *M. Hislop* 3681 (B). Drawings by Skye Coffey.

ovary 5-locular, glabrous; style glabrous and smooth; stigma not, or barely, expanded; fruit ellipsoid to obovoid, circular in section, ± dry and smooth, gynophore absent.

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 19 Apr. 1991, *N. Gibson & M. Lyons* 590 (CANB, PERTH); 26 Nov. 2006, *M. Hislop* 3681 (CANB, CNS, PERTH); 28 Apr. 2021, *M. Hislop* 4851 (CANB, CNS, MEL, PERTH); 2 June 1995, *B.J. Lepschi* 1893 (CANB, NSW, PERTH); 31 Mar. 2003, *A. Webb* AW 2250 (PERTH); 11 Jan. 2008, *A. Webb* 09008 (PERTH); 8 Oct. 2020, *A. Webb* AW 09126 (PERTH).

Distribution and habitat. *Styphelia intricata* has an apparently restricted distribution in the far south-west of the Jarrah Forest and the far west of the Warren bioregions, from south-east of Margaret River to east of Augusta. It occurs in seasonal wetlands in open woodland or heath. Associated species include *Melaleuca preissiana*, *Taxandria* spp., *Beaufortia sparsa*, *Aotus intermedia* and numerous restiads and sedges.

Phenology. The main flowering period is between April and June. Mature fruit have been recorded in October and November.

Etymology. From the Latin *intricatus* (entangled), a reference to the species' distinctive growth habit.

Conservation status. Listed as Priority Two (Smith & Jones 2018) under Conservation Codes for Western Australian Flora under the name *Leucopogon* sp. Gingilup (N. Gibson & M. Lyons 590). Known from two nature reserves and from a population in state forest. Restricted as it is to a wetland habitat in one of the wettest districts of Western Australia, this species is likely to be particularly vulnerable to the warming and drying effects of ongoing climate change. The damp habitat is also likely to make it especially susceptible to the root-rot pathogen, *Phytophthora cinnamomi* Rands. Populations of this species should accordingly be monitored on a regular basis.

Affinities. *Styphelia intricata* belongs in Group V of Puente-Lelièvre *et al.* (2016). In the published phylogenetic tree, it was placed (as *Leucopogon* sp. Gingilup) in the same clade of sixteen as *S. graniticola, S. inframediana*, and *S. madida*.

The tangled growth habit, very narrow, more or less patent to strongly retrorse leaves, together with a wetland habitat make *S. intricata* a distinctive species that is not easily confused with others. Most congeners in the Warren and southern Jarrah Forest bioregions have either uniformly antrorse, or broader, leaves (usually both). Only *S. inframediana* (described above) does frequently have retrorse leaves but it occurs well to the east of the range of *S. intricata* and is a plant of dry habitats on upland sites. In any case that species can be distinguished by its generally wider leaves (widest leaves per specimen 1.5–2.5 mm long *cf.* 1.0–1.7 mm in *S. intricata*) with more gently recurved margins, smaller fruit (3.0–3.3 mm long *cf.* 4.0–4.8 mm), hairy rather than glabrous inflorescence axes and longer filaments (0.5–1.0 mm long *cf.* 0.3–0.6 mm).

The northernmost collection of *S. intricata* differs from the others in having a very short, sparse abaxial sepal indumentum. These hairs are similar in character, but much sparser, than those seen on the sepals of *L. globosa*. Another collection (*A. Webb* 09060) from the same area has a denser sepal indumentum and leaves that are patent to shallowly antrorse. These specimens suggest the possibility that hybridisation does, or has, occurred between these taxa. Generally, there is a distinct difference in habitat preference between the two species, with *L. globosa* occurring in dry habitats. This would presumably mitigate against the likelihood of such hybridisation events.

Styphelia madida Hislop, *sp. nov.*

Typus: 21.7 km north-west of Walpole on road to Manjimup, Western Australia, 5 February 1980, *J.M. Powell* 1449 (*holo*: PERTH 02996014; *iso*: BISH, CANB 333114.1, K, L, MEL 0611332A, NSW 403068).

Leucopogon sp. Walpole (R.J. Cranfield 10940), Western Australian Herbarium, in *Florabase*, https://florabase.dpaw.wa.gov.au/ [accessed 30 July 2021]

Erect open *shrubs*, to *c.* 1.5 m high and 1.5 m wide, single-stemmed at ground level, with a fire-sensitive rootstock. Young *branchlets* with a sparse to dense indumentum of hairs, to 0.4 mm long. *Leaves* spirally arranged, from shallowly to steeply antrorse, rarely some shallowly retrorse; apex long-mucronate, pungent, the mucro slightly deflexed to slightly inflexed, 0.7–2.0 mm long; base attenuate to cuneate; petiole 0.5–1.2 mm long, adaxial surface hairy, abaxial surface glabrous and the margins glabrous or ciliate; lamina linear, very narrowly elliptic, narrowly obovate to obovate, or very occasionally very narrowly ovate, 8–21 mm long, 0.8–3.8 mm wide, convex adaxially with the margins varying from slightly recurved to revolute, longitudinal axis shallowly recurved to shallowly incurved; surfaces ± concolorous or the abaxial surface distinctly paler; adaxial surface shiny, glabrous, apart from sparse hairs in the lower half, with 3–5 obscure veins evident, at least towards the base; abaxial surface matt or slightly shiny, glabrous, with 5–7 primary veins (the midrib slightly broader than the others, at least towards the apex), ± flat or very shallowly and openly grooved between the veins; margins glabrous, or sparsely ciliate towards the base. *Inflorescence* axillary, pendulous; axis 3.0–10 mm long, 1–3-flowered, with a sparse to dense indumentum or sometimes ± glabrous, terete below the uppermost fertile bract, plano-convex and often shortly winged above, terminating in a bud-rudiment; flowers pendulous, pedicellate below the bracteole, with a pedicel 0.5–1.5 mm long. *Fertile bracts* ovate, 0.7–0.9 mm long, 0.5–0.6 mm wide, with 2–3(4) sterile bracts below the lowest fertile bract. *Bracteoles* broadly ovate, 1.0–1.6 mm long, 1.0–1.5 mm wide, keeled, obtuse, mucronate (the mucro 0.2–0.7 mm long); abaxial surface glabrous, not or scarcely striate, margins minutely ciliolate. *Sepals* ovate to narrowly ovate, 1.8–3.0 mm long, 1.0–1.3 mm wide, acute or subacute, often mucronate; abaxial surface glabrous, straw-coloured, venation obscure; adaxial surface hairy in the upper half, margins ciliolate with hairs to 0.08 mm long. *Corolla tube* white, obovoid or broadly obovoid, *c.* equal to, to distinctly longer than the sepals, 1.8–2.7(–3.0) mm long, 1.6–2.4 mm wide, external surface glabrous, internal surface glabrous throughout or with hairs immediately beneath the lobes, and then glabrous below that. *Corolla lobes* white, longer than the tube, 3.2–4.5 mm long, 1.0–1.3 mm wide at base, erect in basal 1/2–2/3 of their length, and then spreading and revolute to partially coiled, external surface glabrous, internal surface with a dense, white indumentum of flattened to ± terete, twisted and ornamented hairs. *Anthers* partially exserted (by at least 7/8 of their length), or fully exserted from the corolla tube, but not exserted beyond the erect basal portion of the corolla lobes, (1.6–)1.8–2.6 mm long, only slightly narrowed towards the shortly emarginate apex. *Filaments* terete, 0.6–1.0 mm long, attached to anther *c.* 1/2 above anther base, a little above or a little below, adnate to tube just below the sinuses. *Nectary* annular, 0.3–0.5 mm long, glabrous, distinctly lobed, often with longitudinal grooves below the sinuses. *Ovary* ellipsoid to broadly ellipsoid, or ovoid to broadly ovoid, 0.8–1.1 mm long, 0.5–0.7 mm wide, glabrous, 5-locular, dark green to almost black. *Style* (3.5–)4.0–6.2 mm long, glabrous and smooth, exserted from the corolla tube well beyond the erect corolla lobe bases, tapering smoothly from ovary apex; stigma not, or barely, expanded. *Fruit* globose or broadly ellipsoid, 3.2–5.0 mm long, 3.2–5.0 mm wide, much longer than the sepals, circular in section, gynophore absent; surface glabrous, rugose at maturity; apex rounded; style shed before maturity.

