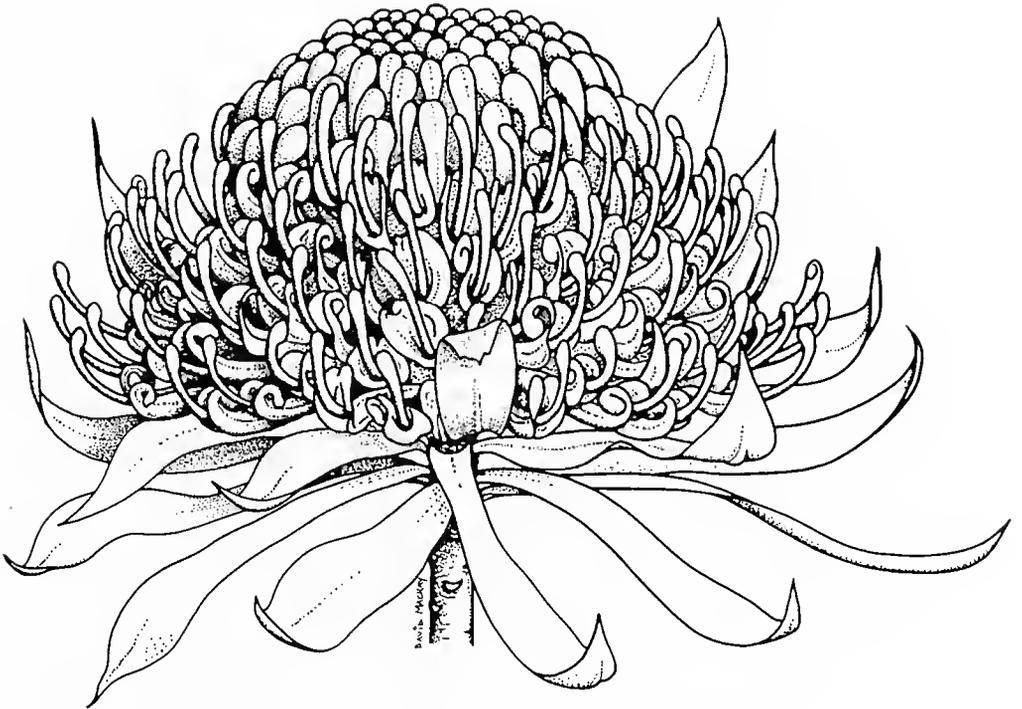


# TELOPEA

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*Cover illustration*

The Waratah, *Telopea speciosissima* (Sm.) R. Br., belongs to the family Proteaceae. The species is endemic in eastern New South Wales and is the official State floral emblem. Illustration by David Mackay

# TELOPEA

A journal of plant systematics

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# *Alocasia suhirmaniana* (Araceae–Colocasieae) — a spectacular new aroid from Sulawesi, Indonesia

Yuzammi and A. Hay

## Abstract

Yuzammi<sup>1</sup> and Hay, A.<sup>2</sup> (<sup>1</sup>Leubaga Ilmu Pengetahuan Indonesia, Upt Balai Pengembangan Kebun Raya, P.O. Box 309, Bogor 16003, Indonesia; <sup>2</sup>Royal Botanic Gardens, Mrs Macquaries Road, Sydney, NSW, Australia 2000) 1998. *Alocasia suhirmaniana* (Araceae–Colocasieae) — a spectacular new aroid from Sulawesi, Indonesia. *Telopea* 7(4): 303–306. A new species of *Alocasia*, *A. suhirmaniana*, is described, endemic to southeast Sulawesi, Indonesia. Features distinguishing the new species from the closely allied *Alocasia longiloba* Miq. complex are discussed.

## Introduction

Recent plant-collecting initiatives by staff of the Kebun Raya, Bogor, together with the ongoing revision of the genus *Alocasia* by A.H., have resulted in the discovery and recognition of a highly ornamental new species of that genus from Sulawesi, described here.

*Alocasia suhirmaniana* Yuzammi & A. Hay, sp. nov.

Ab *Alocasia longiloba* sens. latiss. petiolo puberulo, spathae lamina extus atropurpurea, stigmatis rotunde lobatis, synconnectivis ad margines leviter expansis differt.

Typus: Indonesia: cultivated Kebun Raya, Bogor, ex S.E. Sulawesi, Kabupaten Kolaka, Yuzammi s.n., 23 June 1997 (holo BO; photo NSW).

Terrestrial herb; rhizome 13–15 cm long; leaves 1 to 3 together; petiole to c. 60 cm long, sheathing in the lower c.  $\frac{1}{5}$ – $\frac{1}{4}$ , yellowish green, densely longitudinally and obliquely mottled purple-brown, minutely and densely puberulous, subtended by papery membranous cataphylls; blade broadly ovato-sagittate (shield-shaped), peltate, pointed down, thinly leathery, with the margin slightly undulate, glossy dark green adaxially with the major venation pale grey-green, dark purple abaxially; anterior lobe to c. 35 cm long  $\times$  10–24 cm wide, widest about  $\frac{1}{4}$  of the way distally from the junction with the petiole, the tip broadly acute to obtuse, shortly apiculate; anterior costa with up to 8 primary lateral veins on either side, the proximal ones diverging at 70–80°, the distal ones at c. 45°, with conspicuous purple glands in their axils abaxially; primary veins of anterior lobe each with 1–3 subsidiary veins thicker than, but running the same course as, the secondary venation; secondary venation inconspicuous, forming undulating intercostal collective veins; costae and primary veins prominent both adaxially and abaxially; posterior costae diverging at c. 35–45°; posterior lobes about  $\frac{1}{2}$  to  $\frac{2}{3}$  the length of the anterior, joined for c.  $\frac{1}{2}$  to  $\frac{2}{3}$  of their length, the tips acutely rounded. Inflorescences paired, subtended by papery membranous cataphylls to c. 11 cm long; peduncle to 24 cm long; minutely puberulous in the upper part, purple brown; spathe c. 12.5 cm long, deep purple, slender, glabrous, abruptly constricted at c. 2 cm from the base; lower spathe subcylindric; limb narrowly lanceolate; spadix somewhat shorter than spathe, c. 10 cm long, slender, very shortly

stipitate for 4 mm, stipe ivory; female zone c. 1.2 cm long, c.1 cm wide at the base, with c. 96 pistils; ovaries greenish yellow, unilocular; stigma bluntly 2–4-lobed, sessile, yellow; interstice of sterile organs c. 0.5 cm long, narrowed level with the spathe constriction to c. 4 mm diam.; lowermost synandrodia strongly lobed, the rest rhombohexagonal, c. 1.5 mm diam.; male zone c. 2 cm long, 1 cm diameter, cylindrical; synandria rhombohexagonal, the tops deeply impressed, c. 2 mm across, yellowish ivory; thecae opening by apical pores laterally displaced by lobed overgrowth of the synconnective; appendix c. 6 cm, 8 mm diameter at the base, yellowish, the interface with the male zone slightly constricted, the rest cylindrical, somewhat rugose in the lower half, tapering in the upper third; fruit unknown.

**Derivation of epithet:** we are pleased to dedicate this very beautiful and distinctive new species to Dr Ir. Suhirman, formerly Director of the Indonesian Botanic Gardens, who has done much to support botanical exploration and conservation in Indonesia.

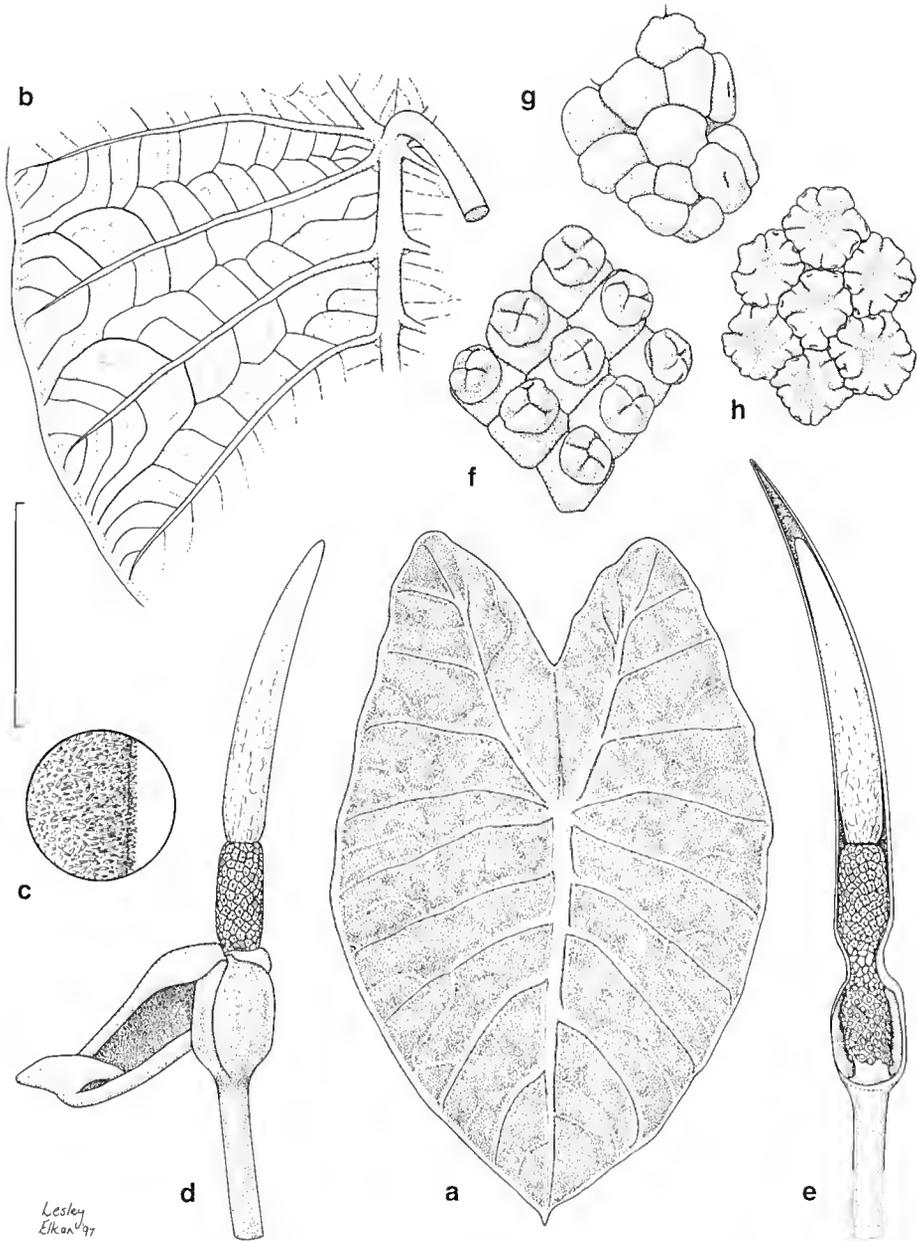
**Habitat:** in damp shady spots in lowland rainforest on slopes. Kjellberg 2428 on limestone at sea level.

**Distribution:** Indonesia, SE Sulawesi, known only from the type locality and Tolala.

**Notes:** *Alocasia suhirmaniana* is a member of the *A. longiloba* Miq. group, which is characterised by a strongly rhythmic growth pattern, with a pronounced delay between flowering and resumption of leaf-production; thinly membranous cataphylls, degrading into rather sparse fibres; mostly peltate leaves, often purple-backed, often with white major venation, solitary or few together; spadix stipitate; stipe white; ovaries green with white to yellowish usually acutely lobed stigmas; the sterile interstice attenuate and corresponding with the spathe constriction; male zone ivory to yellowish ivory; synandria with the thecae not overtopped by synconnective; appendix pale orange-pink to yellow, occasionally ivory. The *A. longiloba* group includes, in addition to *A. suhirmaniana*, *A. sanderiana* W. Bull (Philippines) and a number of incompletely delineable 'species' currently being reduced to informal entities in the Indochinese and West Malesian *A. longiloba* complex (Hay, in prep.). In addition, an inadequately known, as yet unnamed, Philippine element may represent a fourth circumscribable species in this group (Hay, in prep.).

*A. suhirmaniana* is nearest in leaf shape and colour to *A. longiloba* 'watsoniana' (syn. *A. watsoniana* Mast.), a Bornean, Sumatran and Malay Peninsula variant in the taxonomically intractable *A. longiloba* complex. The new species differs mainly in the undulate (vs strongly zig-zag) intercostal collective veins, the puberulent (vs glabrous) petiole, the flat to irregularly bullate leaf blade (vs bullate in a concentric pattern around the petiole insertion) and the straight posterior costae (vs pedately in-curved). With the exception of the puberulent petiole, which is unique in this species group, the leaf is somewhat intermediate between *A. longiloba* 'watsoniana' and Bornean *A. longiloba* 'korthalsii' (syn. *A. korthalsii* Schott), though significantly larger than the latter and distinguished by the frequent production of subsidiary veins (sporadically distributed veins following the course of secondary veins, but intermediate in thickness between the primary and secondary venation).

In reproductive features *A. suhirmaniana* differs from all other members of the *A. longiloba* group in the deep purple colour of the spathe. This feature is not infrequent in Araceae, generally associated with saproentomophily, but very rare in *Alocasia*, being known only in some populations of Bornean *A. robusta* M. Hotta and *A. ?regia* N.E. Brown, and Philippine *A. atropurpurea* Engl. The stigmas in *A. suhirmaniana* have rather blunt lobes whereas they are generally distinctly acute in the group; however, the specimen from which the description has been prepared had not attained anthesis and the stigmatic lobes may not be fully developed. The tops of the synandria are deeply impressed with the marginal portions of the synconnective



Lesley  
Elkan 97

**Fig. 1.** *Alocasia suhirmaniana*. **a**, leaf blade in adaxial view; **b**, venation in abaxial view; **c**, petiolar pubescence; **d**, inflorescence; **e**, unopened inflorescence with part of spathe removed; **f**, pistils; **g**, neuter organs of sterile interstice; **h**, synandria from above. Scale bar: **a** = 10 cm; **b** = 6 cm; **c** = 3 mm; **d**, **e** = 4 cm; **f**, **g**, **h** = 6 mm. All prepared from the Type except **a**, **b** & **c**, which are based on material cultivated at the Royal Botanic Gardens Sydney (Acc. No. 970541) from the same original collection as the Type.

somewhat extended so that the pores of the thecae are slightly deflected, where they are more usually flat-topped with the pores facing upwards in the *A. longiloba* group.

Several species in other parts of the genus *Alocasia* have puberulent petioles, including *A. puber* (Hassk.) Schott (Java to Malay Peninsula) and closely allied *A. maquilingsensis* Merr. (Philippines) and Bornean *A. sarawakensis* M. Hotta (the latter in juveniles only). Hairy leaves are also known in some Sumatran individuals of *A. ovalifolia* Ridl. and *A. arifolia* Hallier f., and some individuals of New Guinean *A. nicolsonii* A. Hay. In the first three the hairs are tapering and pointed, while those in other species are generally blunt and very short (see e.g. Hay & Wise 1991: fig. 1d). Those of *A. suhirmaniana* are of the latter type, and so small as to be almost invisible to the naked eye, except as a fine velvety bloom.

**Other specimens seen:** Cult. RBG Sydney, Acc. No. 970541, propagated from material cultivated at Kebun Raya, Bogor, Hay 14006 (voucher NSW); SE Sulawesi, Tolala, Kjellberg 2428 (BO).

### Acknowledgments

We thank Pak Samsudin and nursery staff of the Kebun Raya, Bogor and Ian McLellan and nursery staff of the Royal Botanic Gardens Sydney for cultivating the plants cited here, Lesley Elkan for the illustration, and Clare Herscovitch for technical assistance.

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Manuscript received 7 October 1997

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# *Georgeantha hexandra*, a new genus and species of Ecdeiocoleaceae (Poales) from Western Australia

Barbara G. Briggs and L.A.S. Johnson†

## Abstract

Briggs, Barbara G. and Johnson, L.A.S. (Royal Botanic Gardens, Mrs Macquaries Road, Sydney, NSW 2000, Australia) 1998. *Georgeantha hexandra*, a new genus and species of Ecdeiocoleaceae (Poales) from Western Australia. *Telopea* 7(4): 307–312. The genus *Georgeantha* and its single species are described. *G. hexandra* is a rare species of sandplains in the Jurien–Eneabba region north of Perth in the south-west of Western Australia. Brief comment is included on culm anatomy, flavonoids and DNA findings, in addition to the exomorphological features distinguishing this from *Ecdeiocolea*, the only other genus of the Ecdeiocoleaceae.

## Introduction

This paper validates the name of this new genus in advance of the treatment of Ecdeiocoleaceae in *The Families and Genera of Flowering Plants*, edited by K. Kubitzki (Linder, Briggs & Johnson in press), in Meney & Pete (in press), and in the *Flora of Australia* (Briggs, Johnson, Porter & Krauss in preparation). The Ecdeiocoleaceae, Restionaceae and some related families are also currently the subject of flavonoid analysis by Harborne, Williams and Greenham (Williams et al. 1997 & in press) as well as investigation by DNA sequencing of *rbcL* and the *trnL* intron (Briggs, Marchant, Gilmore & Porter, unpublished results).

Features of *Georgeantha* were previously reported under the unpublished name 'Georgiella' (e.g. by Williams et al. 1997, Meney et al. 1997, Roche et al. 1997), but the latter name is unavailable, being preoccupied by a member of the Rhodophyceae.

*Georgeantha* B.G. Briggs & L.A.S. Johnson, **gen. nov.**

Ab *Ecdeiocolea* combinatione characterum sequentium distinguitur: habitus rhizomatosus, rhizomatibus basibusque culmorum villosis; vaginae spiculaeque aliquot per culmum, vaginis culmi caducis; tepala staminaque 6; loculi stylicae 3; fructus capsulares; chlorenchyma costis sclerenchymatis tenuibus divisum.

**Type species:** *Georgeantha hexandra* B.G. Briggs & L.A.S. Johnson.

Monoecious, rhizomatous. *Rhizomes* villous, largely covered by almost glabrous cataphylls. *Culms* terete, striate. *Sheaths*: basal sheaths persistent, striate, lamina reduced; lower culm sheaths caducous, the nodes swollen and prominent. *Inflorescence* of two or few spikelets. *Spikelets*: axis with long pale branched hairs; glumes all fertile, either male or female flowers at the spikelet base, flower sex alternating once or twice towards the apex depending on spikelet size. *Flowers*: male and female flowers similar; tepals 6, outer tepals keeled, the abaxial outer tepal and inner tepals  $\pm$  flat. *Male flowers*: stamens 6, free; anthers 2-locular, 4-sporangiate, versatile, latrorse, dehiscent by two longitudinal slits; pistillode present. *Female flowers*: staminodes minute; ovary 3-locular; styles 3, free, stout, wholly stigmatic, densely covered adaxially with long stigmatic branches. *Fruit* a loculicidal capsule. *Seeds* patterned with convex, strongly lobed cells.

† Deceased 1 August 1997.

Culm anatomy: with deep narrow grooves extending halfway to base of chlorenchyma, stomates and accompanying sclereids at base of grooves, ridges with a central sclerenchyma rib 1–3 cells wide extending outwards from the parenchyma around the outer bundles to the sclerenchyma cap (Fig. 1). The flavonoids of *Georgeantha* and *Ecdeiocolea* are clearly distinct (Williams et al. 1997), *G. hexandra* containing quercetin and galactose which are absent from *E. monostachya*, whereas both genera contain isorhamnetin. *Georgeantha* and *Ecdeiocolea* are closely associated in analyses of genetic sequence data of DNA from *rbcL* and the *trnL* intron (Briggs, Marchant, Gilmore & Porter, unpublished results).

The name commemorates Alex George, a notable Australian botanist, expert in the flora of Western Australia and for some years Executive Editor of the *Flora of Australia*, who discovered this taxon and kindly drew it to our attention.

Distinguished from *Ecdeiocolea* by the rhizomatous habit (so that plants form widely-spaced clumps of culms over an area up to 50 cm across), villous rhizome and culm bases, the culms consisting of several internodes, prominent scars left by the caducous culm sheaths, inflorescence of 2–3 spikelets, trimerous flowers with tepals and stamens 6, trilocular ovary with 3 styles, fruit a capsule, and sclerenchyma ribs extending through the chlorenchyma to the sub-epidermal sclerenchyma. The contrasting features of *Ecdeiocolea* are: caespitose habit with large dense tussocks, rhizome and culms glabrous, culms consisting of a single long internode with 1 or 2 persistent sheaths high on the culm, spikelet solitary, flowers 2-merous with tepals and stamens 4, unilocular ovary with 2 styles, fruit a nut, and the lack of sclerenchyma ribs extending through the chlorenchyma to the sub-epidermal sclerenchyma.

A monotypic genus endemic in Western Australia.

*Georgeantha hexandra* B.G. Briggs & L.A.S. Johnson, sp. nov.

Type: Western Australia: 8 km NNW of Jurien Road on Cockleshell Gully road, 30°11'30"S 115°08'E, B. Briggs 7461 & L.A.S. Johnson, 29 Sep 1984 (holo NSW; iso B, BRI, CANB, K, MEL, MO, NBG, NY, PERTH).

Culmi 50–80 cm longi, 3- vel 4-nodis; spiculae 1.2–1.7 cm longae.

*Rhizome* horizontal, stout, 7–10 mm diam., densely villous with white hairs 6–10 mm long, partially covered by scarious cataphylls; the cataphylls pale brown, glossy, glabrous except for long hairs at the base and rarely distally on the keel, broadly ovate to deltoid but split along median line by sympodial growth of rhizome. *Culms* closely spaced, mostly 5(–8) mm apart on the rhizome, erect, 50–80 cm long, 1–1.5 mm diam., grey-green, internodes 4 or 5, the lowest internode and base of the second internode densely woolly with white hairs up to 3.5 mm long. *Culm sheaths*: the 2 or 3 uppermost sheaths persistent, often crowded below the uppermost elongated internode; (2.2–) 4.5–7.0 cm long, green or straw coloured, glabrous, auriculate with a narrow membranous margin; lamina subulate, (1–)4–5(–9) mm long. *Inflorescence branches* slender, 1–2 cm long. *Spikelets* ovoid, 1.2–1.7 cm long, 0.5–1 cm wide; axis sinuous; glumes 8–12, ovate to broad-lanceolate, 4–8 mm long, dark-brown to black, concave, rigid, acute to acuminate, densely pubescent; margins broad, hyaline. *Male flowers*: tepals lanceolate, dark-brown, soft, densely pubescent adaxially toward the apex with pale hairs, acute, 5.5–7.5 mm long; filaments 3–7 mm long; anthers 2.5–3.5 mm long, attached slightly above the middle to the short connective. *Female flowers*: tepals lanceolate, acute, concave, dark brown with pale hyaline margins; pubescent toward the apex with pale, tangled, branched, multicellular hairs; outer tepals keeled, c. 5 mm long; inner tepals almost flat, 6–6.5 mm long. *Capsule* 3.5–4.0 mm long, brown, smooth, the valve margins prominently thickened and pale, often 1 or 2 carpels aborted. *Seeds* broad-ellipsoidal, c. 1.5–2.0 mm long. *Chromosome number*:  $2n = c. 64-66$  (Briggs unpublished; voucher: Gittins 1710b) (Fig. 2).

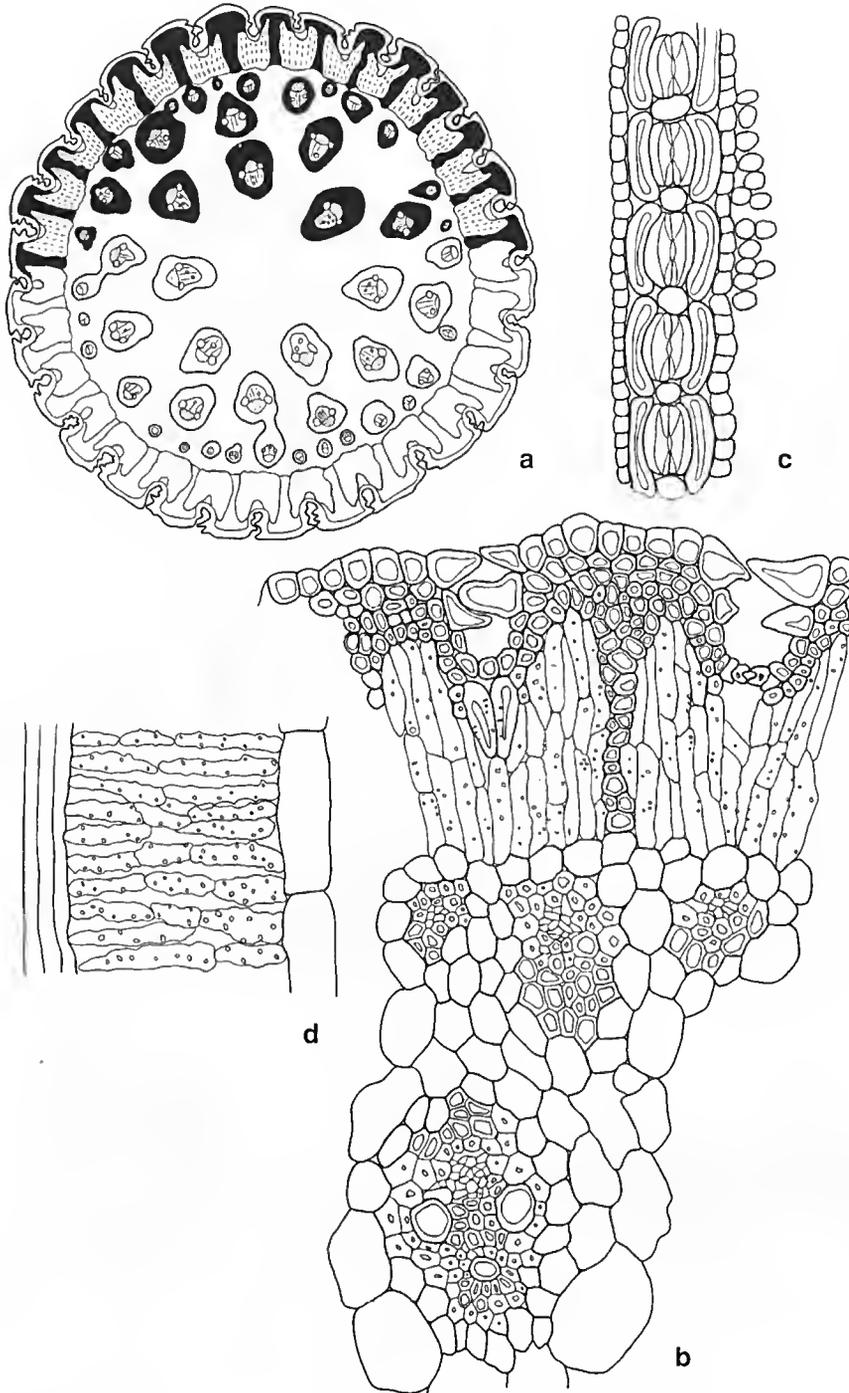


Fig. 1. *Georgeantha hexandra*, culm anatomy. a, transverse section showing sclerenchyma ribs and deep crypts (sclerenchyma indicated in black; chlorenchyma stippled). b, detail of T.S., note the enlarged, overarching epidermal cells at entrance to crypts and stomates and sclereids at base. c, tangential longitudinal section showing row of stomates at base of crypt. d, radial longitudinal section of chlorenchyma showing peg cells in horizontal plates. (From Gittins 1710b.) Magnifications: a  $\times 45$ ; b-d  $\times 240$ .

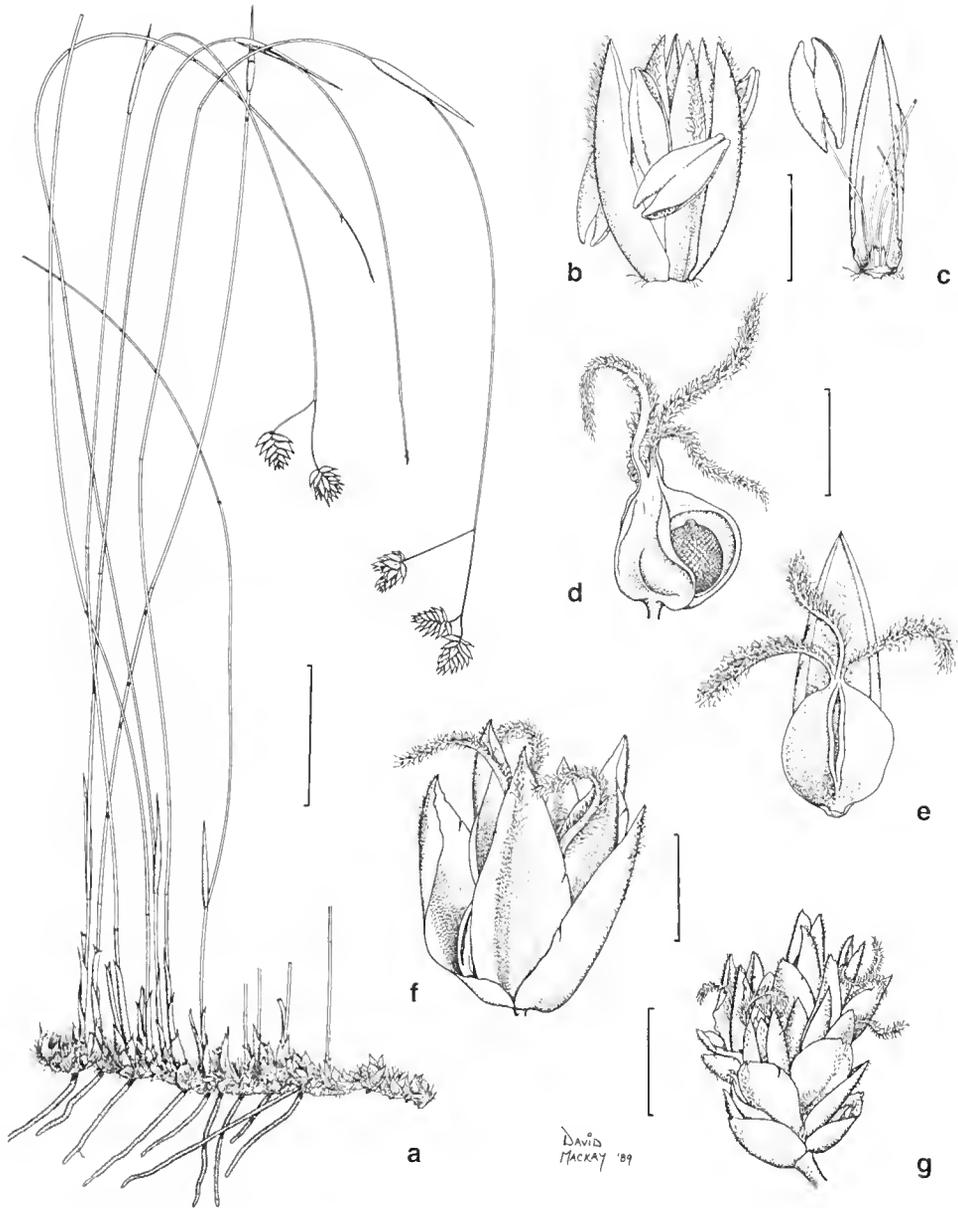


Fig. 2. *Georcantha hexandra*. a, habit. b, male flower. c, dissected male flower. d, fruit with seed. e, f, female flower. g, spikelet. a-c, from Briggs 7461; d, Briggs 6395; e, Gittins 17 106; f, Haegi 1911. Scale bars: a = 5 cm, b-f = 3mm, g = 6 mm.

The epithet is from the Greek *hexa*, six, and *-andrus*, male, referring to the six stamens in the flower.

**Distribution:** in the Jurien–Eneabba region north of Perth in the west of Western Australia, in seasonally moist sites in tall shrubland or low heath on deep moist sand in a region of low rainfall. Resprouts after fire (Pate, Meney & Dixon 1991, as '*Ecdeiocolea georgei*'; Meney, Dixon & Pate 1997, as '*Georgiella hexandra*').

**Conservation status:** rare but not currently under threat (Meney et al. in press), Western Australian CALM Conservation Code P4, proposed ROTAP Code 2RCa.

**Selected specimens examined:** Western Australia: Irwin: 5 km S of Mineral Sands minesite, Eneabba, *Meney 3090*, 20 Dec 1990 (voucher for DNA sample, grown from tissue culture from wild source, NSW); c. 8 km S of Eneabba, *Huatiuk 771147*, 17 Sep 1977 (PERTH, NSW); Brand Hwy, 13.5 km S of Eneabba at S boundary of Carnamah Shire, *Briggs 6395*, 27 Sep 1976 (NSW, PERTH); Stockyard Ck crossing, c. 22 km E of Green Head on road to Brand Hwy, *Haegi 1911*, 1 Nov 1979 (NSW, BRI, CANB, K, PERTH, RSA), *1912* (NSW, BRI, CBG, PERTH, RSA); 1 km W of Brand Highway on Jurien road, *Wilson 2684*, 2 Oct 1979 (NSW); 0.6 km N of Cockleshell Gully, W of Mt Peron, *Briggs 6347*, 26 Sep 1976 (NSW, MEL, PERTH), *6348* (NSW, AD, MO, RSA); Cockleshell Gully, *Briggs 9016*, 8 Oct 1992 (NSW, KPBG); near Mt Lesueur, *Gittins 1710b*, Sep 1976 (NSW); W of Coomallo Ck., E of Jurien, *Griffin 2704*, *2716*, *2717*, 24 July 1980 (PERTH); c. 6 km W of Mt Lesueur, *George 14599*, 17 June 1977 (PERTH).

## Acknowledgments

Many people assisted in this study and related work on Restionaceae over the years. Thanks go especially to Carolyn Porter, Siegfried Krauss, Anna-Louise Quirico, Barbara Wiecek and Kate Green, also to Lesley Elkan and David Mackay for the illustrations. Peter Wilson assisted greatly with the Latin diagnoses and nomenclature. The opportunity to examine specimens on loan or in other herbaria assisted the work. Cooperation and joint fieldwork with John Pate and Kathy Meney gave information and valuable insights, as did associated DNA sequencing studies by Adam Marchant, Simon Gilmore and Carolyn Porter and investigations of flavonoids by Christine Williams and Jeffrey Harborne. Grants from the Australian Research Council and Australian Biological Resources Study provided valuable technical help and supported field studies.

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# On *Neorapinia* (*Vitex sensu lato*, Labiatae-Viticoideae)

D.J. Mabberley

## Abstract

Mabberley, D.J. (*Rijksherbarium, University of Leiden, Netherlands and Royal Botanic Gardens, Sydney NSW 2000, Australia*) 1998. On *Neorapinia* (*Vitex sensu lato*, Labiatae-Viticoideae). *Telopea* 7(4): 313–317. *Neorapinia*, currently considered a monotypic genus restricted to New Caledonia, is assessed in the context of *Vitex* s.l. and, pending a complete survey of that genus, is here referred to it, as *V. collina*. There is not only one ‘*Neorapinia*’ species in New Caledonia (and Vanuatu), but other species also referable to that group in *Vitex sensu lato* include a second (*V. lucens*) in New Zealand and a third (*V. lignum-vitae*, currently called *Preuma lignum-vitae*) in eastern Australia, all of which would be referable to *Neorapinia* (or an earlier synonym) if *Vitex* were ever to be split up. *Vitex evoluta* (New Caledonia), on the other hand, is referred to *Gmelina* and the new combination, *G. evoluta*, made.

## Introduction

The name *Neorapinia* was published by Moldenke (1955) as a *nomen novum* for the New Caledonian genus, *Rapinia* Montr. (1860, Labiatae (Lamiaceae)-Viticoideae, formerly Verbenaceae, s.l.), non Lour. (1791; = *Sphenoclea* Gaertner, Sphenocleaceae), and its sole species, *R. collina* Montr., became *N. collina* (Montr.) Mold. It is still the only species referred to the genus, which is therefore considered a New Caledonian endemic. This is despite the fact that, almost a century ago, Beauvisage (1901) transferred *R. collina* to *Vitex*, as *V. collina* (Montr.) Beauvisage and raised one of Montrouzier’s informal infraspecific variants of it (*‘triphyllo’*) to species rank as *V. rapinii* Beauvisage, which Moldenke and others have accepted as a true *Vitex*. Moreover, Moldenke (1957) has conceded that the flowers of *N. collina* and *V. rapinii* are ‘similar’.

In preparation for an account of Labiatae (Lamiaceae) s.l. for *Flore de la Nouvelle-Calédonie et Dépendances*, all the New Caledonian holdings of *Vitex* s.l. in B, BISH, BM, L, K, NSW and P, as well as type material of *V. evoluta* held in Z, were examined.

## *Vitex collina*

Type material (Montrouzier 187, P; the LY sheets of Montrouzier’s own set of New Caledonian plants are all destroyed — P. Morat, pers. comm.) of *Vitex* (*Rapinia*) *collina* has unifoliolate leaves. Such plants are small shrublets often with small, often 1-flowered inflorescences, apparently restricted to ‘maquis’ on serpentine. However, there are forms, e.g. *H.S. MacKee* 20521 (P) from Poya, Avangui, alt. 100 m, with both unifoliolate (‘simple’) and trifoliolate leaves, thus intermediate between the type and the plants called *V. rapinii*, which are often sizeable trees in rain forest and have larger many-flowered inflorescences. There are no distinctions in the structures of the flowers or fruits. Leaves on saplings (f. *dentata* Mold.), epicormics and occasionally fertile branches, are lobed. Beauvisage (1901) felt that small-leaved and large-leaved variants might belong to distinct but allied species, but such, e.g. var. *minia* Mold, are merely different developmental stages or from plants from different habitats, notably

depauperate thick-leaved specimens being collected from degraded maquis. The widespread forest plant has leaves with three or five leaflets, corresponding to the two infraspecific variants recognised by Montrouzier in his original publication. In north-west New Caledonia, there is, in addition, a very distinctive local population, characterised by leaves having usually seven leaflets: it is possible that this population should be recognised formally.

*Vitex rapinioides* Guillaumin, described from Vanuatu, and until now considered endemic there, is indistinguishable from the common forest plant of *V. collina* in New Caledonia. The isotypes (J.P. Wilson in Kajewski 992, K, P) perfectly match New Caledonian material, notably H.S. MacKee 25014 (P) from Pouembout, alt. 30 m. It has been collected on Aneityum, Efaté and Erromango.

In his argument, Beauvisage (1901) compared *Rapinia* with *V. littoralis* A.Cunn. (non Decne), i.e. *V. lucens* Kirk (puriri) of northern New Zealand, using their similarity as a major reason for referring *Rapinia* to *Vitex*. There is no doubt that the two species are congeneric, agreeing in vegetative and floral features, though the flowers of *V. lucens* are larger.

*Vitex collina* and *V. lucens* differ from *Vitex* sensu Munir (1987) in their 4-merous corollas (though the upper corolla lip of *V. lucens* is entire or sometimes bifid according to the literature while Mark Large (pers. comm.) has examined trees at localities in North Island, New Zealand, finding the 'flowers are variable with the corolla having 4–6 lobes. This variation can occur within a single tree': vouchers deposited in NSW) and from *Viticipremna* H.J. Lam (which genus Munir (1985) is one of the few recent authors to recognise), in their lateral inflorescences. With a narrow generic concept, then, the correct name for the Vanuatu and New Caledonia plant is *Neorapinia collina* (Montr.) Mold., but a name in *Neorapinia* has not been coined for puriri. However, *Vitex* sensu Munir includes both species with terminal inflorescences, like the type species, *V. agnus-castus* L. (Mediterranean) and the closely allied *V. trifolia* L. (found in Australia), and those with lateral ones, e.g. *V. glabrata* R.Br. and *V. helogiton* Schumann in Australia. If *V. collina* is retained in the genus, *Viticipremna* should logically be included too: the conclusion of most other authors. From a palynological study, it would appear that the only readily recognisable segregate from *Vitex* is *Chrysomallum* Thouars, centred in Madagascar (Large & Mabberley 1996). Without a complete generic overhaul of *Vitex* throughout its range, however, this matter cannot be resolved further.

*Vitex collina* (Montr.) Beauvisage, Gen. Montr.: 66 (1901); Guillaumin & Beauvisage, Ann. Soc. Bot. Lyon 38: 105 (1913); Guillaumin, Fl. Anal. Nouv.-Caléd.: 308 (1948).

*Rapinia collina* Montr., Mém. Acad. Lyon 10: 243 (1860).

Type: New Caledonia: Ile Art, X. Montrouzier 187; lectotype (selected here): P; the LY sheet from Montrouzier's own set is lost.

*Neorapinia collina* (Montr.) Mold., Phytol. 5: 225 (1955); Morat et al., Bull. Mus. Nat. Hist. Nat. Paris 4 ser., 8, sect. B, Adansonia 2:175 (1986).

*Vitex rapinii* Beauvisage, Gen. Montr.: 66, 67 (1901, as '*V. rapini*'); Guillaumin & Beauvisage, Ann. Soc. Bot. Lyon 38: 106 (1913, as '*V. rapini*'); Moore, J. Linn. Soc. Bot. 45: 376 (1921, as '*V. rapini*'); Däniker, Viert. Nat. Ges. Zürich 78, Beibl. 19: 409 (1933); Guillaumin, Fl. Anal. Nouv.-Caléd.: 308 (1948); Mold., Phytol. 6: 108 (1957), 17: 33 (1968), 49: 460 (1981); Morat et al., Bishop Mus. Spec. Publ. 72: 120 (1984), Bull. Mus. Nat. Hist. Nat. Paris 4 ser., 8 sect. B, Adansonia 2:175 (1986); **syn. nov.**

Type: New Caledonia: Ile Art, X. Montrouzier 280; lectotype (selected here): MPU; the LY sheets cited by Beauvisage from Montrouzier's own herbarium (185, 186) are lost.

[*Rapinia triphylla* Montr. ex Beauvisage, *l.c.*, *nom. in synonym.*]

*V. rapinioides* Guillaumin, *J. Arn. Arb.* 13: 27 (1932); *Mold., Phytol.* 6: 109 (1957); **syn. nov.**

Type: Vanuatu: Aneityum, Anaunoe, Sept 1929, *J.P. Wilson* in *Kajewski 992*; holo A, n.v.; iso K, P.

