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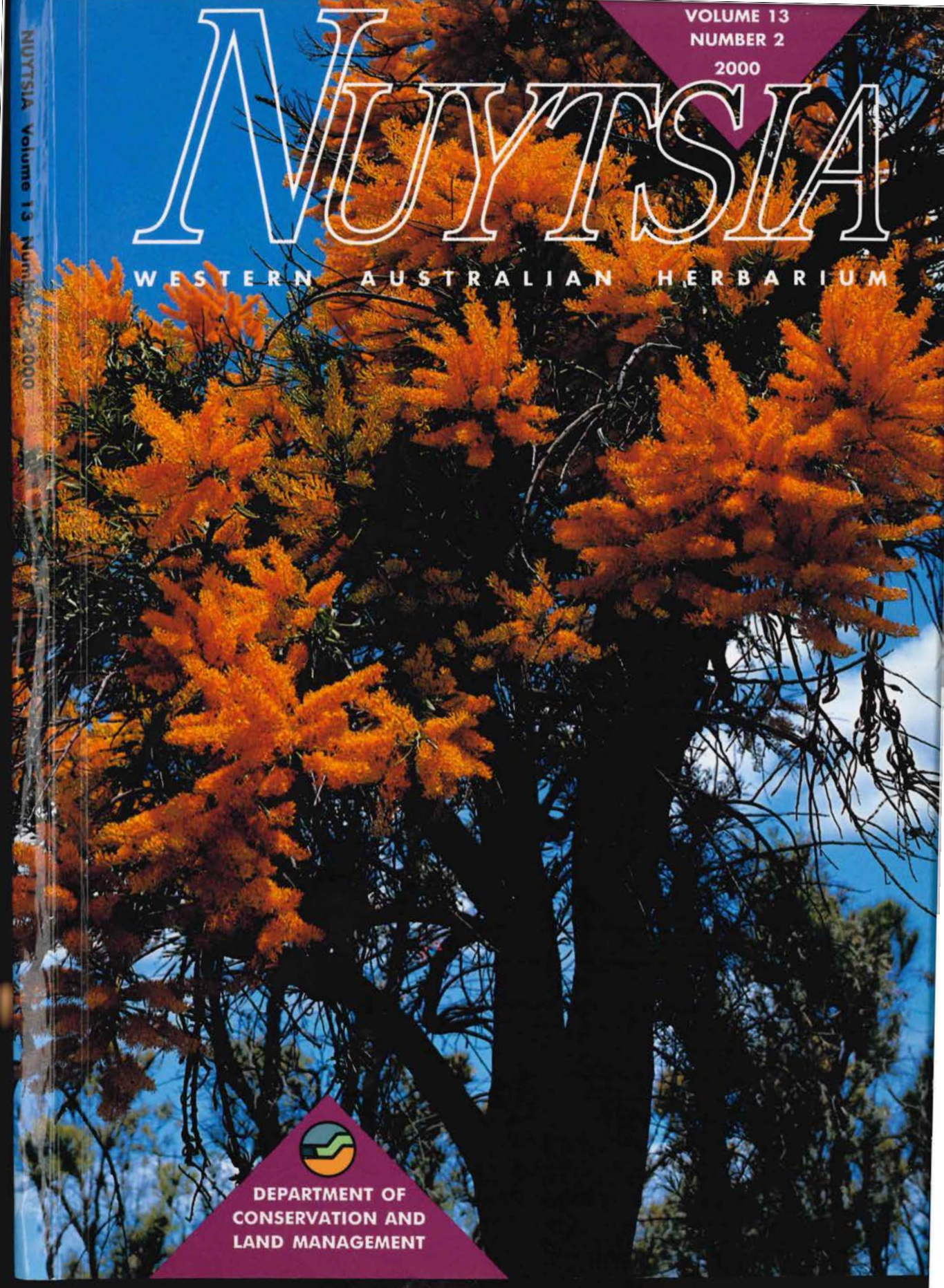

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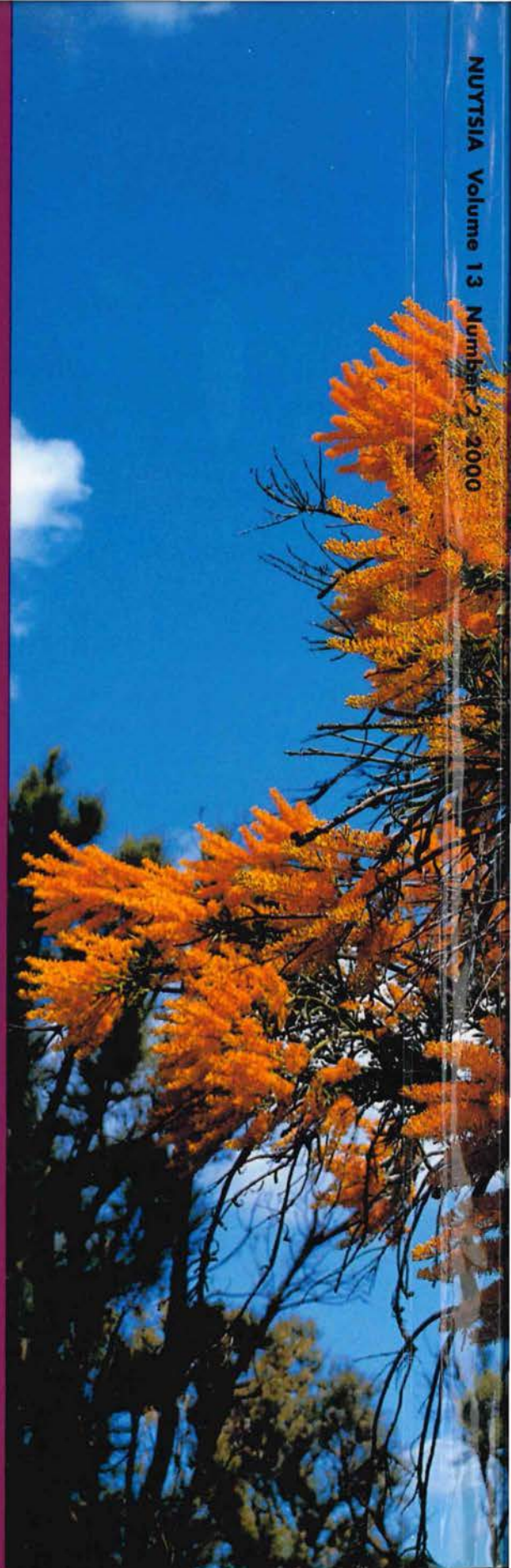

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Short Communications

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Department of Conservation and Land Management, Western Australia

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Short Communications

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Cover

Nuytsia floribunda (Labill.) R. Br. ex Fenzl (Loranthaceae) – the Western Australian Christmas Tree is one of the few arborescent mistletoes in the world. This endemic tree is a semi-parasite common in sandy soil from the Murchison River to Israelite Bay. The journal is named after the plant, which in turn commemorates Pieter Nuijts, an ambassador of the Dutch East India Company, who in 1627 accompanied the "Gulde Zeepard" on one of the first explorations along the south coast of Australia.

Cover design by Sue Marais

Photograph A.S. George

Synaphea brachyceras (Proteaceae: Conospermeae), new species from the Arthur River area in south-west Western Australia

Ryonen Butcher

Department of Botany, The University of Western Australia, Nedlands, Western Australia 6907

Abstract

Butcher, R. *Synaphea brachyceras* (Proteaceae: Conospermeae), a new species from the Arthur River area in south-west Western Australia. *Nuytsia* 13(2): 265–271 (2000). *Synaphea brachyceras* R. Butcher, an apparently rare taxon from the Arthur River area of Western Australia is described, and its affinities discussed. Illustrations of the species and a distribution map are also provided.

Introduction

The genus *Synaphea* R. Br. (Proteaceae: Conospermeae) comprises 50 named species following the "Flora of Australia" treatment published by A.S. George (1995). Prior to this treatment, *Synaphea* had not been revised since "Flora Australiensis" (Bentham 1870) when eight species were recognized. Of the 54 taxa in *Synaphea*, 38 are currently included in the Department of Conservation and Land Management's "Declared Rare and Priority Flora List" (Anon. 1997), with *S. quartzitica* A.S. George a recent inclusion as Declared Rare Flora and *S. stenoloba* A.S. George in the process of being gazetted as such. *Synaphea* is endemic to the South West Botanical Province and the South-western Interzone of Western Australia, and ranges from Kalbarri National Park in the north to the Nuytsland Nature Reserve in the south-east, with some extension inland beyond Southern Cross.

The author is currently undertaking further revision of the genus as a number of species complexes (e.g. *S. spinulosa* (Burm.f.) Merr. and *S. petiolaris* R. Br.) are still problematic, as is the delimitation of morphologically similar taxa. Additionally, the high level of polymorphism displayed by some species with regards to leaf and stigma morphology, floral size and degree of indumentum, has made the delimitation of taxon boundaries difficult, and as more material is collected, the current taxonomy becomes increasingly difficult to apply. A specimen of *Synaphea* collected by V. Crowley in 1995 and lodged at the Western Australian Herbarium brought to light an apparently new taxon which is here described, before completion of the full revision, in view of its apparent rarity.

Methods

This study is based on observations of live plants in the field as well as examination of herbarium collections from PERTH, including the type material of 36 taxa and type photographs of 13 taxa

described in George (1995). Measurements of leaves and habit were made from dried herbarium specimens and floral characters were measured from fresh, reconstituted and pickled (70% ethanol) material. Illustrations of floral and foliage features were prepared by the author.

Taxonomy

Synaphea brachyceras R. Butcher, *sp. nov.*

? *Synaphea favosa* var. *lanceolata* Meisn. in A.L.P.P. de Candolle, Prodr. 14: 314 (1856). *Type:* Swan River Colony [Western Australia], *J. Drummond* 3rd coll. 258 (*syn:* BM, K, *n.v.*).

Folia integra vel pinnatifida, ad apicem obtusa vel acuta, reticulo tenui atque profundo vel foveato. Perianthium in demidio inferiore glabratum vel puberulum. Tepalum adaxiale 4.1–5.5 mm longum, 1.7–2.4 mm latum. Tepalum abaxiale 2.5–3.7 mm longum, 0.7–1.9 mm latum, ad apicem valde recurvatum. Stigma manifeste bicorne, et super pagina dorsali cornu parvo recurvo instructum, 1.2–1.5 mm longo, 0.9–1.6 mm lato.

Typus: north-west of Arthur River [precise locality witheld], Western Australia, 29 September 1998, *R. Butcher & J.A. Wege* RB 498 (*holo:* PERTH 05495660; *iso:* CANB, K, MEL, NSW).

Caespitose *subshrub* to 50 cm tall, 20–90 cm wide. *Stems* several, to 15 cm long, appressed-pubescent on upper stems. *Petioles* 3.5–20 cm long, glabrous to shortly pubescent, with scattered long hairs; sheath appressed pubescent. *Leaf blades* entire and oblanceolate or three-lobed to pinnatipartite with the lowest pair of lobes again pinnatipartite; ultimate lobes linear to lanceolate; apices rounded to acute, shortly pungent; 6.5–17.5 cm long, 0.6–17 cm wide, sub-glabrous to shortly pubescent, with scattered long hairs; reticulation fine and deep to pitted. *Inflorescence* a spike, 2.5–15 cm long, shorter than or just exceeding the leaves; flowers moderately crowded, internodes half to *c.* equal the flower length; peduncle 2.5–17 cm long, simple to little-branched, appressed puberulous to pubescent; rachis appressed pubescent; bracts ovate, obtuse, 1–1.5 mm long, pubescent at base, glabrous toward apex with ciliate margin. *Perianth* ascending, gaping, externally glabrescent to sparsely puberulous in lower half; adaxial tepal concave, margins reflexed towards apex, 4.1–5.5 mm long, 1.7–2.4 mm wide, sparsely puberulous internally in the distal half; abaxial tepal convex, 2.5–3.7 mm long, 0.7–1.9 mm wide, apex acute and strongly reflexed to 0.6–1 mm of its length, pubescent internally behind the anther; lateral tepals falcate, 2.7–4 mm long, 1.5–3.1 mm wide, the apex reflexed to 0.7–1.4 mm of length, puberulous internally behind the anthers. *Stigma* transversely elliptic to elliptic, convex, 1.2–1.5 mm long, 0.9–1.6 mm wide, with two divergent, reflexed horns 0.7–1 mm long, the dorsal surface of the stigma with a short, curved projection of *c.* 0.3 mm length; ovary cylindric to ellipsoid, with apical beak to 0.2 mm long (after style separates), sericeous, *c.* 0.9 mm long, 0.5 mm wide, with a ring of translucent gland-like hairs at apex. *Fruit* elliptic, with a beak to 0.5 mm long, pubescent, *c.* 4.5 mm long. *Seed* narrowly turbinate, *c.* 2.2 mm long, 0.9 mm wide; testa cream, smooth. (Figure 1 A–J)

Other specimens examined. WESTERN AUSTRALIA [precise localities withheld]: NW of Arthur River, 28 Sep. 1998, *R. Butcher & J.A. Wege* RB 497 (PERTH); NW of Arthur River, 29 Sep. 1998, *R. Butcher & J.A. Wege* RB 499 (PERTH); NW of Arthur River, 30 Sep. 1997, *R. Butcher, J.A. Wege & C.F. Wilkins* RB 307 (PERTH); NW of Arthur River, 30 Sep. 1997, *R. Butcher, J.A., Wege & C.F. Wilkins* RB 308 (PERTH); NW of Arthur River, 30 Sep. 1997, *R. Butcher, J.A. Wege & C.F. Wilkins*

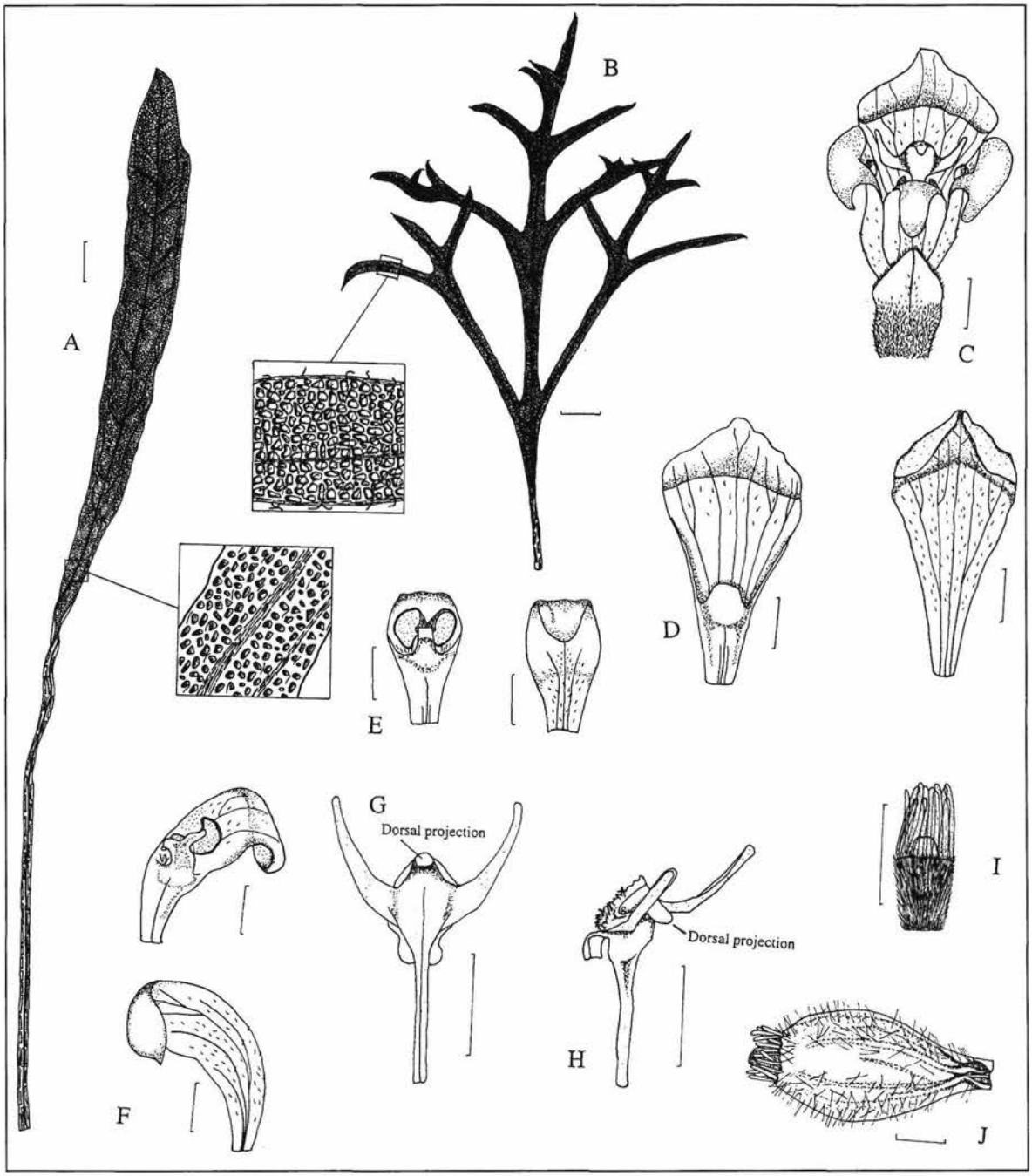

Figure 1. *Synaphea brachyceras* A – simple leaf with detail of pitted reticulation; B – pinnatipartite leaf with detail of deep reticulation and scattered hairs; C – flower viewed from the abaxial surface showing the widely opening perianth and bract glabrescent in the upper half; D – adaxial tepal, inner surface (left) with sterile anther filament and outer surface showing reflexed margins at apex; E – abaxial tepal, inner surface (left) with bilocular anther and outer surface showing strongly reflexed apex; F – lateral tepal, inner surface (above) showing unilocular anther and outer surface with reflexed apex; G – dorsal surface of stigma showing divergent horns and projection (arrowed); H – stigma viewed from side showing convex ventral surface and connective tissue and small, recurved dorsal horn; I – sericeous ovary with apical glands; J – nut. Figures A and B drawn from *R. Butcher, J.A. Wege & C.F. Wilkins* RB 309 and *R. Butcher, J.A. Wege & C.F. Wilkins* RB 308 respectively. Figures C–L drawn from *R. Butcher, J.A. Wege & C.F. Wilkins* RB 307. Figure M drawn from *R. Butcher & J.A. Wege* RB 499. Scale bar = 1 mm, except A and B, where scale bar = 1 cm.

RB 309 (PERTH); NNE of Arthur River, 30 Aug. 1995, *V. Crowley* DKN 140 (PERTH); NNE of Arthur River, 30 Aug. 1995, *V. Crowley* DKN 142 (PERTH); E of Dardadine, 22 Oct. 1995, *V. Crowley* DKN 141 (PERTH); NW of Arthur River, 24 Sep. 1998, *M. Graham* MSG 985 (PERTH); Quinns Block State Forest 52, SW of Highbury, 28 Sep. 1998, *G. Warren* 62 (PERTH).

Distribution. *Synaphea brachyceras* is restricted to a few small reserves and roadside remnants in the Arthur River–Highbury area, *c.* 200 km SE of Perth (Figure 2). Fieldwork carried out in 1997 and 1998 around Hillman, Dardadine, Tarwonga and Piesseville failed to locate additional populations. Further survey in surrounding areas is urgently required in light of the rarity of this species.

Habitat. *Synaphea brachyceras* has been collected from red-brown clayey sand over laterite and grey sandy gravel over granite. Associated vegetation includes *Eucalyptus wandoo* open woodland with a low shrub understorey comprising *Isopogon teretifolius* and species of *Dryandra*, *Beaufortia*, *Bossiaea*, *Hibbertia*, *Dampiera*, *Leptospermum* and *Hypocalymma*, as well as *Allocasuarina humilis* and *Hakea trifurcata* open scrub over a low heath of *Adenanthos flavidiflorus*, *Dryandra cuneata* and *Xanthorrhoea* sp. with occasional *Nuytsia floribunda* and *Banksia attenuata*. In undisturbed populations *S. brachyceras* has a scattered distribution, but in highly disturbed populations it is common along the edges of tracks and gravel scrapes suggesting that it may be a disturbance opportunist.

Phenology. Flowers of *Synaphea brachyceras* have been recorded from August to October with fruits recorded in November and December.

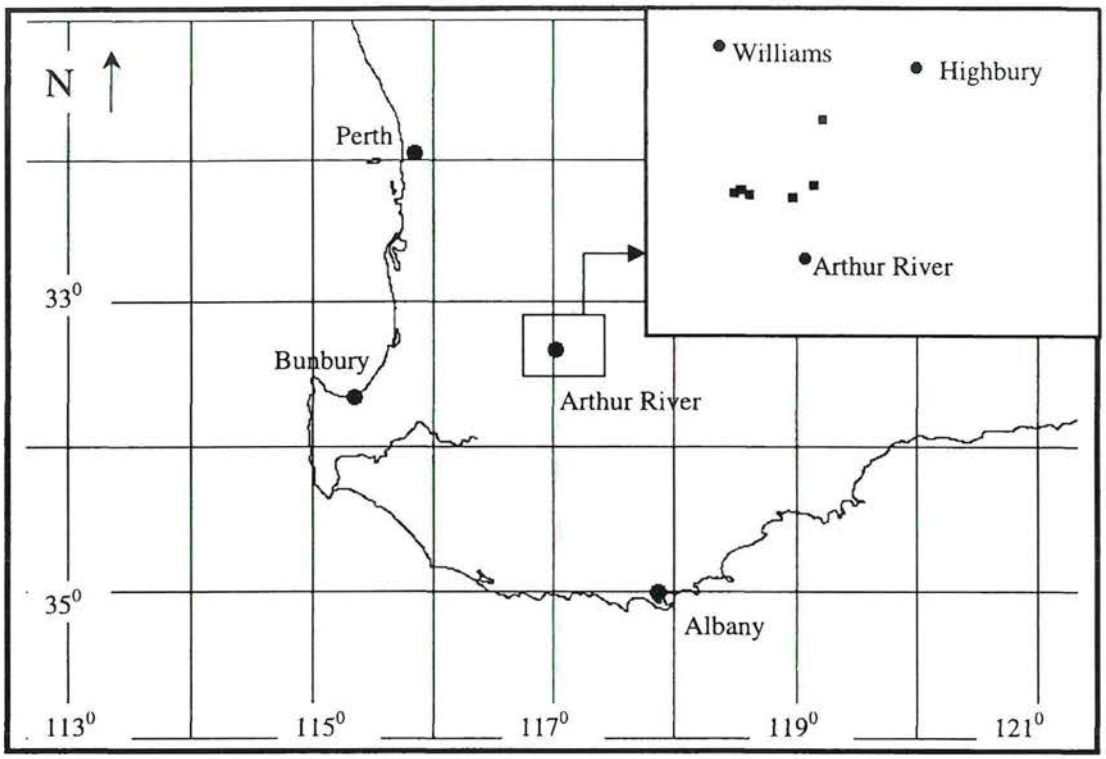

Figure 2. Distribution of *Synaphea brachyceras* to the north and north-west of Arthur River.

Etymology. The specific epithet is derived from the Greek *brachys* meaning "short" and *ceras* meaning "horn" in reference to the projection on the dorsal surface of the stigma.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority Two. This coding is considered appropriate in light of the apparently restricted distribution of *Synaphea brachyceras*, but with some plants in reserves, and the large amount of land under cultivation in the Arthur River–Highbury area.

Affinities. Synaphea brachyceras is somewhat anomalous with regard to the existing infrageneric classification of *Synaphea*, and as such is not placed in any section pending the completion of a full taxonomic revision. It appears to show greatest affinity to members of section *Bicornis* A.S. George, with which it shares prominent stigmatic horns. However, the new species could not be placed there without altering the current delimitation of the section (George 1995), as it does not possess entire to shortly dentate leaves and has stigmatic horns which are divergent rather than erect to incurved.

In both floral and vegetative characters, *S. brachyceras* most closely resembles *S. favosa* R. Br., with both species possessing gaping, glabrescent to puberulous perianths, bracts that are glabrous in the distal half and fine, deep to pitted reticulation on the leaf lamina. *S. brachyceras* can be differentiated from *S. favosa* by its deeply divided, 3-lobed to pinnatipartite leaves, but, as is common in this variable genus, a degree of overlap is evident in leaf morphology between these two taxa. For example, whilst *S. favosa* typically possesses oblanceolate to obovate leaves, or leaves that are cuneate with three broad, obtuse lobes, three collections from the Cranbrook area (*Steward s.n.*, *Davis* 6434 and *Butcher & Wege* RB 501) have deeply divided leaves with acute apices that are similar to those of *S. brachyceras*. Similarly, oblanceolate leaves, which usually occur in *S. brachyceras* as juvenile, or post-disturbance foliage, can also occur on the mature plant (*Crowley* DKN 142 and *Graham* MSG 985), although they are longer and narrower in this species than in *S. favosa* (7.5–17.5 x 0.6–1.3 cm compared with 5–12 x 1.5–3 cm).

These two taxa can be differentiated by their habit also as *Synaphea favosa* is typically prostrate or decumbent whilst *S. brachyceras* is a domed sub-shrub. The flowers of *S. favosa* are generally larger than those of *S. brachyceras* (adaxial tepals 5.2–6.8 mm long compared with 4.1–5.5 mm) and the tepals are hairier both externally, over the entire perianth, and internally behind the anthers. However, some smaller-flowered *S. favosa* specimens from the south coast (e.g. *Croxford* 5772, *Hoyle* 1382, *Cranfield* 4998 and *George* 14381) with widely gaping tepals and stigmas lobed to less than half their length, have adaxial tepals in the range of *S. brachyceras* (3.9–4.9 mm long). These may represent an undescribed taxon or possibly be the result of damage through insect galling, a condition seen in a number of other taxa.

Whilst there may be some overlap between *Synaphea brachyceras* and *S. favosa* with regard to leaf morphology and flower size, these two species can be easily differentiated by their stigma morphology. In *S. favosa* the stigmatic lobes are usually parallel and more or less erect and there is moderate thickening of the dorsal surface of the stigma, whilst in *S. brachyceras*, the stigmatic horns are divergent and reflexed and the dorsal surface bears a pronounced, recurved projection. Within sect. *Bicornis* both *S. reticulata* (Sm.) Druce and *S. hians* A.S. George also have dorsal thickening of the stigma but both these species have a longer stigma (1.5–2.5 mm) with erect horns and the thickening is ridge-like rather than a recurved projection. These two taxa can be further distinguished from *S. brachyceras* by their cuneate leaves, pubescent perianth and long (2–6 mm), villous bracts.

Vegetative specimens of *Synaphea brachyceras* could be confused with *S. interioris* A.S. George of sect. *Synaphea*, as both species have similar leaf morphology. However, *S. interioris* can be

distinguished from *S. brachyceras* by the very fine and shallow reticulation on the leaf lamina, as well as the broader, less divided leaf lobes, the lowest of which are usually curved downwards. Similarly, specimens of *S. brachyceras* having only simple leaves on the plant can be distinguished from the wheatbelt species *S. platyphylla* A.S. George which possesses very shallow reticulation on the leaf lamina, and a stigma which is square to obtrapeziform and lobed to approximately a third of its length without a dorsal projection.

In its divergent stigmatic horns, *S. brachyceras* is akin to *S. nexosa* A.S. George which has long lobes at the apex of the stigma like members of sect. *Bicornis*, but is included in sect. *Synaphea* due to its deeply divided leaf lamina (A.S. George). *S. brachyceras* can be easily differentiated from *S. nexosa* as its leaves have pinnatipartite division, acute apices to the lobes and fine, deep to pitted reticulation whilst those of the latter taxon have tripartite division, obtuse to rounded apices to the leaf lobes and open, shallow reticulation. Additionally, *S. brachyceras* has its inflorescences shorter than to shortly exceeding the leaves whereas *S. nexosa* has its flower spikes greatly exceeding leaf length. Although *S. petiolaris* subsp. *triloba* A.S. George is very similar to *S. nexosa*, no members of the *S. petiolaris* species complex have been included in this discussion for the sake of simplicity, as the taxonomy of this group is far from resolved and their inclusion does little to further the purpose of this paper.

Notes. The name *Synaphea favosa* var. *lanceolata* Meisn. may belong in synonymy with *S. brachyceras*, but the available syntype and isotype material examined is sterile and this remains a name of uncertain application.

Amendments to key in "Flora of Australia"

The recognition of *S. brachyceras* requires some amendments to be made to the existing key to species (George 1995), although the only changes suggested here are to facilitate the distinction of *S. brachyceras*. Two new couplets (3 and 7), are required, with the original couplet 3 now designated '3a'. Some changes are also necessary to size ranges in some of the couplets; all modifications and new couplets are marked with an asterisk. The following extract may be inserted at the start of the key in George (1995).

1. Stigma divided to half-way or more into 2 narrow horns
2 Leaf lamina deeply divided into linear to lanceolate, obtuse (rarelyacute) lobes
*3 Mature leaves trilobed to pinnatipartite; reticulation very fine and deep; inflorescence shorter than or shortly exceeding leaves [Arthur River area] ..... **S. brachyceras**
*3: Mature leaves once or twice trilobed; reticulation open and shallow inflorescence greatly exceeding leaves
3a Shrub to 60 cm tall; petiole to 20 cm long; peduncle to 35 cm long; fruit 5–6 mm long [Perth to Busselton and E to Cape Arid] ..... **S. petiolaris**
3a: Shrub to 1 m tall; petiole often 20–30 cm long; peduncle to 60 cm long; fruit 8–9 mm long [Scott River] ..... **S. nexosa**
2: Leaf lamina entire to dentate or shortly lobed with triangular lobes
4 Leaves obovate to oblanceolate

5 Adaxial tepal 4.2 mm long; spikes greatly exceeding leaves [Busselton area] ..... **S. petiolaris**

*5: Adaxial tepal 4.1–6.5 mm long; spikes not or only shortly exceeding leaves

*6 Leaves finely pitted; bracts 1–1.5 mm long; stigma 1.2–1.5 mm long

*7 Stigma with prominent curved horn on dorsal surface [Arthur River area] ..... **S. brachyceras**

*7: Stigma without prominent curved horn on dorsal surface [Rocky Gully to Bremer Bay] ..... **S. favosa**

6: Leaves shallowly reticulate; bracts 3–3.5 mm long; stigma 1.5–2 mm long [Yallingup to Kojonup] ..... **S. floribunda**

Acknowledgements

I wish to thank Paul Wilson for his considerable help with the Latin component as well as Jenny Chappill, Alex George and Brendan Lepschi for their comments on earlier drafts. Thanks are due also to CALM, Neville Marchant and the staff and volunteers at PERTH for provision of herbarium facilities. Additional thanks for their input and assistance are due to Alex Chapman, Val Crowley, Greg Durrell, Mal Graham, Jim Grimes, Dennis Stevenson, Gwen Warren, Juliet Wege and Carol Wilkins. Editorial comments from Barbara Rye and an anonymous reviewer were appreciated.

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A review of the genus *Lythrum* (Lythraceae) in Western Australia, including typification of *L. paradoxum*

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Abstract

B.J. Lepschi. A review of the genus *Lythrum* (Lythraceae) in Western Australia, including typification of *L. paradoxum*. *Nuytsia* 13 (2): 273–282 (2000). The species of *Lythrum* (Lythraceae) occurring in Western Australia are reviewed, and two native and one naturalized taxon are recognized. Both of the native species, *L. paradoxum* Koehne and *L. wilsonii* Hewson, are new records for the State. *Lythrum hyssopifolia* L., regarded as native in eastern Australia, is treated as introduced in Western Australia. A further species, the exotic *L. junceum* Banks & Sol., is known from only one old record and is no longer considered to be naturalized in Western Australia. A key is provided for all taxa, and the distribution of the three extant species is mapped. A neotype is also selected for *L. paradoxum*.

Introduction

Lythrum L. (Lythraceae) is a cosmopolitan genus of approximately 35 species, represented in Australia by four indigenous and one introduced species (Hewson 1990). The genus has not been comprehensively treated since Koehne (1903), but the Northern Territory species were reviewed by Mitchell (1976) and all Australian species were treated in the "Flora of Australia" by Hewson *loc. cit.*

Two species of *Lythrum* are recorded for Western Australia: *L. hyssopifolia* and *L. junceum* (Hewson 1990). However, recent field and herbarium work by the author and colleagues has revealed the occurrence of two additional species in the state, *L. paradoxum* and *L. wilsonii*, and has also brought to light additional information on the morphology and distribution of these species and *L. hyssopifolia*. This information is presented as part of a review of *Lythrum* in Western Australia.

Materials and methods

This study is based on examination of herbarium collections from AD, CANB, DNA and PERTH, with selected material from BRI and NSW. All measurements were made from herbarium material

(reconstituted where necessary). Conservation codes used are those adopted by the Department of Conservation and Land Management (see the end of this issue for definitions of conservation codes). Introduced taxa are denoted with an asterisk.

Taxonomic treatment

Information presented here for previously described species is restricted to new data regarding morphology, distribution and affinities (and typification in the case of *Lythrum paradoxum*). However, a full description of *L. wilsonii* is provided, as recent collections of this species from Western Australia have expanded the range of morphological variation previously known for this taxon (e.g. Hewson 1990, Highet & Wilson 1991).

Lythrum L., Gen. Pl. 1: 446 (1753).

See Koehne (1903) and Hewson (1990) for generic descriptions.

Key to the species of *Lythrum* in Western Australia

1 Inflorescence a single flower (very rarely some 2–flowered inflorescences may occur)
  2 Hypanthium with pigmented spots at base, petals 4–6 mm long. Stamens 10–12, 5–6 included and the remainder exserted. Stoloniferous perennial ..... **2. *L. junceum**
  2: Hypanthium without pigmented spots at base, petals 2–4 mm long. Stamens 4–6 and included, or rarely 8–12 (with 4–6 included and the remainder barely exserted) ..... **1. *L. hyssopifolia**
1: Inflorescence of (1)2–7 flowers
  3 Stamens 8–12, exserted. Plants glabrous ..... **3. L. paradoxum**
  3: Stamens 4–6, included to exserted. Plants frequently minutely scabrous ..... **4. L. wilsonii**

1. *Lythrum hyssopifolia L., Sp. Pl. 1: 447 (1753).

Illustrations. Jessop (1986: Figure 461 B); Rye (1987: Figure 132 A–D); Hewson (1990: Figure 33 G–I); Jeanes (1996: Figure 185 J–I).

Descriptions. Jessop (1986); Rye (1987); Hewson (1990); Jeanes (1996). See also under notes below.

Selected specimens examined. WESTERN AUSTRALIA: Oxbow Lake, Warriup, 17 Nov. 1982, *G.J. Keighery* 5777 (PERTH); base of Yellowdine Rock, *c.* 500 m WNW of Yellowdine Roadhouse, 1 Dec. 1997, *B.J. Lepschi* 3854 (PERTH); 19.4 km ENE of Jerramungup on road to Ravensthorpe, 27 Oct. 1997, *B.J. Lepschi & B.A. Fuhrer* 3732 (CANB, PERTH); *c.* 29 km WNW of Esperance on road to Munglinup, 29 Oct. 1997, *B.J. Lepschi & B.A. Fuhrer* 3807 (PERTH); 16.1 km S of Grass Patch on road to Scaddan, 30 Oct. 1997, *B.J. Lepschi & B.A. Fuhrer* 3808 (AD, PERTH); *c.* 11.5 km WNW of Shackleton, 9 Feb. 1997, *B.J. Lepschi & T.R. Lally* 3392 (AD, CANB, PERTH); *c.* 1 km NE of Howatharra Hill Reserve, 21 miles [*c.* 34 km] N of Geraldton, 22 Oct. 1976, *D. & N. McFarland s.n.* (PERTH 04362497); Belleview [Bellevue], 26 Nov. 1953, *R.D. Royce* 4500 (PERTH); Yanchep

National Park, 21 Dec. 1965, *E.M. Scrymgeour* 193 (PERTH); Nut Rd, Walpole–Nornalup National Park, 15 Dec. 1991, *J.R. Wheeler* 2966 (PERTH).
SOUTH AUSTRALIA: Yundi, 20 Feb. 1977, *R. Bates* 2602 (AD); Myrtlebank, *c.* 4 km SE of Adelaide, 11 Nov. 1970, *T.J. Smith* 1882 (AD).
NEW ZEALAND: Ramsgate Terrace, Mairangi Bay, 11 Dec. 1973, *E.B. Bangerter* 5124 (AD; AK *n.v.*).
CZECH REPUBLIC: near Mikulov, 28 Aug. 1963, *M. Deyl* 258 (AD; PR *n.v.*).
UNITED STATES OF AMERICA: Camel Highlands, opposite Yankee Point, 17 July 1963, *E.K. Balls* 12070 (AD).

Distribution. Recent treatments (e.g. Rye 1987, Hewson 1990) give a relatively restricted distribution of *L. hyssopifolia* in Western Australia, bounded approximately by Yanchep, Albany and York. However, *L. hyssopifolia* is considerably more widespread in this state, extending as far north as the Howatharra area (*c.* 20 km N of Geraldton), east to at least Yellowdine, and as far as Esperance and Grass Patch in south coastal and near-coastal districts (Figure 1). The collections, however, are concentrated in the south-west corner of the state (in the area outlined above), with only patchy records outside of this area. This is almost certainly due to under-collecting, and further field work in the eastern wheatbelt and western goldfields regions during late spring and summer should reveal additional populations of this species.

Lythrum hyssopifolia also occurs in New South Wales, Queensland, South Australia, Tasmania and Victoria, where it is apparently native. Populations in Western Australian are treated as introductions (Rye 1987, Hewson 1990). The species is also widespread throughout much of the rest of the world, including southern Europe where it is regarded as indigenous (Holm *et al.* 1979, Jessop 1986, Hewson 1990).

Habitat. Lythrum hyssopifolia has been recorded growing in damp to inundated soils (ranging from sands to clays), in a variety of habitats and vegetation types, ranging from more or less undisturbed areas such as natural wetlands and watercourses, through to highly disturbed sites (e.g. artificial drains, roadsides, suburban gardens, etc.). It is also an occasional weed of irrigated summer crops (Hussey *et al.* 1997), but is of negligible economic importance in this regard. *Lythrum hyssopifolia* occupies similar habitats in eastern Australia, where it is also recorded as an infrequent crop weed (e.g. Cunningham *et al.* 1981).

Phenology. Flowering and fruiting recorded between October and February.

Notes. Descriptions of *L. hyssopifolia* in the Australian literature (see above) record the inflorescence of this species as consisting of a solitary flower borne in the leaf axils. However, as noted by Koehne (1903), the inflorescence in *L. hyssopifolia* may very rarely consist of two flowers. This condition has been observed in Australian (e.g. *Bates* 2602, *Keighery* 5777, *Wheeler* 2966), as well as extra-Australian material (e.g. *Balls* 12070, *Bangerter* 5124, *Deyl* 258). The frequency of two-flowered inflorescences on individual plants of *L. hyssopifolia* is also very low, usually with only a single such inflorescence per individual.

Lythrum hyssopifolia has been confused with *L. paradoxum* and *L. wilsonii*, but all three taxa are amply distinct. *Lythrum paradoxum* differs from *L. hyssopifolia* in flower and stamen number as well as stamen exsertion (although there may be some overlap in the first two characters), while *L. wilsonii* differs from *L. hyssopifolia* in a number of vegetative and floral features; see under that taxon for further discussion.

2. *Lythrum junceum Banks & Sol., *in* A. Russell, Nat. Hist. Aleppo, 2nd edn, 2: 253 (1794).

Illustrations. Jessop (1986: Figure 461 C); Hewson (1990: Figure 33 D–F); Jeanes (1996: Figure 185 G–H).

Descriptions. References as for *L. hyssopifolia.* See also under notes below.

Selected specimens examined. WESTERN AUSTRALIA: East Perth, Oct. 1902, *C. Andrews s.n.* (PERTH).
SOUTH AUSTRALIA: Tantanoola, Nov. 1991, *R. Bates* 26328 (AD); near McLaren Vale, *c.* 25 km SSW of Adelaide, 4 Mar. 1956, *R.N. Oram s.n.* (AD 96413093; E, MEL, NSW *n.v.*).
VICTORIA: 10.5 miles [*c.* 17 km] NW of Petersborough, 21 Jan. 1969, *J. Anderson* 341 (AD; MEL *n.v.*); Condah Swamp area, Macarthur–Myamin road, 11 Feb. 1969, *A.C. Beauglehole & A.E. Orchard* 30520 (AD; MEL *n.v.*); Bridgewater Lakes, 21 Jan. 1993, *J.M. Dalby* 93/06 (AD; MEL *n.v.*).

Distribution. Known in Western Australia from a single old collection. This species does not appear to have become established in Western Australia, and should be excluded from the flora record for the state. Naturalized in South Australia and Victoria, and also recorded from New South Wales and Queensland on the basis of single, old specimens (Hewson 1990). Apparently indigenous to the Mediterranean region and south-western Europe, and widespread elsewhere (Holm *et al.* 1979, Hewson 1990).

Notes. As with *L. hyssopifolia*, the inflorescence in *L. junceum* has been described in the Australian literature as a solitary flower in the axil of a leaf, but two-flowered inflorescences are occasionally produced (Koehne 1903, Webb 1968). Like *L. hyssopifolia*, such inflorescences would appear to be rare, but have been observed in Australian material (e.g. *Bates* 26328).

Lythrum junceum can easily be distinguished from all other *Lythrum* species in Western Australia by its stoloniferous habit, the presence of dark-pigmented spots at the base of the hypanthium and large petals.

3. Lythrum paradoxum Koehne, *Bot. Jahrb. Syst.* 23 Beibl. 56: 19 (1897). *Type citation:* Australia interior, in cl. Mitchell expeditione collecta (vidi in Herb. cl. Martius [= BR; see Stafleu & Cowan 1979]). Brisbane (num ibi collecta?) comm. J.M. Bailey (vidi in museo reg. Berol. [= B]). *Type:* in spring 20 km SE of Arkaroola, South Australia, 16 April 1990, *R. Bates* 22952 (*neo:* AD 99026150, here nominated; *isoneo*: I *n.v.*).

Illustrations. Koehne (1903: Figure 9 C); Hewson (1990: Figure 33 J–L).

Descriptions. Koehne (1897, 1903); Hewson (1990).

Specimens examined. WESTERN AUSTRALIA: Fanny's Peak [Mt Fanny], *c.* 85 km S of Giles Meteorological Station on road to Warburton Mission, 29 Aug. 1973, *B. Lay* 865 (AD, PERTH).
NORTHERN TERRITORY: Ross River Tourist Resort, 6 Apr. 1983, *P.K. Latz* 9839 (CANB, DNA); Amburla Station, 18 Oct. 1974, *A.S. Mitchell* 166 (DNA).
SOUTH AUSTRALIA: McKinlay Creek E of Nepabunna, Gammon Ranges National Park, 16 Apr. 1990, *R. Bates* 22971 (AD, CANB; MY *n.v.*); creek near Balacanoona Homestead, 12 Dec. 1974, *L.D. Williams* 6405 (AD).

Distribution. In Western Australia *L. paradoxum* has been recorded from one site south of Giles, close to the Northern Territory and South Australian borders (Figure 1). *Lythrum paradoxum* also occurs in the drier parts of the Northern Territory, Queensland and South Australia (Hewson 1990). The central desert areas of Western Australia have been inadequately surveyed botanically, and it is likely that further populations of *L. paradoxum* will be found in suitable habitat in this and neighbouring arid regions (*cf. L. wilsonii*, below).

Hewson (1990) referred to a collection of this species (*Weld Blundell* 13), which she suggested may have originated from the Kimberley region of Western Australia. The collection is labelled "Gordon Downs", and indeed there is a homestead of the same name south-east of Halls Creek near the Northern Territory border. However, according to information received from the Queensland Herbarium (BRI), the Weld Blundell collection originates from another pastoral property, also called Gordon Downs, approximately 50–70 km N of Emerald in central Queensland (see also McLaughlin *et al.* 1979). Twelve other Weld Blundell collections are held at BRI, all from the Queensland locality, and this is undoubtedly where *Weld Blundell* 13 was collected.

Typification. Hewson (1990) commented on the need to typify the name *L. paradoxum*, but was unable to examine any type material. Searches at B and BR did not reveal any type material of *L. paradoxum*, and it is likely that the Bailey syntype seen by Koehne at B was destroyed during the Second World War (B. Leuenberger pers. comm.). Further searches at BM, BRI, CGE, E, K, M and W were also unsuccessful. In the absence of any type material, a neotype has been designated which preserves both the original and current (*sensu* Hewson 1990) circumscription of the taxon.

Habitat. The sole Western Australian collection of *L. paradoxum* is recorded as growing in a "rocky gully". In eastern Australia *L. paradoxum* occurs on damp, generally sandy soils on creeks and other ephemeral or permanent drainage areas. There is no information available on associated vegetation for the Western Australian specimen, and data is similarly sparse for eastern Australian collections. However, *L. paradoxum* has generally been recorded growing with various grasses, sedges and herbs characteristic of damp sites.

Phenology. The specimen from Western Australia, collected in August, is in flower and fruit. Examination of material of *L. paradoxum* from eastern Australia indicates the species may produce flowers and fruits in any month of the year, possibly in response to rain. This is likely to be the case in Western Australia as well, but further collections are required.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority Three. *Lythrum paradoxum* is poorly collected in Western Australia, but is not considered to be under threat given its widespread occurrence in adjacent parts of eastern Australia. Additionally, the area from which *L. paradoxum* has been recorded in Western Australia is remote and under-collected, and it is likely that additional populations of this taxon will be found with further survey activity.

Notes. Lythrum paradoxum is sometimes confused with *L. hyssopifolia*, but the two species are easily distinguishable. See notes under *L. hyssopifolia*.

4. Lythrum wilsonii Hewson, Fl. Australia 18: 322 (1990).

Lythrum sp. Towrana (*R.J. Cranfield* 2183).

Illustration. Hewson (1990: Figure 33 M–O).

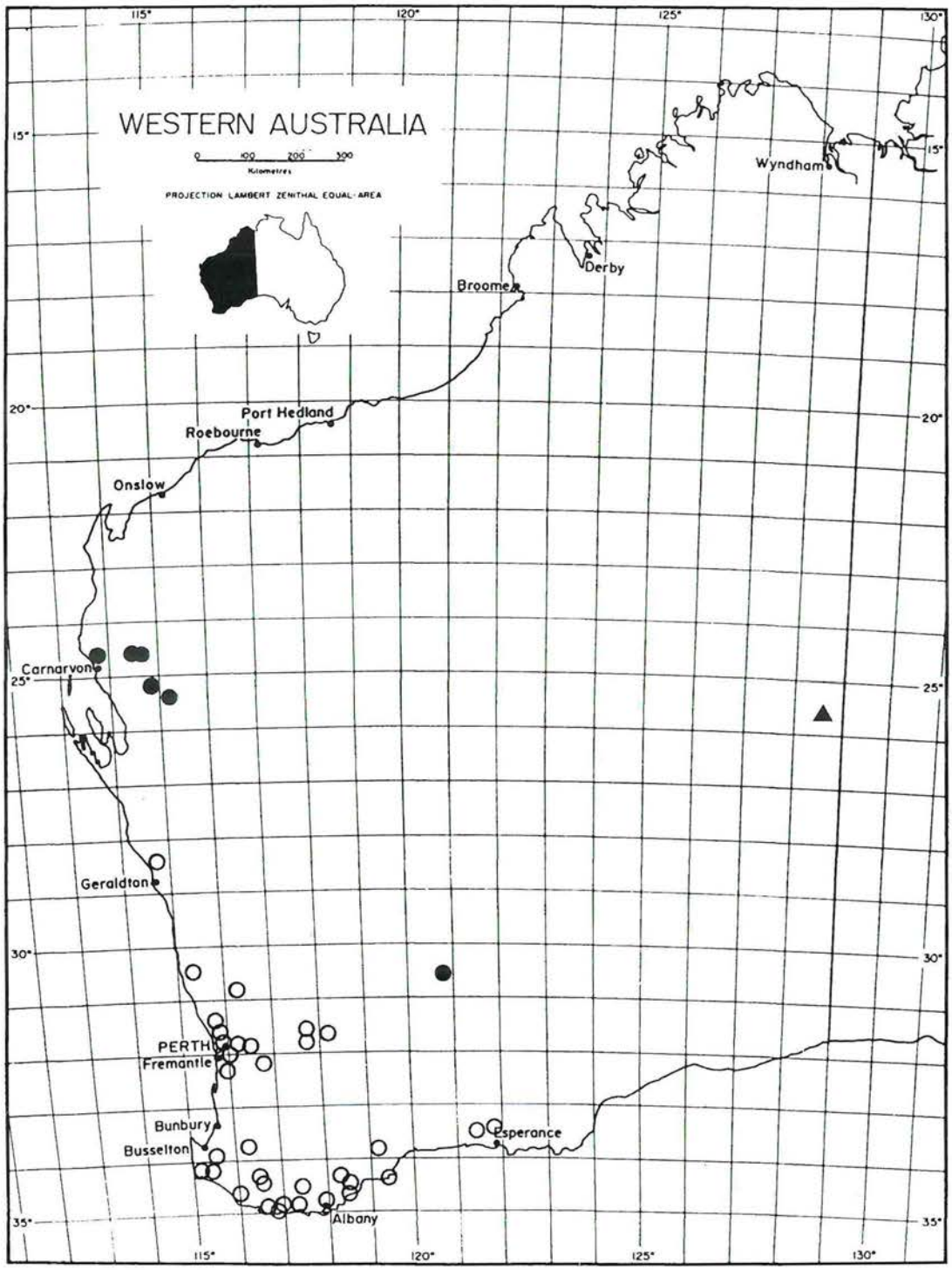

Figure 1. Distribution of *Lythrum hyssopifolia* ○, *L. paradoxum* ▲, and *L. wilsonii* ● in Western Australia. The single early record of *L. junceum* is not mapped (see text).

Ascendent to erect annual or perennial *herb*, 4.5–35 cm tall, stems angled, sometimes woody at base. *Leaves* alternate, frequently opposite at the lower nodes (especially in depauperate plants), sessile to shortly petiolate; petiole 0–0.8 mm long; lamina narrowly elliptic to elliptic or rarely narrowly ovate, 2.7–24.5 mm long, 1–6.7 mm broad; base attenuate to narrowly cuneate; apex acute to rarely obtuse; margins, midvein (and very rarely the lamina also) usually minutely scabrous. *Inflorescence* of 1–7 flowers in bracteate cymes inserted in the upper leaf axils. *Bract* 1 (though sometimes absent in 1–flowered inflorescences and from the central flower of few-flowered inflorescences), very narrowly ovate to subulate, 0.8–1 mm long, margin frequently minutely scabrous. *Pedicels* 0.7–1.2 mm long, lengthening to 1.7 mm long in fruit. *Bracteoles* 2, inserted in the proximal *c.* 1/3 of the pedicel (though sometimes absent, especially from the central flower of few-flowered inflorescences), linear to linear-subulate, 0.4–0.7 mm long, margin frequently minutely scabrous. *Hypanthium* narrowly obconical to narrowly campanulate or (less often) more or less fusiform; 3–4.5 mm long, 0.6–1.2 mm wide, longitudinally ribbed, frequently minutely scabrous. *Accessory sepals* 4(–6), narrowly triangular, 0.6–1.5 mm long, frequently minutely scabrous. *Primary sepals* 4(6), semitransversely elliptic to truncate, shortly apiculate, 0.3–0.5 mm long. *Petals* 4(6), obovate to elliptic, pink to lilac, mauve or purple, 2–3.5 mm long. *Stamens* 4(6), included (not exceeding the primary sepals) or exserted (exceeding the primary sepals and approximately level with the apices of the accessory sepals); filaments 0.6–3.2 mm long, anthers *c.* 0.3 mm long. *Ovary* cylindrical to more or less fusiform, 1.5–1.8 mm long, style 0.7–1.5 mm long, stigma capitate. *Capsule* cylindrical to more or less fusiform, 2.5–4 mm long. *Seeds* numerous, angular-obovoid, light brown to reddish brown, *c.* 0.5 mm long.

Selected specimens examined. WESTERN AUSTRALIA: Rowles Lagoon, 7 Nov. 1993, *G. Barrett s.n.* (PERTH); 2 km NE of Towrana Homestead, 30 Apr. 1982, *R.J. Cranfield* 2183 (PERTH); 3.5 km due W from North West Coastal Highway–Quobba Rd intersection, 24 Aug. 1995, *G.J. Keighery & N. Gibson* 2037 (BRI, CANB, K, MEL, PERTH); Chagra Well, Jimba Jimba Station, 29 Aug. 1995, *G.J. Keighery & N. Gibson* 2038 (CANB, PERTH); unnamed claypan on Boolathana Station, on fence *c.* 0.5 km NNE of Innaman Tank, 24 Aug. 1995, *G.J. Keighery & N. Gibson* 2039 (PERTH).
NORTHERN TERRITORY: Lake Surprise, 32 km SW of Tennant Creek, 6 May 1994, *P.K. Latz* 13705 (DNA); Ilparpa Swamp, Alice Springs, 22 Feb. 1995, *P.K. Latz* 14034 (DNA).
QUEENSLAND: Georgina River, Sep. 1910, *E.W. Bick* 100 (BRI); Braidwood, Jundah, July 1960, *M.M. Cole s.n.* (BRI).
NEW SOUTH WALES: Roo Roo Station, Wentworth, 8 Sep. 1975, *I. Eade s.n.* (NSW); Willow Point Station, 65 miles [*c.* 104 km] N of Wentworth, 18 Mar. 1959, *L.A.S. Johnson & E.F. Constable s.n.* (NSW).
SOUTH AUSTRALIA: Wirrigilpina Swamp, 43 km WSW of Stuart Creek Homestead, 2 Mar. 1984, *F.J. Badman* 655 (AD); Clayton River, *c.* 95 km N of Marree, 15 Nov. 1955, *R. Hill* 484 (AD; GZU, MY *n.v.*); Roxby Downs Station, *c.* 60 km N of Pimba, 27 Mar. 1973, *B. Lay* 713 (AD; AK *n.v.*); Goyder Lagoon, 64 miles [*c.*105 km] SSW of Birdsville, 24 June 1966, *D.R. Smyth* 65 (AD; SYD *n.v*).

Distribution. In Western Australia, *L. wilsonii* has been recorded from two widely disjunct areas: the Carnarvon–Gascoyne Junction district, and Rowles Lagoon, *c.* 70 km NW of Kalgoorlie (Figure 1). This disjunction is probably not a true representation of the distribution of this species in Western Australia, and is likely to be the result of inadequate collecting (*cf. L. hyssopifolia* and *L. paradoxum*, above). *Lythrum wilsonii* also occurs widely in the arid and semi-arid regions of New South Wales, the Northern Territory, Queensland and South Australia (Hewson 1990).