Diagnostic characters. Within Group V, *S. madida* is distinguished by the following character combination: leaves linear, very narrowly elliptic, narrowly obovate to obovate, or very occasionally very narrowly ovate, shallowly to steeply antrorse, rarely some shallowly retrorse, 0.8–3.8 mm wide, adaxially convex, the margins slightly recurved to revolute, leaf apices long-mucronate, pungent, the mucro 0.7–2.0 mm long; inflorescences pendulous, 1–3-flowered; sepals glabrous, acute to subacute, often mucronate; corolla tube about equal to, to distinctly longer than, the sepals, shorter than the corolla lobes; ovary 5-locular, glabrous and smooth; stigma not, or barely, expanded; fruit usually globose, less often broadly ellipsoid, circular in section, strongly rugose, gynophore absent.

Etymology. From the Latin *madidus* (moist, wet, soaked), a reference to the fact that the species occurs in the wettest parts of south-west Australia.

Affinities. *Styphelia madida* belongs in Group V of Puente-Lelièvre *et al.* (2016). In the published phylogenetic tree, it was placed (as *Leucopogon* sp. Walpole) in a moderately supported polytomy with *S. pendulus* and *S. woodsii* within the larger clade of sixteen (that also includes other species described herein, namely *S. graniticola, S. inframediana*, and *S. intricata*. It should be noted that it was the typical subspecies of *S. madida* that was sequenced for the phylogeny.

Two allopatric subspecies are recognised based, in large part, on indumentum differences together with leaf width and shape.

Styphelia madida Hislop subsp. **madida**

Young *branchlets* with a sparse to moderately dense indumentum of short, straight hairs, to *c.* 0.1 mm long. *Leaf lamina* usually linear or very narrowly elliptic, very occasionally very narrowly ovate or very narrowly obovate, 0.8–2.0 mm wide, the widest leaves usually 1.8 mm or less. *Inflorescence axes* with a sparse, or occasionally with a moderately dense indumentum, or sometimes ± glabrous. *Bracteole* mucro 0.2–0.4 mm long. *Sepals* 1.8–2.7 mm long, mucronate or not. *Fruit* globose or broadly ellipsoid, 3.5–5.0 mm long, 3.2–4.6 mm wide. (Figures 14–16)

Other specimens examined. WESTERN AUSTRALIA: Point 48 hilltop, Walpole-Nornalup National Park, 21 Feb. 1989, *A.R. Annels* 703 (PERTH); Fernhook Falls [NW of Walpole], 16 Mar. 2006, *G. Byrne* 1784 (PERTH); 41 km N of Walpole, 4 Feb. 1997, *R.J. Cranfield* 10940 (NSW, PERTH); 1.5 km from South Coast Hwy along Nut Rd, E of Walpole, 10 Oct. 2003, *D.M. Crayn* 708, *K.A.Kron & A.J. Perkins* (NSW, PERTH); 2.3 km along Pool Rd from junction with Jones Rd, 30 m to the E of road on edge of river [N of Walpole], 13 Feb. 1997, *P. Ellery & C. Godden* W 46.4 (PERTH); Denmark Shire. Kordabup Rd. Forest Reserve 214 on N boundary, 24 Mar. 2000, *B.G. Hammersley* 2421 (PERTH); Denmark Shire. Forest Reserve 179-25, on the west bank of the Kent River, *c.* 0.5 km N from South Coast Hwy, 6 Oct. 2000, *B.G. Hammersley* 2680 (CANB, PERTH); environs of Fernhook Falls campsite on the Deep River, NW of Walpole, 2 Sep. 2005, *M. Hislop* 3505 (CNS, PERTH); Walpole-Nornalup National Park, environs of Circular Pool, 16 Nov. 2020, *M. Hislop* 4845 (CANB, CNS, K, MEL, PERTH); Mount Frankland National Park, Thompson Rd, *c.* 2.2 km N of Mt Frankland Rd, N of Walpole, 31 Mar. 2021, *M. Hislop* 4849 (CANB, CNS, MEL, PERTH); Mount Frankland National Park, Thompson Rd, *c.* 1 km S of Johnston Rd, N of Walpole, 31 Mar. 2021, *M. Hislop* 4850 (CANB, K, NSW, PERTH); Champion Drive (off Harewood Rd), Harewood State Forest, Denmark, 19 Apr. 2003, *F. & J. Hort* 1967 (CANB, CNS, NSW, PERTH); William Bay National Park, Apr. 1984, *C.V. Malcolm s.n.* (PERTH); 9.1 km W of Nichol Rd and Thompson Rd intersection, 40 m S of Nicol Rd [Mt Frankland National Park], 12 Feb. 1997, *C. McChesney & C. Day* W 18.7 (PERTH);

Figure 14. *Styphelia madida* subsp. *madida*. A, B – flowering branchlets *in situ*. Vouchers *G. Byrne* 1784 (A, B). Photographs by Geoff Byrn.