*V. rapinii* f. *dentata* *Mold., Phytol.* 22: 126 (1971, as '*V. rapinum* f. *dentata*'), 49: 460 (1981), 52: 139 (1982); **syn. nov.**

Type: New Caledonia: Koghis, Mt Bouo, alt. 700–1000 m, 6 Nov 1951, *Baumann–Bodenheim 15809*; holo NY, n.v.; iso, P (juvenile foliage).

*V. rapinii* var. *nana* *Mold., Phytol.* 22: 126 (1971, as '*V. rapinii*' var. *nana*), *Phytol.* 49: 461 (1981); **syn. nov.**

Type: New Caledonia: Koghis, Mt Moné, alt. 1079m, 18 July 1951, *Hürlimann 1645*; holo NY, n.v.; iso, P.

Distribution: New Caledonia and southern Vanuatu (Aneityum, Efaté, Erromango), 20–1200 m.

### ***Premna lignum-vitae***

Whilst examining the New Caledonian taxa, particularly the specimens with unifoliolate leaves, I was strongly reminded of the Australian '*lignum-vitae*', a tree of southern Queensland and the North Coast of New South Wales, currently called *Premna lignum-vitae* (Schauer) Pieper (Munir 1984, Conn 1992), the palaeotropical genus *Premna* being otherwise unrepresented in New South Wales. Like *Vitex collina* and *V. lucens*, *P. lignum-vitae* has lateral inflorescences of purplish red to pinkish mauve flowers with a somewhat curved corolla tube to 10 mm long, followed by pink to purple drupes to 15 mm long. It resembles no other *Premna* species, all the rest of which have terminal inflorescences of creamy white flowers with much shorter tubes followed by smaller, black, fruits.

As in *V. collina*, the juvenile foliage is often lobed or incised (see Conn 1992). The 'simple' leaves have misled some workers but the laminas are in fact articulated with the petioles as pointed out by Conn (1992): they are unifoliolate. From the start, the generic position of *lignum-vitae* has been uncertain, Schauer adding a '?' when publishing Cunningham's manuscript name, *Vitex lignum-vitae*. Pieper (1928), in a paper on *Vitex* in Africa and Madagascar, excluded the Australian (!) species from *Vitex*, putting it in *Premna* without explanation and this disposition seems to have been accepted in recent publications. However, *lignum-vitae*, *V. lucens* and *V. collina* are clearly congeneric: *P. lignum-vitae* should therefore be excluded from *Premna* and returned to *Vitex*. If *Vitex* is split up and *Neorapinia* recognised, possibly with an earlier name, then *lignum-vitae* as well as *puriri* must be moved to that genus.

*V. lignum-vitae* is easily separated from *V. collina*, even when sterile, not only in its being a tree with constantly unifoliolate leaves, but also because these have domatia not seen in *V. collina*. There is a very interesting parallel in this with *Dysoxylum* (Meliaceae) in that *D. bijugum* (Labill.) Seem. of New Caledonia and Vanuatu (and Norfolk Island), a species without domatia, is very closely allied to *D. fraserianum* (A.Juss.) Benth. of eastern Australia, a species with domatia (Mabberley 1988 and in press).

***Vitex lignum-vitae*** [A. Cunn. ex] Schauer in De Candolle, *Prodr.* 11: 692 (1847); Francis, *Aust. Rain-For. Trees*: 372, tt. 233, 234 (1951).

Type: Australia: Queensland: Brisbane River, *A. Cunningham* 2 Aug 1829; holo G-DC, fiche seen; iso K. Schauer cites only the G-DC specimen, though Munir (1984), who

considers a sheet at BM ('1642', June & July 1829) an isolectotype, inexplicably calls it a lectotype.

*Premna lignum-vitae* (Schauer) Pieper in Engl., Bot. Jahrb. 62, Beibl. 142: 80 (1928); Munir, J. Adelaide Bot. Gard. 7: 20, fig. 4 (1984); Stanley & Ross, Fl. S.E. Qd. 2: 374 (1986); Conn in Harden, Fl. NSW 3: 616 cum tt. (1992)

Distribution: Australia (NE New South Wales, Queensland).

### Vitex evoluta

All the rest of the true *Vitex* material seen from New Caledonia is quite different from *V. collina*, *V. Incens* and *V. lignum-vitae* and is referable to typical *V. trifolia* L. or its maritime subsp. *littoralis* Steenis (*V. rotundifolia* L.f.). However, plants currently under the name *V. evoluta* Däniker have the corolla shape (bilobed upper lip and trilobed lower one with tube narrowed at base), stamens inserted in the lower part of corolla tube, unequally lobed stylehead and succulent drupe with tough endocarp typical of the genus *Gmelina* L. Indeed this tree seems closely allied to the other four (two so far undescribed) *Gmelina* species of the island: all are endemic.

*Gmelina evoluta* (Däniker) Mabb., **comb. nova**

*Vitex evoluta* Däniker, Vierteljahrsschr. Naturf. Ges. Zürich 78, Beibl. 19: 408 (1933).

Type: New Caledonia: Koumac, foot of Mt Kaala, 25 February 1925, A.U. Däniker 1228; holo Z; iso Z, Z.

### Conclusions

1. The '*Neorapinia* group', if recognised as a genus distinct from *Vitex*, is neither monotypic nor a New Caledonian endemic; in the western Pacific alone there are three species — in Vanuatu and New Caledonia (1), eastern Australia (1) and northern New Zealand (1).
2. An investigation of generic limits in the Viticoideae is a prerequisite for definitive ranking of the '*Neorapinia*' group, which, pending that review, is returned to *Vitex*.
3. There are only two *Vitex* (including the '*Neorapinia* group') species native in New Caledonia (*V. collina* and *V. trifolia*), *V. evoluta* being referred to *Gmelina*.
4. The Latin name for the lignum-vitae of Eastern Australia is, once more, *Vitex lignum-vitae*; hence the genus *Premna* is not represented in New South Wales.

### Acknowledgments

Work for this paper was largely carried out in Paris in August-September 1997, when, through the good offices of Professor P. Morat, the author was Professeur Invité at the Muséum National d'Histoire Naturelle. I am indebted to Mark Large (Palmerston North) for collecting voucher specimens of *V. Incens* in New Zealand and to Barry Conn (NSW), who critically read over an early draft of the paper.

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# Contributions to the systematics of *Prostanthera* (Labiatae) in south-eastern Australia

Barry J. Conn

## Abstract

Conn, B.J. (Royal Botanic Gardens, Mrs Macquaries Road, Sydney NSW 2000, Australia) 1997. Contributions to the systematics of *Prostanthera* (Labiatae) in south-eastern Australia. *Telopea* 7(4): 319–332. *Prostanthera cuneata* is regarded as endemic to mainland Australia, with the type material based on cultivated material grown in *Formosa* garden, Tasmania. The new species ***Prostanthera galbraithiae*** B.J.Conn is here formally described. A morphological re-evaluation of *Prostanthera melissifolia* concludes that this species is endemic to Victoria. *Prostanthera melissifolia* sensu Conn, from the Northern Tablelands of New South Wales, is *P. caerulea* R.Br., and *Prostanthera* sp. aff. *melissifolia* sensu Beauglehole, from East Gippsland (Victoria), probably is *P. incisa* R.Br. (s. lat.). A full description, habitat notes, distribution map and illustration of each of the first three species are provided.

## Introduction

This paper presents the conclusions of revisionary studies into the genus *Prostanthera* section *Prostanthera*, arising particularly from work towards the preparation of an account of the genus for the forthcoming *Flora of Victoria*, volume 4.

Terminology follows Conn (1984), except inflorescence terminology as modified by Conn (1995). Distribution information for Victoria follows Conn (1993).

### 1. Distribution of *Prostanthera cuneata* Benth.

Previously, *Prostanthera cuneata* has been regarded as occurring in New South Wales, Tasmania and Victoria. Although the type specimen of this species (Gunn 725, 7 Dec. 1842) is stated to have been collected from the 'South Esk' River, south of Launceston in Tasmania, Buchanan (1988, 1990) states that Gunn actually collected from 'Formosa' garden, on the estate of W.E. Lawrence, on this date. Since all other Tasmanian collections of this species are either from known cultivated specimens or their collection source is unknown, it is here proposed that the Tasmanian records of this species are probably based on cultivated material. In particular, the type is likely to have been taken from cultivated material growing at 'Formosa' garden. This species is common throughout the Snowfields region of Victoria and subalpine region of the Southern Tablelands of New South Wales.

The significance of Gunn's comments on the habitat of this species in Tasmania is unclear. In a note sent with the original collection to the Royal Botanic Gardens, Kew (as stated in Sealey 1950, p. 132), he notes that this species 'grows abundantly on the banks of the South Esk [river] about 9 miles from Launceston, which is the only place I have seen it in the colony — it grows in the poorest gravelly sand washed up by the river'. Whatever the status of the collection at the time of Gunn's collection, the absence of any extant stands leads me to conclude that it is not native or naturalised in Tasmania now.

### Taxonomy

*Prostanthera cuneata* Benth., in DC., Prodr. 12: 560 (1848).

J.D.Hook., Fl. Tasm. 1: 284, t. 90 (1857); F.Muell., Fragm. 6: 108 (1868); Benth., Fl. Austral. 5: 99 (1870); F.Muell., Syst. Census Austral. Pl., p. 101 (1882); Stirling, Trans. & Proc. Roy. Soc. Victoria 21: 42 (1883); F.Muell., Key Vict. Pl. 2: 42 (1885); F.Muell., Sec. Syst. Census Austral. Pl., p. 169 (1889); C.Moore, Handb. Fl. N.S.W., p. 352 (1893); Briq., in Engl. & Prantl, Nat. Pflanzenfam. 4(3a): 220 (1895); W.A.Dixon, Pl. New S. Wales, p. 232 (1906); Guilf., Austral. Pl., p. 302 (1911); Ewart, Fl. Victoria, p. 983 (1930); Sealy, in Curtis, Bot. Mag. 167: 132 (1950); W.M.Curtis, Fl. Tasmania 3: 554 (1967); B.J.Conn, Fl. New South Wales 3: 650 (1992).

Lectotype (here chosen): Tasmania: Cultivated at Formosa garden [not South Esk River, as stated on the BM herbarium sheet (in Gunn's hand)], *R.Gunn* 725, 7 Dec 1842 (BM); possible isolecto: (NSW 229615).

Usually erect, ± compact shrub 0.5–1.5 m high, often becoming trailing and/or procumbent with age. *Brauches* ± terete, rarely subquadrangular, densely hairy throughout or within each axil to the next upper node; hairs ± straight, patent to spreading, short, 0.05–0.2 mm long, white; glands present. *Leaves* dark green above, paler below, strongly aromatic (when crushed); *petiole* absent or to 0.5 mm long; *lamina* obovate, rarely subcircular, frequently appearing obtriangular (cuneate) when margin and apex slightly recurved, (3–)4–6(–8) long, (2.5–)3.5–5 mm wide, glabrous or with occasional hairs, particularly towards base; base subcuneate to cuneate; margin entire, rarely crenulate; apex obtuse to rounded, often appearing truncate when apex slightly recurved; venation not visible, midrib slightly raised basally. *Inflorescence* a frondose racemiform conflorescence, uniflorescence monadic; 4–10-flowered per conflorescence. *Pterophylls* not seen. *Podium* 1–2 mm long, glandular, although appearing glabrous, usually moderately to densely hairy, but hairs minute, to 0.5 mm long. *Prophylls* persistent, inserted just below the calyx [propodium to anthopodium ratio (1.6–)4–11], opposite, narrow, oblong or elliptic to obovate, 2.5–3.5 mm long, 0.7–1.5 mm wide, with occasional hairs, particularly on margin (hairs 0.06–0.2 mm long), or glabrous, glandular; base subcuneate; margin entire, ± recurved; apex obtuse to rounded; venation faint. *Calyx* green, usually with purple tinge on lobes and/or adaxial surface, glabrous, except margin densely fringed with white hairs, often with hairs just extending onto inner surface at base of lobes; outer surface densely glandular basally, sparser distally; tube 2.5–3 mm long; *abaxial lobe* broadly ovate to broadly oblong, (2.2–)3–4.6 mm long, 3.2–4.3 mm wide at base, apex rounded to slightly emarginate, sinus to 0.1 mm long; *adaxial lobe* very broadly ovate to broadly ovate, 2.5–4 mm long, 3–4.4 mm wide at base, apex ± rounded. *Corolla* 9–15 mm long, pale lavender to almost white, inner abaxial-median surface of tube with irregular row of yellow spots flanked by brownish spots or maroon-orange spots, and laterally with dark violet/purple dots; outer surface glabrous basally, distally sparsely to moderately hairy, hairs 0.1–0.2 mm long, spreading, antrorse to retrorse, sparsely glandular (particularly in bud); inner surface glabrous, except mouth and base of lobes sparsely hairy, hairs 0.6–0.8 mm long; *tube* (5–)6–8 mm long; *abaxial median lobes* very broadly spatulate, 6.5–9 mm long, 7–9.5 mm wide, apex irregular and rounded, usually bilobed (sinus 1.2–1.5 mm long, 1.5–2.5 mm wide distally); *lateral lobes* very broadly to broadly ovate, 4–5.5 mm long, 3.5–5.5 mm wide, apex rounded and slightly irregular; *adaxial median lobe-pair* depressed ovate to very broadly ovate, (4–)5–6 mm long, (4–)7–8.5(–10) mm wide [length to width ratio 0.5–0.8], apex rounded to subtruncate, slightly irregular, bilobed (sinus 1–2(–2.5) mm long, median margin of lobes usually touching or overlapping). *Stamens* inserted 1.6–2.7 mm above base of corolla; filaments 3.7–5.4 mm long; anthers 1–1.4 mm long, lobes cristate on basal

dorsal surface (narrowly triangular trichomes 0.1–0.2 mm long) and with small acumen basally, connective extended to form a basal appendage 1–1.6 mm long, terminating in 1–5 narrowly triangular trichomes 0.1–0.2 mm long. Disc c. 0.3 mm long. *Pistil* 7.5–10 mm long; *ovary* cylindrical obovoid, 0.4–0.5 mm long, diameter at base 0.6–0.7 mm, lobes 0.1–0.2 mm long, glands present; *style* 6.6–8.5 mm long; *stigma lobes* 0.5–0.6 mm long. *Fruiting calyx* not or only slightly enlarged (abaxial lobe 2.5–4 mm long, 3–4 mm wide; adaxial lobe 3–4 mm long, 3.5–5 mm wide). *Mericarps* 1.8–2 mm long, distally 1–1.2 mm extended beyond base of style, distal diameter 2.3–2.5 mm; seeds ellipsoid-cylindrical, 1–1.2 mm long, c. 0.5 mm diameter. Fig. 1.

**Flowering:** (October–) November–February (–April). **Fruiting:** December–March.

**Distribution:** this species is distributed throughout the mountainous areas of southern New South Wales (Southern Tablelands) and eastern Victoria (Snowfields). Fig. 4.

**Habitat:** this species usually forms a dense shrub-layer under *Eucalyptus niphophila* subalpine woodland or in subalpine heathland communities (at altitudes of 1500–2000 m), on coarse sandy/gravelly soils, often peaty, frequently amongst conglomerate or granitic rocky outcrops. Associated species include *Olearia phlogoppapa*, *Bossiaea foliosa*, *Orites lancifolia*, *Baeckea ramosissima*, *Phebalium squamulosum* and *Grevillea australis*.

**Notes:** morphologically, this species is very homogeneous. Occasional plants in a population may have leaves that are crenulate and more rarely crenate. These plants are frequently taller than those that have entire leaves and probably represent a hybrid between *P. cuneata* and *P. lasianthos*. The origin of the presumed cultivated Tasmanian specimens is not known. Although, these collections tend to have narrower leaves and hairier prophylls than characteristic of most mainland populations, *Porter 003 & Conn*, from the Bogong High Plains (Victoria), is somewhat similar to the Tasmanian material.

**Conservation status:** this widespread species is not considered to be rare or threatened.

**Selected specimens examined (258 examined):** New South Wales: Southern Tablelands: Mt Kosciuszko National Park: Charlotte Pass, *Ashby 2825*, 3 Mar 1969 (AD 97120306); summit of Mt Bimberi, *Darbyshire 122*, 17 Jan 1961 (BRI 79384, CANB 89036, K, MEL 43027, NSW 229116); on road between Mt Gingera and Blackfellows Gap, *Darbyshire 155*, 15 Feb 1961 (BM, CANB 90406).

Victoria: Snowfields: near summit of Mt Stirling, *Corrick 7949*, 30 Jan 1982 (MEL 602631); Mt Buffalo plateau, *Hill 1268*, 31 Dec 1963 (AD 96410034); ascent from Dargo to Hotham Heights *Phillips 63*, without date (AD 97329180, CBG 046274); eastern slopes of Rocky Valley Dam catchment, Bogong High Plains area, *Porter 003 & Conn*, 18 Dec 1987 (NSW 196966).

### Presumed cultivated Tasmanian material

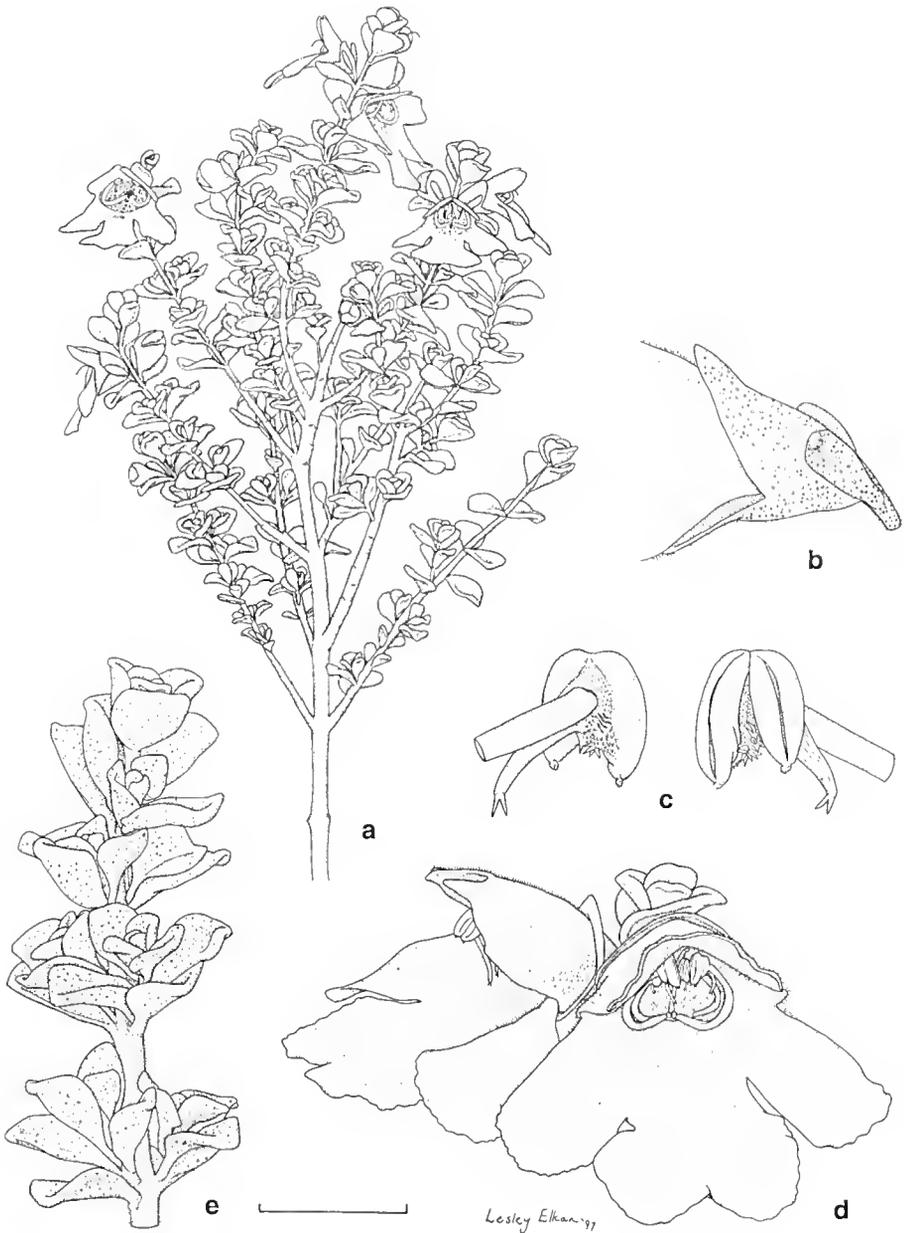
Tasmania: Midlands: *s. loc.*, *Ex W.H. Archer herb. s.n.*, without date (NSW 134359); Cultivated, Hobart Government Gardens, originally from Launceston, *Gunn 725/1842*, 3 Feb 1840 (HO 7279); *s. loc.* [?Formosa Garden at W.E. Lawrence estate], *Gunn 725/1842*, *anno* 1842 (NSW 229615); Formosa garden [not South Esk River], *Gunn 725/1842*, 7 Dec 1842 (HO 7278; NSW 134505); Formosa garden, *Gunn 725/1842*, 5 Dec. 1848 (NSW 134537); Perth [suburb of Launceston, presumed cultivated], *Rodway s.n.*, without date (HO 12925, NSW 231162); South Esk River, ?C. *Stuart s.n.*, 10 Dec 1851 (MEL 43031); Van Diemensland, C. *Stuart s.n.*, without date, (LUND, MEL 43029).

## 2. *Prostanthera galbraithiae*

### *Prostanthera galbraithiae* B.J.Conn, sp. nov.

*Prostanthera* sp. aff. *linearis* R.Br. sensu Beauglehole, *Victorian Vasc. Pl. Checkl.* (1980)173.

*Frutex* erectus effusus 0.1–2 m altus. *Rami* plus minusve transverse quadrangulati, dense tomentosi, pilis antrorsis adpressis, 0.1–0.3 mm longis, sparsim glandiferi. *Folia* sessilia, plerumque glabra, sparsim glandifera; *lamina* anguste ovata vel oblonga,



**Fig. 1:** *Prostanthera cuneata* Benth. a, Flowering branchlet; b, detail of calyx and prophylls; c, stamens with basal appendage, showing ventral and dorsal views; d, open flower showing stamens and gynoecium; e, detail of branchlets showing the typically crowded leaves. (a Gittins 432; b–e Porter 003 & Conn). Scale bar: a = 30 mm; b = 4 mm; c = 2 mm; d = 6 mm; e = 6.7 mm.

(5-)8-15(-25) mm longa, ad 2 mm lata, basi subobtusata, margine integro plus minusve valde revoluta, apice plus minusve obtuso. *Podium* 1.5-2.3 mm longum. *Prophylla* 2-2.5 mm longa, 0.4-0.6 mm lata. *Calyx* extra sparsim ad moderate tomentosus, *tubo* 2-2.5 mm longo, *lobi* 2-3 mm longi. *Corolla* permalvina ad purpurea punctis marroninis, 7-10 mm longa, glaber, *tubo* 3-3.5 mm longo, *lobo abaxiali-mediano* late obovato ad leviter spathulato, 4.2-4.5 mm longo, *lobis lateralibus* late oblongis ad leviter late obovatis, 3.5-3.8 mm longis, *lobo adaxiali-mediano* depresso obovato ad perdepresso ovato, 3.5-5 mm longo. *Antherae* 1.2-1.5 mm longae, appendice absens. *Pistillum* 5.5-6 mm longum. *Mericarpia* non visa.

Holotype: Victoria: Gippsland Plains: Holey Plains State Park, Conn 2486 & Corrick, 14 Oct 1986 (MEL 1552450); isotype: NSW 451472.

Erect or spreading subshrub or shrub, 0.1-2 m high. *Branches* ± transversely quadrangular in section, slightly laterally 2-ridged, especially on young branchlets, densely hairy [100-160 hairs/mm<sup>2</sup>] between ridges and at nodes, otherwise glabrous; hairs antrorse, appressed, 0.1-0.3 mm long, white; glands scattered and usually very sparse. *Leaves* mid green, ± aromatic (when crushed), sessile, hence *petiole* absent; *lamina* very narrowly ovate or oblong, appearing ± linear because margin strongly revolute, (5-)8-15(-25) mm long, up to 2 mm wide [length to width ratio up to c. 13, length of maximum width from base to total lamina length ratio up to c. 0.1], glabrous, rarely with an occasional minute hair, sparsely glandular; base subobtusate; margin entire, ± strongly revolute; apex ± obtuse; venation indistinct, midrib slightly raised on abaxial surface. *Inflorescence* a frondose metabotryoidal conflorescence, uniflorescence racemiform, 8-24-flowered. *Podium* 1.5-3 mm long, densely hairy (similar to branchlets) or glabrous. *Prophylls* persistent, inserted just below the calyx [propodium 1.2-3 mm long; anthopodium 0.2-0.5 mm long; propodium to anthopodium ratio 6-7.5], opposite, narrowly elliptic, 2-2.5 mm long, 0.4-0.6 mm wide [length to width ratio c.5], glabrous or with a few scattered hairs near base at apex, not glandular; margin entire; apex obtuse; venation not visible. *Calyx* green abaxially, maroon adaxially; outer surface sparsely to moderately hairy, especially on abaxial surface of tube and on abaxial lobe, including margin of both lobes, adaxial surface (including lobe) usually glabrous, with hairs white, appressed, antrorse, c. 0.1 mm long, sparsely glandular; *tube* 2-2.5 mm long, with inner surface glabrous except for a few scattered hairs at mouth (hairs ± patent, to 0.1 mm long); *lobes* with inner surface densely hairy distally, with ± spreading hairs to c. 0.1 mm long; *abaxial lobe* very broadly ovate, 2-3 mm long, 2.4-3 mm wide at base [length to width ratio 0.7-1], apex rounded; *adaxial lobe* very broadly ovate, 2-3 mm long, 3.3-4 mm wide at base [length to width ratio 0.6-0.8], apex obtuse [adaxial lobe length to abaxial lobe length ratio 0.8-1]. *Corolla* 7-10 mm long, deep mauve to purple with maroon dots at base of lobes and in mouth and throat, glabrous, glands absent; *tube* 3-3.5 mm long; *abaxial median lobes* broadly obovate to slightly spathulate, 4.2-4.5 mm long, 3.5-5 mm wide [length to width ratio 0.8-1.3], apex slightly irregular and rounded, usually bilobed (sinus to 0.5 mm long, 1-1.5 mm wide distally); *lateral lobes* broad, oblong to slightly obovate, 3.5-3.8 mm long, 3.2-3.5 mm wide [length to width ratio 1-1.2], apex rounded to almost truncate, slightly irregular; *adaxial median lobe-pair* depressed obovate to very depressed ovate, 3.5-5 mm long, 6.5-7 mm wide [length to width ratio 0.5-0.7], apex rounded, irregular, bilobed (sinus to 3.5 mm long, median margin of lobes usually touching or overlapping). *Stamens* inserted 2-2.2 mm above base of corolla; filaments 1.6-2 mm long; anthers 1.2-1.5 mm long, distinctly papillate, lobes with a few narrowly triangular trichomes c. 0.1 mm long on basal dorsal surface and usually with small acumen basally, connective lacking basal appendage. Disc c. 0.2 mm long. *Pistil* 5.5-6 mm long; *ovary* cylindrical obovoid, 0.4-0.5 mm long, diameter at base 0.5-0.6 mm, lobes 0.1-0.2 mm long, glands present; *style* c. 6 mm long; *stigma lobes* c. 0.3 mm long. *Mature fruits* not seen. Fig. 2.

**Selected specimens examined (6 examined):** Victoria: Gippsland Plains: c. 4 km SE of Dutson Downs and c. 500 m SW of track from Dutson Downs to the Ninety Mile Beach, *Conn 2485 & Corrick*, 14 Oct 1986 (MEL 1552449); Dutson Downs, 135 m from junction of track to Lake Reeve, *Robinson s.n.*, 10 Oct 1986 (MEL 1552737); Holey Plains State Park, Chessum Road, 0.2 km W of Kellys Road, *Conn 2487 & Corrick*, 14 Oct 1986 (CHR, MEL 1552448, NSW 451473, RSA); 200 m E of fire tower on summit of Holey Hill, *Walsh 1615*, 1 Oct 1986 (MEL, NSW 206771).

**Distribution:** this species is restricted to the Dutson Down–Holey Plains State Park region, Gippsland Plains, Victoria. Fig. 4.

**Habitat:** this species occurs in sandy soils, often quartz-rich or gravelly, overlying clays. This substrate supports an open *Eucalyptus obliqua* woodland community, with a heathland understorey dominated by *Leptospermum myrsinoides*, *Acacia oxycedrus*, *Epacris impressa*, *Lepidosperma concavum* and *Platylobium obtusangulum*. In more disturbed sites the ground layer is often dominated by bracken fern.

**Etymology:** the specific epithet honours Jean Galbraith who was one of the first people to discover this species and to recognise its vulnerability from inappropriate management procedures. Jean has made a significant contribution to our understanding of the flora of Victoria, particularly in association with the Latrobe Valley Field Naturalists Inc. Her efforts have directly resulted in the protection of the 'Wildflower Track' population of this species by the then Forestry Commission.

**Notes:** this species is characterised by having sessile, very narrowly ovate or oblong leaves that are more or less strongly revolute, corolla with abaxial median lobe approximately the same width as the lateral lobes, and distinctly papillate anthers that lack an appendage. The affinities of this species are uncertain, but it appears to have closest affinities with the *P. saxicola* group.

**Conservation status:** although the conservation status of *Prostanthera galbraithiae* is unknown, individual plants are sometimes locally common, especially after fire. However, most populations appear to be only represented by a few, scattered plants. Some populations appear to have been lost in recent years (Thompson, pers. comm. 26 March 1997; Walsh, pers. comm. 26 March 1997). The complete exclusion of disturbance (eg. fire) appears to be detrimental to the species, as observed at the 'Wildflower Track' reserve.

### 3. Systematics of *Prostanthera melissifolia* F.Muell. (*s. str.*)

During the preparation of an account of the genus for the *Flora of New South Wales* project (Conn 1992), collections from northern New South Wales were incorrectly referred to *Prostanthera melissifolia*. Subsequent research has revealed that this species is endemic to Victoria, with the above collections from New South Wales redetermined as *P. caerulea* (further discussed below).

## Taxonomy

*Prostanthera melissifolia* F.Muell., *Fragm.* 1: 19 (1858); 1: 242 (1859); Benth., *Fl. Austral.* 5: 95 (1870); F.Muell., *Syst. Cens. Austral. Pl.*, p. 101 (1882); Sullivan in *Wing, S. Sci. Rec.* 3: 215 (1883) [as *Prostanthera mellissifolia*]; F. Muell., *Key Vict. Pl.* 2: 42 (1885); 1: 386 (1887); *Sec. Cens. Austral. Pl.*, p. 169 (1889); Briq. in *Engl. & Prantl, Nat. Pflanzenfam* 4(3a): 221 (1895); Guilf., *Austral. Pl.*, p. 305 (1911); Ewart, *Fl. Vict.*, p. 985 (1930); Worsdell, *Index Lond. Suppl. pt. II(I–Z)*, p. 276 (1941); Althofer, *Cradle of Incense*, pp. 70, 72 & 73 (1978).

Lectotype (here chosen): Victoria: 'Upper Barwan [Barwon River] of Apollo Bay', *F. Mueller s.n., s. dat.* (MEL 43368); probable isolecto.: (MEL 43367, 43369 & 43370). (refer Typification)

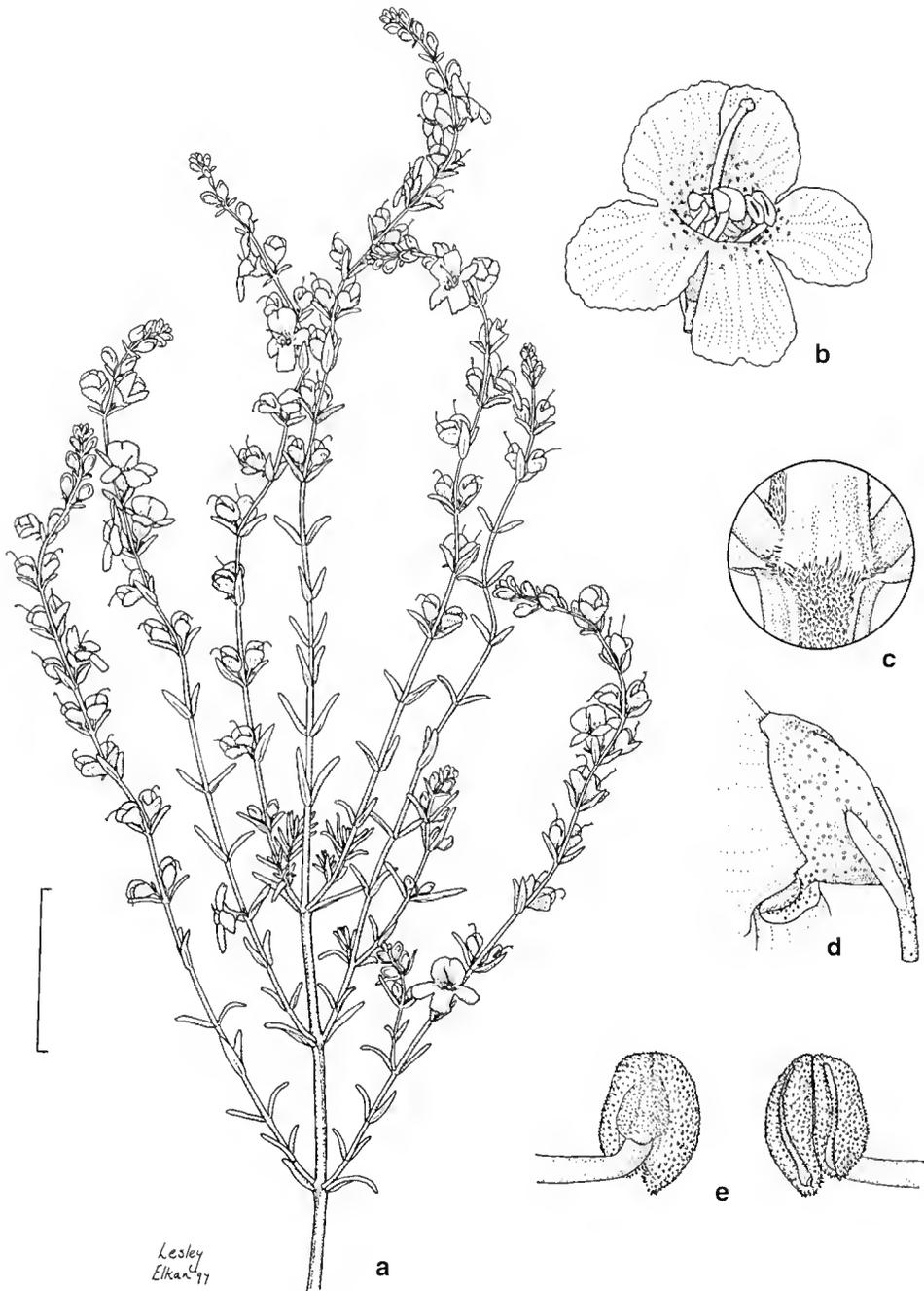


Fig. 2: *Prostanthera galbraithiae* B.J. Conn. a, Flowering branchlet; b, open flower showing stamens and gynoecium; c, detail of branchlets at node showing indumentum; d, lateral view of calyx, with detail of prophylls and propodium; e, ventral stamen, showing dorsal surface and connective (left) and ventral surfaces; (a – e Conn 2488). Scale bar: a = 30 mm; b = 6 mm; c = 3 mm; d = 4 mm; e = 2 mm.

*P. melissifolia* F. Muell. var. *parvifolia* Sealy, in Cotton, *Curtis's Bot. Mag.* 164(1948) t. 9687.

Iconotype (here chosen): Plate 9687, in Cotton, *Curtis's Bot. Mag.* 164(1948). (refer Typification)

Erect shrub to small tree, 1–5 m high. *Branches* subquadrangular, often with 2 pairs of lateral ridges, or terete, sparsely to moderately hairy particularly along lateral ridges and at nodes; hairs white,  $\pm$  antrorse to slightly spreading,  $\pm$  curled, c. 0.2 mm long; sparsely to moderately glandular. *Leaves* dark-green above, paler below, slightly and faintly unpleasantly aromatic, densely glandular; *petiole* (8–)10–15 mm long, usually deeply grooved adaxially, moderately to densely hairy (hairs as for branches); *lamina* ovate to narrowly ovate, rarely elliptic, 12–50(–60) mm long, 9–25(–30) mm wide [length to width ratio 1.2–2(–3)]; base attenuate,  $\pm$  assymmetric; margin toothed, rarely entire; teeth directed forward (0.5–1 mm long, 0.5–1 mm wide at base), 2–7 pairs of teeth, or teeth absent; apex obtuse; venation distinct, midrib and veins raised on abaxial surface; almost glabrous, except abaxial midrib and basal part of margin moderately to densely hairy (hairs as for branches), with adaxial midrib usually more sparsely hairy. *Inflorescence* a bracteose tribotryoidal to many-botryoidal conflorescence, occasionally botryoidal, uniflorescence a botryoid; (4–)10–20-flowered [per uniflorescence]. *Pterophylls* not persistent, broadly to narrowly ovate (apex appearing abruptly tapered when margin incurved), c. 2 mm long, c. 1 mm wide [length to width ratio 1.1–3.3], moderately hairy, with margin fimbriate (hairs c. 0.1 mm long), densely glandular; venation indistinct. *Podium* 2–3 mm long, moderately hairy (hairs as for branches), densely glandular. *Prophylls* usually maroon, persistent, inserted just below the calyx [propodium to anthopodium ratio c. 10], opposite, linear, 1–1.5 mm long, c. 0.1 mm wide [length to width ratio 6–10]; moderately hairy particularly along margin, moderately glandular; margin entire, incurved; apex obtuse; venation not visible. *Calyx* green, often with maroon tinge; outer surface sparsely hairy particularly on margin and between base of lobes (hairs as for branches), very densely glandular; inner surface glabrous; tube 1.8–2.3 mm long; *abaxial lobe* very broadly ovate to ovate, 1.5–2.5 mm long, 2–2.3 mm wide [length to width ratio 0.7–1.3], apex rounded, occasionally slightly emarginate; *adaxial lobe* depressed ovate to oblong, 1.5–2.5 mm long, 2.5–3 mm [length to width ratio 0.6–1], apex rounded [adaxial lobe length to abaxial lobe length ratio c. 1]. *Corolla* (8–)10–12 mm long, dark mauve, occasionally pinkish, markings absent; outer surface glabrous near base, sparsely to moderately hairy distally (hairs as for branches), sparsely glandular; inner surface glabrous, except margin of lobes fimbriate (hairs  $\pm$  tangled, 0.1–0.3 mm long), or sparsely to moderately hairy on lobes; *tube* abruptly broadly campanulate (collar-like at base), 5–6 mm long; *abaxial median lobes*  $\pm$  circular to obovate, 5.5–7 mm long, 5–6 mm wide [length to width ratio 1–1.2], apex rounded, often slightly irregular, slightly bilobed (sinus to 0.3 mm long, to 2 mm wide distally); *lateral lobes* ovate, 4.2–6 mm long, 4.8–6 mm wide [length to width ratio 0.9–1], apex slightly irregular, rounded to slightly retuse; *adaxial median lobe-pair* depressed ovate, 3–3.5 mm long, 7–8 mm wide [length to width ratio c. 0.3], apex rounded, irregular, bilobed (sinus 3–3.5 mm long, 2.5–3 mm wide). *Stamens* inserted 1–1.5 mm above base of corolla; filaments 2.5–3 mm long; anthers dark purple, 1.2–1.5 mm long, lobes cristate on basal dorsal surface (trichomes narrowly triangular, 0.1–0.2 mm long) and with small acumen basally 0.1–0.2 mm long, basal appendages 1 or 2 per locule (usually with 1 undeveloped), to 0.5 mm long, frequently appearing absent, frequently with narrowly triangular trichomes distally. Disc c. 0.2 mm long. *Pistil* 8–10.5 mm long, often glandular; *ovary* cylindrical obovoid, 0.4–0.6 mm long, diameter at base 0.2–0.4 mm, lobes 0.1–0.2 mm long; *style* lilac, 7–10 mm long; *stigma lobes* 0.3–0.4 mm long (to 0.8 mm long in fruit). *Fruiting calyx* slightly enlarged (abaxial lobe 4–4.5 mm long, 4–4.5 mm wide [length to width ratio 0.9]; adaxial lobe 4.5–5 mm long, 5.5–6 mm wide [length to width ratio 0.8–0.9]; [adaxial lobe length to abaxial lobe length ratio 1–1.3]). *Mericarps* 1.8–2 mm

long, distally c. 1 mm extended beyond base of style, distal diameter 2–2.5 mm; seeds ellipsoid-cylindrical, c. 1 mm long, c. 0.5 mm diameter. Fig. 3.

**Distribution:** this species is here regarded as endemic in Victoria, occurring from the Otway Ranges (in the west), Eastern Highlands, Gippsland Highlands, Snowfields and (doubtfully) East Gippsland (in the east)(see Notes, below). Fig. 4.

**Flowering:** November–January (–April). **Fruiting:** December–January (–June). Last season's old fruits frequently persist on the plant.

**Vernacular name:** Balm Mint-bush (Willis 1973, p. 588).

**Notes:** the leaves of this species are morphologically variable. However, local populations are usually relatively homogeneous, except that smaller leaves frequently occur on the distal end of branches (particularly near inflorescence). In general, at higher altitudes, there is a reduction in leaf size, such as near Lake Mountain (*Forbes 1909*) and Powelltown (*Muir 955* – MEL 48250). However, plants with smaller leaves occur within populations of otherwise normal leaf-sized plants (eg. near Foster, *Beaunglehole 63002*, between Toora and Gonyah, *Willis & Smith s.n.*, and two plants seen (one destroyed) from near Creswick, *Hateley s.n.*). Since *Prostanthera melissifolia* var. *parvifolia* is merely one of these small leaf variants, it is here reduced to the synonymy of *P. melissifolia*. The leaf margin is variously toothed, varying between leaves of a single plant, within-populations (*Muir 955* – NSW 253733) or between-populations. Detailed population studies are required to evaluate the taxonomic status of this latter collection. However, apart from the leaf-margin, all other features are typical of *P. melissifolia*.

Although this species has been once recorded as occurring in the You Yangs (Midlands, Victoria)(*Walter s.n.*), it no longer appears to occur there. It is possible that this locality is incorrect.