Habitat. Collections of *L. wilsonii* from Western Australian have been made from similar habitats to those recorded throughout the rest of the species range in eastern Australia, namely damp soils (predominantly clays), on the margins of ephemeral or permanent waterbodies. Vegetation communities

recorded in Western Australia include herbland, samphire associations, shrubland and eucalypt woodland. This is again similar to what has been recorded in eastern Australia.

Phenology. Flowering and fruiting has been recorded during August, November and April in Western Australia. As with *L. paradoxum* (above), eastern Australian populations of *L. wilsonii* have been recorded flowering and fruiting in all months of the year, possibly in response to rain. Once again, this may also apply to populations in Western Australia, but there are insufficient collections to confirm this.

Conservation status. While currently known from only a few sites in Western Australia, *L. wilsonii* is not considered to be under threat. It occurs widely in eastern Australia, and, as with *L. paradoxum*, further surveys of suitable habitat in arid and semi-arid areas of Western Australia are likely to reveal additional populations.

Notes. Individuals of *L. wilsonii* from the Carnarvon area (e.g. *Cranfield* 2183, *Keighery & Gibson* 2037–2039) differ slightly in stamen morphology from plants elsewhere in the species range. In 'typical' *L. wilsonii*, the stamens are included within the hypanthium (i.e. not exceeding the primary sepals), with the filaments 0.6–1.6 mm long, while in plants from the Carnarvon area the stamens are exserted (i.e. exceeding the primary sepals and approximately level with the apices of the accessory sepals), with the filaments 2.6–3.2 mm long. However, two collections from northern South Australia (*Badman* 655, *Lay* 713) exhibit intermediate stamen morphology. In these plants the stamens are included to barely exserted, and the filaments are 2–2.1 mm long. Plants from the Carnarvon area could potentially be afforded separate taxonomic status, but this is not considered appropriate at this stage, given the existence of apparently intermediate individuals and the frequent plasticity of floral morphology in the Lythraceae (Hewson & Beesley 1990). Variation in staminal morphology (and also stamen number) is also known to occur in *L. hyssopifolia*, in which there may be 4–6 included stamens and occasionally 4–6 additional (barely) exserted stamens (Koehne 1903, Hewson 1990). Further collections of *L. wilsonii*, particularly from Western Australia, would assist in clarifying this variation.

Lythrum wilsonii is superficially similar to *L. hyssopifolia*, and the two species are sometimes confused. Both taxa have a similar overall morphology, but *L. wilsonii* can be distinguished most readily by its inflorescence, which consists of 1–7 flowers, as opposed to *L. hyssopifolia*, in which the inflorescence usually consists of a single flower (very rarely two flowers may be present in some individuals). Single-flowered inflorescences are not infrequent in *L. wilsonii*, especially in young or depauperate plants, and some difficulty may be experienced in separating such individuals from *L. hyssopifolia*. However, plants of *L. wilsonii* generally bear at least two or three inflorescences of two or more flowers, whereas in *L. hyssopifolia* two-flowered inflorescences are comparatively rare, and it is unusual to find more than one such inflorescence per individual. Leaf shape and (to some extent) stamen number also help to separate *L. wilsonii* and *L. hyssopifolia*, although there is some overlap in these characters. Leaves in *L. wilsonii* are narrowly elliptic to elliptic, rarely narrowly ovate, whereas in *L. hyssopifolia* leaves tend to be narrowly oblong in overall shape (though occasionally narrowly ovate or rarely narrowly elliptic). *Lythrum wilsonii* has 4–6 (usually 4) stamens, while *L. hyssopifolia* may have either 4–6 or rarely 8–12 stamens.

In her descriptions, Hewson (1990) records *L. wilsonii* as being "minutely scabrous", and *L. hyssopifolia* as "glabrous". Examination of herbarium collections of *L. hyssopifolia* by the present author have shown that the vegetative and floral parts of this taxon are also frequently minutely scabrous, and as a result this character is not exclusively diagnostic for *L. wilsonii*. *Lythrum wilsonii* and *L. hyssopifolia* also exhibit some broad ecological differences, with *L. wilsonii* occurring around

natural waterbodies in arid and semi-arid areas, and *L. hyssopifolia* occupying predominantly disturbed habitats, mostly in the more mesic parts of southern Australia. *Lythrum hyssopifolia* does occur within the range of *L. wilsonii*, at least in New South Wales and South Australia, but there would appear to be no documented instances of actual sympatry.

Hewson (1990), when describing *L. wilsonii*, did not speculate on its relationships, apart from a comment that "...the two endemic species [i.e. *L. paradoxum* and *L. wilsonii*] belong in sect. *Mesolythrum* Koehne, an Australian section." This was presumably based on the treatment of Koehne (1903), in which *L. wilsonii* keys out to sect. *Mesolythrum* (in subg. *Hyssopifolia* Koehne) on the basis of flower number, i.e.: (1)3–7 flowers as opposed to 1(2) flowers for the other sections. As mentioned above, *L. wilsonii* is morphologically similar to *L. hyssopifolia*, but it is not certain whether this is indicative of any close relationship between the two taxa. The main similarity between *L. wilsonii* and *L. paradoxum* is flower number, which is inherently variable and may not give a true indication of relationships. Koehne's (1903) classification is in need of revision, and the relationships of the Australian species of *Lythrum* should be considered as part of a wider study aimed at presenting a modern monographic treatment of the genus.

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I am grateful to Neil Gibson, Greg Keighery and Mike Lyons for their efforts in collecting material of *L. wilsonii* in the Carnarvon area, and to David Halford and Rod Henderson for information regarding the Weld Blundell collection of *L. paradoxum*. Thanks are also due to Alex Chapman, Beat Leuenberger and Ernst Vitek for searching for type material on my behalf at CGE, B and W respectively. The curators of AD, BM, BR, BRI, DNA, E, K, M and NSW are thanked for allowing me to examine collections in their care or for facilitating searches for type material.

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A taxonomic review of the naturalized species of *Babiana* (Iridaceae) occurring in Western Australia

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Abstract

Lepschi, B.J. & Manning, J.C. A taxonomic review of the naturalized species of *Babiana* (Iridaceae) occurring in Western Australia. *Nuytsia* 13 (2): 283–292 (2000). The taxonomy of the naturalized species of *Babiana* in Western Australia is reviewed and three taxa are recognized: *B. angustifolia* Sweet, *B. nana* (Andr.) Spreng. and *B. tubulosa* (Burm.f.) Ker Gawl. var. *tubiflora* (L.f.) G.J. Lewis. A key and distribution maps for these taxa are provided. The widespread misapplication of the names *B. disticha* Ker Gawl. and *B. stricta* (Ait.) Ker Gawl. to naturalized *Babiana* species in Western Australia is also discussed.

Introduction

Babiana is one of a number of genera of southern African Iridaceae to have become naturalized in Australia. As in many other plant groups introduced to Australia, the correct nomenclature for many naturalized Iridaceae has not been fully established. Recent Australian floras and censuses have generally recognized one species of *Babiana*, *B. stricta*, as occurring in Australia (e.g. Cooke 1986a, b, James & Brown 1993, Conn 1994), although Green (1985) and Perry (1987) recorded the presence of a second species, *B. disticha* Ker Gawl., in Western Australia. Field observations by the first author and Greg Keighery, however, indicated that three species of *Babiana* occurred in Western Australia, two of these representing taxa not accounted for by Green (1985) or Perry (1987). Further investigations also revealed confusion regarding the nomenclature of these taxa. As *Babiana* species are, or have the potential to become, serious environmental weeds in Western Australia, a critical review of the species occurring in the state is required.

Babiana is also naturalized in New South Wales, South Australia and Victoria (Cooke 1986a), but these plants are not considered here. See notes under *B. angustifolia* below.

Materials and methods

This study is based on examination of herbarium collections from PERTH, as well as selected material from CANB, along with observations made on live plants of all species except *B. tubulosa*. As only a single Australian collection of *B. tubulosa* was available, the description of this taxon is partly based on South African material housed at NBG (see Holmgren *et al.* 1990). All measurements were made from herbarium material (reconstituted where necessary). Terminology for indumentum follows Hewson (1988).

Taxonomic treatment

Synonymy data presented in this paper is restricted to names that have been applied to *Babiana* in Australia, or names used by Lewis (1959) in her monograph of the genus. For additional nomenclatural information and further synonymy refer to Phillips (1951) and Lewis (1959).

Babiana Ker Gawl., *Curtis's Bot. Mag.*, 15: sub t. 539 (1802).

Perennial herbs. Corms usually deep-seated, tunics papery, decaying into fine or coarse fibres. *Stem* subterranean or aerial, erect to declinate or decumbent, simple or sometimes branched, terete to angular. *Leaves* basal, distichous, usually plicate, sometimes tortuous, curled or undulate, lamina flat or rarely terete, hairy or rarely glabrous. *Inflorescence* a spike, flowers distichous, spiral or secund. *Bracts* and *bracteoles* sheathing, free or partially united, herbaceous, apical portion usually scarious, hairy or glabrous. *Flowers* usually zygomorphic and bilabiate, sometimes actinomorphic and funnel-shaped, mostly shades of blue but rarely red, yellow or cream, often fragrant. *Perianth tube* straight or curved, cylindrical or funnel-shaped. *Tepals* equal or unequal. *Stamens* inserted in the mouth of the perianth tube, usually unilateral and arcuate, rarely symmetrically arranged and erect, anthers basifixed. *Ovary* glabrous or hairy. *Style* exserted or rarely included; style branches 3, slender or apically expanded. *Fruit* a cartilaginous capsule, glabrous or hairy. *Seeds* several per locule, funicle prominent and swollen, rugose, shiny. *Chromosome number* x=7.

A genus of *c.* 65 species in southern Africa with one in Socotra.

Etymology. Derived from the Dutch for baboon 'baviaan' or its Cape corruption 'babianer', the common name applied to *Babiana* species in the Cape region of South Africa, as a result of their status as a favoured food of these animals (Lewis 1959).

Key to naturalized taxa of *Babiana* occurring in Western Australia

1 Perianth tube more than twice as long as the tepals, 45–85 mm long; flowers cream ..... **1. B. tubulosa** var. **tubiflora**

1. Perianth tube shorter than to as long as the tepals, 7–18 mm long; flowers predominantly blue to magenta

2. Bracteoles united *c.* two-thirds to four-fifths of their length, herbaceous to the margins; flowers with the marked tepals lowermost; ovary glabrous or pubescent on the ribs only ..... **2. B. nana**

2. Bracteoles free to the base, mostly herbaceous, with a scarious, reddish-brown margin to 0.4 mm wide; flowers twisted such that the marked tepals are uppermost and facing the stem apex; ovary densely sericeous ..... **3. B. angustifolia**

1. Babiana tubulosa (Burm.f.) Ker Gawl. var. **tubiflora** (L.f.) G.J. Lewis, *J. S. African Bot.* Suppl. 3: 120 (1959).

Illustrations. Jeppe, Spring and Winter Flowering Bulbs of the Cape 104–105 (1989); Manning & Goldblatt, West Coast: S. African Wild Flower Guide 7: 70–71 (1996).

Perennial herb 12–45 cm high. *Corm* subglobose, 20–35 mm diameter, tunics papery, decaying into fine fibres. *Stem* 50–250 mm long. *Leaves* distichous, spreading to erect, plicate, pubescent; sheathing base 40–100 mm long; lamina linear to linear-elliptic, 60–250 mm long, 2–6 mm wide, base attenuate-oblique, apex narrowly acute to acuminate. *Inflorescence* shorter than leaves, 2–8-flowered, flowers not twisted to face the stem apex; scape simple, usually straight, pubescent. *Bracts* sheathing, herbaceous, reddish-brown, narrowly to very narrowly ovate-triangular in lateral view (margins often ± straight), 20–65 mm long, densely pubescent, grading to sericeous-pubescent distally; scarious apical portion glabrous; apex very narrowly acute. *Bracteoles* united for *c.* half of their length, sheathing, herbaceous, narrowly to very narrowly ovate-triangular in lateral view (margins often ± straight), *c.* 14–17 mm long, pubescent at base, grading to sericeous-pubescent distally, scarious apical portion glabrous; apex of individual bracteoles very narrowly acute. *Perianth* white to cream (the tube often flushed mauve abaxially), lower three tepals with a red saggitate or triangular-shaped mark centrally on the adaxial surface, glabrous; perianth tube cylindrical proximally, flared towards the apex, 45–85 mm long; tepals subequal, narrowly obovate to obovate, 15–23 mm long, 2–5 mm wide; base attenuate; apex acute to apiculate, the outer tepals sometimes cuspidate. *Stamens* arching, filaments 10–14 mm long; anthers narrowly oblong, mauve, 2–4 mm long. *Ovary* ovoid, *c.* 3 mm long, glabrous; style 50–80 mm long, dividing near the base of the anthers, style branches 3–4 mm long. *Capsule* broadly obovoid, distended due to pressure from seeds, 8–10.5 mm long, glabrous; seeds few, ovoid, ellipsoid or ± globose (frequently misshapen due to the attached funicle), *c.* 4–5.5 mm long, seed coat wrinkled or folded, grey-brown to brown (appearing dark reddish-brown where the seed coat adheres to the endosperm).

Specimen examined. WESTERN AUSTRALIA: Bold Park, 8 km W of Perth, 23 Aug. 1988, *G.J. Keighery s.n.* (PERTH 04180607).

Distribution. Native to the Western Cape Province, South Africa. In Western Australia known from one nature reserve in metropolitan Perth. (Figure 1A)

Habitat. Keighery s.n. is recorded as occurring in grey calcareous sand on a gentle slope in *Eucalyptus gomphocephala* woodland. Occurs on coastal sands in restioid fynbos (heathland) in South Africa.

Phenology. Keighery s.n. collected in late August, is in fruit. Flowering probably occurs in July and August in Western Australia.

Breeding system. Within its natural range, *Babiana tubulosa* var. *tubulosa* is adapted to pollination by the nectar-feeding fly *Moegistorhynchus longirostris* Wiedemann (Diptera: Nemestrinidae) which is a highly specialized flower visitor with a proboscis 40–70(90) mm long (Manning & Goldblatt 1997). Var. *tubiflora*, however, appears to be facultatively autogamous. No floral visitors have been observed in Western Australia.

Notes. Babiana tubulosa is a distinctive taxon and is unlikely to be confused with other *Babiana* species naturalized in Western Australia. The only known population in Western Australia is still extant (as at July 1999) and is expanding, albeit slowly (G.J. Keighery pers. comm.). Of the three species

of *Babiana* naturalized in Western Australia, *B. tubulosa* is probably the least significant in terms of weediness, at least on the basis of present observations (G.J. Keighery pers. comm.).

2. Babiana nana (Andr.) Spreng., Syst. Veg. 1: 156 (1825).

Illustrations. Jeppe, Spring and Winter Flowering Bulbs of the Cape 96–97 (1989); Manning & Goldblatt, West Coast: S. African Wild Flower Guide 7: 70–71 (1996); Hussey *et al.*, Western Weeds 29 (1997) [as *B. disticha*].

Perennial herb 10–30 cm high. *Corm* subglobose to broadly ovoid, 10–20 mm in diameter, tunics papery, decaying into fine fibres. *Stem* 45–100 mm long, cormlets occasionally present in leaf axils of the subterranean portion. *Leaves* distichous, spreading (fanwise) to erect, scarcely plicate, pubescent; sheathing base 20–80 mm long; lamina narrowly obovate-elliptic to narrowly elliptic, 45–160 mm long, 7–25 mm wide, base attenuate-oblique, apex acuminate to acute. *Inflorescence* shorter than to (usually) longer than leaves, 1- or 2-branched, 2–10-flowered, flowers not twisted to face the stem apex, straight to occasionally flexuose, pubescent. *Bracts* sheathing, herbaceous, reddish-brown, ± narrowly ovate in lateral view (margins often ± straight), 12–20 mm long, pubescent to sericeous-pubescent, scarious apical portion glabrous; apex acute to obtuse, rarely apiculate. *Bracteoles* united for *c.* two-thirds to four-fifths of their length, sheathing, herbaceous, reddish-brown, ± narrowly ovate in lateral view (margins often ± straight), 12–20 mm long, pubescent to sericeous-pubescent, scarious apical portion glabrous; apex of individual bracteoles acute to narrowly acute. *Perianth* mauve to purple or bluish-purple, the lower three tepals each with a whitish or cream area near the middle and a reddish mark near the base, apiculum of outer tepals purplish-black, glabrous; perianth tube straight, cylindrical proximally, flared towards the apex, 12–17 mm long; tepals subequal, narrowly obovate to obovate, 25–40 mm long, 6–10 mm wide; base attenuate; apex obtuse to acute or the outer tepals apiculate. *Stamens* arching, filaments 10–14 mm long, anthers narrowly oblong, cream to mauve, 5–5.5 mm long. *Ovary* ellipsoid to rarely ovoid, 3–5 mm long, glabrous or pubescent on the (longitudinal) ribs; style 24–28 mm long, style dividing between the middle and the apex of the anthers, style branches 3.5–5 mm long. *Capsule* and seeds not seen.

Specimens examined. WESTERN AUSTRALIA: Vasse Highway, Busselton, 1 Sep. 1987, *G.J. Keighery* 9150 (PERTH); old cemetery, Middleton Road, Albany, 14 Sep. 1990, *E. Croxford* 6748 (PERTH); Moodong Nature Reserve, 14 Sep. 1992, *G.J. Keighery* 13519 (PERTH); adjacent East Perth Cemetery, Bronte St, Perth, 16 Sep. 1995, *B.J. Lepschi & T.R. Lally* 1971 (PERTH).

Distribution. Native to the Western Cape Province, South Africa. In Western Australia, *B. nana* is known from a few sites in the Perth metropolitan area, as well as the settlements of Busselton and Albany. This species is probably more widespread in Western Australia than current collections would indicate. The first author has observed a naturalized population of this species at Kings Park, West Perth, but this is not supported by a voucher specimen. It is likely that other naturalized populations exist elsewhere in the state, especially near settlements in coastal and near-coastal areas in the south-west. (Figure 1B)

Habitat. In Western Australia *B. nana* has been recorded growing in sand in *Agonis flexuosa* woodland, *Eucalyptus marginata/Banksia* spp. woodland, and amongst various weeds in disturbed sites. Occurs on coastal sands in restioid fynbos (heathland) in South Africa.

Phenology. Flowering recorded during August and September in Western Australia.

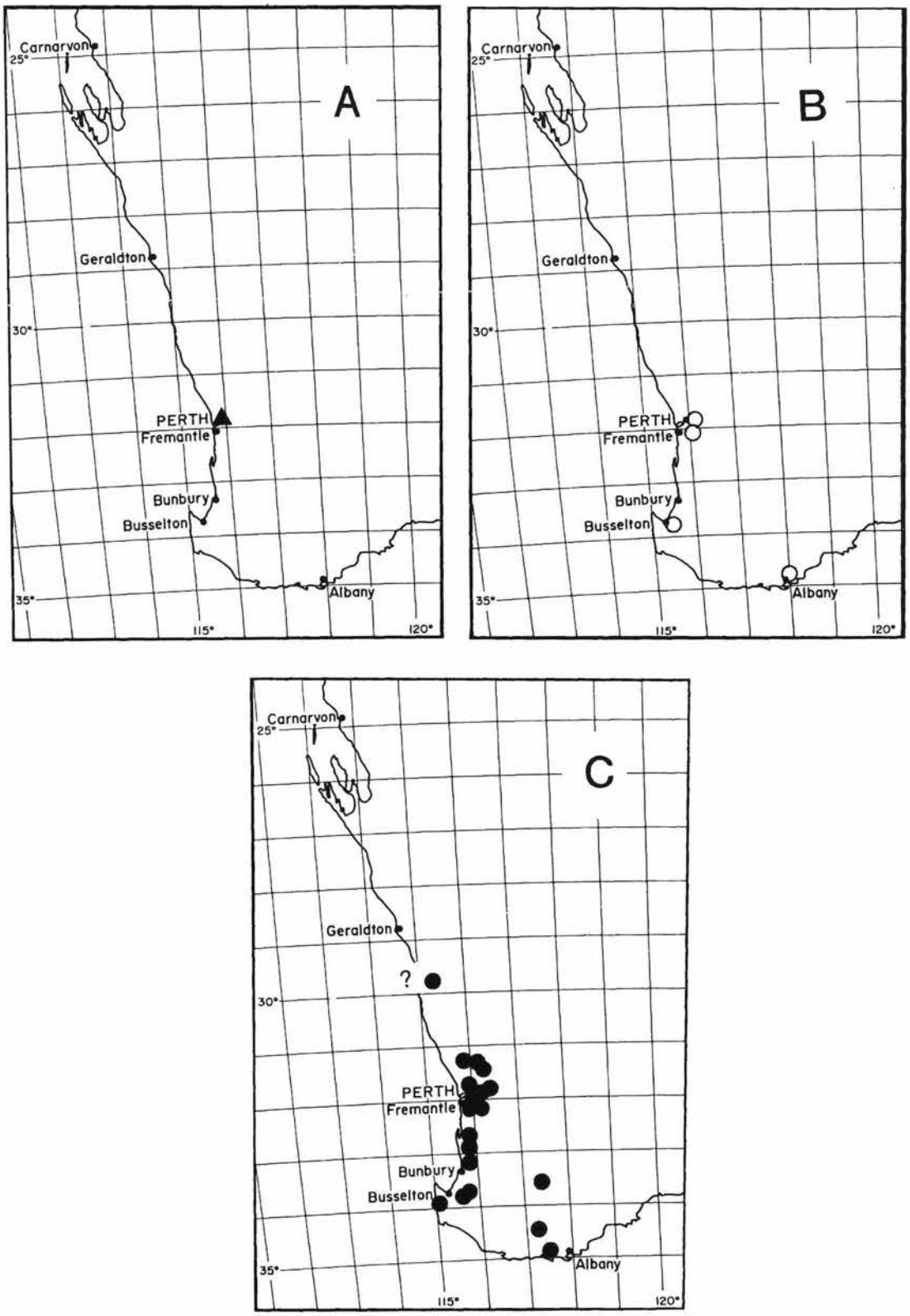

Figure 1. Distribution of *Babiana* species. A – *B. tubulosa* var. *tubiflora*, B – *B. nana*, C – *B. angustifolia*.

Breeding system. Within its natural range, *B. nana* is pollinated by the large solitary bee *Anthophora diversipes* Friese (Hymenoptera: Apidae) (Manning, unpubl.). Honeybees *Apis mellifera* L. (Hymenoptera: Apidae) have been observed gathering pollen from this species in Western Australia (G.J. Keighery unpubl. obs.).

Notes. *Babiana nana* is superficially similar to *B. angustifolia*, and it is possible that it has been overlooked in Western Australia as a result of confusion with the latter species. *Babiana nana* has been referred to *B. disticha* in Western Australia *in herb.* (at PERTH) and in Hussey *et al.* (1997), but is not closely related to that species. The earliest herbarium specimen of *B. nana* dates from 1987, but it is likely that this species was naturalized in Western Australia some years prior to this date. Although only sparingly naturalized in Western Australia at present, *B. nana* has the potential to become a serious weed on sandy soils in the higher rainfall areas of the south-west of the state (G.J. Keighery pers. comm.). The presence of a very large population spreading through *Banksia* woodland in a nature reserve on the outskirts of Perth (see *Keighery* 13519) demonstrates the threat this species poses to remnant vegetation.

3. Babiana angustifolia Sweet, Hort. Brit. ed. 1: 396 (1827).

Babiana pulchra G.J. Lewis, *J. S. African Bot.* Suppl. 3: 49 (1959) [as *B. pulchra* (Salisb.) G.J. Lewis].

?*Babiana plicata auct. non* (Thunb.) Ker Gawl., *Curtis's Bot. Mag.*, 16: t. 576 (1802). See Cooke (1986a) and notes below.

Babiana disticha auct. non Ker Gawl., *Curtis's Bot. Mag.*, 16: t. 626 (1803).

Babiana stricta auct. non (Ait.) Ker Gawl., *Curtis's Bot. Mag.*, 16: t. 621 (1803).

Illustrations. Jeppe, Spring and Winter Flowering Bulbs of the Cape 104–105 (1989); Manning & Goldblatt, West Coast: S. African Wild Flower Guide 7: 68–69 (1996); Hussey *et al.*, Western Weeds 29 (1997) [as *B. stricta*].

Perennial herb 15–60 cm high. *Corm* subglobose to broadly ovoid, 10–30 mm in diameter, tunics papery, decaying into coarse or fine fibres and extending up the base of the stem for 20–80 mm. *Stem* 5–20 mm long. *Leaves* distichous, spreading (fanwise) to erect, plicate, pubescent; sheathing base 40–200 mm long; lamina narrowly to very narrowly elliptic, linear-elliptic, or rarely very narrowly ovate, narrowly oblong-elliptic or narrowly oblong, 35–200 mm long, 4–22 mm wide, base attenuate-oblique, apex narrowly acute to acuminate. *Inflorescence* longer than the leaves (often markedly so), 2–35-flowered, flowers twisted to face the stem apex (so that the lower (patterned) tepals are uppermost); scape simple, 1- or 2-branched, rarely much-branched, straight to occasionally flexuose, pubescent. *Bracts* sheathing, herbaceous, reddish-brown, ± narrowly ovate to very narrowly ovate or narrowly to very narrowly ovate-triangular (margins often ± straight), or rarely narrowly oblong in lateral view, 15–30 mm long, pubescent to sericeous-pubescent, scarious apical portion glabrous; apex acuminate to long-acuminate (frequently also lacerate), rarely narrowly acute or aristate. *Bracteoles* free, loosely sheathing, herbaceous, brown to reddish-brown, ± narrowly ovate in lateral view (margins often ± straight), 12–30 mm long pubescent, scarious apical portion and margins glabrous; apex of individual bracteoles narrowly acute to acuminate. *Perianth* colour variable, usually purple to deep purple, bluish-purple or violet, less often white (with pale blue flush abaxially), pinkish-purple or purplish-crimson, the lower three tepals each with a dark red or blackish mark at the base (frequently with an

area of yellowish-cream to whitish coloration extending into the throat), sometimes the lower lateral tepals with the central portion yellowish-cream to whitish, apiculum of outer tepals purplish-black, glabrous except for an occasional line of hairs towards the apices of the outer tepals; perianth tube straight to very slightly curved, cylindrical proximally, flared towards the apex, 7–18 mm long; tepals subequal, narrowly obovate to obovate, 15–25 mm long, 5–11 mm wide, base attenuate, apex obtuse to acute or the outer tepals apiculate. *Stamens* scarcely arching, filaments 8–12 mm long; anthers narrowly oblong, mauve to bluish-purple, 4–6 mm long. *Ovary* ellipsoid to rarely ovoid, 3–3.5 mm long, densely sericeous; style 17.5–25 mm long, dividing at or beyond the apex of the anthers, style branches 1.5–5 mm long. *Capsule* ± globose, 9–10 mm long, walls smooth, pubescent; seeds few, ellipsoid, ± globose or ovoid (frequently misshapen due to the attached funicle), seed coat wrinkled or folded, grey-brown to brown (appearing dark reddish-brown where the seed coat adheres to the endosperm), *c.* 3.5–5 mm long.

Selected specimens examined. WESTERN AUSTRALIA: 9 miles [*c.* 14.4 km] NE of Katanning, 24 Sep. 1974, *T.E.H. Aplin* 6024 (CANB, PERTH); 1.5 km SE of Gosnells on Albany Highway, 15 Oct. 1982, *R.J. Cranfield s.n.* (PERTH 02023024); Forrest Hill, 20 km W of Mount Barker towards Manjimup, 4 Nov. 1986, *G.J. Keighery* 8439 (PERTH); Maddington Rd, Maddington, Perth, 18 Sep. 1983, *K.F. Kenneally* 8837 (PERTH); vacant land at junction of Albany Highway and Dalziell St, Maddington, Perth, 15 Oct. 1995, *B.J. Lepschi & T.R. Lally* 2116 (CANB, MEL, PERTH); 1.1 km S of Atkins Rd turnoff on Mundaring Weir Rd, *c.* 2 km NE of Mundaring Weir wall, E of Perth, 8 Oct. 1997, *B.J. Lepschi* 3570 (AD, CANB, MEL, NSW, PERTH); 12 km N of Toodyay on road to Bolgart, 21 Oct. 1997, *B.J. Lepschi & T.R. Lally* 3624 (CANB, PERTH); Bindoon, 5 Oct. 1982, *G. Perry* 1503 (PERTH); Midland, 7 Oct. 1984, *G. Perry* 1429 (PERTH); Guildford, 18 Sep. 1944, *R.D. Royce s.n.* (PERTH 02022958); 1 mile [*c.* 1.6 km] N of Kirup, 29 Sep. 1948, *R.D. Royce* 2753 (PERTH); Waterloo, N of Busselton, 16 Sep. 1953, *R.D. Royce* 4342 (PERTH).

Distribution. Native to the Western Cape Province, South Africa. In Western Australia, *B. angustifolia* is naturalised over a small part of the south-west of the state. The main occurrence of this species is from the Gingin–Bindoon area in the north, along the Swan Coastal Plain and adjacent parts of the Darling Range south to Margaret River. More or less isolated populations also occur in the Denmark–Albany area, near Katanning and Mount Barker township. A rather poor collection from "near Eneabba" (*Ollerenshaw & Carriage* 132 (CANB)), is probably also this species. (Figure 1C)

Habitat. Habitat data for Western Australia are sparse, but generally recorded growing in heavier soils (e.g. loams and clays), although *Lepschi & Lally* 2116 was collected growing in white sand. Occurs in disturbed sites amongst weeds, also invading disturbed eucalypt woodland, especially after fire. Occurs on damp clay or silt lowlands in renosterveld (*Elytropappus rhinocerotis* shrubland) in South Africa.

Phenology. Flowering recorded during July, and September to November. Fruiting recorded during October and November.

Breeding system. In South Africa, this species is pollinated by the large solitary bee *Anthophora diversipes* Friese (Hymenoptera: Apidae) (Manning, unpubl.). Honeybees have been observed gathering pollen from this species in Western Australia (G.J. Keighery unpubl. obs.). D.L. Jones (pers. comm.) also reports honeybees visiting flowers of cultivated babianas (possibly *B. angustifolia* or a related taxon) in eastern Australia.

Notes. The taxon treated here as *B. angustifolia* has previously been referred to *B. plicata* [= *B. disticha*] (early collections *in herb*. at PERTH), *B. disticha* or *B. stricta* (Green 1985, Cooke 1986a, Perry 1987). All three taxa are similar in overall morphology, but may be distinguished by various floral characters. In *B. disticha* the perianth tube is longer (18–25 mm as opposed to 7–18 mm in *B. angustifolia*), and the stamens are more obviously arched. The flowers are also not twisted to face the stem apex (as in *B. angustifolia*), so the lower (marked) tepals face away rather than towards the stem apex, and the flowers are often markedly zygomorphic. These features can be difficult to distinguish on dried material, and are best observed in live plants. *Babiana stricta* may be distinguished from *B. angustifolia* by the same character of flower-orientation as described above, as well as its somewhat broader, ± saggitate anthers (anthers in *B. angustifolia* are narrowly oblong).

Nordenstam (1970) pointed out that the earliest name for this taxon, *Acaste pulchra* Salisb., was not validly published and that the next available name is *Babiana angustifolia* Sweet. The species treated as *Babiana pulchra* by Lewis (1959), the most recent monographer of the genus, is thus correctly identified as *B. angustifolia*.

It should be noted, however, that material here referred to *B. angustifolia* may not represent the 'true' wild variant of that species. Many species of *Babiana* are of horticultural interest (Bailey 1914, Harrison 1963, Bryan & Griffiths 1995), and the genus has been in cultivation in Australia since approximately the mid 19th Century (D.L. Jones pers. comm.). Naturalized babianas in Australia (including Western Australia) are presumably derived from these horticultural introductions. In the case of *B. angustifolia*, naturalized plants show considerably greater variation in perianth colour than do wild populations of this species in South Africa, in which perianth colour ranges from pale to deep bluish-purple or purple. The variability exhibited by naturalized plants is probably the result of horticultural selection, possibly through hybridization with species such as *B. disticha* or *B. purpurea* (Jacq.) Ker Gawl., although this has not been confirmed.

The name *B. stricta* has been widely applied to cultivated babianas for many years, both in Australia (e.g. Pescott 1968, Hitchmough 1989) and overseas (e.g. Bailey 1914, Synge 1961, Harrison 1963, Bryan 1989). The concept of *B. angustifolia* has varied considerably between authors of horticultural texts, being variously cited as a synonym of *B. pulchra* (e.g. Bryan 1989; *cf.* Lewis 1959) regarded as a variety (var. *angustifolia* (Sweet) Baker) of *B. stricta* (e.g. Bailey 1914, Synge 1961) or treated at specific rank (e.g. Bryan & Griffiths 1995). This suggests a degree of confusion with regard to the taxonomy of cultivated babianas, and clarification of the identity of at least the more commonly grown taxa would be advantageous, particularly as this is the source from which the naturalised members of the genus originate.

Babiana angustifolia is the most common and widespread species of *Babiana* in Western Australia, and is also the most aggressively weedy. It is a major weed of heavy soils on the Swan Coastal Plain and the adjacent Darling Range area, often forming extensive monocultures to the detriment of indigenous herbaceous and bulbous plants. While presently only naturalized over a relatively small portion of the state, *B. angustifolia* has the potential to extend further into the more mesic coastal regions between Geraldton and Esperance; rainfall (along with soil type) appears to be the main limiting factor affecting the distribution of this species in Western Australia (G.J. Keighery pers. comm.).

The earliest collection of this species from Western Australia seen by the present authors was made at Gingin in 1925 (*Road Board Secretary s.n.* PERTH 02022893). However, Ostenfeld (1921) records collecting "*Babiana plicata*" on a roadside at Armadale in 1914 (*Ostenfeld* 166). This is almost

certainly referable to *B. angustifolia* (cf. Cooke 1986a) although in the absence of a specimen at PERTH (the bulk of Ostenfeld's Western Australian collections are held at herb. C) the authors are unable to confirm this at present. Despite these early records, no species of *Babiana* were included by Gardner (1931) in his census of the Western Australian flora.

The taxon referred to *B. stricta* in eastern Australia by various authors (e.g. Cooke 1986a, b, James & Brown 1993, Conn 1994) is probably also referable to *B. angustifolia*. However, this is based on the examination of only a few herbarium specimens at CANB by the first author, and requires confirmation through field studies.

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Three new species of *Stylidium* (Stylidiaceae) from south-west Western Australia

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Abstract

Lowrie, A. and Kenneally, K.F. Three new species of *Stylidium* (Stylidiaceae) from south-west Western Australia. *Nuytsia* 13(): 293–302 (2000). Three new triggerplant species, *Stylidium hortiorum*, *Stylidium sidjamesii* and *Stylidium tinkeri* Lowrie & Kenneally are described and illustrated. All are endemic to south-west Western Australia and one of them has a high priority for conservation.

Introduction

The three new species described here are all members of *Stylidium* subgenus *Tolypangium* (Stylidiaceae). *Stylidium hortiorum* belongs to section *Saxifragoideae* Mildbr., the species which are characterized by having rosetted linear to obovate-spathulate leaves and simple racemose inflorescences (see Mildbraed 1908). *Stylidium sidjamesii* and *S. tinkeri* belong to section *Despectae* Mildbr. the species which are characterized by their small annual herbaceous habit; rosettes (when present) sparsely leaved; cauline leaves bracteiform, sparse and often inconspicuous; hypanthium linear or oblong; and labellum without basal appendages (Mildbraed 1908). All members of this subgenus occur in south-west Western Australia, with two taxa, S. *beaugleholei* J.H. Willis and *S. inundatum* R.Br., also recorded from South Australia, south-east Victoria and Tasmania.

The term "mirror-mounds" is adopted here for the silvery reflective structures borne in the corolla throat in *Stylidium hortiorum* as recorded previously for *Stylidium glabrifolium* Lowrie & Kenneally: "The mirror-like mounds are convex and so reflect sunlight regardless of the sun's position throughout the day...The glistening mounds contain no nectar but act as a ruse to entice any flying insects that might act as pollinators." (Lowrie & Kenneally 1997: 189).

Taxonomy

Stylidium hortiorum Lowrie & Kenneally, *sp. nov.*

Stylidio coatesiano Lowrie & Carlquist affinis sed foliis minute scabris et glanduliferis trichomatibus obtectis; hypanthio infundibuliforme; fauce 3 speculo-tumulo ornato uterque paribus appendicibus spinoideis praeditis; labello appendicibus basalibus instructo.

Typus: north of Crawler Rd, Shire of York, [precise locality withheld], Western Australia, 24 October 1999, *A. Lowrie* 2399 *& F. & J. Hort* (*holo:* PERTH 05584922; *iso:* MEL).

A basally rosetted caespitose perennial *herb* 18–31 cm (mostly 20–23 cm) tall including the scape and inflorescence; leafy rosettes 2–5 cm diam., singular or in clusters of mostly 2–3 but sometimes more, positioned just above the soil surface (younger plants) or positioned well above the soil surface (older plants) perched on stems bearing stilt roots. *Stem(s)* 1.5–4 cm long, short stems (of younger plants) hidden by the persistent long leafy remains of previous seasons' growth, spent leaves (of older plants) eventually deciduous, revealing the outline of the single or branching stems and stilt roots, rosette nodes ± visible although still densely covered with spent (but now very much abbreviated) basal portions of the leaves. *Leaves* green, linear, 1.5–2.5 cm long, 0.7–2 mm wide, ± lenticulate in section, adaxial surface convex, abaxial surface slightly concave with a raised and rounded longitudinal mid vein ridge, adaxial and abaxial surface as well as the margin minutely scabrid (easily visible with a 40x lens) and additionally covered with translucent white glandular trichomes 0.2–0.3 mm long. *Inflorescence(s)* 1–2 per rosette, racemose, 8–30-flowered, 16–27 cm long (including scape); scape green, reddish maroon in the upper parts, sometimes bearing a small solitary sparsely glandular bract just below the inflorescence, glabrous. *Floral bracts* green mottled reddish maroon, narrowly ovate as well as lanceolate, 1.5–2.5 mm long, 0.3–0.5 mm wide, sparsely glandular; bracteoles green mottled reddish maroon, narrowly ovate, 0.6–1.5 mm long, 0.2–0.4 mm wide, sparsely glandular. *Pedicels* reddish maroon, attached at the base to the inflorescence major axis by a distinctive yellow mound-like swelling (easily visible in live specimens, but somewhat deflated in dried specimens), 7–12 mm long, sparsely glandular only between the bracteoles and hypanthum. *Hypanthium* green or brown, infundibuliform, 1.5–2.5 mm long, 0.7–1 mm diam. at anthesis, sparsely glandular at the base only. *Calyx* of 5 free sepals, green or brown, reddish blotched towards the apex, with a fine translucent white hyaline margin, 2 sepals 2–2.5 mm long, 3 sepals 1.7–2 mm long, glabrous. *Corolla* pale yellow fading to creamy yellow with age, with irregular purple marks (sometimes absent) near the base of the lobes, abaxial surface pale yellow fading to creamy yellow, glabrous, lobes laterally paired; anterior lobes narrowly elliptic, 4–4.5 mm long, 2.2–3 mm wide; posterior lobes narrowly elliptic, 4–4.5 mm long, 2–2.2 mm wide. *Throat* dark yellow, bearing 3 mirror-mounds at the base of the posterior lobes, mounds yellow around their bases with apices pearl-like and sunlight refective, each with a lateral pair of yellow thorn-like slightly falcate appendages. *Labellum* pale yellow to creamy yellow; boss narrowly ovate, convex, *c.* 0.7 mm long, *c.* 0.3 mm wide, smooth; apical point, *c.* 0.7 mm long, twisted and appressed over one edge of a sepal margin, papillose; basal appendages of different lengths, the one closest to the corolla lobe *c.* 0.2 mm long, the outer one *c.* 0.4 mm long, papillose. *Gynostemium* white, *c.* 5 mm long, *c.* 0.3 mm wide below the anthers, *c.* 0.5 mm wide at the base, the sensitive torosus yellow, positioned about mid way along the column, *c.* 0.6 mm wide, glabrous; anthers blackish maroon, vertically paired, abaxial surface covered with small glassy bead-like mounds, pollen white; stigma green, elliptic, cushion-like, *c.* 0.5 mm long, *c.* 0.3 mm wide. *Capsule* (including persistent sepals) powdery purple from *c.* midway to the apex, gradually changing to black towards base, infundibuliform, 2.5–3 mm long, 1.8–2 mm diam. *Seeds* dark brown, ± ovoid or ellipsoid (mostly ovoid), 1.4–1.9 mm long, 1.1–1.4 mm diam., surface sculptured with large irregular longitudinal deep depressions creating an overall ruminate appearance on the non-depressed surface, entire surface (including depressions) longitudinally minutely striate. (Figure 1)

Other specimens examined. WESTERN AUSTRALIA: Westdale Hill, Shire of Beverley, [population 2, precise locality withheld], 6 Feb. 2000. *F. & J. Hort* 958 *& M. Hislop* (PERTH, MEL), same location, 19 Mar. 2000. *F. & J. Hort* 959 (PERTH, MEL); Dobaderry Rd, Shire of Beverley, [population 3, precise locality withheld], 19 Mar. 2000. *F. & J. Hort* 960 (PERTH, MEL); Dobaderry Rd, Shire of Beverley, [population 4, precise locality withheld], 19 Mar. 2000. *F. & J. Hort* 961 (PERTH, MEL).

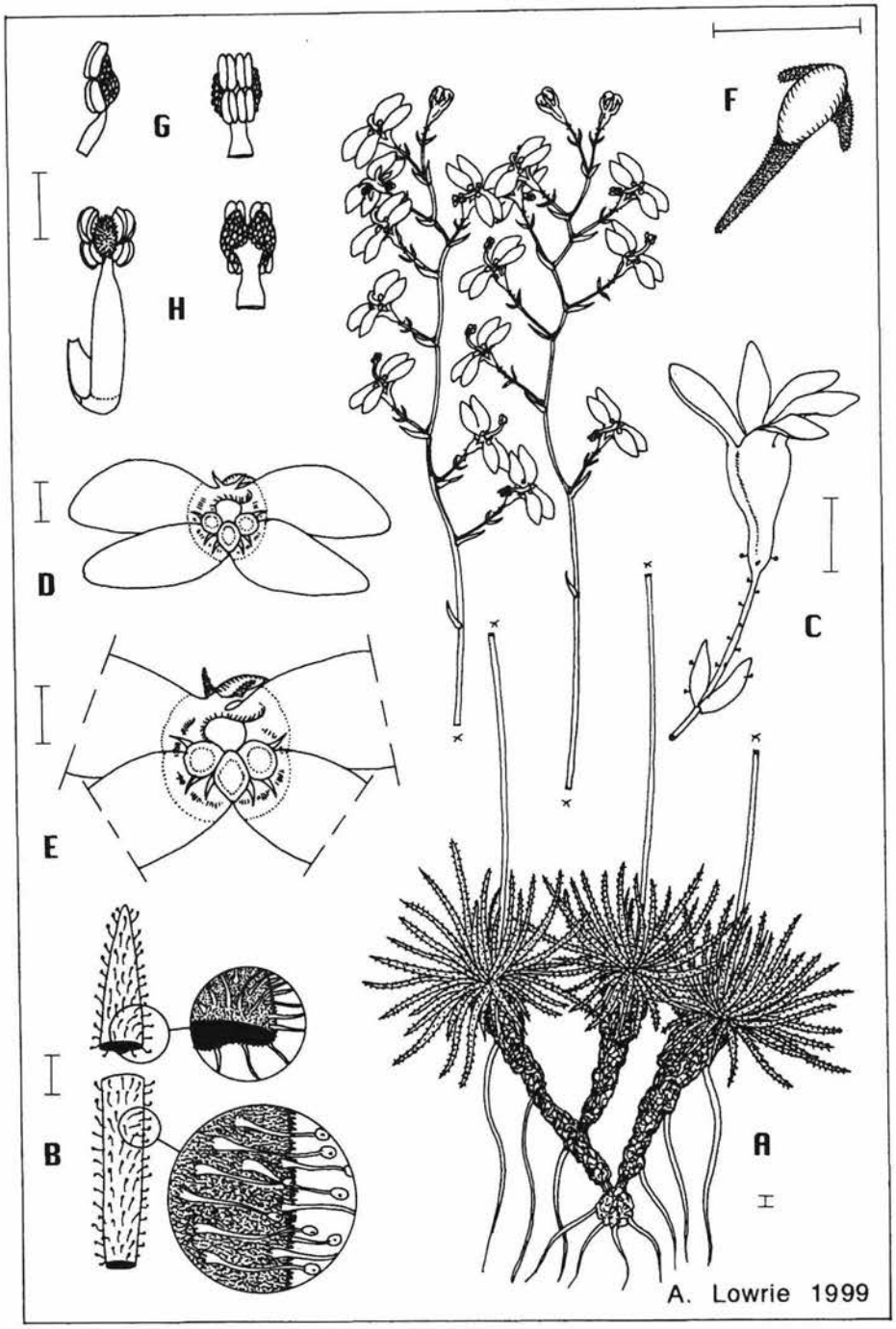

Figure 1. *Stylidium hortiorum* A – habit of flowering plant; B – leaf (adaxial surface) and leaf section, with enlargements showing scabrid and glandular indumentum; C – hypanthium and sepals with pedicel and bracteoles below; D – corolla; E – throat of corolla enlarged showing the 3 mirror-mounds with thorn-like appendages at the base of the posterior lobes; F – labellum; G – side and front views of gynostemium tip; H – front view of gynostemium, showing entire column, sensitive torosus (on bend) and mature stigma and back view of gynostemium tip. Scale bar for all = 1 mm. Drawn from *A. Lowrie* 2399 (PERTH, MEL).

Distribution. Occurs in the Shire of York region where it is known from the type collection area and at three other locations, *c.* 30 km, 35 km and 55 km south in the Shire of Beverley.

Habitat. Grows in clayey sand covered by laterite gravel over weathered granite. Restricted to the upper slopes and summits of hills and breakaways. Occurs with *Drosera spilos* Marchant & Lowrie; *Stylidium paulineae* Lowrie & Kenneally and *S. amoenum* R. Br., *Grevillea scabra, Hakea spathulata* and *Leucopogon gracillimus* at the type location; *Gastrolobium trilobum, Goodenia pinifolia, Hakea loranthifolia, Grevillea monticola, Stylidium leptocalyx* Sond. and *Petrophile heterophylla* (at the site of collection *F. & J. Hort* 959); *Eucalyptus accedens, Gastrolobium trilobium, Astroloma* sp., *Dryandra sessilis, Hibbertia enervia, Goodenia pinifolia* and sedge sp. (at the site of collection *F. & J. Hort* 960); *Eucalyptus accedens, Gastrolobium trilobum, Hakea trifurcata, Grevillea monticola, Dryandra sessilis, D. nobilis, Goodenia pinifolia, Leucopogon cinereus* and *Macrozamia riedlei* (at the site of collection *F. & J. Hort* 961).

Phenology. Flowering October to early November. Mature seed shed by mid December.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority Two. Known from four locations including a nature reserve, and currently not under threat.

Etymology. The epithet *hortiorum* is named in honor of Fred and Jean Hort, botanical enthusiasts who were with one of us (A.L.) when this species was discovered.

Affinities. The closest relative to *Stylidium hortiorum* is considered to be *S. coatesianum.* Both have basal rosettes supported on stilt roots (in older specimens), leaves (without magnification) appear hairy, and racemose inflorescences that bear yellow flowers. *S. coatesianum* differs from *S. hortiorum* in having the margins of the leaves incurved with the adaxial and abaxial surfaces as well as the margins densely covered with short white translucent non glandular hairs, the abaxial surface of the corolla lobes bearing red wine-coloured marks over most of the yellow surface; labellum without basal appendages; throat appendages with 3 slight mounds, not smooth and shining, but similar in texture and colour to the petal surface, and 4 yellow longitudinally flattened appendages, laciniate at their apices with brown capitate tips; and mauve pollen.

Stylidium sidjamesii Lowrie & Kenneally, *sp. nov.*

Stylidio utricularioides Benth. affinis sed corollae lobo antico anguste elliptico, supra marginem exteriorem parum concavo, 1.5–1.7 mm longo, 0.6–0.7 mm lato; lobo postico obovato apice plerumque apiculato sed saepe obtuso, 1.8–2.3 mm longo, 1–1.4 mm lato; chromosatum numero n = 30.

Typus: along Great Northern Highway north of Bullsbrook, 1 km south of Wandena Rd (south end), on east side of highway, Western Australia, 9 November 1991, *A. Lowrie* 494 (*holo:* PERTH 05584957; *iso:* MEL).

Erect annual *herb* 3–6 cm (mostly 3.5–4 cm) tall including inflorescence; basal stem (below the soil) white-translucent, cylindrical, hollow, sheath-like, 3–4 mm long, *c.* 1 mm diam., surrounding a solid stem 0.2–0.3 mm diam.; major stem axis and lateral branches when present (above the soil) reddish maroon, mature specimens often branching from low on the stem, 2.5–4 cm long, 0.4–0.6 mm diam., branches when present 1.5–2.5 cm long, with 4–8 bract-like leaves scattered along the erect major stem

axis, with smaller numbers of bract-like leaves scattered along the branches, glabrous very low on the plant, sparsely glandular above and throughout. *Leaves* reddish maroon, subulate, 1.5–2.5 mm long, 0.5–0.7 mm wide, sessile, adaxial surface longitudinally concave in section, leaves very low on the plant glabrous, all other leaves sparsely glandular on the margin and abaxial surface. *Inflorescence* a 1–3-flowered terminal raceme, up to 1.5 cm long, additional inflorescences arising from the apex of the branches, sparsely glandular throughout. *Floral bracts* subulate, 1.5–2.5 mm long, 0.3–0.4 mm wide, sparsely glandular; bracteoles absent. *Pedicels* 2–2.5 mm long, sparsely glandular. *Hypanthium* oblong, 3.5–6.5 mm long, 0.7–1 mm diam. at anthesis, sparsely glandular. *Calyx* of 3 free sepals and 2 connate sepals, 1.5–1.7 mm long, sparsely glandular, connate sepals united to within *c.* 0.1 mm of their apex. *Corolla* white with pink tips, yellow at the base of all lobes with a red linear mark near the base on the inner margin of the anterior lobes only, abaxial surface of the anterior lobes white with pink tips with a red mid vein, sparsely glandular, posterior lobes of similar colouring but glabrous, lobes vertically paired; anterior lobes narrowly elliptic in outline, with the upper outer margin a little concave, 1.5–1.7 mm long, 0.6–0.7 mm wide; posterior lobes obovate, apex commonly apiculate, but often obtuse, 1.8–2.3 mm long, 1–1.4 mm wide. *Throat* bearing 6 yellow papillose appendages, 4 appendages in V-shaped opposite pairs, the lower appendage of each pair *c.* 0.5 mm long, the other *c.* 0.4 mm long, joined by a raised ± four-sided papillose pad between and positioned near the sinus and base of the posterior lobes; 2 appendages conical, *c.* 0.15 mm long, positioned near the base of the anterior lobes. *Labellum* positioned *c.* 0.1 mm below the sinus of the anterior corolla lobes; boss pale yellow, ovate, convex, *c.* 0.5 mm long, *c.* 0.25 mm wide, smooth; apical point pale yellow, *c.* 0.1 mm long, touching one edge of the connate sepals, glabrous. *Gynostemium c.* 3.5 mm long, *c.* 0.1 mm wide below the anthers, dilating to *c.* 0.3 mm wide towards the sensitive torosus, positioned *c.* 1.5 mm above the *c.* 0.25 mm wide base, glabrous; anthers maroon, vertically paired, abaxial surface covered with erect glassy moniliform hairs to the margins, pollen pale greyish blue; stigma green, elliptic, cushion-like and bristly, *c.* 0.4 mm long, *c.* 0.3 mm wide, well developed when anthers are actively shedding pollen. *Capsule* narrowly ellipsoid or narrowly obovoid 3–5 mm long, 0.8–1 mm diam. *Seeds* brown, ± ellipsoid, 0.3–0.35 mm long, 0.15–0.2 diam., with smooth, prominent, slightly undulating longitudinal ridges. (Figure 2)

Other specimens examined. WESTERN AUSTRALIA: near The Lakes turnoff S of the road to York, 13 Dec.1997, *A. Lowrie* 1991 (PERTH, MEL); Banovich Rd just before right angle bend and start of walk trail to Mt Lesueur, 22 Oct. 1998, *A. Lowrie* 2141 (PERTH, MEL); nature reserve, on Great Northern Highway N of Bullsbrook, 1 km S of Wandena Rd (south end) [type location], 24 Oct. 1998, *A. Lowrie* 2168 (PERTH, MEL); on Brand Highway, *c.* 15 km N of Cataby, 21 Oct. 1999, *A. Lowrie* 2386 & *R.E. Oliver* (PERTH, MEL).

Distribution. Extends from the Mt Lesueur region south to The Lakes.

Habitat. Grows in black sandy soil on a winter wet swamp flat at the type location, in similar soil on the margins of a lake at The Lakes as well as at a swamp margin near Cataby, and in brown loam in a winter wet floodway depression in the Mt Lesueur region.

Phenology. Flowering late October to mid December.

Chromosome number. n = 30, *A. Lowrie* 494 (S.H. James previously unpublished data).

Conservation status. The type location is a CALM nature reserve. This location and the other three known locations are currently not under threat.