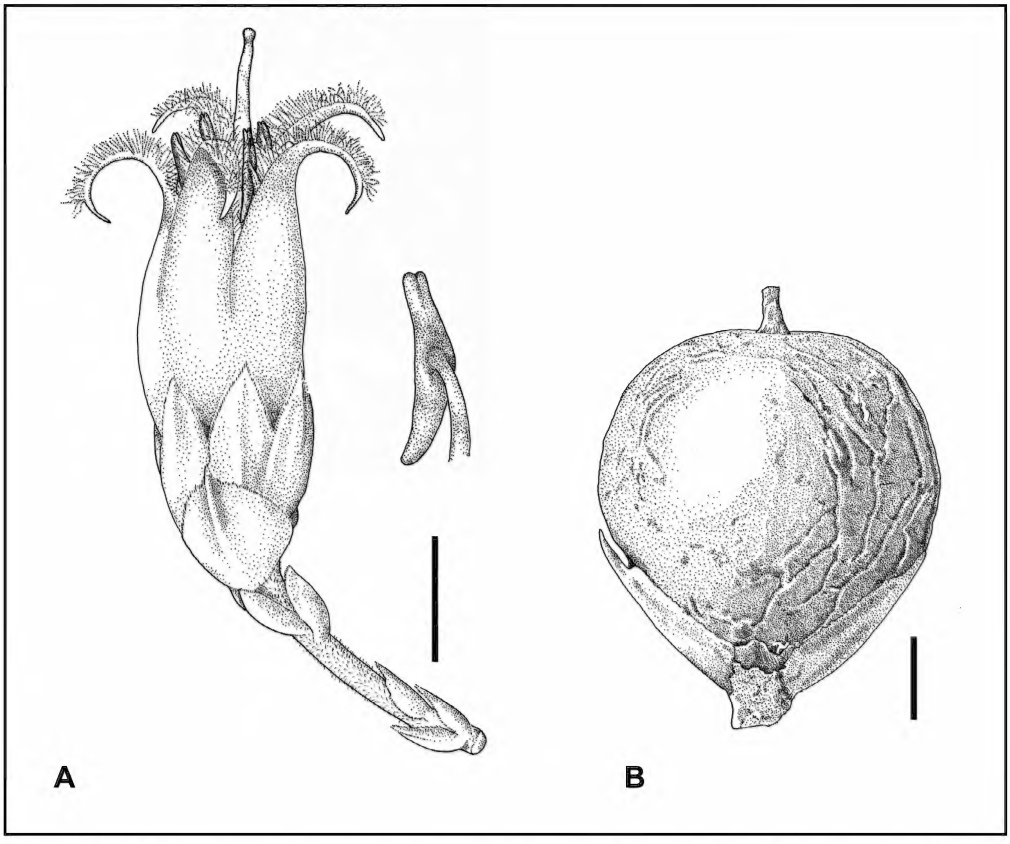

Figure 15. *Styphelia madida* subsp. *madida*. A – 1-flowered inflorescence, stamen; B – fruit. Scale bars = 1 mm. Vouchers *G. Byrne* 1784 (A), *M. Hislop* 3505 (B). Drawings by Skye Coffey.

Figure 16. *Styphelia madida* subsp. *madida*. Scanned image of flowering branchlet. Voucher *G. Byrne* 1784.

Walpole, junction of Rest Point Rd and Sandy Beach Rd, opposite golf course, 27 Jan. 1987, *S. Patrick* 405 (PERTH); Site 135, ENE off Angove Rd [N of Walpole], 24 Aug. 1997, *K.A. Redwood* 394 (PERTH); Walpole-Nornalup National Park, 2.8 Mile Rd, 1 km N of [South Coast] Hwy, 28 Jan. 1993, *J.R. Wheeler* 3839 *& S. Patrick* (PERTH).

Distribution and habitat. Distributed in the wettest part of south-western Australia from north-west of Walpole to the William Bay area, west of Denmark, in the east of the Warren and far south of the Jarrah Forest bioregions. The taxon grows in sand or sandy loam soils, often over laterite, in dry or winter-damp habitats, mostly in Jarrah and Marri woodland or forest. Some of the more commonly associated species are *Taxandria parviceps*, *T. linearifolia*, *Beaufortia sparsa*, *Podocarpus drouynianus* and *Dasypogon bromeliifolius.*

Phenology. Peak flowering is between January and April. Most fruiting collections have been made between August and November.

Conservation status. Although the distribution of this taxon is rather restricted it is locally common in several national parks and nature reserves. No conservation coding is recommended here.

Affinities. Before its recognition as *Leucopogon* sp. Walpole in 1999, the typical subspecies had mostly been confused either with *S. propinqua* (R.Br.) Spreng. or *S. racemulosa* (DC.) F.Muell., presumably because those species also have pungent and relatively long, narrow leaves. Subsp. *madida* can be distinguished from *S. propinqua* by its strictly pendulous, rather than erect or spreading, inflorescences

and in having a smooth style with an unexpanded, or barely expanded, stigma (*cf.* style scabrous in the upper half with a greatly expanded stigma in *S. propinqua*). The same combination of spreading inflorescences, scabrous style and expanded stigma also serve to distinguish *S. racemulosa* from the typical subspecies of *S. madida*. In addition, there is a significant difference in the fruit of *S. racemulosa*, that species being one of only three in Group V (along with *S. allittii* (F.Muell.) F.Muell. and *S. filifolia* Hislop & Puente-Lel.) in which the drupe is strongly zygomorphic and bilaterally compressed.