Whether or not *P. melissifolia* occurs in East Gippsland is not known. One collection (*Willis & Beaunglehole s.n.*) from the Howe Range has ovate leaves with somewhat oblique leaf bases more characteristic of the nominate variant from the Otways Range. Since Willis' locality information is usually accurate, this collection is anomalous. For a discussion of the typical Howe Range populations, previously regarded as *P. sp. aff. melissifolia*, refer to *P. incisa* R.Br. s. lat. (below).

**Typification:** although the four Mueller collections of *Prostanthera melissifolia*, as held at MEL, are from the same locality, MEL 43368 is here chosen as the lectotype because it has several flowers (with corolla and anthers intact) remaining on the collection. The other collections (cited above) have fewer flowers (corolla and anthers intact) or flowers with only calyx and gynoecium remaining.

Unfortunately, there appears to be no herbarium material of *P. melissifolia* var. *parvifolia*. This material was originally introduced to the Royal Botanic Gardens, Kew in 1929 as *P. sieberi*, from material cultivated in New Zealand (Sealy 1948). Since the illustrations (t. 9687) included with the protologue are sufficient to circumscribe this taxon, these are chosen as the iconotype.

**Habitat:** throughout much of its range, this species is commonly associated with openings in the forest, particularly along roads, and margin of Open Tall *Eucalyptus*-dominated (Wet Sclerophyll) forest, at altitudes of 250–700 m. The dominant eucalypts are usually *Eucalyptus obliqua* or *E. regnans*. The understorey typically consists of *Hedycarya angustifolia*, *Bedfordia arborescens*, *Cyathea australis*, *Dicksonia antarctica*, *Olearia lirata*, *Polyscias saubucifolia*, *Acacia dealbata*, and *Pomaderris* spp.

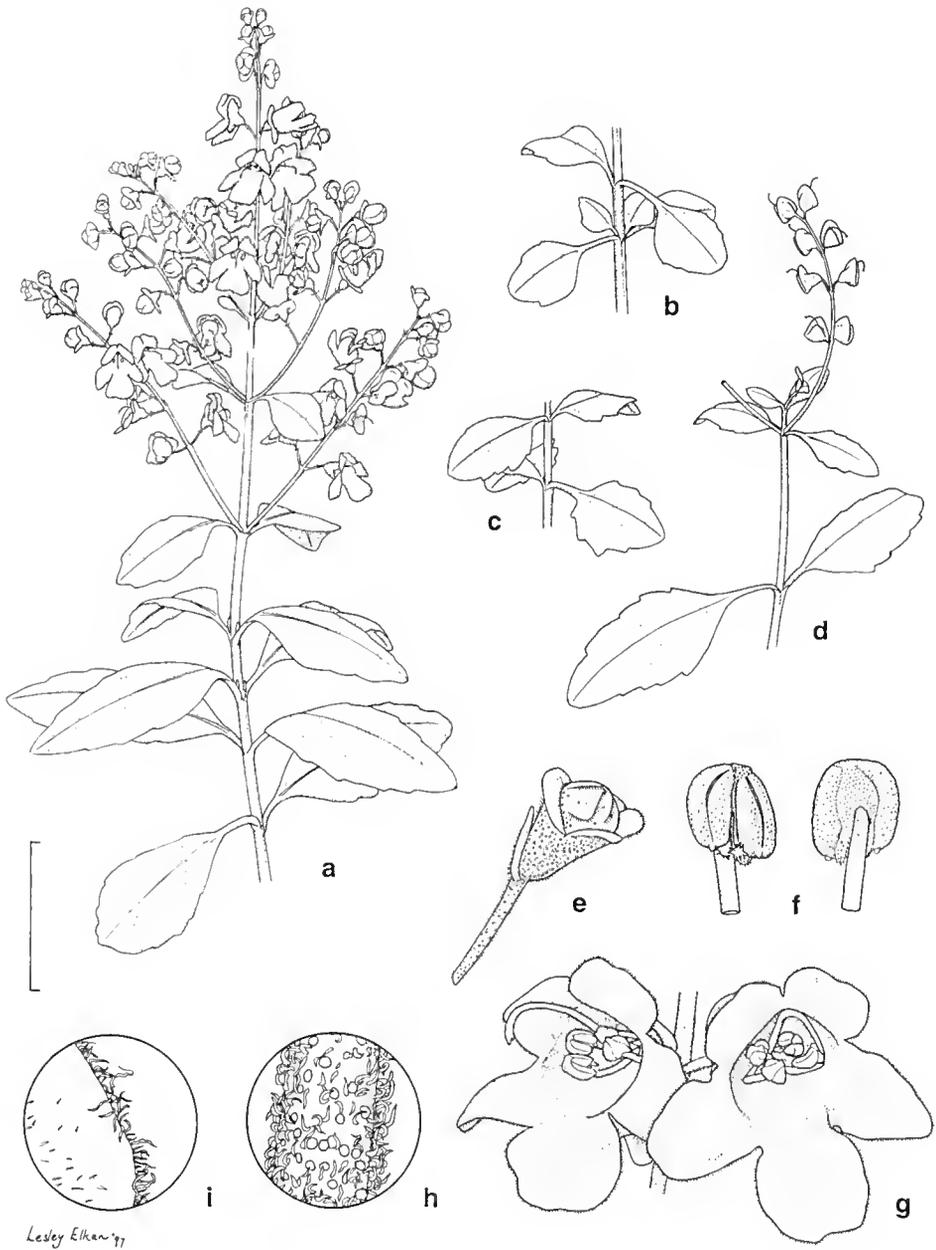


Fig. 3: *Prostanthera melissifolia* F.Muell. **a**, Flowering branchlet; **b**, branchlet showing smaller leaves with slightly attenuate lamina bases; **c**, branchlet showing smaller leaves with more rounded lamina bases; **d**, branchlet with larger leaves and young infructescence; **e**, detail of calyx, prophylls and propodium in bud; **f**, ventral stamen, showing ventral surface (left) and dorsal surface and connective (right); **g**, open flowers showing stamens and gynoecium; **h**, detail of indumentum and sessile glands on branchlet; **i**, indumentum on margin of corolla lobes. (a, e–i *Conn* 3044; b *Forbes* 1909; c *Nordenstam & Anderberg* 1187; d *Mueller s.n.*, MEL 43368). Scale bar: a–d = 30 mm; e = 4 mm; f = 2 mm; g = 6 mm; h & i = 1.2 mm.

**Selected specimens examined** (c. 90 examined). Victoria: Snowfields: Lake Mountain Road, near Kellys Plain, *Forbes* 1909, 21 Dec 1983 (MEL 665262, NSW 410716); ?East Gippsland: Howe Range, *Willis & Beaglehole s.n.*, 2 Nov 1969 (MEL 43371)(refer Notes, above); Eastern Highlands: 0.9 km (by road) S of Dom Dom Saddle, Black Spur on Maroondah Highway, *Conn* 3044, 11 Nov 1988 (AD, KUN, MEL, NSW 218450, NY); Above Ada River, c. 6 miles NE of Powelltown, *Muir* 955, 13 Dec 1959 (MEL 48250, NSW 253773); Gippsland Highlands: Bulga National Park, *Carrick* 3322, 23 Jan 1973 (AD 97331154); Grand Ridge Road, 1 km W of Dingoes Creek Road, 19 km NE of Forster Post Office, *Beaglehole* 63002, 21 Dec 1978 (MEL); Grand Ridge Road, 4 km E of English Corner, *Walsh* 190, 22 Nov 1978 (MEL 547864); Between Toora and Gonyah, S. Gippsland, *Willis & Smith s.n.*, Nov 1951 (MEL 43373); Midlands: Creswick Plantations, *Hateley s.n.*, Feb 1986 (MEL 1546704); You Yangs, *Walter s.n.*, Oct 1892 (NSW 134088); Otway Range: Mt Sabine, on road to Forest, *Melville* 3196, 27 Feb 1953 (MEL 1554255, NSW 253676).

#### 4. Status of *Prostanthera melissifolia* sensu Conn (1992)

*Prostanthera melissifolia* F.Muell. sensu B.J.Conn, Fl. New South Wales 3: 655, 656 (1992) non F.Muell. (1858) = *Prostanthera caerulea* R.Br. (refer 'Orthography', below)

**Notes:** Morphologically, *Prostanthera caerulea* and *P. melissifolia* are superficially very similar, with both having similar indumentum on branchlets, densely glandular calyces, and variously mauve corollas that lack markings. The leaf lamina of *P. caerulea* is usually narrowly ovate (occasionally ovate), 18–65 mm long, 6–22 mm wide [length to width ratio c. 3], with base cuneate to narrowly obtuse, symmetric, and petiole 2–12 mm long; whereas that of *P. melissifolia* is ovate to narrowly ovate, rarely elliptic, 12–50(–60) mm long, 9–25(–30) mm wide [length to width ratio 1.2–2(–3)], with base attenuate, more or less asymmetric, and petiole (8–)10–15 mm long. In *P. melissifolia*, the prophylls are

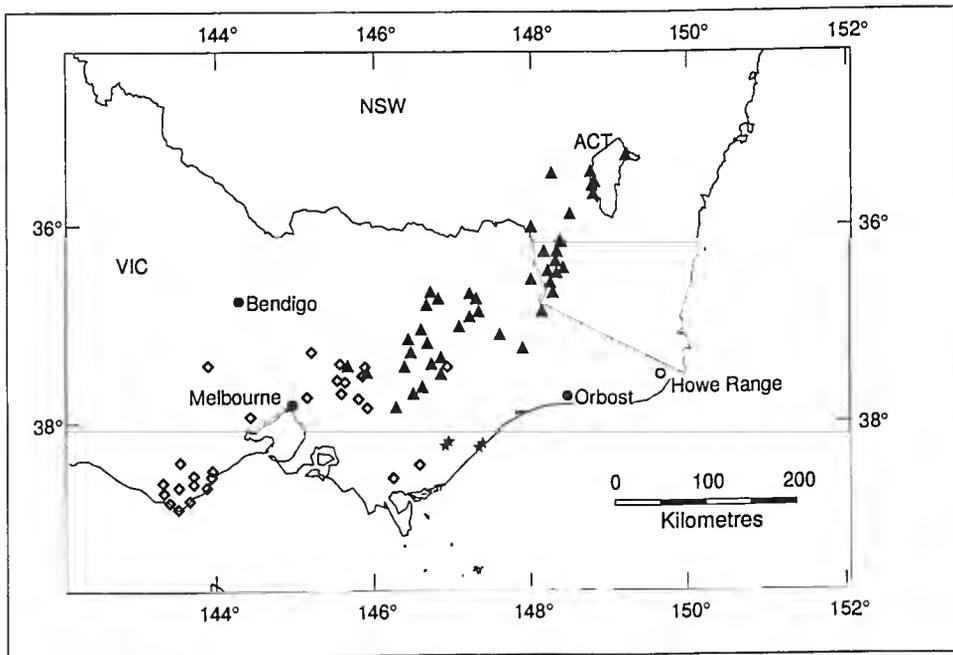


Fig. 4: Distribution of species in Victoria and south-eastern New South Wales; *Prostanthera cuneata* (solid triangle); *P. galbraithiae* (solid star); *P. melissifolia* (open diamond). Note: open circle refers to locality of the Howe Range.

persistent, 1–1.5 mm long, c. 0.1 mm wide (cf. in *P. caerulea*, not persistent, 2.5–3 mm long, c. 0.5 mm wide). The stamens of *P. melissifolia* lack anther appendages, whereas although appearing to be absent in *P. caerulea* they are only c. 0.5 mm long. *Prostanthera caerulea* is an erect shrub, 0.5–3 m high, that flowers in spring (from September to November), whereas *P. melissifolia* is an erect shrub to small tree, 1–5 m high, flowering in summer (from November to January, rarely to April). *Prostanthera caerulea* occurs from southern Queensland to the Northern Tablelands, Central Tablelands, North Coast and Central Coast regions of New South Wales.

**Orthography:** there has been some confusion as to the correct spelling of *Prostanthera caerulea*. In the protologue, Brown (1810, p. 508) used the diphthong 'æ' in the specific epithet, namely '*caerulea*'. However, confusion has occurred because the italicisation of 'æ' superficially looked like the diphthong 'œ' ('æ' italicised becomes 'œ'). This is clear from Brown's use of 'æ' in '*Anthraea*' in the protologue. For a distinction between italicised and non-italicised 'æ' diphthong refer Fowler (1965: 12). Bentham (1834, p. 450) was the first to inadvertently convert 'æ' to 'œ' (as 'CÆRULEA'), and later by Mueller (1867: 106) (as 'cœrulea') and again by Bentham (1870: 94) (as 'cœrulea'). More recently, Chapman (1991) followed Bentham's (1870) spelling of the epithet, rather than the entry in *Index Kewensis* (Hooker & Jackson 1894: 630).

**5. *Prostanthera incisa* R.Br., *P. violacea* sensu Ewart (1931), and *P. sp. aff. melissifolia* sensu Beaglehole (1980)**

Ewart (1931) identified collections of *Prostanthera* from Cape Howe and Cann River (both East Gippsland) as *P. incisa* R.Br. and *P. violacea* R.Br., respectively. Although Willis (1973) excluded these two species from the flora of Victoria, he did not indicate which species these collections belonged to. However, he did suggest that the reference to *P. violacea* was based on 'an erroneous record' (Willis 1972, p. 590). Likewise, the validity of the reference to *P. violacea* var. *albiflora* [F.Muell.] (Ewart 1931, p. 984) is unknown because no collections are referred to this taxon. Subsequently, the affinities of the Howe Range material have been placed with *P. melissifolia* (as *P. sp. aff. melissifolia*, Beaglehole 1980). Although there is some doubt about the true identity of the Howe Range collections, it is here concluded that they are best regarded as part of *P. incisa* R.Br. *sensu lato* (as applied by Conn 1992).

### Taxonomy

The following description is provided to assist in the recognition of the East Gippsland populations here referred to this taxon.

***Prostanthera incisa* R.Br., *Prodr.* (1810) 509.**

Type: 'Grose [River], first branch', *Brown [Beunett 2367] s.n.*, 'Dec 23, 1804' (Brown ms.) (BM, 3 sheets).

*Prostanthera sp. aff. melissifolia* sensu Beaglehole, *Victorian Vasc. Pl. Checkl.* (1980) 173.

At least in part, probably based on: *Beaglehole 31386, 31450, 33659, 32527* (refer Notes, below).

*Prostanthera incisa* sensu Ewart, *Fl. Victoria* (1931) 985

Possibly based on: 'Cape Howe Ranges, Vict.', *Walter s.n.*, no date (MEL 43377).

Possible synonyms:

*Prostanthera violacea* sensu Ewart, *Fl. Victoria* (1931) 984, non R.Br. (1810).

Based on: Unknown.

*Prostanthera violaceae* var. *albiflora* sensu Ewart, Fl. Victoria (1931) 984, ? non F. Muell. (1867).

Based on: Unknown.

Erect (fide MEL, Oct 1997), openly branched shrub, 2–2.5 m high, strongly and  $\pm$  unpleasantly aromatic; branches laterally ridged, moderately to densely covered with short, curled hairs, densely covered with subsessile glands. Leaves green, paler below, covered with short, curled hairs basally and along midrib of abaxial surface, densely covered with subsessile glands; petiole 3–10 mm long; lamina ovate, 15–30 mm long, 8–12 mm wide; base short- to long-attenuate and  $\pm$  decurrent, usually symmetric; margin  $\pm$  coarsely toothed with teeth directed forward to laterally; apex obtuse. Inflorescence a frondobraceose botryoid. Prophylls not persistent, c. 1 mm long, c. 0.2 mm wide. Calyx 4–5 mm long; tube c. 2 mm long; adaxial lobe c. 2 mm long (slightly enlarged in fruit). Corolla pale mauve to mauve, 7–10 mm long. Anthers with appendage greatly reduce, only slightly extended beyond anther locule, hence appearing absent, each locule with a tuft of basal narrowly triangular trichomes.

**Flowering:** September–November. **Fruiting:** November–December.

**Victorian specimens examined:** East Gippsland: About 2 km SE of Mt Carlyle summit, *Albrecht* 3625 & *Walsh*, 4 Sep 1988 (MEL, NSW 451476); Howe Ranges, *Beauglehole* 31386, 30 Oct 1969 (AD 97209279); 31450, 1 Nov 1969 (AD 97209277); 33659, 8 Aug 1970 (AD 97209222); Mallacoota Inlet National Park, *Beauglehole* 32527, 16 Dec 1969 (AD 97209278); Cape Howe Range, *Walter s.n.*, without date (MEL 43377); Howe Range, *Willis s.n.*, 24 Oct 1948 (MEL 43372).

**Distribution:** *Prostanthera incisa* (*s. lat.*) occurs in the Central Tablelands, North Coast, Central Coast and South Coast regions of New South Wales, and is here extended to include the Howe Range populations (refer Fig. 4) of East Gippsland in Victoria.

**Habitat:** tall open forests dominated by *Eucalyptus muelleriana*, *E. smithii* and *Callitris rhomboidea*.

**Vernacular name:** cut-leaf Mint-bush (Ewart 1931, p. 985; Willis 1973, p. 588).

**Notes:** although Beauglehole (1980) did not cite any collections as vouchers of his informal name '*P. sp. aff. melissifolia*', his reference to region 'Z' (namely, East Gippsland), suggests that he was referring to the Howe Range/Mallacoota National Park populations of this species.

Apart from distributional data, little is known about this taxon. Although these populations are morphologically very similar to *P. melissifolia* (at least in herbarium material), the leaves tend to be smaller and narrower than the latter. It is not entirely certain, but the Howe Range populations tend to be strongly aromatic, more typical of the known New South Wales populations of *P. incisa* and *P. sieberi*. Although variable, the prophylls tend to be inserted on the distal third of the podium, whereas those of *P. melissifolia* are inserted just below the calyx.

Studies into the systematics of the *P. incisa*–*P. sieberi* complex are necessary before the status of these Howe Range populations can be completely resolved.

## Acknowledgments

I gratefully thank Margaret Corrick (joint collection of the type specimen of *Prostanthera galbraithiae* B.J.Conn) (then MEL) for her assistance in the field. Bonnie Thompson (South Traralgon) and Neville Walsh (MEL) generously provided advice on the conservation status of this species. Lesley Elkan (NSW) prepared the illustrations in this paper. I thank the Directors and Curators of the many herbaria for allowing me the opportunity of studying material in their care.

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# Australian Citreae with notes on other Aurantioideae (Rutaceae)

D.J. Mabberley

## Abstract

Mabberley, D.J. (Rijksherbarium, University of Leiden, Netherlands and Royal Botanic Gardens Sydney, Mrs Macquaries Road, Sydney, NSW, Australia 2000) 1998. *Australian Citreae with notes on other Aurantioideae (Rutaceae)*. *Telopea* 7(4):333–344. Both subtribes of tribe Citreae (Rutaceae: subfam. Aurantioideae) are represented in Australia: the sole representative of 'Triphasiinae' is here referred to *Luvunga* Wight & Arn., in which the new combination, *L. monophylla* (D.C.) Mabb., is proposed, and the relationships of the Australian Citrineae to the genus *Citrus* L. are reassessed; *Eremocitrus* Swingle and *Microcitrus* Swingle are reunited with *Citrus*. A new species, *C. gracilis* Mabb. from the Northern Territory, is described and a conspectus of, and an identification key to, Australian native *Citrus* spp. presented; 'Sydney Hybrid' is formally described and named *C. × virgata* Mabb.; a new combination, *C. × floridana* (J. Ingram & H. Moore) Mabb., for the name of the limequat and a new name, *C. wintersii* Mabb., for one of the Papuan endemic species formerly referred to *Microcitrus* are proposed. In tribe Clauseneae, notes on *Glycosmis*, *Microuelum* and *Murraya*, especially on typification of names, are presented.

## Rutaceae: Aurantioideae in Australia

This paper is a prelude to the account of the subfamily Aurantioideae Horan. for *Flora of Australia*, in which full descriptions will be found, so those are not repeated here. The subfamily in its wild state is restricted to the tropics and subtemperate parts of the Old World and comprises two tribes: Clauseneae Wight & Arn. and Citreae Meissner, both of which are represented in Australia. Native Clauseneae are species of *Clausena* Burm.f., *Glycosmis* Correa, *Microuelum* Blume and *Murraya* L. (see Appendix); Citreae are represented by species referred to two of the three subtribes recognised by Swingle (1944: 136–7), viz. Triphasiinae Swingle (apparently not validly published) and Citrineae Engl.

It is worth noting here that the traditionally used subfamily name for this assemblage was validly published in 1847 (I am greatly indebted to Jim Reveal for pointing this out):

Rutaceae Juss. subfam. Aurantioideae Horan., Char. Ess. Reg. Veg.: 203 (1847 as 'Aurantiaceae', sub Meliaceae)

Aurantiaceae Juss., Gen. Pl.: 260 (1789).

Type: *Aurantium* Tournef. ex Miller (= *Citrus* L.)

Linnaeus (see references under account of *Citrus*, below) combined Tournefort's genera *Aurantium* (oranges), *Citream* (citrons) and *Limon* (lemons) as his new genus *Citrus*, a name used in Classical Latin for *Tetraclinis articulata* (Vahl) Masters (Cupressaceae), a North African tree with fragrant timber. The type species of *Citrus* L. is *C. medica* L., the citron. In reviving Tournefort's genera, Miller effectively split up *Citrus*, with *Aurantium* and *Limon* being legitimate names and *Citream* a superfluous renaming of *Citrus*. Suprageneric names based on *Aurantium* Tournef. ex Miller are therefore legitimate.

### Australian 'Triphasiineae'

The sole Australian representative of the subtribe was collected in the Sir Edward Pellew Group, Gulf of Carpentaria, in December 1802 by Robert Brown during Flinders's *Investigator* circumnavigation of Australia; further material was gathered a few months later in Timor by J.B.L.C.T. Leschenault de la Tour on Baudin's voyage. The first gathering was the basis for *Atalantia* (?) *recurva* Benth. (1863) but the second was described long before as *Triphasia monophylla* DC. (1824). Currently (Pedley 1987), the plant, which is native in Java and the southern Philippines too, is referred to *Paramignya* Wight as *P. trimera* (Oliver) Burkill (*P. monophylla* is another species). Swingle (1944: 254) considered *P. trimera* 'aberrant' in *Paramignya* because of its trimerous flowers and other features. The genus *Luvunga* Wight & Arn. was held to differ from *Paramignya* in its 3–5 petals, 6–10 stamens and 2–4 locules in the ovary, so that *P. trimera* is more logically placed in *Luvunga*. The simple leaves characteristic of *Paramignya*, including *P. trimera*, sometimes occur in *Luvunga*: in those cases, the leaves have petioles shorter than those of the usual trifoliolate leaves, and very closely resemble the leaves of *Paramignya* species. Swingle, following earlier authors, notably Oliver, considered that the two genera were extremely close; further study of Malesian species may lead to their complete amalgamation.

#### *Luvunga monophylla* (DC.) Mabb., **comb. nova**

*Triphasia monophylla* DC., Prod. 1: 536 (1824)

Type: Timor: *Anon.* (ex herb. Paris 1821 [J.B.L.C.T. Leschenault de la Tour, 1803]); holo: G–DC (fiche seen); iso: K ['Leschenault'], L ['ex herb. Paris']

*Atalantia trimera* Oliver, J. Proc. Linn. Soc. Bot. 5, suppl. 2: 24 (1861), non *A. monophylla* DC.

*Paramignya trimera* (Oliver) Burkill, Gard. Bull. Straits Settlement. 5: 213 (1931), non *P. monophylla* Wight.

*Atalantia* (?) *recurva* Benth., Fl. Austral. 1: 370 (1863).

Type: Australia: Gulf of Carpentaria, Sir Edward Pellew Group, 18 Dec. 1802, *R. Brown* s.n. [Bennett 5342]; lecto (selected here): K (annotated by Bentham); isolecto: BM.

### The generic problem in Citrineae

The species of the subtribe Citrineae are unique in bearing orange- or lemon-shaped fruits with pulp-vesicles filling all the space in the segments of the fruit not occupied by seeds. These pulp-vesicles are the basis for the most important fruit industry in warm countries, for, in species and hybrids of *Citrus* subg. *Citrus*, they contain potable juice of great commercial significance.

Within the subtribe, Swingle (1944: 340) called *Citrus* and five other genera the 'True Citrus Fruit Trees', all except *Clymenia* with slender-stalked pulp-vesicles. Most of the genera had been segregated from *Citrus* by Swingle himself: *Clymenia* Swingle, *Eremocitrus* Swingle, *Fortunella* Swingle, *Microcitrus* Swingle and *Poncirus* Raf. The group is represented by species from northern India to northern China, through Malesia to eastern Australia. *Citrus* sensu stricto is found throughout this range, except in northern China (where *Poncirus*, 1(?) or 2 spp, the second possibly a hybrid with *Citrus* – cf. Swingle (1944: 373), but see below) is native) and Australia (the only representatives of the entire subtribe being, besides naturalised *Citrus* subg. *Citrus*, the endemic *Eremocitrus* (1 sp.) and *Microcitrus* (5 (4 endemic) of the seven known allopatric species plus one from the Northern Territory so far unnamed)). The two last genera have been shown to be very closely allied to one another by Barrett and Rhodes (1976); Swingle had already noted that they (though this has not been confirmed for

all *Microcitrus* spp. now known) resembled one another in their dimorphic foliage and free stamens, such distinctive juvenile foliage not being found in *Citrus* and free stamens only in *Citrus* subg. *Papeda* (Hassk.) Swingle. Species of *Citrus* subg. *Papeda* have simpler floral vascular systems than do those of subg. *Citrus* and, in this regard, resemble species referred to the segregate genera which share the free stamens typical of this subgenus (though species of subg. *Papeda* 'sect. *Papedocitrus*' (an invalidly published name) have stamen-bases cohering as in subg. *Citrus* and in *Fortunella*). Swingle considered that *Eremocitrus*, like *Fortunella*, had 3–5(–7)-locular fruits with only two seeds per locule, *Microcitrus* resembling *Citrus*, *Clymenia* and *Poncirus* in having 6–8(–16)-locular fruits with 4–12 seeds per locule. *Poncirus*, like *Eremocitrus*, is deciduous but has trifoliolate leaves, though the range of trifoliolate to unifoliolate leaves is seen in other Citreae, e.g. *Luvunga* (see above).

Although apparently relatively unconsidered in experimental work, species of *Citrus* subg. *Papeda*, which have been hybridised with species in subg. *Citrus*, have petioles which are broadly winged and very large compared with those in subg. *Citrus*; the pulp vesicles contain globules of very acrid oil and are sometimes attached to the radial locule walls for half to three-quarters the distance from the dorsal wall to the centre of the fruit. Typical *Clymenia* has most vesicles attached to the radial walls of the locules; all the other genera have all or most vesicles attached to the dorsal walls. Oil droplets are abundant in the vesicles of *Poncirus*, *Microcitrus* and *Citrus* subg. *Papeda*, fewer in *Clymenia* (? fruits sweet), *Eremocitrus* and *Fortunella* besides *Citrus* subg. *Citrus*. *Citrus halimii* Stone (subg. *Citrus*, Thailand, Malay Peninsula, Borneo) approaches *Fortunella* in other respects (Stone et al. 1973) as does *C. swinglei* Burkill ex Harms (*C. polyandra* (Ridley) Burkill non Tanaka; *Fortunella polyandra* (Ridley) Tanaka; *F. swinglei* MSS) with 5-celled globose fruit and 2 ovules per locule. Moreover, *Microcitrus garrawayae* has 4-merous fruits (and *M. papuana* H. Winters from New Guinea 3–5-merous) like *Fortunella* and *Eremocitrus*, while the new 'Microcitrus', from the Northern Territory, has much of the habit of *Eremocitrus* but the gynoeceal structure of the first described *Microcitrus* species.

By the time of Swingle's monograph (1944), intergeneric hybrids had been raised between species from all genera except *Clymenia* (Bismarck Archipelago, though *C. platypoda* Stone described from New Guinea since then may actually be a natural *Citrus*–*Clymenia* hybrid (Stone 1985) and *Microcitrus inodora*, which is quite distinct from the other Australian *M.* spp. in its leaf-venation, resembling that in *Clymenia*, has also been hybridised with *Eremocitrus* (Rahman & Nito 1994)) and successful intergeneric grafts made. This latter is of great importance as Tristeza Virus-resistant rootstocks from a number of allied taxa can be combined with susceptible scions of commercially important citrus.

The commercially important citrus are largely derived from three allopatric *Citrus* (subg. *Citrus*) spp.: *C. medica* L. (India), *C. reticulata* Blanco (China) and *C. maxima* (Burm.) Merr. (SE Asia), though there are at least two as yet unrecognised species in the ancestry of the lime, *C. × aurantiifolia* (Christm.) Swingle, and the lemon, *C. × limon* (L.) Osb. (see Mabberley 1997). One of these has been suggested to be a species of *Microcitrus* (Scora & Kumamoto 1983), Barrett and Rhodes (1976) speculating that lime is a trihybrid involving that unknown species, *C. medica* and *C. maxima* (*C. grandis*). Rahman and Ito (1994) analysed the leaf isozymes of glutamate oxaloacetate transaminase in *Citrus*–*Microcitrus* crosses and concluded that the two 'genera' have very similar genetic systems and that the species of the two 'genera' are indeed very closely related to one another; moreover, they showed that common alleles at the three loci controlling GOT isozymes are found in genera of the 'True Citrus Fruit Trees', suggesting that a genetic identity is conserved among them, even those climatically, geographically and reproductively isolated. Vardi et al. (1989) fused *Citrus* and

*Microcitrus* protoplasts and the resultant microcalli gave rise to embryos which grew into trees with *Citrus* morphology, though their mitochondria had novel DNA indicating recombination between the chondriomes of the two 'genera'. In the embryos their chloroplasts were from either or both parents, tending to sort out to one parental type as the trees matured.

If it should transpire that *Microcitrus* has indeed contributed to the genetic make-up of the lime, then, with Swingle's classification, the lime would have to be considered an 'intergeneric hybrid' unless *Microcitrus* be returned to *Citrus* once more. Such 'intergeneric hybrids' abound in this group and they include the commercially significant limequats,  $\times$  *Citrofortunella* J. Ingram & H. Moore (*Citrus*  $\times$  *Fortunella*) in which the calamondin, an important ornamental, is accommodated; the (Troyer) citrange,  $\times$  *Citroucirus* J. Ingram & H. Moore (*Citrus*  $\times$  *Poncirus*); and even some 'trigeneric' hybrids like citrangequats and citrangedins (*Poncirus*  $\times$  *Citrus*  $\times$  *Fortunella*) have been synthesised. Of native Australian species, *Eremocitrus glauca* has been crossed with lemon to give 'eremolemons' and with sweet orange to give 'eremoranges', which also have to be given 'intergeneric hybrid' status if *Eremocitrus* is kept distinct from *Citrus*; 'eremoranges' have also been involved in 'trigeneric' hybrids adding *Poncirus* to give 'citrangeremos' (Swingle 1944: 366). Swingle opines (p. 366), 'If it proves possible to cross-pollinate successfully a citrangeremo with another trigeneric hybrid already existing, the faustrimedon [= *Microcitrus*  $\times$  (*Fortunella*  $\times$  *Citrus*)], no fewer than 5 genera of True Citrus Fruit Trees will have been combined in the resulting hybrid, viz., *Citrus*, *Fortunella*, *Microcitrus*, *Eremocitrus*, and *Poncirus*! Naturally [sic!] such ultra-complex hybrids, if obtained, would not be recognised by taxonomists as constituting true genera or true species [!]'.

Long before the borders of these finely distinguished genera were so strikingly transgressed by discovery of new species and found to be increasingly indistinct by breeding and molecular work, Burkill (1931) re-united Swingle's genera (referring to them as "microgenera" with a narrowness which offends my conception of what a genus is'). In so doing, he obviated the necessity for the description of 'intergeneric' hybrids in this tight-knit group and he recognised Swingle's 'genera' at subgeneric level. Whether even subgenera are now worth recognising must await monographic work on *Citrus* for *Flora Malesiana*. However, in treating for *Flora of Australia* the calamondin cultivated on Christmas Island, Du Puy (1993) has already followed the lead of Hiroe (1974) in referring it to *Citrus* and not  $\times$  *Citrofortunella*, re-amalgamating *Fortunella* with *Citrus*. Considering all the evidence now before us, there indeed seems to be no reasonable alternative to following them and Burkill. Although it is perhaps sad (at least for 'biodiversitimetricians'!) to see the 'loss' of an Australian 'endemic genus' (*Eremocitrus*) and regrettable to see the names of well-known cultivated plants change (back), the demise of hybrid mouthfuls resulting from an overenthusiastic splitting of a genus earlier this century will not, I suspect, be mourned for long. Indeed, the subtle distinctions between the Swingle 'microgenera' have not only long troubled botanists, but have baffled and confused commercial growers and amateur gardeners alike.

### Citrus indigenous in Australia

A conspectus of the species in Australia, with notes on typification where appropriate, follows: full descriptions will be presented in the forthcoming *Flora of Australia* account. The cultivated species classically referred to *Citrus* have been covered by Mabberley (1997); other exotic species seen in Australia are:

\***kumquats or cumquats**: — cultivars of *Citrus japonica* Thunb. (*Fortunella japonica* (Thunb.) Swingle; including *C. margarita* Lour. (*F. margarita* (Lour.) Swingle) according

to recent Japanese authors following T. Makino, *Makino's New Illustrated Flora of Japan* (1964: 339)).

\***calamondin**: *C. × microcarpa* Bunge

Type (?holotype): 'Chine boreal', *Auou.* in Herb. Bunge (P).

[*C. × uitis* Blanco, × *Citrofortunella mitis* (Blanco) J. Ingram & H. Moore, × *C. microcarpa* (Bunge) Wijnands, *Citrus* (F.) *margarita* (= *C. japonica*, kumquat) × *C. reticulata* Blanco (mandarin)].

\***limequat**: *Citrus × floridana* (J. Ingram & H. Moore) Mabb., **comb. nova**

× *Citrofortunella floridana* J. Ingram & H. Moore in *Baileya* 19: 170 (1975).

Type: An illustration (*J. Agric. Res.* 23: 237 t. 4 (1923)) was cited as type by the authors.

[*Citrus × aurantiifolia* (Christm.) Swingle (lime) × *C. (F.) japonica* (kumquat); including × *Citrofortunella swinglei* J. Ingram & H. Moore (non *Citrus swinglei* Burkill ex Harms), i.e. *Citrus margarita* (= *C. japonica*) × *C. × aurantiifolia*].

For discussion on the synthesis of limequats in F.W. Savage's citrus grove in Eustis, Florida, USA in 1909, see Swingle and Robinson (1923).

Whether the rather distinctive temperate Chinese *Poncirus trifoliata* (L.) Raf. (*Citrus trifoliata* L.), with deciduous trifoliolate leaves, and consequently × *Citroncirus* J. Ingram & H. Moore (citrangors, citrandarins, citranges [× *C. webberi* J. Ingram & H. Moore, *Citrus × hybrida* hort.], citrangequats), should be re-amalgamated with *Citrus* (cf. Hiroe (1974)), awaits further work. However Fang and Zhang (1992) have already argued that *P. polyandra* S.Q. Ding, X.N. Zhang, Z.R. Bao & M.Q. Liang, a species with evergreen trifoliolate leaves recently found in Yunnan, may be a 'missing link' between the two genera.

**Citrus** L., *Sp. Pl.* 2: 782 (1753)

Type: *C. medica* L.

[*Citreum* Tournef. ex Mill., *Gard. Dict.*, abr. ed. 4: [383] (1754), nom. superfl. pro *Citrus*] *Eremocitrus* Swingle, *J. Agric. Res.* 2: 86 (1914); *Citrus* L. subg. *Eremocitrus* (Swingle) Burkill, *Gard. Bull. Straits Settlements* 5: 218 (1931).

Type: *E. glauca* (Lindley) Swingle = *C. glauca* (Lindley) Burkill

*Microcitrus* Swingle, *J. Wash. Acad. Sci.* 5: 570 (1915); *Citrus* L. subg. *Microcitrus* (Swingle) Burkill, *Gard. Bull. Straits Settlements* 5: 219 (1931).

Type: *M. anstralasica* (F. Mueller) Swingle = *C. anstralasica* F. Mueller

*Fortunella* Swingle, *J. Wash. Acad. Sci.* 5: 167 (1915); *Citrus* L. subg. *Fortunella* (Swingle) Burkill, *Gard. Bull. Straits Settlements* 5: 218 (1931).

Type: *F. margarita* (Lour.) Swingle = *C. japonica* Thunb.

× *Citrofortunella* J. Ingram & H. Moore in *Baileya* 19: 169 (1975).

Type: not indicated.

Six species (five endemic) are native in Australia.

## Key to identification

1. Leaves 8–20 × 4–10 cm with numerous lateral veins; spines often paired ..... 1. *C. inodora*
1. Leaves 1.5–6(–9) × 0.4–3 cm without numerous lateral veins; spines solitary ..... 2
2. Leaves ovate to rhombic ..... 3
3. Fruits ovoid to ellipsoid ..... 2. *C. garrawayae*
3. Fruits cylindrical-fusiform ..... 3. *C. australasica*
3. Fruits globose ..... 4. *C. australis*
2. Leaves narrowly ovate to sublinear ..... 4
4. Leaves not coriaceous, glabrous; locules 8 or 9 ..... 5. *C. gracilis*
4. Leaves coriaceous, adpressed grey-hairy; locules 3 ..... 6. *C. glauca*

1. **Citrus inodora** F.M. Bailey, Rep. New Plants: 1 (1889)\* as *C. inodorus*

Type: Queensland: Russell R., Harvey's Creek, F.M. Bailey s.n.; holo: BRI, n.v.; ?iso: K.  
*Microcitrus inodora* (F.M. Bailey) Swingle, J. Wash. Acad. Sci. 5: 577 (1915).

*C. maideniana* Domin, Bibl. Bot. 89: 297 (1927); *M. maideniana* (Domin) Swingle, J. Wash. Acad. Sci. 28: 533 (1938).

Type: Queensland: Russell R., Harvey's Creek, K. Domin 5602; holo: PR.

Russell River lime, North Queensland lime; Queensland (Cook District).

2. **Citrus garrawayae** F.M. Bailey, Qld. Agric. J. 15: 491 (1904) as *C. garrawayi*

Type: Queensland: Cape York Peninsula, Mt White near Coen, May 1904, R.W. Garraway s.n.; holo: BRI, n.v.; iso: P.

*Microcitrus garrawayae* (F.M. Bailey) Swingle, J. Wash. Acad. Sci. 5: 574 (1915) as '*M. garrawayi*'.

[*M. australasica* sensu Stone, Proc. Acad. Nat. Sci. Philadelphia 137: 226 (1985) p.p. (cf. P.I. Forster, Telopea 4: 357, 1991)]

Mount White lime. Queensland (Cape York Peninsula), New Guinea (Goodenough Is.)

3. **Citrus australasica** F. Mueller, Fragm. Phytogr. Aust. 1: 26 (1858)

Type: Queensland: Moreton Bay, W. Hill s.n.; holo: MEL.

*Microcitrus australasica* (F. Mueller) Swingle, J. Wash. Acad. Sci. 5: 572 (1915)

?*Citrus cataphracta* W. Hill, Queensland Timbers: 23 (1880) e descr.

Type: not preserved?

Finger lime; southern Queensland, northern New South Wales.

This has been crossed not only with *C. australis* (q.v.) but also with the calamondin (*C. × microcarpa* Bunge) to give the faustrimedon (Swingle 1944: 360)

\*Oct 1889 (fide A.D. Chapman, Austr. Pl. Name Index A–C: 730 (1991), n.v.; Bailey in Meston, Rep. Bellender-Ker Range [ Votes & Proc. Legisl. Ass. Qld 1889, 4]: 15 (post 7 Oct 1889) & Bailey, Bot. Bellenden-Ker Exped.: 34 (1889), both as *C. inodorus*.

4. *Citrus australis* (Mudie) Planchon, Hort. Donat.: 18 (1858)*Limouia* ? *australis* A. Cunn. ex Mudie, Pict. Austral.: 151 (1829)*L. australis* A. Cunn. ex Mudie, Veg. Subs.: 420 (1829)

Type: Queensland: Moreton Bay, 1829, A. Cunningham '26'; lecto (chosen here): BM; isolecto: K.

*Microcitrus australis* (Mudie) Swingle, J. Wash. Acad. Sci. 5: 575 (1915).[*C. plauchonii* F. Mueller, Austral. Veg.: 23 (1867) nom. nud.; Fragm. Phytogr. Aust. 9: 105 (1875), nom. superfl. pro *C. australis*]

Australian lime, dooja; southern Queensland.

Mudie described fruiting material (the fruit shaped like that of a lime [unlike that of the finger-lime, *M. australasica*, with which it might otherwise have been confused]) sent by Allan Cunningham, quoted from Cunningham's letters (Mabberley 1992) and attributed the name *Limouia australis* to him. Mudie seems to have had access to this information through his contacts at Kew, for Cunningham sent living material with some of black bean, *Castanospermum australe* A. Cunn. ex Mudie (Leguminosae/Fabaceae) to William Townsend Aiton there on board the *George Canning* 12 March 1829 (Mabberley 1992). As with the black bean, there is in the Drawings Collection at Kew a watercolour (by George Bond [Desmond 1995:218]) of a seedling ('26', '1041'). It is annotated 'Received in 1829 from Mr Cunningham discovered by him at Moreton Bay, east Coast of New South Wales...Limonia australis C.' in the same hand as that on the label attached to a Cunningham specimen now at BM (whither Robert Brown removed such material prior to the takeover of Kew by William Jackson Hooker [Desmond 1995: 155]); that sheet is also annotated '26' and, apparently in Cunningham's hand, 'Limonia australis'. This then links to Mudie and is here designated lectotype. Swingle (1944: 380) typified '*Citrus australis* Planch.' with a Leichhardt sheet in Paris but there is no evidence Mudie saw this material, which was also collected at Moreton Bay.

*Citrus australis* has allegedly been hybridised with *C. australasica* to give 'Sydney hybrid' (Swingle 1944: 382).

***Citrus* × *virgata* Mabb., hybr. nova**

Hybrida hortensis e *C. australasica* F. Muell. et *C. australe* (Mudie) Planchon exorta, inter parentes media, sed virgis numerosis, puberulis, fructibus elongato-obovoideis vel ellipsoideis.