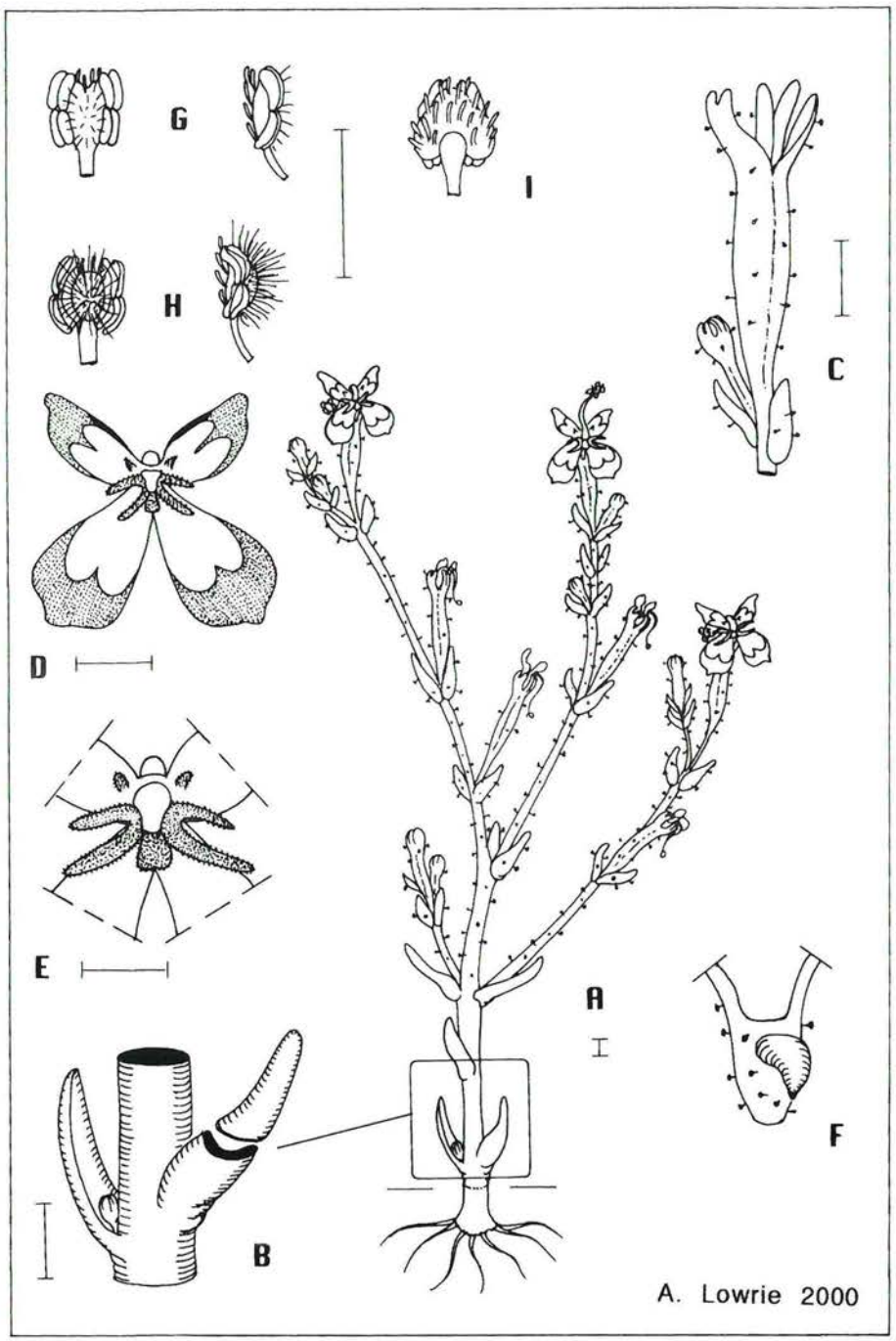

Figure 2. *Stylidium sidjamesii* A – habit of flowering plant; B – leaves and section of leaf, and portion of lower stem major axis; C – hypanthium and sepals with pedicel, floral bracts and juvenile flower bud below; D – corolla; E – throat of corolla enlarged showing the 4 V-shaped opposite paired appendages joined by a raised ± four-sided pad between and the 2 conical appendages, positioned near the base of the anterior; F – labellum showing its position on the corolla tube below the sinus of the anterior corolla lobes; G – front and side views of gynostemium tip; H – front and side views of gynostemium tip with mature stigma; I – back view of gynostemium tip. Scale bar for all = 1 mm. Drawn from *A. Lowrie* 2168 [type location] (PERTH, MEL).

Etymology. The epithet *sidjamesii* honours the late Associate Professor Sidney Herbert James (1933–1998) who used Stylidiaceae extensively for his work in cyto-evolution and population genetics (see A. Burbidge *et al.* 1999), and honours his friendship and collaboration with both authors over many years.

Affinities. The three closest relatives to *Stylidium sidjamesii* are considered to be *S. inundatum* (of which S. *despectum* R. Br. is probably a synonym), the *Stylidium* species recorded and illustrated as *S. despectum* in Erickson (Erickson 1958: 56, plates 7 & 11), and *S. utricularioides* Benth.

Both *Stylidium utricularioides* and *S. sidjamesii* grow near each other at the type location. Both have an ephemeral life form consisting of a fleshy major stem axis with lateral branches, bract-like leaves, vertically paired white with pink tipped flowers bearing 6 throat appendages. *S. utricularioides* differs from *S. sidjamesii* in having larger flowers with anterior and posterior lobes each *c.* 5 mm long, posterior lobes ± pandurate or spathulate and always distinctly dilated at their apex, and a chromosome number (S.H. James previously unpublished data) of n = 15, *A. Lowrie* 500 (PERTH).

Stylidium inundatum has been recorded in a similar seasonally wet habitat approximately 1 km south of the *S. sidjamesii* type location. *S. inundatum* is distinguished from *S. sidjamesii* by having a basal rosette of non whorled leaves, laterially paired flowers, and a non-sensitive fixed forward-arched gynostemium.

The *Stylidium* species recorded as *S. despectum* in Erickson is known to us from Palgarup in the Manjimup region and from Walpole to Manypeaks on the south coast of south-west Western Australia. This taxon has a similar lifeform to that of *S. sidjamesii* and in pressed material it is difficult to distinguish the two taxa without the aid of a microscope. However, in living material this species is easily distinguished from *S. sidjamesii* by its 3 mound-like, *c.* 0.2 mm high, papillose, throat appendages. It also has a chromosome number (S.H. James previously unpublished data) of n = 15, *A. Lowrie* 549 (PERTH). Further study is required to determine the status of this taxon in relation to *S. inundatum* and *S. despectum.*

Notes. The majority of the larger and older specimens of *Stylidium sidjamesii* from the type location are rather robust plants. These specimens have a major stem diameter at least two to four times greater than smaller and finer specimens from the same location. Specimens from the other known locations compare well with the smaller and finer plants from the type location. Specimens from the Mt Lesueur region differ from the type in having very pale pink corolla tips.

Stylidium tinkeri Lowrie & Kenneally, *sp. nov.*

Stylidio xanthopis R. Erickson & J.H. Willis affinis sed foliis omnibus caulinis, corollae lobis parte supera alba vel pallido rosea, corollae lobis anticis anguste ellipticis leviter falcatis, corollae lobis posticis panduratis apice emarginatis, faucis appendicibus 6, quorum 4 in paribus oppositis crista separatis, 2 conicis, polline pallido malvino differt.

Typus: north-east of Eneabba, [precise locality withheld], Western Australia, 22 October 1998, *A. Lowrie* 2144 (*holo:* PERTH 05405009; *iso:* MEL).

Erect *annual herb* 3–7 cm (mostly 4–5 cm) tall including inflorescence; stem (below the soil) white-translucent, cylindrical, hollow, sheath-like, 1.5–5 mm long, *c.* 1 mm diam., surrounding a solid stem *c.* 0.2 mm diam.; stem (above the soil) green, mottled reddish brown, 2.5–3.5 cm long, 0.3–0.4 mm diam.,

with 5–7 bract-like leaves scattered along erect stem, sparsely glandular throughout. *Leaves* green, mottled reddish brown, narrowly elliptic, 0.8–1.2 mm long, *c.* 0.4 mm wide, sessile, adaxial surface longitudinally concave in section, margin and abaxial surface sparsely glandular. *Inflorescence* a 1–5-flowered terminal raceme up to 3.5 cm long, an additional inflorescence sometimes arising from the axil of a lower leaf, sparsely glandular throughout. *Floral bracts* narrowly elliptic-lanceolate, 1–1.5 mm long, 0.2–0.3 mm wide; bracteoles narrowly elliptic-lanceolate, 0.7–1 mm long, 0.1–0.2 mm wide, sparsely glandular. *Pedicels* 4–7.5 mm long, sparsely glandular. *Hypanthium* oblong, 2.5–3.5 mm long, 0.5–0.6 mm diam. at anthesis, sparsely glandular. *Calyx* of 3 free sepals and 2 connate sepals, 1.2–1.4 mm long, connate sepals united to within *c.* 0.3 mm of their apex, sparsely glandular. *Corolla* white to pale pink, yellow at the base of all lobes with red marks near the base of the anterior lobes only, abaxial surface white with a few red broken lines along the midvein, glandular on the anterior lobes only, lobes vertically paired; anterior lobes narrowly elliptic in outline, with the inner margin and the upper outer margin concave thus presenting the lobe as slightly falcate, 1.7–2.5 mm long, 1.2–1.7 mm wide; posterior lobes pandurate, apex emarginate, 3.3–4 mm long, 1.7–3 mm wide. *Throat* bearing 6 yellow papillose appendages; 4 appendages in opposite pairs *c.* 0.6 mm long, joined by a papillose ridge between and positioned at the base of the posterior lobes; 2 appendages conical, *c.* 0.2 mm long, positioned near the base of the anterior lobes. *Labellum* positioned *c.* 0.1 mm below the sinus of the anterior corolla lobes; boss yellow, broadly ovate, convex, *c.* 0.3 mm long, *c.* 0.4 mm wide, smooth; apical point yellow, *c.* 0.2 mm long, twisted and appressed over the edge of the connate sepals margin, glabrous. *Gynostemium* 5–6.3 mm long, *c.* 0.2 mm wide, geniculate *c.* 1.5 mm below the anthers, the sensitive torosus *c.* 0.5 mm long, *c.* 0.4 mm wide, positioned *c.* 1.5 mm above the *c.* 0.3 mm wide base, glabrous; anthers blackish maroon, vertically paired, abaxial surface with glassy clavate moniliform hairs along the margins, pollen pale mauve; stigma orbicular, cushion-like, *c.* 0.6 mm diam. *Capsule* narrowly ellipsoid or narrowly obovoid, 3–5 mm long, 0.8–1 mm diam. *Seeds* brownish orange, ± ellipsoid, 0.2–0.25 mm long, 0.1–0.15 diam., with smooth, prominent, undulating longitudinal ridges and very fine shallow transverse ridges between. (Figure 3)

Other specimen examined. WESTERN AUSTRALIA: NE of Eneabba, [precise locality withheld], 22 Oct. 1998, *A. Lowrie* 2147 (PERTH, MEL).

Distribution. Known only from the type collection area and nearby locations in the same seasonal wetland system.

Habitat. Grows in grey (white-grained) sandy soil under low shrubs with *Stylidium mimeticum* Lowrie & Carlquist (*A. Lowrie* 2146 (PERTH, MEL)) and *Levenhookia leptantha* Benth. (*A. Lowrie* 2145 (PERTH, MEL)) in a seasonal wetland system.

Phenology. Flowering in October.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority One. Known only from the type and nearby locations on uncleared private land and currently not under threat.

Etymology. The epithet *tinkeri* is named in honour of Allan Neil Tinker, naturalist and botanical enthusiast who first discovered this species.

Affinities. The closest relative to *Stylidium tinkeri* is considered to be the "Yellow-eyed Triggerplant" *S. xanthopis* R. Erickson & J.H. Willis. Both species have a corolla with a distinctive yellow centre. *S. xanthopis* differs from *S. tinkeri* in having basal leaves rosetted as well as cauline; upper portions of the corolla lobes dark pink; anterior corolla lobes broadly elliptic, posterior corolla lobes obovate, slightly falcate; throat appendages 5, mound-like; and pollen cobalt blue.

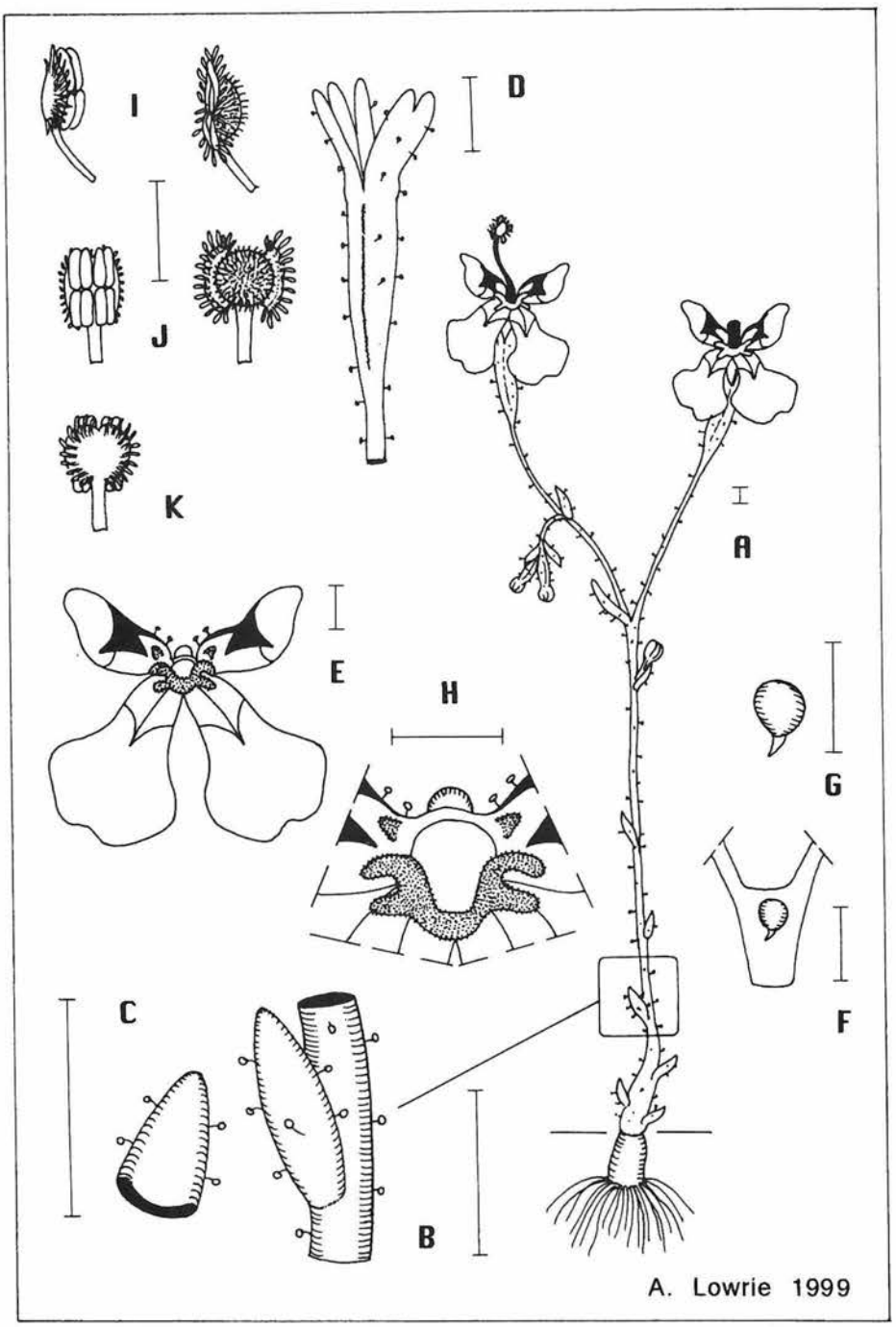

Figure 3. *Stylidium tinkeri* A – habit of flowering plant; B – stem section and leaf; C – leaf section; D – hypanthium and sepals; E – corolla; F – labellum, showing its position on the corolla tube below the sinus; G – labellum; H – throat appendages; I – side views of gynostemium tip, with mature anthers (left) and mature stigma (right); J – front views of gynostemium tip, with mature anthers (left) and mature stigma (right); K – back view of gynostemium tip. Scale bar for all = 1 mm. Drawn from *A. Lowrie* 2144 (PERTH, MEL).

Acknowledgements

We would like to thank the late Sid James for freely sharing his scientific knowledge with us and for the chromosome counts he obtained from our material. Fred and Jean Hort for sharing their botanical discoveries with us. Allan Tinker for bringing his species to our attention. Mary Hancock and Juliet Wege for their habitat observations and Juliet's living specimens from the *Stylidium tinkeri* type location region as shown to them by Allan Tinker. Paul Wilson for his assistance with the Latin diagnoses; Barbara Rye for her comments, and the staff of the Western Australian Herbarium.

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A review of the *Eucalyptus calycogona* group (Myrtaceae) including the description of three new taxa from southern Australia

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Abstract

Nicolle, D. A review of the *Eucalyptus calycogona* group (Myrtaceae) including the description of three new taxa from southern Australia. *Nuytsia* 13(2): 303–315 (2000). *Eucalyptus* L'Hérit. series *Heterostemones* Benth. (Myrtaceae) is described and a key is provided for the seven species now recognized. *E. calycogona* Turcz. is described under a reduced circumscription and two new subspecies and a new species are described. *E. calycogona* subsp. *calycogona* occurs in the wheatbelt area of southern Western Australia and disjunctly in South Australia, mainly on Eyre Peninsula. New subspecies of *E. calycogona* described are: subsp. *spaffordii* Nicolle, restricted to Eyre Peninsula in South Australia; and subsp. *trachybasis* Nicolle, widespread in eastern South Australia and western Victoria, just extending into New South Wales. The new species *E. prolixa* Nicolle is endemic to the southern goldfields region of Western Australia, differing from *E. calycogona* in its mallet habit and larger, elongate fruits. Distribution maps and representative illustrations are provided for the newly described taxa.

Introduction

Eucalyptus calycogona was first described by Turczaninow (1852) from material collected in Western Australia by J. Drummond, the precise locality of which is unknown, but which would be in the far south-western part of the distribution of the species on account of the collector's known field travels (Erickson, 1969). Both the locality and the morphology of the type correspond to the smooth-barked mallee form of *E. calycogona* with relatively small and not strongly-ribbed buds and fruits, herein recognized as subsp. *calycogona*. Turczaninow's protologue also firmly establishes what is currently recognized as *E. calycogona*, including in the description "cupula tetragonis" referring to the quadrangular fruits which distinguish the species within *Eucalyptus* series *Heterostemones* Benth. (equivalent to Pryor & Johnson's (1971) informal *E.* ser. *Calycogonae*).

Taxonomy

Eucalyptus series **Heterostemones** Benth., Flora Australiensis 3: 190, 209 (1867). *Type: Eucalyptus gracilis* F. Muell.

A small series of seven species from southern Australia, distinguished by its combination of bisected cotyledons; stem pith glands absent; small tree (mallet) or mallee habit; axillary, unbranched inflorescences; inflexed staminal filaments, the outer filaments twisted, particularly manifest in flowers (cf. within buds), without anthers and longer than the fertile filaments; ovules in four vertical rows; the outer operculum dehiscing during bud development; and the somewhat ovoid seed with an almost smooth to quite smooth reticulum.

Key to the species of *Eucalyptus* series *Heterostemones*

1. Buds and fruit square in transverse section, at least on lower part of hypanthium
 2. Fruit oblong to urceolate in outline
  3. Mallet, fruit length:width ratio 2.5:1–4:1 ..... **E. prolixa**
  3. Mallee, fruit length:width ratio 1.5:1–2.5:1 ..... **E. calycogona**
 2. Fruit obconical to cupular in outline ..... **E. quadrans**
1. Buds and fruit round in transverse section
 4. Pedicels equal to or longer than bud length ..... **E. yilgarnensis**
 4. Pedicels shorter than bud length
  5. Fruit urceolate, much longer than broad ..... **E. celastroides**
  5. Fruit obconical to cupular to barrel-shaped
   6. Peduncles to 5 mm long ..... **E. brevipes**
   6. Peduncles > 5 mm long ..... **E. gracilis**

1. *Eucalyptus calycogona* Turcz., Bull. Cl. Phys.-Math. Acad. Sci. Saint-Petersburg 10: 388 (1852). *Type:* Swan River Colony, Western Australia, 1849, *J. Drummond* 5: 184 (*holo:* KW; *iso:* BM, FI, K, MEL, PERTH, W).

Notes. Recognized within *E.* series *Heterostemones* by the mallee habit; the relatively large buds and fruits that are longer than wide, square in transverse section and have four longitudinal ribs or wings extending from the pedicel-hypanthium join to the top of the hypanthium. Staminal colour varies from white to dark pink. Three subspecies are herein recognized.

Intergrades between *E. calycogona* and the closely related *E. gracilis* F. Muell. have been postulated (Brooker & Kleinig 1996), and Maiden (1903) refers to "insensible gradations" between *E. gracilis* and *E. calycogona*, without citing localities or specimens. These reports have not been substantiated in the field by the author. The two taxa are distinguishable by bud and fruit characteristics, *E. gracilis* having much smaller buds and fruits that are terete in transverse section and barrel-shaped rather than urceolate fruits. *E. quadrans* Brooker & Hopper is also closely related to *E. calycogona* showing some morphological approach to it in its angular hypanthium. *E. quadrans* differs in its obconical, angular rather than ribbed, shorter buds and fruits. Intermediates between *E. quadrans* and *E. calycogona* (subsp. *calycogona*) have been recorded (M. French pers. comm.).

Key to the subspecies of *Eucalyptus calycogona*

1. Most adult leaves 14–24 mm wide, firm; fruit 6–9 mm wide, ribs very prominent ..... subsp. **spaffordii**
1. Most adult leaves 6–15 mm wide; fruit 3–7 mm wide, ribs less prominent

2. Bark smooth or rough only at very base ..... subsp. **calycogona**
2. Bark rough, tessellated for 0.5–2.5 m ..... subsp. **trachybasis**

1a. Eucalyptus calycogona Turcz. subsp. **calycogona**

Mallee, usually erect-stemmed, 3–5 m tall, forming lignotubers. *Bark* smooth throughout, grey to light grey over light grey to cream, decorticating in short ribbons. *Seedling leaves* opposite for 5–7 pairs then alternate, shortly petiolate, narrow-lanceolate then narrow-elliptic, up to 20 mm long and 5 mm wide, ± concolorous to slightly discolorous, dull, green. *Adult leaves* alternate, petiolate, narrow-lanceolate to lanceolate, 55–100 mm long, 7–13 mm wide, concolorous, glossy, green to dark green; reticulation sparse to moderate, with numerous island oil glands, lateral veins at 30–45° from midrib. *Inflorescences* axillary, unbranched, 7-flowered; peduncles terete to angular, 4–9 mm long; pedicels 2–4 mm long. *Buds* fusiform, 8–10 mm long, 3–5 mm diam., hypanthium with four vertical ribs; operculum equal in width to hypanthium, smooth, conical, apiculate. *Flowers* creamy white to dark pink. *Stamens* inflexed, outer stamens without anthers; fertile anthers on shorter filaments, versatile, cuboid to globoid, opening by pores and slits. *Ovules* in 4 vertical rows. *Fruits* pedicellate, urceolate, with four weak but distinct vertical ribs, 8–10 mm long, 4–6 mm diam.; operculum scar very narrow, level to ascending, to 0.8 mm wide; disc descending, valves 4, deeply enclosed in fruit. *Seeds* angular-ovoid, 0.8–1.8 mm long, somewhat glossy, tan-brown, with shallow longitudinal grooves and a very finely pitted to smooth reticulum; chaff glossy, orange-brown. (Figure 1)

Selected specimens examined. WESTERN AUSTRALIA (west to east): 15 km N of Lake Grace, 8 Aug. 1984, *M.I.H. Brooker 8619* (AD, CANB, PERTH); 11.4 km NNW of Hyden towards Narembeen, 3 Oct. 1975, *M.I.H. Brooker* 4993 (AD, CANB, PERTH); 2.9 km E of Rabbit Proof Fence on Varley–Southern

Figure 1. *Eucalyptus calycogona* subsp. *calycogona* habit from between Darke Peak and Mangalo, Eyre Peninsula, South Australia.

Cross road, 1 Sep. 1988, *K. Hill* 3048 (CANB, NSW, PERTH); 98.5 km E of Hyden on Hyden–Norseman road (i.e. 11.7 km E of crossroads), 17 May 1988, *L.A.S. Johnson* 9101 & *M. Johnson* (NSW, PERTH); Frank Hann National Park, E of Lake King towards Ninety Mile Tank, 33°04'21"S, 120°13'01"E, 22 Nov. 1994, *D. Nicolle* 1112 (PERTH).
SOUTH AUSTRALIA (west to east): Eyre Highway between Kimba and Kyancutta, Eyre Peninsula, 33°12'20"S, 136°11'36"E, 23 July 1995, *D. Nicolle* 1407 (AD); *c.* 3 km NE of the Kallimba entrance on the Darke Peak–Curtinye road, *c.* 16 km SSE of Kimba, 29 Aug. 1983, *J.D. Briggs* 1098 (AD, CANB); between Darke Peake and Mangalo, Eyre Peninsula, 33°29'19"S, 136°26'15"E, 16 Feb. 1996, *D. Nicolle* 1688 (AD, CANB); road between canoe tree and Tonkin's Currency Creek Winery, Fleurieu Peninsula, 35°21'37"S, 138°49'11"E, 28 May 1995, *D. Nicolle* 1362 (AD); road between canoe tree and Tonkin's Currency Creek Winery, Fleurieu Peninsula, 11 Apr. 1993, *D. Nicolle* 383 (CANB).

Distribution and habitat. Subsp. *calycogona* occurs in mallee and low woodland vegetation and, like the other subspecies of *Eucalyptus calycogona*, it generally occurs on locally heavier soils. It is restricted to three disjunct regions (Figure 2):

1. Central and southern wheatbelt areas of Western Australia, from north-east of Esperance west to the Lake Grace area, where it may be associated with *E. flocktoniae* (Maiden) Maiden (subsp. *flocktoniae*), *E. pileata* Blakely, *E. depauperata* L. Johnson & K. Hill, *E. densa* Brooker & Hopper (subsp. *densa*) and *E. oleosa* F. Muell. ex Miq. (subsp. *corvina* L. Johnson & K. Hill).

2. Eyre Peninsula in South Australia, especially from Kyancutta to Cummins and eastwards to Spencer Gulf, where it may be associated with *E. phenax* Brooker & Slee, *E. incrassata* Labill., *E. leptophylla* F. Muell. ex Miq., *E. oleosa*, *E. cretata* Brooker & P. Lang, *E. porosa* F. Muell. ex Miq. and *E. peninsularis* Nicolle.

3. Fleurieu Peninsula in South Australia, from Newland Head north-eastwards to near Strathalbyn.

Flowering period. July to November.

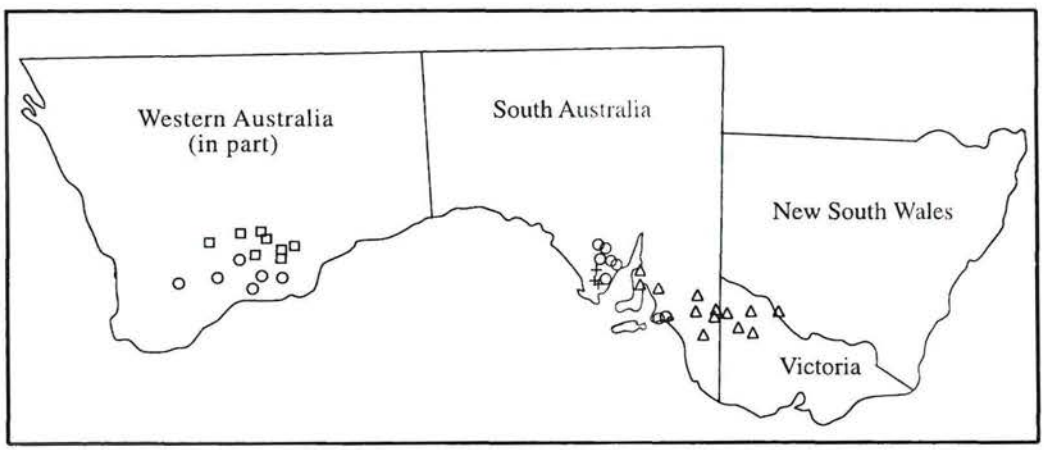

Figure 2. Map of southern Australia showing the distribution of *Eucalyptus calycogona* subspp. *calycogona* ○, *trachybasis* △ and *spaffordii* + and *Eucalyptus prolixa* □.

Conservation status. Although the distributional range of this newly circumscribed typical subspecies has been significantly reduced, *E. calycogona* subsp. *calycogona* is not considered to be under threat. It is common and well represented in conservation reserves on Eyre Peninsula in South Australia. While apparently of more scattered occurrence in Western Australia, it is known to occur in Frank Hann National Park and Lake Magenta Nature Reserve. A small population of the eastern outlier of subsp. *calycogona* on Fleurieu Peninsula is known on the cliffs immediately east of Newland Head Conservation Park.

Notes and affinities. E. calycogona subsp. *calycogona* is distinguished within the species by the smooth bark; the small leaves, buds and fruits; buds and fruits with weak to moderately prominent ribs and the white to dark pink staminal filaments. Previously included with it in *E. calycogona sens. lat.* were the rough-barked mallees of eastern South Australia, Victoria and New South Wales (subsp. *trachybasis*); populations with coarse leaves, buds and fruit in central Eyre Peninsula previously referred to as var. *staffordii* Blakely (subsp. *spaffordii*); and steep-branched mallets with very elongate fruits from the Western Australian southern goldfields (*E. prolixa*).

On Eyre Peninsula *E. calycogona* subsp. *calycogona* commonly has staminal filaments coloured various shades of pink; elsewhere it only rarely has coloured filaments. In Western Australia, *E. calycogona* subsp. *calycogona* is partly sympatric with the closely related *E. celastroides* Turcz. subsp. *virella* Brooker, which differs in its rough, persistent bark and smaller, non-ribbed fruits that are terete, not square, in transverse section. Intergrades between the two taxa are known in the west of the distribution of *E. calycogona* subsp. *calycogona*, such as west of Lake Grace.

1b. Eucalyptus calycogona subsp. **trachybasis** Nicolle, *subsp. nov.*

A subspecie typica cortice non-decorticato, leviter tessellato, basi, habitu effusiore, foliis adultis leviter latioribus, alabastris fructibusque majoribus differt.

Typus: Tailem Bend–Loxton Highway between Mindarie and Wanbi, 34°48'31"S, 140°13'11"E, South Australia, 30 July 1994, *D. Nicolle* 984 (*holo:* AD; *iso:* CANB, NSW).

Spreading or straggly *mallee* 2–6 m tall, forming lignotubers. *Bark* rough for 0.5–2.5 m, thick, finely fissured, weakly to prominently tessellated, brown to grey or dark grey, then smooth above, dull, grey over olive-cream to pale yellow-white, decorticating in short ribbons. *Seedling leaves* opposite for 2 or 3 pairs then alternate, petiolate, narrow-lanceolate then narrow-elliptic, up to 35 mm long and 8 mm wide, ± concolorous to slightly discolorous, dull, green. *Adult leaves* alternate, petiolate, lanceolate, 45–90 mm long, 8–15 mm wide, concolorous, glossy, green to dark green; reticulation sparse to moderate, with numerous large island oil glands, lateral veins at 35–55° from midrib. *Inflorescences* axillary, unbranched, 7-flowered; peduncles terete to angular, 5–11 mm long; pedicels 3–5 mm long. *Buds* fusiform, 10–12 mm long, 3.5–5.5 mm diam., hypanthium with four ribs; operculum equal in width to hypanthium, smooth, conical, apiculate. *Flowers* creamy white to less commonly pale pink. *Stamens* inflexed, outer stamens without anthers; fertile anthers versatile, cuboid to globoid, opening by pores and slits. *Ovules* in 4 vertical rows. *Fruits* pedicellate, urceolate, with four weak ribs, 8–13 mm long, 4–7 mm diam.; operculum scar very narrow, level to ascending, to 0.8 mm wide; disc descending, valves 4, deeply enclosed in fruit. *Seeds* angular-ovoid, 1–2 mm long, slightly glossy, tan-brown, with shallow longitudinal grooves and a very finely pitted to smooth reticulum; chaff glossy, orange-brown. (Figures 3, 4)

Figure 3. *Eucalyptus calycogona* subsp. *trachybasis* habit from south of Pinnaroo, South Australia.

Selected specimens examined. SOUTH AUSTRALIA (west to east): Bute to Port Broughton Rd, 33°44'08"S, 137°58'47"E, 13 Sep. 1995, *D. Nicolle* 1486 (AD, CANB, NSW); *c.* 15 km from Bute on Port Broughton Rd, 2 July 1967, *B. Copley* 1356 (AD); 13.1 km N of Mallala towards Balaklava, (34°20'S, 138°29'E), 19 July 1975, *G. Chippendale* 1350 & *M.J. Brennan* (AD); Tailem Bend–Loxton Highway just N of Mindarie, 34°48'53"S, 140°13'01"E, 30 July 1994, *D. Nicolle* 985 (AD, CANB); just W of Lameroo on highway, 35°19'28"S, 140° 29'58"E, 27 Dec. 1993, *D. Nicolle* 732 (AD); near Keith, 21 Aug. 1950, *J.W. Green* 188 (AD); 10 km N of Pinnaroo towards Paruna (35°08'S, 140°56'E), 3 Aug. 1976, *J.D. Turner* 19 & *H. Vos* (AD).
VICTORIA (west to east): 13.2 km W of Murrayville towards Pinnaroo, (35°15'S, 141°02'E), 23 July 1975, *G. Chippendale* 1383 & *M.J. Brennan* (AD); 20 km N of Rainbow to Hopetoun, (35°49'S, 142°08'E), 15 Sep. 1977, *J.D. Turner* 118 (AD, PERTH, MEL, NSW); Wyperfeld National Park, Ginap Track, 2 miles [3 km] W of Eagle Track Junction, 3 Oct. 1968, *A.C. Beauglehole* 28875 (AD, NPA); 12 km E of Ouyen to Manangatang, 16 Sep. 1977, *J.D. Turner* 122 (AD, PERTH, MEL, NSW).
NEW SOUTH WALES: 14.5 km from Tooleybuc towards Koraleigh, 35°07'33"S, 143°24'14"E, 13 Dec. 1999, *D. Nicolle* 2896 (AD, CANB).

Distribution and habitat. Widespread but scattered in the Mid North and Murray Mallee regions of South Australia, extending into adjacent areas of Victoria and just into New South Wales near Koraleigh (Figure 2). It occurs in mallee shrubland in red-brown loams, occasionally as the dominant plant. Associated species include *E. socialis* F. Muell. ex Miq., *E. dumosa* A. Cunn. ex Oxley, *E. oleosa* (subsp. *oleosa*) and *E. phenax* (subsp. *phenax*). Brooker (1986) considered it surprising that *E. calycogona* (subsp. *trachybasis*) was absent from most of New South Wales that is inhabited by several other mallee species common with that taxon in Victoria. The same could be said of *E. gracilis* in Western Australia and *E. brevipes* Brooker (a very restricted mallee of the northern wheatbelt of Western Australia), both also of *E.* ser. *Heterostemones* and both surprisingly do not extend further into apparently similar habitats in Western Australia.

Figure 4. Holotype of *Eucalyptus calycogona* subsp. *trachybasis (D. Nicolle* 984*).*

Parsons & Rowan (1968) found that in the eastern part of its range, *E. calycogona* (subsp. *trachybasis*) is found on heavier soils than the related *E. gracilis*, the spatial separation being a possible explanation for the lack of hybrids between these two species. A similar situation occurs in Western Australia with *E. calycogona* and *E. prolixa* occurring on generally heavier (more clayey) soils that the related *E. gracilis, E. brevipes, E. celastroides* and *E. quadrans*. *E. calycogona* subspp. *trachybasis* and *calycogona* are allopatric although plants of subsp. *calycogona* on north-eastern Eyre Peninsula do show some tendency towards subsp. *trachybasis* with occasional plants having some persistent bark around ground level. These plants are not considered to be intergrades but are subsp. *calycogona* with possibly some past genetic influence from subsp. *trachybasis*.

Flowering period. July to October.

Conservation status. Widespread and not considered to be at risk. Abundant in reserves such as Ngarkat and Scorpion Springs Conservation Parks in South Australia and Wyperfeld National Park in Victoria.

Etymology. The epithet is derived from Greek *trachys* – rough and *basis* – base, referring to the persistent rough bark on the lower stems of this subspecies, contrasting with the smooth bark of subspp. *calycogona* and *spaffordii*.

Notes and affinities. E. calycogona subsp. *trachybasis* differs from subsp. *calycogona* in the persistent, rough bark on the lower stems, the more spreading, straggly habit, the slightly broader adult leaves and the larger buds and fruits.

E. calycogona subsp. *trachybasis* is the eastern variant of *E. calycogona* and is geographically separate from the other two subspecies. Plants of subsp. *trachybasis* sometimes attain the same height as typical plants of subspp. *calycogona* and *spaffordii*, but they are usually spreading and have more crooked, spreading stems unlike the erect, straight stems of the other two subspecies. The rough bark character readily distinguishes subsp. *trachybasis* from the other subspecies of *E. calycogona*. It also has somewhat larger buds and fruits than subsp. *calycogona* and marginally larger leaves. The rough bark of this subspecies is usually somewhat tessellated, like that of other rough-barked taxa in the series, viz. *E. gracilis*, *E. celastroides* and *E. yilgarnensis* (Maiden) Brooker.

1c. Eucalyptus calycogona Turcz. subsp. **spaffordii** Nicolle, *subsp. nov.*

Eucalyptus calycogona Turcz. var. *staffordii* Blakely, Key Eucalypts 265 (1934). *Type:* Yeelanna, South Australia, June 1917, *W.J. Spafford s.n.* (*syn:* NSW).

A subspecie typica foliis juvenilibus latioribus, foliis adultis crassioribus latioribus, alabastris fructibusque majoribus et valde costatis differt.

Typus: between Cummins and Yeelanna, Eyre Peninsula, 34°11'53"S, 135°43'41"E, South Australia, 16 February 1996, *D. Nicolle* 1682 (*holo:* AD; *iso:* CANB, PERTH).

Erect-stemmed *mallee* 2–4 m tall, forming lignotubers. *Bark* smooth throughout, light grey to grey over cream, decorticating in ribbons. *Seedling leaves* opposite for many pairs, shortly petiolate, broad-lanceolate, 16–22 mm wide, 4–7 mm long, ± concolorous to slightly discolorous, dull, green. *Adult leaves* alternate, petiolate, lanceolate, 75–105 mm long, 13–24 mm wide, firm (to 1 mm thick), concolorous, glossy, dark green; reticulation moderate, oil glands numerous, irregular, mostly island, lateral veins at 25–35° from midrib. *Inflorescences* axillary, unbranched, 7-flowered; peduncles angular, 10–17 mm long; pedicels tapering to fruit, 5–9 mm long. *Buds* fusiform, 12–15 mm long x 4–7 mm diam., hypanthium with four sharp ribs or wings; operculum equal in width to hypanthium, smooth, conical, apiculate. *Flowers* white. *Stamens* inflexed, outer stamens without anthers; fertile anthers versatile, cuboid to globoid, opening by pores and slits. *Ovules* in 4 vertical rows. *Fruits* pedicellate, ovoid to urceolate (not including ribs), with four wings extending to pedicel, 11–13 mm long, 6–9 mm diam.; operculum scar very narrow, level to ascending, to 0.8 mm wide; disc level to descending, valves 4, deeply enclosed in fruit. *Seeds* compressed-ovoid, to 2 mm long, glossy, tan-brown, with a finely pitted reticulum; chaff orange-brown. (Figures 5, 6)

Selected specimens examined. SOUTH AUSTRALIA: Yeelanna, Eyre Peninsula, (34°09'S, 135°45'E), 5 June 1967, *C. Boomsma s.n.* (AD); 6 km N of Cummins on Yeelanna road, Eyre Peninsula, 9 Aug. 1992, *D. Nicolle* 86 (CANB); N of Yeelanna towards Lock, Eyre Peninsula, 34°10'39"S, 135°43'42"E, 17 July 1994, *D. Nicolle* 949 (AD, CANB); Mt Pillowerta, Eyre Peninsula, near Todd Valley, (34°09'S, 135°57'E), 11 Nov. 1952, *J.D. Purdy s.n.* (AD).

Distribution and habitat. Restricted to central Eyre Peninsula, mainly in the Yeelanna–Cummins area, occurring in mallee communities (Figure 2). It has also been recorded in the nearby Koppio Hills. Recorded associated species include *E. peninsularis*, *E. pileata*, and *E. diversifolia* Bonpl. (subsp.

Figure 5. Holotype of *Eucalyptus calycogona* subsp. *spaffordii (D. Nicolle* 1682*).*

diversifolia). *E. calycogona* subspp. *calycogona* and *spaffordii* are completely sympatric and few intergrades are known, however, considering the differences between these two subspecies are quantitative and individuals with coarse leaves, buds and fruits of subspp. *calycogona* and *trachybasis* elsewhere approach subsp. *spaffordii* in leaf, bud and fruit morphology, it is here maintained at an infraspecific rank.

Flowering period. Flowers recorded in July.

Conservation status. Most populations occur in remnant vegetation along roadsides and railway reserves and the taxon is not known to occur in any conservation reserves. The conservation status 2R is recommended using criteria of Briggs & Leigh (1996).

Etymology. Named after the collector of the type, W.J. Spafford (see notes below).

Notes and affinities. This taxon was first recognized by Blakely (1934). Unfortunately Blakely cited the type specimen in error as collected by W.J. Stafford instead of correctly W.J. Spafford, and in doing

Figure 6. *Eucalyptus calycogona* subsp. *spaffordii* habit from between Cummins and Yeelanna, Eyre Peninsula, South Australia.

so, named the variety *staffordii* Blakely. As the taxon is here recognized as a subspecies, the opportunity is taken to correct the name to subsp. *spaffordii*.

E. calycogona subsp. *spaffordii* differs from subsp. *calycogona* in the broader juvenile leaves, the broader and thicker adult leaves, and the much larger and more prominently ribbed buds and fruit; from subsp. *trachybasis* in the smooth bark, more erect habit, broader juvenile leaves, the broader and thicker adult leaves, and the larger and more prominently ribbed buds and fruit; and from *E. prolixa* in the mallee habit, the coarser leaves and the wider, more prominently ribbed buds and fruits.

2. Eucalyptus prolixa Nicolle, *sp. nov.*

Affinis *E. calycogonae* sed characteribus sequentibus distinguitur: habitu arborescenti (forma "mallet"); alabastris fructibusque elongatioribus differt.

Typus: Daniell Railway Siding, Esperance road, Western Australia, 31 March 1968, *S.G.M. Carr* 615 *& D.J. Carr* (*holo:* PERTH 04918576; *iso:* CANB, NSW).

Erect-stemmed *mallet* 6–10 m tall, with a steep branching habit, not known to form lignotubers. *Bark* smooth throughout, grey over coppery-red, decorticating in short ribbons. *Seedling leaves* opposite for 4–6 pairs then alternate, shortly petiolate, narrow-lanceolate to narrow-elliptic, up to 27 mm long and 9 mm wide, slightly discolorous, dull, green. *Adult leaves* alternate, petiolate, lanceolate, 65–92 mm long, 8–16 mm wide, concolorous, glossy, green; reticulation moderate with many large, mostly island oil glands, lateral veins at 30–50° from midrib. *Inflorescences* axillary, unbranched, 7-flowered; peduncles angular, 5–14 mm long; pedicels 2.5–10 mm long. *Buds* fusiform,

12–14 mm long, 3–4 mm diam., hypanthium with four ribs; operculum equal in width to hypanthium, smooth, conical, apiculate. *Flowers* creamy white. *Stamens* inflexed, outer stamens without anthers; fertile anthers versatile, cuboid to globoid, opening by pores and slits. *Ovules* in 4 vertical rows. *Fruits* pedicellate, urceolate, with four distinct ribs, 12–17 mm long, 3.5–6 mm diam.; operculum scar very narrow, level to ascending, to 0.8 mm wide; disc descending, valves 4, deeply enclosed in fruit. *Seeds* ovoid to compressed-ovoid, 1.0–1.6 mm long, slightly glossy, tan-brown, with a finely pitted to smooth reticulum; chaff orange brown. (Figures 7, 8)

Selected specimens examined. WESTERN AUSTRALIA (west to east): 1.4 miles [2 km] W of Bullabulling, 7 Mar. 1967, *G. Chippendale* 111 (AD, CANB, PERTH); Bremer Range track, 32°15'46"S, 120°31'52"E, 21 Apr. 1998, *D. Nicolle 2281* (PERTH); Hyden–Norseman track, 10 km E of Mt Day turnoff, 12 Nov. 1987, *A. Taylor* 126 *& A. Napier* (PERTH); W of Coolgardie on highway, 31°01'20"S, 120°50'43"E, 15 Aug. 1997, *M. French* 249 (PERTH); Woodline, *c.* 100 km S of Coolgardie, 2 Sep. 1926,

Figure 7. Holotype of *Eucalyptus prolixa* (*S.G.M. Carr* 615 *& D.J. Carr*).

Figure 8. *Eucalyptus prolixa* habit from north of the Bremer Range, Western Australia.

J.B. Cleland s.n. (AD); 24.5 and 35.1 km W of Cave Hill on track to Victoria Rock road, 30 Mar. 1997, *M. French* 174 (PERTH); Norseman–Hyden road, 5.1 km W of Coolgardie–Norseman road, 32°01'04"S, 121°36'45"E, 18 Apr. 1997, *R. Davis* 3048 (PERTH); 4.5 miles [7 km] W along (L) turnoff, 6.4 miles [10 km] N of Norseman, 11 Nov. 1970, *J. Baker* 50 (AD, CANB, PERTH); 24.2 miles [39 km] S of Norseman, 13 Nov. 1970, *J. Baker* 60 (AD, CANB, PERTH); car park area at Jimberlana Hill, 5.9 km NE of Norseman, 16 Apr. 1995, *B.J. Lepschi* 554 & *T.R. Lally* (CANB, PERTH).

Distribution and habitat. Endemic to Western Australia, restricted to the goldfields, from east of Norseman westwards to Bullabulling, especially abundant in the area bounded by Mt Day, south of Norseman and Coolgardie (Figure 2). Its eastern and western distributional limits are poorly known. It grows in clay-loams usually in broadly undulating landscapes. Recorded associated eucalypt species include *E. cylindrocarpa* Blakely, *E. dundasii* Maiden, *E. tenuis* Brooker & Hopper, *E. urna* Nicolle, *E. salubris* F. Muell., *E. salmonophloia* F. Muell., *E. pterocarpa* P. Lang ex C. Gardner and *E. protensa* L. Johnson & K. Hill.

Flowering period. Poorly known.

Conservation status. Widespread and fairly abundant in the uncleared vegetation between Hyden and Norseman and not considered to be under any short-term threat.

Etymology. From the Latin *prolixus* – stretched out long, with two intended meanings; referring firstly to the slender mallet habit of this species and secondly referring to the more elongate fruits compared to *E. calycogona*.

Notes and affinities. E. prolixa is distinguished from *E. calycogona* by the steep-branched mallet habit and the very elongate but slender fruits, longer even than in *E. calycogona* subsp. *spaffordii*, but not as coarse and lacking the prominent ribbing (i.e. not winged) on buds and fruits of that subspecies. In the southern part of its range, *E. prolixa* and *E. calycogona* (subsp. *calycogona*) are sympatric, although usually parapatric at a more local level, probably due to slight differences in preferred habitat, *E. prolixa* usually occurring on locally somewhat heavier soils than *E. calycogona*. No intergrades or hybrids between the two species are known.

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Three new taxa of *Eucalyptus* subgenus *Eudesmia* (Myrtaceae) from Queensland and Western Australia

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Abstract

Nicolle, D. Three new taxa of *Eucalyptus* subgenus *Eudesmia* (Myrtaceae) from Queensland and Western Australia. *Nuytsia* 13(2): 317–329 (2000). Two new species and a new subspecies of *Eucalyptus* subgenus *Eudesmia* (R. Br.) L.A.S. Johnson & K.D. Hill (Myrtaceae) are described. One of the new species, *Eucalyptus chartaboma* Nicolle, is endemic to the central northern region of Queensland. It is related to *E. miniata* A. Cunn. ex Schauer, differing in the flaky-papery, light-coloured persistent bark, the narrower adult leaves and the larger, ovoid fruits. The other new species, *E. extrica* Nicolle, is endemic to the southern coast of Western Australia. It is related to *E. pleurocarpa* Schauer, differing in the non-pruinose branchlets, adult leaves, buds and fruits, the longer and narrower, broad-lanceolate, green adult leaves, the slightly longer peduncles and pedicels and the ovoid fruits. The taxonomic status of the previously confused *E. tetragona* (R. Br.) F. Muell. is discussed. A new subspecies of *E. gittinsii* Brooker & Blaxell (subsp. *illucida* Nicolle) is described, endemic to the northern wheatbelt and adjacent coastal sandplain region of Western Australia. It differs from the typical subspecies in the dull, pale green to slightly blue-green, thinner adult leaves, the more effuse habit and the generally less ribbed buds and fruits. Distribution maps, keys, tables and representative illustrations for the new taxa are provided.

Introduction

Eucalyptus L'Hérit. subgenus *Eudesmia* (R. Br.) L.A.S. Johnson & K.D. Hill consists of approximately 25 taxa (species and subspecies), distributed in all mainland Australian States except Victoria. The phylogeny of *Eudesmia* is poorly known in comparison to the other major eucalypt groups, viz. *Corymbia* L.A.S. Johnson & K.D. Hill and *Eucalyptus* informal subgenera *Symphyomyrtus* and *Monocalyptus* (Pryor & Johnson 1971). Although *Eudesmia* is a small and well defined subgenus, it shows a high amount of diversity and distinctiveness between species. Limited morphological (e.g. Hill 1998) and molecular studies (Steane *et al.*, unpublished) indicate there are between two and eight major lineages in the subgenus that are relatively basal in phylogeny compared to related *Eucalyptus* taxa and *Angophora* Cav. taxa. Further studies are needed to establish the phylogeny of *Eudesmia* between the subgenus and species level. Hill & Johnson (1998) provided an informal classification of the subgenus at sectional, series and subseries rank, following the system used by Pryor & Johnson (1971). Formal names at series rank only have been used here because of the uncertainty regarding natural sections within *Eudesmia*.

Two of the taxa described here (*E. gittinsii* subsp. *illucida* and *E. chartaboma*) remained unrecognized in a recent review of the subgenus by Hill & Johnson (1998). The third taxon described here (*E. extrica*) had previously been considered to represent a distinct taxon (Brooker & Kleinig, 1988), or had been included under *E. tetragona* (Hill & Johnson, 1998), because of confusion regarding the identity of *E. tetragona*.

Taxonomy

Eucalyptus series **Heteroptera** Maiden, Critical Revision of the Genus Eucalyptus 7: 115 (1925). *Type: Eucalyptus tetragona* (R. Br.) F. Muell. [= intergrade between *E. extrica* Nicolle and *E. pleurocarpa* Schauer].

A series of seven species endemic to the southern part of Western Australia (except *E. eudesmioides* which also extends north to Warroora Station at 23° 30'S), distinguished within subgenus *Eudesmia* by the 3-flowered umbellasters, staminal filaments in four fascicles (bundles) and the creamy-white, or in *E. erythrocorys*, bright yellow, staminal filaments.

Eucalytus eudesmioides is here taken to include the recently described *E. pallida* L.A.S. Johnson & K.D. Hill which I believe is not specifically distinct. Variably glaucous populations of *E. eudesmioides* do occur west of the Great Northern Highway in the Shark Bay region and also in the Kennedy Range, and these may warrant subspecific recognition. However, the type of *E. pallida*, and other individuals from the type locality and elsewhere along the Great Northern Highway north of Geraldton, are not prominently glaucous and are morphologically very similar to *E. eudesmioides* occurring elsewhere.

E. tetragona is no longer recognized as a species within the series but is instead considered to represent intergrades between *E. pleurocarpa* and *E. extrica* as discussed under the latter.

Key to the species of *Eucalyptus* series *Heteroptera*

1. Staminal filaments sulphur yellow, operculum red ..... **E. erythrocorys**
1. Staminal filaments creamy-white, operculum green to yellow or pruinose
  2. Juvenile leaves sessile or sub-sessile, adult leaves small, 6–22 mm wide
    3. Adult leaves dull ..... **E. eudesmioides**
    3. Adult leaves glossy ..... **E. selachiana**
  2. Juvenile leaves petiolate, adult leaves large, 15–75 mm wide
    4. Branchlets, adult leaves, buds and fruits not pruinose
      5. Fruit <12 mm diameter, ± square in transverse section ..... **E. gittinsii**
      5. Fruit >13 mm diameter, terete in transverse section ..... **E. extrica**
    4. Branchlets, adult leaves, buds and fruits pruinose
      6. Leaves on mature plant lanceolate, 15–35 mm wide ..... **E. conveniens**
      6. Leaves on mature plant elliptic to ovate, 30–75 mm wide ..... **E. pleurocarpa**

1. Eucalyptus gittinsii Brooker & Blaxell, *Nuytsia* 2(4): 228 (1978). *Type:* 67 km south of 'Billabong Roadhouse', Wannoo, Highway 1 (27° 30'S, 114° 45'E), Western Australia, 9 October 1975, *D.F. Blaxell* W75/113 (*holo:* NSW; *iso:* CANB, K, PERTH 01389777, 01389785, 01389793).

Notes. E. gittinsii is a Western Australian endemic species with two disjunct occurrences on the west coast sandplains: between Geraldton and Wannoo (subsp. *gittinsii*) and between the Moore River and Three Springs (subsp. *illucida*). *E. gittinsii* is distinguished within *E.* ser. *Heteroptera* by the non-glaucous mature adult leaves, buds and fruits; the white staminal filaments; the medium-sized adult leaves and fruits; the prominent persistent sepals on the buds and fruits and the square (in transverse section) fruits.

Key to the subspecies of *Eucalyptus gittinsii*

1. Adult leaves glossy, green ..... subsp. **gittinsii**
1. Adult leaves dull, light green to blue-green ..... subsp. **illucida**

1. Eucalyptus gittinsii subsp. **illucida** Nicolle, *subsp. nov.*

A subspecie typica foliis adultis pallido-viridibus, hebetibus, alabastris fructibusque minus costatis differt.

Typus: Hi-Valley (Williams' Farm), Tootbardi Rd, north of Badgingarra, Western Australia, 21 September 1982, *M.I.H. Brooker* 7651 (*holo:* PERTH 01366262; *iso:* PERTH 01366297).