In her treatment of *Leucopogon* for the *Flora of the South West*, Wheeler (Wheeler *et al.* 2002) was apparently referring to specimens of *S. madida* subsp. *madida* when she made the comment that 'some collections from the south coast appear intermediate between this [*L. pendulus*] and *L. propinquus* and may belong to *L. pendulus* var. *cuspidatus* Benth.' The latter taxon is now treated as a distinct species, *S. psilopus* (Stschegl.) Hislop, Crayn & Puente-Lel., which is restricted to the eastern peaks of the Stirling Range. It is distinguished from *S. madida* by its non-pungent leaf tips and narrowly ellipsoid drupes.

Styphelia madida Hislop subsp. **hirtigera** Hislop, *subsp. nov.*

Typus: Bettys Beach Road, *c.* 150 m east of start of rough track running east of Boulder Hill, north of Two Peoples Bay, Western Australia, 14 February 2004, *M. Hislop* 3165 (*holo*: PERTH 07027656; *iso*: CANB, CNS).

Young *branchlets* with a dense indumentum of straight or wavy hairs 0.1–0.4 mm long. *Leaf lamina* usually very narrowly obovate to obovate, occasionally narrowly elliptic, 1.5–3.8 mm wide, the widest leaves usually at least 2.2 mm. *Inflorescence axes* with a moderately dense to dense indumentum. *Bracteole* mucro 0.4–0.7 mm long. *Sepals* 2.5–3.0 mm long, always strongly mucronate. *Fruit* globose, 4.0–5.0 mm long, 4.0–5.0 mm wide. (Figure 17)

Diagnostic characters. Distinguished from the typical subspecies by its longer and denser indumentum on branchlets and inflorescence axes and in having wider leaves that are usually very narrowly obovate to obovate.

Other specimens examined. WESTERN AUSTRALIA: Plot 5456, Boulder Hill, Two Peoples Bay area, 27 May 1992, *A.R. Annels & G. Wardell-Johnson* ARA 2157 (PERTH); Bald Island, 16 Oct. 2003, *J.A. Cochrane & S. Comer* 52 (PERTH); Beside track to water weir on Black Cat Creek, W of Two People Bay, 20 Apr. 1996, *E.J. Croxford* 7395 (PERTH); Mt Gardner, Two Peoples Bay, 8 Mar. 1967, *A.S. George s.n.* (PERTH); Waychinicup National Park, granite hill between Waychinicup Inlet and Mermaid Point, 27 Jan. 2002, *M. Hislop* 2542 (PERTH); Waychinicup National Park, *c.* 600 m E of Waychinicup Inlet, 27 Jan. 2002, *M. Hislop* 2543 (CNS, PERTH); access road to Waychinicup Inlet at crossing of Waychinicup Creek, 27 Jan. 2002, *M. Hislop* 2544A&B (PERTH); Mt Martin Botanical Park, trackside between turnoffs to Mt Martin and Dick Renshaw Lookout, 20 Apr. 2003, *M. Hislop* 2941 (PERTH); Mt Martin Botanical Park, Mary Sherwood trail, *c.* 800 m W of Ledge Beach carpark, 20 Apr. 2003, *M. Hislop* 2942 (MEL, PERTH); S slopes of Mt Manypeaks, 17 July 1986, *G.J. Keighery* 8155 (CANB, CNS, PERTH); Mt Manypeaks, E ridge track and plateau area, 27 Aug. 1986, *J.M. Powell* 2654 (MEL, NSW, NY, PERTH).

Distribution and habitat. Occurs from a little east of Albany to Bald Island in the far south of the Jarrah Forest and far west of the Esperance Plains bioregions. Subspecies *hirtigera* grows in sand or sandy loam soils, often over granite or laterite, in heath, thicket or open woodland. Associated species

Figure 17. *Styphelia madida* subsp. *hirtigera*. Scanned image of fruiting branchlet. Voucher *J.M. Powell* 2654B.

include *Corymbia calophylla*, *Banksia formosa*, *Hakea elliptica*, *H. cucullata*, *Agonis theiformis* and *Taxandria marginata*.

Phenology. As for the typical subspecies.

Etymology. From the Latin *hirtus* (hairy, shaggy) and *-ger* (bearing), a reference to the noticeably longer hairs on branchlets and inflorescence axes relative to those of the typical subspecies.

Conservation status. As with the typical subspecies, while subsp. *hirtigera* is not widespread, it is often locally common and well represented on the conservation estate. No conservation coding is therefore recommended here.

Affinities. Presumably because of its relatively wide leaves, earlier collections of subsp. *hirtigera* were most often confused with *Styphelia erubescens* (previously *Leucopogon oxycedrus* Sond.). While the leaf morphology can certainly be similar in the two taxa, flowering specimens of *S. erubescens* are easily distinguished by the widely spreading rather than pendulous inflorescences, a strongly scabrous style with a much-expanded stigma (*cf.* smooth style with an unexpanded or scarcely expanded stigma in *S. madida* subsp. *hirtigera*) and obtuse sepals (*cf.* acute or subacute and distinctly mucronate).

New species from Group VIII

Styphelia carolineae Hislop, *sp. nov.*

Typus: north-east of Jurien Bay, Western Australia [precise locality withheld for conservation reasons], 7 June 2010, *M. Hislop* 4034 (*holo*: PERTH 08290997; *iso*: CANB, CNS, K, MEL, NSW).

Leucopogon sp. Cockleshell Gully (J.M. Powell 1749), Western Australian Herbarium, in *Florabase*, https://florabase.dpaw.wa.gov.au/ [accessed 30 July 2021]