Typus: Cultivated in USDA greenhouses, Washington DC, USA, 'C.P. & B. no. 7775-E', 23 Oct. 1939, W.T. Swingle s.u.; holo: NSW.

['*Microcitrus* hybrid' Winston et al., J. Agric. Res. 30: 1092 (1925)]

[*Microcitrus* × *virgata* H. Hume, Cult. Citrus Fruit : 31, t. 38 f. 19 (1926), pro sp., nom. nud.; Klotz & Fawcett, J. Agric. Res. 41: 420 (1930), pro sp., nom. nud.]

According to Swingle (1944: 382, q.v. for full description), the plant was raised from seed sent to USDA's Agricultural Research Service by J.H. Maiden, Director of the Sydney Botanic Gardens, 'Before its hybrid nature had been established, this form [sic] was called ... *Microcitrus virgata*, a provisional name alluding to its very numerous slender, straight, whiplike twigs ... More than 200 meters of twigs both large and small, were borne on a single branch, 3 cm in diameter, of a Sydney hybrid growing near Riverside, California, which survived for several decades on land no longer irrigated where citrus trees made little or no growth'. There is a plant in the Royal Botanic Gardens Sydney today, but I have been unable to establish when or from whom it was received or whether it, too, was grown from Maiden's seeds; it is also

unclear when Maiden sent seeds to Swingle or whether he had deliberately made the cross.

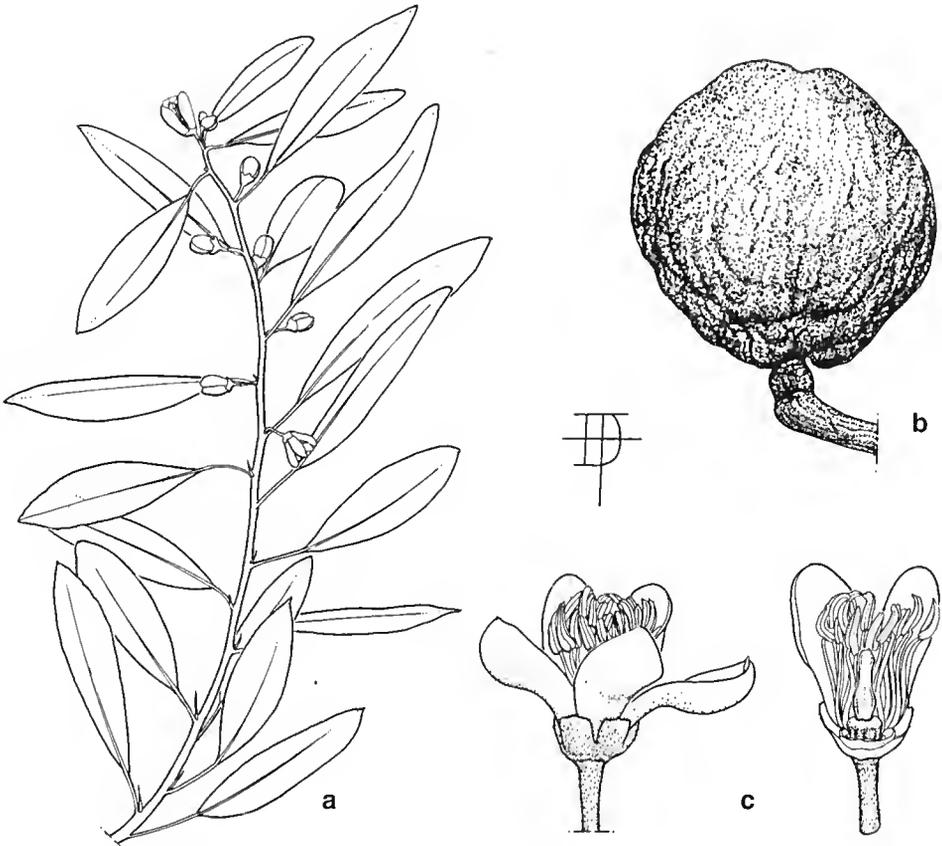
Material from Swingle's stock can be called *C. × virgata* 'Sydney Hybrid'. According to Stephen Sykes of CSIRO (pers. comm.), 'Sydney Hybrid' has been successfully crossed, as the male parent, with clementine (*C. reticulata* cv.)

#### 5. *Citrus gracilis* Mabb., sp. nova

*C. wintersii* Mabb. (*Microcitrus papuana* Winters) simulans, a qua imprimis differt ovariiis 8- vel 9-loculatis, hesperidiis sphaericis ad 7 cm diam.

Typus: Australia: Northern Territory: 5 miles [c. 8 km] W of Humpty Doo, J. McKean B19; holo: NSW, iso: CANB, DNA.

Armed straggling tree to 4 m high, often coppicing and suckering; bark cracking into irregular squares. Leafy twigs c. 2 mm diam., terete, fawn-pubescent when young; spines to c. 12 mm long, solitary. Leaves c. 4–6(–9) cm long, lamina to c. 4.5(–7) × 1.1(–2) cm, narrowly ovate to lanceolate or oblanceolate, those subtending young twigs with narrow leaves sometimes ovate, those on suckers often sessile, smaller and much narrower (to sublinear), apex acute, base acute to cuneate, margin sometimes distally



**Fig. 1.** *Citrus gracilis* Mabb. a, flowering twig ( $\times 0.9$ ). b, flowers (? functionally male;  $\times 3.6$ ). c, fruit ( $\times 0.67$ ). (a, b from T.G. Hartley et al. 15142. c, from J. Tiddy s.n., May 1984). (Drawing by Don Fortescue, reproduced with kind permission of T.G. Hartley).

subcrenulate, costae c. 6 on each side, acute; petiole c. 3–15 mm long, in largest leaves sometimes clearly articulated at base of lamina. Flowers usually solitary, rarely in fascicles of 3, subsessile or with finely hairy pedicel up to c. 3 mm long. Calyx c. 2 mm long, 3.5 mm across, salveriform to cupular, 5-lobed, subglabrous to finely hairy without, lobes truncate to acute or mucronate, margins ciliate. Petals c. 8 mm long, 4 mm wide, obovate, cucullate, pinkish white, apex rounded to acute. Stamens 26–30, c. 7 mm long; anthers c. 2 mm long. Disk c. 1.5 mm across, cushion-shaped. Pistil c. 4 mm long, stout, 8- or 9-ribbed basally (though sometimes scarcely developed -? pistillode), with a few hairs near apex; ovary 8- or 9-locular. Fruit c. 8 cm diam., globose. Fig. 1.

Eucalypt woodland with grassy understorey on sandy or gravelly soils. Fruits said to be eaten by Aboriginal people.

**Other material seen:** Northern Territory: Howard Springs Hunting Reserve, 350m S of NE Corner, S.M. Taylor 142, 146 (DNA); Sawyer Road near Howard Springs, G. Leach & L. Tumbilis 3907 (DNA); Harrison Dam, 4 Oct 1988, J. Cusack s.n. (CANB); Kakadu, Kapalga Station, I. Cowie 704 (DNA), J. Cusack et al. 3094 (FHO), T.G. Hartley et al. 15142 (CANB, FHO); 1.5 km W Twin Point North, C.R. Dunlop & J. Cusack 7925 (DNA); Arnhem Land, Maningrida–Oenpelli road, M.J. Clark 1332 (DNA); 2 km E of Oenpelli, May 1984, J. Tiddy s.n. (CANB); Marrakai, Mt Bundy Road, D.A. Hearne 194 (BRI, CANB); Peppimenarti, 12 Mar 1993, K. Reynolds s.n. (DNA).

The type specimen is apparently the first collection (1971). The specific epithet refers to the graceful aspect of the flowering twigs. Superficially resembling *C. wintersii* Mabb. (see below) in its narrow leaves, it differs from that New Guinea endemic in not having cylindrical fruits; from the other New Guinea endemic, *C. warburgiana*, with which some forms share the broader leaves characteristic of many specimens of that species, it differs in its much larger fruit as it also does from *C. glauca*, which also has narrow leaves and suckering spiny shoots. The characteristic large fruits with many locules also point up the artificiality of any system maintaining *Microcitrus* as a genus distinct from *Citrus*.

Whether the occurrence of pistillodes indicates dioecy or plants with hermaphrodite and functionally male flowers remains to be ascertained: without field studies this can only be investigated by unacceptable destructive sampling of herbarium material. It is to be noted that non-fruiting forms of *C. glauca* have been recorded and that both male and hermaphrodite flowers are known from individual cultivated citrus trees, indicating that the breeding system in *C. gracilis* may not be unique to that species.

#### 6. *Citrus glauca* (Lindley) Burkill\*, Gard. Bull. Straits Settle. 5, Index: 3 (1932)

*Triphasia glauca* Lindley in Mitchell, J. Exped. Trop. Austral.: 353 (1848)

Type: [Queensland: Dublin County near junction of Maranoa & Merivale Rivers,] 17 Oct. 1846, 'Tastes like Rue', T.L. Mitchell 398; holo: CGE (transparency seen); iso: BM, K, L ['subtropical New Holland 1846'].

*Atalantia glauca* (Lindley) Benth., Fl. Austral. 1: 370 (1863)

*Eremocitrus glauca* (Lindley) Swingle, J. Agric. Res. 2: 88 (1914)

*Atalantia glauca* var. *inermis* Bailey, Qld. Agric. J. II, 3: 29 (1915)

Syntypes: Queensland, near Dalby, Sept 1913, T.C. Bancroft s.n. (BRI, n.v.); Chinchilla, Dec. 1914, R.C. Beasley s.n. (BRI, n.v.).

Limebush, Australian desert lime, wild lime, native lime, desert kumquat; Queensland, New South Wales, South Australia.

Hybrids between *C. glauca* and *C. japonica*, *C. medica*, *C. × aurantium* and *C. × aurantiifolia* have been raised but those with the last set no seed and those with *C. medica* died when small (Barrett 1978).

\*Name not in *Index Kewensis* or other works.

### Non-Australian '*Microcitrus*'

The two non-Australian species formerly referred to *Microcitrus* are restricted to New Guinea.

1. *Citrus warburgiana* F.M. Bailey, Contrib. Fl. Brit. New Guinea: [1] + tab. (1902)

Type: Papua New Guinea: Gibara, Milne Bay, W.E. Armit s.u.; holo: BRI, iso: P.

*Microcitrus warburgiana* (F.M. Bailey) Tanaka, Bull. Soc. Bot. France 75: 714 (1928)

2. *Citrus wintersii* Mabb., **nomen novum**

*Microcitrus papuana* H. Winters, Baileya 20: 19 (1976), non *C. papuana* F.M. Bailey (= *C. macroptera* Montr.).

Type: Papua New Guinea: Central Dist., Brown River Forest Station, H.F. Winters & J.J. Higgins 763; holo: NA, n.v.; iso: L.

'Brown River finger lime'. South-eastern Papua New Guinea.

The new name commemorates Harold F. Winters of the USDA, Beltsville, who first described the plant. Fertile hybrids between *C. wintersii* and *C. glauca* as well as between it and *C. japonica* and also *Poucirus trifoliata* have been raised in USA (Winters 1976).

### Notes on Tribe Clauseneae Wight & Arn.

1. *Glycosmis macrophylla* (Blume) Miq.

The type of *Sclerostylis ?macrophylla* Blume, Bijdr.: 135 (1825), the basionym of *G. macrophylla* (*G. sapiindoides* Lindl. ex Oliver), the name of a widespread Malesian species found in northern Western Australia and the Northern Territory, is given as Java. However, in Blume's herbarium at Leiden, the only sheet bearing his MS name for his new species is an unnumbered gathering collected by C.G.C. Reinwardt on Halmaheira in August 1821. It is here chosen as lectotype.

2. *Micromelum minutum* (Forst. f.) Wight & Arn.

One of the synonyms of *M. minutum*, a common and widespread coastal tree of the Indopacific, is *M. pubescens* Blume, Bijdr.: 138 (1825) which was described from Java but has not, to my knowledge, been precisely typified. I here select from the Blume sheets at Leiden that with the binomial in Blume's hand (sheet HLB 908203-1854) as lectotype of *M. pubescens*.

3. *Murraya paniculata* (L.) Jack

This species, found throughout Indomalaysia to New Caledonia and Australia, comprises a number of distinctive forms, one of which, probably domesticated in China, has been long and widely cultivated. In Australia, where it is one of the most commonly seen shrubs in older gardens in Sydney, for example, it is locally naturalised. This is the orange jasmine/jessamine or Chinese box, '*Murraya exotica*', a form with rather small leathery leaflets and was the cultivated *Camunium japonense* of Rumphius's *Herbarium amboinense* (5:t. 18 f. 2, 1747). Rumphius contrasted it with the wild form on Ambon, his *Camunium vulgare* (Herb. Amb. 5: t. 17, 1747), which figure is the lectotype selected by Nair (Reg. Veg. 127: 32 (1993)) for *Chalcas paniculata* L., Mant.: 68 (1767), i.e. *M. paniculata*; it is also the holotype of *M. scandens* Hassk., Abl. Naturf. Gesell. Halle 9: 233 (1866), which is thus a superfluous illegitimate name.

'*M. exotica*' is perhaps best treated as a cultivar. Also in cultivation is a free-flowering form with more ovate leaves, resembling wild forms in Australia: it is the commonly seen shrub with neat foliage used in modern civic plantings and private gardens. The cultivation of different forms of *M. paniculata* taken from different parts of its natural range mirrors the situation seen in white cedar, *Melia azedarach* L. (Meliaceae; see Mabberley 1984).

*Murraya exotica* L. var. *ovatifoliolata* Engl. in Engl. & Prantl, Nat. Pflanzenfam. III, 4: 188 (1896), has an exiguous description: 'mit rundlichen oder eiförmigen Blättchen, im tropische Nordaustralien' and apparently no extant authentic material, but Australian workers have applied this name to the wild plant (i.e. typical *M. paniculata*), distinguished from the cultivated forms in its straggling habit, rather hairy shoots and broadly oval or ovate leaflets. Two other varieties were distinguished by Swingle (1944), one of them, var. *zollingeri* (Tanaka) Tanaka, J. Ind. Bot. Soc. 16: 232 (1937), described from Timor, having small leaflets with deflexed margins. In Australia, with very few intermediate exceptions, plants from dry semi-deciduous to deciduous vine-thickets tend to be low sprawling shrubs less than 3 m tall with such leaflets, highly aromatic when crushed (the 'Small Leaves' plant of Brophy et al. (1994) ? = var. *zollingeri*). Plants from 'less dry' semi-deciduous notophyll forests form small trees with larger less aromatic leaflets ('Big Leaves' of Brophy et al. 1994) and correspond to the *M. paniculata* s.s. as represented elsewhere in Indomalaysia. Whether the two leaf-forms are genetically or merely phenotypically distinct variants remains to be demonstrated and their relationship to plants in neighbouring territories is not yet fully elucidated.

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# New genera and species of Australian Restionaceae (Poales)

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## Abstract

Briggs, Barbara G. and Johnson, L.A.S. (Royal Botanic Gardens, Mrs Macquaries Road, Sydney, NSW 2000, Australia) 1998. *New genera and species of Australian Restionaceae (Poales)*. *Telopea* 7(4): 345–373. Sixteen new genera and five new species of Australian Restionaceae are described and combinations made for a further eleven species. Newly described genera are *Catacolea*, *Kulinia*, *Guringalia*, *Acion*, *Saropsis*, *Chordifex*, *Eurychorda*, *Platychora*, *Tremulina*, *Melanostachya*, *Taraxis*, *Tyrbastes*, *Cytogonidium*, *Stenotalis*, *Dapsilanthus*, *Apodasmia*. Newly described type species are: *Catacolea enodis*, *Kulinia eludens*, *Chordifex stenandrus*, *Taraxis grossa*, *Tyrbastes glaucescens*. New combinations are made for the type species of the remaining genera: *Guringalia dimorpha*, *Acion monocephalum*, *Saropsis fastigiata*, *Eurychorda complanata*, *Platychora applanata*, *Tremulina tremula*, *Melanostachya ustulata*, *Cytogonidium leptocarpoides*, *Stenotalis ramosissima*, *Dapsilanthus elatior*, *Apodasmia brownii*. Lectotypes are selected for several species. Brief comment is included on culm anatomy, flavonoids, seed ornamentation and DNA findings, in addition to exomorphological features. Keys are provided to distinguish the new genera from other members of the *Desmocladus*, *Loxocarya* and *Leptocarpus* groups. All the new genera occur in Australia but *Apodasmia* also includes species in New Zealand and Chile while *Dapsilanthus* is represented also in New Guinea, Aru Islands and Southeast Asia.

## Introduction

The last comprehensive systematic account of Australian Restionaceae was by Bentham (1878), building especially on the notable work of Brown (1810) and Mueller (1872–4). Subsequently 12 relevant new genera have been described, but two of these, *Desmocladus* Nees and *Baloskion* Raf., were never adopted by botanists in Australia and one, *Sporadanthus* F. Muell., was considered to be a New Zealand endemic. Over recent decades we have developed a revised classification, including 16 new genera (described here) and 51 new species. Publications are in preparation to describe the further new species of many of these genera.

The morphology of Restionaceae may be partly responsible for the inadequate nature of early classifications of the Australian members. The leaves are reduced to sheathing scales and the wind-pollinated flowers mainly differ in the extent of reduction of floral parts. The dearth of exomorphological characters, however, conceals a diversity of anatomical characters, as shown by the extensive studies of Gilg (1890) and Cutler (1969, 1972) who drew attention to many discrepancies between the existing classification and anatomical findings. Structures mentioned here, such as peg-cells, pillar cells and protective cells, are described by Cutler (1969). Anatomical studies have been extended to the rhizome and roots by Pate & Delfs (in press) and Meney, Pate & Hickman (in press). Palynology (Chanda 1966, Linder 1984, Linder & Ferguson 1985) and flavonoids (Harborne 1979, Williams et al. 1997 & in press) also show diversity largely concordant with the major distinctions between Australian and African groups and assist in characterising some genera. The early classifications also reflect the inadequacies of the available collections since many species and several genera are rare and of restricted distribution, so that they were not represented in early collections.

<sup>†</sup> Deceased 1 August 1997.

Our classification, or partially developed aspects of it, have been used in a number of contexts in advance of validation of the new names (Rye 1987; Pate, Meney & Dixon 1991; Pate, Raisins, Thumfort, McChesney & Meney 1995; Linder 1992; Meney, Pate & Dixon 1996; Meney, Dixon & Pate 1997; Williams et al. 1997 & in press; Meney & Pate in press; Meney, Pate & Hickman in press; Briggs & Johnson in press).

The present paper arises from the need to validate names in advance of the treatment of Restionaceae in *The Families and Genera of Flowering Plants*, edited by K. Kubitzki, (Linder, Briggs & Johnson in press). We describe the newly distinguished genera and make combinations for, or describe, their type species. The genera are treated in a systematic sequence, as in Linder et al. (op. cit.) and keys are provided to distinguish the new genera from other members of the *Desmocladius*, *Loxocarya* and *Leptocarpus* groups. The species referred to the new genera, where not monotypic, are enumerated in Briggs & Johnson (in press). Further information and illustrations of all Australian taxa are given by Meney & Pate (in press) and Meney, Pate & Hickman (in press). The new taxa will be placed in context in the treatment of the family in the *Flora of Australia* (Briggs, Johnson, Porter & Krauss in prep.) and, so far as practical in advance of that treatment, in revisions of individual genera. All types cited have been examined. Precise locations are not given for collections of very rare species.

### Descriptions of taxa, new combinations and distinguishing features

#### *Desmocladius* group (Briggs & Johnson in press)

The new genera *Catacolea* and *Kulinia* are placed in the *Desmocladius* group, so a partial key to genera of this group is provided. DNA sequence data (Briggs, Marchant, Gilmore & Porter unpublished results) show that the members of this group sampled, apart from *Empodisma* which has been regarded as its least specialised member, form a robust association.

#### Partial key to *Desmocladius* group

(i.e. Western Australian genera with single style and chlorenchyma not interrupted by pillar cells or sclerenchyma girders). (Names of new genera in bold.)

- 1 Culms simple, culm sheaths lacking or 1–3 ..... 2
- 1\* Culms branching or simple, culm sheaths >3 .....  
..... *Desmocladius*, *Harperia*, *Lepidobolus*
- 2 Culms densely pubescent; male spikelets 2–7-flowered ..... ***Kulinia***
- 2\* Culms glabrous; male spikelets many-flowered ..... 3
- 3 Culms strongly flattened, male spikelets on slender pendulous or patent stalks  
..... ***Catacolea***
- 3\* Culms not flattened, male spikelets terminal or axillary on culms .....  
..... *Onychosepalum*

#### *Catacolea* B.G. Briggs & L.A.S. Johnson, gen. nov.

Plantae glabrae; culmi valde compressi; vaginae culmorum deficientes vel raro unicae; spiculae masculinae multiflorae saepe pendulae, pedunculis tenuibus; spiculae femineae pauciflorae.

Type species: *C. enodis* B.G. Briggs & L.A.S. Johnson

Dioecious. Caespitose, glabrous, with glossy dark brown to straw-coloured basal sheaths. Culms simple, strongly flattened, straight or curved, glabrous, mostly of a single internode, rarely with a persistent appressed sheath mid-culm. Inflorescence subtended by a small scarious bract. Male inflorescence terminal, of 1–several many-flowered spikelets on short slender pendulous or patent peduncles. Female inflorescence of 1 terminal spikelet with 1–several flowers and several sterile lower glumes. Flowers: tepals (4)5(6), membranous. Male flowers: stamens 3, anthers exserted. Female flowers: ovary 1-locular, style 1. Fruit a nut; shed with persistent pedicel, perianth, and stylar beak. Seed smooth, with an irregular pattern of subangular cells.

Culm flattened and lacking a central cavity; chlorenchyma not interrupted, of 1 layer of elongated peg-cells; pillar and protective cells absent, but inward-projecting epidermal cells partially lining the substomatal cavity; epidermal cells with radial walls not or scarcely sinuous but thickened on outer wall and outer part of radial walls; radially elongated epidermal cells forming mounds on the culm surface; with vascular bundles in central ground tissue. *Catacolea* is distinct in its flavonoids from allied genera (Williams et al. in press); containing quercetin, kaempferol, isorhamnetin, and gossypetin 7-methyl ether, also differing from all other members of the *Desmocladius* group of genera except *Coleocarya* in lacking flavones.

The name is from the Greek *kata-*, down, below, basal, and *coleus*, a sheath, referring to the prominent basal sheaths, whereas sheaths are lacking on the culm.

Within the *Desmocladius* group the many-flowered spikelets on slender peduncles and the broad compressed culms of *Catacolea* are distinctive. The culm nodes few or lacking further distinguish *Catacolea* from all genera except *Onychosepalum* and *Kulinia*. *Catacolea* is glabrous unlike the densely pubescent *Kulinia* and differs from the latter in the presence of tepals in female flowers.

A genus of one rare species in the south-west of Western Australia, in a seasonally dry region.

*Catacolea enodis* B.G. Briggs & L.A.S. Johnson, sp. nov.

Culmi 10–30 cm longi, 1.2–2 mm lati; spiculae masculinae floribus c. 70; spiculae femineae floribus 1–3, tepalis plerumque 5.

Type: Western Australia: E of Brand Hwy on Green Head–Coorow road, Alexander Morrison National Park, (c. 30°S, 115°30'E), B.G. Briggs 7740 & L.A.S. Johnson, 30 Sep 1984 ♀ (holo: NSW; iso K, MEL, MO, PERTH).

Forming small dense clumps of many culms, with short ascending rhizomes. Culms erect or recurved, 10–30 cm long, 1.2–2.0 mm wide, tuberculate, yellowish green. Sheaths: almost all basal, closely overlapping, persistent, glossy dark-brown to straw-coloured, outer sheaths c. 1 cm long, but inner sheaths to c. 3 cm long, with a short subulate lamina up to c. 3 mm long; cauline sheaths when present 1–1.8 cm long, loosely appressed, pale-brown, striate, with a short subulate lamina 2–3 mm long. Inflorescence subtended by a green to straw-coloured bract, 0.6–1.0 cm long, with a subulate tip 1.5–2.5 mm long. Male inflorescence of 1–3 ovoid spikelets, 7–12 mm long, 6–9 mm wide; lower 2 glumes sterile; upper c. 70 glumes fertile, 5–6 mm long, lanceolate, acuminate, smooth, scarious, golden-brown, glabrous, without a mucro or awn. Female spikelets narrow-ovoid, 13–15 mm long, 2.0–3.8 mm wide, 1–3-flowered; glumes 3–5, rigid, broad-lanceolate, mucronate, 6–7 mm long; mucro erect, 2.5–3.2 mm long, glossy, dark-brown, glabrous. Male flowers: outer tepals aristate, 3.7–4.5 mm long; inner tepals lanceolate, 2.2–3.3 mm long; filaments 3.0–4.5 mm long; anthers 1.6–2.1 mm long. Female flowers: outer tepals keeled, 5.5–7.0 mm long; inner tepals

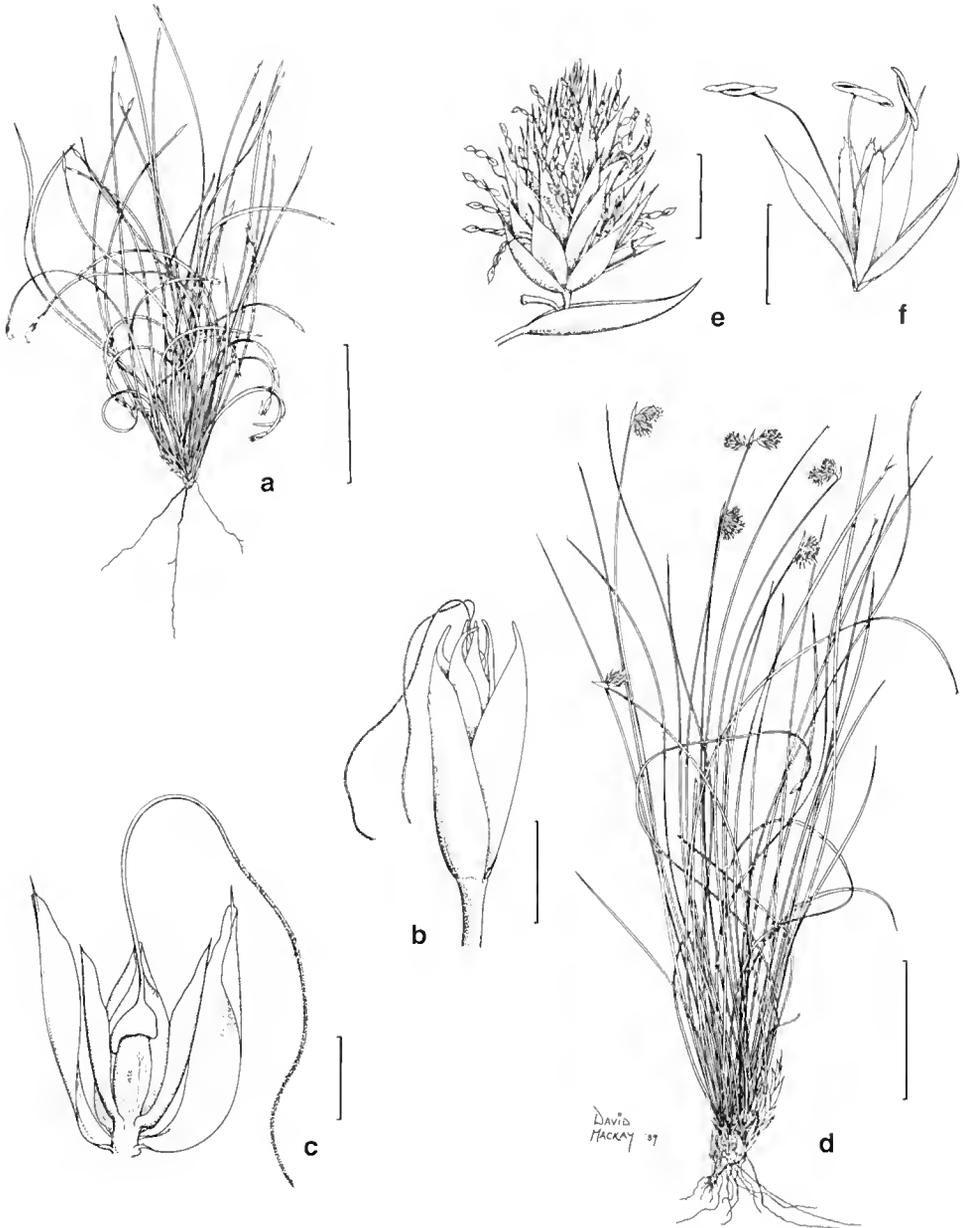


Fig. 1. *Catnacoleda enodis*. a–c, female: a, habit. b, spikelet. c, flower (holotype). d–f, male: d, habit. e, spikelet. f, flower (Briggs 7739). Scale bars: a, d = 7 cm; b, c, e, f = 2 mm.

lanceolate, 5.0–5.5 mm long. Nut 3.5–4 mm long, c. 2 mm wide. Seed smooth, ellipsoid, chestnut-brown, glossy, c. 1.8 mm long (Fig. 1).

Occurs in the Alexander Morrison National Park area, c. 200 km N of Perth, W.A., in tall heath on deep white sand over laterite.

The epithet is from the Latin *e-*, without, and *nodus*, a node, referring to the culms which mostly consist of a single internode.

**Conservation status:** Rare, vulnerable, some populations not endangered but poorly known (Meney, Pate, Dixon, Briggs & Johnson in press), Western Australian CALM Conservation Code P3, proposed ROTAP Code 2RC–.

**Specimens examined:** Western Australia: Irwin: E of Brand Highway on Green Head–Coorow road, Alexander Morrison National Park, Briggs 7728 & Johnson, 30 Sep 1984 ♂ (NSW), 7729 ♀ (NSW, K, MEL, MO, PERTH), 7729a ♀ (NSW, AD, CANB, RSA), 7730 ♀ (NSW, BRI, DNA, NBG, NY, PERTH), 7739 ♂ (NSW, AD, BRI, CANB, K, MEL, MO, NBG, PERTH), 7741 ♀ (NSW, AD, K, MEL, MO); c. 140 km NNW of Gingin, *Apliu & Coveny* 3177 ♂, ♀, 2 Sep 1970 (NSW); W of Brand Hwy on Bibby Road, Briggs 9383 & Pate, 6 Oct 1995 ♂ (NSW), Briggs 8578 & Johnson, Linder, Pate & Meney, 6 Sep 1990 ♀ (NSW, BOL, CANB, K, KPBG).

***Kulinia* B.G. Briggs & L.A.S. Johnson, gen. nov.**

Ab *Onychosepalum* combinatione characterum sequentium distinguitur: plantae dense albipubescentes, pilis basi longis; spiculae masculinae pauciflorae solitariaeque; spiculae femineae aliquot per culmum uniflorae, tepalis nullis.

Type species: *Kulinia eludens* B.G. Briggs & L.A.S. Johnson

Dioecious. Caespitose, the base densely villous with long hairs. Culms simple, terete, pubescent, with 1–3 persistent sheaths. Male inflorescence a solitary terminal spikelet, 2–7-flowered. Female inflorescence of 2 or 3 spikelets, each 1-flowered and terminal or axillary, with several sterile glumes; outer glumes with a dark rigid mucro, inner glumes membranous. Male flowers: tepals 2–5, membranous, stamens 3, anthers exerted. Female flowers lacking tepals, ovary unilocular, style 1. Fruit a thin-walled small nut.

Culms with chlorenchyma not interrupted, of 1 layer of elongated peg-cells, pillar and protective cells absent; inward-projecting epidermal cells partially lining the substomatal cavity; epidermal cells thickened on outer wall and outer part of radial walls but radial walls not sinuous; culm with vascular bundles in central ground tissue, central cavity absent but central cells thin-walled; with stalked, branched multicellular hairs. *Kulinia* has a unique flavonoid pattern among Australian Restionaceae based on chrysoeriol and flavone C-glycosides (Williams et al. in press), although the latter compounds are also found in some species of several related genera.

The name refers to Kulin, a small town east of Narrogin in Western Australia, near which the one known species occurs.

A genus of one rare species in the south of Western Australia in a seasonally dry region.

***Kulinia eludens* B.G. Briggs & L.A.S. Johnson, sp. nov.**

Culmi usque ad 15 cm longi simplices, teretes vel teretiusculi; vaginae culmorum 1–3; inflorescentiae femineae spiculis 2 vel 3.

Type: Western Australia: Kulin Nature Reserve, ESE of Kulin (c. 32°40'S, 118°20'E), B.G. Briggs 8531 & L.A.S. Johnson, 1 Nov 1988 ♀ (holo NSW; iso AD, B, BRI, K, MEL, MO, NBG, PERTH, RSA).

In small clumps to 15 cm diam., or in circular patches to 30 cm diam., sometimes dying in the centre and forming spreading rings to 50 cm diam.; with a conspicuous tuft of

long dense white hairs at the base of the culms. Culms erect or spreading, terete or almost so, often flexuose and tangled above the first internode, pubescent with dense short white hairs, the culms appearing grey-green, to 15 cm long, 0.5–1.0 mm diam.; internodes 2–4, to 10 cm long, smooth. Sheaths loosely appressed, 0.5–1.5 cm long, narrow-ovate,  $\pm$  acute, red- to pale-brown, sparsely pilose; lamina erect, c. 1 mm long. Male spikelets: narrow-elliptic, c. 4.0–5.0 mm long; subtending bract longer than spikelet; mucro 1.0–1.5 mm long; glumes 2–7, ovate-lanceolate, acute, 3.0–3.5 mm long, pale-brown with a membranous margin, glabrous or sparsely pubescent with short pilose hairs; mucro c. 0.8 mm long. Female spikelets: narrow-ellipsoid, 5.0–7.0 mm long; subtending bract longer and almost completely enclosing spikelet; mucro c. 1.0 mm long; glumes 6 or 7, narrow-ovate, acute, 3.1–4.2 mm long, brown with membranous margins, abaxial surface partially pilose; mucro to 2.2 mm long; the 2 uppermost glumes reduced, c. 2.7 mm long with a filiform base. Male flowers: lowest flower in spikelet with 5 tepals, upper flowers with 2 tepals, tepals obtuse; outer tepals narrow-lanceolate, 2.5–3.3 mm long; inner tepals linear, often twisted, 2.0–2.6 mm long; anthers 1.2–1.4 mm long. Nut: pale brown, c. 2.8 mm long including the short pedicel and beak at base of the style (Fig. 2).

The epithet refers to the species eluding us and not being found on our first attempts to locate the site of its original discovery.

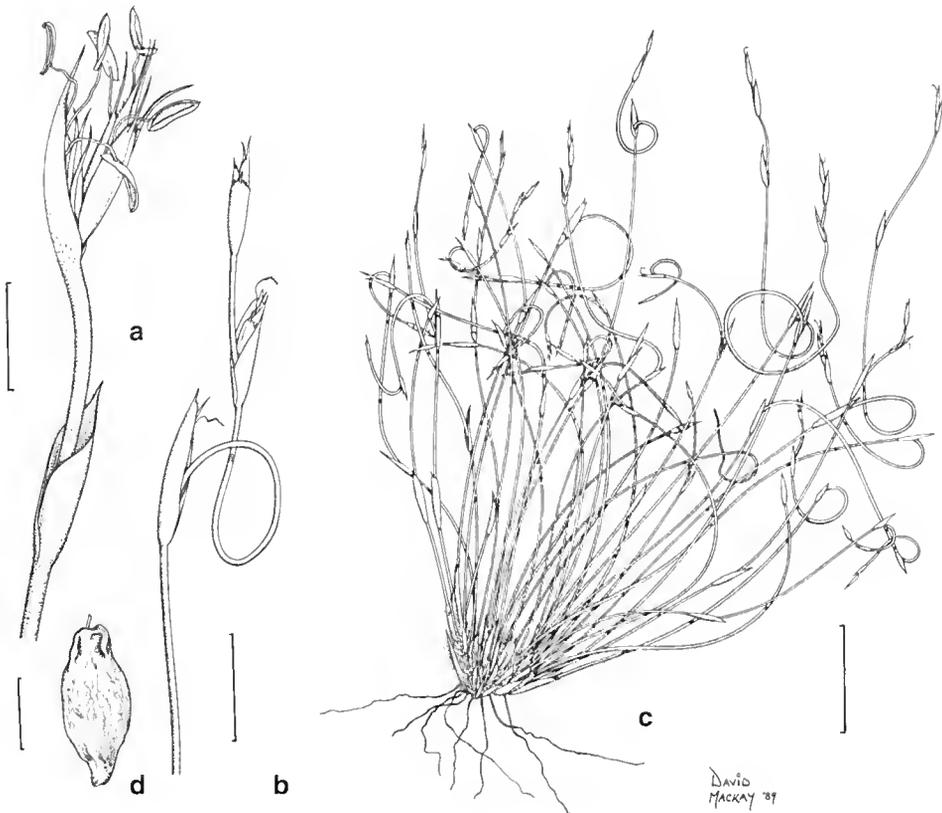


Fig. 2. *Kulinia eludens*. a, male inflorescence (Briggs 8530). b, c, female: b, inflorescence. c, habit (holotype). d, fruit (Briggs 9352). Scale bars: a = 3 mm; b = 6 mm; c = 2.5 cm; d = 1.2 mm.

Currently known only from Kulin Nature Reserve (Hopkins Reserve) and c. 27 km S of Hyden. Grows on deep pale-yellow sand in openings in open shrubland. Regenerates from seed after fire.

**Conservation status:** Rare, endangered (Meney, Pate, Dixon, Briggs & Johnson in press), ROTAP Code 2KCit (Briggs & Leigh 1996), as '*Loxocarya eludens*'.

**Specimens examined:** Western Australia: Roe: c. 25 km S of Hyden, W of Holt Rock (W of Lake King-Hyden road), Briggs 8522 & Johnson, 1 Nov 1988 ♀ (NSW); [Hopkins Reserve] SE of Kulin, R. Huatiuk 770315, 13 July 1977 ♀ (PERTH, NSW), R. Huatiuk 850001, 3 Nov 1985 ♀ (PERTH, NSW), Briggs 8530 & L.A.S. Johnson, 1 Nov 1988 ♂ (CANB, K, MO, PERTH), Briggs 9351 & Pate, 4 Oct 1995 ♂ (NSW, NBG, PERTH), 9352 ♀ (NSW, MO, PERTH).

*Loxocarya* group (Briggs & Johnson in press)

Almost all the described species of this group were included in an extremely wide and unnatural concept of *Restio*. Morphological features (when carefully investigated), anatomical, palynological and phytochemical data are all consistent in supporting the restriction of *Restio* to species of the African region, and showing that *Restio*, thus restricted, is more closely allied to other African genera than to the extra-African taxa formerly referred to *Restio* (Cutler 1969, Johnson & Briggs 1981, Linder & Ferguson 1985, Linder et al. in press, Briggs & Johnson in press, and unpublished data of Linder, Barker, Briggs and Johnson).

DNA data suggest that the *Loxocarya* group may be paraphyletic with respect to some or all of the *Winifredia*, *Desmocladus* and *Leptocarpus* groups. For the present time, however, while further investigations continue and since the present DNA data do not give conclusive evidence, the groupings recognised by Briggs & Johnson (in press) are maintained as informal categories. The DNA data also suggest that the conspicuous anatomical feature of pillar cells interrupting the chlorenchyma may be less reliable than we had originally thought and the circumscription of the *Loxocarya* group reflects the possibility that pillar cells have originally been more widespread and are now lost from genera including *Guringalia*, *Baloskion*, *Acion*, *Saropsis*, *Tremulina*, *Dielsia*, *Tyrbastes* and others.

### Key to genera of the *Loxocarya* group

- 1 Female flowers subterranean except for style and stigmatic branches which emerge above ground level; rhizome and culm bases sheathed by glossy scales; rhizomes long and slender ..... *Alexgeorgea*
- 1\* Female flowers not subterranean; rhizome and culm bases sheathed by dull or glossy scales; rhizomes long or short or plant caespitose ..... 2
- 2 Chlorenchyma continuous, not interrupted by pillar cells, girders or enlarged epidermal cells; culm usually not striate ..... 3
- 2\* Chlorenchyma interrupted by pillar cells, girders or enlarged epidermal cells; culm usually longitudinally striate ..... 6
- 3 Female flower attached to glume; capsule falling with glume and perianth attached; female flowers with 4 tepals; seeds smooth ..... *Baloskion*
- 3\* Female flower not attached to glume; capsule not falling at seed dispersal; female flowers with 6 tepals; seeds striate with longitudinal lines of convex cells ..... 4
- 4 Female spikelets with > 5 flowers; culms simple or sparingly branched; chlorenchyma 2–3 cells thick ..... *Acion*

- 4\* Female spikelets 1-flowered; culms little- or much-branched; chlorenchyma 1 cell thick ..... 5
- 5 Sheaths lax; culms repeatedly branched ..... *Guringalia*
- 5\* Sheaths appressed; culms simple below the inflorescence ..... *Saropsis*
- 6 Female spikelet structure not conspicuous (flowers singly in axil of a herbaceous bract or the glumes of the spikelet scarcely overlapping, not forming a compact spikelet), culms repeatedly branched ..... 7
- 6\* Female spikelet structure conspicuous (multi-glumed spikelets with overlapping glumes), culms simple or branched ..... 8
- 7 Rhizomatous; culms stout, 10–15 mm diam at base; female flowers singly in axils of bracts, tepals 2 or 3, reduced to minute deltoid scales c. 0.7 mm long; commonly with large galls that resemble much-enlarged spikelets ..... *Taraxis*
- 7\* Caespitose, culms not stout, 1–1.5 mm diam. at base; female flowers 1–3 in spikelets with herbaceous glumes scarcely overlapping, tepals 6, 3–4 mm long; not commonly galled ..... *Tyrbastes*
- 8 Culms flattened ..... 9
- 8\* Culms terete ..... 11
- 9 Male flowers with 2 stamens; anthers exerted; female flowers with 4 tepals ..... *Eurychorda*
- 9\* Male flowers with 3 stamens; anthers not exerted; female flowers with 6 tepals ..... 10
- 10 Ovary 3-locular; style branches 3; seed surface of subangular or slightly lobed cells in an irregular pattern ..... *Platychora*
- 10\* Ovary 2-locular; style branches 2; seed surface of rhombic cells in longitudinal lines ..... *Tremulina*
- 11 Female spikelets 1-flowered; culms dimorphic with fertile culms erect but sterile culms more branched and flexuose ..... *Loxocarya*
- 11\* Female spikelets several- or many-flowered; culms not dimorphic, simple or branched ..... 12
- 12 Male and female spikelets more than 10 mm long ..... 13
- 12\* Spikelets less than 10 mm long ..... 14
- 13 Spikelets ovoid, more than 3 mm diam.; glumes rigid and black ..... *Melanostachya*
- 13\* Spikelets cylindrical, less than 3 mm diam.; glumes scarious-membranous ..... *Dielsia*
- 14 Chlorenchyma interrupted by pillar cells; male spikelets erect and anthers exerted (in all except in *C. microcodon*) ..... *Chordifex*
- 14\* Chlorenchyma interrupted by enlarged epidermal cells; male spikelets pendulous and anthers not exerted ..... *Cytogonidium*

**Guringalia** B.G. Briggs & L.A.S. Johnson, *gen. nov.*

A *Baloskion* combinatione characterum sequentium distinguitur: culmi ramosi; spiculae femineae uniflorae, floribus tepalis 6, a glumis liberis; capsula rigidula, seminibus longitudinaliter striatis, striis e cellulis convexis serialibus constatis.