Mallee, often of sprawling or effuse habit, 2–4 m tall. *Lignotubers* present. *Bark* completely smooth, grey over tan, or with some rough, persistent ribbony bark on the lower stems. *Branchlets* not glaucous, pith glands absent. *Cotyledons* reniform. *Seedling leaves* opposite for 1–3 pairs then alternate, petiolate, ovate-elliptical, dull, grey-green, prominently hairy. *Adult leaves* alternate, petiolate, broad-lanceolate, 70–110 mm long, 20–35 mm wide, concolorous, not glaucous, dull, pale green to blue-green; reticulation sparse to moderate, with numerous island oil glands, lateral veins at 35–50° from midrib. *Inflorescences* axillary, unbranched, 3-flowered; peduncles ± flattened and broadening towards pedicels, 6–12 mm long; pedicels 6–8 mm long. *Buds* non-glaucous, clavate, 5–7 mm long, 4-6 mm wide; hypanthium obconical, tapering to pedicel, with four longitudinal ribs extending to prominent teeth-like sepals; operculum flattened-hemispherical to obtusely conical, apiculate to rounded, ± equal in width to hypanthium, smooth, pale green. *Flowers* white. *Stamens* conspicuously bundled in four clusters, inflexed, all fertile; anthers versatile, oblong to ovoid, opening by longitudinal slits. *Ovules* in 4(6) vertical rows. *Fruits* not glaucous, oblong to somewhat barrel-shaped, sepals persisting as teeth on rim, 12–16 mm long, 9–11 mm wide, with four weak longitudinal ribs, ± square in transverse section; operculum scar very narrow and partly obscured by sepals; disc descending, 1.5–2.5 mm wide; valves 3, base enclosed, tips to around rim level. *Seeds* irregularly pyramidal, 3–5 mm long, dull, dark grey-brown to almost black, with a narrow, very thin wing extending around the dorsal edge; chaff glossy, red-brown. (Figures 1, 2)

Selected specimens examined. WESTERN AUSTRALIA (north to south): *c.* 10 miles [16 km] SW of Three Springs towards Eneabba, 7 Jan. 1970, *M.I.H. Brooker* 2359 (PERTH); Coomallo Nature Reserve, top of mesa near gas installation, *c.* 500 m to SE, 11 Sep. 1993, *S. Patrick* 1531 (PERTH); Lesueur National Park, 1 km N of Mt Michaud, on N/S line bisecting Mt Lesueur–Mt Michaud, on old track, 30°09'15"S, 115°11'28"E, 7 Feb. 1993, *B. Evans* WE 467 (PERTH); just S of Alexander Morrison National Park, 7 km S of Coorow–Green Head road along Tootbardi Rd, 24 Jan. 1979, *M.D. Crisp* 5450

Figure 1. Holotype of *Eucalyptus gittinsii* subsp. *illucida* (*M.I.H. Brooker* 7651).

(CANB, NSW, PERTH); NW of Dandaragan, 30°4'46"S, 115°34'23"E, 25 Jan. 1996, *D. Nicolle* 1651 (PERTH); S side of Mt Misery at base of hill, 30°41'50"S, 115°36'53"E, 11 Dec. 1992, *D. Nicolle* 252(AD); 3 km S of Yandan Rd on Brand Highway, 9 Apr. 1984, *M.I.H. Brooker* 8502 (AD, CANB, PERTH).

Distribution and habitat. Endemic to Western Australia, restricted to the northern wheatbelt and nearby coastal sandplains, from the Moore River in the south, northwards to near Three Springs (Figure 3). It usually occurs in white or grey sands or shallow gravelly sands over laterite. Associated species include *Corymbia calophylla* (Lindl.) K.D. Hill & L.A.S. Johnson, *Eucalyptus falcata* Turcz. *sens. lat.*, *E. arachnaea* Brooker & Hopper (subsp. *arachnaea*), *E. drummondii* Benth., *E. leprophloia* Brooker & Hopper, *E. pleurocarpa* Schauer, *E. macrocarpa* Hook. (subspp. *elachantha* Brooker & Hopper and *macrocarpa*), *E. albida* Maiden & Blakely, *E. rigidula* Maiden and *E. abdita* Brooker & Hopper.

Flowering period. December to March.

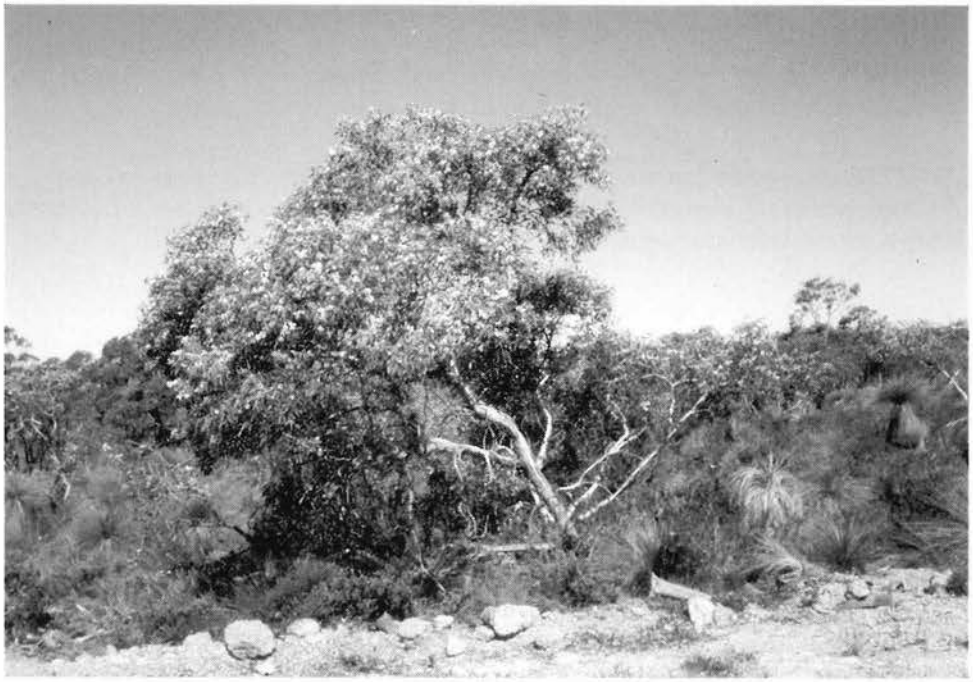

Figure 2. *Eucalyptus gittinsii* subsp. *illucida* habit north-west of Dandaragan.

Conservation status. Of scattered occurrence but locally abundant and not considered to be threatened. Known from several conserved areas including Lesueur National Park and Coomallo Nature Reserve.

Etymology. From the Latin *il* – not and *lucidus* – shining, bright, referring to the dull adult leaves compared to the glossy leaves of subsp. *gittinsii*.

Notes and affinities. Distinguished from subsp. *gittinsii* in the dull, pale green to slightly blue-green adult leaves (glossy and yellow-green to green in subsp. *gittinsii*). *E. gittinsii* subsp. *illucida* also differs from subsp. *gittinsii* in the generally more effuse habit, thinner adult leaves and the usually less coarse buds and fruits with less prominent ribbing.

E. gittinsii subsp. *illucida* is geographically separate from subsp. *gittinsii*, the nearest populations of the former occurring some 200 km to the south of the latter. No intermediates are known.

Intergrades are known between *E. gittinsii* subsp. *illucida* and *E. eudesmioides* F. Muell. (e.g. *D.F. Blaxell 1996)* but not between *E. gittinsii* subsp. *gittinsii* and *E. eudesmioides*, although the latter two are sometimes associated in the field.

E. conveniens L.A.S. Johnson & K.D. Hill is thought to be of stabilized hybrid origin (Hill & Johnson 1998), with *E. gittinsii* (subsp. *illucida)* and *E. pleurocarpa* being the hypothesized parents. It is possible that the southern race of *E. gittinsii* (subsp. *illucida*) has differentiated from the northern, type race because of long term genetic contact with *E. pleurocarpa* and later *E. conveniens* and, therefore,

may also ultimately be of complex hybrid origin. If this is the case, the populations attributed to *E. gittinsii* subsp. *illucida* have certainly now stabilized, as there is no evidence of current hybridization between *E. gittinsii* subsp. *illucida* and *E. conveniens* or *E. pleurocarpa*. A more likely hypothesis for the origin of *E. gittinsii* subsp. *illucida* is that it and the northern populations (subsp. *gittinsii*), through long term isolation, differentiated from one another because of differing environmental pressures; subsp. *gittinsii* usually occurring on much deeper, red, aeolian sands.

E. gittinsii subsp. *illucida* is superficially similar to *E. extrica*, especially in leaf morphology, but can be distinguished by the complete lack of pruinosity and the smaller, more slender fruits that are prominently square in transverse section.

2. Eucalyptus extrica Nicolle, *sp. nov.*

Eucalyptus sp. B, "Eastern tallerack" of Brooker & Kleinig (1990).

Affinis *E. pleurocarpae* sed characteribus sequentibus distinguitur: ramulis, foliis adultis, alabastris fructibusque non-pruinosis; foliis adultis longioribus angustioribus, late-lanceolatis et viridibus; pedunculis et pedicellis longioribus; fructibus ovoideis differt.

Typus: c. 3 km north-east of Howick Hill, in location 251, Western Australia, 21 September 1968, *A.E. Orchard* 1121 (*holo:* PERTH 01441779; *iso:* AD, CANB, L).

Spreading, usually effuse *mallee*, 1–4 m tall; new growth usually lightly glaucous. *Lignotubers* present. *Bark* smooth, light grey over tan to brown, sometimes with some rough, persistent ribbony bark on the lower stems. *Branchlets* strongly quadrangular, not glaucous, pith glands absent. *Cotyledons* reniform. *Seedling leaves* opposite for many pairs, petiolate, elliptic to ovate, dull, grey-green, prominently hairy at first. *Adult leaves* alternate, petiolate, broad-lanceolate and sometimes falcate, 75–140 mm long, 25–50 mm wide, concolorous, not glaucous, dull, pale green to slightly blue-green; reticulation sparse to moderate, with scattered, mostly island, oil glands, lateral veins at 35–50° from midrib; petiole flattened. *Inflorescences* axillary, unbranched, 3-flowered; peduncles ± flattened and broadening towards pedicels, 12–20 mm long; pedicels flattened, 11–15 mm long. *Buds* not glaucous, clavate, 6–9 mm long, 4–6 mm wide; hypanthium obconical, tapering to pedicel, with four longitudinal ribs, most prominent at the base of the hypanthium, sepals present but not conspicuous; operculum flattened-hemispherical, rounded, ± equal in width to hypanthium, smooth, pale green to yellow. *Flowers* white. *Stamens* conspicuously bundled in four clusters, inflexed, all fertile; anthers versatile, oblong, opening by longitudinal slits. *Ovules* in 4–6 vertical rows. *Fruits* often conspicuous in or above crown, glossy, green to yellow-orange, not glaucous, ovoid to somewhat barrel-shaped, sepals sometimes persisting as inconspicuous teeth on rim, 10–22 mm long, 13–17 mm wide, with four very weak to prominent longitudinal ribs, terete in transverse section; operculum scar narrow and obscured by sepals; disc descending, 2–4 mm wide; valves 3 or 4, base enclosed, tips below rim level. *Seeds* irregularly pyramidal, 5–6.5 mm long, dull, dark grey-brown to almost black, with a narrow, thin wing extending around the dorsal edge; chaff glossy, dark red-brown.

Selected specimens examined. WESTERN AUSTRALIA (west to east): near Condingup, 33°46'56"S, 122°31'22"E, 8 Dec. 1992, *D. Nicolle* 171 (PERTH); 76.6 miles [123 km] E of Esperance, 25 Mar. 1968, *G.M. Chippendale* 402 (AD, PERTH); sandy slope on NW side of Howick Hill, *c.* 1 km from summit, 8 Nov. 1983, *L. Haegi* 2610 & *P.S. Short* (AD, PERTH); scrub N of Fisheries Rd, *c.* 10 km ESE of Howick Hill, 17 Sep. 1968, *E.N.S. Jackson* 1233 (AD, CANB, PERTH, K); 2.5 km S of Tower Peak, Ragged

Range, 6 Jan. 1979, *Crisp* 4827 (CANB, NSW, PERTH); near Israelite Bay, 33°35'06"S, 123°34'42"E, 21 Nov. 1994, *D. Nicolle* 1092 (PERTH).

Distribution and habitat. Endemic to Western Australia, from the Condingup area in the west, eastwards to at least Israelite Bay (Figure 3). It grows in white sand over limestone. Associated species include *Eucalyptus incrassata* Labill. *sens. lat.*, *E. cooperiana* F. Muell., *E. micranthera* F. Muell. ex Benth., *E. discreta* Brooker, *E. leptocalyx* Blakely, *E. tetraptera* Turcz., *E. conglobata* (R. Br. ex Benth.) Maiden and *E. lehmannii* (Schauer) Benth. The distribution of *E. extrica* is more coastal than that of its closest postulated relative, *E. pleurocarpa*, and the former is only known within 35 km of the coast. *E. pleurocarpa,* which occurs largely to the west, extends more inland, at least to Peak Charles and north-west of Lake King. The eastern distributional limit of *E. extrica* is unknown; it possibly occurs further east of Israelite Bay in inaccessible and poorly surveyed coastal mallee shrublands.

Flowering period. January to April.

Conservation status. Abundant within its known distribution and well represented in conserved areas such as Cape Arid National Park.

Etymology. From the Latin *extrico* – disentangled, free, referring to the identity of this species being previously confused with that of *E. tetragona*.

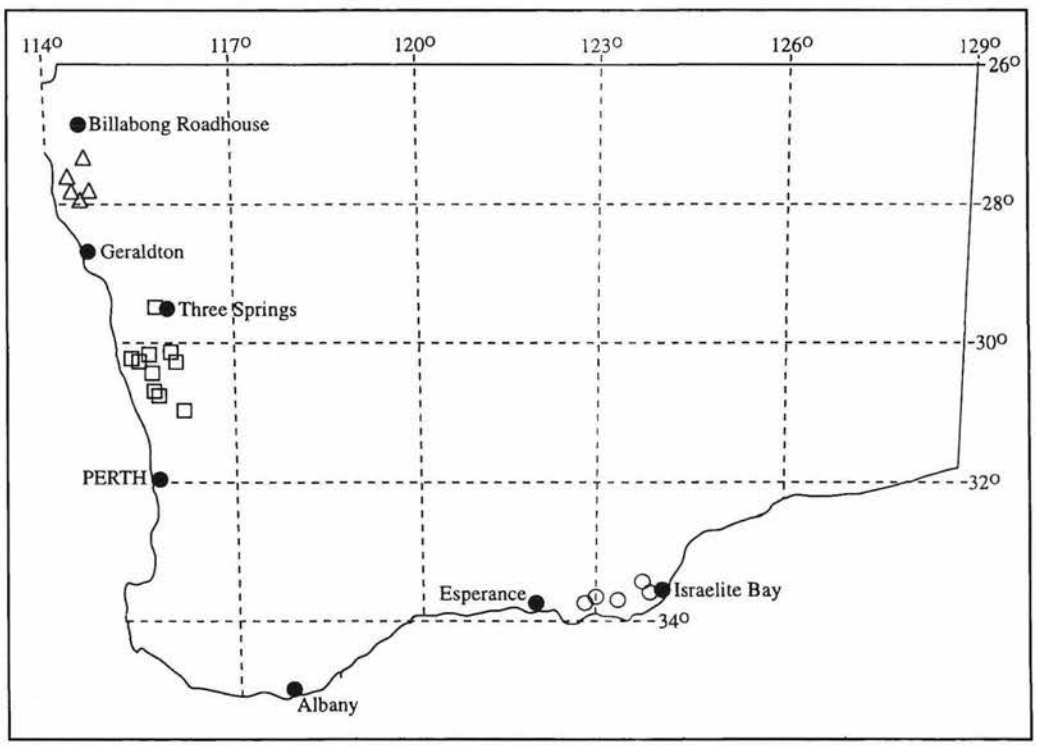

Figure 3. Map of Western Australia below 26°S, showing the distribution of *Eucalyptus gittinsii* subspp. *gittinsii* △ and *illucida* □ and *Eucalyptus extrica* ○.

Notes and affinities. Distinguished from *E. pleurocarpa* in the non-pruinose branchlets, mature adult leaves, buds and fruits (all strongly pruinose in *E. pleurocarpa*); the longer and narrower, broad-lanceolate, green adult leaves (elliptic to ovate and grey in *E. pleurocarpa*); the slightly longer peduncles and pedicels; and the ovoid fruits (globoid in *E. pleurocarpa*).

This taxon has in the past been referred to as the "green" (Chippendale, 1988) or "non-glaucous" (Elliot & Jones, 1986) variant of *E. tetragona*. The type of *E. tetragona* is now recognized as representing an intergrade between the common and well-known tallerack (*E. pleurocarpa,* previously erroneously referred to as *E. tetragona*), and the less widespread "green variant", *E. extrica.*

Intergrades between *E. extrica* and *E. pleurocarpa* occur over a east-west range of about 30 km between the western end of Cape Le Grand National Park and Condingup, with the type of *E. tetragona* from Lucky Bay in Cape Le Grand National Park. These intergrades are recognizable by their crown of lightly glaucous leaves.

E. extrica is also superficially similar to *E. gittinsii* subsp. *illucida*, especially in adult leaf morphology. It can be distinguished by the generally coarser adult leaves; the longer peduncles and pedicels; the less prominent sepals on the buds and fruits and the larger, ovoid fruits that are terete in transverse section.

Eucalyptus series **Miniatae** Blakely, Key Eucalypts 14, 72 (1934). *Type: Eucalyptus miniata* A. Cunn. ex Schauer.

A series of five species of tropical Australia, distinguished within *Eucalyptus* subgenus *Eudesmia* by the persistent bark on the trunk(s), the 7- or >7-flowered umbellasters, and especially by the bright orange staminal filaments that occur in a continuous ring. Orange flowers are known elsewhere in the genus (occasional individuals of *E. petiolaris* (Boland) K. Rule have dull orange or apricot-coloured filaments), and in *Corymbia* K.D. Hill & L.A.S. Johnson (*C. ficifolia* (F. Muell.) K.D. Hill & L.A.S. Johnson often has orange-vermilion staminal filaments); however, they are never consistent amongst all individuals within a species nor the clear orange colour of those seen in all species of the *Miniatae*.

Key to the species of *Eucalyptus* series *Miniatae*

1. Umbellasters >7-flowered
   2. Whole plant strongly glaucous ..... **E. ceracea**
   2. No adult structures glaucous ..... **E. phoenicea**
1. Umbellasters 7-flowered
   3. Branchlets, buds and fruits not glaucous ..... **E. gigantangion**
   3. Branchlets, buds and fruits glaucous
      4. Fruit 45–65 mm long, 35–45 mm wide. Persistent bark papery ..... **E. chartaboma**
      4. Fruit 30–40 mm long, 18–28 mm wide. Persistent bark fibrous ..... **E. miniata**

3. Eucalyptus chartaboma Nicolle, *sp. nov.*

Affinis *E. miniatae* sed characteribus sequentibus distinguitur: cortex in trunco pallidior squamato-chartaceus, folia adulta angustiora, fructus majores, ovoidei differt.

Typus: Mount Garnet to Lappa Junction Road, north of Mount Garnet, 17°32'26"S, 144°57'21"E, Queensland, 2 October 1998, *D. Nicolle* 2509 (*holo:* BRI; *iso:* CANB).

Tree, sometimes several-stemmed, 6–18 m tall. *Lignotubers* present. *Bark* rough for *c.* 3 m, thick, soft, flaky-papery, pinkish-brown to yellowish-brown to whitish, then smooth above, pale creamy-yellow to white. *Branchlets* glaucous, pith glands absent. *Cotyledons* reniform. *Seedling leaves* opposite for a few pairs then alternate, petiolate, ovate to elliptic, dull, green, both seedling leaves and stems prominently hairy. *Adult leaves* alternate, petiolate, narrow-lanceolate to lanceolate, 85–165 mm long, 10–24 mm wide, glabrous, discolorous, dull, pale green; reticulation dense, with numerous island and intersectional oil glands, lateral veins at 50–65° from midrib. *Inflorescences* axillary, unbranched, 7-flowered; peduncles thick, flattened, 16–25 mm long; pedicels to 3 mm long. *Buds* glaucous, ovoid, 17–20 mm long, 8–10 mm wide; hypanthium pyriform, tapering to pedicel, longitudinally ribbed; operculum hemispherical to conical, rounded, equal in width to hypanthium, smooth to ribbed, both opercula present to anthesis. *Flowers* bright orange. *Stamens* inflexed, all fertile; not bundled (in a continuous ring); anthers versatile, oblong, opening by longitudinal slits. *Ovules* in 4 vertical rows. *Fruits* sessile, glaucous, especially when young, ovoid, 45–65 mm long, 35–45 mm wide, with strong irregular longitudinal ribs; disc steeply descending, to 20 mm wide; valves (3)4, deeply enclosed. *Seeds* ovoid and angular, 5–8 mm long, ± dull, dark grey to black, hilum ventral, reticulum very finely pitted; chaff orange to brown. (Figures 4–6)

Figure 4. Holotype of *Eucalyptus chartaboma* (*D. Nicolle* 2509).

Figure 5. *Eucalyptus chartaboma* habit from between Pentland and Burra, Queensland.

Figure 6. Bark on lower trunk of *Eucalyptus chartaboma*.

Selected specimens examined. QUEENSLAND (south to north): 8 miles [13 km] SW of Pentland Township, 21 June 1953, *R.A. Perry* 3583 (AD, BRI); headwaters of Bett's Creek, White Mountains National Park, W of Charters Towers, 8 Apr. 1992, *A.R. Bean* 4255 (BRI); near Croydon on the Gulf Developmental road, 18°13'17"S, 142°48'07"E, 15 Apr. 1995, *D. Nicolle* 1327 (AD); 85 km W of Georgetown, W of Gilbert River, 8 Mar. 1990, *M.I.H. Brooker* 10416 (BRI, CANB, DNA, MEL, NSW); "Mount Surprise", beside Six Mile Rd, *c.* 2 km from O'Brians Creek crossing, 8 Apr. 1992, *I.G. Champion* 635 (BRI); Mt Eliza, 8 km NW of Mt Surprise, 20 Jan. 1993, *A.R. Bean* 5499 & *P.I. Forster* (BRI); Stannary Hills Road 8 miles [13 km] S of Mutchilba, 31 May 1971, *G. Stocker* 728 (BRI); 20.4 miles [33 km] from Walsh's River crossing towards Wrotham Park, 27 Jan. 1972, *M.I.H. Brooker* 3373 (BRI); 36 km from the Walsh River crossing on the Mungana–Wrotham Park road, 7 Feb. 1980, *J.R. Clarkson* 2810 (BRI, CANB, NSW, Mo); 138 miles [222 km] SW of Cooktown, 171 miles [275 km] SE of mouth of Mitchell River, 19 Aug. 1966, *Story* 8014 (BRI, CANB, K).

Distribution and habitat. Endemic to Queensland, occurring from the Croydon area east to near Einasleigh and Mount Garnet and north to Maitland Downs on southern Cape York Peninsula (Figure 7). There is an apparently disjunct occurrence to the south in the Burra–Pentland area. Subsequent field survey will determine if the southern population is really disjunct or if it is an artefact of inadequate field survey in the area between the two populations. *E. chartaboma* usually occurs on locally elevated sites in gritty sands or gravelly soils. Recorded associated species include *Corymbia leichhardtii* (Bailey) K.D. Hill & L.A.S. Johnson, *C. ligans* K.D. Hill & L.A.S. Johnson (subsp. *novacastrensis* K.D. Hill & L.A.S. Johnson), *C. pocillum* (D.J. Carr & S.G.M. Carr) K.D. Hill & L.A.S. Johnson, *C. "serendipita", C. stockeri* (D.J. Carr & S.G.M. Carr) K.D. Hill & L.A.S. Johnson, *Eucalyptus crebra* F. Muell., *E. persistens* L. Johnson & K. Hill, and *E. tetrodonta* F. Muell.

Eucalyptus miniata, as now circumscribed, extends only into the far north-west of Queensland, west of the Burke Developmental Road between Normanton and Cloncurry.

Flowering period. February to May.

Conservation status. Widespread and not considered to be at risk. Recorded from White Mountains National Park in the south of its distribution.

Etymology. From the Greek *charte* – of paper and *bomos* – base, referring to the papery persistent bark on the trunk(s), especially compared to the other species of *E.* ser. *Miniatae*.

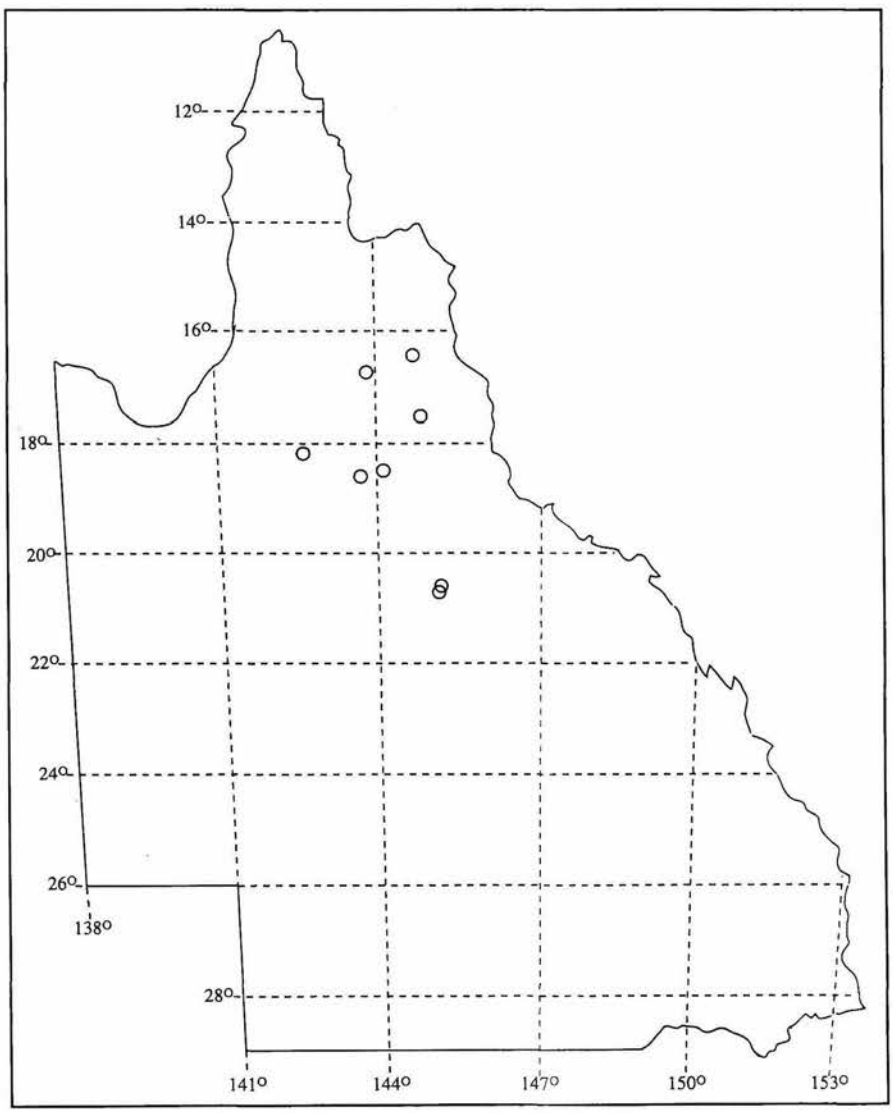

Figure 7. Distribution of *Eucalyptus chartaboma* in Queensland.

Notes and affinities. Distinguished from *E. miniata* by the flaky-papery, paler-coloured rough bark, the narrower adult leaves and the larger, ovoid fruits. Distinguished from *E. gigantangion* L. Johnson & K. Hill by the flaky-papery, paler-coloured persistent rough bark, the glaucous branchlets, buds and fruits, the autumn flowering time and the ovoid, ribbed fruits. The main characters distinguishing these three species are shown in Table 1.

A distinctive species in the field because of its flaky-papery rough bark on the lower trunk (Figure 6), bright orange flowers and massive fruits, which are probably the longest in the genus, possibly equalled only by the fruits of the related *E. gigantangion* and the unrelated *E. pyriformis* Turcz. and *E. youngiana* F. Muell.

On favourable sites in the wetter, northern part of its range, *E. miniata* grows up to 30 metres tall, much larger than *E. chartaboma* is known to. On less favourable sites in areas of lower rainfall, *E. miniata* is a lower woodland tree and can be indistinguishable in habit from *E. chartaboma.*

Table 1. Differentiating characters between *Eucalyptus minata, E. chartaboma* and *E. gigantangion.*

	E. minata	***E. chartaboma***	***E. gigantangion***
Distribution	tropical WA, NT, just extending into Qld	central northern Qld	Arnhem Land plateau, NT, parapatric with *E. miniata*
Persistent bark	fibrous (long fibres), grey-brown to reddish brown	flaky-papery (small thin scales), white to yellowish brown to pinkish brown	fibrous (long fibres), grey-brown to reddish brown
Adult leaves	broad-lanceolate to lanceolate, 20–40 mm wide	narrow-lanceolate to lanceolate, 10–24 mm wide	narrow-lanceolate to lanceolate, 14–23 mm wide
Pruinosity	strongly glaucous on branchlets, buds and fruits	strongly glaucousa on branchlets, buds and fruits	absent
Flowering period	autumn to early winter	autumn	late winter to early spring
Fruit shape	cylindrical-ovoid	ovoid	urceolate with a distinct neck
Fruit size	30–40 mm long 18–28 mm wide	45–65 mm long 35–45 mm wide	45–70 mm long 30–50 mm wide
Fruit ribbing	prominently to extremely ribbed	prominently ribbed	almost smooth to weakly ribbed

Acknowledgements

I would like to thank staff at the State Herbarium of South Australia for support and continuing access to the herbarium, Neville Marchant and staff at the State Herbarium of Western Australia for efficiently and enthusiastically making loan specimens available to me and the State Herbarium of Queensland for assisting with specimen loans. Thanks also to Ian Brooker (CSIRO, Canberra) for many discussions and correcting the Latin diagnoses and Malcolm French of Perth for his welcomed hospitality and field assistance in Western Australia.

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Brachysola (Lamiaceae: Prostantheroideae), a new Western Australian genus

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Abstract

Rye, B.L. *Brachysola* (Lamiaceae: Prostantheroideae), a new Western Australian genus. *Nuytsia* 13(2):331–338(2000). *Brachysola* Rye is described as a new genus, based on *Chloanthes* sect. *Brachysolenia* F. Muell. but with a simplified name. It belongs in Lamiaceae subfamily Prostantheroideae, resembling the genera of tribe Westringieae in its fruit but appearing more similar to tribe Chloantheae in its inflorescence, and is unique in having stellate hairs. *Brachysola* comprises two species and occurs in the south-west of Western Australia. A lectotype is chosen for the type species, *Brachysola halganiacea* (F. Muell.) Rye, which is known from only three collections and has been placed on the Priority Flora List. The other species, reinstated here with the new combination *Brachysola coerulea* (F. Muell. & Tate) Rye, is known from many specimens over a much wider area.

Introduction

The new genus described here was first recognized as a distinct entity by Mueller (1876), who named it *Chloanthes* sect. *Brachysolenia*, distinguishing its only known member, *Chloanthes halganiacea*, from typical *Chloanthes* species by its different corolla shape. Diels & Pritzel (1904) transferred the section to *Pityrodia* R. Br. and recognized two species. Munir (1979) recognized only one species and did not maintain the section. However, he noted several further unique features of this group in comparison with other species placed in *Pityrodia,* these being the absence of hairs on the ovary and inside of the corolla tube, the lack of basal appendages on the anthers and anther dehiscence occurring "sooner after the flowers open than in other species" Munir (1979: 38).

Recent work has shown that this plant group is very distinct and needs to be removed from *Pityrodia*. A cladistic study based on morphological characters (Cantino 1992) has indicated that *Pityrodia*, as traditionally accepted, is polyphyletic, with *Pityrodia halganiacea sens. lat.* (i.e. section *Brachysolenia*) forming a sister group to all other members of tribe Chloantheae and being closer than they are to tribe Westringieae. This has been strongly supported by a cladistic study based on DNA sequences (Olmstead *et al.* 1999), which has provided a more objective indication of relationships. Even after removal of sect. *Brachysolenia, Pityrodia* appears to be polyphyletic, the cladistic studies suggesting that *Pityrodia*, or at least part of it, needs to be united with *Chloanthes* R. Br. and *Hemiphora* (F. Muell.) F. Muell.

Section *Brachysolenia* is raised here to the generic level and its name shortened to make it easier to pronounce. The new genus belongs in Lamiaceae subfamily Prostantheroideae (often previously referred to by its synonym Chloanthoideae) and appears to be somewhat intermediate in morphology between the two tribes Chloantheae and Westringieae. However the molecular data (Olmstead *et al.* 1999) clearly place the genus in tribe Choantheae.

Taxonomy

Brachysola Rye, *nom. et stat. nov.*

Chloanthes sect. *Brachysolenia* F. Muell. (Mueller 1876: 14–15). – *Pityrodia* sect. *Brachysolenia* (F. Muell.) E. Pritz. (Diels & Pritzel 1904: 515). *Type: Chloanthes halganiacea* F. Muell. [= *Brachysola halganiacea* (F. Muell.) Rye].

Shrubs with non-glandular stellate hairs on the stems and leaves, and with a mixture of non-glandular stellate hairs and simple glandular hairs on vegetative parts of the inflorescence and on the outside of the flowers; stellate hairs with the branches spreading and usually longer than the patent stalk; glandular hairs patent, the stalk comprised of a number of large cells, the terminal gland forming a capitate apex. *Young stems* terete, densely hairy. *Leaves* opposite or in near-whorls, sessile, densely hairy on undersurface. *Inflorescence* a terminal panicle of 1–7-flowered cymes. *Calyx* 5-lobed, with a similar indumentum to that of the pedicels outside and distally inside (on the upper part of the lobes), glabrous inside the tube and base of the lobes, persistent in fruit but scarcely enlarged; lobes more or less triangular, about as long as or longer than the tube, acute. *Corolla* 5-lobed, broader than long when fully opened, largely bluish purple with the base more deeply coloured surrounding a yellow viscid centre; tube shorter than the lobes, with a narrow tubular base and a broad spreading upper portion, glabrous inside; lobes spreading, the lowest (abaxial) one largest, the other two pairs of lobes about equal, variable in shape, commonly broadly ovate to broadly obovate, obtuse. *Stamens* 4, somewhat didynamous, the lower pair usually with a slightly longer filament than the upper pair, inserted almost at the base of the corolla within the narrow basal portion of the tube, glabrous, yellow; filament somewhat thickened above the middle but otherwise filiform; anther of two broad parallel lobes, dorsifixed near the base, lacking appendages, each lobe longitudinally dehiscent. *Ovary* 4-celled, with 1 ovule in each cell, glabrous, with scattered sessile glands on the summit, dark purple. *Style* terminal, arising at summit of ovary but its insertion point becoming exceeded by the 4 fruitlets surrounding it at maturity, long-exserted, filiform, 2-lobed at apex, glabrous, purplish; lobes closely adherent at first, separating at maturity, each with a terminal stigma. *Fruit* a schizocarp, distinctly 4-lobed, separating into four 1-seeded fruitlets (mericarps), enclosed in the calyx; mericarps indehiscent, hard, the outer surface reticulate-patterned and brown turning to black, with a paler hard compartment on the inside enclosing soft tissue; seeds somewhat flattened and strongly incurved around the inner compartment, soft, white.

Size and distribution. A genus of two species, restricted to the south-west of Western Australia. It occurs in the central-eastern part of the South West Botanical Province and in the western part of the South-western Interzone, its northernmost known extent not far south of the Eremean Botanical Province. Figure 1 shows the distributions of both species.

Etymology. From the Greek words *brachys* – short and *solen* – pipe or channel, referring to the short tubular basal portion of the floral tube. To make it less cumbersome, this name has been shortened by removal of two syllables from *Brachysolenia* to *Brachysola*.

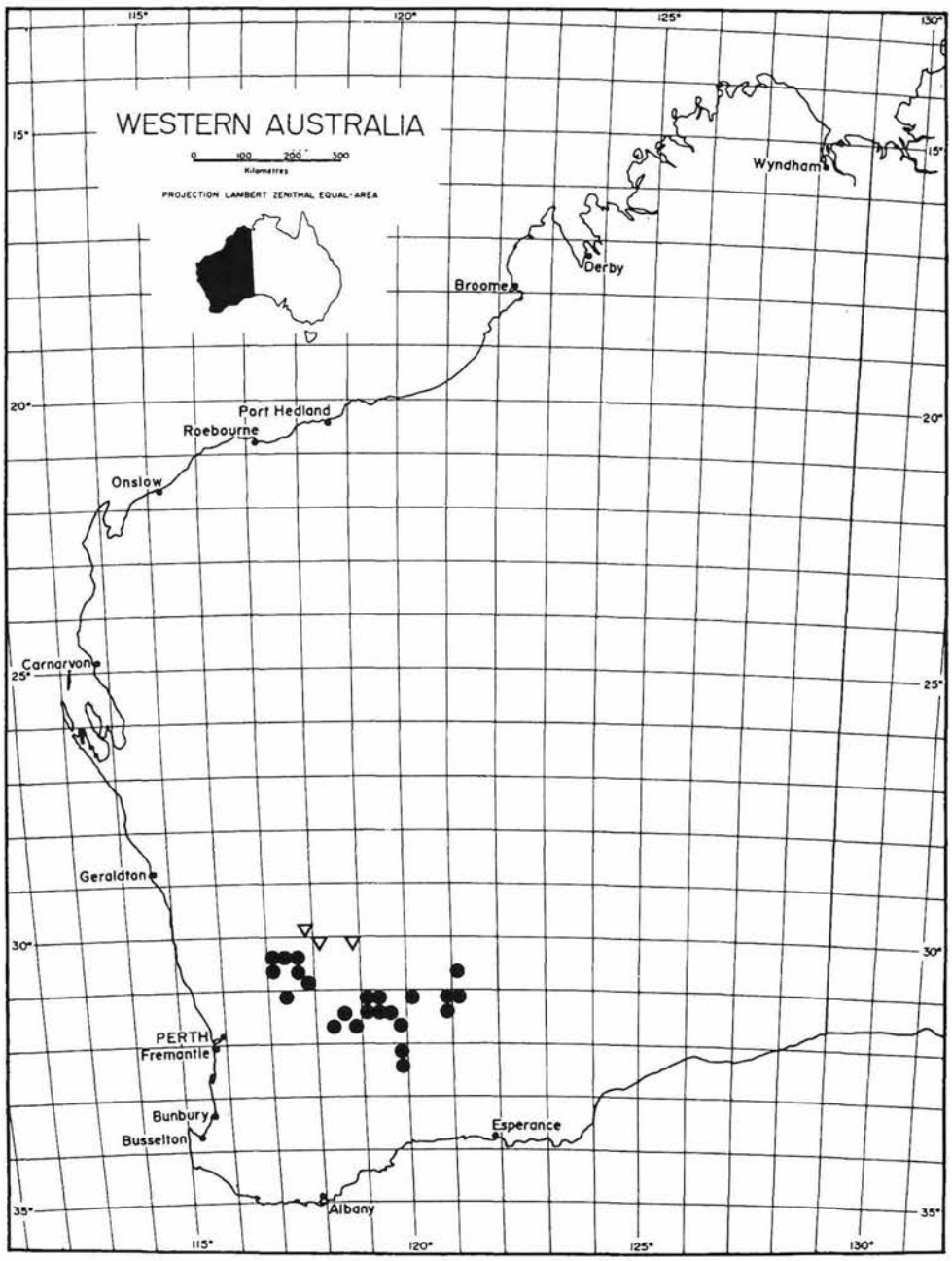

Figure 1. Distribution of *Brachysola coerulea* ● and *Brachysola halganiacea* ▽ .

Notes. Chloanthes sect. *Brachysolenia* F. Muell. is not a *nom. inval.* as indicated by Chapman (1991: 703), but the brief description of the new section is readily overlooked as it is given in a note that happens to appear alone on the next page following the description of the type species.

Since *Brachysola* has previously been placed in *Chloanthes* and *Pityrodia*, a list of the main morphological differences between *Brachysola* and the *Pityrodia* group is given in Table 1 to emphasize how inappropriate that placement was. In view of the great morphological variability in the *Pityrodia* group, the number of clear-cut differences in the table is surprisingly large and leaves no doubt as to the distinctiveness of *Brachysola*.

Table 1. Morphological differences between *Brachysola* and the *Pityrodia* group (including *Chloanthes* and *Hemiphora*).

Character	*Brachysola*	*Pityrodia* group
branched hairs	stellate	dendritic
corolla		
shape	widely spreading	more tubular
indumentum inside	absent	present
stamen insertion	very near base	towards centre of tube
anthers		
attachment	near base	almost central
basal appendage	absent	present
ovary	glabrous	hairy
fruit		
number of fruitlets	4	2 (or fruit indehiscent)
style insertion	in central depression	at summit
fruitlet core	with a compartment	simple

Although *Brachysola* is placed in tribe Chloantheae, it is somewhat intermediate in its morphology between this tribe and tribe Westringieae. It matches tribe Westringieae in its fruit, with the style inserted in a depression between 4 fruitlets, whereas members of tribe Chloantheae have a fruit that is either indehiscent or separating into 2 fruitlets, which are united at first fully or almost to the summit, with the style arising at the summit. Several genera including *Hemigenia* R. Br. have fruitlets specialized for myrmecocorous dispersal. They have a hard compartment attached to the inside-base of each fruitlet containing readily accessible fleshy tissue attractive to ants, this elaiosome-like structure being separated by a hard wall from the soft white seed, which is hidden and protected inside the fruitlet. In these genera of tribe Westringieae the elaiosome-like structure is derived from the receptacle, one of several organs that have been known to develop this function in Australian plant groups (Berg 1975). *Brachysola* appears to have the remnants of a similar adaptation but with the fleshy tissue reduced and fully encased so that it is no longer accessible to ants. Its compartment is located centrally on the inner surface of the fruitlets, not near the base as in *Hemigenia*, so could have a somewhat different origin.

In its inflorescence *Brachysola* is closer to genera of tribe Chloantheae, which commonly have cymes in a variety of arrangements, than to tribe Westringieae with its mostly racemose inflorescences. *Cyanostegia* Turcz. of the former tribe has the same type of inflorescence as *Brachysola* but looser, and also shows the closest approach to *Brachysola* in its stamens, with the anther similar but more elongate. *Cyanostegia* is readily distinguished by its persistent enlarged calyx of fused sepals, which bears a superficial resemblance to the *Brachysola* corolla in its shape, size and colour. The *Pityrodia* group (including *Chloanthes* and *Hemiphora*) differs from *Brachysola* in having the anthers more centrally

dorsifixed, the free lower portions of the lobes often divergent, and with a minute to large basal appendage on the anther lobes. They also have a more tubular corolla tube, with a transverse circle of hairs at or below the base of the stamen filaments, which are inserted higher on the corolla tube than in *Brachysola*, and a hairy ovary. *Brachysola* has the base of the floral tube narrow and the upper part very widely spreading, and is glabrous on the inside of the corolla tube and on the ovary.

One characteristic of *Brachysola* not found in either tribe of subfamily Prostantheroideae is its stellate indumentum. The presence of branched hairs is taken to be the primary character separating the Chloantheae from the Westringieae in the morphological cladogram (Cantino 1992) but no distinction is made between stellate and dendritic hairs. Dendritic hairs are very uncommon in the Westringieae but are known in a few species such as *Hemigenia macrantha* F. Muell. In the Chloantheae, dendritic hairs are common in all genera except *Brachysola*.

It would be interesting to determine the origin of the stellate hairs in *Brachysola*. Perhaps they were derived either from dendritic hairs by contraction of the axis above the first branching point, or from simple hairs by terminal branching. *Dicrastylis micrantha* Munir is the only other species in subfamily Prostantheroideae known to have a hair with multiple branches radiating from a single point (Rye & Trudgen 1999: Figure 3B), but in this case the axis continues as a long simple extension, with a terminal gland; this specialised hair may have been derived from a simple multicellular glandular hair. In *Brachysola* the stellate hairs have many branches, typically 8 or 9, radiating at varied angles to the stalk, whereas in *D. micrantha* there are fewer branches in a single whorl.

Key to species of *Brachysola*

1. Leaves and cymes mostly or partially in near-whorls of 4; leaves linear or ± very narrowly oblong, 0.7–3 mm wide ..... **B. coerulea**
1. Leaves and cymes opposite; leaves narrowly ovate to obovate, 5–7 mm wide ..... **B. halganiacea**

Brachysola coerulea (F. Muell. & Tate) Rye, *comb. nov.*

Chloanthes coerulea F. Muell. & Tate (Mueller & Tate 1893: 317). – *Pityrodia coerulea* (F. Muell. & Tate) E. Pritz. (Diels & Pritzel 1904: 516). *Type:* near Gnarlbine, Western Australia, 12 November 1891, *R. Helms* (*lecto:* PERTH 03738086, here chosen; *isolecto:* AD, G *n.v.*, K *n.v.*, MEL 69304 & 69305, NSW *n.v.*, PERTH (ex AD) 03738108); Parker Range, Western Australia, 1892, *E. Merrall* (*excluded syn:* MEL 69302).

Illustrations. Blackall & Grieve (1965: 568 [as *Pityrodia caerulea*]); Munir (1979: Figure 10 [as *Pityrodia halganiacea*]).

Shrub 0.2–0.7(0.9) m high, often broader than high; stellate hairs up to 1.3 (but usually less than 1) mm long on the inflorescence, mostly shorter elsewhere; glandular hairs with 4–6 large cells, 0.4–1.4 mm long. *Leaves* usually all or mostly in near-whorls of 4 (one pair of leaves slightly or distinctly higher than the other pair), sometimes rather irregularly arranged but always at least some leaves 'whorled', the 'whorls' alternating with those of adjacent nodes, linear or very narrowly ovate to very narrowly obovate, 14–32 x 0.7–3 mm, the margins strongly recurved to revolute, usually almost meeting at midvein at least for part of their length and largely hiding the undersurface but occasionally well separated, densely stellate-hairy on undersurface, less densely so on upper surface at first and

usually becoming glabrous or partially glabrous, usually with scattered sessile glands and occasionally with a few short glandular hairs on upper surface or on midvein of undersurface; stellate hairs very fine, sometimes of distinct sizes, with branches horizontal or slightly reflexed, shorter than the stem hairs but sometimes broader. *Panicle* (50)80–160 mm long, 30–85 mm wide at the base, the cymes mostly or at least some of them arranged in near-whorls of 4 similar to the arrangement of the leaves, densely stellate-hairy and with scattered to fairly numerous glandular hairs on the main axis, branches and pedicels; bracteoles 2–3 mm long, shorter than the bracts at the summit of the cyme peduncles, which in turn are shorter than the leaf-like bracts subtending the peduncles. *Pedicels* up to 5 mm long. *Calyx* 3.5–4.5 mm long in flower and 4–5 mm long in fruit, tending to be pinkish; lobes more or less triangular or narrowly so, usually somewhat longer than the tube, up to 3.5 mm long, 1.5–2 mm wide at the base. *Corolla* with similar hairs but less densely hairy outside than the calyx, sometimes with a few stellate hairs inside on the lobes; tube with the narrow yellow base 1–1.5 mm long, the widely spreading upper part extending 2–3 mm from the centre to the base of the largest lobe; largest lobe 6–10 mm long, stellate-hairy at the centre and base but with a broad glabrous margin; other lobes 4–6 mm long, uniformly hairy outside. *Androecium*: lower filaments 4.5–7 mm long; anthers 0.8–1.3 mm long. *Style* 5–8 mm long. *Fruit* 2–2.3 mm long, 2.5–2.8 mm wide, 2–2.3 mm deep; seeds 2–2.3 x 1–1.3 mm.

Selected specimens examined. WESTERN AUSTRALIA (all PERTH): Bounty Camp, 32°06'S, 119°47'E, 22 Aug. 1995, *G. Barrett*; between Coolgardie and Victoria Rock, Nov. 1964, *C. Davies*; 3 miles [5 km] WSW of Kulja, 13 Nov. 1971, *A.S. George* 11174; 4.5 km W of Bencubbin on road to Mukinbudin, 8 Sep. 1996, *B.J. Lepschi* 2933 & *T.R. Lally*; 12 miles [19 km] from Southern Cross towards Bullfinch, 18 Sep. 1962, *M.E. Phillips* (ex CBG 057400); Mt Day road, 23.5 miles [38 km] SE of Marvel Loch, 6 Nov. 1984, *B.H. Smith* 523 (ex MEL).

Distribution and habitat. Extends from Kulja (between Dalwallinu and Koorda) south-east to near Forrestania (east of Hyden) and east to near Coolgardie, its known range about 370 km long. It occurs mainly in sandy soils, often with laterite, in shrublands or open woodlands, the associated vegetation often including mallee (*Eucalyptus*), *Acacia* and *Grevillea* species.

Phenology. Flowers mainly September to early December, also recorded March and August. Mature fruits recorded from early November to late December.

Conservation status. A relatively widespread and common species, not considered to be at risk.

Notes. Mueller & Tate's description of this species was distributed as a galley proof in 1893 and was published in *Botanisches Centralblatt* (Mueller & Tate 1893) on 30 August 1893 (Chapman 1991: 704). It was republished a few years later (Mueller & Tate 1896) with the specific epithet spelt *caerulea*. This later spelling of the epithet has commonly been used, but the earlier spelling, i.e. *coerulea*, has priority.

Munir (1979) reduced the species to a synonym of the taxon now known as *Brachysola halganiacea*, but probably had seen no material of true *halganiacea* apart from the fragmentary type specimen. Certainly there was no material of the species available at PERTH until recently, when the two specimens cited below were incorporated. *Brachysola coerulea* is here reinstated as a distinct species, readily distinguished from *B. halganiacea* as indicated in the key. Further differences are apparent in the indumentum. In *B. coerulea* the stems tend to have larger glandular hairs with more cells than in *B. halganiacea*, and the upper surface of the leaf tends to be less densely hairy and to have finer stellate hairs. No clear differences have been found in the flowers of the two species, however, although *B. halganiacea* does tend to have a less hairy corolla than *B. coerulea*.

Both Diels & Pritzel (1904) and Blackall & Grieve (1965) distinguished the two *Brachysola* species partly by inflorescence size in their keys. *B. halganiacea* does tend to have smaller panicles than *B. coerulea* but there is too much overlap in this character for it to be really useful in a key.

Brachysola halganiacea (F. Muell.) Rye, *comb. nov.*

Chloanthes halganiacea F. Muell. (Mueller 1876: 14). – *Pityrodia halganiacea* (F. Muell.) E. Pritz. (Diels & Pritzel 1904: 516). *Type:* near Mt Churchman, Western Australia, *J. Young* (*holo:* MEL 885).

Illustration. Blackall & Grieve (1965: 568) [as *Pityrodia halganiacea*].

Shrub up to 0.5 m high and 0.75 m wide; stellate hairs up to 0.7 (but usually less than 0.5) mm long on the inflorescence, mostly shorter elsewhere; glandular hairs with 3 or 4 large cells, 0.3–0.7 mm long. *Leaves* opposite, decussate, narrowly ovate to obovate, 12–28 x 5–7 mm, the margins recurved, usually well separated, closely and densely stellate-hairy on both surfaces at first, sometimes becoming sparsely hairy on upper surface, with scattered short glandular hairs on undersurface especially on or near the midvein and less frequent on upper surface, sometimes also with sessile glands; stellate hairs rather uniform, with branches horizontal or slightly reflexed, smaller than the stem hairs. *Panicle* with few to many cymes in an opposite-decussate arrangement, 40–90 mm long, 25–45 mm wide at the base, densely stellate-hairy and with scattered to fairly numerous glandular hairs on the various axes and bracts; bracteoles 2–3 mm long, shorter than the bracts at the summit of the cyme peduncles, which in turn are shorter than the leaf-like bracts subtending the peduncles. *Pedicels* up to 3 mm long. *Calyx* 3–4 mm long in flower and 4–5 mm long in fruit, colour not recorded; lobes ovate to broadly triangular, about as long as the tube, 1.4–2.3 mm wide at the base. *Corolla* with similar hairs but less densely hairy outside than the calyx, glabrous inside; tube with the narrow tubular base *c.* 1.5 mm long, the very spreading upper part extending *c.* 2.5 mm from the centre to the base of the largest lobe; largest lobe *c.* 6 mm long, largely glabrous outside but with a central basal area hairy; other lobes *c.* 4 mm long, more uniformly hairy outside but the apex of the lower pair sometimes glabrous. *Androecium*: lower filaments *c.* 4 mm long; anthers *c.* 1 mm long. *Style c.* 7 mm long. *Fruit c.* 2.4 mm long, *c.* 3 mm wide, not seen at full maturity.

Specimens examined. WESTERN AUSTRALIA: Karroun Hill Reserve (East), 47 km NNE of Beacon, date unknown [probably *c.* 1994], *H. King* 179 (PERTH); 4 km W of Yache Yachine Dam [Mt Jackson Station], *c.* 70 km NNW of Bullfinch, 3 Oct. 1981, *K.R. Newbey* 9285 (PERTH).

Distribution and habitat. Extends from near Mt Churchman east to Mt Jackson Station, a distance of about 110 km. Habitat data are available only for the easternmost locality, where *B. halganiacea* was recorded in deep yellow sand on a flat with "*Acacia* high shrubland".

Phenology. Flowers and young fruits recorded in early October.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority Two. Known from three localities, with only one plant recorded in the population on Mt Jackson Station. This poorly known species needs to be surveyed to determine its conservation status and other aspects of its biology more accurately. It occurs in a relatively inaccessible region that has not been well surveyed botanically, which would partially explain the poor representation of this species in the herbarium.

Notes. One of the flowers examined had only the upper pair of stamens fertile and with a longer filament (*c.* 4 mm long) than the staminodes below. This appeared to be an abnormality as other flowers examined

on the same specimen had four fertile stamens with the lower two filaments slightly larger (*c.* 4 mm long) than the upper two (*c.* 3 mm long).

Brachysola halganiacea appears to have a distinct geographical range, with all its known localities occurring to the north of the known range of *B. coerulea* (Figure 1).

Acknowledgements

I am grateful to Paul Wilson for nomenclatural advice, and to Richard Olmstead and Brendan Lepschi for early access to, and discussion of, their cladistic data.

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Trymalium monospermum (Rhamnaceae), a new species from south-western Australia

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Abstract

Rye, B.L. *Trymalium monospermum* (Rhamnaceae), a new species from south-western Australia. *Nuytsia* 13(2): 339–343 (2000). A description and illustration of *Trymalium monospermum* Rye (Rhamnaceae) are given, together with an updated generic description and key. The new species has a high priority for conservation as it is currently known from only one small population, which is located near Narrogin in the south-west of Western Australia. It is unique in its genus in being completely glabrous and in its 1-seeded trigonous fruit.

Introduction

A newly discovered species of *Trymalium*, known from a single population in south-western Australia, is described and illustrated. It differs from all previously named species of Rhamnaceae from the region in having a uniloculate one-seeded trigonous fruit. There is one undescribed south-western species of *Cryptandra* Sm. with a uniloculate one-seeded fruit, but its fruit differs in being terete.

This paper also gives a full description of the genus *Trymalium*, encompassing the unique features of the new species. The key to Western Australian members of the genus given in (Rye 1996) is revised.

Taxonomy

Trymalium Fenzl (Fenzl 1837: 20). *Type: Trymalium ledifolium* Fenzl., lectotype *fide* Suessenguth (1953: 113).