Erect, spreading *shrubs*, to *c.* 30 cm high and 40 cm wide, single-stemmed at ground level, with a fire-sensitive rootstock. Young *branchlets* glabrous. *Leaves* spirally arranged, steeply antrorse; apex long-mucronate, pungent, the mucro straight, 0.3–0.7 mm long; base cuneate to attenuate; petiole 0.4–1.0 mm long, glabrous throughout or with a few short hairs on the adaxial surface; lamina narrowly ovate to narrowly elliptic, 6–11 mm long, 1.2–2.2 mm wide, concave adaxially, longitudinal axis gently incurved; surfaces discolorous; adaxial surface shiny, glabrous or with a few short hairs towards the base, venation not evident; abaxial surface paler, ± glaucous, matt on younger leaves, sometimes becoming ± shiny with age, glabrous, with 5–7 primary veins, the midrib not, or scarcely broader than the others, shallowly to moderately deeply grooved between the veins; margins glabrous or minutely ciliolate with stiff, antrorse hairs, < 0.05 mm long. *Inflorescence* axillary, pendulous; axis 3.2–6.5 mm long, 1- or 2-flowered, usually sparsely to moderately densely hairy or sometimes ± glabrous, ± terete below the uppermost fertile bract, narrowly winged above, terminating in a bud-rudiment; flowers pendulous, pedicellate below the bracteoles, with a pedicel to 1.0 mm long. *Fertile bracts* ovate in outline, ± clasping the pedicel and therefore usually strongly folded lengthways, 1.2–2.0 mm long, 0.7–0.9 mm wide, and with 4–5 sterile bracts below the lowest fertile bract. *Bracteoles* ovate to ± elliptic, 2.5–4.2 mm long, 1.7–2.0 mm wide, not keeled, obtuse to acute, often prominently mucronate; abaxial surface shortly hairy to ± glabrous, striate, various shades of pink or purple; margins minutely ciliolate, at least towards the apex. *Sepals* narrowly ovate, 4.8–6.5 mm long, 1.4–1.8 mm wide, acuminate with an apical mucro; abaxial surface glabrous or shortly hairy, straw-coloured, but usually conspicuously tinged with pink, venation very obscure; adaxial surface with a few short hairs towards the apex, otherwise glabrous; margins minutely ciliolate with hairs < 0.05 mm long. *Corolla tube* white, obovoid or narrowly obovoid, shorter than the sepals, 3.0–3.5 mm long, 1.9–2.3 mm wide, external surface glabrous, internal surface glabrous or occasionally with a few hairs in the upper half. *Corolla lobes* white, or very pale pink, longer than the tube, 5.7–7.4 mm long, 1.2–1.4 mm wide at base, erect in the basal 2/3–3/4 of their length, and then revolute to partially coiled, external surface glabrous, internal surface with a dense, white indumentum comprising hairs of two kinds: straight, antrorse, clearly ornamented hairs over most of the lobe length, with a zone of more obviously flattened, twisted, scarcely ornamented hairs towards the apex. *Anthers* fully exserted from the tube, but not exserted beyond the erect basal portion of the corolla lobes, 3.1–4.0 mm long, apex entire and filiform or very shortly emarginate. *Filaments* terete, 2.2–3.1 mm long, attached to the anther 1/3–1/2 above base, adnate to the tube just below the sinuses. *Nectary* partite, the scales 0.4–0.5 mm long, 0.3–0.5 mm wide, glabrous. *Ovary* narrowly ellipsoid to narrowly obovoid, 1.0–1.3 mm long, 0.5–0.7 mm wide, glabrous, 2- or 3-locular, pale green. *Style* glabrous and non-scabrous, 7.6–10.4 mm long, exserted from the corolla tube to a point well beyond the erect bases of the corolla lobes, arising from a depression at ovary apex (clearly discontinuous with the ovarian tissue); stigma not, or scarcely, expanded. *Fruit* narrowly ellipsoid to narrowly obovoid, 3.6–4.6 mm long, 1.8–2.1 mm wide, shorter than the sepals, angular in transverse section with prominent longitudinal ribs, gynophore absent; surface glabrous, ± dry, smooth (mesocarp not, or poorly, developed); apex rounded; style usually shed at or before maturity. (Figures 18, 19)

Figure 18. *Styphelia carolineae* – flowering branchlet. Photograph by Lochman Transparencies.

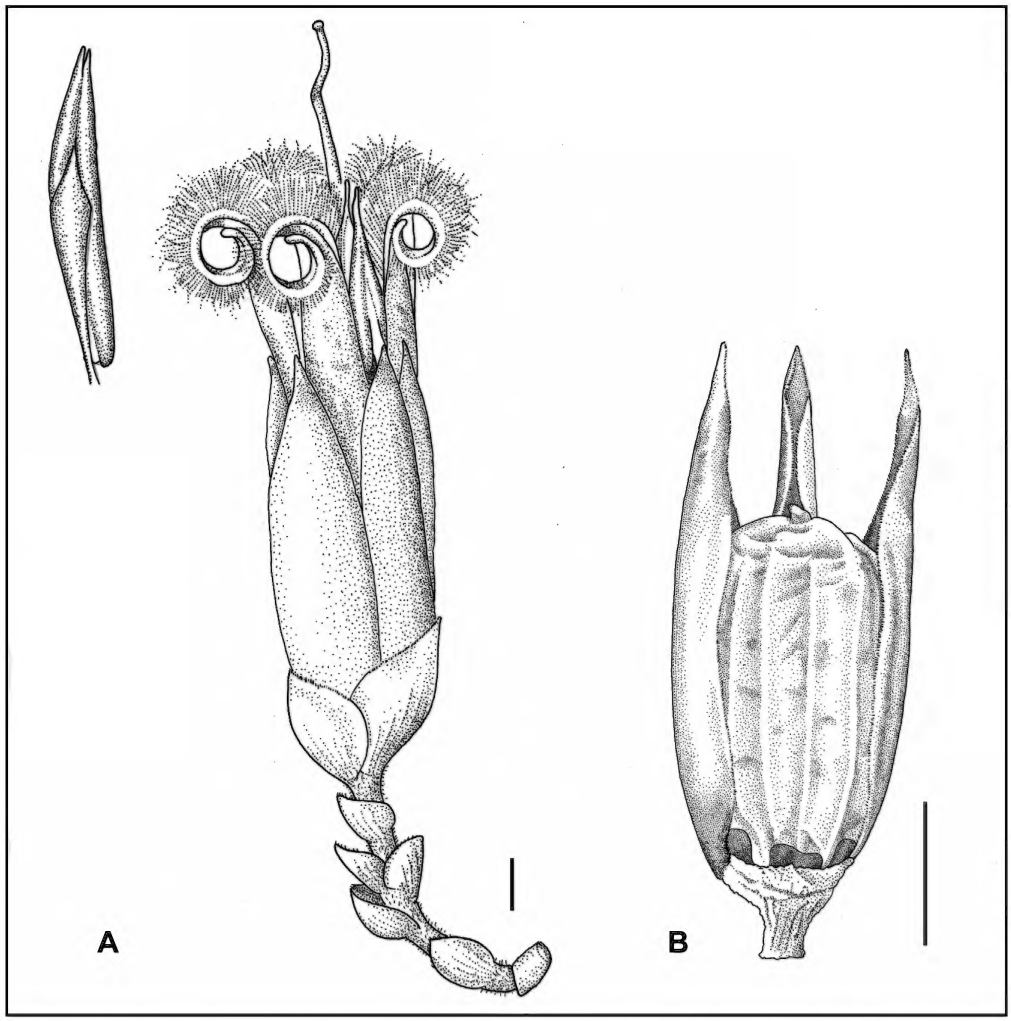

Figure 19. *Styphelia carolineae*. A – 1-flowered inflorescence, stamen; B – fruit. Scale bars = 1 mm. Vouchers *M. Hislop* 4034 (A), *E.A. Brown* 97/143 & *G. Taaffe* (B). Drawings by Skye Coffey.