Type species: *Guringalia dimorpha* (R. Br.) B.G. Briggs & L.A.S. Johnson

Dioecious. Rhizomatous, the base pubescent. Culms repeatedly branched, erect or sinuous, glabrous; sheaths persistent, lax. Inflorescence of spikelets, terminal or axillary on culm and on short branches at several upper nodes. Male spikelets with 3–8 flowers and 7 or 8 sterile lower glumes. Female spikelets with 1 flower and 7–10 sterile lower glumes. Flowers: tepals 6. Male flowers: outer tepals keeled, keel villous; inner tepals flat; stamens 3, anthers exerted. Female flowers: outer tepals sparsely pubescent, ovary 2-locular but often 1 locus aborted, style branches 2. Fruit a firm-walled capsule. Seeds striate with longitudinal lines of convex cells.  $2n = 14$  (Briggs 1963, as *Restio dimorphus*) (Fig. 3d–3f).

Culm with chlorenchyma of 1 layer of elongated cells, not interrupted, pillar and protective cells absent, central cavity present. *Guringalia* and *Saropsis* differ from *Baloskion* in containing the flavonoids hypolaetin and sometimes flavonoid sulphates (Williams et al. in press).

The name refers to the Guringai (or Kuring-gai), a name applied to the tribal group of indigenous people of much of the region in the Central Coast of New South Wales where the only species occurs.

*Guringalia*, *Acion* and *Saropsis* resemble *Baloskion* in having culms with uninterrupted chlorenchyma. The three new genera, however, share the following features which distinguish them from *Baloskion*: female flowers free from the glume, tepals 6, capsule with a firm pericarp which is not late-dehiscent, and striate seeds. By contrast, *Baloskion* has tepals 4, capsule with a thin and papery pericarp, seed dispersal by a late-dehiscent capsule attached to the glume, and the seeds are smooth. *Acion* differs from *Guringalia* in its unbranched or sparsely branched culms and multi-flowered female spikelets. *Saropsis* differs from *Guringalia* in its appressed culm sheaths and culms unbranched below the inflorescence but with highly branched inflorescences. In addition, *Guringalia* has chlorenchyma of 2–3 layers of cells, whereas *Acion* and *Saropsis* have a single layer of elongated cells; *Baloskion* shows 1–3 layers of cells in the chlorenchyma, with different conditions in different species.

A genus of one species in the Sydney region of Eastern Australia, in well-drained or seasonally moist sites.

**Guringalia dimorpha** (R. Br.) B.G. Briggs & L.A.S. Johnson, *comb. nov.*

Basionym: *Restio dimorphus* R. Brown, Prodr.: 246 (1810).

Type citation: (J.) v.v.

Type: New South Wales: Port Jackson, *R. Brown No. 13*, 1802–5 ♀ (lecto, here selected, BM). Residual syntype: Port Jackson, *R. Brown No. 13*, 1802–5 ♂ (BM; isosyn E, MEL 15106).

**Acion** B.G. Briggs & L.A.S. Johnson, *gen. nov.*

A *Guringalia* combinatione characterum sequentium distinguitur: culmi simplices vel pauciramosi; spiculae femineae multiflorae; chlorenchyma e stratis cellularum 2 vel 3 formatum.

Type species: *Acion monocephalum* (R. Br.) B.G. Briggs & L.A.S. Johnson



Fig. 3. a–c, *Saropsis fastigiata*. a, habit (Hind 3217a). b, female inflorescence (Hartley 14290). c, male inflorescence (Constable, 16 Oct 1957). d–f, *Guringalia dimorpha*. d, habit (Constable 7306). e, female inflorescence (Johnson, 6 Nov 1948). f, male inflorescence (Benson 2358). Scale bars: a, d = 10 cm; b, c, e, f = 2 cm.

Dioecious. Rhizomatous, the rhizome pubescent. Culms unbranched or sparingly branched, erect, glabrous, sheaths persistent, lax. Inflorescence of spikelets terminal on culm or axillary at several upper nodes. Spikelets multiflowered (with 6–17 flowers and 5–20 sterile lower glumes). Flowers: tepals 6. Male flowers: outer tepals keeled, keel villous, inner tepals flat; stamens 3, anthers fully or partially exerted. Female flowers: tepals glabrous, ovary loculi and style branches 2. Fruit a firm-walled capsule. Seeds striate with longitudinal lines of convex cells.  $2n = 32$  (Briggs 1963, as *Restio monocephalus*).

Culm with chlorenchyma of 2–3 layers of elongated cells, not interrupted, pillar and protective cells absent, central cavity present. The flavonoids of *Acion* resemble those of some *Baloskion* species (Williams et al. in press).

The name is from the Greek *a-*, without, and *kion*, a pillar or column, referring to the continuous chlorenchyma of the culms, which is not interrupted by pillar cells.

Differences from related genera are given under *Guringalia*.

A genus of two species in Tasmania, in well-drained or seasonally wet sites on sand or peat.

***Acion monocephalum* (R. Br.) B.G. Briggs & L.A.S. Johnson, comb. nov.**

Basionym: *Restio monocephalus* R. Brown, Prodr.: 245 (1810).

Type citation: (D.) v.v.

Type: Tasmania: In ericetis inter Baie du nord ouest fl. Derwent, R. Brown, Apr 1804 ♀ (holo BM; probable iso K).

***Saropsis* B.G. Briggs & L.A.S. Johnson, gen. nov.**

A *Guringalia* combinatione characterum sequentium distinguitur: culmi infra inflorescentias simplices sed inflorescentiae ramosissimae; vaginae culmorum appressae; spiculae femineae uniflorae vel pauciflorae.

Type species *Saropsis fastigiata* (R. Br.) B.G. Briggs & L.A.S. Johnson

Dioecious. Rhizomatous, the rhizome short and pubescent. Culms unbranched below the inflorescence but with numerous elongated inflorescence branches, erect, glabrous, sheaths persistent, appressed. Inflorescence of narrow spikelets, terminal or axillary at many upper nodes of inflorescence branches. Male spikelets: c. 7-flowered, all glumes fertile. Female spikelets: 1-flowered, with several sterile lower glumes. Flowers: tepals 6. Male flowers: tepals glabrous, 2 outer tepals keeled; stamens 3, anthers exerted. Female flowers: tepals usually ciliate; ovary loculi and style branches 2. Fruit a firm-walled capsule. Seeds striate with longitudinal lines of convex cells.  $2n = 14$  (Briggs 1963, as *Restio fastigiatus*) (Fig. 3a–3c).

Culm with chlorenchyma of 1 layer of elongated cells, interrupted by greatly enlarged epidermal cells which meet and sometimes interrupt the parenchyma sheath opposite short sclerenchyma girders over the outer vascular bundles; pillar and protective cells absent; central cavity present. *Saropsis* and *Guringalia* differ from *Baloskion* in containing the flavonoids hypolaetin and sometimes flavonoid sulphates (Williams et al. in press).

The name is from the Greek *saron*, a broom and *opsis*, appearance, likeness, referring (as does the specific epithet of the only species) to the clustered and much-branched inflorescence branches.

Differences from related genera are given under *Guringalia*.

A genus of one species, in eastern Australia in central coastal New South Wales and also south-east Queensland; in seasonally moist sandy soils.

**Saropsis fastigiata** (R. Br.) B.G. Briggs & L.A.S. Johnson, **comb. nov.**

Basionym: *Restio fastigiatus* R. Brown, Prodr.: 246 (1810).

Type citation: (J.) v.v.

Type: New South Wales: Port Jackson, R. Brown, 1802–5 ♂ (holo BM; iso E, MEL 14868).

**Chordifex** B.G. Briggs & L.A.S. Johnson, **gen. nov.**

Rhizomata pubescentes; spiculae erectae (spiculae masculinae raro pendulae), pauciflorae vel multiflorae; tepala 5 or 6, pari extimo carinato; stamina 3, antheris exsertis (raro inclusis); loculi stylique 2 (raro 1); fructus capsulares seminibus longitudinaliter striatis, striis e cellulis convexis serialibus constatis; chlorenchyma e stratis cellularum 1–3 formatum, cellulis columnaribus interruptum.

Type species: *Chordifex steuandrus* B.G. Briggs & L.A.S. Johnson

Dioecious. Caespitose or rhizomatous, the base pubescent. Culms simple or much branched, erect or flexuose, terete, striate, glabrous or the lowest internode pubescent, with persistent appressed or lax sheaths; the lowest internode often elongated and slender. Male and female inflorescences similar, the flowers in erect spikelets (except the males pendulous in '*C. microcodon*'), terminal or several clustered in upper axils or many in a slender much-branched inflorescence; spikelets with several or many flowers and several or many sterile lower glumes. Male flowers: tepals 5 or 6, glabrous or adaxially pubescent, 2 outer tepals keeled; stamens 3, anthers exserted (except in '*C. microcodon*'); pistillode present or absent. Female flowers: tepals mostly similar to males, staminodes 0–3, loculi and style branches 2 (except reduced to 1 in '*C. leucoblepharus*' and usually in '*C. sphacelatus*'). Fruit a firm-walled capsule. Seeds striate with longitudinal lines of convex cells (sometimes imprinted with a further striate or irregular pattern) or the lines exaggerated into sharp ridges of radially elongated cells.

Culm with chlorenchyma of 1–3 layers of short peg-cells, interrupted by pillar cells opposite outer vascular bundles, protective cells absent, central cavity mostly present. The flavonoids of *Chordifex* were found to be heterogeneous (Williams et al. in press); groupings based on flavonoid patterns are not congruent with those based on morphological studies.

The name is from the Latin *chorda*, a rope or twine, and *-fex*, a maker; *Chordifex* and *Restio* both having the same meaning of 'rope-maker'.

On morphological grounds this appears to be a relatively coherent genus, despite some diversity, but DNA data suggest that it may not be monophyletic. For this reason, the type species is chosen from among those included in the DNA analyses, although this has led to the choice of a rare and, until now, undescribed species. Publication of other new combinations and the description of other undescribed species of *Chordifex* are in preparation.

Differences from some related genera are given under *Platychora*.

A genus of seventeen species of the south of Western Australia; mostly in mesic regions on soils of low fertility.

**Chordifex stenandrus** B.G. Briggs & L.A.S. Johnson, **sp. nov.**

Planta rhizomatosa; culmi simplices, 30–80 cm longi; vaginae culmorum laxae, 1–2.5 cm longae, obtusae vel truncatae, ciliatae; inflorescentiae tenues spiculis numerosis; flores masculini tepalis anguste linearibus; capsulae 3.5–4 mm longae.

Type: Western Australia: SE of Mt Lesueur, N of Jurien—Coomallo Rd on track E of Mt Lesueur, *B. Briggs 7473 & L. Johnson*, 29 Sep 1984 ♀ (holo NSW; iso AD, CANB, K, MEL, NBG, PERTH, PRE, RSA).

Rhizome horizontal, up to c. 10 cm long, 2.5–4.5 mm diam., densely pubescent, partly covered by brown to pale-brown, scarious cataphylls. Culms spaced up to c. 1 cm apart, erect, straight, terete, simple, 30–80 cm long, 1–2 mm diam., green, mostly glabrous but the lowest internodes shortly woolly pubescent; internodes several, c. 3–10 cm long. Sheaths appressed at the base, distally lax and open, narrow-obovate, 1.0–2.5 cm long, striate, pale to red-brown; apex obtuse to truncate, shortly ciliate; lamina narrow, erect, 1–2 mm long with a narrow, membranous margin. Inflorescence narrow, erect, 4–20 cm long; subtending bracts similar to culm sheaths but shorter. Male spikelets narrow-ellipsoid, 7–9 mm long, c. 2 mm wide; sterile lower glumes 5–12, fertile upper glumes 5–7; glumes narrow-lanceolate, light- to dark-brown, glabrous, acuminate, 6.0–7.5 mm long. Female spikelets narrow-obovoid to campanulate, 9–12 mm long, 2–4 mm wide; sterile lower glumes 4–8, fertile upper glumes 2–3, narrow-elliptical, light- to dark-brown, glabrous, mucronate, 7–9 mm long; mucro dark-brown, 0.5–1.0 cm long. Male flowers: tepals 5 or 6, narrow linear, membranous, brown; outer tepals sparsely pubescent, 5–6 mm long; inner tepals flat, glabrous, 4.0–4.5 mm long; filaments 5–6 mm long; anthers c. 2.4 mm long; pistillode minute. Female flowers: tepals 5, narrow-lanceolate; outer tepals 6–7 mm long; inner tepals 4–5 mm long; staminodes 3; ovary 2-locular, but sometimes only 1 locule developing. Capsule c. 3.5–4 mm long, smooth, brown. Seeds oblong, c. 1.9 mm long; the surface white, colliculate (Fig. 4).

Occurs in the Mt Lesueur district, inland from Jurien. Grows in intermittently moist watercourses in heath on yellow sand with some lateritic gravel washed from nearby hills.

**Conservation status:** Rare, vulnerable (Meney, Pate, Dixon, Briggs & Johnson in press), ROTAP Code 2KC– (Briggs & Leigh 1996), as '*Restio stenandra*'.

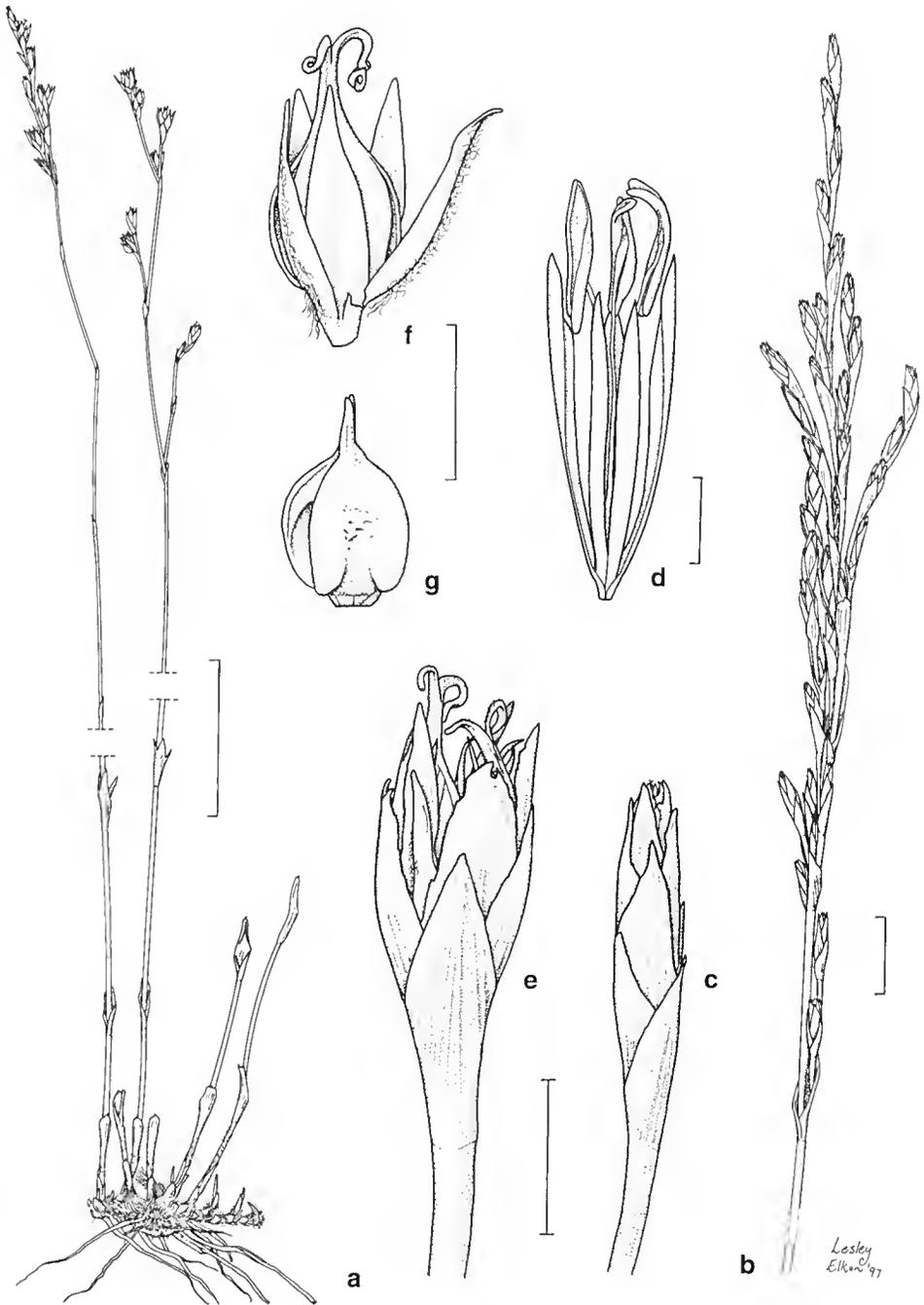
**Specimens examined:** Western Australia: Irwin: W of Brand Hwy on Green Head Rd from 'Half Way' Roadhouse, c. 30 km (direct) S of Eneabba, *Briggs 8601, Johnson, Meney, Pate & Linder*, 7 Sep 1990 ♂ (NSW, BOL), 8602 ♀, (NSW, BOL); N of Mt Benia and ENE of Mt Lesueur, NE of Jurien, *Griffin 2300*, 21 Sep 1979 ♂ (PERTH); hill NE of Mt Lesueur, NE of Jurien, *Griffin 2534*, 17 Nov 1979 ♂ (PERTH), 2535 ♀ (PERTH); SE of Mt Lesueur, N of Jurien—Coomallo Rd on track E of Mt Lesueur, *Briggs 7474 & Johnson*, 29 Sep 1984 ♀ (NSW, K, MO, PERTH), 7475 ♂ (NSW, CANB, PERTH, PRE, RSA), 7476 (galled, NSW, NBC, PERTH), 7477 ♂ (NSW, NBG, CANB); Brand Hwy, N of Jurien turn-off, *Meney 3892*, 16 Sep 1992 (voucher for DNA sample, grown from tissue culture from wild source) (NSW); Brand Hwy, N of Jurien turn-off (near Tootbardi Farm), c. 30 km (direct) NNW of Badgingarra, *Briggs 8587, Johnson, Meney, Pate & Linder*, 6 Sep 1990 ♀ (NSW, BOL, NBG, RSA).

**Eurychorda** *B.G. Briggs & L.A.S. Johnson, gen. nov.*

Plantae caespitosae; vaginae culmorum appresae; antherae exsertae; chlorenchyma cellulis columnaris interruptum. A *Chordifex* distinguitur culmis valde compressis, testa e cellulis subangularibus planiusculis haud serialibus constata.

Type species: *Eurychorda complanata* (R. Br.) B.G. Briggs & L.A.S. Johnson

Dioecious. Caespitose, the base pubescent in the axils of glabrous cataphylls. Culms simple, erect, striate, strongly compressed, edges of culms minutely scabrid, glabrous, with persistent appressed herbaceous sheaths with obtusely angled auriculate apices. Male and female inflorescences similar, with erect spikelets on slender peduncles, solitary or a few together at several upper nodes. Male spikelets: with 30–50 flowers and several sterile lower glumes. Female spikelets: flowers 5–13, with several sterile lower glumes; glumes aristate. Flowers: tepals 4, outer tepals keeled and sparsely pubescent. Male flowers: stamens 2, anthers exserted. Female flowers: ovary 2-locular,



**Fig. 4.** *Chordifex stenandrus*. **a**, habit (holotype). **b–d** male: **b**, inflorescence. **c**, spikelet. **d**, flower, (Briggs 7475). **e–h** female: **e**, spikelet. **f**, fruit with perianth, (Briggs 7474). **g**, fruit (Briggs 8587). Scale bars: **a** = 5 cm; **b–c**, **e** = 4 mm; **d**, **f–g** = 1 mm.

style branches 2. Fruit a capsule. Seeds with irregular pattern of subangular or slightly lobed, flat or slightly convex, isodiametric cells.  $2n = 24$  (Briggs 1963, as *Restio complanatus*) (Fig 5a–c).

Culm with chlorenchyma of 1–2 layers of short peg-cells, interrupted opposite some outer vascular bundles by pillar cells (1 or 2 together as seen in transverse section); girders and protective cells absent; central cavity present. *Eurychorda* shows a flavonoid pattern distinct from that of *Chordifex* and other allied genera (Williams et al. in press), including triclin and gossypetin as well as the more widely found luteolin.

The name is from the Greek *eurys*, broad or wide, and *chorde*, rope, referring to the broad, flattened culms.

Differences from related genera are given under *Platychorda*.

One species of eastern Australia from southern Queensland to Tasmania, in wet or seasonally wet sites.

***Eurychorda complanata* (R. Br.) B.G. Briggs & L.A.S. Johnson, comb. nov.**

Basionym: *Restio complanatus* R. Brown, Prodr.: 245 (1810).

Type citation: (J.) v.v.

Type: New South Wales: Port Jackson, R. Brown 1802–5 ♂ (lecto, here selected, BM [mounted with some ♀ pieces]; isolecto E). Residual syntypes: Port Jackson, R. Brown 1802–5 ♀ (BM); Derwent, R. Brown ♀ (BM; isosyn E).

***Platychorda* B.G. Briggs & L.A.S. Johnson, gen. nov.**

A *Chordifex* combinatione characterum sequentium distinguitur: culmi compressi; antherae inclusae; loculi stylique 3; testa e cellulis subangularibus planiusculis haud serialibus constata; chlorenchyma costis sclerenchymatis interruptum, cellulis columnaribus nullis.

Type species: *Platychorda applanata* (Spreng.) B.G. Briggs & L.A.S. Johnson

Dioecious. Caespitose, the base pubescent in the axils of glabrous cataphylls. Culms unbranched below the inflorescence, erect, striate, compressed, without scabrid edges, glabrous, with persistent appressed scarious or membranous sheaths with gradually tapering auriculate apices. Male and female inflorescences similar, spikelets at several or many nodes of slender branches, erect or the males somewhat pendulous; the branches singly or in clusters at several upper nodes. Spikelets with several flowers and many sterile lower glumes; glumes blunt or acute. Flowers: tepals 6, 2 outer tepals keeled. Male flowers: stamens 3, anthers not exerted. Female flowers: ovary 3-locular, style branches 3. Fruit a capsule. Seeds with irregular pattern of subangular or slightly lobed, flat or slightly convex, isodiametric cells (Fig. 5 d–g).

Culm with chlorenchyma of 2–3 layers of short peg-cells; interrupted opposite outer vascular bundles by narrow, radially elongated sclerenchyma girders; pillars and protective cells absent; central cavity present. *Platychorda* shows a flavonoid pattern distinct from that of *Chordifex* and other allied genera (Williams et al. in press), including apigenin as well as the more widely found luteolin.

The name is from the Greek *platys*, broad, flat, and *chorde*, rope, referring to the broad and somewhat flattened culms.

*Platychorda* differs from *Chordifex*, *Eurychorda*, and *Tremulina* in retaining 3 loculi and 3 style branches. Tepal number is reduced to 4 in *Eurychorda*, but is 5 or 6 in the other genera. Seed surfaces show marked differences: *Chordifex* has striate seeds with lines of strongly convex cells, *Tremulina* has a distinctive regular pattern of flat rectangular

cells (remarkably similar to that of *Dielsia*), while the other two genera have an irregular pattern of subangular flat or slightly convex cells. *Chordifex* and *Eurychorda* have pillar cells interrupting the chlorenchyma (generally opposite all outer vascular bundles in *Chordifex* but only some vascular bundles in *Eurychorda*), whereas pillars are lacking in *Platychora* and *Tremulina*, in which the chlorenchyma is interrupted by sclerenchyma girders.

A genus of two species (one undescribed) of the south-west of Western Australia, in wet or seasonally wet sites.

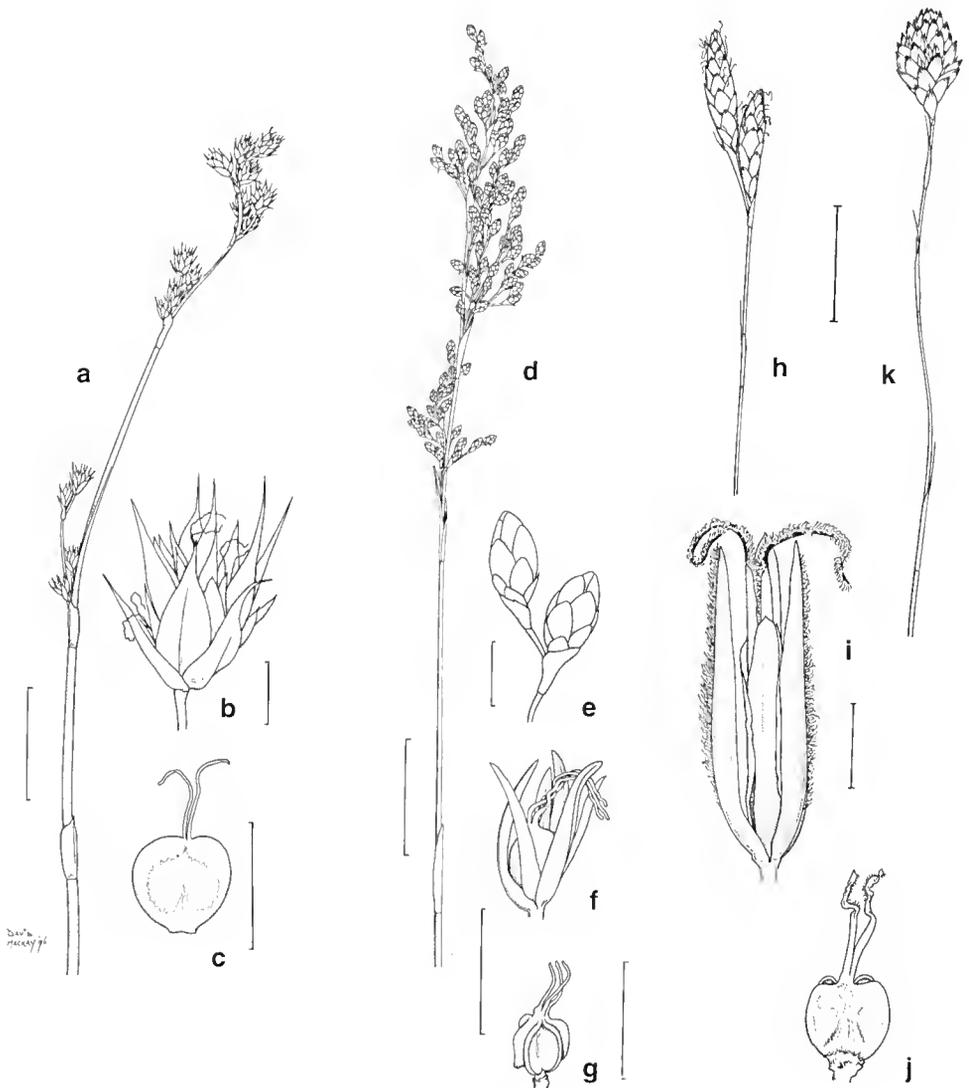


Fig. 5. a–c, *Eurychorda complauata*, female: a, inflorescence. b, spikelet. c, fruit (Lyne 357). d–g, *Platychora applanata*, female: d, inflorescence. e, spikelets. f, young fruit. g, old fruit (Briggs 8642). h–k, *Melanostachya ustulata*, h–j, female: h, spikelets. i, female flower. j, fruit (Jackson, Jan 1913). k, male spikelet (Briggs 785). Scale bars: a, d = 2 cm; b, c, e–g = 2 mm; h, k = 1 cm; i, j = 1 mm.

**Platychora applanata** (Spreng.) B.G. Briggs & L.A.S. Johnson, **comb. nov.**

Basionym: *Restio applanatus* Sprengel, Syst. Veg. 1: 185 (1825) = *Restio compressus* R. Brown, Prodr.: 245 (1810) nom. illeg., non Rottboell, Descr. icon. rar. pl. (1773).

Type citation: (M) v.v.

Type: Western Australia: KGS [King Georges Sound], R. Brown (Bennett 5863), 1802–5 ♀ (lecto, here selected, BM). Residual syntype: KGS, R. Brown 1802–5 ♂ (BM, 2 sheets).

**Tremulina** B.G. Briggs & L.A.S. Johnson, **gen. nov.**

A *Chordifex* combinatione characterum sequentium distinguitur: culmi plus minusve compressi; spiculae pedunculis tenuibus; tepala 6; antherae inclusae; testa e cellulis rectangularibus serialibus constata; chlorenchyma costis sclerenchymatis interruptum, cellulis columnaribus nullis.

Type species: *Tremulina tremula* (R. Br.) B.G. Briggs & L.A.S. Johnson

Dioecious. Caespitose, the base pubescent but cataphylls glabrous. Culms unbranched or sometimes dimorphic with repeatedly branched sterile culms and taller less branched fertile culms, erect, strongly compressed or terete, without scabrid edges, striate, glabrous or the lowest internode pubescent with branched multicellular hairs; sheaths persistent, appressed, with blunt auriculate apices. Male and female spikelets terminal or at a few nodes on slender lateral branches borne singly or in clusters at several upper culm nodes; spikelets erect or the males pendulous. Male spikelets with 10–50 flowers; female spikelets with 1–8 flowers; both with several sterile lower glumes; glumes blunt or acute, not auriculate. Flowers: tepals 6, 2 outer tepals keeled. Male flowers: stamens 3, anthers not exerted. Female flowers: ovary 2-locular, style-branches 2. Fruit a capsule. Seeds with longitudinal lines of flat, rectangular or rhombic cells which are transverse or oblique to the long axis.

Culm with chlorenchyma of 3–4 layers of short palisade cells, interrupted opposite some outer vascular bundles by sclerenchyma girders; pillars and protective cells absent; central cavity present. *Tremulina* shows a flavonoid pattern distinct from that of *Chordifex* and other allied genera (Williams et al. in press), including chrysoeriol as well as the more widely found luteolin.

The name is from the Latin *tremulus*, shaking, quivering, and *-ina*, a diminutive suffix, referring to the spikelets (especially on male plants) on long slender stalks and to the epithet of the type species.

Differences from related genera are given under *Platychora*.

A genus of two species (one undescribed) of the south-west of Western Australia, in wet or seasonally wet sites.

**Tremulina tremula** (R. Br.) B.G. Briggs & L.A.S. Johnson, **comb. nov.**

Basionym: *Restio tremulus* R. Brown, Prodr.: 245 (1810).

Type citation: (M.) v.v.

Type: Western Australia: King George III Id Sd [Sound], R. Brown 1802–5 ♂ (lecto, here selected, BM, photo NSW; isolecto K). Residual syntype: King George III Id Sd [Sound], R. Brown 1802–5 ♀ (BM, mounted on same sheet as holo).

**Melanostachya** B.G. Briggs & L.A.S. Johnson, **gen. nov.**

A *Chordifex* combinatione characterum sequentium distinguitur: spiculae magnae; carinae tepalorum exteriorum dense rufopubescentes; testa e cellulis planis elongatis

parietibus sinuatis constata; chlorenchyma cellulis epidermalibus dilatatis interruptum, cellulis columnaribus nullis.

Type species: *Melanostachya ustulata* (F. Muell. ex Ewart & Sharman) B.G. Briggs & L.A.S. Johnson

Dioecious. Caespitose, the base pubescent. Culms terete, simple or occasionally with 1 or 2 branches, glabrous, striate, with persistent appressed sheaths. Male and female inflorescences similar, of large erect spikelets terminal or 2 or 3 at upper nodes, the spikelets with 10–20 flowers and several sterile glumes toward both base and apex; the glumes rigid, dark brown or black, obtuse or with a short rigid acute tip. Flowers: tepals 6, 2 outer tepals keeled and with dense red-brown hairs along the keel toward the apex, inner tepals flat. Male flowers: stamens 3, anthers exerted. Female flowers: ovary loculi and style-branches 2. Fruit a capsule. Seeds broad-ellipsoid, with longitudinally elongated cells with sinuous walls (Fig. 5h–k).

Culm epidermis with greatly enlarged tanniferous cells opposite outer vascular bundles; enlarged epidermal cells that extend to (and interrupt) the parenchyma sheath over sclerenchyma girders opposite the outer vascular bundles alternating with ones that extend only part-way through the chlorenchyma; chlorenchyma of 1 layer of elongated peg-cells, pillar and protective cells absent, central cavity present. *Melanostachya* shows a flavonoid pattern distinct from that of *Chordifex* and other allied genera (Williams et al. in press), including hypolaetin and flavone C-glycosides, as well as the more widely found luteolin.

A genus of one species, of the south-west of Western Australia; in wet or seasonally wet sites.

*Melanostachya ustulata* (F. Muell. ex Ewart & Sharman) B.G. Briggs & L.A.S. Johnson, **comb. nov.**

Basionym: *Restio ustulatus* F. Muell. ex Ewart & Sharman, Proc. Roy. Soc. Victoria 28: 237, t. XXVI, Figs 12–19 (1916).

Type (not cited in protologue [Ewart & Sharman 1916]): Western Australia: [probably Geographe Bay distr.], *Mrs Irvine*, labelled 'The ♀ plant exhibited at Royal Society Nov. 1915' ♀ (lecto, here selected, MEL 14812 p.p., ♀ piece on left of sheet). Residual syntypes: (MEL 14812 p.p.); Blackwood R., *J. Forrest* 'Exhibited at Royal Society Nov 1915' ♂ (MEL 14811, BM). Probable syntypes: *Forrest* ♂ (MEL 14813, 14815); *Drummond* 65 ♂ (MEL 14814).

*Cytogonidium* B.G. Briggs & L.A.S. Johnson, **gen. nov.**

A *Chordifex* combinatione characterum sequentium distinguitur: spiculae masculinae pendulae ramulis tenuibus; antherae inclusae; chlorenchyma cellulis epidermalibus valde dilatatis interruptum, cellulis columnaribus nullis.

Type species: *Cytogonidium leptocarpoides* (Benth.) B.G. Briggs & L.A.S. Johnson

Dioecious or populations parthenocarpic and female only. Caespitose, the base pubescent. Culms terete, simple or sparsely branched, glabrous, striate, with persistent appressed sheaths. Male and female spikelets very different in appearance; solitary or several together at 1 or several upper nodes. Male spikelets pendulous on slender pedicels, with spreading lanceolate, acute glumes, 30–50 flowers and 1 or 2 sterile lower glumes. Female spikelets erect, ovoid, with broad ovate aristate glumes, 5–10 flowers and often 1–3 sterile lower glumes. Flowers: tepals 5, 2 outer tepals keeled and in females with dense red-brown hairs along the keel; inner tepals flat. Male flowers: stamens 3, anthers not exerted. Female flowers: ovary loculi and style-

branches 2. Fruit a capsule. Seeds broad-ellipsoid, surface covered with convex cells in irregular longitudinal lines (not separated by lines of flat cells as in *Chordifex*).

Culm with chlorenchyma of 1 layer of elongated peg-cells, interrupted by greatly enlarged epidermal cells that extend outwards overarching the stomates and that mostly extend inwards to (and often interrupt) the parenchyma sheath over sclerenchyma girders opposite the outer vascular bundles, pillar and protective cells absent, central cavity present. *Cytogonidium* is similar in its flavonoids (including only hypolaetin) to *Dielsia*, *Loxocarya cinerea* and some *Chordifex* species (Williams et al. in press).

The name is from the Greek *cyto*,- relating to a cell, *gonia*, an angle or corner, and *-idion*, a diminutive suffix, referring to the lines of greatly enlarged cells that give the culms a striate appearance.

*Cytogonidium* is characterised by male spikelets pendulous on slender branches, anthers not exerted, and by the greatly enlarged epidermal cells that interrupt the chlorenchyma and parenchyma sheath and give a striate appearance to the culms.

A genus of one species of the south-west of Western Australia; in moist or seasonally moist sites.

***Cytogonidium leptocarpoides* (Benth.) B.G. Briggs & L.A.S. Johnson, comb. nov.**

Basionym: *Restio leptocarpoides* Bentham, Fl. Austral. 7: 229 (1878) = *R. deformis* sensu Mueller, Fragn. 8: 65 (1873), non R. Br.

Types: Western Australia: *Drummond 1st coll.* 907 ♀ (lecto, here selected, MEL 14770; isolecto BM). Residual syntypes: Busselton, *Pries* ♀ (MEL 14768, 14769); Swan River, *Drummond 1st coll.* 381 ♂ (CGE, MEL 14763), 369 ♀ (MEL 14766, 14772, LUND). The lectotype is chosen from among specimens cited by Mueller, excluding Mueller's own collection from 'Circum montes Stirlingi' which Bentham regarded as possibly a separate variety of this species, and also excluding '*Drummond 869*' since this appears to be a misreading of '369'.

***Taraxis* B.G. Briggs & L.A.S. Johnson, gen. nov.**

A *Chordifex* et *Tyrbastes* combinatione characterum sequentium distinguitur: rhizomata glabrata; spiculae femineae uniflorae glumis tepalisque ad squamas reductis, ovariis uniloculatis; a *Chordifex* item distinguitur habitu serpenti et stylis plerumque 3.

Type species: *Taraxis grossa* B.G. Briggs & L.A.S. Johnson

Dioecious. Rhizomatous, rhizome stout, glabrous except for tufts of hairs in the cataphyll axils. Culms stout near base, much branched, upper branches slender, flexuose, forming tangled masses, terete to compressed, striate, glabrous except in sheath axils, with appressed, persistent sheaths. Male spikelets in small clusters at several upper nodes. Female spikelets solitary at several upper nodes. Male spikelets 4–13-flowered, glumes mostly fertile. Female spikelets 1-flowered. Male flowers: tepals 5(or 6), 2 outer tepals keeled, inner tepals flat; stamens 3, anthers exerted. Female flowers: glumes and tepals reduced to very small membranous scales; ovary unilocular, laterally thickened on two edges, style branches (2)3, shortly connate. Fruit and seeds not known.

Chlorenchyma of 1 layer of elongated peg-cells interrupted by pillar cells over some outer vascular bundles, protective cells lacking; central cavity lobed or angular in the lower culm resulting from inner vascular bundles arranged in large aggregations that are separated by a broad band of sclerenchyma from the outer vascular bundles. *Taraxis* resembles *Tyrbastes* in having a basic luteolin/hypolaetin flavonoid profile but contains free luteolin and lacks triclin (Williams et al. in press).

The name is from the Greek *taraxis*, a confusion, disturbance or trouble, referring to the habit, with tangled masses of culms, and to the confusion that has existed in the classification of this and allied taxa.

Resembling *Tyrbastes* in its trailing and repeatedly branching habit but differing in its long stout rhizomes, 1-flowered female spikelets, greatly reduced glumes and tepals, chlorenchyma (especially in the slender upper branches) interrupted by pillar cells; and in the distinctive grouping of culm vascular bundles, resulting in a lobed central cavity.

A genus of one previously undescribed species of the south-west of Western Australia, in a region of high rainfall.

***Taraxis grossa* B.G. Briggs & L.A.S. Johnson, sp. nov.**

Culmi 0.5–2 m longi, implicati, 4–7 mm diam. crassi versus bases; plantae plerumque cecidiophorae, gallis (10–)15–22 mm longis spiculis simulantibus.

Type: Western Australia: Carey Brook, Pemberton–Nannup Rd (E border of Manjimup Shire), W.A., 34°25'S 115°49'E, 14 Oct 1992, B.G. Briggs 9074 & K. Meney ♂ (holo NSW; iso K, MO, PERTH).

Rhizome stout, long creeping or ascending, 5–7 mm diam., with a tuft of hairs in scale axil. Culms stout, rigid, erect, forming large tangled masses to 2 m tall, yellowish-green, 0.5–1.7 m long; 4–7 mm diam. at the base; tapering apically, flexuose, diam. decreasing to c. 0.5 mm. Sheaths green to brown or straw-coloured; 1.5–3.0 cm long near the base; c. 0.5 cm long on the branches; lamina erect, terete, 1–3 mm long with pale membranous margins. Spikelets in the upper axils, males mostly in small clusters, females singly; subtending bracts: males c. 3–5 mm long, acute with a mucro to 4.0 mm long; females c. 8 mm long, 2 mm wide, acute. Male spikelets ellipsoidal, 3.3–7.0 mm long; glumes 4–13, acute to mucronate, keeled, 2.8–4.0 mm long, purplish to green to straw-coloured, mostly glabrous, or basally pubescent with long white hairs; mucro to 2.2 mm long. Female spikelets: 1-flowered, only the stigmas emerging from the subtending bract. Male flowers: tepals 5(6), lanceolate, acute; outer tepals slightly longer, 2.4–3.2 mm long; filaments 3–5 mm long; anthers 1.2–2.0 mm long. Female flowers: glumes apparently represented by 2 or 3 membranous, ovate scales c. 0.3 mm long; tepals deltoid c. 0.7 mm long; style branches fused 1/8–1/2 of length. Fruit and seeds rarely produced and not seen. Most plants bearing numerous large galls that resemble spikelets, 1.2–3.5 cm long with c. 80 sterile 'glumes', the 'glumes' 6–15 mm long, narrow elliptic, acuminate, green or straw-coloured (Fig. 6a–c, 7a).

Occurs in the south-west of Western Australia near Dwellingup and from the Busselton district to near Walpole, in a region of high rainfall, on seasonally or permanently wet sands and peats in swamps and along stream banks. Regenerates after fire or damage by resprouting.