Plants low shrubs to small trees, the branchlets not spinescent in most taxa; indumentum of simple and/or stellate hairs or absent. *Stipules* free, close and often overlapping at the base on adaxial side of petiole but widely separated on abaxial side. *Leaf blades* either conduplicate in bud or relatively flat and with margins recurved, most taxa with the midvein slightly impressed and the margins recurved at maturity, entire or toothed. *Cymes* terminal and axillary on the branchlets, usually very loose, with

few to many pedicellate flowers, occasionally some cymes reduced to a single flower; pedicels long except in *T. densiflorum*. *Floral tube* entirely adnate to the ovary and disc or almost so, not extended beyond the disc. *Sepals* 5, prominent and petalline. *Petals* 5, smaller than the sepals, spathulate, with the lamina cupped around an anther in bud. *Disc* prominent, more or less horizontal, thick, formed into an undulate ring at first (with 5 lobes extending outwards between the stamen bases alternating with five lobes extending inwards), becoming broader and more uniformly circular in fruit but with 5 indentations around the outside where the petals and stamens inserted, glabrous in most taxa. *Ovary* (2)3-celled. *Style* with (2)3 stigmatic branches or long lobes, or less prominently 3-lobed. *Fruit* a 3-celled schizocarp in most taxa, either a 2-celled schizocarp or 1-celled in the remaining taxa, about half to fully inferior, enclosed at the base or for its full length in the floral tube, which either splits irregularly from the base upwards to release 1–3 monocarps (fruiting carpels) or forms three regular longitudinal slits to release the monocarps; monocarp(s) coriaceous to crustaceous, entire, indehiscent, with (2)3 surfaces, all surfaces or the inner one(s) brown and minutely to prominently patterned. *Seeds* with a darkened base, the remainder uniformly brown-coloured or with a pale border; aril very reduced to a thin saucer-like structure, hugging the base of the seed but readily detached, entire to distinctly 3-lobed, translucent.

Notes. A genus of 15 species occurring in southern mainland Australia, with 12 species endemic to the south-west of Western Australia, one species endemic to southern South Australia and two species endemic to The Grampians in Victoria.

Revision of key to Western Australian *Trymalium* species

The new species falls into the second main division of the key to Western Australian species given in Rye (1996). This portion of the key covers the taxa with a glabrous ovary and is revised below to include *T. monospermum* and to correct a later reference to the fruit of *T. ledifolium* Fenzl. In the previous key *Trymalium ledifolium* was distinguished from *T. elachophyllum* Rye partly on the basis of its fully inferior fruit, but it was recently observed that half of the few fruiting specimens of *T. ledifolium* var. *ledifolium* do not have fully inferior fruits like the other varieties of this species. One specimen (*E.A. Griffin* 6673) has the fruits varying from about three-quarters to almost half inferior.

1. Ovary (only summit visible) glabrous. Fruit glabrous, partially or fully enclosed in the floral tube, which is usually also glabrous.
 9. Leaves narrowly obcordate to broadly obtriangular, with margins flat or incurved at maturity. Floral tube constricted below apex in fruit and extended slightly above the fully inferior fruit.
  10. Leaves entire, hairy. Fruit terete, 3-seeded ..... **T. urceolare**
  10. Leaves distally toothed, glabrous. Fruit trigonous,1-seeded. ..... **T. monospermum**
 9. Leaves linear to oblong-elliptic, with margins somewhat recurved to revolute at maturity. Floral tube not constricted in fruit and exceeded or equalled in length by the half-inferior to fully inferior fruit.
  11. Leaves 2–5 mm long. Fruit *c.* two-thirds inferior, erect or spreading, regularly dehiscent into three equal parts. Monocarps coriaceous to brittle at maturity; inner surface finely reticulate, not ridged ..... **T. elachophyllum**
  11. Leaves 8–40 mm long. Fruit usually fully inferior (except in *T. ledifolium* var. *ledifolium),* pendulous, irregularly dehiscent. Monocarps very hard at maturity; inner surface prominently ridged, with large deep lacunae ..... **T. ledifolium**

Trymalium monospermum Rye, *sp. nov.*

Plantae omnino glabrae; folia conduplicata, dentata; ovarium uniloculare; fructus trigonus, uniseminalis.

Typus: Narrogin area [precise locality withheld], Western Australia, 15 July 1999, *L.W. Sage*1540, *J.P. Pigott & E.B. Pigott* (*holo:* PERTH 05301661; *iso:* CANB, K, MEL, NY).

Shrubs 0.1–0.3 m high and up to 0.5 m wide, multi-stemmed at base, not spinescent, completely glabrous. *Young stems* with minute tubercles, becoming dark grey. *Stipules* ovate or broadly ovate, 0.7–1 mm long, acute or shortly acuminate, entire or somewhat toothed. *Petiole c.* 0.5 mm long. *Leaf blades* conduplicate or with margins incurved at first, becoming flat or nearly flat, narrowly obcordate to broadly obtriangular, 5–8 x 2–4.5 mm, entire in the basal part and dentate distally, rather prominently 2-lobed at apex with a triangular mucronulate sub-lobe or a point at the junction of the two main lobes, each of the main lobes usually 2–5-denticulate but sometimes just with a single mucronulate tip; upper surface minutely reticulate-pitted; lower surface minutely rugose with furrows and pits. *Flowers* cream or off-white. *Cymes* terminal and axillary on the branchlets, mostly 5–12-flowered, very loose, up to 14 mm long in fruit, not including the peduncle, which is up to *c.* 6 mm long. *Pedicels* 1–1.5 mm long in flower and up to 4 mm long in fruit. *Floral tube c.* 0.5 mm long in flower, enlarging to *c.* 2.6 mm long in fruit and becoming constricted just below the summit which forms a spreading terminal portion *c.* 0.15 mm long. *Sepals c.* 0.8 mm long. *Petals c.* 0.4 mm long. *Disc c.* 0.25 mm wide. *Ovary* 3-celled. *Style c.* 0.2 mm long; apex with a flattened 3-lobed stigma. *Fruit* fully inferior, 1-celled, trigonous, truncate-obovate in outline and 6–7 x 3.5–4 mm including the floral tube and other attached parts, the floral tube splitting irregularly from the base upwards to release the single monocarp; monocarp equilaterally triangular in cross-section with each of the three surfaces obovate to elliptic, *c.* 2.4 x 1.4 mm, brown, coriaceous, very minutely reticulate-pitted. *Seed c.* 1.7 x 1 mm, medium orange-brown with a darkened base; aril 3-lobed, clear-translucent. (Figure 1)

Other specimens examined. WESTERN AUSTRALIA [precise locality withheld]: Narrogin area, 29 Aug. 1997, *G.J. Keighery & N. Gibson* 2088; Narrogin area, 15 July 1999, *L.W. Sage*1541 & 1542, *J.P. Pigott & E.B. Pigott.*

Distribution. Occurs in the Narrogin area in the South West Botanical Province of Western Australia.

Habitat. Recorded in red-brown gravelly sandy soil on a lateritic ridge, in a low heath vegetation including *Melaleuca pungens*, a number of members of the Proteaceae such as *Dryandra armata*, and two *Allocasuarina* species.

Phenology. Flowers and young fruits recorded in July, and mature fruits in late August.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority Two. Known from a single small population, located on a nature reserve. When surveyed in December 1999, the population comprised 28 plants (Kim Kershaw pers. comm.). Searches in nearby areas of bushland failed to locate any further populations of the species (Leigh Sage pers. comm.).

Etymology. From the Greek *mono* – one, and *sperma* – seed, referring to the 1-seeded fruit.

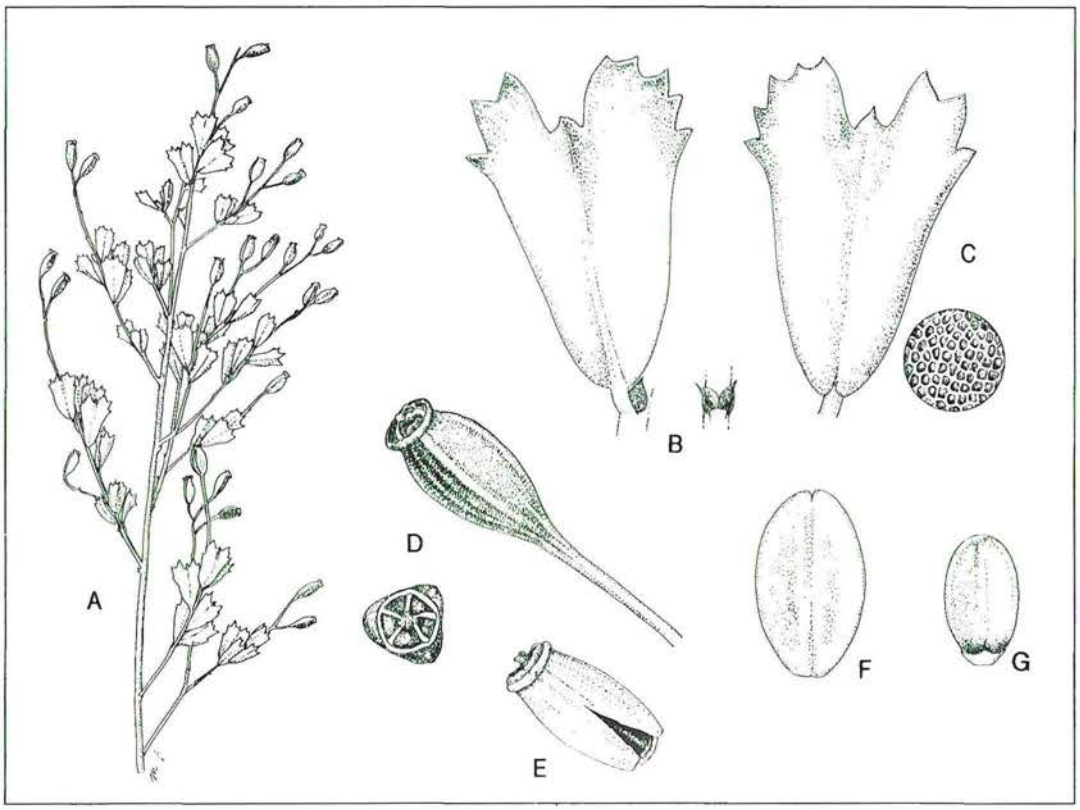

Figure 1. *Trymalium monospermum*. A – fruiting branch (x1), B – stipules and undersurface of leaf (x6); C – upper surface of leaf (x6) with enlargement of reticulate pitting; D – top and side view of fruit (monocarp enclosed in floral tube) and pedicel (x8); E – floral tube splitting at base to reveal monocarp (x8), F – monocarp (x10), G – seed with basal aril (x10). Drawn from *G.J. Keighery & N. Gibson* 2088.

Notes. Its closest relative appears to be *Trymalium urceolare* (F. Muell.) Diels, which is similar in having conduplicate leaves, completely glabrous flowers, the floral tube constricted near the summit and a completely inferior fruit.

Trymalium monospermum is a very distinctive species, apparently the smallest member of its genus and the only one to be completely glabrous, and is readily identified by its more or less obcordate to obtriangular leaves with two large tooth-like or prominently denticulate lobes. Also unique to this species are the flattened stigma and 1-celled trigonous fruit with a solitary seed. Although *T. monospermum* has a 3-celled ovary with an apparently fertile ovule in each cell, only one cell develops into a monocarp, the two aborted cells not even being visible in the mature fruit.

All other species of *Trymalium* have a terete fruit with more than one monocarp. Apart from *T. floribundum* Steud. subsp. *floribundum*, they all have a stigma with three long lobes, and three unequally 3-faced monocarps. Each monocarp has a rounded outer surface, which is larger than the two flatter inner surfaces, and the inner surfaces are more prominently patterned than the outer surface. In *T. floribundum* subsp. *floribundum* the ovary is 2-celled, the stigma 2-lobed and each monocarp has a rounded outer surface and flatter, more prominently patterned inner surface. A logical expectation for a 1-celled fruit in *Trymalium* would be for it to have a single rounded surface, i.e. to be terete, since the solitary monocarp has no internal surfaces adjacent to other monocarps. Instead the monocarp of *Trymalium monospermum* is trigonous, with three surfaces of uniform shape, size and patterning.

Acknowledgements

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Aluta, a new Australian genus of Myrtaceae

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Abstract

Rye, B.L. & M.E. Trudgen. *Aluta*, a new Australian genus of Myrtaceae. *Nuytsia* 13 (2): 345–366 (2000). *Aluta* Rye and Trudgen, a genus of five species belonging to the *Chamelaucium* alliance of the Myrtaceae, is described. The new genus occurs in inland regions of Western Australia, the Northern Territory and South Australia. *Aluta* is distinguished from other genera belonging to the *Chamelaucium* alliance by the prominent retrorse gland on its stamens and by the prominently reticulate-pitted disc on its flowers. The relationships of the new genus are discussed, and a key and full descriptions are provided for each of the species and subspecies recognized. Four new combinations based on taxa previously included in the genus *Thryptomene* Endl. are made, viz. *Aluta appressa* (C.R.P. Andrews) Rye & Trudgen, *A. aspera* (E. Pritz.) Rye & Trudgen, *A. maisonneuvei* (F. Muell.) Rye & Trudgen and *A. maisonneuvei* subsp. *auriculata* (F. Muell.) Rye & Trudgen. Lectotypes are chosen for the base names *Thryptomene appressa* C.R.P. Andrews, *T. aspera* E. Pritz. and *T. auriculata* F. Muell. Six of the taxa are illustrated, including the four new taxa *Aluta aspera* subsp. *hesperia* Rye & Trudgen, *A. aspera* subsp. *localis*, *A. quadrata* and *A. teres*.

Introduction

This paper presents a taxonomic revision of *Aluta* (Myrtaceae), a new genus distributed in western and central Australia. Of the five species referred to *Aluta*, three were originally named under *Thryptomene* Endl. and the other two are new species. There do not appear to be any specific references in the literature to the close relationship beween the three previously named species of *Aluta*, and they have never been placed into any infrageneric group or genus of their own.

Prior to Bentham's (1867) treatment of the Australian Myrtaceae, only one species of *Aluta* had been described, as *Thryptomene maisonneuvei*. Two further species, described as *Thryptomene appressa* and *T. aspera*, were known by the time Stapf (1924) placed the species of *Thryptomene* into five sections. Recognizing that *Thryptomene appressa* and *T. maisonneuvei* were not well placed in *Thryptomene*, Stapf excluded them as well as a number of species that are currently placed in either *Micromyrtus* Benth. or *Malleostemon* J.W. Green. While Stapf retained *Thryptomene aspera* in sect. *Thryptomene*, he was clearly doubtful of this placement as *T. aspera* was the only species shown with a question mark.

Green (1983) removed some species from *Thryptomene* to his new genus *Malleostemon*, but not those now considered to belong in *Aluta*. While Green (1980, 1986) made use of some of the unusual features of *T. maisonneuvei* to distinguish it from the other species included in his keys to the arid zone and South Australian species of *Thryptomene*, he otherwise drew little attention to the atypical characteristics of this species.

Methods

Apart from type material borrowed from MEL, all specimens cited are housed at PERTH, although duplicates may exist in other herbaria. All measurements were taken from dry pressed material. Leaf measurements were obtained from the largest leaves on each specimen. Filament lengths were taken from the longest stamens of each flower and style lengths from very mature flowers and young fruits.

Distribution maps were prepared using distribution data from PERTH herbarium specimens and additional data from Green (1983). The Botanical Provinces used are those defined by Beard (1980). Conservation codes have been assigned according to the Western Australian Department of Conservation and Land Management's system, the categories of which are defined at the end of this *Nuytsia* issue.

Relationships and differentiation of *Aluta*

Aluta is one of over 20 genera currently recognized in the *Chamelaucium* alliance in the informal classification of the Myrtaceae devised by Briggs & Johnson (1979). Phylogeny within the alliance is still far from certain, but there appears to be a good basis for separation of this group from other alliances in the family, as discussed by Johnson & Briggs (1985).

Some problems in the delimitation of genera within the *Chamelaucium* alliance have been satisfactorily dealt with in recent years, notably for *Calytrix* and its close relatives (Craven 1987a,b). Among the genera Bentham (1867) included in his very broadly circumscribed concept of *Baeckea* L., some progress has been made by the description of *Ochrosperma* Trudgen (Trudgen 1987) and the reinstatement of *Babingtonia* Lindl. (Bean 1997), *Euryomyrtus* Schauer (Trudgen in press), *Rinzia* Schauer (Trudgen 1986) and *Triplarina* Raf. (Bean 1995). However there are significant problems remaining in the delimitation of genera in the alliance, particularly in the group including *Thryptomene*. These problems and the lack of comparative studies of the morphology and anatomy of other genera within the *Chamelaucium* alliance limit the certainty with which relationships of *Aluta* can be discussed.

In anther morphology, *Aluta* appears to show a closer relationship to *Malleostemon* than to *Thryptomene* and its allies. *Aluta* and *Malleostemon* both have anthers (see Figure 1) with the following characteristics:

1. The grooves of each cell are oblique, not parallel to the connective, and meet towards the apex of the anther. This indicates that the orientation of the two cells is divergent rather than parallel.

2. The adjacent parts of the two cells (i.e. those parts located to the inside of the two grooves) differ in shape from the outer parts, becoming expanded towards the lower end such that they meet and are fused along the length of the anther connective.

3. Pollen dehiscence is by two pores (or very short slits), each located along one of the divergent grooves, closer to the point where the two grooves meet than to the outer edge of the cells.

4. The connective gland is large, with an expanded body directed towards the outside of the flower and tapering towards the connective to a small tip located between the anther cells at the summit of the connective.

In *Aluta* the connective gland is very obvious as it is free except for its attachment at the tapered end to the connective, and the filament joins the connective via a depression located on the outer surface of the anther directly below the gland (Figure 1A). *Malleostemon* differs in having the gland united for its full length to the connective and the distal end of the filament (Figure 1B), forming a structure distinctly broader than the upper part of the free filament. Usually the filament has a fairly sudden bend at the junction of this fused structure and the free portion. This type of stamen is referred to as geniculate (Green 1983).

The geniculate stamen of *Malleostemon* is of the same type as is found in several related groups with multi-loculate ovaries, viz. those Bentham (1867) treated as *Baeckea* sections *Babingtonia* (Lindl.) Benth., *Harmogia* (Schauer) Benth. & J.D. Hook. and *Oxymyrrhine* (Schauer) Benth. & J.D. Hook. All these geniculate groups have the same type of anther as *Aluta* and it is suggested here that *Aluta* represents an evolutionary line that predates the connective gland becoming fused to the filament. If this interpretation is correct, then the separation of *Aluta* or its precursors from the *Babingtonia* lineage is of some antiquity, certainly predating the origin of *Malleostemon*. Like *Aluta*, *Malleostemon* has a 1-celled ovary, but it shows a much greater similarity to the *Babingtonia* lineage in having geniculate stamens, the style in a depression and the flowers often several per peduncle.

Comparison also needs to be made with *Thryptomene* Endl., in which all previously named species of *Aluta* were included, and the genera traditionally considered to be close to *Thryptomene*. These genera have a variety of stamen types, all of which differ from those of *Aluta* and *Malleostemon* in having the connective gland differently attached and with the bulk of the gland directed towards the inside of the flower. Like *Aluta* their stamens are not geniculate, but they often differ in the orientation, fusion or dehiscence of the anther cells. For example, *Thryptomene* has the anther cells free and separated at the base and *Micromyrtus* has dehiscence by long slits reaching the margins of the cells. Members of this group of genera all also differ from *Aluta* in disc ornamentation (see below) and some of them show further differences in ovule number or placentation, inflorescence, hypanthium and sepal characters. Considering all of these characters, each genus shows at least four clear morphological differences from *Aluta*.

Apart from its distinct stamen morphology, *Aluta* can be readily distinguished from other members of the *Chamelaucium* alliance by its very prominently reticulate-pitted disc, which has pits larger than any pits or other pattern units on the hypanthium (Figure 1C,D). Although some members of the other genera have some patterning on the disc, it is never deeply pitted as in *Aluta*, and most of them have much more prominent patterning on the hypanthium than on the disc.

Taxonomic revision of *Aluta*

Aluta Rye & Trudgen, *gen. nov.*

Fruticuli, foliis pusillis oppositis decussatis. Flores axilares solitarii, bracteolis duabus persistenibus subtendis. Sepala 5, in parte herbacea, in fructo persistentia. Petala 5, patentia, sepala multo superantia,

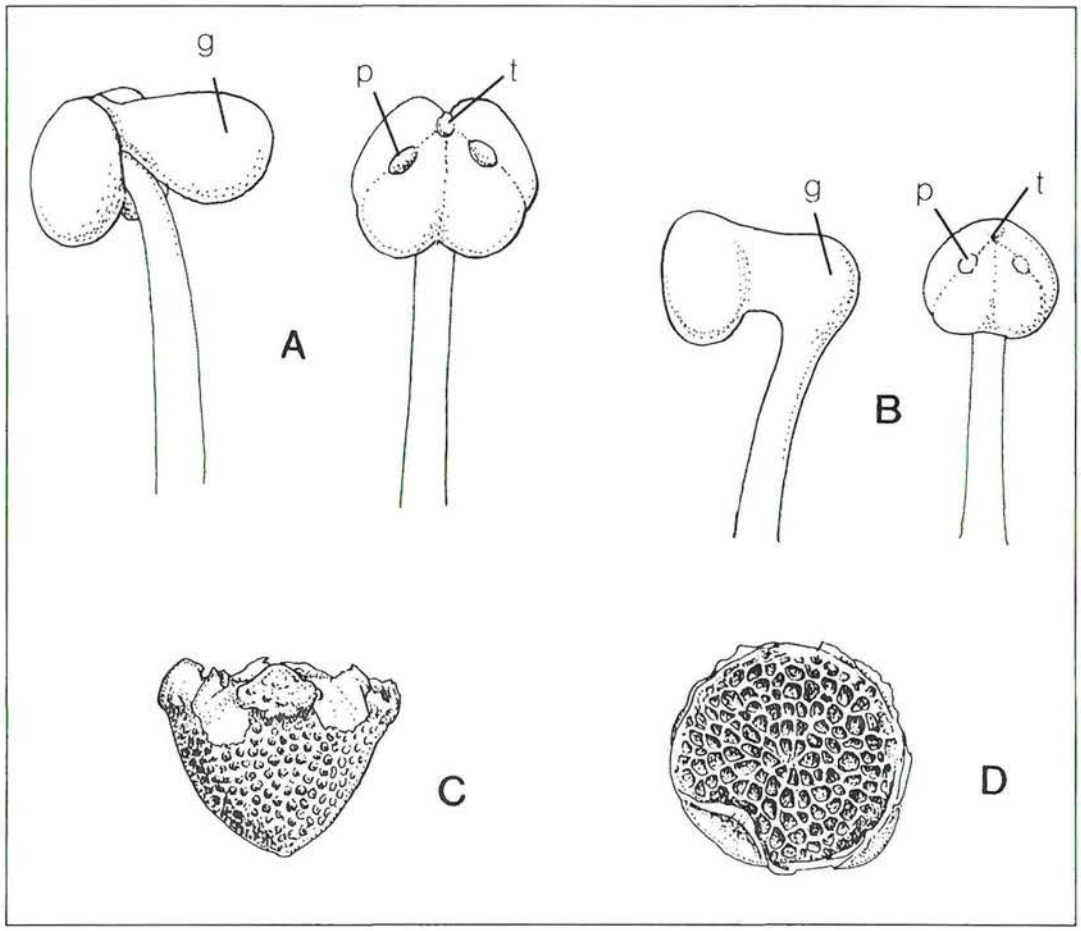

Figure 1. A,B – two views of stamen of *Aluta* (A) and *Malleostemon* (B), the lateral view prior to dehiscence and the inner view after dehiscence, g – gland, p – pore of anther cell through which pollen is released, t – tip of gland, located at apex of connective. C – side view of *Aluta* fruit showing pitted hypanthium. D – top view of *Aluta* fruit showing reticulate-pitted disc.

alba vel rosea, ad basim breviter unguiculata. Stamina 5 sepala opposita, vel *c.* 10 – *c.* 20 irregulariter deposita. Antherae bilobatae, uterque lobus dehiscentius poro prope centrum sulci qui ex apicem connectivi versus marginem exteriorem lobi; connectivum glande magna clavata ad florem exterium versus. Discus reticulato-foveolatus. Ovarium unicellulare, placenta sub-basalis; ovula in 2 vel 3 paribus oblique superposita. Stylus centralis, nec depressus. Fructus siccus, indehiscens.

Type: Aluta aspera (E. Pritz.) Rye & Trudgen.

Shrubs small to large; young stems 4-angled. *Leaves* opposite, decussate, small; petiole very short or almost absent; blade thick especially towards apex, often with two distinct lateral surfaces as well as the adaxial and abaxial ones, concolorous, with usually very prominent oil glands particularly on the lateral surfaces. *Inflorescence* of solitary axillary flowers grouped into a subterminal cluster or cylindrical formation on each fertile branchlet, each flower subtended by 2 bracteoles at the summit

of a peduncle, which is shorter than the subtending leaf. *Bracteoles* imbricate and enclosing flower in very young bud, with a thick herbaceous portion from base to apical point and membranous sides, prominently keeled, incurved, persistent; membranous sides broadest at or near base, sometimes somewhat auriculate. *Flowers* actinomorphic, small, protandrous, glabrous throughout except sometimes for the floral tube and sepals. *Hypanthium* adnate to ovary, with no free portion above, usually minutely to fairly prominently pitted or closely wrinkled. *Sepals* 5, more or less herbaceous at the base and sometimes to the apex, the remainder membranous, persistent in fruit; herbaceous portion prominently gland-dotted; membranous portion(s) broad, sometimes auriculate. *Petals* 5, widely spreading, much larger than the sepals, white or pink, shortly clawed at base, broadly rounded at apex. *Stamens* 5, *c.* 10 or *c.* 20, if 5 then one opposite each sepal and sometimes alternating with staminodes located opposite the petals, if *c.* 10 or more then irregularly arranged (with up to 5 opposite the sepals and all or most of the rest alternating with both sepals and petals); filament flattened, tapering from the base to a more slender apex; anther 2-celled, each cell opening by a pore located slightly above the middle of a groove which runs from near the apex of the connective obliquely to the margin of the cell, the connective with a prominent gland directed towards outside of flower; gland clavate, about as large as each anther cell. *Disc* prominently reticulate-pitted, usually horizontal in young fruit and convex in mature fruit. *Ovary* 1-celled, with an oblique sub-basal placenta; ovules in 2 or 3 obliquely superposed pairs, each pair collateral and touching. *Style* central, not sunken, broadest at base; stigma capitate. *Fruit* indehiscent, dry, depressed globular to very broadly ellipsoid, often infertile. *Seed(s)* apparently hard, wedge-shaped or filling available space, smooth and rounded on outer surface, golden brown, glossy.

Size and distribution. The genus comprises five species, with subspecies recognized in two of the species, giving a total of eight taxa recognized. *Aluta* is distributed in arid and semi-arid regions of western and central Australia, extending from the upper Gascoyne River in Western Australia east to the Simpson Desert in the Northern Territory and south-east to near Lake Acraman in South Australia. (Figure 2A)

Etymology. From the Latin *aluta* – purse or pouch of soft leather, referring to the prominent pouch-like connective gland on the anther.

Morphology. As in other members of the *Chamelaucium* alliance, this genus is glabrous but may have minute epidermal outgrowths usually forming denticulate margins. Hair-like structures can develop by extension of these outgrowths into simple or branched slender projections referred to from here on as 'hairs'. This has occurred in *Aluta aspera* subsp. *aspera*, which has apparently hairy young stems, leaves and bracteoles. Subsp. *aspera* also has a hairy hypanthium.

The leaf-bearing stems of the plants are 4-angled (having four equal surfaces) and may be reddish when actively growing but soon develop a thick whitish bark in strips between the leaf axils on each of their four surfaces. Both the leaves and the strips of whitish bark are shed from the older stems, which have a darker bark and may become deeply longitudinally grooved. The darker bark may appear smooth to the naked eye but is minutely and irregularly rugose, usually with long strips but sometimes with smaller patches.

In most species of *Aluta*, the leaves are distinctly 4-sided in transverse section and their lateral surfaces are often more prominently gland-dotted than the abaxial surface. Only *A. teres* lacks well defined lateral surfaces, but these are often apparent near the apex of the leaf. In *A. teres* most of the leaf is more terete than in other members of the genus, with very prominent glands disrupting the otherwise smooth surface, but the glands are still arranged mainly in two lateral rows.

Both the bracteoles and sepals in *Aluta* are partially membranous, with the remainder somewhat to very herbaceous and usually prominently dotted with oil glands. At first the membranous portion(s) are clear-translucent but they may become whitish and thicker with age. The herbaceous portion of the bracteoles is very thick, keeled and green or partially green. In the sepals the herbaceous portion is usually much less thickened and may become more membranous as the sepals age.

In young fruits the disc is deep pink to dark red. By the time the fruit has fully matured, the stamens and usually also the petals have been shed, but the sepals remain attached. At this stage both the bracteoles and the sepals are quite glossy. The bracteoles are persistent for a while after the fruits are shed. The two bracteoles of each pair usually overlap at the base where the membranous margins are broadest. Retention of the papery sepals in most taxa may result in the fruits being more easily wind-blown, promoting wider dispersal of the seeds.

Genetic and breeding systems. Like most other genera of Myrtaceae, *Aluta* probably has a base chromosome number of 11. More chromosome number counts are needed, however, as there is only one record to date for the genus, a tetraploid number of *c.* 22 for *Aluta maisonneuvei*. The plants evidently favour outbreeding, having protandrous flowers that appear to be suited to pollination by small insects.

Key to species and subspecies of *Aluta*

1. Flowers 4.5–6(7) mm diameter, with 5(6) stamens opposite the sepals
   2. Stems with firmly attached grey bark. Leaves 3.5–6.5 mm long, with a prominent recurved apical point 1–1.4 mm long. Peduncles 1–3 mm long. (Mt Jackson to Salmon Gums) ..... **A. appressa**
   2. Stems with loose flaky red-brown bark. Leaves 1–2.5 mm long, scarcely pointed. Peduncles up to 0.8 mm long. (Meekatharra to Northern Territory and South Australia) ..... **A. maisonneuvei**
      3. Leaves 1.2–1.6 mm wide; lateral surfaces very oblique (*c.* 45 degrees to almost horizontal), 0.5–0.7 mm wide, with usually 2 rows of prominent oil glands. (Kumarina to Northern Territory and South Australia) ..... subsp. **maisonneuvei**
      3. Leaves 0.7–1.2 mm wide; lateral surfaces somewhat oblique (less than 45 degrees) to vertical, usually 0.3–0.4 mm wide and with 1 row of prominent oil glands. (Meekatharra to South Australia) ..... subsp. **auriculata**
1. Flowers 7–12 mm diameter, with *c.* 10 or more stamens, usually irregularly arranged, always with some alternate to the sepals and petals
   4. Leaves 15–20 mm long, with an erect to incurved apical point. Outer sepals distinctly auriculate. Stamens 15–22. (Eastern Pilbara) ..... **A. quadrata**
   4. Leaves 1.5–13 mm long, with apical point recurved or very reduced to absent. Sepals not or scarcely auriculate. Stamens *c.* 10
      5. Leaves more or less terete, with a prominent recurved apical point. Bracteoles ovate, with a recurved apical point. (Sandstone area) ..... **A. teres**
      5. Leaves 4-angled in cross-section, scarcely pointed. Bracteoles broadly ovate or with a very broad base and linear apex, acute. (Gascoyne River to Wongan Hills and Kalgoorlie area) ..... **A. aspera**
         6. Leaves with both simple and branched hairs 0.2–0.4 mm long. Sepals ciliolate. Fruit with a densely hairy hypanthium. (Bungalbin Hill to Yindi Station) ..... subsp. **aspera**

6. Leaves glabrous or with simple hairs less than 0.1 mm long restricted to the 4 angles of the blade. Sepals entire. Fruit glabrous
   7. Leaves 4–13 mm long, finely denticulate to ciliate along the angles. Bracteoles 3–5 mm long. (Gabbin to Mukinbudin) ..... subsp. **localis**
   7. Leaves 1.5–4.5(5.5) mm long, coarsely denticulate or smooth on the angles. Bracteoles 1.3–3 mm long. (Upper Gascoyne River to Wongan Hills to Sandstone) ..... subsp. **hesperia**

Aluta appressa (C.R.P. Andrews) Rye & Trudgen, *comb. nov.*

Thryptomene appressa C.R.P. Andrews (Andrews 1904: 41). *Type:* north of Esperance, Western Australia, October 1903, *C.R.P. Andrews* 1275 (*lecto:* PERTH 01620959; *isolecto:* PERTH 01620940).

Shrubs usually 0.7–2 m high, sometimes many-branched near base, up to at least 1.2 m wide, glabrous; leaf-bearing branchlets mostly arising at angles of 10–20 degrees, long and slender, 4-ridged; leaves mostly separated by internodes about as long as the leaves but often more crowded towards ends of branchlets, mostly antrorse to appressed, but those subtending flowers sometimes almost patent; older stems developing a dark grey bark with strips mostly firmly attached. *Petioles* up to 1 mm long. *Leaf blades* more or less narrowly oblong-elliptic in outline, 3.5–6.5 x 1–1.2 mm not including point, 4-angled, with a flat abaxial surface broader than the oblique lateral surfaces, the adaxial surface fairly flat but recurved at apex; apical point 1–1.4 mm long, but upper part often broken off in older leaves; glands not always obvious, mostly in 2 rows on each lateral surface and less clear on abaxial surface, up to 0.1 mm diameter. *Inflorescence* with rarely fewer than 5 pairs of flowers and up to *c.* 20 pairs in a cylindrical formation on each branchlet; peduncles 1–3 mm long. *Bracteoles* ovate or broadly ovate, 1.4–2 mm long, acute and with a minute to prominent apical point; membranous margins 0.2–0.5 mm wide, entire. *Flowers* 4.5–6(7) mm diameter; disc yellow at first, turning deep red. *Sepals* depressed ovate to semicircular, 0.5–0.8 mm long not including auricles; herbaceous portion almost reaching apex, often reddish; auricles usually evident on outermost sepals, extending up to 0.2 mm below base of sepal. *Petals* almost circular, 2–3 mm long, white or pink, entire, slightly crenulate. *Stamens* 5, opposite the sepals, alternating with very reduced staminodes; filament 0.5–0.6 mm long, reddish; anther 0.3–0.4 mm wide, red-brown; gland yellow at first, turning reddish. *Staminodes* 1–3 (most commonly 1) opposite the petals, point-like, *c.* 0.1 mm long. *Ovules* 4. *Style* 0.5–0.7 mm long. *Fruit* 1.2–1.5 mm long, apparently 4-seeded; hypanthium with a fairly prominent ornamentation of close wrinkles or a fine reticulum enclosing small pits; disc 1.3–1.6 mm diameter. *Seeds* not seen at maturity, wedge-shaped, the inner surfaces somewhat rough and indented, 0.8–1.2 mm long. (Figure 3A–C)

Selected specimens examined. WESTERN AUSTRALIA: 280 mile peg, Great Eastern Highway [*c.* 49 km E of Yellowdine], 11 Sep. 1962, *T.E.H. Aplin* 1959; Rollonds Rd, Cascade, 4 July 1994, *R. Bruhn* 6/4794; 10.5 km WSW of Salmon Gums, 2 Oct. 1983, *M.A. Burgman & S. McNee* 2592; *c.* 35 km WSW of Coolgardie, 5 Sep. 1973, *N.N. Donner* 4554 (ex AD); South Ironcap, 11 Nov. 1978, *J.W. Green* 4899; Frank Hann National Park, 2 Aug. 1978, *D. Monk* 068; 2 miles [3 km] N of Daniell, 11 Sep. 1966, *K.R. Newbey* 2569.

Distribution. Distributed in the inland part of the South West Botanical Province and in the South-western Interzone of Western Australia, extending from near Mt Jackson south-east to near Salmon Gums. (Figure 2B)

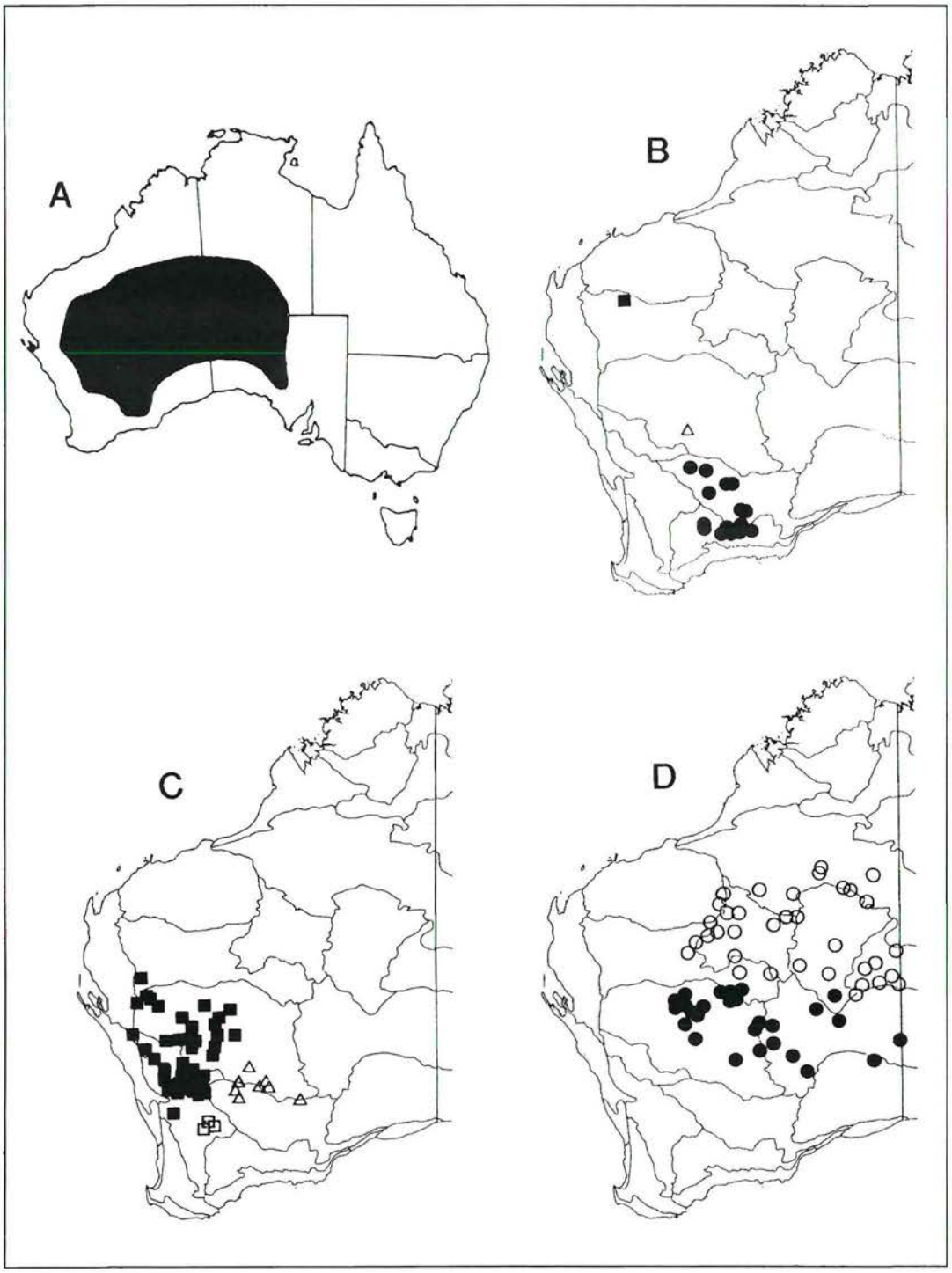

Figure 2. Geographic distribution of *Aluta*. A – whole genus; B – *Aluta appressa* ●, *A. quadrata* ■ and *A. teres* △ ; C – *Aluta aspera* subsp. *aspera* △ , *A. aspera* subsp. *localis* □ and *A. aspera* subsp. *hesperia* ■ ; D – *Aluta maisonneuvei* subsp. *auriculata* ● and subsp. *maisonneuvei* ○ in Western Australia.

Habitat. Recorded from yellow sand or from yellow-brown clayey sand and/or gravel or laterite, with the north-easternmost record from an ironstone ridge. Occurs in low to tall shrublands, sometimes dominated by *Casuarina*, *Melaleuca* or mallee *Eucalyptus* species.

Phenology. Flowers recorded from early July to September. Only two specimens are in mature fruit, one in October and one in November.

Conservation status. Not considered to be at risk at present.

Typification. Of the two type specimens at PERTH, the one chosen as lectotype has an attached label indicating that it was part of Cecil Andrews' herbarium, while the other one was evidently a duplicate that was previously part of C.A. Gardner's private herbarium.

Notes. Like *Aluta maisonneuvei*, this species has five stamens, each directly opposite the centre of a sepal, and minute staminodes (when present) opposite the centre of each petal. Other members of the genus have at least nine stamens, usually in an irregular arrangement, with up to five of the stamens opposite the sepals but with most of the stamens alternating with both the sepals and petals. *A. maisonneuvei* can be readily distinguished from *A. appressa* by the characters used in the key and also by its almost sessile leaves.

Aluta aspera (E. Pritz.) Rye & Trudgen, *comb. nov.*

Thryptomene aspera E. Pritz. (Diels & Pritzel 1904: 35, Figure 49F–M). *Type:* Comet Vale, 25 km south of Menzies, Western Australia, 28 October 1901, *L. Diels* 5163 (*lecto:* PERTH (ex B) 01620975, here selected; *isolecto:* B, destroyed).

Shrubs 0.2–3 m high; leaf-bearing branchlets 4-ridged; older stems developing a medium or dark grey bark with strips mostly firmly attached. *Leaf blades* 4-angled, with oblique lateral surfaces as broad as or broader than the usually concave adaxial surface, mucronate or lacking an apical point; oil glands in 1 or 2 rows on each lateral surface, usually prominent, up to 0.2 mm diameter. *Bracteoles* broadly ovate or with a very broad base and distal half leaf-like; membranous margins broad at base but not reaching apex. *Sepals* more or less broadly elliptic or depressed ovate and sometimes emarginate; herbaceous portion ovate to narrowly oblong, reaching apex sometimes but often broadly bordered around apex, often green at centre and with reddish margins, becoming more membranous and fading to orange in fruit, the oil glands very prominent; membranous margins not or scarcely auriculate. *Flowers* 7–12 mm diameter; disc becoming deep pink. *Petals* broadly obovate. *Stamens* usually 10, sometimes 9; anther 0.25–0.4 mm wide, reddish to almost black; gland usually translucent and somewhat yellowish at first, becoming darker and probably pinkish. *Staminodes* often a few present in the larger gaps between stamens but very reduced, tooth-like or point-like, less than 0.1 mm long. *Fruit* 1.2–2 mm long; hypanthium with a fairly prominent ornamentation of wrinkles or a reticulum enclosing small to large pits, sometimes hidden by hairs; disc 1.5–2.5 mm diameter. *Seeds* not seen at maturity.

Distribution. Occurs in Western Australia, extending from near the upper Gascoyne River south to Wongan Hills and south-east to near Yindi Station.

Typification. Two specimens were cited in the protologue; portions removed from B (Berlin) specimens of both of these former syntypes were donated to PERTH prior to the destruction of the Berlin material

during the second World War. The larger of these PERTH specimens is chosen here as the lectotype. The rejected syntype was: near Menzies, October 1901, *E. Pritzel* 841 (PERTH (ex B) 01620975).

Notes. A polymorphic taxon whose three main variants are treated here as subspecies, all appearing from the available records to be allopatric. The differences between these subspecies appear to be significant but are certainly smaller than those differentiating the five species of *Aluta* currently recognized. There is ample material of two of the subspecies but very little of the third, which is therefore of less certain status.

a. Aluta aspera (E. Pritz.) Rye & Trudgen subsp. **aspera**

Illustration. Diels & Pritzel (1904: Figure 49F–M).

Shrubs 0.2–1.1 m high, usually rather dense, sparsely to moderately densely 'hairy' on young stems, leaves and bracteoles; leaf-bearing branchlets arising mostly at angles of 30–60 degrees, usually short; leaves usually crowded on end of branchets; 'hairs' simple or branched, patent, 0.2–0.4 mm long, coarse. *Petioles* up to 0.7 mm long. *Leaf blades* narrowly oblong or narrowly obovate to obovate in outline, 3–5.5 x 0.8–1.4 mm. *Inflorescence* usually with 1–5 pairs of flowers densely clustered, but occasionally with up to 7 widely spaced pairs of flowers per group; peduncles 0.5–1.5 mm long. *Bracteoles* 2–3 mm long; membranous margins 0.3–0.8 mm wide, minutely ciliate-denticulate. *Flowers* 9–12 mm diameter. *Sepals* 1–2 mm long, minutely ciliate, sometimes also with a few hairs on outer surface. *Petals* 3.5–5.5 mm long, white, denticulate. *Stamens*: filament 1.3–2 mm long. *Style* 0.9–1.2 mm long. *Fruit* with hypanthium densely covered by curved or curly hairs. (Figure 3D)

Selected specimens examined. WESTERN AUSTRALIA: 2 miles [3 km] W of Musson's Soak, 10 Sep. 1970, *J.S. Beard* 6256; 17 km SE of Johnson Rocks, Walling Rock Station, 15 Sep. 1988, *R.J. Cranfield* 7476; 5 km N of Comet Vale, 5 July 1995, *R.J. Cranfield* 9849; 1 mile [1.6 km] N of Comet Vale, 17 Sep. 1927, *C.A. Gardner* 1927; *c.* 1.6 km SW of North West Peak, Mt Manning Range, 4 Nov. 1995, *N. Gibson & B. Moyle* 3260; 64.5 km by road E of Comet Vale and 2.2 km E of the grid at eastern boundary of Goongarrie National Park, 24 Apr. 1991, *T.D. Macfarlane* 1897; 15 km NE of Bungalbin Hill, 1 Dec. 1981, *K.R. Newbey* 9432; 10 miles [16 km] SW of Yindi, 11 Oct. 1974, *E. Wittwer* 1368.

Distribution. Occurs in the South-western Interzone, extending from between Johnson Rocks and Bungalbin Hill east to near Yindi Station. (Figure 2C)

Habitat. Recorded from sand or sandy clay, the soil often yellow but sometimes brown or red, sometimes with laterite and one record from granite. The vegetation may be dominated by mallees (*Eucalyptus*) or by *Banksia*.

Phenology. Flowers: July to November. Fruits: October to December.

Conservation status. Probably not at risk at present.

Notes. This is the only 'hairy' member of the genus (see morphology section above). It usually has longer stamens than the other two subspecies of *A. aspera*, and occurs well inland in the south-eastern part of the species range. Unlike the other two subspecies, subsp. *aspera* appears always to have white flowers.

b. Aluta aspera subsp. **hesperia** Rye & Trudgen, *subsp. nov.*

Ab aliis subspeciebus floribus minoribus et foliis integris vel grosse dentatis recedit.

Typus: near east bank of Lake Moore, *c.* 51 km north of Cleary, Western Australia, 2 September 1967, *P.G. Wilson* 6124 (*holo:* PERTH 02186500; *iso:* CANB, K, MEL).

Shrubs 0.4–3 m high, often widely spreading, glabrous; leaf-bearing branchlets arising mostly at angles of 25–50 degrees, usually long and slender; leaves usually not very crowded. *Petioles* up to 0.8 mm long. *Leaf blades* narrowly to broadly obovate in outline, 1.5–4.5(5.5) x 0.7–2.3 mm, entire or coarsely denticulate. *Inflorescence* of usually 1–4 pairs of flowers in a tight cluster but sometimes up to 8 pairs in a cylindrical arrangement; peduncles 0.4–1.5 mm long. *Bracteoles* 1.3–3 mm long; membranous margins 0.3–0.8 mm wide, entire. *Flowers* 7–10(11) mm diameter. *Sepals* 1–2.5 mm long; herbaceous portion ovate to narrowly oblong, reaching apex sometimes but often broadly bordered around apex; membranous margin(s) entire. *Petals* 2.5–4(5) mm long, white or pink, usually entire or somewhat crenulate, rarely denticulate. *Stamens*: filament 0.7–1.4 mm long, white to deep pink. *Style* 0.8–1.3 mm long. *Fruit* glabrous. (Figure 3E–I)

Selected specimens examined. WESTERN AUSTRALIA: Dairy Creek Station, 21 Aug. 1965, *J.S. Beard* 4358; Byro Station, *c.* 28 km NW of the Mullewa–Gascoyne Junction road on road to Woodleigh Station, 12 Sep. 1985, *B.J. Conn* 2082 (ex NSW); 1.5 km S of Jingermarra Homestead, 27 June 1985, *R.J. Cranfield* 5250; Weld Range, 21 July 1966, *A.R. Fairall* 1837; Mount Magnet, 12 July 1931, *C.A. Gardner* 2247; 20 km WNW of Youangarra, Paynes Find–Sandstone road, 24 June 1995, *S. Patrick* 2289; Wongan Hills, *P. Roberts* 205; 14 miles [23 km] W of Sandstone, 17 Oct. 1972, *R.D. Royce* 10478; 1 mile [1.6 km] S of Caron, 15 Oct. 1972, *C.I. Stacey* 215; 37.3 km N of Wubin on Great Northern Highway, 30 Aug. 1975, *M.E. Trudgen* 1418; Tallering Peak, 14 Sep. 1978, *M.E. Trudgen* 2227.

Distribution. Occurs in the Eremean and South West Botanical Provinces, extending from Dairy Creek Station (near the upper Gascoyne River) south to Wongan Hills and south-east to near Sandstone. (Figure 2C)

Habitat. Recorded from sand or sandy clay, the soil often yellow but sometimes brown or red, sometimes on breakaways or other rocky sites. The associated vegetation commonly includes *Acacia* as one of the dominants, often also *Casuarina* and *Eucalyptus*.

Phenology. Flowers: March to October, especially May to September. Fruits: recorded August to November.

Conservation status. A widespread taxon not considered to be at risk.

Etymology. From the Latin *hesperia* – western, referring to the distribution of this subspecies, which extends further west than any other member of the genus *Aluta.*

Notes. This variant has a much larger distribution than the other two subspecies but apparently does not overlap with either of them, occupying the northern and western parts of the species distribution. It usually has smaller flowers than the other subspecies but there are occasional large-flowered

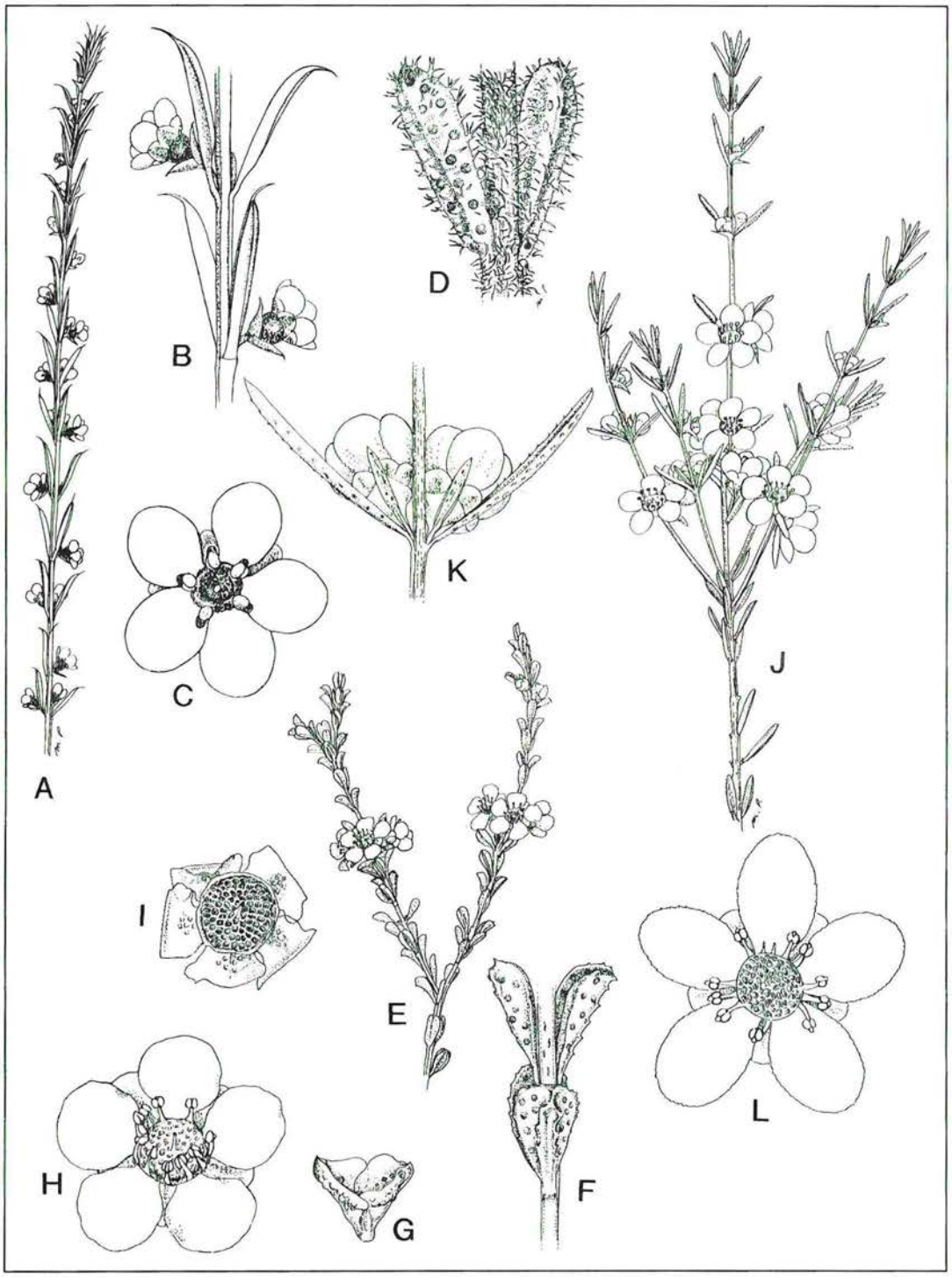

Figure 3. A–C. *Aluta appressa*. A – flowering branch (x1), B – portion of flowering stem (x4), C – top view of flower (x6); D – *Aluta aspera* subsp. *aspera*, portion of stem and pair of leaves (x7.5); E–I. *Aluta aspera* subsp. *hesperia*. E – flowering branch (x1), F – portion of stem with paired leaves (x5), G – bracteoles (x5), H – top view of flower (x4), I – disc and sepals in fruit (x5); J–L. *Aluta aspera* subsp. *localis*. J – flowering branch (x1), K – portion of flowering stem (x3), L – top view of flower (x4). Drawn from *K.R. Newbey* 5629 (A,B), *J.S. Beard* 4751 (C), *R.J. Cranfield* 9849 (D), *S. Patrick* 2268 (E–H), *R.J. Cranfield* 6203 (I) and *N. & P. Moyle s.n.* (J–L).

specimens. It has been known as *Thryptomene aspera* subsp. *glabra* J.W. Green ms. and also by the phrase name *Thryptomene aspera* subsp. Paynes Find (*C.A. Gardner* 11996).

c. Aluta aspera subsp. **localis** Rye & Trudgen, *subsp. nov.*

A subspecie typica foliis glabris vel minus pilosis et sepalis integris recedit.