Diagnostic characters. Within Group VIII, *S. carolineae* is distinguished by the following character combination: leaves narrowly ovate to narrowly elliptic, adaxially concave, the apices long-mucronate, pungent; inflorescences pendulous, 1- or 2-flowered; bracteoles and sepals conspicuously tinged pink or purple; sepals large, 4.8–6.5 mm long, longer than the corolla tube; corolla tube shorter than the sepals; corolla lobes very long, 5.7–7.4 mm, hairs on inner surface noticeably dimorphic consisting of straight, antrorse, clearly ornamented hairs over most of the lobe length, with a zone of more obviously flattened, twisted, scarcely ornamented hairs towards the apex; nectary partite; ovary pale green, glabrous, 2- or 3-locular; style very long (7.6–10.4 mm), arising from a depression at ovary apex (clearly discontinuous with the ovarian tissue); fruit narrowly ellipsoid to narrowly obovoid, ± dry.

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 21 May 1969, *E.M. Bennett* 2921 (NSW, PERTH); 1 Oct. 1997, *E.A. Brown* 97/143 & *G. Taaffe* (NSW, PERTH); 9 Sep. 2004, *R.K. Brummitt, A.S. George & E.G.H. Oliver* 21179 (PERTH); 15 July 1980,

R.J. Cranfield 1478 (PERTH); 1 May 1991, *R.J. Cranfield* 7991 (PERTH); 17 June 1977, *A.S. George* 14594 (NSW, PERTH); 7 June 2010, *M. Hislop* 4033 (HO, K, PERTH); 11 July 1982, *J.M. Powell* 1749 (CANB, K, L, NSW, PERTH); 10 July 2010, *C. Puente-Lelièvre, M. Hislop & E.A. Brown* CPL 71 (NSW, PERTH); 23 July 2011, *J.E. Wajon* 2422 (PERTH).

Distribution and habitat. Restricted to a small area in the southern Geraldton Sandplains bioregion. Grows in white sand over laterite in dense, species-rich heath. Associated species include *Allocasuarina humilis*, *Banksia armata*, *Hakea ruscifolia*, *H. conchifolia* and *Daviesia angulata*.

Phenology. Flowers between May and July. Mature fruit have been collected in September and October.

Etymology. Named in honour of botanist and molecular biologist, Dr Caroline Puente-Lelièvre, whose meticulous research into the phylogeny of the *Styphelia–Astroloma* clade (Puente-Lelièvre 2013; Puente-Lelièvre *et al.* 2016) led to the acceptance of a broad circumscription for *Styphelia* and culminated a decades-long series of investigations into this complex subject.

Conservation status. Recently listed as Priority Two (Western Australian Herbarium 1998–) under Conservation Codes for Western Australian Flora under the name *Leucopogon* sp. Cockleshell Gully (J.M. Powell 1749). All collections, with one possible exception, have been made in a single national park, where *S. carolineae* appears to be quite localised. The given locality statement on *R.J. Cranfield* 1478 suggests the possibility that the species also occurs in a nature reserve well to the north of its confirmed area of occurrence, but the wording is too ambiguous to put the question beyond doubt.

Affinities. A member of the *S. conostephioides* group (or Group VIII) of Puente-Lelièvre *et al.* (2016). Although *S. carolineae* did not appear in the published phylogeny in that paper, it was included (as *L.* sp. Cockleshell Gully) in a separate study into the relationship between four members of Group VIII, which formed part of Puente-Lelièvre's original thesis (Puente-Lelièvre 2013).

The morphology of *S. carolineae* conforms well with that of the other members of Group VIII (the group is keyed out in Hislop 2021), although it is one of a minority (with *S. hispida* (E.Pritz.) Sleumer and *S. exarata* Hislop, described below) that has a consistently glabrous ovary. Two other members of the group are known to occur in the same national park in the vicinity of *S. carolineae*: *S. conostephioides* and *Leucopogon* sp. short style (S. Barrett 1578).

Styphelia carolineae is readily distinguished from *S. conostephioides* by its larger floral parts, e.g. sepals 4.8–6.5 mm long (*cf.* 2.5–3.8 mm long in *S. conostephioides**), corolla lobes 5.7–7.4 mm long (*cf.* 2.5–4.5 mm long*), style 7.6–10.4 mm long (*cf.* 3.5–5.6 mm long*), glabrous branchlets (*cf.* branchlets with a moderately dense to dense indumentum) and glabrous ovary (*cf.* very shortly hairy in the Geraldton Sandplains, refer notes below). There is another significant difference in the corolla lobe indumentum. In *S. carolineae* it is of two kinds, the hairs being straight, antrorse and clearly ornamented over most of the lobe length, but with a zone of more obviously flattened, twisted, scarcely ornamented hairs towards the apex. In *S. conostephioides* by contrast the hairs are similarly twisted and ornamented across the entire lobe length. The two species grow in close proximity at the type locality of *S. carolineae* but there is an apparent habitat preference with *S. conostephiodes* occurring on deeper sands generally downslope from *S. carolineae*.

Leucopogon sp. short style (S. Barrett 1578) can be easily distinguished from all other members of Group VIII by its distinctly shorter style with the stigma presented at the top of the tube rather than long-exserted beyond the tube which is otherwise the norm for the group.

Notes. A notable feature of *S. carolineae* is the strong tendency for the bracteoles and sepals, and often also the corolla lobes, to be tinged various shades of pink or purple. In the case of both the bracteoles and sepals this coloration darkens as the fruit matures. Although very pronounced in *S. carolineae*, this attribute is not restricted to the species but is sometimes also apparent in collections of *S. conostephioides* from the Geraldton Sandplains.