**Conservation status:** Relatively common; not considered to be at risk (Meney, Pate & Hickman in press), although some populations are remnants in areas subject to clearing and eutrophication.

**Selected specimens examined:** Western Australia: Darling: Dwellingup district, *Stoate*, Sep 1935 ♂ (PERTH); Jindong, Busselton district, *Royce*, 4601 ♂ 4602 ♀, 20 Oct 1953 (PERTH); Carburnup, *Keighery & Gibson 1008*, 15 Oct 1992 ♂ (PERTH, NSW); Carburnup River, 2 km S of Jindong, *Briggs 8329b*, 26 Oct 1988 ♀ (NSW); Barlee Brook, 34 km SSE of Nannup, *Briggs 7597 & Johnson*, 6 Oct 1984 ♂ (NSW, AD, BRI, DNA, NBC, NY, PERTH, RSA); c. 5 km E of Karridale, 3.7 km S of Brockman Hwy on Glenarty Rd, *Briggs 8366 & Johnson*, 27 Oct 1988 ♂ (NSW); Carey Brook, Pemberton–Nannup road, *Briggs 9075 & Meney*, 14 Oct 1992 ♀ (NSW); Brennans Ford, Scott R., *Keighery 1871b*, 3 Nov 1978 ♂ (PERTH); Shannon River, c. 22 km E of Northcliffe, *Pullen 9945*, 10

Dec 1974 ♂ (CANB, BRI, NSW); 1.7 km W of Walpole, *Briggs 7604 & Johnson*, 7 Oct 1984 ♂ (NSW, AD, CANB, K, MEL, MO, PERTH); Walpole River, 1 mile [1.5 km] SW of Walpole, *Briggs 653*, 18 Sep 1966 ♂ (NSW, CANB); near bridge on road to Pt. Nuyts, *Wrigley*, 14 Oct 1968 (CBG, NSW); Bow R., *Jackson*, Nov 1912 (NSW); 2 miles [3 km] S of Bow Bridge, on Peaceful Bay road, 12 miles [19 km] E of Walpole, *Briggs 635*, 17 Sep 1966 ♂ (NSW, BRI, PERTH), 636 ♂ (NSW, K).

*Tyrbastes* B.G. Briggs & L.A.S. Johnson, gen. nov.

A *Taraxis* combinatione characterum sequentium distinguitur: plantae caespitosae, basibus pubescentes; spiculae femineae floribus 1 usque ad pluribus, tepalis 6, loculis 2 vel 3; chlorenchyma costis sclerenchymatis et cellulis epidermalibus dilatatis interruptum, sine cellulis columnaribus.



Fig. 6. a-e, *Taraxis grossa*, a-b, male: a, habit. b, spikelets (*Briggs 9074*). c-e, female: c, gall. d, e, spikelets (varying in number of style-branches) (*Briggs 9075*). f-h, *Tyrbastes glaucescens*, f, male spikelets (*Briggs 8337*). g, h, female: g, spikelet (*Briggs 9056*). h, habit, (*Briggs 8645*). Scale bars: a, h = 10 cm; b-g = 1 cm.

Type species: *Tyrbastes glaucescens* B.G. Briggs & L.A.S. Johnson

Dioecious. Caespitose, the base pubescent. Culms slender, erect or trailing, flexuose and much-branched, often forming tangled masses, terete to compressed, striate, glabrous except in sheath axils, with appressed, persistent sheaths. Inflorescences of spikelets mostly singly at the upper nodes. Male spikelets of several or many flowers. Female spikelets with 1–several flowers. Male flowers: tepals 6, 2 outer tepals keeled, inner tepals flat; stamens 3, anthers exerted. Female flowers: tepals 6, outer tepals longer than inner; ovary loculi and style-branches 2(3), branches shortly connate. Fruit a thin-walled capsule. Seed ellipsoid, with distinctive pattern of slightly convex, slightly lobed cells in indistinct rows.

Culms with enlarged epidermal cells interrupting the chlorenchyma and meeting the parenchyma sheath over low girders opposite some outer vascular bundles; chlorenchyma of 2–3 layers of short peg-cells; pillars and protective cells lacking; central cavity present (not lobed). In flavonoid constituents *Tyrbastes* is similar to the morphologically very different *Alexgeorgea*; it also resembles *Taraxis* in having a basic luteolin/hypolaetin flavonoid profile but contains triclin and lacks free luteolin (Williams et al. in press).

The name is from the Latin *tyrbastes*, a trouble-maker or agitator, referring to the difficulty we have had in determining the affinities of the genus.

Similar in general appearance to *Taraxis* but differing in the caespitose habit, pubescent base, female spikelets usually of several flowers (but the axis extended so that the glumes do not form a compact spikelet), well developed tepals, ovary 2- or 3-locular, chlorenchyma interrupted by sclerenchyma ribs and enlarged epidermal cells but without pillar cells; also generally lacking the galls that are such a prominent feature of *Taraxis*.

A genus of one species of the south-west of Western Australia, in a region of high rainfall.

***Tyrbastes glaucescens* B.G. Briggs & L.A.S. Johnson, sp. nov.**

Culmi erecti, ramosissimi, implicati, 0.3–1 m longi, 1.0–1.5 mm diam. versus bases; spiculae masculinae 4–7.5 mm longae; flores femineae tepalis 3–4 mm longis.

Type: Western Australia: Brockman Highway, c. 11 km E of Alexandra Bridge, 8.6 km W of junction with Sues Rd, 34°09'S 115°24'E, B.G. Briggs 8645, L.A.S. Johnson, K. Meney, J. Pate & P. Linder, 10 Sep 1990 ♀ (holo NSW; iso CANB, K, MEL, PERTH).

Plant tufted; with scales covering a pale woolly pubescence. Culms erect or spreading, flexuose, minutely dotted with tanniferous cells, dull-grey to green or yellowish, 0.3–1.0 m long; 1.0–1.5 mm diam. basally, upper branches 0.5–1 mm diam. Sheaths 0.5–2.0 cm long, green to light-brown or often speckled; mucro narrow, compressed to terete, to 2–3 mm long, occasionally longer; margin narrow, caducous, membranous. Spikelets sessile or on short pedicels at upper nodes; subtending bracts green to light-brown, with a reddish tinge when young, 2.5–4.5 mm long; mucro erect, terete, to 3 mm long. Male spikelets narrow-ovoid, 4.0–7.5 mm long; glumes 4–10(–24), mostly fertile, mucronate, green to golden-brown with a reddish apex, glabrous, 1.7–2.5 mm long; mucro, short, blunt, c. 0.5–1.4 mm long. Female spikelets when 1-flowered usually with 1–several abortive flowers below or above the fertile flower, often with an elongated axis so that the glumes do not overlap; glumes mostly subtending a flower or abortive flower, narrow-ovate, acute to subulate, herbaceous, green or pale-brown, glabrous, 5.0–6.0 mm long, mucro to 2.2 mm long, the axis with 2 membranous narrow-linear glumes 4 mm long. Male flowers: outer tepals narrow-lanceolate, 1.8–3.2 mm long; inner tepals ± lanceolate, c. 2.0–2.5 mm long; filaments 2.5–3.5 mm long, to c. 0.3 mm wide; anthers 1.2–1.6 mm long. Female flowers: outer tepals c. 4 mm

long, narrow-linear, hyaline; inner tepals narrow oblong, hyaline, acute, 3–4 mm long; staminodes sometimes present, c. 0.5 mm long. Capsule 2.0–2.5 mm long, dark brown. Seed 1.0–1.3 mm long (Fig. 6 f–h, 7b, c).

Occurs in the south-west of Western Australia near Collie and from the Busselton district to Albany, in a region of high rainfall, on seasonally or permanently wet sands and peats in swamps and along stream banks. Regenerates by seed after fire.

**Conservation status:** Relatively widespread and common although some populations are remnants in areas subject to clearing and eutrophication.

**Selected specimens examined:** Western Australia: Darling: Harris River, 3 km S of Collie, *Briggs* 6707, 10 Oct 1976 ♀ (NSW, PERTH), 6709 ♂ (NSW, AD, PERTH); Carburnup River, 1.5 miles [2 km] SW of Jindong, Busselton district, *Briggs* 873a, 20 Sep 1966 ♂ (NSW, CANB, K, MO, NY, PERTH); The Rapids, Margaret R., *Briggs* 8337 & *Johnson*, 26 Oct 1988 ♂ (NSW), 8338, ♀ (NSW, B, L, PERTH); Black Point Rd, 9 km SW of Fouracres Rd, *Gibson & Lyons* 113, 5 Apr 1991 ♀ (PERTH); Brennans Ford (Scott River crossing), ENE of Augusta, *Strid* 21414, 16 Nov 1982 ♂ (PERTH, NSW); Gingilup Swamps Nature Reserve, *Gibson & Lyons* 567, 18 Apr 1991 ♀ (PERTH); Walpole River, 1 mile [1.5 km] SW of Walpole on west bank, *Briggs* 655, 18 Sep 1966 ♂ (NSW, K, MO, MEL, NBC, NY, PERTH); Bow R., *Jackson*, Jan 1913 ♀ (NSW); W side of Bow River at Bow Bridge, *Briggs* 6543, 3 Oct 1976 ♂ (NSW, CANB, MEL, PERTH); west shore of King Georges Sound, c. 5 miles [9 km] from Albany, *K. Mair* E26, Oct 1965 ♂ (NSW).

***Leptocarpus* group** (Briggs & Johnson in press)

All species of this group were formerly included in the genera *Leptocarpus* and *Hypolaena*. DNA sequence data (Briggs, Marchant, Gilmore & Porter unpublished

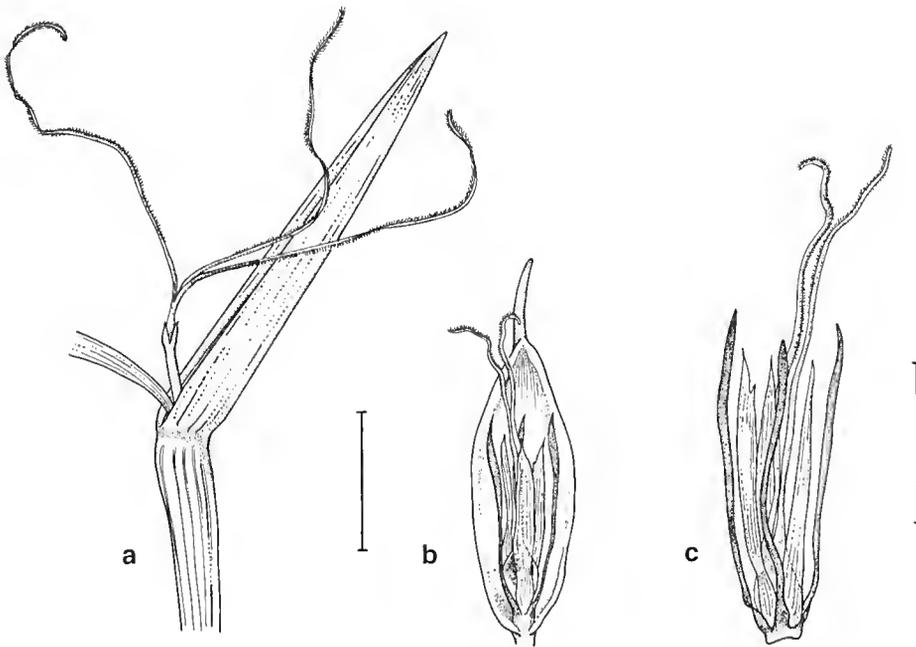


Fig. 7. *Taraxis* and *Tyrbastes*, female spikelets and subtending bracts. a, *Taraxis grossa*, female flower (1-flowered spikelet) in axil of subtending bract, tepals represented by small scales (*Briggs* 9075). b, c, *Tyrbastes glaucescens*, female flower (and glume), adaxial and abaxial (*Briggs* 8645). Scale bars: a, b = 3 mm, c = 2 mm.

results) show the members sampled forming a robust association. Examination of inflorescence structure has shown that what have been described as spikelets are diverse and not equivalent in the different taxa. Our observations and interpretations accord with those of Kircher (1986) for taxa that he studied. The spikelet may be simple (*Leptocarpus*) or compound (other genera). The dispersal unit is a compound spikelet (*Hypolaena* p.p.), or is an individual spikelet (flower with stalk and one or two bracts on the axis (*Hypolaena* p.p., *Leptocarpus*, *Meeboldiua*, *Stenotalis*, *Dapsilanthus* and *Apodasmia*) or consists of the flower and glume only (*Chaetanthus*). The fruit is a nut with a pericarp that is hard and woody (*Hypolaena*) or thin and papery (other genera).

Note: The application of the name *Leptocarpus* used here will require conservation of a new type for the genus. This will be sought to avoid nomenclatural change to its most widespread member and to *Chaetanthus*.

**Key to genera of *Leptocarpus* group**

- 1 Pericarp of nut woody ..... *Hypolaena*
- 1\* Pericarp of nut thin-textured ..... 2
- 2 Female flowers in distinct spikelets, spikelets not compound, with no bracts between the flower and subtending glume; flowers dorsiventrally flattened with winged lateral tepals ..... *Leptocarpus*
- 2\* Female flowers in large clusters without conspicuous spikelet structure or in compound spikelets with small bracts between the flower and subtending glume; flowers not dorsiventrally flattened (sometimes laterally flattened) ..... 3
- 3 Male flowers with a globular swollen base; females with clusters of 3–5 flowers crowded into larger aggregations; culms simple below the inflorescence ..... 4
- 3\* Male flowers without a swollen base, female spikelets distinct or females crowded into large aggregations; culms simple or branched ..... 5
- 4 Caespitose, fruiting perianth with awns or slender tepals 2-8 times as long as fruit ..... *Chaetanthus*
- 4\* Rhizomatous, fruiting perianth with ovate or lanceolate tepals less than 2 times as long as fruit ..... *Apodasmia*
- 5 Female flowers in clusters of 3–5 which are crowded into larger aggregations (without conspicuous spikelet structure); male inflorescences appearing similar to the females and with exerted anthers or of distinct pendulous spikelets with non-exserted anthers ..... *Dapsilanthus*
- 5\* Female flowers in distinct spikelets (compound spikelets); male and female inflorescences very different in appearance; male spikelets pendulous and anthers not exerted ..... 6
- 6 Female spikelets (compound spikelets) very slender, 1- or 2-flowered; culms much branched ..... *Stenotalis*
- 6\* Female spikelets (compound spikelets) not very slender, several or many-flowered; culms branched or simple ..... *Meeboldiua*

***Stenotalis* B.G. Briggs & L.A.S. Johuson, gen. nov.**

A *Leptocarpus* combinatione characterum sequentium distinguitur: culmi ramosissimi; inflorescentiae masculinae feminaeque spiculis in fasciculis parvis dispositis, in

ramulis dispersis; spiculae femineae compositae floribus 1 vel 2, pedicellis unibracteatis, floribus non dorsiventraliter compressis, pari extimo tepalorum non alato.

Type species: *Stenotalis ramosissima* (Gilg) B.G. Briggs & L.A.S. Johnson

Dioecious. Caespitose with ascending rhizomes, base pubescent. Culms much branched, striate, with appressed 'fan-hairs'; with persistent appressed sheaths. Inflorescence: males and females very different, male spikelets usually numerous, several to many-flowered, pendulous; female flowers in very narrow 'spikelets' with 1 or 2 flowers but which are compound with 1 bract on the flower-stalk. Male flowers: tepals 5, stamens (2)3, not exerted. Female flowers: tepals 6, ovary 1-locular, style branches 3. Fruit a small, thin-walled nut, shed with enclosing glume and persistent perianth. Seed ellipsoid, smooth.

Culm with chlorenchyma of 2–4 layers of short cells arranged in transverse plates, interrupted by pillar cells opposite the outer vascular bundles. The flavonoids of *Stenotalis* are those common to most members of the *Leptocarpus* group of genera: luteolin, hypolaetin, flavonoid sulphates and flavone glucuronides, but also with quercetin reported in one sample (Williams et al. in press).

The name is from the Greek *stenos*, narrow, and *talis*, a marriageable maiden, referring to the very slender female spikelets.

*Stenotalis* is characterised by much-branched culms, slender female inflorescences of 1 or 2 flowers in compound spikelets, bearing a bract on the flower stalk.

A genus of one species in the south of Western Australia, in seasonally moist sites.

***Stenotalis ramosissima* (Gilg) B.G. Briggs & L.A.S. Johnson, comb. nov.**

Basionym: *Hypolaena ramosissima* Gilg, Bot. Jahrb. Syst. 35: 89 (1904).

Type: Western Australia: pr. King George Sound ad lacum Grasmere, *Diels 5500 p.p.*, Nov. [1901] ♀ (lecto, here selected, B). Residual syntype: *Diels 5500 p.p.* ♂ (isosyn K).

***Dapsilanthus* B.G. Briggs & L.A.S. Johnson, gen. nov.**

A *Leptocarpus* combinatione characterum sequentium distinguitur: culmi ramosissimi; inflorescentia feminea e spiculis 3–5 floribus constata, sed spiculae confertae, pedicellis unibracteatis, floribus non dorsiventraliter compressibus, tepalis pari extimo non alatis.

Type species: *Dapsilanthus elatior* (R. Br) B.G. Briggs & L.A.S. Johnson

Dioecious. Caespitose or rhizomatous, base pubescent. Culms branched, striate, with appressed or spreading 'fan-hairs' and persistent appressed sheaths. Male and female inflorescences similar or dissimilar, branched. Male spikelets distinct and pendulous with non-exserted anthers or small, erect, in dense clusters and with exerted anthers. Female inflorescences compound, with clusters (true spikelets) of 3–5 very small flowers each with 1 bract on the 'flower-stalk' crowded in larger aggregations. Flowers: tepals hyaline or scarious, acute or acuminate; outer tepals keeled. Male flowers with 4–6 tepals and 2–3 stamens, anthers mostly exerted. Female flowers: tepals 6; ovary 1-locular; style-branches 3. Fruit a small, thin-walled nut, shed with enclosing glume, bract and persistent perianth. Seed smooth, with a pattern of subangular cells (Fig. 8a–8e).

Culm with chlorenchyma of 2–4 layers of short cells arranged in transverse plates, interrupted by pillar cells opposite the outer vascular bundles; usually with an inner sclerenchyma sheath 1 cell layer thick separating the outer and inner ground tissue. *Dapsilanthus* shows a hypolaetin plus luteolin flavonoid pattern that is more similar to

*Hypolaena* than to other members of the *Leptocarpus* group of genera (Williams et al. in press).

The name is from the Greek *dapsilis*, abundant or plentiful, and *anthos*, flower, referring to the very numerous flowers in the inflorescence.

Four species; three in seasonally wet sites in northern Australia and monsoonal areas of southern New Guinea (two of these also in the Aru Islands), as well as one species in south-east Asia (Malaysia, Cambodia, Thailand and the southeastern Chinese island of Hainan).

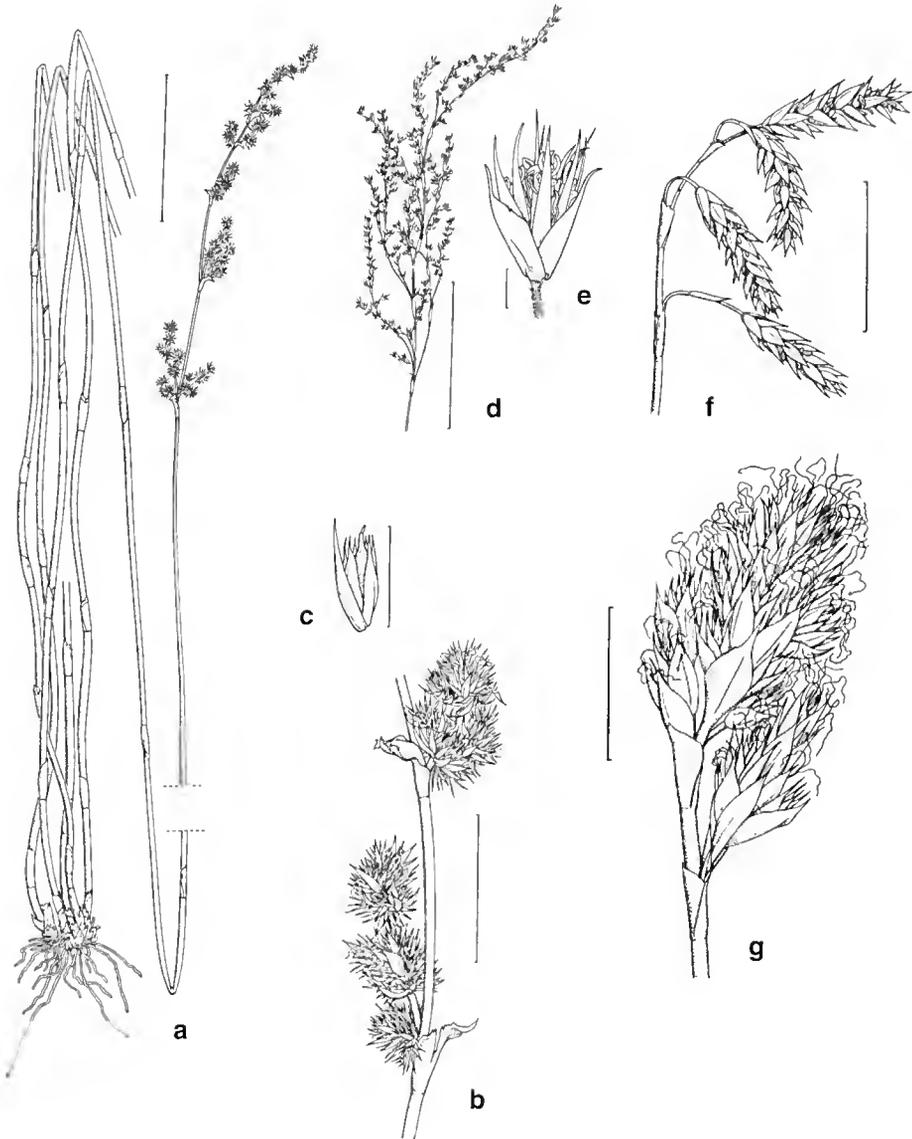


Fig. 8. a–e, *Dapsilanthus elatior*, a–c, female: a, habit. b, inflorescence. c, capsule with tepals and glume (disseminule) (Clarkson 4995). d, e, male: d, inflorescence, e, spikelet (Cowie 3222). f, g, *Apodasmia brownii*, f, male spikelets (Beaglehole 19995b); g, female, part of inflorescence (Briggs 2922). Scale bars: a, d = 5 cm; b = 1 cm; c, e = 1 mm; f = 7 mm; g = 14 mm.

**Dapsilanthus elatior** (R. Br.) B.G. Briggs & L.A.S. Johnson, **comb. nov.**

Basionym: *Leptocarpus elatior* R. Brown, Prodr.: 250 (1810).

Type citation: (T.) v.v.

Type: C. [Gulf] of Carpentaria, R. Brown (Bennett No. 5875), ♀ (holo BM; iso BRI, E, K).

**Apodasmia** B.G. Briggs & L.A.S. Johnson, **gen. nov.**

A *Leptocarpus* combinatione characterum sequentium distinguitur: culmi infra inflorescentias simplices; flores masculini basi globosi tumidi; spiculae femineae compositae floribus 3–5 sed spiculae confertae, pedicellis unibracteatis, floribus non dorsaliventraliter compressis, pari extimo tepalorum non alato.

Type species: *Apodasmia brownii* (Hook. f.) B.G. Briggs & L.A.S. Johnson

Dioecious. Rhizomatous, base pubescent. Culms unbranched below the inflorescence, striate, glabrous to densely pubescent; with appressed, or spreading 'fan-hairs' and persistent appressed sheaths. Male and female inflorescences similar or dissimilar, branched, spikelet structure obvious in males or obscured by clustering in both males and females. Male spikelets erect or pendulous, with partly exerted anthers. Female inflorescences compound, with clusters (true spikelets) of 3–5 very small flowers each with 1 bract on the 'flower-stalk' crowded in larger aggregations. Flowers: tepals hyaline or scarious, acute or acuminate; outer tepals keeled. Male flowers: the base globular and swollen; tepals 4–6; stamens 3, anthers mostly exerted. Female flowers: tepals 5–6, rigid; ovary 1-locular; styles 3, fused at base. Fruit a small, thin-walled nut, shed with enclosing glume, bract and persistent perianth. Seed smooth, with a pattern of subangular cells (Fig. 8f–8g).

Culm with chlorenchyma of 2–4 layers of short cells arranged in transverse plates, interrupted by pillar cells opposite the outer vascular bundles and usually with an inner sclerenchyma sheath of 1 cell layer separating the outer and inner ground tissue. *Apodasmia* shows a very homogeneous and unusual flavonoid profile with gossypetin 7-methyl ether (found elsewhere in Australian Restionaceae only in the very dissimilar *Catacolea*) as a major constituent (Williams et al. in press). The species from South Australia and Chile have identical aglycone flavonoid patterns with the same unusual glycoside (3-galactoside-8-glucoside) while the Western Australian species contain several additional flavonoids.

The name is from the Greek *apodasmios*, separated, referring to the widely disjunct distribution of the species.

A genus of four species, one each in the south of Western Australia (undescribed), south-eastern Australia, New Zealand, and Chile.

**Apodasmia brownii** (Hook. f.) B.G. Briggs & L.A.S. Johnson, **comb. nov.**

Basionym: *Leptocarpus brownii* J.D. Hooker, Fl. Tasman. 2: 73, t.136 (1858).

Type citation: *Gunn* 338, masc; 778, 964 in Herb Lindl., et 1444, foem.

Type: Circular Head, *Gunn* 338, 15.9.[18]38 ♂ (lecto, here selected, K). Residual syntypes: Banks of Derwent *Gunn* 338, 31.12.[18]40 (K); V.D. [Van Diemens] Land, *Gunn* 338 ♂ (herb Lindley CGE); Tasmania, R.C. *Gunn* ex herb Hooker ♂ (CGE). Probable isolecto or isosyn: *Gunn* s.n. ♂ (GH, K, US), ♀ (B).

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# Systematic studies in the eucalypts.

## 8. A review of the Eudesmioid eucalypts, *Eucalyptus* subgenus *Eudesmia* (Myrtaceae)

K.D. Hill and L.A.S. Johnson<sup>†</sup>

### Abstract

Hill, K.D. and Johnson, L.A.S. (National Herbarium of New South Wales, Royal Botanic Gardens, Sydney, Australia 2000) 1998. *Systematic studies in the eucalypts. 8. A review of the Eudesmioid eucalypts, Eucalyptus subgenus Eudesmia (Myrtaceae)*. *Telopea* 7(4): 375–414. A revision of *Eucalyptus* subgenus *Eudesmia* is presented. A formal combination is made for subgenus **Eudesmia**. 22 species are included, three of them described as new (*Eucalyptus pallida*, *E. selachiana*, *E. conveniens*), with one new subspecies (*E. ebbanoensis* subsp. *glaucoiramula*). Long-standing misapplication of the name *E. tetragona* is corrected, the name *E. pleurocarpa* Schauer reinstated from synonymy, and a lectotype is designated for *E. phoenicea*. Relationships within the group are discussed, and an infrageneric classification is presented, with keys to subgroupings and species.

### Introduction

The extracodical subgenus *Eudesmia* of Pryor & Johnson (1971) is a diverse and rather heterogeneous assemblage. Although the group has been suggested to be paraphyletic (Ladiges & Humphries 1983), our studies in the eucalypt group generally (Hill & Johnson 1995) and later studies by others (Ladiges et al. 1995) indicate that the group is probably monophyletic. Analysis of character sets based on morphological data at this level show a high degree of homoplasy, and have proven to be inadequate in fully resolving relationships. While few of the defining characters are apomorphic and exclusive to the group in the context of the *Eudesmia* and *Eucalyptus* suballiances of Johnson & Briggs (1984), several natural monophyletic units may be recognised within the group. It is here treated as a subgenus with the same circumscription as subgenus *Eudesmia* in the sense of Pryor and Johnson, partly as a convenience pending adequate resolution of relationships at this level. The various monophyletic units within the group are treated as sections.

### Terminology

Terminology and nomenclature is as in previous papers in this series (see Hill & Johnson 1995). The names applied to series and subspecies by earlier authors are cited below merely to indicate the way in which those authors grouped the species concerned. Nothing is implied about their standing, since we are using only our extracodical system between genus and species. Names of sections, series and subspecies (but not of subgenera or of species and subspecies) used by us are intentionally published in a system devised by Pryor & Johnson (1971) and external to the International Code of Botanical Nomenclature. This avoids the confusion created by formal recognition of 'series' and 'subseries' used by Maiden (1903–1933) in a loose and informal sense, and classifying according to particular organ sets rather than as taxa. Moreover, as explained previously by Pryor & Johnson (1971), it allows for clear

<sup>†</sup> Deceased 1 August 1997.

application of names and categories. Since it has a perfectly clear formalism of its own, the term 'extracodical', rather than 'informal', is appropriate. Subseries names here differ from those used by Pryor & Johnson in ending with '-osae'. This is because '-inae', as previously used, is a subtribal ending (International Code of Botanical Nomenclature, 1994, Art. 19.3).

Rare or threatened species are allocated conservation status codes according to the system of Briggs & Leigh (1996).

The hairs on juvenile leaves of some taxa in subgenus *Eudesmia* are described as 'stellate hairs' for brevity. These are not stellate hairs as occurring in, for example, certain Chenopodiaceae, but distinctive structures in which a number of simple hairs arise from a raised oil gland (discussed by Johnson (1972) and Ladiges (1984)). They are also different in detail from superficially similar structures appearing in the bloodwoods (Hill & Johnson 1996) and the stringybarks (Ladiges & Humphries 1986). The comparable structures in the latter two groups are clearly apomorphic within those groups, and one hypothesis is that the structures in *Eudesmia* are also synapomorphic.

### Taxonomic history

Brown (1814) described the genus *Eudesmia* R. Br. for the single species *E. tetragona* R. Br. Subsequent authors have generally submerged *Eudesmia* in *Eucalyptus*. A group of species was recognised as subseries *Eudesmiae* by Bentham (1867), including *E. tetragona* and other taxa corresponding to section *Quadraria* of Pryor & Johnson (Bentham placed *E. miniata* and *E. phoenicea* in separate, widely differing groups with many other unrelated taxa).

Mueller (1882) placed all species of section *Quadraria* and most of *Apicaria* into the much more inclusive section *Parallelantherae*. The exception was *E. baileyana*, which he placed in section *Renantherae*, being misled by mixed material that included *Eucalyptus tindaliae* Blakely.

Maiden (*Crit. Revis. Eucalyptus* 6) placed the six *Quadraria* species then known with most of *Apicaria* (*E. baileyana*, together with *E. similis* and *E. lirata* which had by then been described) into a group *Eudesmiae* (≡ subseries, in section *Macrantherae* subsection *Longiores* series *Non-corymbosae*). He placed *E. miniata* and *E. phoenicea* together, in the same section and subsection as *Eudesmiae*, in an anomalous un-named subseries in series *Corymbosae*. Blakely (1934) grouped the species as Maiden did, but ranked them as series *Eudesmiae* and series *Miniatae*, both in section *Macrantherae*.

Chippendale (1988) placed the species included in subgenus *Eudesmia* sensu Pryor & Johnson into seven series, corresponding to Pryor & Johnson groups at various ranks but with no indication of hierarchical relationships among the somewhat heterogeneous 'series' (or indeed among the 92 highly heterogeneous 'series' taken to comprise the genus *Eucalyptus* sens. lat.).

### Present classification

Subgenus *Eudesmia* is here applied in the same sense as in Pryor & Johnson's original circumscription (1971). Although some studies suggest that this group may be paraphyletic (Ladiges & Humphries 1983), our earlier studies (Hill & Johnson 1995) indicate that this is not necessarily the case. Our findings are supported to some extent by subsequent morphological and molecular studies by others than ourselves (Ladiges

et al. 1995). The degree of morphological homoplasy at this level, however, renders morphology alone inadequate in resolving relationships, and very few characters are informative and unequivocal. A simple cladistic analysis of the characters useful in separating species and species groups at this level (listed in Table 1) clearly illustrates the inadequacy of these characters in resolving phylogenetic relationships (Fig. 1). Similarly, molecular studies reported to date do not clearly resolve relationships within *Endesmia* (Ladiges et al., op. cit.).

The free or partially free calyx segments separate the eudesmioid group, together with *E. microcorys*, from the remainder of *Eucalyptus* sens. strict. Analyses (cited above) of the eucalypt groups indicate that the free persistent calyx is an ancestral condition, and thus that the free or partially free calyx condition is of no grouping value at this level (see Drinnan & Ladiges 1989a & b for discussion of the partial fusion of calyx and corolla). Floral development with fasciculate stamens is also indicated to be an ancestral condition and likewise a shared plesiomorphic state. The development of a stemophore from the staminal buttress (Drinnan & Ladiges 1989a & b, 1991) is apomorphic for the entire *Eucalyptus* sens. strict. clade except *E. curtisii*, and does not help resolve relationships at the base of this clade.

Possession of eudesmioid hairs can be viewed as a strong and distinctive synapomorphic character uniting the three sections *Quadraria*, *Xeraria* and *Apicaria*. If this is so, inflorescence structure must be regarded as highly flexible within *Eudesmia* and of limited use in defining groups. The partial fusion of the calyx with the corolla evident in *Apicaria*, *Xeraria* and part of *Quadraria* is most parsimoniously viewed as an independent development to the calycine fusion seen in the remainder of *Eucalyptus*, possibly arising more than once within the eudesmioid group. The presence of oil glands in bark is also equivocal but in one possible interpretation this is a synapomorphy for *Eudesmia* and independently derived elsewhere in *Eucalyptus*. Another equivocal condition is the opposite adult leaves occurring in some groups. This may represent neotenus retention i.e. a secondary loss of the disjunct adult condition, or may genuinely represent a plesiomorphic state such as occurs in *Allosyncarpia*.

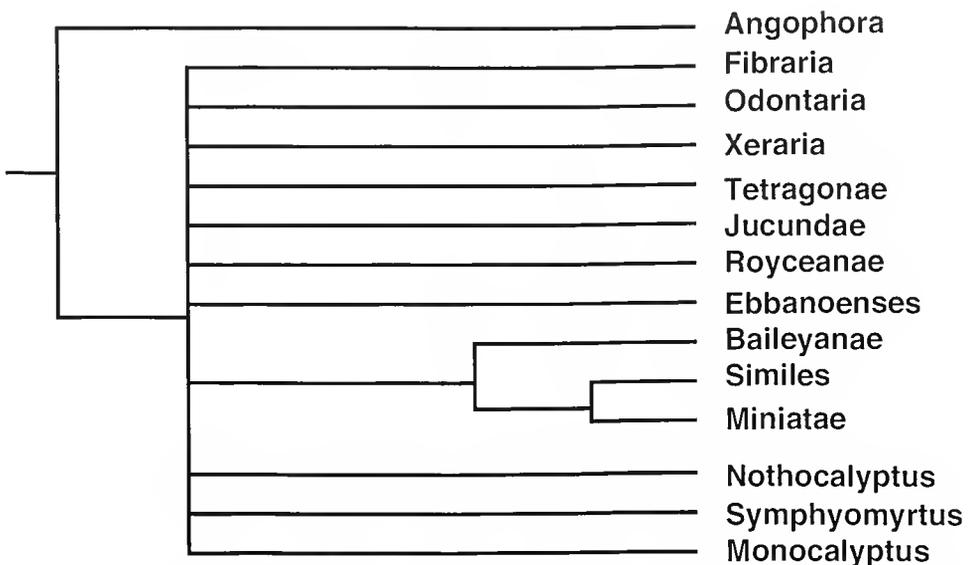


Fig. 1. Consensus cladogram from data as presented in Table 1 (generated from 93 equally parsimonious trees, length = 32 steps, consistency index = 0.42). Analysed using Hennig86 (Farris 1988).

**Table 1. Characters defining subgenus *Eudesmia* and constituent groups**

Character	0	1	
1. Habit	mallee	tree	
2. Long fibrous bark	absent	present	
3. 'Micaceous' bark	absent	present	
4. Bark glands	absent	present	
5. Eudesmioid hairs	absent	present	
6. Juvenile leaves	sessile	petiolate	
7. Juvenile leaves	opposite	disjunct	
8. Adult leaves	opposite	disjunct	
9. Inflorescences	not simple axillary umbellasters	simple axillary umbellasters	
10. Calyx	free	partially fused	
11. Calyx	persistent	deciduous	
12. Stamens	present	stamens continuous	
13. Flowers	white	yellow or orange	
14. Staminal buttress	absent	present	
Odontocarpae	10000	11110	0101
Gongylocarpae	00011	11101	1001
Eudesmiae	10011	11100	0101
Tetragonae	10011	01100	0111
Erythrocorrythosae	10001	01100	0111
Ebbanosae	10011	00001	1101
Jucundae	10011	01111	1101
Royceanae	10011	01111	1101
Fibridia	01010	00000	0101
Similosae	01111	00001	1001
Baileyanosae	01111	00001	1101
Miniatosae	01111	00001	1011
Nothocalyptus	01100	01110	0001
Angophora	00000	10000	0100
Symphyomyrtus	00000	01111	1001

The largest species group is the south-western Australian section *Quadraria*, with some 11 species in 4 series. Inflorescence, calyx and bark characters mentioned above are flexible within the section, and the only uniform character is possession of eudesmioid hairs. The mallee habit is universal in this section (although present elsewhere in *Eucalyptus*), and can be viewed as an independent development also uniting the section.

*E. gongylocarpa*, *E. odontocarpa* and *E. gamophylla* were included in a clade and referred to by Hill & Johnson (l.c.) as *Odontocalyptus*. However, no clear apomorphies unite this clade, and it is here treated as two separate sections, *Xeraria* and *Odontaria*. *Xeraria* shares eudesmioid hairs as a synapomorphy with section *Quadraria* as treated here, and *Odontaria* shares the mallee habit with section *Quadraria*.

Pryor & Johnson's section *Apicaria*, comprising two series, *Miniatae* and *Baileyanae*, is clearly monophyletic, defined as below, and shares eudesmioid hairs as a synapomorphy with sections *Xeraria* and *Quadraria*. *Apicaria* and the generally very different series *Jucundae* of *Endesmia* sens. str. have somewhat similar bud morphology (Drinnan & Ladiges 1989a), but we consider this a case of homoplasy. These two together are referred to as 'Eudesmia B' by Carr & Carr (1963, 1968) and Drinnan & Ladiges (1989a). Bark characters (see below) can be regarded as synapomorphic for this section.

The remaining species in the subgenus, *E. tetradonta*, is a taxonomically isolated entity here placed in a monospecific section (see Table 2 for a summary of the classification proposed herein). It does not possess eudesmioid hairs, and thus does not share any clear and unique synapomorphies with the above sections. Oil glands in the bark occur in all sections except *Odontaria*, and may be synapomorphic, although similar glands occur sporadically in other eucalypt groups.

### Taxonomic treatment

**Eucalyptus** subgenus **Eudesmia** (*R. Br.*) *L.A.S. Johnson & K.D. Hill, stat. nov.*

≡ *Eudesmia* *R. Br.*, Appendix Flinders Voyage 2: 599, t. 3 (1814).

Type species: *E. tetragona* *R. Br.*, l.c.

Trees or mallees; bark smooth, sometimes with more or less persistent ribbons or ribbony flakes; or partly or wholly persistent and long-fibrous. Oil glands often present in bark. Radiating, unicellular, blunt-ended thin-walled trichomes arising from flat or slightly prominent glands present on juvenile leaves and shoots, except in sections *Fibraria* and *Odontaria*. Juvenile leaves opposite for few to many nodes. Adult leaves disjunct or sometimes opposite, glabrous; tertiary and higher-order venation of reticulum often much reduced. Conflorescences lateral, anthotelic or anauxotelic, panicles, thyrsoids or metabotryoids, or more often reduced to, or consisting of leafy shoots bearing, 3- or 7-flowered umbellasters, these rarely plurinodate or of condensed metabotryoid form, sometimes with accessory branching (superposed). Perianth 4-merous (fixed); carpels 3(-4). Calyx of free reduced persistent sepals, or more or less fused with the corolla in section *Apicaria* and series *Ebbanoenses*, *Jucundae* and *Royceanae*. Corolla calyptriform, but junctions of petals often discernible. Stamens all fertile, often in 4 ± clearly discernible bundles; filaments white, cream, yellow, yellow-green or orange; anthers dorsifixed, versatile, oval, dehiscing by curved divergent or almost parallel slits. Style short (not reaching calyptra in bud) and straight, or long (touching calyptra in bud) and bent. Stigma blunt or tapered, lobed, with short unicellular papillae (long and multicellular in *E. erythrocoris*). Ovules hemitropous, arranged in 2 separated vertical rows or 4 or 6 vertical rows in each loculus. Seed testa derived from inner and outer integument. Cotyledons emarginate, reniform, not folded in embryo. Seed variable in shape, sometimes keeled or narrowly winged; hilum always ventral. Fruit woody, sometimes 4-winged or with 4 sepaline teeth; capsule usually sunken with valves enclosed.