Typus: Mukinbudin, Western Australia, 21 October 1991, *T. Squire* 2 (*holo:* PERTH 02159449; *iso:* CANB.)

Shrubs height not recorded, glabrous except for the leaf blades; leaf-bearing branchlets arising mostly at angles of 15–30 degrees, long and slender. *Petioles* up to 1.3 mm long. *Leaf blades* linear to narrowly obovate or narrowly ovate in outline, 4–13 x 0.9–1.3 mm, with the 4 longitudinal ridges of the leaf finely denticulate to shortly ciliate, the cilia less than 0.1 mm long. *Inflorescence* with usually 4–8 pairs of flowers per group; peduncles 0.5–1.5 mm long. *Bracteoles* 3–5 mm long; membranous margins sometimes only in basal half of bracteole, 0.8–1.0 mm wide, entire. *Flowers* 9–12 mm diameter. *Sepals* 1.5–2 mm long, entire. *Petals* 3.5–5.5 mm long, pale pink (based on single record), denticulate. *Stamens:* filament 0.8–1.3 mm long. *Style c.* 0.6 mm long. *Fruit* glabrous. (Figure 3J–L)

Specimens examined. WESTERN AUSTRALIA: N of Mukinbudin [precise locality withheld], 6 Nov. 1988, *N. & P. Moyle s.n.*; 'N.' [N of] Korrelocking, 24 Nov. 1959; *S.B. Rosier* 247; N of Gabbin, 27 Oct. 1963; *S.B. Rosier* 368.

Distribution. Occurs in the South West Botanical Province, recorded from north of Gabbin south to near Korrelocking and east to Mukinbudin. (Figure 2C)

Habitat. One of the Mukinbudin specimens is recorded from sandplain. No other habitat details are known.

Phenology. Flowers and fruits: October to November.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority One. Recorded from three or four localities in the wheatbelt.

Etymology. From the Latin *localis* – local, referring to the localized occurrence of the few known populations of this subspecies.

Notes. This variant has been known by the phrase names *Thryptomene aspera* subsp. Mukinbudin (*N. & P. Moyle s.n.*) and *Thryptomene aspera* subsp. Gabbin (*S.B. Rosier* 368), the former tending to have longer leaves than the latter but no significant differences.

This subspecies occurs south-west of the range of subsp. *aspera* and south-east of the range of subsp. *hesperia*. It is intermediate between the other two subspecies in leaf indumentum and perhaps in floral morphology, having the large flowers typical of subsp. *aspera* combined with the short stamens typical of subsp. *hesperia*, but tends to have longer leaves and bracteoles than both of them. The specimens of subsp. *localis* with the larger leaves and flowers are not in fruit, so the fruiting measurements given above apply only to the smaller specimens. Even so, this subspecies apparently tends to have shorter styles than the other two subspecies.

Aluta maisonneuvei (F. Muell.) Rye & Trudgen, *comb. nov.*

Thryptomene maisonneuvei F. Muell. (Mueller 1864: 64–65). *Type:* Finke River, central Australia [Northern Territory], *J.M. Stuart* (*holo:* MEL 70712).

Shrubs 0.3–1.5(1.8) m high, often widely spreading, up to 2.5 m wide, glabrous; leaf-bearing branchlets mostly arising at angles of 30–60 degrees, somewhat indented on the 4 angles; leaves fairly crowded on the branchlets, almost appressed to patent but usually widely antrorse; older stems developing flaky deep red-brown bark with loose strips readily shed. *Petioles* less than 0.2 mm long. *Leaf blades* narrowly obovate to depressed elliptic in outline, 1–2.5 x 0.7–1.6 mm, 4-angled and prominently 4-ridged, with a flat abaxial surface broader than the oblique or perpendicular lateral surfaces, the abaxial surface often somewhat concave, the ridges smooth to coarsely denticulate, scarcely pointed at apex; glands usually 2–6 prominent ones in 1 or 2 rows (sometimes more when in 2 rows) on each lateral surface, usually few or no prominent glands elsewhere, up to 0.1 mm diameter. Inflorescence with 1–3(5) pairs of flowers in an almost terminal cluster or rarely in more than one cluster per branchlet; peduncles up to 0.8 mm long but often very reduced. *Bracteoles* very broadly ovate, 1–1.8 mm long, acute and with a minute to prominent apical point; membranous margins 0.2–0.4 mm wide, minutely denticulate or entire. *Flowers* 4.5–6 mm diameter; disc pink or red. *Sepals* broadly to depressed ovate, 0.5–1.3 mm long not including auricles; vegetative portion reaching or almost reaching apex, ovate or narrowly ovate, keeled and incurved at apex, often reddish; auricles usually prominent, extending laterally and usually also somewhat to far below the base of the sepal, up to 0.6 mm below base of sepal, denticulate. *Petals* almost circular, 1.7–2.5 mm long, white or pink, denticulate. *Stamens* 5(6), opposite the sepals, sometimes alternating with staminodes; filament 0.5–1 mm long, pink to red; anther *c.* 0.3 mm wide; gland often reddish. *Staminodes* usually less than 0.1 mm long but prominent and up to *c.* 0.8 mm long in some specimens. *Ovules* 4. *Style* 0.5–1 mm long. *Fruit* depressed globular to broadly ellipsoid with an almost truncate to strongly convex apex, 1.5–2 mm long, very rarely fertile, when fertile 1-seeded; disc 1.8–2.3 mm diameter. *Seed* aligned across the fruit, probably somewhat reniform and *c.* 1.1 mm long.

Distribution. Distributed from Meekatharra in the Eremean Botanical Province of Western Australia east to Simpson Desert in Northern Territory and south-east to near Lake Acraman in South Australia (Green 1980: Map 1). See also Figure 4.

Habitat. Through most of its range *Aluta maisonneuvei* occurs commonly with spinifex on red sand dunes (both on and between the ridges) and sandplains, and is often the dominent species in open shrublands, although sometimes the dominant species are mallees or other *Eucalyptus* species or occasionally other genera such as *Casuarina* and *Acacia*. However from Meekatharra east to Wongawol Station, most specimens are from high rocky sites, e.g. the tops of breakaways, and the soil is sometimes yellow and/or clayey.

Chromosome number. 2n = *c.* 22 (Rye 1979). The single chromosome number record is from subsp. *auriculata*. The voucher specimen (*B.L. Powell* 73097) was collected from Lorna Glen Station, with no habitat recorded. Judging by its location and the shape of its leaves, however, this specimen appears to be a representive of the 'breakaways' variant of the species that occurs on an atypical high rocky habitat.

Conservation status. Both subspecies have abundant populations over a wide distribution.

Phenology. Flowers mainly recorded April to October, but probably occurring at any month of the year provided there has been sufficient rainfall to stimulate flowering. Fruiting quickly follows, but seed set is very poor. In a sample of 100 fruits of *A. maisonneuvei* ordered from a seed company, only eight contained a seed (Rye & James 1992), the average seed length in this sample being 1.1 mm and the average seed weight 0.41 mgm. No mature seeds were found in fruits sampled from the herbarium specimens examined in the present study, and Green (1980) also failed to locate mature seeds.

Notes. This species differs from all other members of the genus in its very loose flaky red-brown bark and its indented rather than 4-ridged branchlets having each of the internodes on the four surfaces distinctly swollen. It is possibly the only member of the genus to have only one seed per fruit, but seed characters are too poorly known in this genus to draw any definite conclusions.

Not surprisingly in a species with such a wide distribution, there is great variation in vegetative, floral and fruiting characters. For example, the sepal auricles show enormous variation, occasionally being so large that they are about as long as the body of the sepals, but at the other extreme being level with the base of the sepal body (i.e. not extended at all below it). Nearly all flowers have 5 stamens, but very rare 6-staminate flowers have been observed, with two stamens borne opposite one of the sepals.

Other morphological variation within the species is discussed under the two subspecies, which are distinguished primarily by leaf characters.

a. Aluta maisonneuvei (F. Muell.) Rye & Trudgen subsp. **maisonneuvei**

Illustration. Green (1980: Figures 1–11).

Leaf blades mostly broadly obovate to almost circular in outline, sometimes obovate or depressed elliptic, 1–2.5 x 1.2–1.6 mm; lateral surfaces very oblique, at *c.* 45 degrees or more to the perpendicular (i.e. usually closer to horizontal than perpendicular), 0.5–0.7 mm wide, with prominent glands usually in 2 rows. *Fruit:* hypanthium usually with a reticulate pattern of ridges surrounding small to large pits, each pit with a central oil gland, rarely with the surface more closely wrinkled and scarcely pitted.

Selected specimens examined (typical variant). WESTERN AUSTRALIA: 16 km N of Kumarina, 31 Oct. 1978, *H. Demarz* 6974; E of Savory Creek, 13 June 1984, *G.J. Morse* 141 (ex CBG); Blackstone Ranges, Wingelina nickel mines, 8 Jan. 1973, *D.E. Symon* 8381 (ex ADW); 5.5 km WSW of Cooma Well, 23.8 km WNW of Moffettah Well, 8 Aug. 1991, *S. van Leeuwin* 934; Rudall, 23 May 1983, *K. Walker* 274.
NORTHERN TERRITORY: 22 miles [35 km] S of Henbury Homestead, 5 Aug. 1954, *G. Chippendale* 145 (ex NT); NW Simpson Desert, 24° 42'S, 135° 52'E, 25 Aug. 1977, *P.K. Latz* 7439; Lake Neale, 28 Aug. 1973, *J.R. Maconochie* 1881 (ex NT).

Selected specimens examined (atypical variant). WESTERN AUSTRALIA: 51.2 miles [82.4 km] from Carnegie Station on way to Mt Everard, 27 July 1966, A.R. Fairall 2010; between Blackstone and Cavanagh Ranges, 22 July 1963, *A.S. George* 5266.
NORTHERN TERRITORY: 2 miles [3 km] SSE of Santa Teresa Mission, 18 Aug. 1956, *M. Lazarides* 5739 (ex CANB); 100 km W on Lasseter Highway to Ayers Rock, 29 Oct. 1989 *B. Nordenstam & A. Anderberg* 924 (ex S).
SOUTH AUSTRALIA: Birksgate Range, May 1969, *J.R. Ford*; Mt Davies road, *c.* 80 km W of Musgrave Park Station, 30 Oct. 1966, *J.Z. Weber* 208 (ex AD).

Distribution. Distributed from Kumarina in the Eremean Botanical Province of Western Australia east to Simpson Desert in Northern Territory and extending into northern South Australia. (Figures 2D, 4)

Notes. Subsp. *maisonneuvei* is distinguished from subsp. *auriculata* by its leaves with very obliquely angled lateral surfaces, each usually with two rows of prominent oil glands. Subsp. *auriculata* usually has narrower leaves, with the lateral surfaces narrower and moderately oblique to almost perpendicular and with the prominent oil glands mainly located in a single row.

The second most important difference between the two subspecies is that the fruit usually has much more prominent gaps or pitting on the floral tube ornamentation in subsp. *maisonneuvei* than in subsp. *auriculata*, the latter having a more uniformly wrinkled appearance to the floral tube. Sepal shape varies greatly in both subspecies but there appears to be some tendency for subsp. *auriculata* to have more obtuse sepals than the typical subspecies.

Within subsp. *maisonneuvei* there is considerable variation in the size of the pits on the hypanthium, a character which correlates fairly well with the width and degree of obliqueness of the lateral surfaces of the leaf. Plants from the north-western part of the subspecies range, including a majority of the Western Australian specimens, tend to have both the largest pits and the broadest and most oblique (closest to horizontal) lateral leaf surfaces. Many of the Northern Territory specimens, including the type, also have relatively large pitting on the hypanthium and broad lateral surfaces on the leaf. A second variant with less obvious pitting on the hypanthium, and sometimes also narrower lateral leaf surfaces, occurs in central Australia, overlapping with the range of the typical variant. Figure 4 shows the known distributions of the typical and atypical variants of the subspecies, the former with pits usually nearly as large and obvious as those on the disc, the latter with pits much finer than those of the disc or scarcely evident.

b. Aluta maisonneuvei subsp. **auriculata** (F. Muell.) Rye & Trudgen, *comb. nov.*

Thryptomene auriculata F. Muell. (Mueller 1876: 24). *Type:* between Youldeh [Ooldea] and Ouldabinna [east of Lake Dey-Dey], [South Australia], 13 July 1875, *Young* (*lecto:* MEL 70713, here designated).

Illustration. Green (1986: Figure 485D).

Leaf blades narrowly obovate to broadly ovate in outline but mostly more or less obovate, 1.3–2.3 x 0.7–1.2 mm; lateral surfaces somewhat oblique or perpendicular, if oblique then deviating by less than *c.* 30 degrees from the perpendicular, 0.3–0.4(0.45) mm wide; prominent glands in 1 row on each lateral surface. *Fruit:* hypanthium either closely wrinkled or relatively smooth and glossy, gaps or pits between the wrinkles either very small or absent.

Selected specimens examined (typical variant). WESTERN AUSTRALIA: 11 miles [18 km] E of Eeldoun, 18 Aug. 1960, *A.R. Main*; between Tjidichurra Waterhole and South Australian border on Connie Sue Highway, 26 Aug. 1980, *D.E. Symon* 12666 (ex ADW).
SOUTH AUSTRALIA: Serpentine Lakes, 34 km N of Vokes Hill road junction, 7 Aug. 1979, *V. Levitske* 204 (ex AD) Serpentine Lakes (unnamed conservation park), 14.7 km E of the Western Australian border on the Vokes Hill track, 31 July 1979, *L.D. Williams* 10722 (ex AD).

Selected specimens examined (atypical variant on sand). WESTERN AUSTRALIA: De La Poer Range Nature Reserve, 18 Oct. 1996, *A. Chapman et al.* DLP 13; *c.* 35 km W of Plumridge Lakes, 8 km WNW

of Salt Creek airstrip, 15 Sep. 1979, *M.D. Crisp* 5821, *J. Taylor & R. Jackson* (ex CBG); 23 miles [37 km] NE of Cosmo Newberry, 24 Aug. 1961, *A.S. George* 2874; 14 miles [23 km] SE of Murchison Downs, 28 Aug. 1958, *N.H. Speck* 1311 (ex CANB).

Selected specimens examined (atypical variant on breakaways). WESTERN AUSTRALIA: *c.* 49 km NE of Meekatharra on road to Wiluna, 6 Sep. 1985, *B.J. Conn* 1987 (ex NSW); 1.7 km E of Andrews Bore, Yoothapina Station, 12 Aug. 1986, *R.J. Cranfield* 5662; 7 km from Wongawol Homestead on the Wiluna road, 7 Sep. 1982, *L.A. Craven* 7518 (ex CANB); top of breakaway 7.9 km E of Coglad Downs Station on road to Sandstone, 22 June 1995, *S. Patrick* 2279.

Distribution. Distributed from Meekatharra in the Eremean Botanical Province of Western Australia east to the Serpentine Lakes area of South Australia and extending south-east in South Australia at least to the Ooldea area. (Figures 2D, 4)

Typification. The lectotype chosen here comprises two mounted branches and the sheet has a note attached stating "Thryptomene auriculata appears to be a form of T. maisonneuvei", apparently in Mueller's handwriting. There is also material from at least one other collection in a packet attached to the lectotype's sheet; this contains fragmentary pieces of more than one species, including some of *Aluta maisonneuvei* that may have been one of the syntypes (now excluded) cited by Mueller.

Notes. Black (1926) included *Thyryptomene auriculata* as a synonym of *T. maisonneuvei* and this was followed by subsequent authors such as Green (1983). While *T. auriculata* does not appear to be sufficiently distinct to reinstate as a species, it does show differences that appear to be significant enough to justify the subspecific rank assigned to it here. Apart from the morphological differences outlined in the key and in the notes under subsp. *maisonneuvei*, the two subspecies are largely, or perhaps fully, geographically separated as is evident from the distribution maps (Figures 2D, 4).

The lectotype of *Aluta maisonneuvei* subsp. *auriculata* has a relatively smooth glossy hypanthium, matching several other specimens examined from South Australia and also two specimens from the Great Victoria Desert in the south-east of Western Australia. A second variant appears from the available records to be allopatric, occurring further west in Western Australia from the Meekatharra area to the Plumbridge Lakes area. It has a more patterned dull hypanthium than the typical variant, its fruiting hypanthium being intricately wrinkled-tuberculate, with no distinct pits or with very small pits between the wrinkles. Most specimens of this variant apparently occur, like all other variants of *Aluta maisonneuvei*, on sand dune or sandplain habitats, but at least nine specimens are known from elevated rocky habitats such as breakaways. This 'breakaways subvariant' tends to be a slightly smaller plant (0.3 to 1.2 m high) than all other variants of both subspecies (mostly 0.5 to 1.5 m high) and to have narrower leaves. It has predominently narrowly obovate or obovate leaves whereas specimens of subsp. *auriculata* occurring in sandy habitats more commonly have obovate to broadly ovate leaves. The breakaways subvariant occurs in the far west of the subspecies range, extending from Meekatharra south to Coglad Downs Station and east to Wongawol Station, but overlaps in distribution with the 'sand subvariant'. See Figure 4 for an illustration of the distributions of these variants.

Aluta quadrata Rye & Trudgen, *sp. nov.*

Ab aliis speciebus foliis 4-porcatis in sectione transversali quadratis, staminum circa 15, ovulis circa 6 differt.

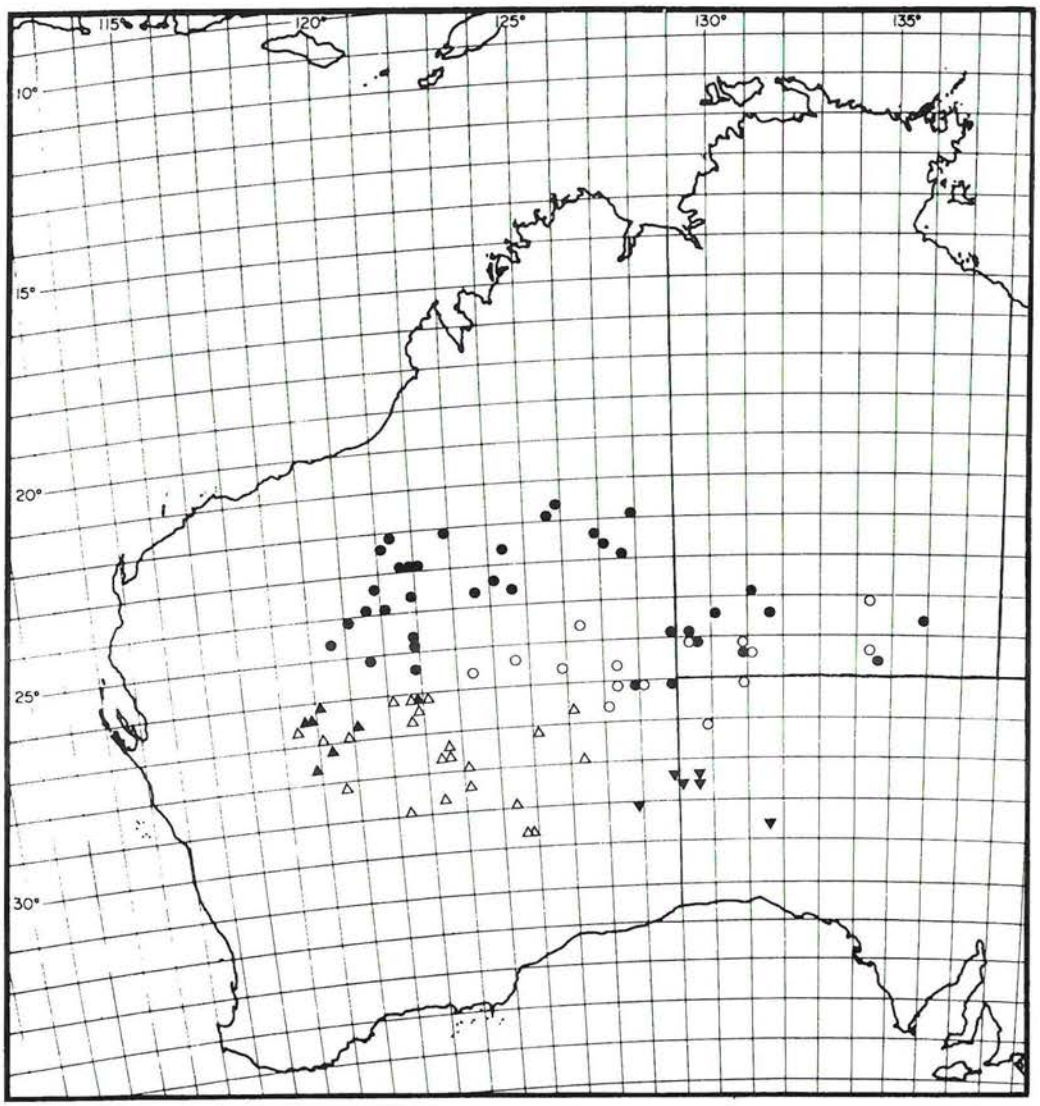

Figure 4. Distribution of the variants of *Aluta maisonneuvei*. Subsp. *auriculata* (known range outlined): typical variant ▼, atypical variant on sand or of unknown habitat △ and atypical variant on breakaways ▲. Subsp. *maisonneuvei*: typical (i.e. large-pitted) variant ● and atypical variant (including immature specimens that could belong to either variant) ○.

Typus: near Paraburdoo [precise locality withheld], Western Australia, 7 June 1985, *M.E. Trudgen* 4920 (*holo:* PERTH 05513987; *iso:* CANB, K, MEL, NSW).

Shrubs 0.8–2.6 m high, sometimes spreading wider than the height, up to 3.5 m across, glabrous; leaf-bearing branchlets arising at angles of 25–60 degrees, prominently 4-ridged; leaves densely clustered on the branchlets, antrorse to patent, tending to be slightly incurved towards apex; older stems developing a dark grey bark with small patches or fine strips appearing almost fibrous. *Petioles* up to

1.4 mm long. *Leaf blades* linear in outline, 15–20 x 0.5–1 mm, 4-angled and almost square in cross-section, with all faces about equal in width and the lateral ones perpendicular to the others, either flat or somewhat indented along the middle of each face, acute at apex and with an erect to incurved apical point; glands prominent and widespread, the largest ones either circular and *c.* 0.1 mm diameter or ellipsoid and almost 0.2 mm long. *Inflorescence* with flowers in 1–4 pairs in a small cluster on each branchlet; peduncles 0.3–0.5 mm long. Bracteoles broadly or very broadly ovate, 2.5–3.5 mm long, acuminate; membranous margins 0.7–1.3 mm wide. *Flowers* 8–10 mm diameter; disc pale green at first. *Sepals* more or less depressed ovate, 1–1.3 mm long; herbaceous portion broadly triangular, green, not reaching apex; membranous margin denticulate, auriculate. *Petals* 5, broadly obovate, *c.* 3.5 mm long, white, usually denticulate. *Stamens* 15–22, usually rather irregularly arranged, occurring both opposite and alternate to the sepals and petals but tending to be more common opposite the sepals than the petals; filament 1–1.4 mm long, white; anther *c.* 0.5 mm wide, brownish; gland colour not recorded. *Staminodes* up to 3 often present opposite the petals but very reduced, tooth-like, up to 0.1 mm long. *Ovules c.* 6. *Style* 0.7–0.9 mm long. *Fruit c.* 2.5 mm long but probably not fully mature, the sepal bases pitted-rugose similar to the hypanthium; hypanthium rather prominently but minutely pitted; disc *c.* 2.7 mm diameter. *Seeds* apparently several per fruit, not seen at maturity. (Figure 5A–F)

Other specimens examined. WESTERN AUSTRALIA, near Paraburdoo [precise localities withheld]: 7 June 1985, *M.E. Trudgen* 4913; 12 June 1985, *M.E. Trudgen* 4995; 22 Oct. 1985, *CK* 402; 26 Oct. 1985, *M.E. Trudgen* 5349, 5350; 26 Oct. 1985, *M.E. Trudgen* 5351.

Distribution. Endemic to the Pilbara region in the Eremean Botanical Province of Western Australia, occurring west and east of Paraburdoo. (Figure 2B)

Habitat. Recorded on the edge of creek beds, at the base of cliffs, in cracks on the cliff face, and near the crest of a large ridge.

Phenology. Flowers recorded in June. Fruits recorded in late October.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority One. Known from a number of populations extending along a range of hills for a distance of *c.* 50 km.

Etymology. From the Latin *quadratus* – square, in reference to the square shape, in cross-section, of both the leaves and the young stems.

Notes. This species has been known by the phrase name *Thryptomene* sp. Mt Channar (*M.E. Trudgen* 4920). It probably has more primitive features than any other members of the genus, having more numerous stamens and ovules, all other species having 5 or *c.* 10 stamens and 4 ovules. The anthers also appear to be primitive in that the cells (from inner view) sometimes have a distinct narrow gap between them through which the connective can be seen, the fusion of the cells being only via the connective. In other species the cells appear to be closely united not only to the connective but also to one another.

Aluta quadrata can also be readily distinguished by its vegetative morphology. It has larger leaves than the other species and is the only member of the genus to regularly have perpendicular rather than oblique lateral surfaces on the leaves, with all four surfaces about equal in size. *A. maisonneuvei* subsp. *auriculata* also tends to have perpendicular or almost perpendicular surfaces on the leaf, but this taxon has very small leaves.

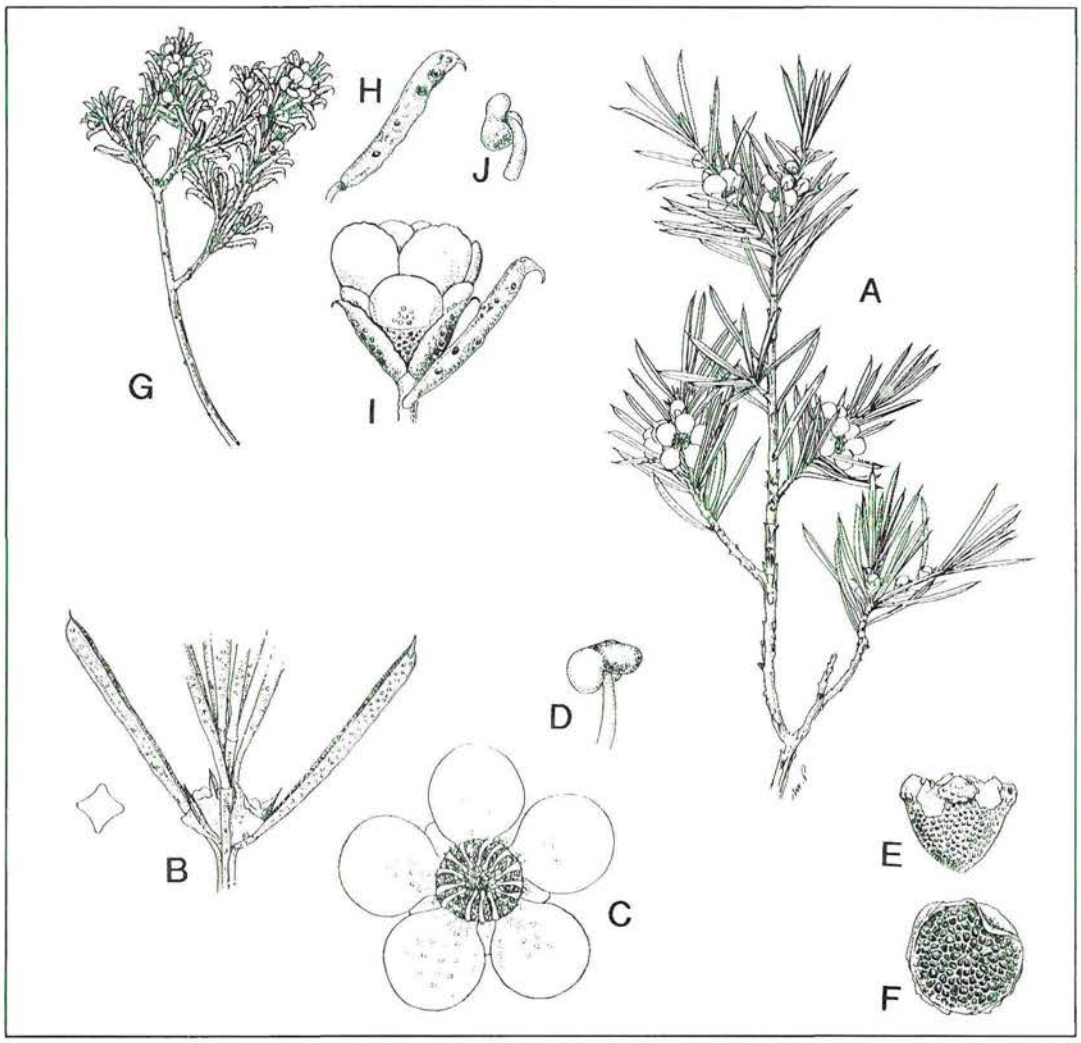

Figure 5. A–F. *Aluta quadrata*. A – flowering branch (x1), B – leaves and axillary flower buds enclosed in bracteoles (x3), with enlarged cross-sectional outline of leaf, C – top view of flower (x4), D – stamen (x20), E – hypanthium and auriculate sepals in fruit (x5), F – disc and sepals in fruit (x5); G–J. *Aluta teres*. G – flowering branch (x1), H – leaf (x5), I – flower with bracteoles and subtending leaf (x5), J – stamen (x20). Drawn from *M.E. Trudgen* 4920 (A–D), *M.E. Trudgen* 5349 (E,F) and *S. Van Vreeswyk* 3138 (G–J).

Aluta quadrata occurs outside the range of most of the members in the *Thryptomene* and *Baeckea* groups of genera. The only species occurring in the same region as *A. quadrata* is currently known as *Thryptomene wittweri* J.W. Green and has a scattered distribution over a large part of the arid zone. It occurs on a different habitat, and differs in many characters including its ribbed floral tube and much fewer stamens.

Aluta teres Rye & Trudgen, *sp. nov.*

Differt a *Aluta aspera* foliis magis teretibus acumine apicali recurvo prominenti.

Typus: Bulga Downs Station [precise locality withheld], Western Australia, 16 September 1992, *S. Van Vreeswyk* 3138 (*holo:* PERTH 04201558; *iso:* CANB).

Shrub c. 0.4 m high, erect, glabrous; leaf-bearing branchlets mostly arising at angles of 30–90 degrees, rather short, somewhat 4-ridged; leaves densely clustered on the branchlets, antrorse to patent, distally recurved; older stems developing a dark grey bark with strips mostly firmly attached. *Petioles* up to 0.6 mm long. *Leaf blades* almost linear in outline, 3.5–4.5 x *c.* 0.6 mm, almost terete but with very prominent bulging glands giving an irregular outline, tapered at apex to a prominent recurved point *c.* 0.5 mm long; glands mainly in two irregular lateral rows of 3–6, one row on each side of leaf, *c.* 0.2 mm diameter. *Inflorescence* with flowers in 1–4 pairs in a small subterminal cluster on each branchlet; peduncles *c.* 0.5 mm long. *Bracteoles* more or less ovate, *c.* 3 mm long, with a recurved apical point; membranous margins 0.2–0.4 mm wide. *Flowers* 7–8 mm diameter. *Sepals* more or less depressed ovate, *c.* 1.3 mm long, largely membranous, not or scarcely auriculate; vegetative portion not reaching apex, often pinkish. *Petals* almost circular, *c.* 3 mm long, probably white or pale pink, entire, slightly crenulate. *Stamens* 9 or 10, a few opposite the sepals and the rest alternating with both sepals and petals; filament *c.* 0.7 mm long; anther *c.* 0.3 mm wide, red-brown; gland apparently somewhat paler than anther cells at first. *Staminodes* often a few present in the larger gaps between stamens but very reduced, tooth-like, less than 0.1 mm long. *Ovules* 4. *Fruit* not seen at maturity. (Figure 5G–J)

Distribution. Recorded from Bulga Downs Station (south-east of Sandstone) in the Eremean Botanical Province of Western Australia. (Figure 2B).

Habitat. Red clayey sand over hard pan on a broad plain with spinifex dominated by *Eucalyptus gongylocarpa*.

Phenology. Flowers recorded in September.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority One. This species is known only from the type collection.

Etymology. From the Latin *teres* – rounded, cylindrical, in reference to the terete leaves.

Notes. The single collection of this species is in bud with a few flowers just opening, so the style is too immature to measure and fruits are unknown, but the characteristic features of the genus are clearly evident. The phrase name *Malleostemon* sp. Bulga Downs (*S. Van Vreeswyk* 3138) has been applied to it.

Aluta teres differs from all other members of the genus in its more terete leaves with more protruding oil glands. There is some evidence near the apex of the 4-angled leaf cross-section found in all the other species, but below this the leaf shape is distorted by the bulging oil glands, giving the leaves an irregular outline.

Like its closest relative *A. aspera*, it has *c.* 10 stamens, and there are no obvious floral differences between the two species. *A. teres* is readily distinguished from *A. aspera* by the prominent recurved points on its leaves and bracteoles as well as by the other leaf characters noted above.

Acknowledgements

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New taxa in *Goodenia* (Goodeniaceae) from the south-west of Western Australia, with an update to the *Goodenia* key in the Flora of Australia

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Abstract

Sage, L.W. New taxa in *Goodenia* (Goodeniaceae) from the south-west of Western Australia with an update to the *Goodenia* key in the Flora of Australia. *Nuytsia* 13(2): 367–377 (2000). Two new species of *Goodenia* from the South West Botanical Province, *G. heatheriana* Sage and *G. lancifolia* Sage & Cranfield are described, illustrated and mapped. *G. heatheriana* has conservation priority while *G. lancifolia* is apparently common throughout its known range. Two subspecies are recognized for the Western Australian species *Goodenia scapigera* R. Br. The type subspecies is widespread in sandy soils of the south-west of the state, whereas the newly named subspecies *graniticola* Sage is restricted to granitic habitats in the vicinity of Peak Charles National Park and has conservation priority. Both subspecies are mapped and illustrated. An error in the key to *Goodenia* species given in "Flora of Australia" Volume 35 is corrected and the key is updated for the new species.

Introduction

As part of an overall review of the genus *Goodenia* Smith (Goodeniaceae) in Western Australia (including conservation status and biology) the author has been working on several undescribed taxa that require formal recognition. This paper describes two new species and one new subspecies from the South West Botanical Province of Western Australia. The characters used in the description of the new species will form the basis of a DELTA database of the Goodeniaceae family being produced by the author.

The three new taxa had been collected prior to the publication of a "Flora of Australia" account of *Goodenia* (Carolin 1992), but all were still very poorly known at that stage. Recent collections have facilitated recognition of their distinctive characters. Many of the older specimens of *Goodenia* are of limited taxonomic value because they have been inadequately pressed and have had insufficient collection data recorded for them. Future collectors of this genus are urged to press the specimens as soon as possible after taking them to preserve floral details, and to note the colour of the corolla throat as well as the adaxial and abaxial lobes. Other data that can be very significant for elucidating the taxonomy of the plants are details of the plant's habit, life history (e.g. annual or perennial and whether clonal), response to fire and disease, and habitat (e.g. substrate, proximity to features such as watercourses and vegetation type).

In addition to naming the new taxa, this paper corrects a significant error in the key to the species of *Goodenia* in "Flora of Australia" and updates the key to include the two new species.

Taxonomy

Goodenia heatheriana Sage, *sp. nov.*

Goodenia pinnatifidae affinis sed sepalis minoribus, ovulis paucioribus, seminibus tantum ad c. 2 mm longis, extremitae loborum adaxialium corollae cum pilis glandularibus purpureis ornatis differt.

Typus: Parker Range [precise locality withheld for conservation purposes], Western Australia, 18 October 1994, *N. Gibson & M. Lyons* 2250 (*holo:* PERTH sheet 05312337).

Annual herb to *c.* 15 cm, spreading, acaulescent, with ± appressed stiff, sharp hairs. *Leaves* basal, narrowly ovate, lobed to entire, 4–21 x 2–10 mm, petiolate, with scattered ± adpressed stiff, sharp hairs; base attenuate to cuneate; apex rounded. *Inflorescence* a raceme to 70 mm; flowers mostly solitary; pedicels 13–42 mm long, hirsute; bracteoles absent; bracts leaf- like, hirsute, acute, 7–10 x 0.5–5 mm. *Corolla* yellow, *c.* 10 mm long, articulate below ovary, auriculate, with an indistinct pouch to *c.* 1 mm x *c.* 0.5 mm; long simple hairs inside the throat and minute glandular hairs and stiff, sharp, appressed hairs outside; long simple hairs on auricle margin; distinctive purple glandular hairs to *c.* 1 mm with glandular head to *c.* 0.2 mm outside near tip of the adaxial corolla lobe along margin. *Sepals* narrowly ovate, acute, 2–2.2 mm long, ± equal, adnate at *c.* three-quarters up the ovary, appressed stiff, sharp hairs mostly on the mid-line, apex acute. *Abaxial corolla lobes* 3.2–3.5 x 1.5–1.7 mm, fused for 3–3.5 mm further than adaxial lobes, wings to *c.* 4 x *c.* 1.5 mm, entire. *Adaxial corolla lobes c.* 4 x *c.* 1 mm, auricle *c.* 1 x 1 mm, wings 2.4–3 mm long, 1–1.4 mm wide opposite to auricle, *c.* 0.5 mm wide above auricle. *Stamen* filaments linear, 1.7–2.2 mm long; anthers 0.9–1.1 mm long. *Ovary c.* 2 mm long, hirsute with appressed stiff, sharp hairs, incompletely 2-locular; septum *c.* half as long as ovary; ovules *c.* 9, in two rows on either side of septum. *Style* 2.3–2.8 mm long; indusium *c.* 1.5 x 1.3 mm, laterally compressed or folded with a tuft of long simple hairs below and scattered simple hairs above and below, bristles on upper and lower lips ± equal, *c.* 0.2 mm long. *Fruit* (mostly immature seen) broadly ellipsoid, *c.* 1 mm long. *Seeds* ovate, flat, *c.* 2 x 1.5 mm, smooth to reticulate; body black; wing *c.* 0.3 mm, yellowish tan. (Figure 1)

Other specimen examined. WESTERN AUSTRALIA: Parker Range [precise locality withheld], 21 Sep. 1979, *K.R. Newbey* 6036 (PERTH).

Distribution. Known from the type location, south-east of Marvel Loch in the Parker Range, and one other location nearby (possibly the same one). Both localities are in the Avon Wheatbelt Interim Botanical Region near the border of the South West and Eremean Botanical Provinces. (Figure 2)

Habitat. Open low *Eucalyptus corrugata* Luehm. woodland with *Eucalyptus yilgarnensis* (Maiden) Brooker mallees, shrubs to 1–2 m and dwarf shrubs to 0.5 m (Muir 1977). Found roadside in red, crumbly clay with greenstone gravel and cobbles.

Phenology. Flowers in late September and October.

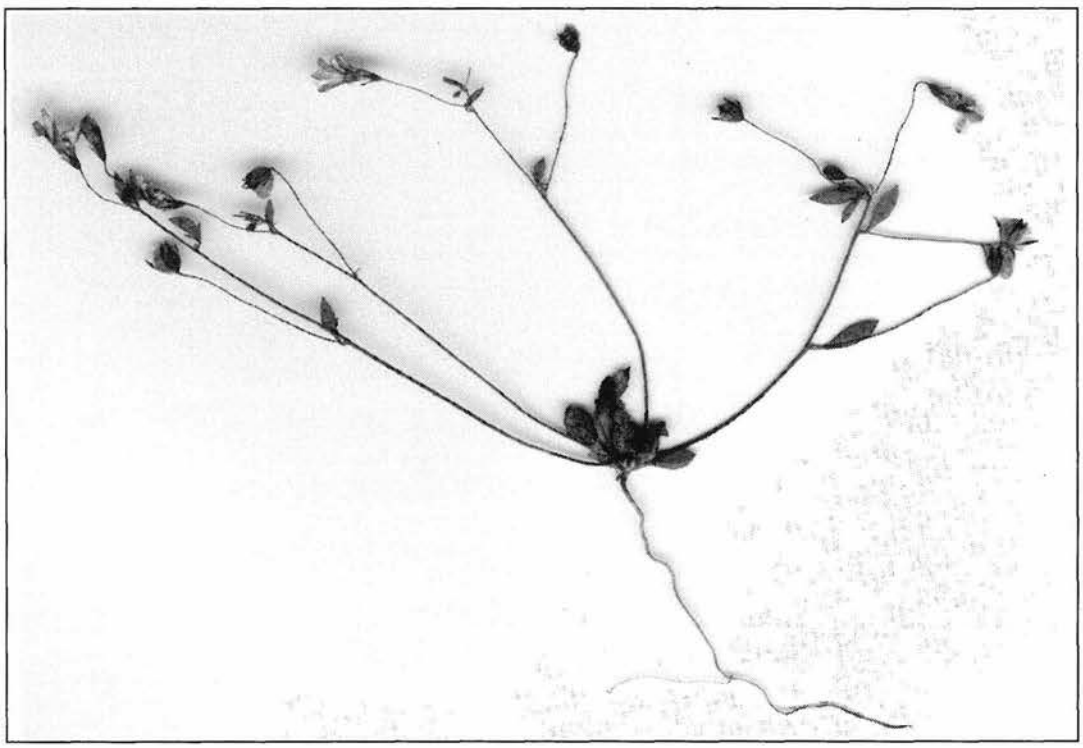

Figure 1. *Goodenia heatheriana* holotype (*N. Gibson & M. Lyons* 2250).

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority One. The species is known only from two populations (possibly the same one though not immediately apparent from discrepancies in the locality details of both known collections). It is under immediate threat from road works and requires urgent survey effort.

Etymology. Named for the author's wife, Heather Susan Roberton Sage (nee Price).

Notes. Goodenia heatheriana Sage was initially collected by the late Ken Newbey in 1979 from the Parker Range as part of a biological survey of the eastern goldfields of Western Australia. The species was recognized as distinct after a second collection of it was made by Neil Gibson and Mike Lyons, of the Department of Conservation and Land Management's Woodvale Research Centre. It was allocated the phrase name *Goodenia* sp. purple hairs (*N. Gibson & M. Lyons* 2250) as it differs from other *Goodenia* species by the presence of long purple hairs on the outside of the adaxial corolla lobes. It is related to *Goodenia pinnatifida* Schldl., which can be easily distinguished by its larger sepals (2.5–5 mm long), more numerous ovules (20–35) and larger seeds (*c.* 5 mm long).

Goodenia lancifolia Sage & Cranfield, *sp. nov.*

Goodenia leptocladae Benth. affinis sed foliis lanceolatis vel anguste lanceolatis, corollae lobis abaxialibus brevioribus, et aliis loborum corollae minoribus.

Typus: 2.2 km south-west on Black Point Rd from Stewart Rd, north-west of Pemberton, Western Australia, 29 January 2000, *L.W. Sage* 2360 *& R.J. Hazeldean* (*holo:* PERTH sheet 05539528; *iso:* AD, BRI, CANB, DNA, G, HO, K, MEL, NSW, NY, SYD).

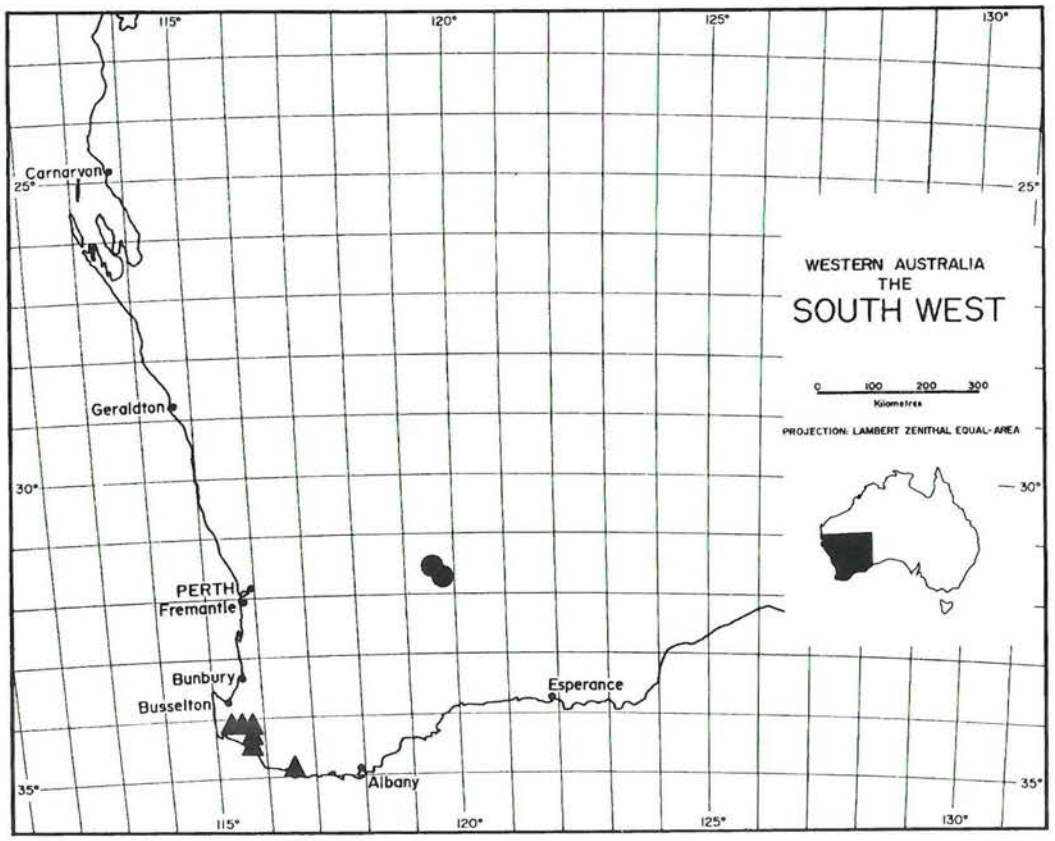

Figure 2. Distribution map of *Goodenia lancifolia* ▲ and *G. heatheriana* ●.

Perennial herb to *c.* 20 x 40 cm, sprawling to erect, open, with long, non-appressed, ± tangled hairs. *Basal leaves* linear to narrowly obovate, 14–65 x 1–4 mm; hairs scattered. *Cauline leaves* sessile, ± stem clasping, lanceolate to narrowly ovate, entire to dentate or lobed, apex acute, 7–28 x 1–5.5 mm, hairs scattered. *Inflorescence* a raceme to *c.* 25 cm long, axis ± flexuose; peduncles 3–32 mm long; bracts leaf like, acute, 7–30 x 1–5 mm, with scattered hairs; pedicels 0–8 mm long, hirsute; bracteoles 2–9 mm long, narrowly lanceolate to linear, acute. *Corolla* dark blue or blue with a white throat, 6–12 mm long, auriculate; tube 0.3–0.8 mm long; pouch absent or obscure; hairs inside corolla throat, enations absent or obscure, long non-adpressed hairs outside, simple hairs on auricle margin. *Sepals* narrowly ovate, acute, 2.4–3.7 x *c.* 0.8 mm, ± equal, often densely hirsute. *Abaxial corolla lobes* 3.5–5.9 x 1.4–2.1 mm, fused for a further 3.3–4.5 mm longer than adaxial lobes; wings 2.8–4.8 x 1.1–1.9 mm, entire. *Adaxial corolla lobes* 4.5–8.0 x 1.4–1.8 mm; wings 2.2–4.8 mm long, 1.5–2.0 mm wide opposite auricle side of lobe (0–0.5 mm difference), 1.3–2.1 mm wide above auricle, the auricle 1.4–2.5 x 1.4–2.0 mm. *Stamen* filaments linear, 2.5–3.3 mm long; anthers 1.3–2.0 mm long 1.3–2.0 mm long. *Ovary* 1.8–3.5 mm long, often densely hirsute, incompletely 2-locular; septum *c.* half to *c.* three-quarters as long as ovary; ovules 11–15, in 2 rows in each locule. *Style* 4.2–5.4 mm long; indusium 1.5–1.9 x 2.1–2.5 mm, deltoid to broadly deltoid, single tuft of simple hairs above with scattered hairs above and below, bristles on lips *c.* 0.2 mm long, ± equal above and below. *Fruit* ellipsoidal to ovoid, split *c.* half to base at maturity. *Seeds* ovate to elliptic, *c.* 1 mm, reticulate-foveate; body brown; wing obscure or obsolete, rim *c.* 0.1 mm. (Figure 3)

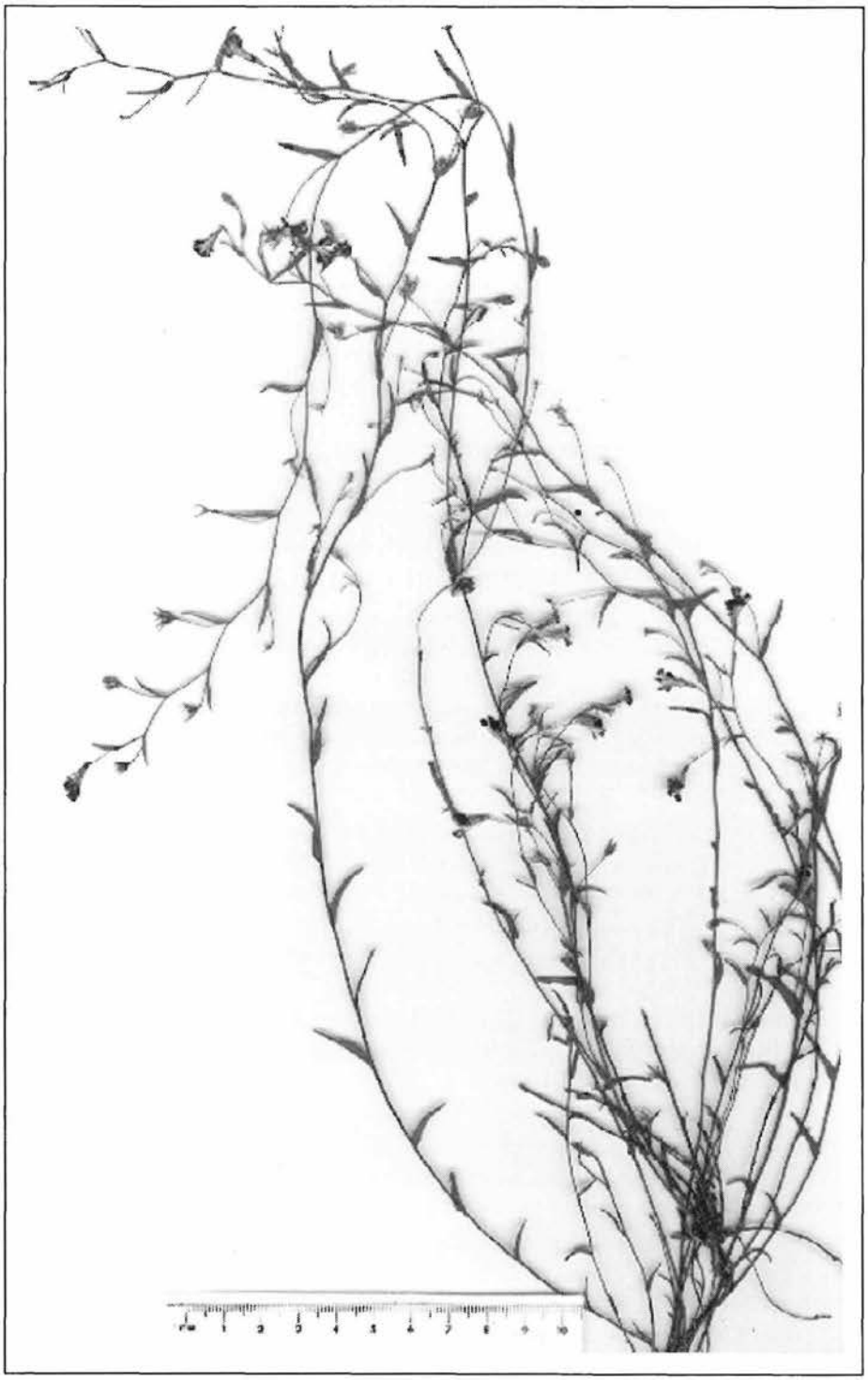

Figure 3. *Goodenia lancifolia* holotype (*LW. Sage* 2360 *& R.J. Hazeldean*).

Other specimens examined. WESTERN AUSTRALIA: N of D' Entrecasteaux National Park on Pneumonia Rd, 1 Jan. 1997, *E.M. Bennett & C. Day* B 133.2 (PERTH); Brockman Highway W of Sues Rd, 13 Jan. 1997, *D. Bright & N. Casson* SC 179.2 (PERTH); Boggy Lake SW of Walpole, 27 Dec. 1957, *D. Churchill s.n.* (PERTH); Black Point Road NW of Pemberton, 11 Mar. 1997, *R.J. Cranfield* 11018 (PERTH); Dennis Road S of Brockman Highway, 14 Jan. 1997, *P. Ellery & T. Annels* SC 185.1 (PERTH); N on Black Point from Wapet Track, 30 Jan. 1997, *B. Evans & E.M. Bennett* P 11.17 (PERTH); Scott National Park, 2 January 1991, *C.J. Robinson* 410 (PERTH); Nillup, SE of Margaret River, 14 January 1945, *R.D. Royce* 4 (PERTH); Scott River, 17 Jan. 1945, *R.D. Royce* 71 (PERTH).

Distribution. Occurring in the extreme south-west corner of Western Australia in the Warren Interim Botanical Region from Scott River National Park south-east to near Walpole. (Figure 2)

Habitat. Occurring in winter wet swamps or lake side vegetation in the *Eucalyptus marginata* forest of the extreme south-west corner of the Warren Interim Botanical Region.

Phenology. Flowers from late December to January (March).

Conservation status. Apparently common throughout its known range though may require monitoring if development in the area (specifically mining) increases. Shown to be more abundant than previously thought through a recent regional flora survey.

Etymology. Named for the typically lanceolate shape of the cauline leaves and bracts of the species.

Notes. Goodenia lancifolia was rarely collected until recent collector effort in the Warren area resulted in finds of further populations and highlighted the need for formal recognition. The co-author of this species, Ray Cranfield, is a botanist with the Western Australian Herbarium based in Manjimup.

Carolin (1992) included this species within the concept of *Goodenia leptoclada* Benth., with few collections of the new species then being available. Distinguished from *G. leptoclada* by leaves narrowly ovate to lanceolate rather than ovate to oblong, smaller abaxial corolla lobes, smaller abaxial corolla lobe wings, ovules 11–15 rather than 4 or 5 and distribution from Scott River to just west of Walpole.

Goodenia scapigera R.Br., Prodr. 578 (1810). – *Stekhovia scapigera* (R.Br.) Vriese, *Natuuk. Vern. Holl. Maatsch. Haalem* ser. 2, 10: 167 (1854). *Type:* Bay I [Lucky Bay, Western Australia], 11 January 1802, *R. Brown* (*holo:* BM, *n.v.*).