Across most of its wide distribution, including the Geraldton Sandplains, *S. conostephioides* has a very shortly hairy ovary, which provides one of the differences between it and *S. carolineae*. However, in the south of its range (in the far south-west corner) there occurs a variant that may have a glabrous ovary. The consistency with which this feature occurs, and whether it correlates with other differences, are questions that require further investigation, as the presence/absence of ovarian hairs is frequently a character of taxonomic importance in the genus.

*The floral measurements for *S. conostephioides* used here were obtained from specimens collected from the Geraldton Sandplains only. Preliminary assessment suggests a similar size range for these floral parts across the remainder of the species' range and that the given size differences between the two species are unlikely to be significantly eroded with further research.

Styphelia exarata Hislop, *sp. nov.*

Typus: north of Cascade, Western Australia [precise locality withheld for conservation reasons], 26 May 2013, *W. R. Archer* 2605132 A (*holo*: PERTH 08489378; *iso*: CANB, CNS, K, MEL, NSW).

Leucopogon sp. Lake Tay (W.R. Archer 2104138), Western Australian Herbarium, in *Florabase*, https://florabase.dpaw.wa.gov.au/ [accessed 30 July 2021]

Erect *shrubs*, to *c.* 40 cm high, single-stemmed at ground level, with a fire-sensitive rootstock. Young *branchlets* with a moderately dense to dense indumentum of patent to retrorse, straight or curved hairs to *c.* 0.2 mm long. *Leaves* spirally arranged, steeply antrorse; apex long-mucronate, the mucro ± straight, fine and brittle, scarcely pungent, 0.4–1.2 mm long; base cuneate; petiole 0.2–0.5 mm long, usually variously hairy on all surfaces or sometimes the abaxial surface glabrescent; lamina narrowly ovate to ovate, 2.5–5.5 mm long, 1.0–1.7 mm wide, concave adaxially, longitudinal axis gently incurved; surfaces ± concolorous or the abaxial surface slightly paler; adaxial surface shiny, sparsely hairy, at least towards the base, venation not evident; abaxial surface slightly shiny, with 5–7(9) raised primary veins (the midrib not, or scarcely broader than the others), shortly and densely hairy in the deep grooves between, the raised vein surfaces hairy or ± glabrescent; margins ciliolate, with stiff, antrorse hairs, to 0.2 mm long. *Inflorescence* axillary, pendulous; axis 2.7–4.5 mm long, 1- or occasionally 2-flowered, densely hairy, ± terete below the uppermost fertile bract, narrowly winged above, terminating in a bud-rudiment; flowers pendulous, pedicellate below the bracteoles, with a pedicel to *c.* 0.6 mm long. *Fertile bracts* ovate to broadly ovate, 0.6–1.0 mm long, 0.6–0.8 mm wide, and with 3–5 sterile bracts below the lowest fertile bract. *Bracteoles* ovate to elliptic, 1.5–2.0 mm long, 1.3–1.5 mm wide, not keeled, obtuse to acute, ± mucronate; abaxial surface hairy or glabrous, striate; margins minutely ciliolate, at least towards the apex. *Sepals* narrowly ovate, 3.2–4.2 mm long, 1.1–1.3 mm wide, acute with or without a short, apical mucro; abaxial surface glabrous or sparsely hairy, straw-coloured, often with some pink tinges post-anthesis, venation very obscure; adaxial surface with a few hairs towards the apex, otherwise glabrous; margins minutely ciliolate, mostly towards the apex, with hairs < 0.05 mm long. *Corolla tube* white, obovoid, shorter than the sepals, 1.5–2.3 mm long, 1.4–1.8 mm wide, external surface glabrous, internal surface glabrous, or with a very few hairs immediately below

the lobes. *Corolla lobes* white, longer than the tube, 3.2–4.1 mm long, 0.7–0.9 mm wide at base, erect in basal 1/2–2/3 of their length, and then spreading and revolute to ± coiled abaxially, external surface glabrous, internal surface with a dense, white indumentum of flat, twisted hairs, not or barely ornamented. *Anthers* fully exserted from the tube, but not exserted beyond the erect basal portion of the corolla lobes, 1.7–2.7 mm long, apex entire, filiform. *Filaments* terete, 1.0–1.3 mm long, attached to the anther 1/3–1/2 above base, adnate to the tube just below the sinuses. *Nectary* usually partite, the scales 0.3–0.5 mm long, 0.3–0.4 mm wide, glabrous, or sometimes appearing annular with the scales weakly cohering. *Ovary* narrowly ellipsoid, 0.7–1.0 mm long, 0.4–0.5 mm wide, glabrous, 2-locular, pale green. *Style* glabrous and non-scabrous, 4.0–5.6 mm long, exserted from corolla tube to a point well beyond the erect corolla lobe bases, tapering smoothly from ovary apex; stigma not, or scarcely, expanded. Mature *fruit* not seen; somewhat immature fruit narrowly ellipsoid to narrowly ovoid, ± circular in transverse section, with obscure longitudinal ribs, gynophore absent; surface glabrous, ± dry, smooth (mesocarp not, or poorly, developed); apex rounded. (Figures 20, 21)

Figure 20. *Styphelia exarata* – flowering branchlet. Voucher *W. R. Archer* 2605132. Photograph by William Archer.