Table 2. A classification of subgenus *Eudesmia*

Subgenus <i>Eudesmia</i>	
Section <i>Xeraria</i>	<i>E. gongylocarpa</i>
Section <i>Odontaria</i>	<i>E. odontocarpa</i> <i>E. gamophylla</i>
Section <i>Quadraria</i>	
Series <i>Tetragonae</i>	
Subseries <i>Eudesmioideosae</i>	<i>E. eudesmiioides</i> <i>E. pallida</i> <i>E. selachiana</i>
Subseries <i>Tetragonosae</i>	<i>E. gittinsii</i> <i>E. conveniens</i> <i>E. eyreana</i> <i>E. tetragona</i>
Subseries <i>Erythrocorrythosae</i>	<i>E. erythrocorrythosae</i>
Series <i>Jucundae</i>	<i>E. jucunda</i>
Series <i>Royceanae</i>	<i>E. roycei</i>
Series <i>Ebbanoenses</i>	<i>E. ebbanoensis</i> subsp. <i>photina</i> subsp. <i>ebbanoensis</i> subsp. <i>glauciramura</i>
Section <i>Fibraria</i>	<i>E. tetrodonta</i>
Section <i>Apicaria</i>	
Series <i>Baileyanae</i>	<i>E. baileyana</i>
Series <i>Similes</i>	<i>E. similis</i> <i>E. lirata</i>
Series <i>Miniatae</i>	
Subseries <i>Miniatosae</i>	<i>E. miniata</i> <i>E. gigantangion</i>
Subseries <i>Phoeniceosae</i>	<i>E. phoenicea</i> <i>E. ceracea</i>

## Key to species

- 1 Inflorescences not simple axillary triads
  - 2 Unit inflorescences compound or aggregated into branched terminal or axillary conflorescences
    - 3 Calyx persistent as 4 small teeth at top of hypanthium
      - 4 Adult leaves glossy, lanceolate, petiolate, disjunct..... 2. *E. odontocarpa*
      - 4\* Adult leaves dull, elliptical, subsessile, opposite ..... 3. *E. gamophylla*
    - 3\* Calyx partially fused to corolla and shed at anthesis
      - 5 Buds not square, not glaucous ..... 12. *E. jucunda*
      - 5\* Buds square, glaucous..... 13. *E. roycei*
  - 2\* Unit inflorescences simple, axillary, 7- or more flowered
    - 6 Inflorescences more than 11-flowered ..... 21. *E. phoenicea*
    - 6\* Inflorescences not more than 11-flowered
      - 7 Adult leaves opposite, sessile..... 22. *E. ceracea*
      - 7\* Adult leaves not opposite or sessile
        - 8 Bark wholly smooth ..... 1. *E. gongylocarpa*
        - 8\* Bark not wholly smooth
          - 9 Bark fully persistent..... 18. *E. baileyana*
          - 9\* Bark not fully persistent
            - 10 Adult leaves lanceolate; fruits ovoid ..... 19. *E. miniata*
            - 10\* Adult leaves narrow-lanceolate; fruits urceolate .....  
..... 20. *E. gigantangion*
  - 1\* Inflorescences simple axillary triads
    - 11 Calyx difficult to discern
      - 12 Bark smooth throughout ..... 14. *E. ebbanoensis*
      - 12\* Bark not smooth throughout
        - 13 Peduncles 20–30 mm long ..... 17. *E. similis*
        - 13\* Peduncles 7–10 mm long ..... 16. *E. lirata*
    - 11\* Calyx reduced, free, evident as 2 or 4 small teeth on rim of hypanthium
      - 14 Calyptra red ..... 11. *E. erythrocorys*
      - 14\* Calyptra not red
        - 15 Mature adult leaves, buds and fruits pruinose with a loose, waxy coating
          - 16 Adult leaves less than 18 mm wide..... 5. *E. pallida*
          - 16\* Adult leaves commonly more than 20 mm wide
            - 17 Adult leaves lanceolate ..... 8. *E. conveniens*
            - 17\* Adult leaves elliptical..... 10. *E. pleurocarpa*

## 15\* Mature adult leaves, buds and fruits not pruinose

18 Trees ..... 15. *E. tetradonta*

## 18\* Mallees

19 Pedicels less than 5 mm long

20 Adult leaves dull ..... 4. *E. eudesmioides*20\* Adult leaves glossy ..... 6. *E. selachiana*

19\* Pedicels more than 5 mm long

21 Fruits 12 mm diam. or less ..... 7. *E. gittinsii*21\* Fruits 13 mm diam. or more ..... 9. *E. tetragona*

## Section Xeraria

This and the following section were combined and treated as Series *Odontocarpae* Chippendale (1988). Chippendale's name is not part of our extracodical system.

Bark smooth, with oil glands. Juvenile growth glabrous or hispid with radiating hairs; juvenile leaves opposite, sessile. Adult leaves opposite or subopposite. Conflorescence axillary, compound; with unit umbellasters 3-flowered, or simple, axillary, 7-flowered. Calyx reduced, persistent as teeth at top of hypanthium. Stamens in 4 bundles; filaments white or cream.

The sectional name refers to the occurrence of the single constituent species in arid regions.

1. *Eucalyptus gongylocarpa* *Blakely*, Trans. & Proc. Roy. Soc. South Australia 60: 153 (1936).

Type: Western Australia: Camp 60, vicinity of Victoria Spring, Victoria Desert, *R. Helms s.n.*, 24 Sep 1891 (holo NSW, cannot be found).

Tree to 15 m. Bark smooth, white to pale grey or cream, often with scattered thin adherent scales. Twigs and stems glaucous. Juvenile leaves to 5 cm long and 3.5 cm wide, opposite, sessile, ovate to orbiculate, cordate, apically rounded, with 'stellate hairs'. Adult leaves 4–7 cm long, 0.8–1.4 cm wide, opposite or sub-opposite, lanceolate to narrow-elliptical, apiculate, glabrous, mid-green, dull, glaucous; petioles 3–10 mm long; lateral veins at c. 30–40° to midrib, moderately closely spaced; secondary reticulum incomplete; intramarginal vein irregular, c. 1 mm from leaf margin. Inflorescences simple, axillary; unit umbellasters 7-flowered; peduncles terete, 8–19 mm long; pedicels terete, 2–5 mm long. Mature buds clavate, glaucous, 3–5 mm long, 3–4 mm diam.; calyx free, persistent as 4 small teeth around top of hypanthium on mature fruits; calyptra shallowly hemispherical,  $\frac{1}{3}$ – $\frac{1}{2}$  as long as hypanthium. Stamens all fertile, in 4 fascicles; filaments regularly inflexed; anthers oblong, versatile, dehiscent through parallel slits. Fruits 3–4-locular, globular, markedly constricted apically, 6–10 mm long, 6–10 mm diam.; disc 1–3 mm wide, steeply depressed; valves deeply enclosed. Seeds dorsiventrally flattened, dull, black, with a narrow translucent wing around the edge; hilum ventral; chaff angular, dark brown.

**Distribution:** centred on the Victoria Desert (Fig. 2), in the region bounded by the George Gill Range (north-east), Vokes Hill (south-east), Plumridge Lakes (south-west), Sandstone (west) and Kumarina (north-west).

**Ecology:** a locally abundant species dominating open savanna woodlands on deep red aeolian sand deposits, with an understorey dominated by *Triodia*.

**Conservation status:** not considered to be at risk.

**Selected specimens (from 40 examined):** Northern Territory: 23 1/2 miles [37.8 km] S of George Gill Range, *Chippendale*, 27 June 1959 (DNA, NSW); 3 miles [4.8 km] E of Lake Amadeus, *Dunlop 1891*, 21 Sep 1970 (DNA, NSW); Dean Range, 4 miles [6.4 km] W of Docker Settlement, *Dunlop 1937*, 6 Oct 1970 (DNA, NSW); 15 miles [24.2 km] Ayers Rock, *Dunlop 2035*, 6 Nov 1970 (DNA, NSW).

South Australia: 4 km W of Vokes Hill junction, 258 km from Cook, Great Victoria Desert, *Alcock 8144*, 22 Aug 1980 (AD, CANB, DNA, NSW, NY, PRE); 195.5 km N of Cook towards Vokes Junction, *Brooker 9423*, 28 Aug 1986 (CANB, NSW); c. 130 km W of Emu along Vokes Hill track, *Lothian 5641*, 18 July 1972 (AD, CANB, NSW); 43 miles [69.2 km] SE of Chestermans Peak road junction, *Symon 2604*, 6 Aug 1962 (AD, NSW); Great Victoria Desert, Connie Sue Highway  $\pm$  6 km W of Vokes Hill Junction, *Symon 12427*, 22 Aug 1980 (AD, CANB, K, DNA, NSW).

Western Australia: 20.2 miles [32.5 km] NW of Agnew, towards Sandstone, *Baker 100*, 19 Nov 1970 (CANB, NSW); between Cashmere Downs and Bulga Downs, *Beard 6494*, 9 Sep 1973 (PERTH, NSW); 42.6 km N of Wiluna towards Cunyu, *Brooker 10722*, 16 Apr 1991 (CANB, AD, DNA, NSW, PERTH); 22 miles [35.4 km] east of Cosmo Newberry, *Carolin 5915*, 27 July 1967 (NSW); 20 km WNW along track from S end of Plumridge Lakes, *Crisp 5801*, 14 Sep 1979 (CANB, NSW, PERTH); 31 miles [49.6 km] NE of Laverton, *George 8688*, 12 July 1967 (PERTH, NSW); 10.7 km N of Kumarina roadhouse on Great Northern Highway, *Hill 500 Johnson Blaxell & Brooker*, 2 Nov 1983 (NSW, CANB, PERTH); 16 miles [25.8 km] NE of Millrose Homestead, Ereman Province, *Speck 1387*, 8 Sep 1958 (CANB, NSW).

### Section Odontaria

This and the previous section were combined and treated as Series *Odontocarpa* Chippendale (1988). Chippendale's name is not part of our extracodical system.

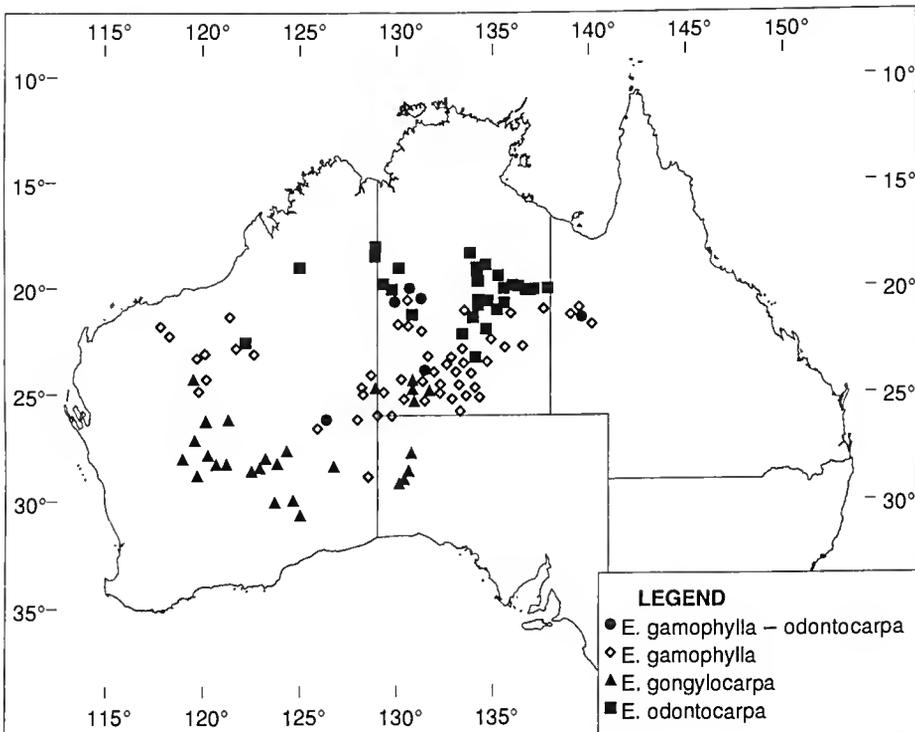


Fig. 2. Distribution of *E. odontocarpa*, *E. gamophylla*, *E. gongylocarpa*.

Mallees. Bark smooth, without oil glands. Juvenile growth glabrous or hispid with radiating hairs; juvenile leaves opposite, often connate, sessile, glabrous. Adult leaves opposite or subopposite. Conflorescence axillary, often compound; with regular unit umbellasters 3-flowered. Calyx free, reduced, persistent as teeth at top of hypanthium. Stamens in 4 bundles; filaments white or cream.

Connation of juvenile leaves, when present, is always a later development and does not occur in the earliest juvenile leaves.

A section with two closely allied species.

**2. *Eucalyptus odontocarpa* F. Muell., J. Linn. Soc., Bot. 3, 98 (1859).**

Type: Sturt's Ck., *F. Mueller s.n.* (holo MEL).

Mallee to 4 m. Bark smooth, white to grey, cream or pinkish. Twigs and stems not or very weakly pruinose. Juvenile leaves to 10 cm long and 2.5 cm wide, opposite, sessile, elliptical to lanceolate, cordate or sometimes connate, apically rounded to acute, glabrous. Adult leaves 6–12 cm long, 0.7–1.5 cm wide, sub-opposite to disjunct, narrow-lanceolate to lanceolate, acuminate, glabrous, mid-green, glossy, not pruinose; petioles 3–10 mm long; lateral veins at c. 30–45° to midrib, moderately closely spaced; secondary reticulum incomplete; intramarginal vein irregular, 1–2.5 mm from leaf margin. Inflorescences compound and terminal or simple and axillary; unit umbellasters simple, 3-flowered; peduncles terete or angular, 2–5 mm long; pedicels terete, 1–3 mm long. Mature buds clavate, not pruinose, 4–6 mm long, 3–4 mm diam.; calyx free, persistent as 4 small teeth around top of hypanthium on mature fruits; calyptra shallowly hemispherical,  $\frac{1}{3}$ – $\frac{1}{2}$  as long as hypanthium. Stamens all fertile, in 4 fascicles; filaments regularly inflexed; anthers oblong, versatile, dehiscing through parallel slits. Fruits 3-locular, cylindrical or barrel-shaped, slightly constricted apically, 4-angled, 8–11 mm long, 5–6 mm diam.; disc 1–2 mm wide, steeply depressed; valves deeply enclosed. Seeds dorsiventrally flattened, dull, greyish black, with a narrow translucent wing around the edge; hilum ventral; chaff angular, dark brown.

Hybrids and intergrades with *E. gamophylla* have been recorded.

**Distribution:** Rudall River region in Western Australia east to south-west of Mt Isa in Queensland (Fig. 2).

**Ecology:** a mallee species in desert shrublands, usually on red sandy soils or sometimes on low stony rises with *Triodia* understorey.

**Conservation status:** not considered to be at risk.

**Selected specimens (from 54 examined):** Northern Territory: 9.4 km W of Stuart highway on Anningie road, *Brooker 5125*, 7 Apr 1976 (CANB, NSW); Alyawarr Desert, 135 km W of Camooweal, *Brooker 11565*, 22 Sep 1993 (CANB, BRI, DNA, NSW); 10 miles [16 km] NW of Tanami on road to Billiluna and Halls Creek, *Carolin 7926*, 23 Aug 1970 (SYD, NSW); 58 miles [92.8 km] S Hookers [Hooker] Creek, *Chippendale*, 14 July 1956 (DNA, NSW); 8.6 miles [13.8 km] W of Soudan homestead, *Chippendale & Johnson*, 2 Oct 1957 (DNA, NSW); Central Mt Stuart, *Chippendale*, 18 July 1958 (DNA, NSW); 11.6 km N of Wauchope on Stuart Highway, *Hill 877 Johnson & Benson*, 12 July 1984 (NSW, CANB, DNA, PERTH); 14.6 km N of Tennant Ck, *Puttock 11113 & Waterhouse*, 17 July 1980 (UNSW, DNA, NSW).

Western Australia: desert S of Fitzroy River, North Kimberly, *Fitzgerald*, Sep 1906 (NSW); 5 miles [8 km] SE of Swindells Field, Great Sandy Desert, *George 9150*, 31 July 1967 (PERTH, NSW); 2.7 km W of Nicholson rd junction, *Hill 1002 Johnson & Benson*, 3 Aug 1984 (NSW, CANB, DNA, PERTH); Rudall River area, *Maslin 2124*, 5 Sep 1971 (PERTH, NSW); 20 miles [32 km] S of Nicholson station, *Perry 2372*, 6 July 1949 (CANB, NSW).

**E. gamophylla–E. odontocarpa intergrades**

**Selected specimens (from 8 examined):** Queensland: 79 km SW of Mt Isa (1.5 km N of Urandangi turn-off), *Harris 602, 603*, 7 May 1990 (NSW).

Western Australia: 60 km SW of Warburton on road to Laverton, *Briggs 3538 a*, 12 June 1970 (NSW).

Northern Territory: 10 miles [16.1 km] E The Granites, *Chippendale*, 4 May 1958 (DNA, NSW); 6 miles [9.7 km] NW of The Granites Township, *Lazarides 6257*, 22 Apr 1957 (CANB, NSW); 64 miles [103.0 km] SE Mongrel Downs Homestead, *Maconochie 1041*, 26 May 1970 (DNA, NSW); near EM-3 Well, Mereenie Oil Field, *Weston 13434*, 9 Mar 1983 (DNA, NSW).

**3. Eucalyptus gamophylla F. Muell., Fragm. 11:40 (1878).**

Type: Western Australia: Mount Pyrtten, Hamersley Range, *J. Forrest* (holo MEL).

Mallee to 7 m. Bark smooth, white to grey, cream or pinkish, sometimes with a short persistent stocking on the lower trunk of larger individuals. Twigs and stems glaucous. Juvenile leaves to 10 cm long and 0.6 cm wide, opposite, sessile, ovate to elliptical, cordate or connate, apically rounded or apiculate, glabrous. Adult leaves 6–8 cm long, 0.9–1.5 cm wide, opposite, sessile, elliptical or ovate to lanceolate, rounded or apiculate, glabrous, mid-green, dull, glaucous; lateral veins at c. 30–45° to midrib, moderately closely spaced; secondary reticulum incomplete; intramarginal vein irregular, 1–2 mm from leaf margin. Inflorescences compound and terminal or simple and axillary; unit umbellasters simple, 3-flowered; peduncles terete or angular, 3–8 mm long; pedicels terete, 1–4 mm long. Mature buds clavate or pyriform, glaucous, 4–6 mm long, 3–4 mm diam.; calyx free, persistent as 4 small teeth around top of hypanthium on mature fruits; calyptra shallowly hemispherical,  $\frac{1}{4}$ – $\frac{1}{3}$  as long as hypanthium. Stamens all fertile, in 4 fascicles; filaments regularly inflexed; anthers oblong, versatile, dehiscing through parallel slits. Fruits 3-locular, cylindrical or barrel-shaped, slightly constricted apically, 4-angled, 6–10 mm long, 5–6 mm diam.; disc 1–2 mm wide, steeply depressed; valves deeply enclosed. Seeds dorsiventrally flattened, dull, greyish black, with a narrow translucent wing around the edge; hilum ventral; chaff angular, dark brown.

Hybridisation with *E. odontocarpa* (q.v.) is known.

**Distribution:** from near Tom Price in the Pilbara region of Western Australia east to south-west of Mt Isa in Queensland (Fig. 2).

**Ecology:** a component of mallee shrublands on red desert dunes with *Triodia* understorey.

**Conservation status:** not considered to be at risk.

**Selected specimens (from 97 examined):** Northern Territory: c. 8 km SSE of Fiddlers Lake; Sangsters Bore area, *Albrecht 6207*, 16 June 1994 (NT, DNA, NSW); 41 miles [65.6 km] from Yuendumu Mt Doreen road, *Carolin 7940*, 24 Aug 1970 (SYD, NSW); 52 miles [83.2 km] W Hermannsburg, *Chippendale*, 24 Aug 1956 (DNA, NSW); 9.6 miles [15.4 km] N of Georgina Downs, *Chippendale & Johnson*, 1 Oct 1957 (DNA, NSW); 4.5 miles [7.2 km] E Lasseters Cave, Petermann Range area, *Chippendale*, 24 June 1958 (DNA, NSW); 18.5 miles [29.6 km] N Lake Amadeus, *Chippendale*, 28 June 1959 (DNA, NSW); 28 km W of Curtin Springs on Ayers Rock rd, *Hill 853*, 10 July 1984 (NSW, CANB, DNA, PERTH); 48 miles [76.8 km] ENE of Harts Range Police Depot, *Lazarides 5215*, 8 May 1955 (CANB, NSW); 3 miles [4.8 km] NW of The Granites Township, *Lazarides 6258*, 22 Apr 1957 (CANB, NSW); 118 miles 188.8 km] W Ayers Rock, *Maconochie 747*, 18 Sep 1969 (DNA, NSW); Uluru (Ayers Rock - Mt Olga) National Park, on Docker River rd, 33.5 km WNW of Ranger Station, *Palmer 150 & Lazarides*, 16 May 1988 (CANB, NSW); near gate to radio station at Heavitree Gap near Alice Springs, *Stocker 532*, 17 June 1970 (CANB, NSW).

Queensland: Oban station, 60 miles [96 km] SW of Mt Isa, *Everist 1701*, 30 Nov 1938 (BRI, NSW); 89.7 miles [135.5 km] from Mt Isa towards Dajarra, *Hall H74/58*, 5 July 1974 (CANB, NSW); 56 km S of Mt Isa, *Harris 420*, 29 July 1989 (BRI, NSW); Yappo Creek, 53 km S of Mt Isa, *Harris 601*, 28 Apr 1990 (NSW, BRI).

South Australia: Boundary of South & Western Australia, *Helms s.n.*, 17 July 1891 (NSW); Mann Range, *Millthorpe 3099*, 3 Nov 1974 (NSW).

Western Australia: S end Schwerin Mural Crescent, *Carolin 6204*, 2 Aug 1967 (NSW); Wittenoom Gorge, above the old asbestos mine, *Croat 52288 A*, 6 Aug 1981 (MO, NSW); 6 km S of Moffita Well campsite, along vermin fence, *Fensom 361 & Wilson*, 29 July 1995 (NSW); 60 miles [96 km] SW of Warburton Mission, *George 8168*, 30 Sep 1966 (PERTH, NSW); S of Rudall River, *George 10736*, 20 May 1971 (PERTH, NSW); 83.6 km W of Wittenoom on track to Millstream, *Hill 435 Johnson Blaxell Brooker & Edgecombe*, 30 Oct 1983 (NSW, AD, CANB, K, MEL, PERTH); 10.7 km N of Kumarina roadhouse on Great Northern Hwy, *Hill 501 Johnson Blaxell & Brooker*, 2 Nov 1983 (NSW, CANB, PERTH); Gibson Range, c. 200 km E of Walgun on Lake Disappointment rd, *Pryor*, 21 Aug 1985 (NSW); 3 miles [4.8 km] S of the Sir Fredrick Range, *Synnon 2283*, 1 Aug 1962 (AD, NSW); 39.5 km along road to Telfer; edge of Great Sandy Desert, *Wilson 939 & Rowe*, 5 Sep 1991 (NSW, CANB, PERTH).

### Section Quadraria

Bark smooth, with or without oil glands. Radiating hairs present on juvenile growth. Juvenile leaves petiolate or sessile, opposite or disjunct. Adult leaves opposite or disjunct. Conflorescence axillary, compound; with unit umbellasters 3–7-flowered, or of simple axillary triads (3-flowered umbellasters). Calyx reduced, persistent as teeth at top of hypanthium, or as teeth on apex of calyptra. Stamens continuous or in 4 bundles; filaments white, cream or yellow.

### Key to series

1. Calyx free, persistent ..... series *Tetragonae*
- 1\* Calyx more or less fused to corolla, shedding as part of calyptra
2. Inflorescences simple axillary triads ..... series *Ebbanoenses*
- 2\* Inflorescences compound, 7–9-flowered
3. Calyx wholly fused to corolla ..... series *Jucundae*
- 3\* Calyx irregularly partially fused to corolla ..... series *Royceanae*

### Series Tetragonae

Treated as Series *Heteroptera* Maiden by Chippendale (1988), with 4 species included. As we have indicated previously, these names attributed to Maiden are classifications of organ-sets and not taxa, and are not acceptable under the ICBN. They are not part of our extracodical system.

Inflorescences consisting of simple, axillary triads (3-flowered umbellasters). Calyx reduced, persistent as teeth at top of hypanthium. Stamens in 4 bundles (with few intermediate stamens in *E. erythrocorys*); filaments white, cream or yellow.

A series of eight species in three subseries, showing wide diversity in form. All species are western Australian, the group ranging from the Shark Bay district south and then east to around Israelite Bay. Constituent species are mainly found on sandy soils, and do not extend into drier areas of the eastern Wheat Belt or Goldfields.

### Key to subseries

- 1 Calyptra and hypanthium similar in colour; oil glands present in bark; filaments white to yellow; stigmatic papillae short; disc sharply depressed in fruit
  - 2 Juvenile leaves sessile; filaments white or cream ..... subseries *Eudesmioidosae*
  - 2\* Juvenile leaves petiolate; filaments cream to yellowish .... subseries *Tetragonosae*
- 1\* Calyptra markedly different to hypanthium in colour; oil glands not present in bark; filaments yellow-green; stigmatic papillae long; disc level or raised in fruit  
..... subseries *Erythrocorythosae*

### Subseries *Eudesmioidosae*

Juvenile leaves opposite, sessile. Adult leaves opposite or subopposite. Oil glands present in bark. Calyptra and hypanthium similar in colour. Filaments white or cream. Stigmatic papillae short. Disc steeply depressed in fruit.

A subseries made up of three species.

4. *Eucalyptus eudesmioides* F. Muell., *Fragm.* 2: 35 (1860); as *E. eudesmoides*.

Type: Western Australia: Murchison R., N of Mt Curious, A. Oldfield (holo MEL, iso K).

We regard the original spelling as an unintentional orthographic error, since the epithet clearly referred to *Eudesmia*.

= *Eucalyptus eudesmioides* F. Muell. var. *globosa* Blakely, *Key Eucalypts*, 69 (1934).

Type: Western Australia: Mingenew, J.H. Maiden, Oct 1909 (holo NSW). Pryor & Johnson (1971) regarded this supposed taxon as not distinct from the type variety; we agree with this.

[*Eudesmia eucalyptoides* F. Muell., *Fragm.* 2: 35 (1860), nom. invalid., in syn. sub *Eucalyptus eudesmioides* F. Muell.]

Burbidge (1947) and Black (1952) used the name *E. eudesmioides* for the taxon now known to be *E. gonylocarpa*, as stated by Jessop (1986: 909).

Mallee to 6 m, usually less than 4 m. Bark smooth, white to grey, cream or pinkish, sometimes with a short persistent stocking on the lower trunk of larger individuals. Twigs and stems not or very weakly pruinose. Juvenile leaves to 7 cm long and 4 cm wide, opposite, sessile, elliptical, becoming ovate, cordate, apically rounded, with 'stellate hairs'. Adult leaves 3–10 cm long, 0.7–2.0 cm wide, opposite, lanceolate, acuminate, somewhat dorsiventral, glabrous, dull, not pruinose; petioles 5–13 mm long; lateral veins at c. 30–45° to midrib, moderately closely spaced; secondary reticulum incomplete; intramarginal vein irregular, c. 1 mm from leaf margin. Umbellasters simple, axillary, 3-flowered; peduncles terete or angular, 5–13 mm long; pedicels terete, 5–9 mm long. Mature buds clavate, not pruinose, 5–7 mm long, 3–5 mm diam.; calyx free, persistent as 4 small teeth around top of hypanthium on mature fruits. Stamens all fertile, in 4 fascicles; filaments regularly inflexed; anthers oblong, versatile, dehiscing through parallel slits. Fruits 3-locular, truncate-pyriform, slightly constricted apically, vaguely 4-angled, 10–15 mm long, 8–10 mm diam.; disc 1–1.5 mm wide, moderately depressed; valves enclosed, reduced, papery. Seeds irregular, angular, dull, brownish black, with a ragged translucent wing around the edge; hilum ventral; chaff angular, dark brown (Fig. 3 e,f).

*E. eudesmioides* is distinguished within the series by the small, lanceolate to broad-lanceolate, opposite, dull greyish but not pruinose adult leaves.

Intergrading populations with *E. gittinsii* are known.

**Distribution:** Murchison River south to near Mogumber, near-coastal in the north, but running inland south of the latitude of Three Springs (Fig. 4).

**Ecology:** locally frequent on sandy soils on sandplain over laterite, or on shallow sandy residuals over laterite.

**Conservation status:** not considered to be at risk. Well represented in conservation areas.



Fig. 3. *E. selachiana*: a, fruits, b, adult leaves (from Brooker 8129); *E. pallida*: c, fruits d, adult leaves (from Blaxell 1981 et al.); *E. eudesmiioides*: e, buds and adult leaves, f, fruits (e from Brooker 9194, f from Melville 4209). Scale bar = 1 cm.

**Selected specimens (from 53 examined):** Western Australia: 2.5 [4 km] miles N of Murchison River on Coastal Highway, *Beard 6717*, 7 Oct 1973 (PERTH, NSW); 10 km NW of Three Springs, *B. Briggs 7750 & Johnson*, 1 Oct 1984 (NSW, PERTH); Babilion Range, N of Mogumber, *Brooker 8524*, 23 Apr 1984 (CANB, NSW, PERTH); Nanson road, *Brooker 9194*, 12 Mar 1985 (CANB, NSW); 29.6 miles [48 km] E of Geraldton, *Chippendale 45*, 20 Oct 1966 (CANB, NSW); 8.3 miles [c. 13 km] N of Watheroo, *Chippendale 316*, 15 Mar 1968 (CANB, NSW); Mingenew, *Fitzgerald*, Sep 1903 (PERTH, NSW); 6 miles [10 km] SW of Mullewa, *Melville 4209 & Calaby*, 20 July 1953 (K, NSW); 1 mile [1.6 km] inland from Kalbarri, *Phillips CBG 39718*, 19 Sep 1968 (CANB, NSW); 14.3 miles [c. 23 km] S of Carnamah, *Tindale 1282*, 28 Mar 1970 (NSW, K, PERTH).

**E. eudesmioides–E. gittinsii intergrades**

**Selected specimens (from 9 examined):** Western Australia: 15.8 km W of Three Springs on Eneabba Road, *Blaxell 1996 & Johnson*, 28 May 1983 (NSW, AD, CANB, PERTH); 31 km W of Three Springs, W end of Nebru Road at junction with Moorlabby Road, *Briggs 7520 & Johnson*, 30 Sep 1984 (NSW, CANB, PERTH); Burma Road Nature Reserve, north side fence-line, *Brooker 7942*, 26 Jan 1983 (CANB, NSW); 11 km SE of Badgingarra on Moora road, *Wilson 2707 a*, 2 Oct 1979 (NSW).

**5. Eucalyptus pallida L.A.S. Johnson & K.D. Hill, sp. nov.**

Affinis *E. eudesmioides* sed characteribus sequentibus distinguitur: ramuli dense albo incerati, fructus plerumque minores et folia angustiora petiolis longioribus.

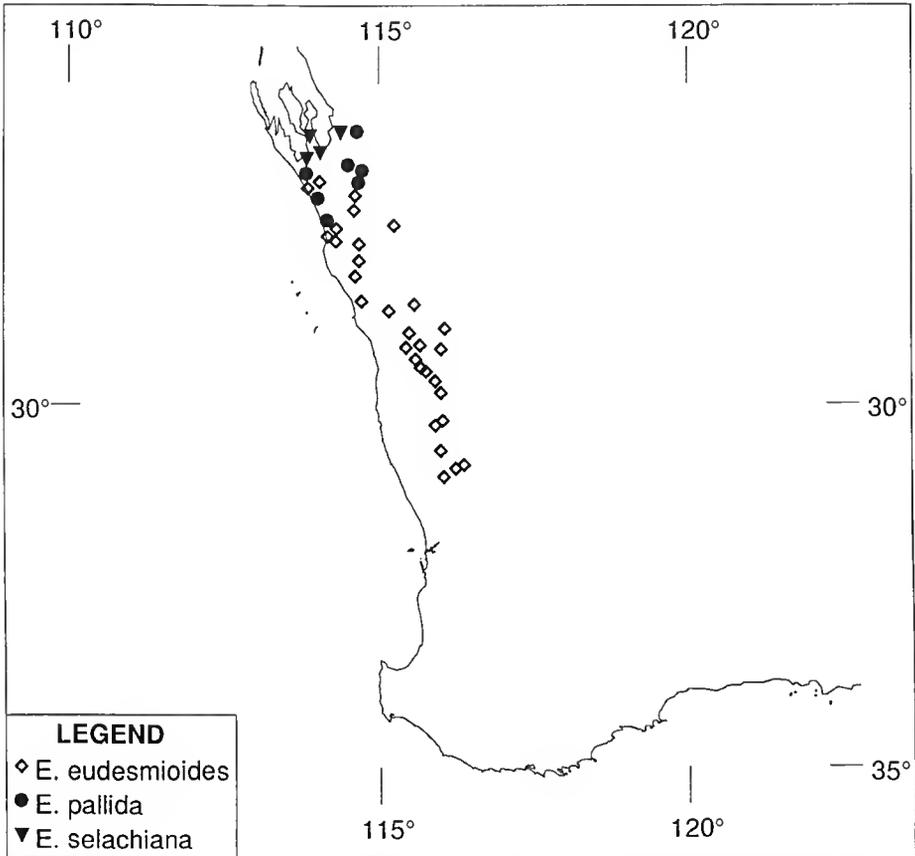


Fig. 4. Distribution of *E. pallida*, *E. selachiana*, *E. eudesmioides*.

Type: Western Australia: 8 km N of Wannoo on highway (26°49'S, 114°37'E), *D. Blaxell 1981*, *L. Johnson*, *I. Brooker*, *S. Hopper*, 26 May 1983 (holo NSW; iso CANB, MEL, PERTH).

Mallee to 8 m. Bark coarsely fibrous-flaky, light grey to about 2 m, smooth, white above. Twigs and stems strongly pruinose. Juvenile leaves 1.5–2.5 cm long, 1–1.5 cm wide, opposite, sessile, ovate to elliptic, cordate, apically rounded, with 'stellate hairs'. Adult leaves 4.5–10 cm long, 0.9–1.6 cm wide, opposite, lanceolate, acuminate, slightly dorsiventral, glabrous, dull, pruinose; petioles 5–9 mm long; lateral veins at c. 30–45° to midrib, moderately closely spaced; secondary reticulum incomplete; intramarginal vein irregular, c. 1 mm from leaf margin. Umbellasters simple, axillary, usually 3-flowered; peduncles terete, 4–9 mm long; pedicels terete, 2–5 mm long. Mature buds pruinose, clavate; calyx free, persistent as 4 small teeth around top of hypanthium on mature fruits. Stamens all fertile, in 4 fascicles; filaments regularly inflexed; anthers oblong, versatile, dehiscing through parallel slits. Fruits 3-locular, truncate-pyriform, slightly constricted apically, vaguely 4-sided, 8–10 mm long, 5–7 mm diam.; disc 1–1.5 mm wide, moderately depressed; valves enclosed, reduced, papery. Seeds irregular, angular, dull, brownish black, with a ragged translucent wing around the edge, hilum ventral, 2–4 mm long, 1.5–3 mm wide; chaff angular, dark brown, 1 mm long (Fig. 3 c, d).

*E. pallida* differs from *E. eudesmioides* in the dense white waxy coating on the stems, the generally smaller fruits, and the narrower leaves with longer petioles. It is also frequently a larger plant, consistently with a short stocking of persistent bark on the lower trunks. This taxon is referred to as the 'northern pallid subspecies' of *E. eudesmioides* by Brooker & Kleinig (1990). It does not intergrade with *E. eudesmioides* or *E. selachiana* (below).

**Distribution:** restricted to a small area north-east of Kalbarri and south-east of Hamelin Pool (Fig. 4).

**Ecology:** locally frequent on red aeolian sandhill country, of less coastal facies than that carrying *E. selachiana*.

**Conservation status:** not considered to be at risk. Although restricted in distribution, this species is common in remote areas that are unlikely to be disturbed.

The specific epithet is from the Latin *pallidus*, pale, referring to the light colour of the wax-covered branchlets.

**Selected specimens (from 13 examined):** Western Australia: 34 km E of 'Woodleigh' homestead, *Brooker 8640*, 29 Aug 1984 (CANB, NSW, PERTH); 150 miles [240 km] S of Carnarvon, *Olsen 558*, 3 Aug 1967 (NSW).

## 6. *Eucalyptus selachiana* L.A.S. Johnson & K.D. Hill, sp. nov.

Affinis *E. eudesmioides* sed characteribus sequentibus distinguitur: folia latiora nitidaque et fructus majores.

Type: Western Australia: Useless Loop road (26°30'S, 114°03'E), *M.I.H. Brooker 8129*, 26 May 1983 (holo NSW; iso CANB, PERTH).

Mallee to 3 m. Bark smooth, pale bronze and white. Adult leaves 6–8 cm long, 1.2–1.8 cm wide, opposite, lanceolate to broad-lanceolate, slightly dorsiventral, glabrous, markedly glossy, dark green; petioles 7–16 mm long; lateral veins at 30–40° to midrib, moderately closely spaced; secondary reticulum irregular and incomplete; intramarginal vein distinct, looped between lateral veins, 1.0–2.5 mm from leaf margin, usually with some reticulation between vein and margin. Umbellasters simple, axillary, 3-flowered; peduncles terete, 5–7 mm long; pedicels terete, 3–5 mm long. Calyx free, persisting as 4 small teeth around top of hypanthium on mature fruits. Stamens all fertile, in 4 fascicles; filaments regularly inflexed; anthers oblong,

versatile, dehiscing through parallel slits. Fruits 3-locular, truncate-pyriform to cylindrical, apically constricted, vaguely 4-sided, 11–14 mm long, 9–11 mm diam.; disc 1.5–2.5 mm wide, moderately depressed; valves enclosed. Seeds irregular, angular, dull, brownish black, with a ragged translucent wing around the edge; hilum ventral; chaff angular, dark brown (Fig. 3 a,b).

*E. selachiana* differs from *E. eudesmioides* in the broader, glossy green leaves and the larger fruits. This taxon is referred to as the 'northern glossy subspecies' of *E. eudesmioides* by Brooker & Kleinig (1990).

**Distribution:** known only from a small area immediately to the south-east of Shark Bay (Fig. 4).

**Ecology:** locally frequent in subcoastal scleromorphic communities on calcareous red aeolian sand, sometimes with subsurface calcrete, with *E. roycei* D. Carr, S. Carr & A.S. George and *E. mannensis* subsp. *vespertina* L.A.S. Johnson & K.D. Hill.

**Conservation status:** 2R. Although restricted, this species occurs in a remote area which is not likely to be disturbed.

The specific epithet is from the neo-Latin zoological group name *Selachii*, sharks and related fishes, ultimately from the Greek *selachos*, a shark or similar fish, in reference to the species' occurrence near Shark Bay. The 'ch' is pronounced hard, as in 'chemistry'.

**Selected specimens (from 7 examined):** Western Australia: 'Tamala' station road, off Shark Bay road, Blaxell 1983, Johnson, Brooker & Hopper, 26 May 1983 (NSW); c. 22 km N of 'Overlander' roadhouse, *Boomsma* 334A, 28 June 1978 (AD, NSW).

### Subseries *Tetragonosae*

Juvenile leaves opposite, petiolate. Oil glands present in bark. Calyptra and hypanthium similar in colour. Stigmatic papillae short. Filaments cream to yellowish. Disc steeply depressed in fruit.

Four species are included in the subseries.

7. *Eucalyptus gittinsii* Brooker & Blaxell, *Nuytsia* 2(4): 228, Fig. 5 (1978).

Type: Western Australia: 67 km S of 'Billabong Roadhouse', Wannoo, Highway 1 (27°30'S, 114°45'E), D.F. Blaxell W75/113, 9 Oct 1975 (holo NSW; iso CANB, K, PERTH).

Mallee to 5 m. Bark smooth, grey-brown, sometimes with a persistent stocking on the lower trunk of larger individuals. Young shoots angular, not pruinose. Juvenile leaves elliptical to ovate, to 9 cm long, 4 cm wide, petiolate, dull greyish, becoming broad-lanceolate, to 15 cm long, 6 cm wide. Adult leaves 7–14 cm long, 1.2–3 cm wide, coriaceous, lanceolate, acuminate, glossy or sub-glossy, not pruinose, green to yellow-green, sub-opposite to disjunct; petioles narrowly flattened, 10–24 mm long; lateral veins at 30–40° to midrib, moderately closely spaced; secondary reticulum irregular and incomplete; intramarginal vein distinct, looped between lateral veins. Inflorescences simple, axillary; umbellasters 3-flowered; peduncles 5–18 mm long; pedicels 5–12 mm long, both narrowly 2-winged. Buds not pruinose, clavate, 5–8 mm long, 4–6 mm diam.; calyptra about  $\frac{1}{4}$ – $\frac{1}{3}$  as long as hypanthium, shallowly hemispherical. Calyx free, persisting as 4 small teeth around top of hypanthium on mature fruits. Stamens all fertile, in 4 fascicles; filaments regularly inflexed; anthers oblong, versatile, dehiscing through parallel slits. Fruits ovoid to elongate-ovoid, often narrowly 2-winged or ridged, 12–20 mm long, 8–12 mm diam., 4-locular; disc vertically depressed. Seeds irregular, angular, dull, dark brownish black, with a ragged translucent wing around the edge; hilum ventral; chaff angular, dark brown.

*E. gittinsii* is distinguished within the series by the often disjunct, green to yellow-green, generally more or less glossy leaves, the lack of pruinosity, and the medium to large leaves, buds and fruits. *E. selachiana* has similar glossy, non-pruinose leaves, but these are opposite and smaller, and buds and fruits are smaller.

**Distribution:** apparently disjunct, with one area of occurrence around the Murchison River and north to the type locality, and the other from the Greenough River south to near Mogumber (Fig. 5).

**Ecology:** locally frequent in tall mallee shrub-heath communities on deep red aeolian sand deposits in the north of the range, in lower shrub heath on shallow sandplains or skeletal sands over laterite in the south.

**Conservation status:** not considered to be at risk. Locally frequent and well-represented in conserved areas.

**Selected specimens (from 32 examined):** Western Australia: Hawkshead Lookout, Kalbarri Natl Park, *Bedford* 587, 31 Oct 1985 (NSW, CANB, PERTH); 9 km NW of Three Springs, *B. Briggs* 7748 & *Johnson*, 1 Oct 1984 (NSW, PERTH); 7 km W of Brand Highway on Cadda Road to Cervantes, *Brooker* 7928, 24 Jan 1983 (CANB, NSW, PERTH); Burma Road Nature Reserve, north side fence line, *Brooker* 7942, 26 Jan 1983 (CANB, NSW, PERTH); 2 km W of Brand Highway on Green Head Road, *Crisp* 5415, 24 Jan 1979 (CANB, NSW, PERTH); Babilion Hills, near Mogumber, *Gardner* 1886, 20 Dec 1922 (PERTH, NSW); 41 miles [65 km] S of Wannoo roadhouse, *Gittins* 1562, Aug 1967 (NSW); NW slope of Mt Michaud, *Hill* 2949, 29 Aug 1988 (NSW).