Scaevola stricta Vriese *in* J.G.C. Lehmann, Pl. Preiss. 1: 408 (1844). *Type:* near Konkoberup Hill [Mt Melville, near Cape Riche], Western Australia, 19 November 1840, *L. Preiss* 1511 (*isolecto:* MEL).

Notes. During examination of collections of *Goodenia scapigera* at the Western Australian Herbarium, the author recognized material belonging to an undescribed variant restricted to a region of granitic soils within the range of the much more widespread typical variant. These plants are morphologically and geographically distinct and recognition at the subspecific level is required.

In a note under his description of *Goodenia scapigera* in the "Flora of Australia", Carolin (1992) mentioned a collection (*C.A. Gardner s.n.*, near Lake Hope, September 1929) that has very narrow leaves. This collection was the first of the new subspecies and the only one seen by Carolin (1992).

Goodenia scapigera R.Br. subsp. **scapigera**

Erect shrub to 1 m tall. *Leaves* cauline, not fasciculate, linear to narrowly obovate, entire to dentate; lamina to 6 cm long, 2–10 mm wide. (Figure 4)

Selected specimens examined. WESTERN AUSTRALIA: near Phillips River, Oct. 1903, *C. Andrews s.n.*; E of Bremer Bay, 30 Oct. 1963, *T.E.H. Aplin* 2758a; 60 km SW of Israelite Bay ruins, opposite Mount Baring, 7 Jan. 1979, *B. Barnsley* 378; 5 miles [8 km] W of Kukerin, 29 Oct. 1962, *J.S. Beard* 2132; Lucky Bay, 30 Oct. 1967, *J.S. Beard* 5367; Ravensthorpe Range, Sept.1980, *E.M. Bennett s.n.*; Beverley Road verge, 8 km NNE of Pingelly, 15 Nov. 1996, *D. Box* 241; Wickepin, 25 Oct. 1957, *W.H. Butler s.n.*; Scanden [Scaddan], 6 Nov. 1978, *R.J. Cranfield* 1064; Hopetoun, 15 Jan. 1974, *H. Demarz* 5035; Wittenoom Hills (Wittenoom Hills are *c.* 50 km NNE of Esperance), 4 Oct. 1968, *N.N. Donner* 2885; Lake Grace area, Oct. 1963, *D.M. Dorrien-Smith s.n.*; Pingelly, 27 Oct. 1920, *C.A. Gardner* 1020; 8 km E of Cape Arid National Park on Fisheries Road , 21 Nov. 1986, *J.W. Green* 5117; near Two Mile Lake, S margin of Stirling Range, 15 Nov. 1982, *G.J. Keighery* 5839; Cut Hill Lakes–York, 19 Sep. 1962, *F. Lullfitz* L1691; W of Lake King, 29 Nov. 1964, *F. Lullfitz* L3941; Whoogarup Range (SE spur), Fitzgerald River National Park, 26 Sep. 1997, *F. Obbens* 6/97; Location 1110, *c.* 40 km ENE of the coast at Stokes Inlet, 16 Oct. 1968, *A.E. Orchard* 1559; along road between the Bremer Bay road and Gardner River, 12 Sep. 1971, *S. Paust* 594; Mylies Beach, Fitzgerald River National Park, 7 Sep. 1986, *B. Pellow* 62; Dryandra State Forest, 9 Oct. 1987, *D.M. Rose* 364; base of Bluff Knoll, S side of Stirling Range, 27 Oct. 1959, *R.D. Royce* 6039; Frank Hann National Park, 10 Dec. 1971, *R.D. Royce* 10204; Noble Rd, NE of Arthur River, 28 Oct. 1998, *L.W. Sage 1060 & F. Obbens*; Mt Toolbrunup [Toolbrunup Peak], Stirling Range, Mar. 1966, *F.A. Spratt* 31; 60 mile peg Brookton road [3.5 km E of Dale on Brookton Highway], 21 Oct. 1972, *E. Wittwer* W.870.

Distribution and habitat. Occurs in the Avon Wheatbelt, Esperance Plains, Jarrah Forest, Mallee and Swan Coastal Plain regions of the South West Botanical Province. Also in the Coolgardie region of the South-western Interzone. Usually occurring in sandy soil in woodland or heath (Carolin 1992). (Figure 5)

Conservation status. *Goodenia scapigera* subsp. *scapigera* is common throughout its known range.

Flowering period. September to January.

Goodenia scapigera subsp. **graniticola** Sage, *subsp. nov.*

A subspecie typico differt foliis anguste linearibus fasciculatus non nisi in solo granitico cresenti.

Typus: Peak Charles National Park [precise locality withheld for conservation purposes], Western Australia, 17 September 1985, *P.J. Poli* 29 (*holo:* PERTH sheet 1874837; *iso:* NSW).

Erect shrub, to 1.5 m tall. *Leaves* cauline, fasciculate, narrowly linear, entire; lamina to 6 cm long, to 2 mm wide. (Figure 5)

Other specimens examined. WESTERN AUSTRALIA: Peak Charles National Park, 10 Oct. 1995, *S. Barrett* 460; near Lake Hope, Sept. 1929, *C.A. Gardner s.n.*; Peak Charles National Park, 8 Nov. 1979, *K.R. Newbey* 6369.

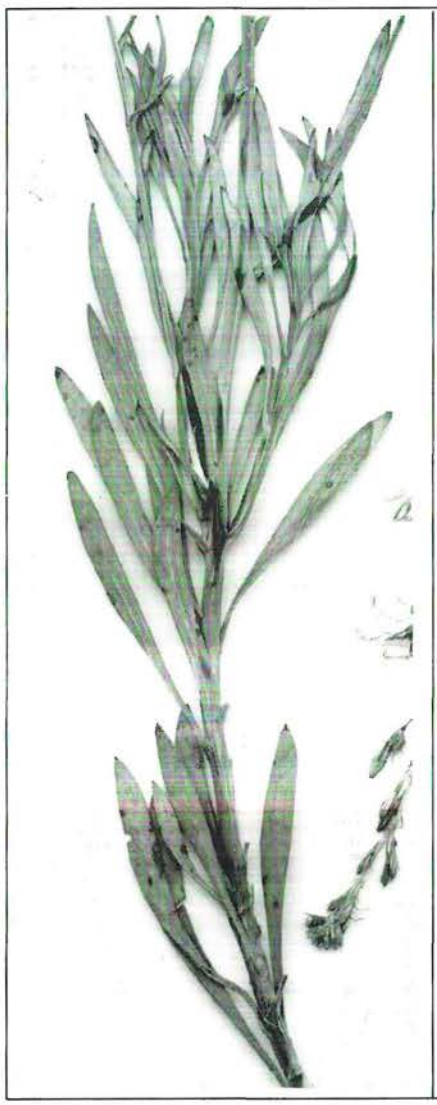

Figure 4. *Goodenia scapigera* subsp. *scapigera* – portion of stem of *L.W. Sage* 1060 & *F. Obbens*, showing typical leaves.

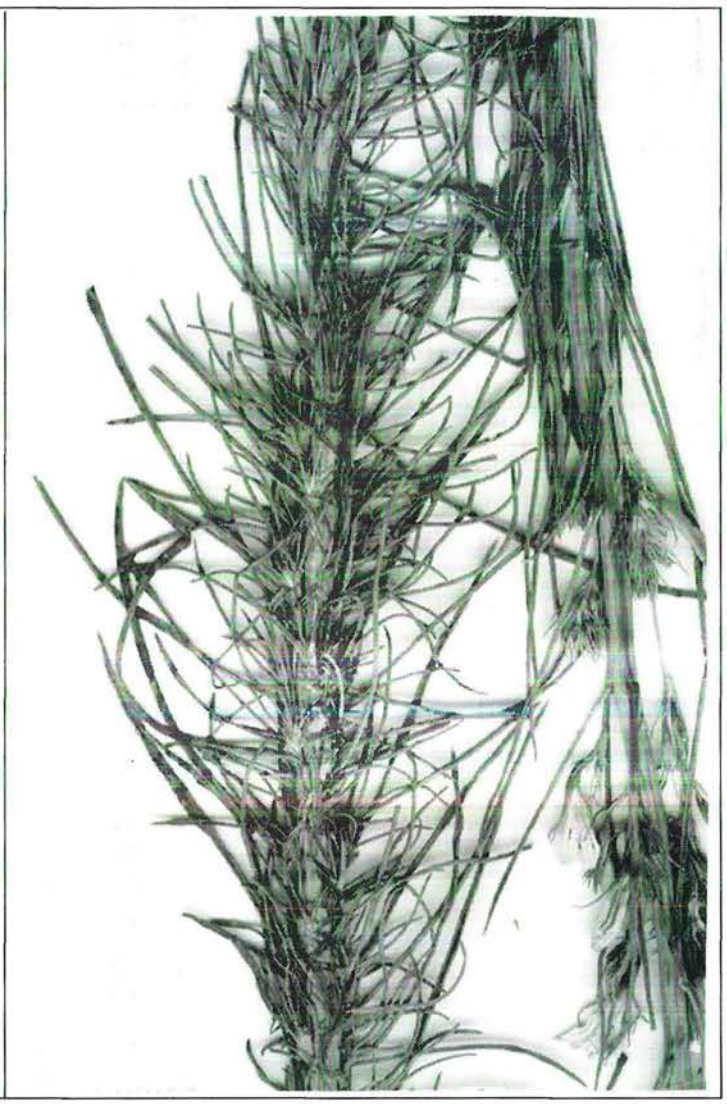

Figure 5. *Goodenia scapigera* subsp. *graniticola* – portion of stem from the holotype (*P.J. Poli* 29).

Distribution and habitat. Restricted to heath on granitic soils in the vicinity of the Peak Charles National Park in the south-west of Western Australia, Mallee Interim Botanical region of the South West Botanical Province. (Figure 6)

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority Two. This subspecies is currently known only from three collections within the Peak Charles National Park and one in the vicinity of Lake Hope.

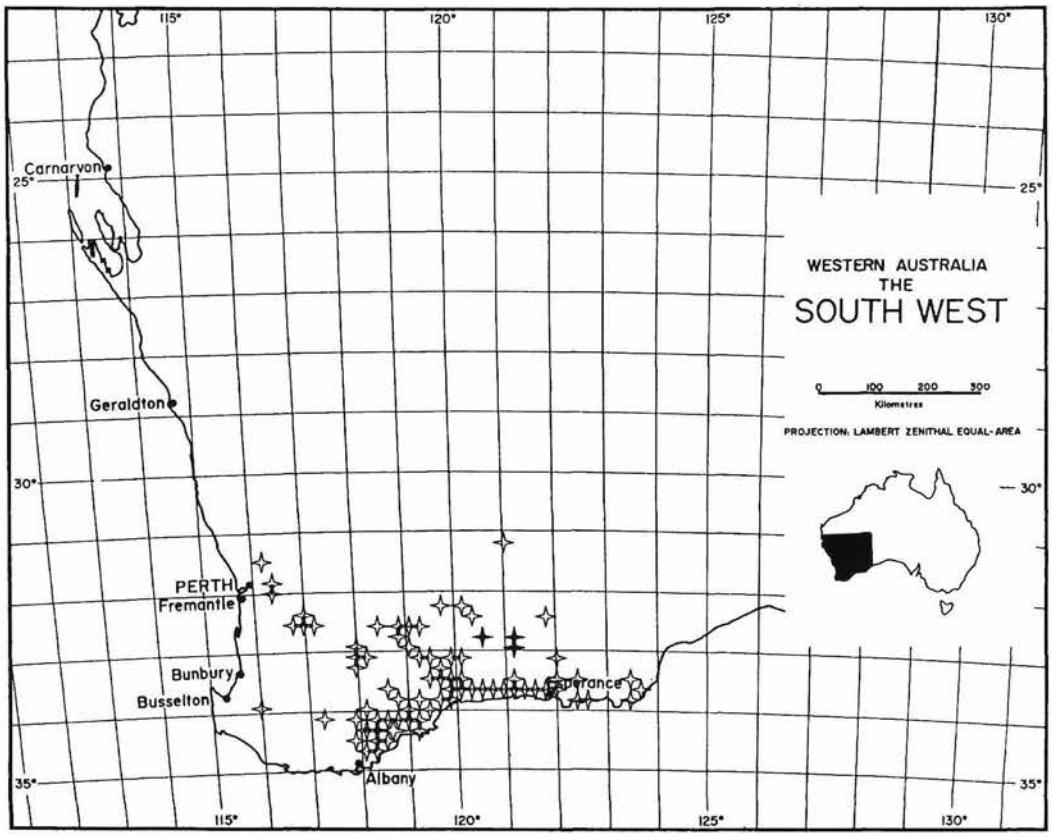

Figure 6. Distribution map of *Goodenia scapigera* subsp. *scapigera* ✧ and *G. scapigera* subsp. *graniticola* ✦

Flowering period. September to November.

Etymology. Named for the occurrence of the subspecies on granitic soils.

Notes. This taxon has been known by the phrase name *Goodenia* sp. Peak Eleanora (*P.J. Poli* 29). The fasciculate, narrowly linear leaves of *Goodenia scapigera* subsp. *graniticola* are very similar to those found on *G. drummondii* subsp. *megaphylla* Sage (Sage 1998). The latter subspecies is also only known from granitic soil and the leaf morphology of both taxa may signify an adaptation to the harsh temperatures found on the surface of granite outcrops in summer in Western Australia.

Update to *Goodenia* key

Couplet 3 of the *Goodenia* key to species of the "Flora of Australia" Volume 35 (Carolin 1992: 149) incorrectly has 'abaxial corolla lobes' instead of 'adaxial corolla lobes'. The bracketed description of Group 8 on page 164 also has this error. As illustrated in Harris & Harris (1994), the abaxial portion of any plant structure is the part away from the axis and the adaxial portion is towards the axis of the plant. In *Goodenia* the abaxial part of the corolla is the lower three corolla lobes and the adaxial part the upper two corolla lobes (see Figure 7). The upper two corolla lobes often have an auricle on the inside below the wings. In the key to species on page 149, the selection of either option in Couplet 3 is based on the width of the lobe wing above the auricle relative to that of the wing on the opposite side of the same lobe (see Figure 7B).

Inclusion of the two new species in the *Goodenia* key can be made by altering couplets 18 and 19 in Group 1 (Carolin 1992: 151) and couplet 10 in Group 8 (Carolin 1992: 164), as follows:

18 Cauline leaves lanceolate or ovate-elliptic
19a Corolla glabrous outside ..... **G. eatoniana**
19a: Corolla cottony hairy ouside
19b Ovules 4 or 5; leaves ovate to oblong ..... **G. leptoclada**
19b: Ovules 11–15; leaves lanceolate to narrowly ovate ..... **G. lancifolia**

10a Leaves linear, entire ..... **G. integerrima**
10a: Leaves wider than linear
10b Ovules 20–35; seeds *c.* 5 mm long ..... **G. pinnatifida**
10b: Ovules *c.* 9; seeds *c.* 2 mm long ..... **G. heatheriana**

Goodenia heatheriana may also key out to couplet 13, *G. pascua* Carolin, but is easily distinguished from this species by smaller abaxial lobes, fewer ovules and disjunct distribution.

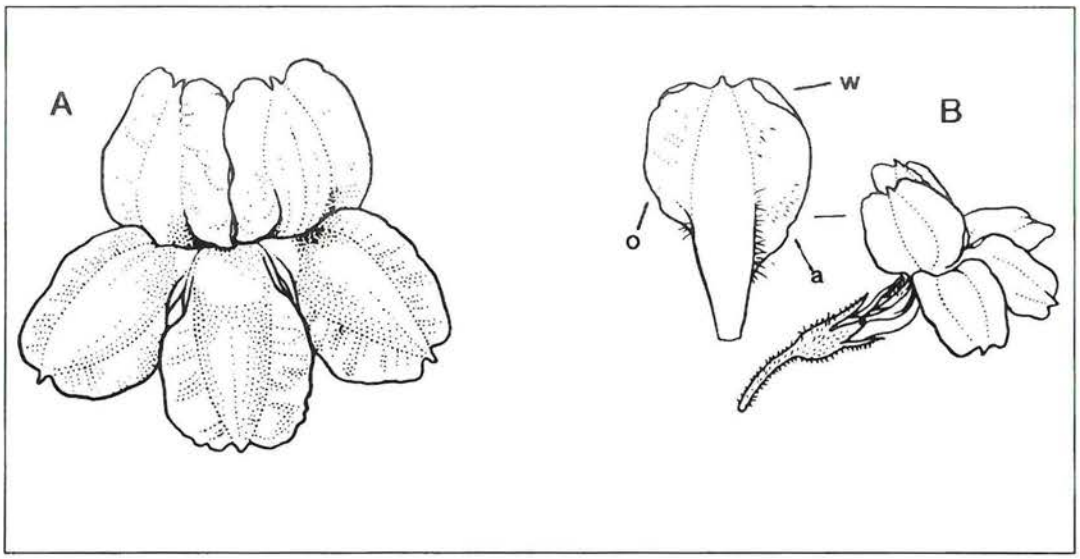

Figure 7. *Goodenia caerulea*. A – corolla; the upper two lobes are adaxial and the lower three lobes abaxial. B – side view of flower with enlargement of an adaxial corolla lobe showing the auricle (a), the wing above the auricle (w), and the wing on the opposite side which lacks an auricle (o). Reproduced with permission from Marchant *et al.* (1987: Figure 232).

Acknowledgements

Thanks to Paul Wilson for the Latin diagnosis, Rosmarie Rees at the British Museum for checking type material and Barbara Rye for her advice on the paper.

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Review of *Hibbertia mucronata* and its allies (Dilleniaceae)

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Abstract

Wheeler, J.R. Review of *Hibbertia mucronata* and its allies (Dilleniaceae). *Nuytsia* 13(2): 379–394 (2000). *Hibbertia mucronata* (Turcz.) Benth. and its close allies are described and illustrated. A new combination *H. ulicifolia* (Benth.) J.R. Wheeler is made and four new species, *H. axillibarba* J.R. Wheeler, *H. carinata* J.R. Wheeler, *H. hamulosa* J.R. Wheeler and *H. charlesii* J.R. Wheeler, are described. All six species occur in the South West Botanical Province of Western Australia and three of them have conservation priority.

Introduction

Hibbertia mucronata was originally described by Turczaninov in 1852 as *Pleurandra mucronata* and was transferred to the genus *Hibbertia* Andr. (Dilleniaceae) by Bentham in 1863. Detailed examination of the PERTH collections of *H. mucronata* revealed several additional, seemingly closely related, taxa. Examination of types revealed that one of the possible new species already had the name *H. stowardii* and a further taxon a name as a variety of *H. acerosa*. All occur in the South West Botanical Province of Western Australia. Three of the new species appear very restricted in distribution.

Hibbertia hamulosa, *H. carinata* and *H. ulicifolia*, appear to be very closely allied to *H. mucronata* and belong with it in the section *Pleurandra* (Labill.) Benth. *Hibbertia axillibarba*, is more closely allied to *H. stowardii*, and both of them also clearly belong to the section *Pleurandra*. *Hibbertia charlesii*, however, although superficially similar to the other species, does not appear to fit any of the currently recognized sections because of the presence and position of its staminodes (Bentham 1863 and Gilg & Werdermann 1925). The genus is badly in need of a revision which also reflects its sectional boundaries.

Terminology

Several characters used in distinguishing between taxa in this paper require some comment.

Hair types. Stellate hairs in some of the species of *Hibbertia* discussed below may sometimes be reduced to hairs with only one or two branches and so appear simple or v-shaped. These hairs, which usually

occur along with normal stellate hairs, are here termed 'semi-stellate' so as to reflect their relationship with normal 'stellate' hairs. Such hairs are known from a number of *Hibbertia* species and are not restricted to this group. They have also been noted in eastern Australia (Toelken 1998).

True simple hairs in the *Hibbertia* species dealt with in this paper are referred to as 'pilose' or 'woolly' hairs, which may be long or short, or as 'uncinate' hairs, which are short and (as implied by their name) hooked.

Leaf shape. Leaf shape is difficult to describe in the many *Hibbertia* species which have the leaf margins recurved to, or almost to, the midrib of the lower surface. The true margin between the adaxial (upper) and abaxial (lower) surfaces of the recurved leaf may be hidden on the lower surface of the leaf, leaving an 'apparent margin' at the edge of the leaf which is actually formed from part of the adaxial leaf surface. The true abaxial surface may be almost or completely hidden, often with only the midrib visible. In the species considered here the leaf is described in terms of the 'upper surface' referring to only the part of the true adaxial surface which remains uppermost, the 'apparent lower surface' which is really the outer edges of the original adaxial surface now recurved to the midrib, and the 'apparent margin' which is the new edge formed after the margins have been recurved. This apparent margin may be rounded or acute. The midrib in some of the species below is enlarged to such an extent that it protrudes beyond the apparent lower leaf surface.

Key to species

1. Young branchlets densely woolly
   2. Stamens 5; staminodes absent ..... **1. H. mucronata**
   2. Stamens 5; staminodes 5–20 ..... **5. H. charlesii**
1. Young branchlets glabrous or with minute stellate hairs
   3. Midrib of lower leaf surface protruding and prominent
      4. Outside of calyx with minute but fairly dense stellate hairs and also scattered uncinate hairs. Stamens 5–8 ..... **2. H. hamulosa**
      4. Outside of calyx almost glabrous. Stamens 9–11(12) ..... **4. H. carinata**
   3. Midrib of lower leaf surface either completely hidden or, if visible, then not protruding but level with to sunken between the revolute leaf margins
      5. Leaf surface smooth and shiny, tip of leaf tapered and long acute, with a pungent mucro. Flowers on a peduncle 4–8 mm long ..... **3. H. ulicifolia**
      5. Leaf surface dull and minutely papillose, tip of leaf more or less obtuse but with a pungent mucro. Flowers sessile or subsessile
         6. Leaf base with a dense tuft of pilose hairs; midrib of lower surface hidden. Sepals with long pilose hairs ..... **7. H. axillibarba**
         6. Leaf base glabrous; midrib of lower surface visible. Sepals almost glabrous ..... **6. H. stowardii**

Descriptions

1. Hibbertia mucronata (Turcz.) Benth., Fl. Austral. 1: 29 (1863). – *Pleurandra mucronata* Turcz., *Bull. Soc. Nat. Mos.* xxv (2): 139 (1852). *Type:* New Holland [Western Australia], *J. Drummond* 5th coll. 290 (*iso:* MEL 666871).

Shrub erect to 1 m high; branchlets woolly-hairy with long fine curled simple hairs and glabrescent ridges below each petiole. *Leaves* spirally arranged, crowded, ascending, usually not spreading beyond 30 degrees to the stem; petiole 1–1.5 mm long, glabrous abaxially and woolly-hairy adaxially; blade linear to subulate and gradually tapering apically but thick to almost semi-terete, 5–18 mm long, 0.9–1.5 mm wide, the margins tightly revolute to the enlarged midrib; upper surface initially with long spreading (woolly) hairs but glabrescent, smooth apart from very occasional minute protuberances particularly on the apparent margin; apparent lower surface glabrous; apparent margins thick and rounded; apex a pungent mucro 0.7–1.5 mm long. *Flowers* solitary, axillary, subsessile or with a hairy peduncle to 2 mm long; bracts at base of peduncle few or absent; bract immediately below flower subulate, 2–3.5 mm long, harshly pungent, glabrous abaxially and woolly-hairy adaxially. *Sepals* 5, connate basally; outer sepals narrowly elliptic to elliptic, 6–8.5 mm long including a harsh mucro 2–4 mm long, the outer surface with short and sometimes very sparse stellate or semi-stellate hairs, the margin minutely ciliolate, the apex and margin woolly inside; inner sepals elliptic to broadly elliptic, 5–5.5 mm long including a short mucro *c.* 0.5 mm long, with short stellate and semi-stellate hairs sometimes sparse, with broad membranous margins which are glabrous apart from the minute cilia. *Petals* 5, golden yellow, obovate, 6–9 mm long, emarginate. *Stamens* 5, connate basally, all on one side of the carpels; anthers narrowly oblong, *c.* 2 mm long, opening by longitudinal slits; staminodes absent. *Carpels* 2, globular to broadly obovoid, loosely but densely hairy; ovules 2 per carpel. *Fruitlets* dry, often only one developing to maturity, obovoid to broadly obovoid, 3–3.5 x 2–2.5 mm, splitting apically and adaxially to release the seeds; seeds brown, broadly ellipsoid to globular, *c.* 3 x 2–2.5 mm, with a cream waxy aril. (Figure 1)

Selected specimens examined (all PERTH). WESTERN AUSTRALIA: Kundip, near Ravensthorpe, 27 Oct. 1963, *T.E.H. Aplin* 2697; 5.7 km W along track from Hopetoun Road turnoff, 20.6 km from Ravensthorpe, 3 June 1998, *M. Bennett* 168; 4 km WSW of Mt Maxwell, 12 Mar. 1996, *R. Davis* RD523; Daniels Rd, N of Hopetoun, 31 Aug. 1963, *A.S. George* 5732; Thumb Peak Range, SW of Ravensthorpe, 31 Oct. 1965, *A.S. George* 7151; 9 miles [15 km] NW of Mt Bland, 30 Sep. 1962, *K. Newbey* 493; along edge of firebreak E of Table Hill Lookout, Hopetoun, 5 Nov. 1997, *H. Taylor* 4; Fitzgerald River National Park, lower slopes of East Mt Barren, Hamersley Drive, 12 Sep. 1983, *J. Taylor* 1719 & *P. Ollerenshaw*; Fitzgerald River National Park, just W of East Mt Barren, *c.* 2 km W of walk trail up East Mt Barren, 23 Sep. 1986, *J.R. Wheeler* 2429; lower slopes of West Mt Barren, Fitzgerald River National Park, 23 Sep. 1986, *J.R. Wheeler* 2436.

Distribution. Western Australia, South West Botanical Province, Eyre District, occurring in Fitzgerald River National Park and east to near Ravensthorpe and just east of Hopetoun. (Figure 2A)

Habitat. Recorded from breakaways, rocky slopes, rock crevices, sand or sand over granite or quartzite, in coastal heath, scrub or mallee-scrub vegetation.

Flowering period. July to January, but some flowers also recorded for March and May.

Conservation status. Restricted but well conserved in a large national park and not considered endangered, although its response to attack by *Phytophthora* has not been documented.

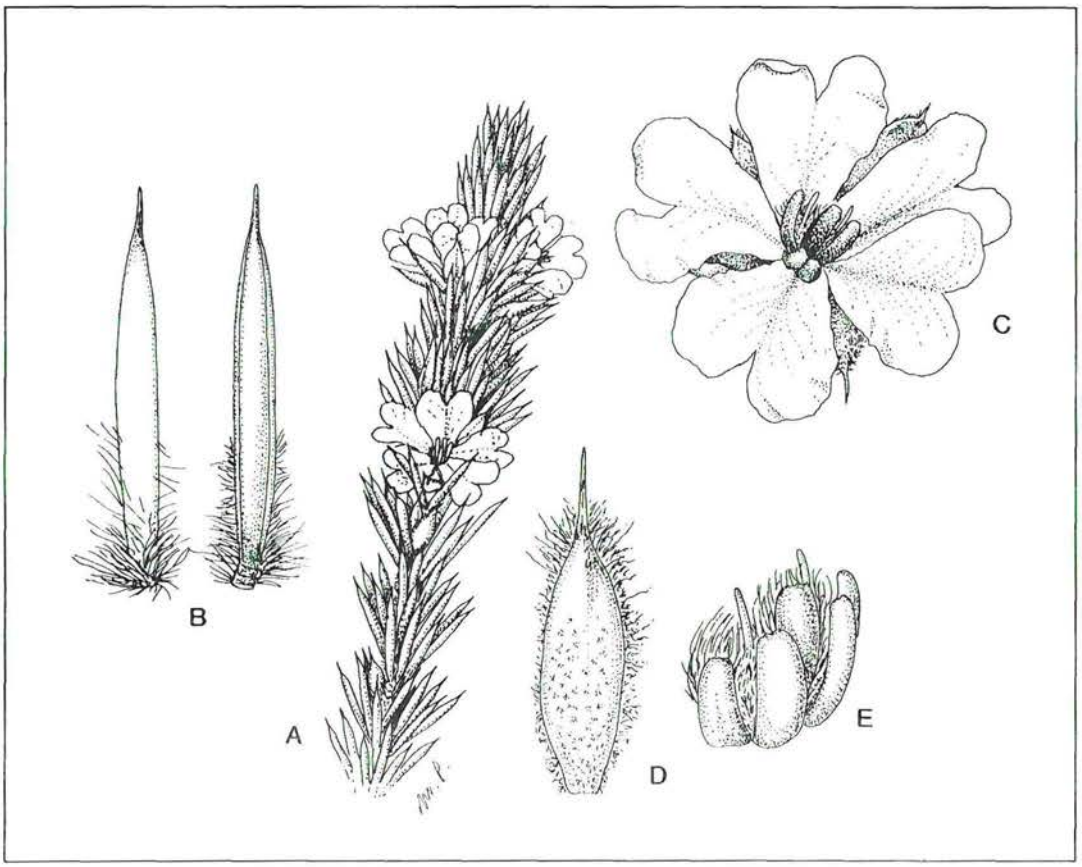

Figure 1. *Hibbertia mucronata* A – flowering branch (x1.5); B – leaf, upper and lower surface (x6); C – flower (x3); D – sepal (x6); E – stamens and carpels (x6). Drawn from *J.R. Wheeler* 2425.

2. Hibbertia hamulosa J.R. Wheeler, *sp. nov.*

Hibbertiae mucronatae affinis sed indumento lanoso caulium foliorumque juvenalium carenti; sepalis pilis parvis uncinatis ornatis differt.

Typus: south-east slope of East Mount Barren, Western Australia, 7 October 1971, *R.D. Hoogland* 12080 (*holo:* PERTH 04395239: *iso:* CANB, L, UC, HBG, K, US).

Shrub erect to 1 m high; branchlets minutely stellate-hairy sometimes sparsely so, ridged below each petiole. *Leaves* spirally arranged, fairly crowded, usually not spreading beyond 45 degrees to the stem; petiole 0.5–1 mm long, minutely stellate-hairy, less often glabrous; blade linear to subulate and gradually tapering apically but very thick to semi-terete, 7–18 mm long and 0.5–1 mm wide, the margins tightly revolute to the enlarged midrib, glabrous, more or less smooth, with occasional scabrous and apically directed protuberances particularly on the thick and rounded apparent margin; apex a pungent mucro 0.7–1.2 mm long. *Flowers* solitary, usually terminating short axillary shoots, rarely axillary; peduncle 2–4 mm long, thick, densely minutely stellate-hairy; bracts at base of peduncle absent (if flowers terminal) or few (if flowers axillary); bract immediately below flower subulate, 1.5–4 mm long, harshly pungent, minutely stellate-hairy towards base. *Sepals* 5, connate

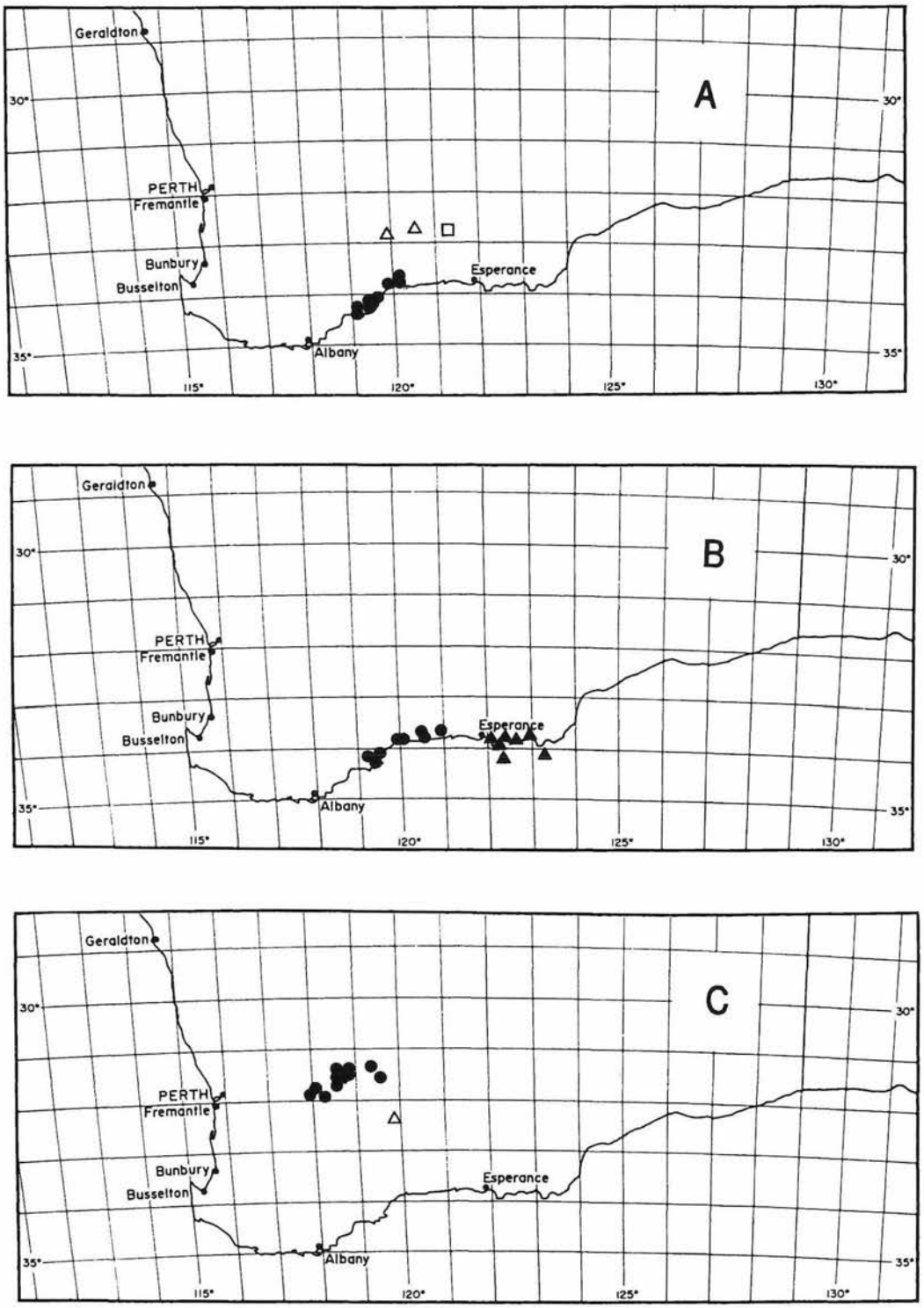

Figure 2. Distribution maps. A – *Hibbertia carinata* △, *H. charlesii* □ and *H. mucronulata* ●; B – *H. hamulosa* ● and *H. ulicifolia* ▲; C – *H. axillibarba* △ and *H. stowardii* ●.

basally, the outer surface minutely and densely stellate-hairy and also with scattered uncinate hairs, the inner surface minutely woolly-hairy towards apex with short curled hairs, harshly mucronate; outer sepals narrowly elliptic, 5–6.5 mm long including a mucro up to 3 mm long; inner sepals a little broader, more obtuse, with sparser stellate and uncinate hairs, with also sometimes semi-stellate hairs, margins membranous and glabrous or minutely ciliolate. *Petals* 5, golden yellow, obovate, 4–7 mm long, emarginate. *Stamens* 5–8, connate basally, all on one side of the carpels; anthers narrowly oblong, 1–1.5 mm long, opening by longitudinal slits; staminodes absent. *Carpels* 2, obovoid to broadly obovoid, loosely but densely hairy; ovules 2 per carpel. *Fruitlets* dry, obovoid to broadly obovoid, 3–4 x *c.* 2.5 mm, splitting apically and adaxially to release the seeds; seeds brown, broadly ellipsoid to globular, with a cream waxy aril. (Figure 3)

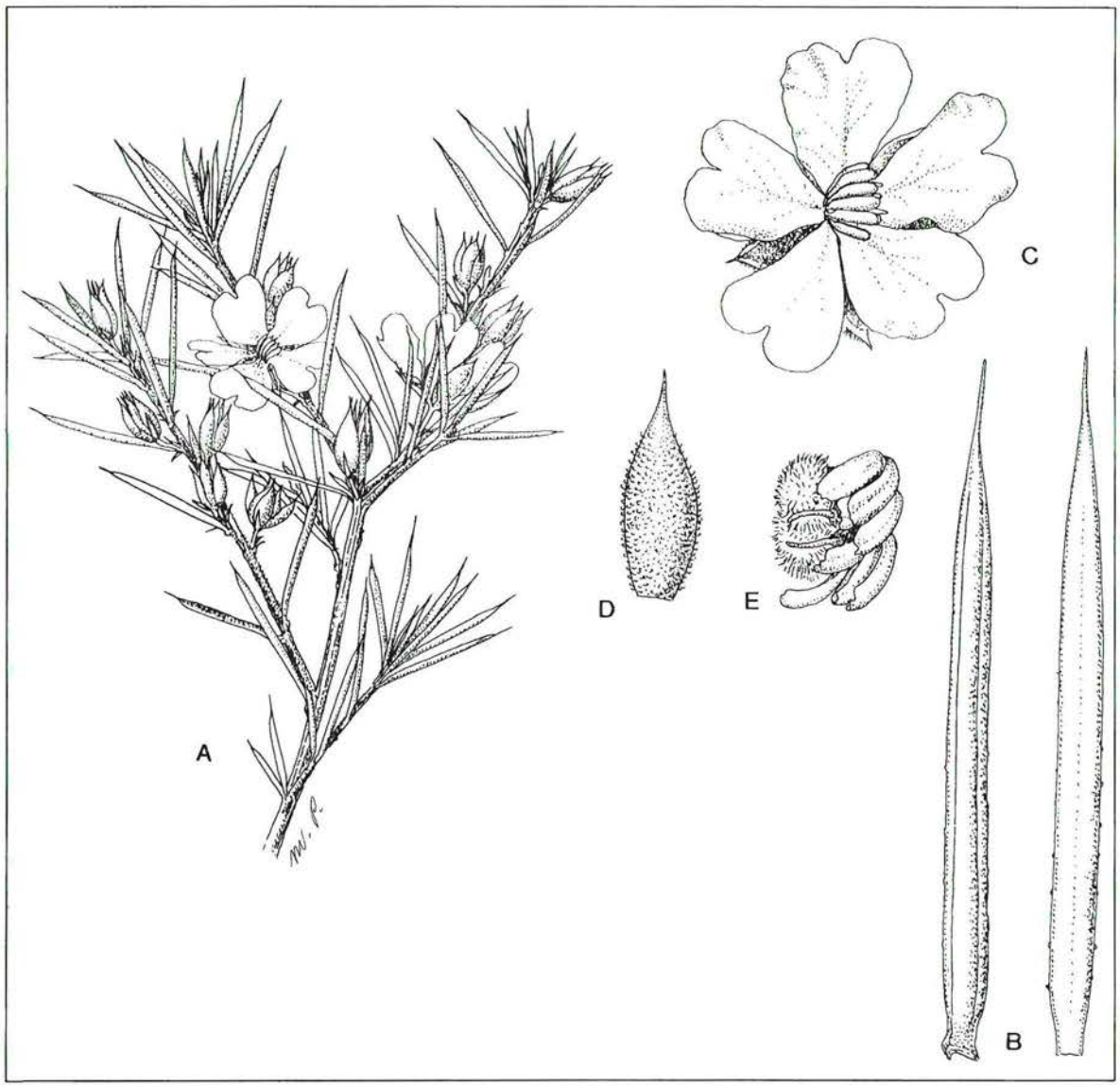

Figure 3. *Hibbertia hamulosa*. A – flowering branch (x1.5); B – leaf, upper and lower surface (x6); C – flower (x3); D – sepal (x6); E – stamens and carpels (x6). Drawn from *J.R. Wheeler* 2434.

Other specimens examined (all PERTH). WESTERN AUSTRALIA: Ravensthorpe–Esperance, 7–9 Mar. 1968, *L. Fell* S455; W side of Mt Bland, Reserve 24048, 15 July 1970, *A.S. George* 10052; Devils Creek Rd, East Gardiner River, 10 Aug. 1981, *B.E. Hall* 64 (ALB); along Ravensthorpe–Esperance road, *c.* 10 miles [16 km] W of Oldfield River, 5 Oct. 1971, *R.D. Hoogland* 12078; SE slopes of East Mt Barren, 7 Oct. 1971, *R.D. Hoogland* 12080; 1 mile [1.6 km] S of Mt Maxwell, 5 Sep. 1973, *K.R. Newbey* 3749; 50 km along Springdale Rd off Hopetoun–Ravensthorpe road, 2 Jan. 1983, *A. Strid* 21901; Fitzgerald River National Park, West Mt Barren, 23 Sep. 1986, *J.R. Wheeler* 2434.

Distribution. Western Australia, South West Botanical Province, Eyre District, from near Bremer Bay to between Ravensthorpe and Esperance. (Figure 2B)

Habitat. Recorded from gravel or rocky slopes, sand or sand over quartzite, in heath or scrub vegetation.

Flowering period. Mostly July to October, but some flowers have been recorded for January; fruits recorded for March.

Conservation status. Restricted in distribution but occurs within a National Park and not considered endangered, although its response to attack by *Phytophthora* has not been documented.

Etymology. From the Latin *hamulosa*, armed with small hooks, referring to the tiny hooked hairs found on the outer surface of the sepals.

Affinities. Differs from *H. mucronata* chiefly in its indumentum and its smaller flowers. Differs from *H. ulicifolia* in its less spreading, almost semi-terete leaves with a more pronounced midrib, its thicker and shorter peduncles and subulate bract below the flowers, the more harshly pungent sepals which have an indumentum of both stellate and simple uncinate hairs and its fewer stamens.

Note. A collection from east of the Hopetoun to Ravensthorpe road (*A. Strid* 21901) is unusual in having sparse long simple hairs (instead of stellate hairs) on the stems and young shoots.

3. Hibbertia ulicifolia (Benth.) J.R. Wheeler, *comb. et stat. nov.*

Hibbertia acerosa (R. Br.) Benth. var. *ulicifolia* Benth., Fl. Austral. 1: 25 (1863). *Type:* King George Sound, [Western Australia], *Baxter* (*holo:* K)

Shrub to 1.2(2) m high; branchlets minutely stellate-hairy but soon glabrescent, somewhat angularly ridged below each petiole. *Leaves* spirally arranged, not usually crowded, spreading usually to 90 degrees to the stem; petiole 0.3–1 mm long; blade linear to subulate and gradually tapering apically but thick, 7–14(18) mm long and 0.6–1.5 mm wide, with the margins tightly revolute to the obvious but not protruding midrib, glabrous and more or less smooth; apparent margins thick, rounded and occasionally with very few scabrous hairs towards the leaf base; apex a pungent mucro 0.5–1.2(1.5) mm long. *Flowers* solitary, axillary; peduncle slender, 4–8 mm long, sparsely and minutely stellate-hairy; bracts at base of peduncle several, brown, narrowly ovate-elliptic to ovate-elliptic, sparsely and minutely stellate-hairy, ciliolate, mucronate; bract immediately below flower narrowly ovate-elliptic to ovate-elliptic, 1–3 mm long, sparsely and minutely stellate-hairy, ciliolate, mucronate. *Sepals* 5, connate basally, the outer surface minutely hairy with sparse stellate or semi-stellate hairs, the inner surface minutely woolly-hairy towards the apex with short curled simple hairs, long-acuminate to shortly mucronate; outer sepals narrowly ovate-elliptic, 4–6.5 mm long including

a mucro 0.2–0.8 mm long; inner sepals a little broader and more obtuse, a little more densely stellate-hairy outside, margins membranous and often minutely ciliolate. *Petals* 5, golden yellow, obovate, 4–7 mm long, emarginate. *Stamens* 9, connate basally, all on one side of and curved over the carpels; anthers narrowly oblong to oblong, 1.5–2.5 mm long, opening by longitudinal slits; staminodes absent. *Carpels* 2, globular, densely shortly stellate-hairy; ovules 2 per carpel. *Fruitlets* dry, *c.* 3 x 2 mm, splitting apically and adaxially to release the seeds; seeds brown, globular, with a small white waxy aril (not seen mature). (Figure 4)

Other specimens examined (all PERTH). WESTERN AUSTRALIA: High Island, Duke of Orleans Bay, Oct. 1970, *T.E.H. Aplin* 4242; Lucky Bay (E of Esperance), 10 Sep. 1966, *E.M. Bennett* 895 B; Cape Le Grand National Park, between Rossiter Bay car park and the Bird Sanctuary, 24 Sep. 1985, *M. Carter* 190; Whistling Rock, 20 m W of Thistle Cove carpark, Cape Le Grand National Park, 19 Oct. 1989, *B.J. Conn* 3437 & *J.A. Scott*; [Cape] Le Grand National Park, SW of Lucky Bay, along walk to Thistle Cove, 14 Oct. 1991, *W. Greuter* 22824; Mondrain Island, Recherche Archipelago, 6 Feb. 1960, *R.D. Royce* 6221; Cape Le Grand National Park, 21 Oct. 1969, *R.D. Royce* 8691; inland from Lucky Bay, E of Esperance, 30 Sep. 1970, *R.A. Saffrey* 1219; *c.* 2 miles [3 km] S of Frenchman Peak, Cape Le Grand National Park, 10 Nov. 1971, *A.S. Weston* 7202; western quarter of Middle Island, Recherche Archipelago, 14 Nov. 1974, *A.S. Weston* 9878; Cape Le Grand, on hill *c.* 25 km SE of Esperance, 7 Oct. 1966, *P.G. Wilson* 5563; Mt Howick, *c.* 76 km E of Esperance and 18 km N of coast, 30 Sep. 1968, *P.G. Wilson* 8131.

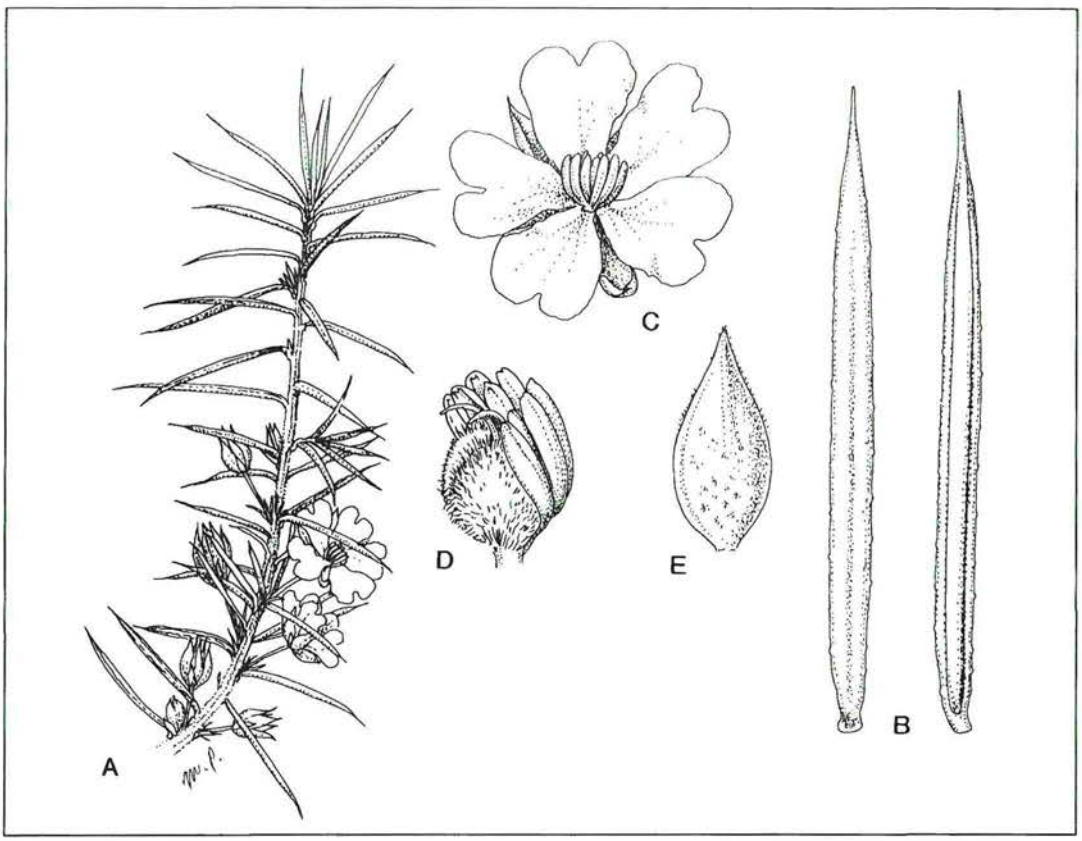

Figure 4. *Hibbertia ulicifolia*. A – flowering branch (x1.5); B – leaf, upper and lower surface (x6); C – flower(x3); D – sepal (x6); E – stamens and carpels (x6). Drawn from *P.G. Wilson* 8131.

Distribution. Western Australia, South West Botanical Province, Eyre District, occurring east of Esperance, from Mt Le Grand to Duke of Orleans Bay, also recorded from slightly north-east at Howick Hill and also from islands of the Recherche Archipelago. (Figure 2B)

Habitat. Recorded mostly in coastal heath on granitic sands or granitic scree slopes.

Flowering period. Flowers mostly September to November, but occasional flowers recorded for February and April.

Conservation status. Occurs within a National Park and not considered endangered, although its response to attack by *Phytophthora* has not been documented.

Affinities. Differs from both *H. mucronata* and *H. hamulosa* in several ways. *H. ulicifolia* has less crowded and greatly spreading leaves in which the lower midrib is not as prominently swollen, an indumentum of only minute stellate hairs (apart from the minute simple hairs on inner surface of the sepals), more numerous stamens, and longer more slender peduncles.

Notes. Originally described by Bentham (1863) as a variety of *H. acerosa*, however it clearly differs in a number of characters. *Hibbertia acerosa* has more slender foliage usually with occasional uncinate hairs, longer peduncles, a linear bract below each flower, smaller acute to obtuse sepals with uncinate hairs and is also distinguished by the presence of staminodes on each side of the stamens.

A collection from Mondrain Island (*Royce* 6221), has unusually long slender leaves 12–18 mm long with a longer mucro 1–1.5 mm long.

4. Hibbertia carinata J.R. Wheeler, *sp. nov.*

Hibbertiae mucronatae affinis sed foliis parvioribus, gracilioribus, indumento lanoso carenti, sepalis exterioribus glabrescentibus et carinatis differt.

Typus: south side of the north-west running grid at 2.46 km from Hatter Hill Mine, *c.* 1.2 km north-west of Hatter Hill, 32°49'4"S, 119°58'13"E, Western Australia, 5 September 1996, *N. Gibson & K. Brown* 3059 (*holo:* PERTH 05291631).

Shrub to 0.4 m, somewhat spreading; branchlets with sparse minute stellate hairs, ridged below each petiole. *Leaves* spirally arranged, crowded, ascending, usually not spreading beyond 30 degrees to the stem, subsessile or with a very short and broad glabrous petiole up to 0.5 mm long; blade linear and slightly tapering apically, thick to almost semi-terete, 3.5–8 mm long and 0.7–1.2(1.7) mm wide, the margins tightly revolute to an enlarged pale midrib; upper surface shiny and usually more or less glabrous, somewhat roughened with minute protuberances and sometimes with very sparse, minute semi-stellate hairs; apparent lower surface more or less glabrous, shiny; midrib shiny with very occasional minute hairs, apparent margin acute and distinctly but often sparsely scabrous; apex a pungent mucro (0.2)0.5–1.3 mm long. *Flowers* solitary, terminating short shoots and somewhat hidden in bud by the crowded leaves, sessile; bract below flower linear, leaf-like, 3–4 mm long, pungent, glabrous or with a few minute scabrous hairs towards the tip of the midrib and on the margin. *Sepals* 5, connate basally, elliptic and with a prominent pale yellowish keel, usually shiny; outer sepals 4.5–6.5 mm long including a pungent mucro 0.3–1 mm long, usually glabrous; inner sepals broader and often with minute semi-stellate hairs, the margins membranous and glabrous. *Petals* 5, yellow,

obovate, 4.5–6.5 mm long, deeply emarginate. *Stamens* 9–11(12), connate basally, all on one side of the carpels; anthers narrowly oblong, 1.5–2 mm long, truncate, opening by longitudinal slits; staminodes absent. *Carpels* 2, globular to obovoid, densely hairy; ovules 4(5) per carpel. Mature *fruitlets* not seen. (Figure 5)

Other specimens examined (all PERTH). WESTERN AUSTRALIA: Esperance, May 1974, *R. Edmiston* E727; to the N of the track, *c.* 1.4 km SW of Hatter Hill, 32 49'46"S, 119 58'0"E, 4 Sep. 1996, *N. Gibson & K. Brown* 3060; to the W of cleared strip *c.* 50 m E of Hatter Hill, 32 49'29"S, 119 58'51"E, 3 Sep. 1996, *N. Gibson & K. Brown* 3061; *c.* 115.7 km E of Lake King, 18 Sep. 1976, *R.J. Hnatiuk* 760876; 0.5 km NW of Hatter Hill, *c.* 40 km NE of Lake King, 9 Aug. 1979, *K. Newbey* 5468; 9 km S of Mt Gibbs, 33 km ENE of Lake King, 10 Aug. 1979, *K. Newbey* 5493.

Distribution. Western Australia, South West Botanical Province, Roe District, being recorded from only a few locations between Lake King and Salmon Gums and a probably generalised locality of Esperance. (Figure 2A)

Habitat. Recorded from scrub or open scrub on well-drained gravelly sand or yellow sand with some gravel.

Flowering period. Flowers recorded for August and September.