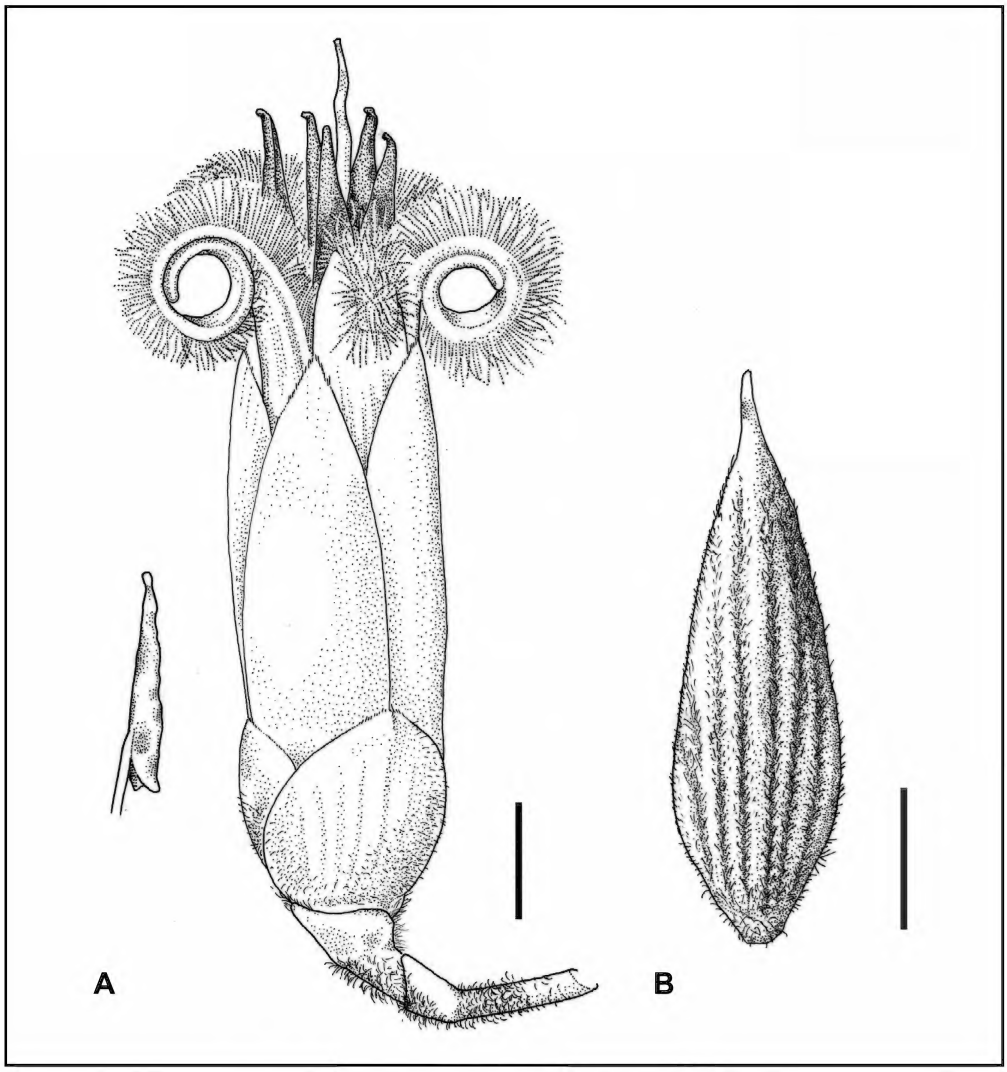

Figure 21. *Styphelia exarata*. A – 1-flowered inflorescence, stamen; B – leaf, abaxial surface. Scale bars = 1 mm. Voucher *W. R. Archer* 2605132. Drawings by Skye Coffey.

Diagnostic characters. Within Group VIII, *S. exarata* is distinguished by the following character combination: leaves narrowly ovate to ovate, adaxially concave, apices long-mucronate with fine, rather brittle mucros, abaxial surfaces hairy, deeply and narrowly grooved; inflorescences pendulous, 1(2)-flowered; corolla tube shorter than the sepals; corolla lobes longer than the tube; anthers with entire, filiform apices; nectary partite, or occasionally the scales weakly cohering; ovary pale green, glabrous, 2-locular; style well-exserted, tapering smoothly from ovary apex.

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 21 Apr. 2013, *W.R. Archer* 2104137 (PERTH); 21 Apr. 2013, *W.R. Archer* 2104138 (CNS, MEL, CANB, PERTH); 22 Apr. 2013, *W.R. Archer* 22041310 (PERTH); 25 May 2013, *W.R. Archer* 2605131 (CANB, PERTH); 26 May 2013, *W.R. Archer* 2605132 B (PERTH); 26 May 2013 *W.R. Archer* 2605133

(PERTH); 26 Apr. 2013, *W.R. Archer* 2605134 (PERTH); 9 June 2013, *W.R. Archer* 906135 (PERTH); 16 Aug. 2015, *W.R. Archer* 1608153 (PERTH).

Distribution and habitat. Known only from a small area well to the north of the settlement of Cascade in the central part of the Mallee bioregion. Grows in deep, white sand under mallee woodland.

Phenology. Flowering specimens have been collected between April and June. A collection from the middle of August has immature fruit present.

Etymology. From the Latin *exaratus* (furrowed), a reference to the deep, abaxial leaf grooves.

Conservation status. Listed as Priority One (Smith & Jones 2018) under Conservation Codes for Western Australian flora under the name *Leucopogon* sp. Lake Tay (W.R. Archer 2104138). Currently known from a very restricted area in a remote part of Western Australia. This part of the state is largely uncleared however, and it seems probable that new populations will come to light over time as the area becomes better known botanically.

Affinities. *Styphelia exarata* was not included in the molecular analysis of Puente-Lelièvre *et al.* (2016) but the combination of pendulous inflorescence, pale green, 2-locular ovary, partite nectary and sepals longer than the corolla tube provides strong morphological evidence that it is a member of Group VIII. Its closer relationships within that group, however, are not obvious. In particular, it is the only species within the group that has deep, hairy abaxial leaf grooves. It is also one of only three to have a consistently glabrous ovary, the others being *S. hispida* (E.Pritz.) Sleumer and *S. carolineae* (described above), both from the Geraldton Sandplains bioregion.

Two other members of Group VIII occur in the Mallee bioregion, *Leucopogon* sp. Coujinup (M.A. Burgman 1085) and *L.* sp. Newdegate (M. Hislop 3585). Both are easily distinguished from *S. exarata* by their more or less glabrous, flat or shallowly grooved abaxial leaf surfaces (*cf.* hairy, with narrow, deep grooves in *S. exarata*) and hairy rather than glabrous ovaries.

Although not a member of Group VIII, *S. sulcata* Hislop & Puente-Lel., also from the Mallee bioregion, bears a strong similarity in its foliar morphology to that of *S. exarata*. When flowering the two should not be confused as *S. sulcata* has an erect rather than pendulous inflorescence and a corolla that is hairy, rather than glabrous, on its external surface. In the absence of the inflorescence character however the two are very similar indeed, with the generally shorter leaves (2.5–5.5 mm long *cf.* 4.0–8.2 mm) and shorter mucros (0.4–1.2 mm long *cf.* 1.0–2.4 mm) of *S. exarata* providing the best means of distinguishing between them.

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The cover of Volume 32 features a mass display of the summer flowering Swamp Bottlebrush *Beaufortia sparsa* R.Br., from north-west of Peaceful Bay in the Walpole-Nornalup National Park. Photograph by Robert Davis.

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