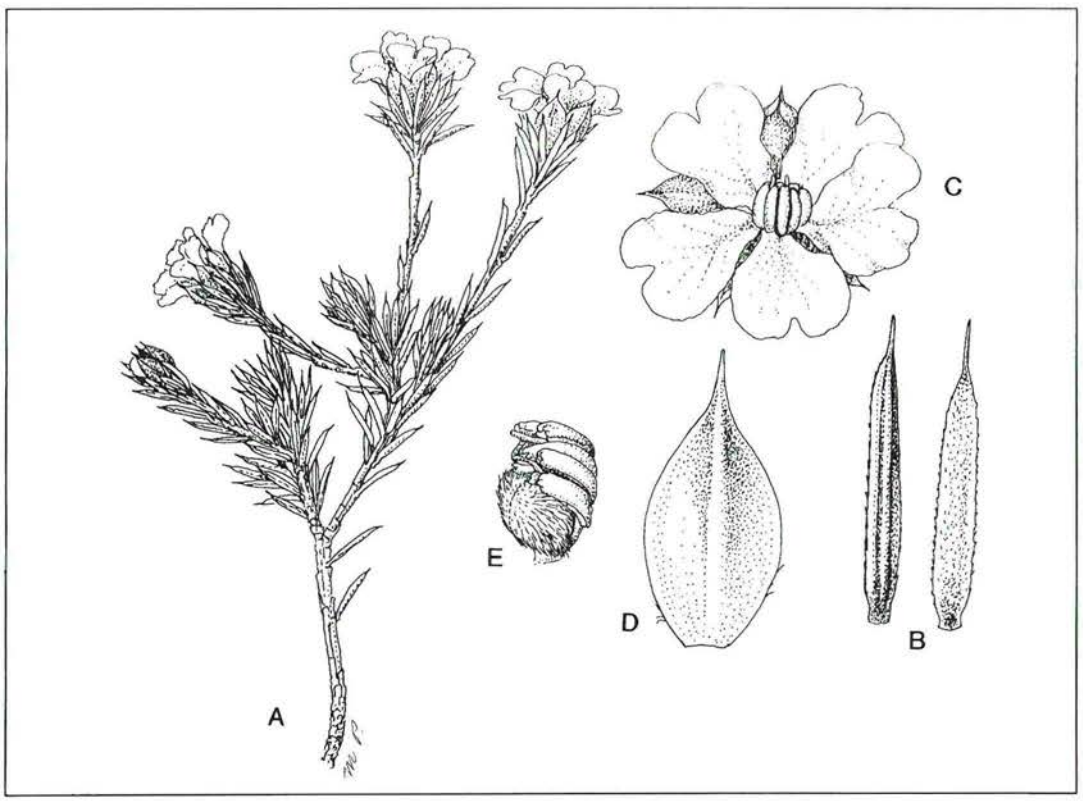

Figure 5. *Hibbertia carinata.* A – flowering branch (x1.5); B – leaf, upper and lower surface (x6); C – flower (x3); D – sepal (x6); E – stamens and carpels (x6). Drawn from *K. Newbey* 5468.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority One. Apparently restricted in distribution and in need of surveying. Currently known from less than five populations but possibly not under immediate threat. Possibly under-collected as the species was recorded as being "frequent" at one locality. Its response to attack by *Phytophthora* has not been documented.

Etymology. From the Latin *carinata*, keeled, referring to the keeled sepals.

Affinities. Probably most closely allied to *H. mucronata* and *H. ulicifolia*. *Hibbertia mucronata* differs in its woolly indumentum, larger flowers, the sepal indumentum, its fewer larger stamens and the presence of only 2 ovules per carpel. *Hibbertia ulicifolia* differs in its longer leaves, shortly pedunculate flowers a denser indumentum on its larger sepals, fewer stamens and carpels with only 2 ovules.

Note. A collection, with a probably rather general collecting locality of "Esperance", (*R. Edmiston* E727) may also be referrable to this species, but has duller sepals less strongly keeled and with a greater number of minute semi-stellate hairs. A further collection (*K. Newbey* 5493) may also be referrable to this species but has shorter broad leaves 3–5 mm long and 1.2–1.7 mm wide with shorter mucro 0.2–0.5 mm long and larger flowers with petals up to 7.5 mm long.

5. Hibbertia charlesii J.R. Wheeler, *sp. nov.*

Hibbertiae mucronatae affinis sed seriei staminodiorum staminis exteriorum posita differt.

Typus: Peak Charles, 25 miles [40 km] west of Dowak, Western Australia, 24 October 1964, *J.S. Beard* 3814 (*holo:* PERTH 04395344; *iso:* AD)

Shrub to 1 m, spreading; branchlets with dense grey to white woolly hairs when young and with glabrescent ridges below the petioles. *Leaves* spirally arranged, crowded, ascending, usually not spreading beyond 45 degrees from the stem; petiole 0.5–2 mm long, the adaxial surface somewhat hairy; blade linear and slightly tapering apically, thick, 6–16 mm long, 1–1.5 mm wide, the margins closely revolute to an enlarged midrib, all surfaces roughened with minute protuberances but otherwise glabrous and shiny; apparent margin thick and rounded; apex a pungent mucro 1–2 mm long. *Flowers* solitary, terminal or terminating short shoots, subsessile; bracts few and leaf-like hidden amongst woolly hairs. *Sepals* 5, connate basally, elliptic; outer sepals somewhat asymmetric, 7–9 mm long, woolly outside and also towards the apex inside, tapered into a leaf-like pungent apex with a mucro 1–1.5 mm long; inner sepals more or less symmetric, broader, margins membranous and almost glabrous, apex more obtuse but with a pungent mucro. *Petals* 5, golden yellow, obovate and deeply emarginate, 6–9 mm long. *Stamens* 5 fertile, basally connate and all on one side of the carpels; anthers narrowly oblong, *c.* 2.5 mm long, opening by longitudinal slits; staminodes 5–20 arranged outside the fertile stamens, varying in size up to 1.5 mm long. *Carpels* 2, obovoid, *c.* 2 x 1–1.3 mm, densely white-hairy; ovules 4 per carpel, sometimes only one developing. Mature *fruitlets* not seen. (Figure 6)

Other specimens examined (all PERTH). WESTERN AUSTRALIA: Peak Charles, Q225, 11 Oct. 1995, *S. Barrett* 608; Peak Charles National Park, *c.* 45 km W of Salmon Gums, 10 Nov. 1979, *K. Newbey* 6445; Peak Charles, 28 Nov. 1973, *A.S. Weston* 8988.

Distribution. Western Australia, South West Botanical Province, Roe District, being recorded only from Peak Charles National Park. (Figure 2A)

Habitat. Recorded from scrub on exposed mountain slopes on granite or skeletal loamy sand over granite.

Flowering period. Flowers recorded October and November.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority Two. Apparently restricted in distribution and in need of surveying. Currently known from one or few populations but not believed to be under immediate threat as it occurs in a national park. Its response to attack by *Phytophthora* has not been documented.

Etymology. This species is named after Peak Charles, the only place so far that it has been collected.

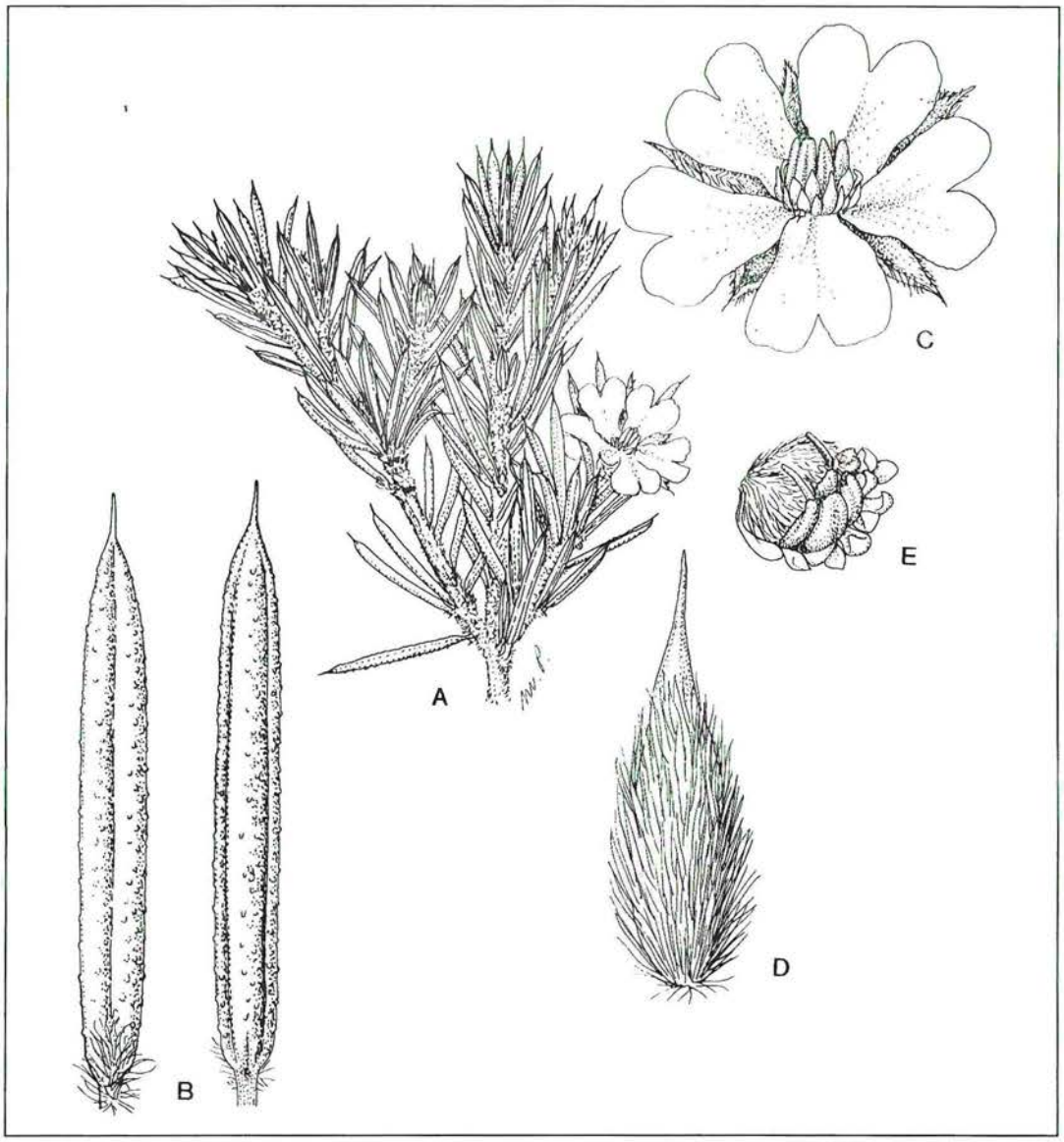

Figure 6. *Hibbertia charlesii.* A – flowering branch (x1.5); B – leaf, upper and lower surface (x6); C – flower (x3); D – sepal (x6); E – stamens and carpels (x6). Drawn from *A.S. Weston* 8988.

Affinities. The woolly indumentum makes this species superficially similar to *H. mucronata.* However *H. charlesii* clearly differs in the presence of a row of staminodes outside the fertile stamens and the presence of 4 rather than 2 ovules in each carpel. The presence and position of the staminodes makes this species difficult to place within the sectional framework traditionally used for the genus (Bentham 1863 and Gilg & Werdermann 1925). Section *Pleurandra* (Labill.) Benth. includes those species with all stamens on one side of two carpels and *H. mucronata* belongs to this section. Section *Hemipleurandra* Benth. includes those species with all stamens on one side of two carpels but which also have either a few staminodes on each side of the stamens or opposite the stamens forming an almost continuous circle. Section *Hemistemma* (Juss. ex Thouars) Benth. includes those species which, like *H. charlesii*, have staminodia all on one side of and outside the fertile stamens, but which, unlike *H. charlesii*, also have peduncles which bear two or more flowers. Further studies are clearly needed on the sectional framework of the genus *Hibbertia.*

6. Hibbertia stowardii S. Moore, *J. Linn. Soc. Bot.* xlv: 163 (1920). *Type:* Kununoppin, Western Australia, *F. Stoward* 727 (*holo:* BM).

Shrub erect to 0.3 m high; branchlets glabrous with smooth greyish bark, with glabrous ridges below the petioles. *Leaves* alternate or in alternate clusters, crowded, ascending, usually spreading to 60 degrees to the stem; petiole less than 0.5 mm long, glabrous; blade narrowly oblong to linear and not or scarcely tapering apically, thick, 4–12 mm long, 1–1.5 mm wide, the margins closely revolute to the midrib; upper surface glabrous, dull and microscopically papillose; apparent margin rounded; midrib not enlarged; apex rounded and with a pungent mucro 0.3–1 mm long. *Flowers* solitary, terminating short axillary shoots, subsessile; bracts subtending flower usually 3, narrowly triangular to narrowly ovate, 1.5–4 mm long, pungent. *Sepals* 5, connate basally, elliptic to broadly elliptic or obovate, mucronate; outer sepals 4–6 mm long including a mucro *c.* 0.5 mm long, almost glabrous; inner sepals 5–7 mm long, broader and more obtuse, with very minute appressed semi-stellate hairs, and with membranous margins. *Petals* 5, golden yellow, obovate and deeply emarginate, 6.5–10 mm long. *Stamens* usually 10, occasionally 8 or 9, connate basally, all on one side of the carpels; anthers narrowly oblong, 1.2–2 mm long, opening by longitudinal slits; staminodes absent. *Carpels* 2, more or less globular, densely white-hairy; ovules 2 per carpel. *Fruilets* dry, obovoid, 2.5–3 x *c.* 2 mm, splitting apically and adaxially to release the seeds; seeds brown, subglobular, 1.5–2 mm across, with a small translucent waxy aril. (Figure 7)

Selected specimens examined (all PERTH). WESTERN AUSTRALIA: E of Carrabin, 4 July 1965, *A.M. Ashby* 1468; Muntadgin, Oct. 1945, *E.T. Bailey* 2; Carrabin, between Merredin and Southern Cross, 22 Aug. 1939, *W.E. Blackall* 4036; ?Bruce Rock, Sep. 1928, *C.A. Gardner s.n.*; 5 miles [8 km]E of Walgoolan, 22 Aug. 1939, *W.E. Blackall* 4014; Muntadgin, Sep. 1947, *T.W. Stone & E.T. Bailey* 818; 7.5 km W of Bodallin on Great Eastern Highway, 22 Sep. 1988, *J.R. Wheeler* 2609; *c.* 50 km SW of Burracoppin along Burracoppin South Rd, 22 Sep. 1988, *J.R. Wheeler* 2616; near Southern Cross, *Anon.*

Distribution. Western Australia, South West Botanical Province, Avon District, recorded between Kellerberrin and Southern Cross, extending south to North Tarin Rock and Muntadgin. (Figure 2C)

Habitat. Recorded from shrubland or heath on lateritic loam or sand.

Flowering period. Flowers recorded from July to October.

Conservation status. Restricted but not considered endangered, although its response to attack by *Phytophthora* has not been documented.

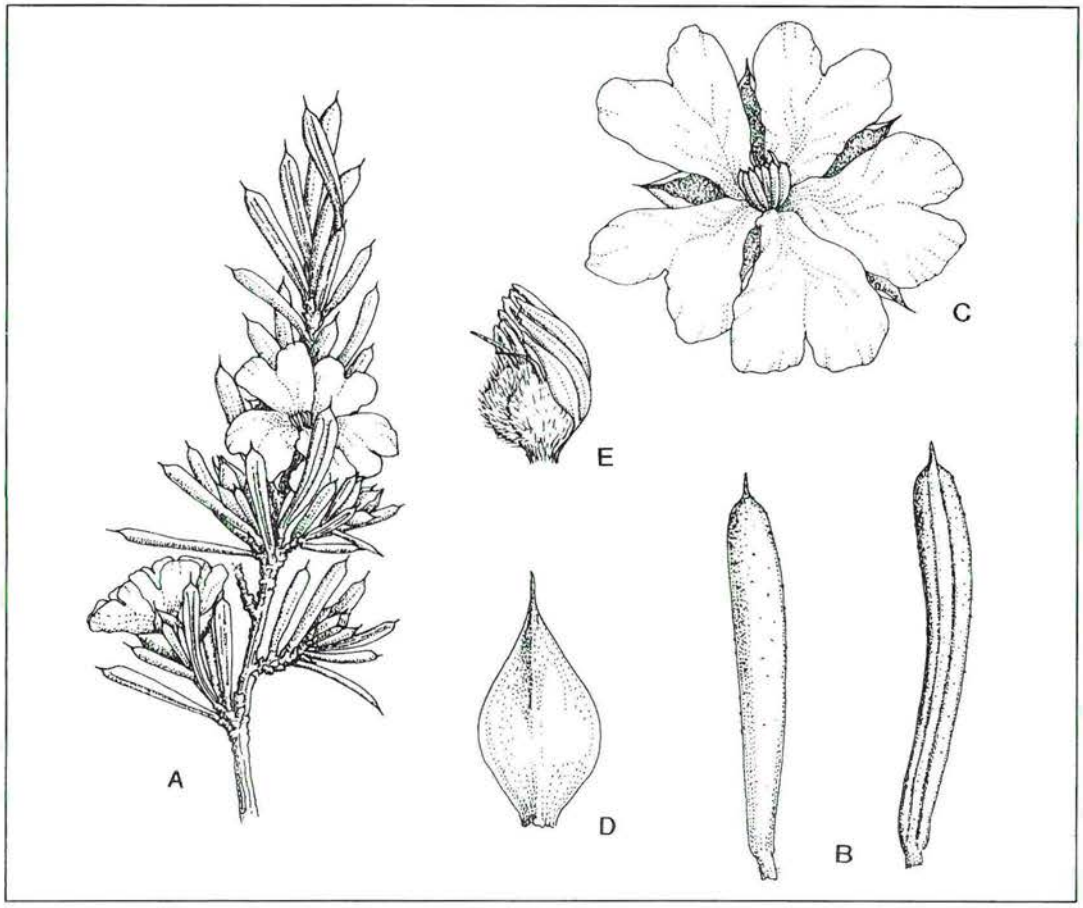

Figure 7. *Hibbertia stowardii*. A – flowering branch (x1.5); B – leaf, upper and lower surface (x6); C – flower (x3); D – sepal (x6); E – stamens and carpels (x6). Drawn from *J.R. Wheeler* 2617 and *C.A. Gardner s.n.* ?Bruce Rock.

Affinities. Sometimes previously confused with *H. mucronata*. However *H. mucronata* has woolly hairs on the young shoots and sepals, its leaves are more gradually tapered to a longer mucro and the leaves have more acute edges, the midrib is much more pronounced, the outer sepals also have a longer pungent mucro and there are only 5 stamens. *H. stowardii* appears quite distinct but most closely related to *H. axillibarba*. *Hibbertia axillibarba* however has tufts of pilose hairs inside the leaf bases and smaller flowers with pilose hairs on the sepals, also the leaves are more crowded with their margins revolute so as to hide the midrib.

Note. A collection from North Tarin Rock Nature Reserve (*M.S. Graham* 765) has short leaves with an indistinct tuft or hairs on the adaxial petiole surface and sepals with a few short appressed simple hairs. Further study is needed to ascertain its relationship with both *H. stowardii* and *H. axillibarba*.

7. Hibbertia axillibarba J.R. Wheeler, *sp. nov.*

Hibbertiae stowardii affinis sed foliis gracilioribus aggregatis, axillis foliorum pilis simplicibus ornatis differt.

Typus: South Ironcap, 200 metres east of the benchmark on summit, 32°40'43"S, 119°46'37"E, Western Australia, 7 September 1999, *J.R. Wheeler* 3963 (*holo:* PERTH; *iso:* AD, K, CANB).

Shrub to 0.7 m high; branchlets somewhat pilose in leaf axils with long simple hairs, ridged below each petiole, the young shoots somewhat pilose. *Leaves* alternate, crowded, somewhat spreading to 60 degrees from the stem, subsessile or with a petiole less than 0.5 mm long, the adaxial petiole surface with a basal tuft of pilose hairs; blade narrowly oblong to linear and not or scarcely tapering apically, thick, 2.5–9 mm long and 0.7–1 mm wide, the margins closely revolute to hide the midrib of the lower surface; upper surface dull, glabrous and microscopically papillose, very occasionally with sparse retrorse uncinate hairs; apparent margins rounded; apex a pungent mucro 0.5–1 mm long. *Flowers* solitary, terminating short axillary shoots, subsessile; bracts subtending flower 1–3, subulate to linear, 3–4 mm long, hairy, pungent. *Sepals* 5, connate basally, narrowly elliptic to elliptic, tapered apically to a soft recurved mucro, outer surface and margin pilose, inner surface with a few pilose hairs towards the apex and often with scattered minute semi-stellate hairs; outer sepals 6–6.5 mm long; inner sepals slightly broader, the margins membranous with fewer hairs. *Petals* 5, yellow, obovate and deeply emarginate, 5–6 mm long, usually shorter than the sepals. *Stamens* 10 or 11, connate basally, all on one side of the carpels; anthers narrowly oblong, *c.* 1.5 mm long, opening by longitudinal slits; staminodes absent. *Carpels* 2, globular to obovoid, densely white-hairy; ovules 2 per carpel. Mature *fruitlets* not seen. (Figure 8)

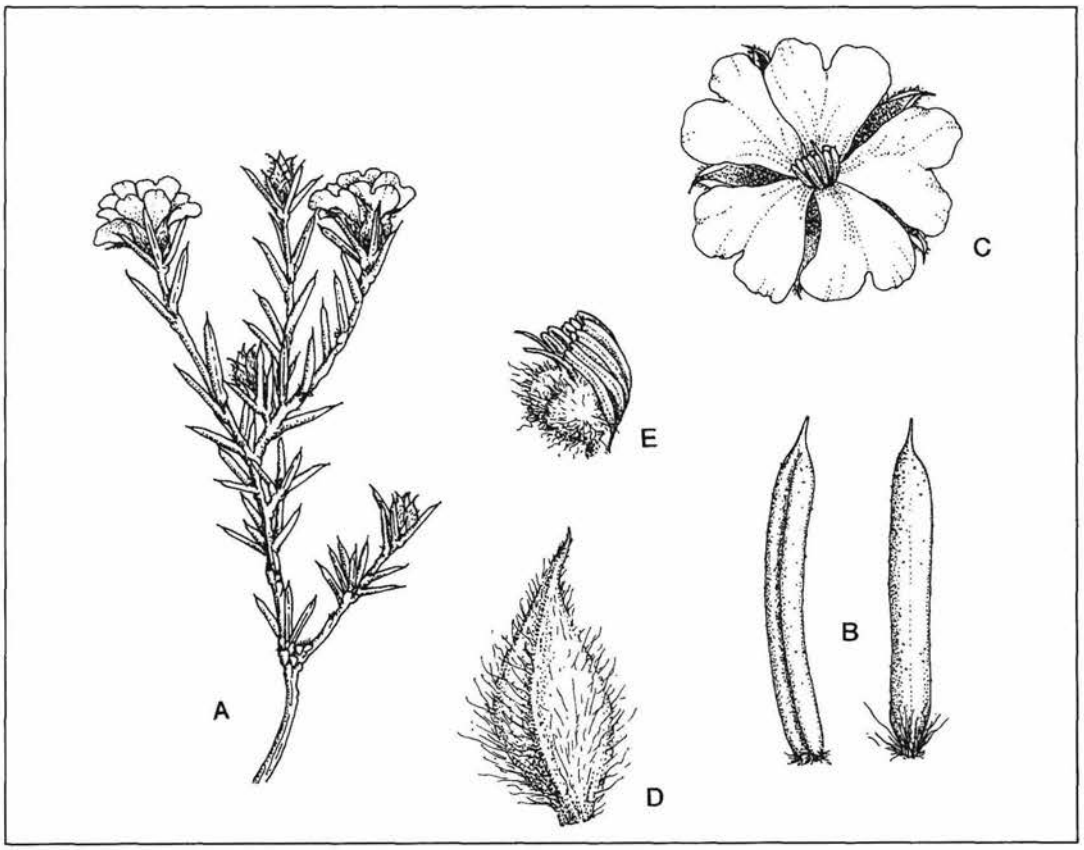

Figure 8. *Hibbertia axillibarba.* A – flowering branch (x1.5); B – leaf, upper and lower surface (x6); C – flower (x3); D – sepal (x6); E – stamens and carpels (x6). Drawn from *J.R. Wheeler* 3963.

Other specimens examined (all PERTH). WESTERN AUSTRALIA: South Ironcap Hill, 16 miles [26 km] N of Hatters Hill (NE of Lake King), 20 Oct. 1964, *J.S. Beard* 3730; South Ironcap, 14 Oct. 1994, *M.D. Carter* 551; on the southern side of gridline, *c.* 100 m S of South Ironcap, 7 Sep. 1996, *N. Gibson & K. Brown* 2524.

Distribution. Western Australia, South West Botanical Province, Roe District, recorded only from South Ironcap. (Figure 2C)

Habitat. Recorded from heath shrubland on ironstone laterites.

Flowering period. Flowers recorded September and October.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority One. Apparently restricted in distribution and in need of surveying, although apparently quite common at South Ironcap. Currently known from less than five populations but possibly not under immediate threat. Its response to attack by *Phytophthora* has not been documented.

Etymology. From the Latin *axilla*, the axils, and *barba*, bearded, referring to the presence of hairs in the leaf axils.

Affinities. Apparently more closely related to *H. stowardii* than to *H. mucronata*. *Hibbertia stowardii* however has leaves in which the revolute margins do not hide the midrib, larger flowers with sepals which are glabrous or have minute semi-stellate hairs and petals which are longer than the sepals.

Acknowledgements

I should like to thank the Director and staff of the Western Australian Herbarium for access to the state collection. Thanks to Margaret Pieroni and Kathleen Trafalski for preparing the fine illustrations, Barbara Rye for assistance with the maps and also to Paul Wilson for preparing the brief Latin diagnoses. Finally thanks also to Mal Grant of CALM Albany and Stuart Wheeler, for assistance during a trip to collect type material of *Hibbertia axillibarba*.

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Hibbertia porongurupensis, a new name for a species of Dilleniaceae endemic to the Porongurup Range

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Abstract

Wheeler, J.R. *Hibbertia porongurupensis*, a new name for a species of Dilleniaceae endemic to the Porongurup Range. *Nuytsia* 13(2): 395–398 (2000). *Hibbertia porongurupensis* J.R. Wheeler & R.D. Hoogland, a new species previously known incorrectly as *H. bracteosa* Turcz., is described and illustrated. It is restricted to the Porongurup Range of Western Australia but appears to be adequately conserved in a national park.

Introduction

For many years a species of *Hibbertia* Andr. (Dilleniaceae) endemic to the Porongurup Range, Western Australia was known as *Hibbertia bracteosa* Turcz. *Hibbertia bracteosa* was described by Turczaninov in 1852 based on a collection by James Drummond. This collection, however, is in fact a specimen of *Hibbertia amplexicaulis* Steud. and not the species to which the name *H. bracteosa* had been applied. In 1983 Ru Hoogland (pers. comm. to J.W. Green) proposed to provide the Porongurup species with a new name, *Hibbertia porongurup* ms. based on his own collection *R.D. Hoogland* 12186. However I have not seen any manuscript and the name was never published.

Description

Hibbertia porongurupensis J.R. Wheeler & R.D. Hoogland, *sp. nov.*

Species insignis foliis latis amplexicaulis, floribus grandibus staminibus numerosis carpella quinque glabra cingentibus, a speciebus nobis notis bene distincta.

Typus: at the base of Devils Slide, Porongurup Range, 31°41'W, 117°51'E, Western Australia, 23 October 1971, *R.D. Hoogland* 12186 (*holo:* PERTH 1058185; *iso:* CANB, K, L, all *n.v.*).

Shrub to 1.5 m high, glabrous, the stems compressed and 2-angled to somewhat narrowly winged. *Leaves* alternate, sessile, broadly elliptic to circular, 15–55 mm long, 12–55 mm wide, the base strongly

amplexicaul, the margin very shallowly and distantly toothed with very tiny teeth, the apex obtuse. *Flowers* axillary; peduncle slender, 15–30 mm long, in fruit somewhat pendulous and lengthening up to 40 mm; bract immediately below flower narrowly oblong-elliptic to oblong-elliptic, 7–10 mm long, apex acute, slightly amplexicaul at the base. *Sepals* 5, connate basally, 10–15 mm long, glabrous; outermost sepals ovate and acute; innermost sepals oblong, narrower, obtuse but minutely apiculate. *Petals* 5, yellow, broadly obovate, 10–20 mm long, emarginate. *Stamens* numerous, tightly packed in a ring around the carpels, a few of the outermost stamens sometimes reduced to staminodes; filaments slender; anthers narrowly oblong-elliptic, 1–1.5 mm long, opening by longitudinal slits. *Carpels* 5, glabrous, with styles protruding out through the ring of stamens; ovules 3–5. *Fruitlets* ovoid-obloid, up to 9 mm long; seeds orange-brown, shiny, almost globular, *c.* 3 x 2 mm, with a small creamy translucent aril. (Figure 1)

Selected specimens examined. WESTERN AUSTRALIA: Porongurup National Park, Devils Slide area, 12 Sep. 1965, *A.C. Beauglehole* ACB 12794 (PERTH); Devils Slide, Porongurup Range, 20 Oct. 1984, *E.J. Croxford* 4031 (ALB, PERTH); "Swan River", *J. Drummond* 5: 286 (PERTH, MEL); at base of Devils Slide, Porongurup Range, 23 Oct. 1971, *R.D. Hoogland* 12187 (PERTH); Devils Slide, Porongurup Range, 11 Nov. 1982, *G.J. Keighery* 5625 (PERTH); Bates Peak, W end of Porongurup Range, 35 km NNE of Albany, 15 Dec. 1987, *G.J. Keighery* 8415 (PERTH); Gibraltar Rock, Porongurup Range, 30 km NE Albany, 15 Dec. 1986, *G.J. Keighery* 8420 (PERTH); Devils Slide, Porongurups, Oct. 1963, *W. Rogerson* 36 (PERTH); Nancy Peak, Porongurup Range National Park, 29 Sep. 1966, *P.G. Wilson* 4244 (PERTH); Porongurup Range, eastern side of Elephant Rock, 23 Sep. 1999, *J.R. Wheeler* 3969 (ALB, PERTH).

Distribution. Western Australia, South West Botanical Province, in the Menzies Subdistrict of the Darling District. Restricted to higher slopes of the Porongurup Range.

Habitat. Occurs in shrubland on loamy soils in association with granite or on moss swards in rock crevices on granite slopes.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority Four. Restricted but well conserved in a National Park, with the Priority Four coding indicating that the species, although rare, is not currently threatened.

Etymology. Named after the Porongurup Range, to which this species appears to be restricted.

Affinities. Probably most closely related to *Hibbertia amplexicaulis* and *H. cunninghamii* but differing in its leaf shape.

Notes. Hibbertia porongurupensis has previously been known by the misapplied name *Hibbertia bracteosa* and later by the manuscript name *Hibbertia porongurup* ms. R.D. Hoogland or the informal name *Hibbertia porongurups* (*R.D. Hoogland* 12186).

When Turczaninov (1852) published his description of *Hibbertia bracteosa*, he based it on a collection of James Drummond (*Drummond* 5: 287) which is clearly a specimen of *Hibbertia amplexicaulis*. The name *Hibbertia bracteosa* is therefore a synonym of the latter species. In the original description there is mention of another species of *Hibbertia* (*Drummond* 5: 286) which Turczaninov believed to be undescribed, but, as the specimen was sterile, it remained without a name. *Drummond* 286 is in fact a collection of the Porongurup species. The description of *H. bracteosa* given

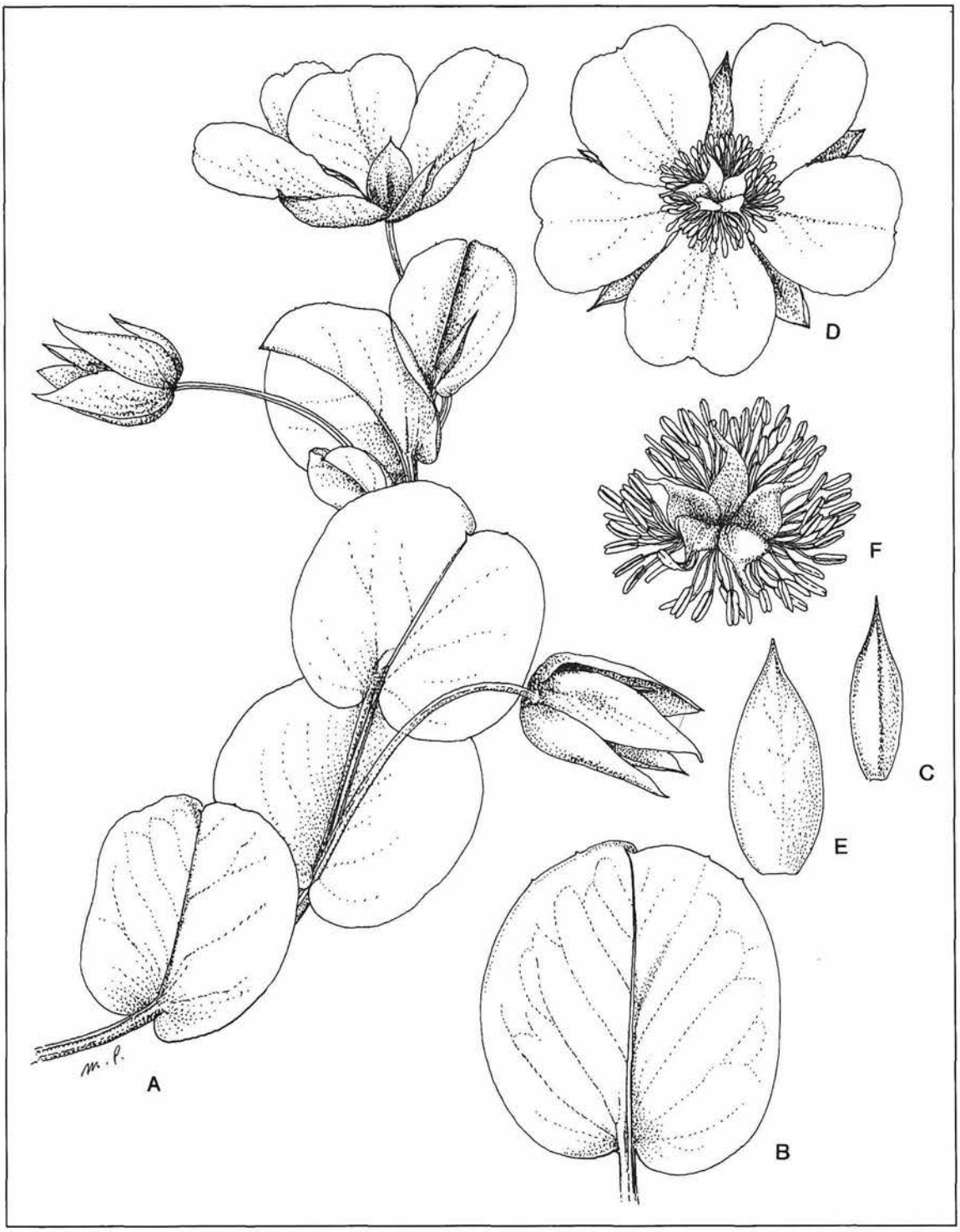

Figure 1. *Hibbertia porongurupensis*. A – flowering branch (x0.75); B – leaf (x0.75); C – bract (x1.5); D – flower (x1.5); E – sepal (x1.5); F – stamens and carpels (x3). Drawn from *A.C. Beauglehole* 12794.

by Bentham (Bentham 1863: 38) is of the Porongurup species, based on the sterile *Drummond* 286 specimen with additional material from Maxwell. Bentham apparently did not see the type of *H. bracteosa*, *Drummond* 287.

Acknowledgements

I should like to thank the Director and staff of the Western Australian Herbarium for access to the state collection. Thanks also to Margaret Pieroni for the fine illustration and to Paul Wilson for taxonomic advice and preparation of the Latin diagnosis. I thank John Green for access to a letter from R.D. Hoogland in which Hoogland's intention to publish a new name for the Porongurup species is stated. I thank also the late R.D. Hoogland whose earlier work I acknowledge in the shared authorship for the name *Hibbertia porongurupensis*.

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SHORT COMMUNICATIONS

Bryophyllum delagoense (Crassulaceae): a new weed for Western Australia and a potentially serious problem for the Abrolhos Islands

Western Australia has a large number of offshore islands, generally with simple plant communities subject to a high level of natural and artificial disturbance, which enables weeds to become readily established. Weeds are major threats to the biological values of these islands (Keighery 1993). This report details the discovery of a potentially serious weed, Mother of Millions (*Bryophyllum delagoense* (Eckl. & Zeyh.) Schinz), located during biological surveys of the Abrolhos Islands during 1999.

Bryophyllum Salisb. (Crassulaceae) is a genus of *c.* 35 species of erect succulent perennial herbs or woody shrubs from Africa and Madagascar. Members of this genus were previously included in *Kalanchoe* Adans., a genus of *c.* 100 species mainly occurring in Africa and Asia but with one species in North America.

Previous records in Australia

Eleven species of Crassulaceae have been recorded as naturalized in Western Australia (Keighery 1999) but these did not include any *Bryophyllum* species. However, five species and a hybrid of *Bryophyllum* have been recorded as naturalized in eastern Australia (Harden 1990, Henderson 1997 and Hnatiuk 1990). These include *Bryophyllum delagoense*, which has often been known by a synonymous name *B. tubiflorum* Harv., and is commonly known as Mother of Millions, Mission Bells or Christmas Bells. The other naturalized taxa are *Bryophyllum daigremontianum* (Raym.-Hamet & H. Perrier) A. Berger, *B. fedtschenkoi* Raym.-Hamet & H. Perrier, *B. pinnatum* (Lam.) Oken (Live or Resurrection Plant), *B. proliferum* Bowie and the hybrid, *B. daigremontianum x B. delagoense* (Devil's Backbone or Mother of Millions). This hybrid arose in gardens as it is not known in the wild and is only known as a weed in Australia.

Bryophyllum delagoense, B. pinnatum and the hybrid (*B. daigremontianum x B. delagoense*) are recorded as weeds of coastal areas in New South Wales and Queensland invading coastal dunes, open bushland, estuaries and heathlands (Armstrong & Swarbrick 1983, Batianoff & Franks 1997, 1998). These taxa are described and illustrated in Armstrong & Swarbrick (1983). The other species are minor weeds of the same areas, spreading from dumped garden refuse. On offshore islands in Queensland *Bryophyllum* species can form monospecific stands, especially where the soil is enriched and disturbed by nesting seabirds (Keighery, unpubl.).

New record in Western Australia

During the 1999 survey of the Abrolhos Islands very dense stands of *Bryophyllum delagoense* were located covering over half of Rat and Pigeon Islands. These populations comprised several thousand plants. Both of these islands are inhabited by fishermen during the crayfishing season and the weed was probably introduced as a garden plant. It is possible that smaller infestations are present on other inhabited islands.

This species is a drought-resistant poisonous succulent capable of rapid spread as it produces abundant seed and also reproduces vegetatively through epiphyllous buds on the leaf margins. It appears to have been introduced relatively recently as it was not reported from either island in biological surveys carried out approximately 20 years ago, although weed species may not have been fully recorded then.

The species appears to be replacing the natural low shrublands present on the islands, probably aided by natural disturbance by nesting seabirds that kill plants and enrich the soil through their guano and nests. This allows the weed to build up dense stands that halt the natural cycle of regeneration after the bird colony has moved on. The poisonous nature of the plant limits predation by native herbivores and could be a serious problem on nearby islands with rare Tammar Wallaby populations if the weed spreads there.

Recommendations

Hand pulling is the recommended method of control for this species. However, care must be taken to ensure the whole plant is removed as vegetative material (especially leaves) can re-establish. Plants should be bagged for removal or burnt on site. Chemical control using 2,4-D (0.2% at flowering time) has been recommended in the past, but currently AF-300-acid is used (Kleinschmidt 1991).

Bryophyllum delagoense is a significant weed of coastal areas and offshore islands in Eastern Australia and has the potential to become a major weed in similar habitats of Western Australia. Because of the increasing usage of the Abrolhos Islands by tourists, there is ample opportunity for this species to spread more widely on the islands and possibly also to the mainland. Eradication of the still localized infestations of this species is possible and highly desirable and is an aim of the management plan for the Abrolhos Islands currently being prepared.

Acknowledgements

Access to the Abrolhos Islands was greatly facilitated by the Western Australian Fisheries Department.

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Sagittaria platyphylla (Alismataceae), a new aquatic weed threat in Western Australia

Sagittaria L. (Alismataceae) is a genus of approximately 25 species, predominantly from the Americas with up to four species occurring in Europe and Asia (Haynes & Holm-Nielsen 1994). Two species, *Sagittaria platyphylla* and *S. montevidensis* Cham. & Schlecht, have been recorded as naturalized in eastern and southern Australia, but neither in Western Australia (Parsons & Cuthbertson 1992; Jacobs 1993). Recently a naturalized population of *S. platyphylla*, a weed of rising concern in eastern Australia (Sainty & Jacobs 1994), was discovered in the Canning River south of Perth. It is currently a Declared Plant under the Western Australian Agriculture and Related Resources Protection Act (1998) of the highest priority for control, i.e. for which eradication is manditory.

The purpose of this paper is to draw attention to the presence of *S. platyphylla* in Western Australia and to facilitate recognition of further occurrences.

Sagittaria platyphylla (Engelmann) J.G. Smith, *Missouri Bot. Gard. Rep.* 6: 29 (1894). – *Sagittaria graminea* var. *platyphylla* Engelmann in A. Gray, Man. Bot., ed. 5: 494 (1867).

Descriptions and illustrations of *Sagittaria platyphylla* can be found in Soerjani *et al.* (1987), Parsons & Cuthbertson (1992) [as *S. graminea*] and Sainty & Jacobs (1994) [as *S. graminea* var. *platyphylla*]. One of these illustrations is reproduced here. (Figure 1)

Specimens examined. WESTERN AUSTRALIA: Canning River, S of the Nicholson Rd bridge, 9 Feb. 1999, *S. Lloyd & D. Dean s.n.* (PERTH, CANB, MEL, NSW); Canning River, 18 Mar. 1997, *W. Vincent s.n.* (PERTH).

Distribution. Sagittaria platyphylla is native to eastern United States of America, Mexico and Panama and has been introduced into numerous countries as an ornamental aquatic plant (Parsons & Cuthbertson 1992). *S. platyphylla* was first recorded (Parsons & Cuthbertson 1992) as naturalized in Australia in Queensland in 1959; it is also recorded as naturalized in New South Wales, Victoria and South Australia (Swarbrick & Skarratt 1994).

Habitat. Sagittaria platyphylla grows in shallow, slow-moving or static aquatic environments such as the banks of rivers and streams and periodically inundated areas (Parsons & Cutherbertson 1992). *W. Vincent* 18 Mar. 1997 was collected from static water in the Canning River, just south of the Nichsolon road bridge in Ferndale, while *S. Lloyd & D. Dean* 9 Feb. 1999 was collected a few hundred metres further south from a drain emptying into the Canning River. Associated with this collection was *Eclipta* sp. Perth (*S. Lloyd s.n.* 3 Apr. 1998), *Typhus orientalis* and *Rubus* aff. *selmeri*.

Notes. Sagittaria platyphylla is a rhizomatous perennial herb to *c.* 80 cm with a basal rosette of emergent leaves that are narrowly elliptic to lanceolate in shape (Sainty & Jacobs 1994; Soerjani *et al.* 1987). Flowers are actinomorphic, up to 2 cm in diameter and arranged in whorls to form a raceme (Soerjani *et al.* 1987).

Leaves of *Sagittaria platyphylla* can be confused with those of *Alisma lanceolatum* With. (Sainty & Jacobs 1994), an aquatic weed of the same family (Alismataceae) occurring in Western Australia, though the two taxa are easily distinguished by their inflorescences.

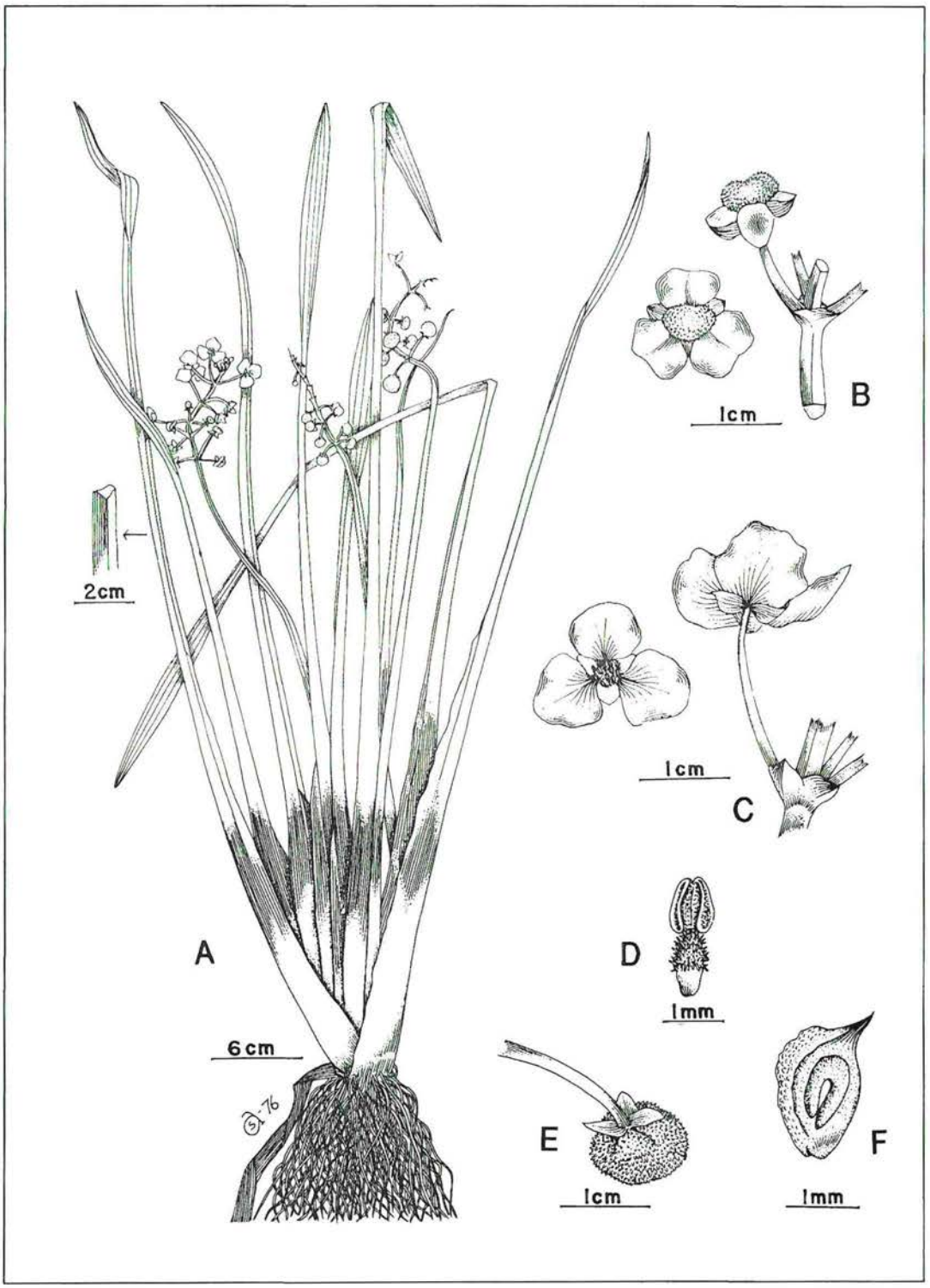

Figure 1. *Sagittaria platyphylla.* A – habit and enlargment of leaf, B – female flowers, C – male flowers, D – stamen, E – fruiting head, F – achene. Reproduced with permission from Soerjani *et al.* (1987: Figure 4.3)

Sainty & Jacobs (1994) state that *S. platyphylla* is "of increasing concern as a weed of rice crops and associated channels and drains" in south-eastern Australia. Parsons & Cuthbertson (1992) note that *S. platyphylla* (as *S. graminea* var. *platyphylla*) can block water flow in its preferred habitat. In Western Australia the dairy farming irrigation system around Harvey about 100 km south of Perth is similar to this and suitable for invasion by *S. platyphylla*. *S. platyphylla* has previously been recorded from the area (and Midvale, metropolitan Perth) as deliberately cultivated and not naturalized. The occurrance of naturalized *S. platyphylla* in the Canning River (part of the Swan River system) is of great concern in a disturbed area already heavily affected by weed invasion and algal blooms . It also poses an environmental threat to other slow moving fresh waterways in the south west of the state.

The recommended method of control is the spot application of approved herbicides, as manual or mechanical removal is likely to leave rhizomes, resulting in further spread of the plant (Sainty & Jacobs 1994; Parsons & Cuthbertson 1992).

Acknowledgements

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CONSERVATION CODES FOR WESTERN AUSTRALIAN FLORA

R: Declared Rare Flora – Extant Taxa (= Threatened Flora = Endangered + Vulnerable)

Taxa which have been adequately searched for, and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such, following approval by the Minister for the Environment, after recommendation by the State's Threatened Species Scientific Committee.

X: Declared Rare Flora – Presumed Extinct Taxa

Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such, following approval by the Minister for the Environment, after recommendation by the State's Threatened Species Scientific Committee.

1: Priority One – Poorly Known Taxa

Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat, e.g. road verges, urban areas, farmland, active mineral leases, etc., or the plants are under threat, e.g. from disease, grazing by feral animals, etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

2: Priority Two – Poorly Known Taxa

Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

3: Priority Three – Poorly Known Taxa

Taxa which are known from several populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in need of further survey.

4: Priority Four – Rare Taxa

Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5–10 years.

Publication date for *Nuytsia* Volume 13 Number 1: 17 December 1999

Notes for Authors

The aim of *Nuytsia* is to publish original papers on systematic botany with preference given to papers relating to the flora of Western Australia. All papers are refereed and the Editorial Advisory Committee reserves the right to reject papers. Opinions expressed by authors are their own and do not necessarily represent the policies or views of the Department of Conservation and Land Management.

After final acceptance of papers, authors are requested to provide discs readable directly by IBM computer or internet attachments. Wherever possible, the MS-WORD software should be used. Original figures should not be lettered but accompanied by copies indicating lettering. Page proofs will be forwarded to authors for checking. Twenty reprints of each paper will be provided free of charge; no additional copies may be ordered.

Style and layout should follow recent numbers of *Nuytsia*. Within a paragraph two spaces are required between sentences; after colons, semicolons, commas and dashes a single space is required. Italics should be used for formal taxonomic names, from the genus level down to the lowest infraspecific categories, and for collectors' names when citing specimens. Incidental Latin words in the text should be italicized but not the Latin diagnosis.

Title. Should include the family name of the genera or species treated, but not authorities. New taxa should be named if not too numerous. The type of paper (e.g. revision, synopsis) and geographic area of study should be given where appropriate.

Structure of papers. Authors are encouraged to use the conventional structure of scientific papers, especially when a complete study, such as a revision, is being reported.

(1) *Abstract.* Should be indented and commence with bibliographic information. New taxa, combinations and names should be listed with their authorities. The major contents of the paper should be concisely summarized but no additional material given.

(2) *Introduction.* Should give some background information and state the purpose of the paper.

(3) *Methods* or *Materials and methods.* May include the method of drawing up the description from specimens, extent of search for types and discussion of concepts of taxonomic categories.

(4) *Results* or *Taxonomy* or *Taxonomic treatment* or various alternative headings as appropriate to the data being presented in the paper.

(5) *Discussion.* A discussion section should be considered, which would include some or all of the following: a summary of the findings emphasizing the most significant; interpretation of the results in the light of other relevant work; statement of new problems which have arisen; advising of aspects which are to be followed up; suggestion of topics which others might usefully pursue; prediction and speculation.

Short Communications. These are short concise contributions, usually with few or no main headings. They lack an abstract and authors' names and addresses are placed at the end.

Headings. All headings should be mainly in lower case, major headings centred and bold, secondary headings (where required) left-justified and bold, and minor headings left-justified and italicized.

Keys. May be either indented (e.g. *Nuytsia* 11: 94) or bracketed (e.g. *Nuytsia* 11: 55–56). Indented keys involving more than nine levels of indentation should be avoided. Where a key is indented, tabs should be used and not space bars.

Species treatments. Use of certain named paragraphs, or sets of paragraphs, for matter following the descriptions is encouraged. The desired sequence and examples of commonly used headings are shown below. Italicized headings should be followed by text on the same line.

(1) Taxon name (in bold) and authority. For previously published taxa this should be followed by the reference, nomenclatural synonyms (if any) and *Type:* heading with full type details.

(2) Other synonyms with their type details, significant manuscript or phrase names. Recent papers should be consulted for examples of an appropriate format for citing synonyms.

(3) Latin diagnoses (for new taxa – not indented).

(4) *Typus:* (for new taxa – not indented).

(5) English description (indented).

(6) *Other specimens examined* or *Selected specimens examined* as appropriate. The number of specimens cited for each taxon should not exceed 20. Western Australian specimens should be cited first followed by any from other states in the order: Northern Territory, South Australia, Queensland, New South Wales, Victoria, Tasmania. Within each region, the specimens cited should be placed in alphabetical order according to the collectors' surnames. For each specimen the order of the details given should be as follows: locality, date, collector's name (in italics) and number, herbarium (in brackets).

(7) *Distribution.*

(8) *Habitat.*

(9) *Phenology* or *Flowering period.*

(10) *Conservation status.* Department of Conservation and Land Management Conservation Codes for Declared Rare and Priority Flora should be cited for any endangered or rare Western Australian plants.

(11) *Etymology.*

(12) *Typification.*

(13) *Affinities.*

(14) *Notes* or *Discussion* or *Comments.*

Threatened species. The Department of Conservation and Land Management has a policy not to publish precise locality data for threatened species. When describing threatened taxa authors are therefore requested to use generalized localities accompanied by the bracketed statement [precise locality withheld].

Standard abbreviations. When abbreviations are used, the following standards should be followed.

(1) Author abbreviations. Follow Brummitt, R.K. & Powell, C.E. (1992). "Authors of Plant Names." (Royal Botanic Gardens: Kew.).

(2) Book titles. These should not be abbreviated in the references but any literature citations in the text should follow Green, J.W. (1985). "Census of the Vascular Plants of Western Australia." 2nd edn. pp. 20–24. (Department of Agriculture: Perth.). A more complete list of book title abbreviations is given in Stafleu, F.A. & Cowan, R.S. (1976–83). "Taxonomic Literature." 2nd edn. (Bohn, Scheltema & Holkema: Utrecht.), but capital initial letters need to be used in *Nuytsia.*

(3) Journal titles. Follow Lawrence, G.H.M. *et al.* (1968). "B-P-H. Botanico-Periodicum-Huntianum." (Hunt Botanical Library: Pittsburgh.)

(4) Dates and directions. Generally should not be abbreviated except under the *Specimens examined* section. In that section, dates should be written in full only if they have less than five letters (e.g. July), otherwise should be shortened to the first three letters and a stop (e.g. Oct.), while compass directions should be abbreviated to capital letters with no stops (e.g. N and SSW).

(5) Other abbreviations. Standard abbreviations for measurements (e.g. mm), Latin abbreviations (e.g. *c.*, *nom. illeg.*), mountains and roads (e.g. Mt Koscuisko, Brooke Rd) are used in *Nuytsia.* Other abbreviations, especially ones that are ambiguous (e.g. Pt), should be avoided.

Figures. Numbers should follow a single sequence including maps.

References. Citation of references in the text should give the author's surname and date (e.g. Smith 1963) and full details should be given in the reference section. This format is also recommended to replace the traditional abbreviations for references listed under taxonomic names, for example using Benth. (Bentham 1878: 234) rather than Benth., Fl. Austral. 7: 234 (1878).