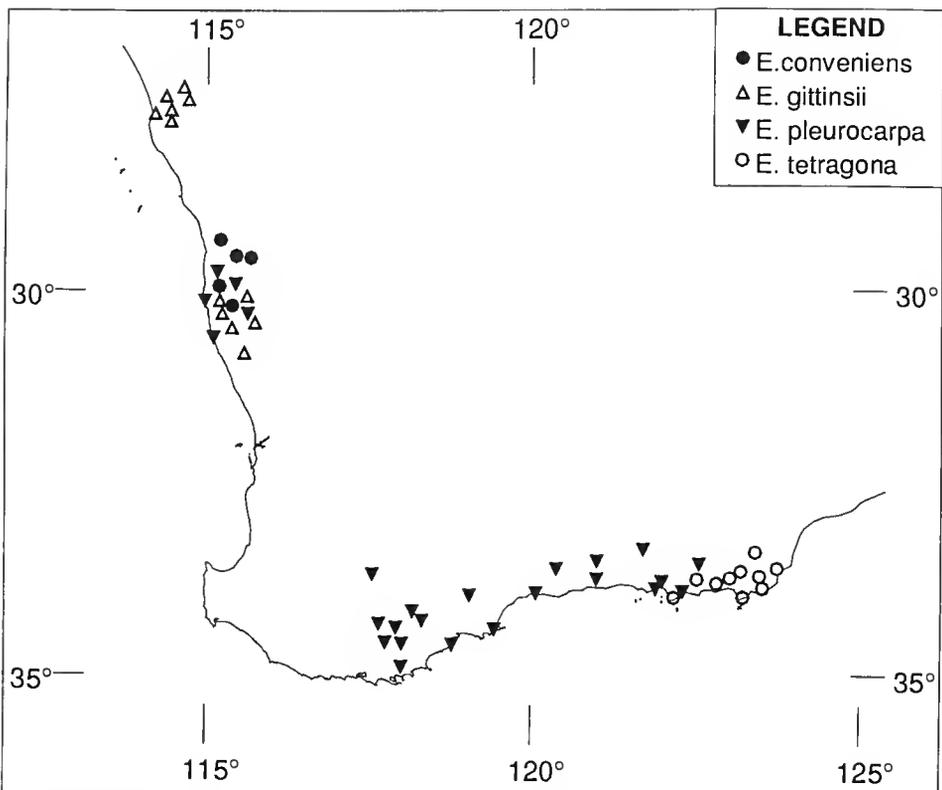


Fig. 5. Distribution of *E. tetragona*, *E. pleurocarpa*, *E. conveniens* and *E. gittinsii*.

### 8. *Eucalyptus conveniens* L.A.S. Johnson & K.D. Hill, sp. nov.

Ab *E. tetragona* fructibus minoribus et foliis minoribus proportione angustioribus, ab *E. gittinsii* foliis non nitentibus sed glaucis vel pruinosis, distinguitur.

Type: Western Australia: Moorlabby Road 22 km S of Midlands Highway, B.G. Briggs 2506 & L.A.S. Johnson, 30 Sep 1984 (holo NSW; iso AD, CANB, PERTH).

[*Eucalyptus* sp. A of Brooker & Kleinig (1990)]

Mallee to 2.5 m. Bark smooth, grey-brown. Young shoots angular, pruinose. Leaves, buds and fruits often pruinose. Juvenile leaves to 9 cm long, 5 cm wide, ovate, petiolate. Adult leaves 6–12 cm long, 1.5–3.5 cm wide, coriaceous, broad-lanceolate to ovate, opposite to subopposite, acute to apiculate, dull grey-green, pruinose; petioles broadly flattened, 15–30 mm long; lateral veins at 30–40° to midrib, moderately closely spaced; secondary reticulum irregular and incomplete; intramarginal vein distinct, looped between lateral veins. Inflorescences simple, axillary; umbellasters 3-flowered; peduncles 6–11 mm long; pedicels 4–7 mm long, both narrowly 2-winged. Buds pruinose, clavate, 7–8 mm long, 5–6 mm diam.; calyptra about half as long as hypanthium, hemispherical. Calyx free, persisting as 4 small teeth around top of hypanthium on mature fruits. Stamens all fertile, in 4 fascicles; filaments regularly inflexed; anthers oblong, versatile, dehiscing through parallel slits. Fruits ovoid to elongate-ovoid, often narrowly 2-winged or ridged, 10–18 mm long, 8–11 mm diam., 4-locular; disc vertically depressed. Seeds irregular, angular, dull, dark brownish black, with a ragged translucent wing around the edge; hilum ventral; chaff angular, dark brown (Fig. 6).

*E. conveniens* is distinguished from *E. pleurocarpa* Schauer by the smaller buds and fruits (buds to 10 mm long, 8 mm diam., fruits to 25 mm long, 22 mm diam. in *E. pleurocarpa*), and the smaller and proportionately narrower leaves. *E. conveniens* differs from *E. tetragona* s. orig. et stricto (distinguished below from *E. pleurocarpa*) in the smaller, narrower leaves, the shorter pedicels and peduncles, and the smaller buds and fruits. It usually retains more pruinosity, seldom seen in *E. tetragona* except on very young shoots.

This taxon has been regarded as a hybrid between *E. pleurocarpa* and *E. gittinsii* Brooker & Blaxell, but closer field examination shows that considerable uniform populations exist. These may have originated as hybrids, but, if so, are now stable and self-sustaining, and hence may be recognised as a species. It seems just as likely that *E. conveniens* is essentially a northern equivalent of *E. tetragona*. *E. gittinsii* differs in the glossier leaves and lack of pruinosity.

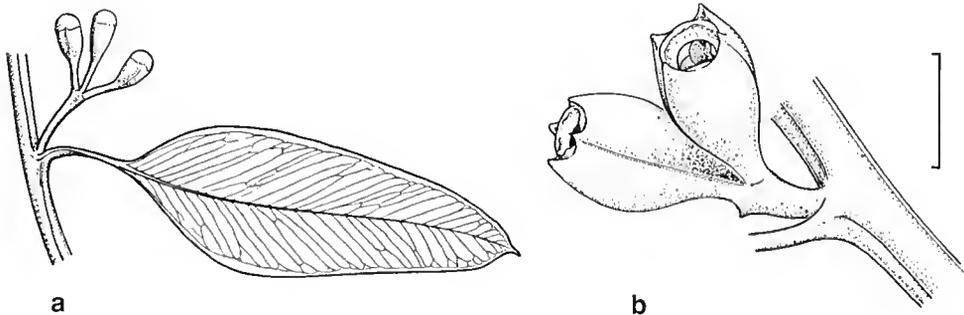


Fig. 6. *E. conveniens*. a, adult leaves and buds. b, fruits (a from Brooker 7950, b from Brooker 7204).

**Distribution:** restricted to the west coast of Western Australia, from around Mt Adams south to near Badgingarra (Fig. 5).

**Ecology:** locally frequent in mallee heath communities on sand plains.

**Conservation status:** not considered to be at risk. Locally frequent and well-represented in conserved areas.

The epithet is from the Latin *conveniens*, coming together, in reference to its somewhat intermediate position between *E. tetragona* and *E. gittinsii*.

**Selected specimens (from 11 examined):** Western Australia: Mt Adams Nature Reserve, *Blaxell* 1983, *Johnson, Brooker & Hopper*, 28 May 1983 (NSW, CANB, PERTH); 36.1 km N of hill River crossing on highway, *Brooker* 7204, 17 Nov 1981 (CANB, NSW, PERTH); 'Hivalley Farm', Tootbardi Road, N of Badgingarra, *Brooker* 7651, 21 Sep 1982 (CANB, NSW, PERTH); opposite proposed Mt Adams Nature Reserve, eastern side, *Brooker* 7950, 26 Jan 1983 (CANB, NSW, PERTH); c. 15 km from Three Springs on Eneabba road, *Hill* 2559, *Johnson, Blaxell & Brooker*, 21 Nov 1986 (NSW, PERTH).

9. *Eucalyptus tetragona* (R. Br.) F. Muell., *Fragm.* 4: 51 (1864).

≡ *Endesmia tetragona* R. Br., *Appendix Flinders Voyage*, 2:599 (1814), t. 3.

**Type:** Western Australia: Lucky Bay, *R. Brown (Bennett 4807)*, 13 Jan 1802 (holo BM; iso K). Although the type is from an area where intergradation between *E. tetragona* and *E. pleurocarpa* is known, the leaf, fruit, pedicel and peduncle shape and dimensions, together with the lack of any mention of marked pruinosity of stems, buds or fruits place it clearly with the eastern taxon.

[*Eucalyptus* sp. B of *Brooker & Kleinig* (1990)]

Mallee to 2 m, usually less than 1.5 m, often procumbent. Bark smooth, grey-brown. Young shoots quadrangular, often glaucous or pruinose. Juvenile leaves to 10 cm long and 6 cm wide, opposite, elliptical to ovate. Adult leaves 6–14 cm long, 2.5–5 cm wide, opposite, coriaceous, broad-lanceolate to ovate, acute to apiculate, dull green; petioles 15–30 mm long; lateral veins at 30–40° to midrib, moderately closely spaced; secondary reticulum irregular and incomplete; intramarginal vein distinct, looped between lateral veins. Inflorescences simple, axillary; umbellasters 3-flowered; peduncles 15–20 mm long; pedicels 7–20 mm long, both narrowly 2-winged. Buds ovoid to clavate, not pruinose, 8–10 mm long, 6–7 mm diam.; calyptra about half as long as hypanthium, hemispherical. Calyx free, persisting as 4 small teeth around top of hypanthium on mature fruits. Stamens all fertile, in 4 fascicles; filaments regularly inflexed; anthers oblong, versatile, dehiscing through parallel slits. Fruits ovoid, often narrowly 2- or 4-winged or ridged, 16–24 mm long, 13–18 mm diam., 4-locular; disc vertically depressed. Seeds irregular, angular, dull, brownish black, with a ragged translucent wing around the edge; hilum ventral; chaff angular, dark brown (Fig. 7).

*E. tetragona* is distinguished from *E. pleurocarpa* Schauer by the ovoid rather than globose fruits with generally longer pedicels and peduncles, the smaller and proportionally narrower leaves (leaves on mature plants of *E. pleurocarpa* are elliptical, to 13 cm long, 7 cm wide), and by the pruinosity being limited to very young growth. Mature adult leaves are consequently dull green rather than whitish- or bluish-grey.

**Distribution:** this species occurs on the south coast of Western Australia, from Lucky Bay to Israelite Bay, and possibly further east (Fig. 5).

**Ecology:** restricted to coastal heath communities on sand plains. This species occurs along the coast in country near Condingup, with *E. pleurocarpa* replacing it further inland. To the east of there, *E. tetragona* wholly replaces *E. pleurocarpa*. The intergradation found in contact areas is quite limited, but does occur near Lucky Bay.

**Conservation status:** not considered to be at risk. This species is abundant in several large national parks.

**Selected specimens (from 21 examined):** Western Australia: 10 miles [16 km] NE of Condingup, *Beard* 6347, 16 Sep 1970 (PERTH, NSW); Lucky Bay, Cape le Grand National Park, *Blaxell* 1684, 22 June 1978 (NSW, CANB, PERTH); 2.5 km S of Tower Peak, Ragged Range, *Crisp* 4827, 6 Jan 1979 (CBG, CANB, NSW, PERTH); 300 metres E of old 'Hill Spring' homestead, SE Mt Arid, *Hill* 3164, 8 Sep 1988 (NSW); slopes of Mt Ragged, *Powell* 3489, *Everett & Bedford*, 24 Nov 1985 (NSW, CANB, PERTH); 8.4 km W of Israelite Bay, *Pryor & J. Briggs s.n.*, 26 Oct 1978 (NSW 340822); Boyatup Hill, *Pullen* 10087, 18 Dec 1984 (CANB, NSW, PERTH); between Hopetoun and E Mt Barren, *Strid* 21896, 2 Jan 1983 (NSW).



**Fig. 7.** *E. tetragona*. **a**, adult leaves and buds. **b**, transverse section of bud. **c**, **d**, anther. **e**, adult leaves and fruits (**a**, **c**, **d**, **e** from *Crisp* 4827, **b** from *Pryor & Briggs* NSW 340822). Scale bar: **a**, **e** = 1 cm; **b** = 5 mm; **c**, **d** = 0.5 mm.

10. *Eucalyptus pleurocarpa* Schauer, in *Lehm., Pl. Preiss.* 1: 132 (1844).

Type: Cited as 'In glareosis sterilibus ad radices collium Konkoberup promontorii Cape Riche, Novembri a. 1840 fructifera. Herb. Preiss. No. 253.' Although this specimen has not been seen in the Preiss herbarium in recent times, we have studied populations corresponding with the protologue at the type locality, and have no doubt that they represent the common 'Tallerack' of the south-west.

Included in *E. tetragona* by Bentham (1867).

Mallee to 5 m, usually with long erect trunks and small, bushy canopy. Bark smooth, grey to pale grey-brown or yellow-brown. Young shoots quadrangular, strongly pruinose. Juvenile leaves initially hairy, opposite, elliptical, becoming glabrous and similar to adult leaves. Adult leaves 5–13 cm long, 3–7 cm wide, opposite or subopposite, coriaceous, broadly elliptical, apiculate, dull grey and strongly pruinose; petioles broadly flattened, 7–20 mm long; lateral veins at 40–60° to midrib, moderately closely spaced; secondary reticulum irregular and incomplete; intramarginal vein distinct, looped between lateral veins. Inflorescences simple, axillary; umbellasters 3-flowered; peduncles 5–15 mm long; pedicels 4–10 mm long, both 2-winged. Buds strongly pruinose, ovoid to clavate, 7–9 mm long, 5–7 mm diam.; calyptra about half as long as hypanthium, hemispherical. Calyx free, persisting as 4 small teeth around top of hypanthium on mature fruits. Stamens all fertile, in 4 fascicles; filaments regularly inflexed; anthers oblong, versatile, dehiscing by parallel slits. Fruits ovoid, often narrowly 2- or 4-winged or ridged, 13–24 mm long, 10–21 mm diam., 4-locular; disc vertically depressed. Seeds irregular, angular, dull, brownish black, with a ragged translucent wing around the edge; hilum ventral; chaff angular, dark brown (Fig. 8).

*E. pleurocarpa* is distinguished within the subseries by the globose fruits with short pedicels and peduncles, the ovate to elliptic adult leaves, and by the strong pruinosity on all parts.

**Distribution:** this species occurs in a zone from about Katanning south-east to Bremer Bay, and east to Lucky Bay, with an outlying northern population from about Eneabba to south of Badgingarra (Fig. 5). In the east, it runs somewhat inland around

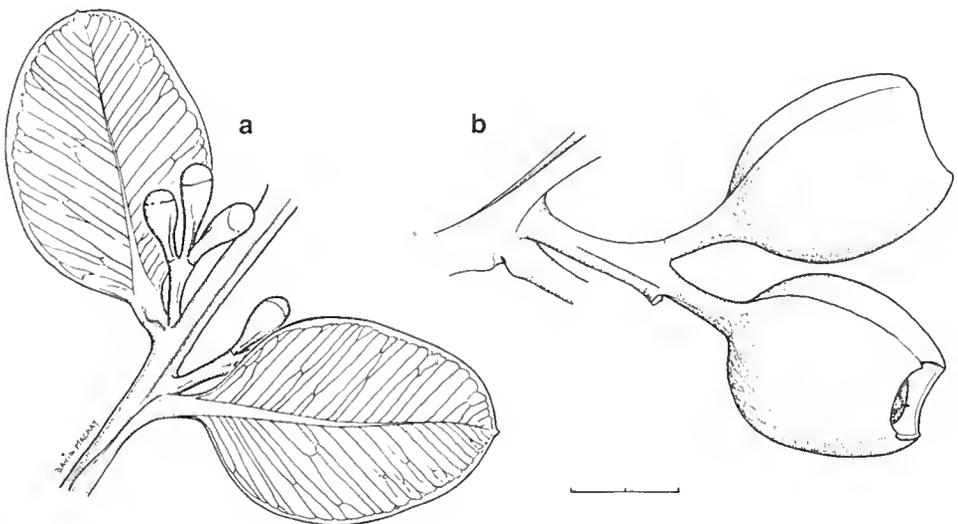


Fig. 8. *E. pleurocarpa*. a, adult leaves and buds. b, fruits (from *Strid 21896*). Scale bar = 1 cm.

Condungup, with *E. tetragona* replacing it along the coast. To the east of there, *E. tetragona* wholly replaces *E. pleurocarpa*. The intergradation found in contact areas is quite limited, but does occur near Lucky Bay.

**Ecology:** restricted to shrub-heath communities on grey or white sand plain country, often in lower areas or sites with slightly impeded drainage.

**Conservation status:** not considered to be at risk. This species is abundant in several large national parks.

**Selected specimens (from 37 examined):** Western Australia: 48 km S of Jurien Bay, *Beadle 178*, 9 Oct 1972 (NSW); c. 15 km E of Esperance on Cape Le Grand road, *Blaxell 1680*, 22 June 1978 (NSW); Brand Highway, 16 km S of Eneabba, *B. Briggs 7722 & Johnson*, 30 Sp 1984 (NSW, PERTH); 22.3 miles [33 km] S of Salmon Gums, *Chippendale 181*, 13 Mar 1967 (CANB, NSW); 22.7 km NW of Muntz Road on Howick Road (33°33'S 122°34'E), *Hill 284 & Johnson*, 21 Oct 1983 (NSW); 12.4 km E Amelup, on Sandalwood Road, *Hill 2435, Johnson & Blaxell*, 12 Nov 1986 (NSW, PERTH); Mt Barker to Woogenellup, *Johnson W82*, 13 Dec 1960 (NSW); Katanning, *Stoward*, Sep 1914 (NSW); between Hopetoun and E Mount Barren, *Strid 21896*, 2 Jan 1983 (NSW); Bremer Bay, *Thorne*, Jan 1970 (NSW); 14.1 km SE of Jerdacuttup River crossing on Ravensthorpe–Esperance road, *Tindale 3812*, 29 Aug 1973 (NSW).

### Subseries *Erythrocorystosae*

Bark smooth; lacking oil glands. Inflorescence simple, 3-flowered. Calyptra red, with prominent cruciform ridges. Filaments yellow-green. Stigmatic papillae long. Disc level or raised in fruit.

A monotypic subseries, related to but clearly distinct from the other subseries.

#### 11. *Eucalyptus erythrocorystos* F. Muell., *Fragm.* 2: 33 (1860).

Type: Western Australia: Murchison R., *A. Oldfield s.n.* (holo MEL; iso K).

[*Eudesmia erythrocorystos* F. Muell., *Fragm.* 2: 33 (1860), nom. invalid., in syn. *Eucalyptus erythrocorystos*]

Tree or stout few-stemmed mallee to 8 m. Bark smooth, grey or cream to pale grey-brown; sometimes irregularly persistent in flaky patches. Juvenile leaves to 10 cm long and 5 cm wide, opposite, petiolate, ovate, green, densely hispid with 'stellate hairs'. Adult leaves 12–20 cm long, 1.2–3 cm wide, opposite or subopposite, coriaceous, narrow-lanceolate to lanceolate, acuminate, glossy, green; petioles 10–30 mm long; lateral veins at 30–40° to midrib, moderately closely spaced; secondary reticulum irregular and incomplete; intramarginal vein distinct, looped between lateral veins. Inflorescences simple, axillary; umbellasters 3-flowered; peduncles 15–30 mm long; pedicels 5–10 mm long, both 2-winged. Buds broadly campanulate, 25–35 mm long, 15–25 mm diam.; calyptra about half as long as hypanthium, shallowly hemispherical, 4-lobed with cruciform ridging, red; hypanthium green. Calyx free, persisting as 4 small teeth around top of hypanthium on mature fruits. Stamens all fertile, in 4 fascicles; filaments regularly inflexed, yellow-green; anthers oblong, versatile, dehiscing by parallel slits. Fruits broadly campanulate, apically broadly 4-lobed, 25–45 mm long, 30–50 mm diam., 4-locular; disc level to domed. Seeds irregular, angular, dull, brownish black, sometimes with a ragged translucent wing around the edge; hilum ventral; chaff angular, dark brown.

**Distribution:** Greenough River south to Hill River, in subcoastal areas (Fig. 9).

**Ecology:** a small tree or tall, few-stemmed 'Bull Mallee', locally abundant in mallee woodland thickets on calcareous sand of old beach dune systems, often partly indurated to form 'sheet limestone' in the soil. Known as 'Illyrarrie' and widely cultivated for its conspicuous flowers and pleasant general appearance.

**Conservation status:** not considered to be at risk.

**Selected specimens (from 28 examined):** Western Australia: Enneabba to Dongarra on highway, *Blaxell W75/90*, 7 Oct 1975 (NSW, PERTH); 14 km NNE of Dongarra, *Brooker 8115*, 24 May 1983 (CANB, NSW, PERTH); Bookara siding, *Johnson W41*, 11 Dec 1960 (NSW).

### Series Jucundae

This series, although formerly misunderstood by us also, does not correspond with the group called series *Jucundae* by Chippendale (1988), the latter not a part of our extracodical system — see 'Terminology' above. The single species appears to have most in common with the groups here retained in our section *Eudesmia*, which is not necessarily fully supported by synapomorphies. However, it differs from all other series in its perianth development and structure, showing what we interpret as a parallel evolutionary condition to that in the members of *Leprolaena* (the *E. miniata*-*E. baileyana* group) as indicated and discussed by Hill & Johnson (1995, esp. pp. 188-193 and 481).

Bark smooth, with oil glands. Juvenile leaves petiolate, hispid with radiating hairs. Unit inflorescences axillary, often appearing compound, made up of three 3-flowered 'umbellasters', sometimes appearing simple and 9-flowered. Calyx fused to corolla, sometimes evident as 4 small teeth at apex of calyptra. Stamens continuous. Filaments white or cream.

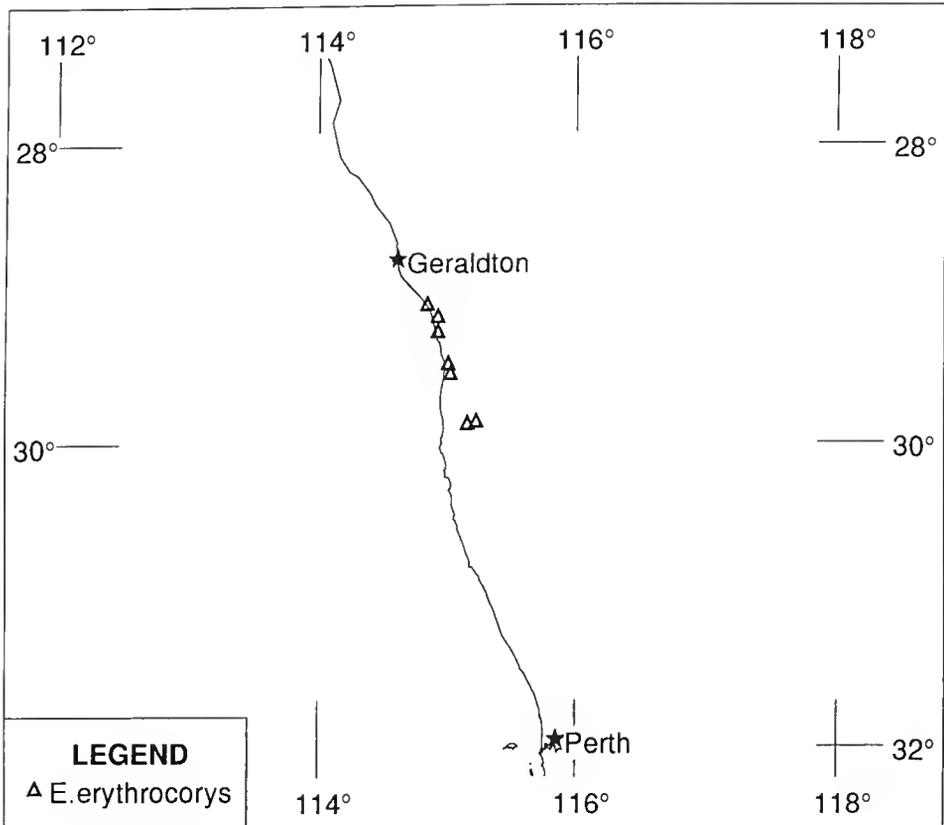


Fig. 9. Distribution of *E. erythrocorys*.

In this and the following series, unit inflorescences often appear compound, but the limits of 'umbellasters' are not well-defined (as is true in a number of cases in section *Eudesmia*).

**12. *Eucalyptus jucunda*** C. Gardner, J. & Proc. Roy. Soc. Western Australia 47: 60 (1964).

Type: Western Australia: near the Greenough River, C.A. Gardner 12066, 6 Jan 1959 (holo PERTH).

Mallee or small tree to 7 m, usually less than 4 m. Bark smooth, grey, grey-brown or pinkish brown, occasionally persistent on lower trunk, grey, shortly fibrous-flaky. Twigs and stems not pruinose. Juvenile leaves to 9 cm long, to 4.5 cm wide, opposite, petiolate, elliptical, becoming ovate, apically rounded, with 'stellate hairs'. Adult leaves 7–11 cm long, 7–20 mm wide, disjunct, narrow-lanceolate to lanceolate, acuminate, glabrous, dull, mid-green to grey-green, not pruinose; petioles 9–20 mm long; lateral veins at c. 30° to midrib, moderately closely spaced; secondary reticulum incomplete; intramarginal vein irregular, 1–2 mm from leaf margin. Umbellasters compound (see above), axillary, 9-flowered; peduncles terete, 5–12 mm long; pedicels angular, 2–5 mm long. Mature buds ovoid to clavate, not quadrangular, not glaucous, 9–12 mm long, 6–8 mm diam.; calyx fused to corolla, persistent as 4 small teeth around top of calyptra on mature buds; calyptra hemispherical, c.  $\frac{1}{3}$  as long as than hypanthium. Stamens all fertile; filaments regularly inflexed, white or cream; anthers oblong, versatile, dehiscing through parallel slits. Fruits 3-locular, subglobose to ovoid, constricted apically, 10–15 mm long, 10–13 mm diam.; disc 2–4 mm wide, strongly depressed; valves deeply enclosed. Seeds irregularly pyramidal, angular, dull, brownish black, with a ragged translucent wing around the edge; hilum ventral; chaff angular, dark brown.

**Distribution:** between Wannoo and Enneabba (Fig. 10).

**Ecology:** locally frequent on yellow sandplain in species-rich mixed shrublands. For apparent involvement in the ancestry of *E. roycei*, see under that species.

**Conservation status:** not considered to be at risk.

**Selected specimens (from 27 examined):** Western Australia: 67 km S of Wannoo, North Coastal Highway, N of Geraldton, *Blaxell W 75/112 & Brooker*, 9 Oct 1975 (NSW, PERTH); between Morawa and Three Springs, *Brooker 8731*, 1 Nov 1984 (CANB, NSW); 90 miles [114.9 km] N of Murchison River Bridge, *Burbidge 6514*, 3 Sep 1959 (CANB, NSW); 7.9 miles [12.7 km] WSW of Tenindewa Siding, *Chippendale 325*, 17 Mar 1968 (CANB, NSW); 18 km N of Yuna on the Dairy Creek, Gascoyne Junction Road, *Foreman 631*, 10 Sep 1984 (MEL, AD, CANB, NSW, PERTH); Western Titanium leases, 8 km S of Enneabba, *Hnatiuk 771336*, 21 Sep 1977 (PERTH, NSW); 5 km along road to The Loop from junction with The Z Bend Road, *Johnson 9400 & Briggs*, 12 Aug 1991 (NSW, PERTH CANB); Mullewa, *Steedman 2*, 30 Jan 1940 (NSW, AD, BRI, CANB, K, MEL, MO, PERTH); 413 Mile Peg on NW Coastal Highway, c. 30 miles [48.3 km] N of Murchison River Crossing, *Tindale 2740*, 21 Aug 1973 (NSW, CANB, K, MEL, PERTH).

### Series Royceanae

Bark smooth, with oil glands. Juvenile leaves petiolate, hairy. Unit inflorescences axillary, often appearing compound, made up of three 3-flowered 'umbellasters', sometimes appearing simple and 9-flowered. Calyx irregularly fused to corolla, usually evident as 4 small teeth at apex of calyptra. Stamens continuous. Filaments white or cream.

**13. *Eucalyptus roycei*** S.G.M. Carr, D.J. Carr & A.S. George, Proc. Roy. Soc. Victoria 83: 159, Figs. 2–8 (1970).

Type: Western Australia: near Hamelin Pool, 32.5 miles [52.3 km] along Loop Road, 64 miles [103.0 km] W of Overlander Road House, Great Northern Highway, *E.M.*

*Scrymgeour 284 & S.G.M. Carr, 2 Mar 1966 (holo PERTH; iso NSW). Cited as: 'E.M. Scrymgeour and S.G.M. Carr 284. PERTH.'*

Mallee or small tree to 7 m, usually less than 4 m. Bark often persistent on lower trunk, grey, shortly fibrous-flaky, smooth above, grey, brownish cream or pinkish. Twigs and stems pruinose. Juvenile leaves to 8 cm long and 6 cm wide, opposite, petiolate, elliptical, becoming ovate to orbiculate, cordate, apically rounded, with 'stellate hairs'. Adult leaves 11–15 cm long, 1.4–2.8 cm wide, sub-opposite to disjunct, lanceolate to broad-lanceolate, acuminate, glabrous, dull, mid-green to grey-green, not pruinose; petioles 9–30 mm long; lateral veins at 30–40° to midrib, moderately closely spaced; secondary reticulum incomplete; intramarginal vein irregular, c. 1 mm from leaf margin. Umbellasters compound (see above), axillary, 9-flowered; peduncles terete or angular, 9–20 mm long; pedicels angular, 2–5 mm long. Mature buds clavate, quadrangular, glaucous, 15–20 mm long, 7–11 mm diam.; calyx fused to corolla to a varying height, distinguishable at least as 4 small teeth around or near top of calyptra on mature buds; calyptra hemispherical, c.  $\frac{1}{3}$  as long as than hypanthium. Stamens all fertile; filaments regularly inflexed, white or cream; anthers oblong, versatile, dehiscing through parallel slits. Fruits 3-locular, subglobose to oblong, quadrangular, constricted apically, 17–30 mm long, 15–25 mm diam.; disc 2–4 mm wide, strongly depressed; valves deeply enclosed. Seeds irregularly pyramidal, angular, dull, brownish black, with a ragged translucent wing around the edge; hilum ventral; chaff angular, dark brown.

The irregular degree of fusion between calyx and corolla points to an origin from hybridisation between *E. gittinsii* (subseries *Tetragonousae*) and *E. jucunda* (series *Jucundae*). These two species have not been observed growing in company at sites of *E. roycei* seen by us, but populations of *E. roycei* show a degree of instability in reproductive and vegetative characters that would indicate hybridisation not too far in the past, despite the fairly strong differences in appearance between the taxa.

**Distribution:** a restricted area south-east of Shark Bay and north-west of Wannoo (Fig. 10).

**Ecology:** an uncommon species in species-rich mixed shrublands on somewhat calcareous orange or red aeolian sand deposits.

**Conservation status:** not considered to be at risk.

**Selected specimens (from 11 examined):** Western Australia: between Hamelin and Tamala, *Beard 6793*, 10 Oct 1973 (PERTH, NSW); 23 km from Coburn to Hamelin, Shark Bay, *Blaxell W 75/102*, 8 Oct 1975 (NSW, K, PERTH); 17 km NNW of Coburn Station, *Brooker 5013 & Blaxell*, 8 Oct 1975 (CANB, NSW); 9 km W of Coburn [homestead], *Brooker 8132*, 27 May 1983 (CANB, NSW); Tamala road 2.7 km S W of Denham road, *Johnson 9376 & Briggs*, 10 Aug 1991 (NSW, PERTH); Tamala [Homestead], Sharks Bay, *Kruiskamp* (NSW); 35.5 miles [57.1 km] along Loop Road from Coastal Highway, *Scrymgeour 297*, 2 Mar 1966 (PERTH, NSW); 32.9 miles [53.0 km] along Loop Road, 64 miles [103.0 km] W of Overlander Road House, Great Northern Highway, *Scrymgeour 293*, 2 Mar 1966 (PERTH, NSW).

### Series Ebbanoenses

This has the same content as the series of the same name described by Chippendale (1988), although no subspecies were recognised by him. We repeat that the series as recognised by Chippendale are not part of our extracodical series.

Bark smooth, with oil glands. Juvenile leaves petiolate, disjunct. Conflorescences axillary, simple, 3-flowered. Calyx fused to corolla, sometimes evident as 4 suture lines on calyptra. Stamens in 4 bundles. Filaments white or cream.

A single species is included in this series.

14. *Eucalyptus ebbanoensis* Maiden, Crit. Revis. Eucalyptus 5: 169, plate 189, Figs. 6, 7 (1921).

Type: Western Australia: Ebbano, east from Mingenew, A. Morrison s.n., 28 Sep 1904 (holo NSW 341209).

Mallee to 6 m, usually less than 4 m. Bark smooth, grey, grey-brown or bronze, sometimes with a short persistent stocking on the lower trunk of larger individuals. Juvenile leaves to 10 cm long and 4 cm wide, disjunct, petiolate, narrowly elliptical, apically rounded, with 'stellate hairs'. Adult leaves 5-12 cm long, 0.7-2.2 cm wide, disjunct, narrow-lanceolate to lanceolate, acuminate, glabrous; petioles 8-15 mm long; lateral veins at c. 30° to midrib, moderately closely spaced; secondary reticulum incomplete; intramarginal vein irregular, c. 1 mm or less from leaf margin. Umbellasters simple, axillary, 3-flowered; peduncles terete or angular, 5-13 mm long; pedicels terete, 1-6 mm long. Mature buds ovoid to pyriform, 6-8 mm long, 4-5 mm diam.; calyx free, often difficult to discern but persistent as 4 or often only 2 small teeth around top of hypanthium on mature fruits; calyptra hemispherical, 1/2 to about as long as hypanthium, usually with 4 calycine suture lines evident. Stamens all fertile, in 4 fascicles; filaments regularly inflexed; anthers oblong, versatile, dehiscing through parallel slits. Fruits 3-locular, globular-truncate to cup-shaped, 7-11 mm long, 8-12 mm

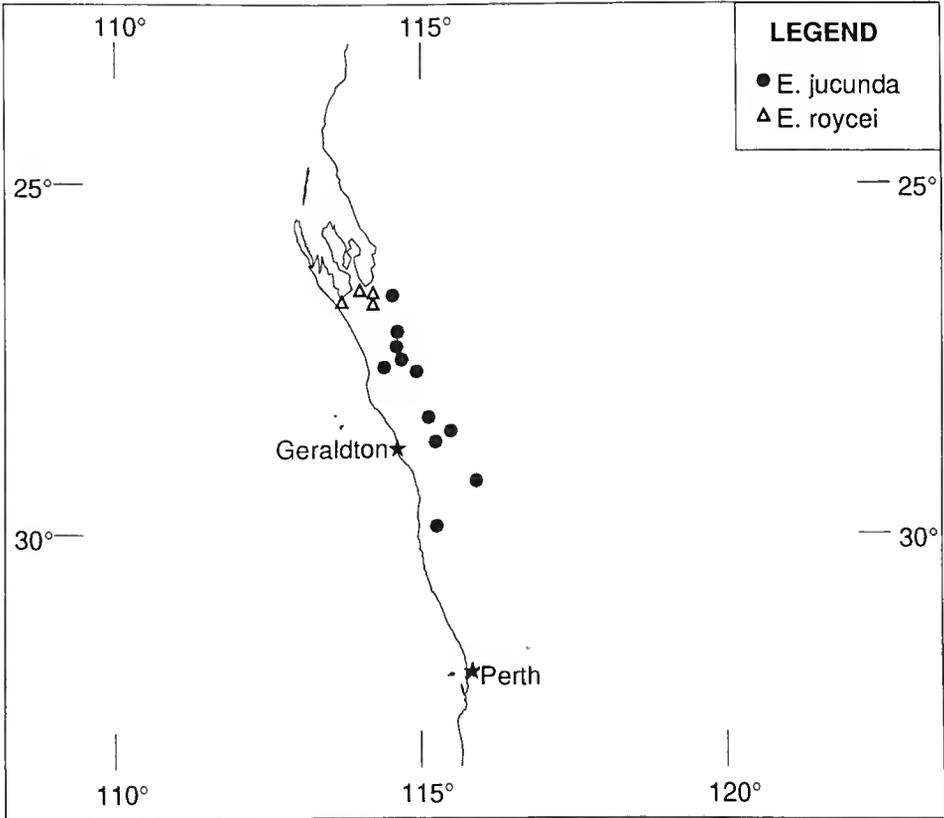


Fig. 10. Distribution of *E. roycei*, *E. jucunda*.

diam.; disc 2–3 mm wide, level to slightly raised; valves enclosed. Seeds ovoid or cuboid, dull, brownish black, not winged; hilum ventral; chaff angular, dark brown.

Three geographic subspecies are recognised, as follows.

1 Adult leaves dull

2 Twigs buds and fruits not glaucous 14A. subsp. *ebbanoensis*

2 Twigs buds and fruits glaucous 14C. subsp. *glauciramula*

1 Adult leaves glossy 14B. subsp. *photina*

#### 14A. *Eucalyptus ebbanoensis* Maiden subsp. *ebbanoensis*

**Distribution:** Canna–Mingenew to Wongan Hills, and sporadically east to near Koolyanobbing (Fig. 11). Although geographically closer to occurrences of subsp. *glauciramula*, the collection from near Koolyanobbing clearly represents the type subspecies.

**Ecology:** widespread but sporadic in mallee shrublands on yellow or red sand over laterite.

**Conservation status:** not considered to be at risk.

**Selected specimens (from 17 examined):** Western Australia: 9.8 miles [15.8 km] W of Three Springs, *Allau* 650, 18 July 1971 (PERTH, NSW); Koolanooka Range near Morawa, *Beard* 6704, 27 Sep 1973 (PERTH, NSW); 11.5 km NW of Three Springs along Midlands Road, *Briggs* 7749 & *Johnson*, 1 Oct 1984 (NSW, CANB, PERTH); 20.2 km NE of Arrino towards Morawa, *Brooker* 8732, 1 Nov 1984 (CANB, NSW); S of Pintharuka rd, 9.6 km from Mingenew–Morawa rd via Yandanooka rd, *Brooker* 9753 a, 9 Sep 1987 (NSW, AD, BRI, CANB, DNA, K, MEL, PERTH, US); 18 miles [29.0 km] E of Mingenew, *Chippendale* 41, 19 Oct 1966 (CANB, NSW); 3 miles SE of Canna turn-off, *Chippendale* 53, 20 Oct 1966 (CANB, NSW); 25 km from Piawaning along road to Wongan Hills town, 1 km S of road, *Crisp* 5483, 26 Jan 1979 (CANB, NSW, PERTH); ca. 7.5 km NE of Bungalbin Hill, Helena Aurora Range, ca. 50 km NNE of Koolyanobbing, *Lepschi* 2000, 25 Sep 1995 (PERTH, BRI, CANB, NSW).

14B. *Eucalyptus ebbanoensis* Maiden subsp. *photina* *Brooker & Hopper*, *Nuytsia* 9: 2 (1993).

Type: Western Australia: Nanson Road, 28 34'S, 114 43'E, *M.I.H. Brooker* 9195 & *S.D. Hopper* (holo PERTH; iso CANB, MEL, NSW).

Distinguished from the other two subspecies of *E. ebbanoensis* by the glossy leaves that are consistent across the known populations.

**Distribution:** north and east of Geraldton, primarily around the Morseby Range, and south to Mt Horner (Fig. 11).

**Ecology:** localised and sporadic, on lateritic breakaways.

**Conservation status:** not considered to be at risk.

**Selected specimens (from 11 examined):** Western Australia: 8 miles [12.9 km] W of Tenindewa, *Beard* 6913, 24 Oct 1973 (PERTH, NSW); Burma Road Nature Reserve, E side 200 m from fence, *Brooker* 7944, 26 Jan 1983 (CANB, NSW); Breakaway SSE of Mount Horner, N of Pincher's road, *Brooker* 8817, 4 Feb 1985 (CANB, NSW); Nanson road, *Brooker* 9195, 12 Mar 1986 (CANB, NSW); 3.7 miles [6.0 km] E of Eradu Siding, *Chippendale*, 17 Mar 1968 (CANB); Mount Michael, *Hill* 2572 & *Johnson*, 23 Nov 1986 (NSW, CANB, MEL, PERTH).

14C. *Eucalyptus ebbanoensis* Maiden subsp. *glauciramula* *L.A.S. Johnson & K.D. Hill*, subsp. nov.

A subspecies typica ramulis alabastris fructibus pruinosis differt.

Type: Western Australia: 10.6 km south of Diemals–Menzies road on Bullfinch road, K.D. Hill 2612 & L.A.S. Johnson, 25 Nov 1986 (holo NSW; iso PERTH).

Distinguished from the other subspecies of *E. ebbanoensis* by the glaucous branchlets, a character no less consistent or demarcated geographically or morphologically than the leaf glossiness of subsp. *pholina*.

**Distribution:** from south of Diemals east to the western edges of the Great Victoria Desert, from Pinjin to Cardunia (Fig. 11).

**Ecology:** widely scattered on red sand or loam, often lateritic, with *Triodia*.

**Conservation status:** not considered to be at risk.

The epithet is from the Latin *glaucus*, blue-green, and *ramula*, a branchlet, from the glaucous branchlets.

**Selected specimens (from 15 examined):** Western Australia: near Sand Queen Mine, 61.6 miles [99.2 km] N of Kalgoorlie, *Baker 86*, 17 Nov 1970 (CANB, NSW); between Davyhurst & Goongarrie, *Beard 6263*, 10 Sep 1970 (KPBG, NSW); c. 3 km N of Karonie Siding on track to Cardunia Rocks, E of Kalgoorlie, *Blaxell 1657*, 20 June 1978 (NSW, PERTH); 6.3 km W of Broad Arrow on Ora Banda track, *Brooker 8061*, 8 Apr 1983 (CANB, NSW); 43 km from Pinjin at turn-off to Lake Minigwal, *Brooker 8593*, 15 May 1984 (CANB, NSW); 1.2 km SW of Carr Boyd Mine, *Brooker 9614*, 6 May 1987 (CANB, NSW); Comet Vale, *Jutson 115*, Dec 1916 (NSW); 60 miles [96.6 km] N of Kalgoorlie, Ereman Province, *Speck 911*, (CANB, NSW).

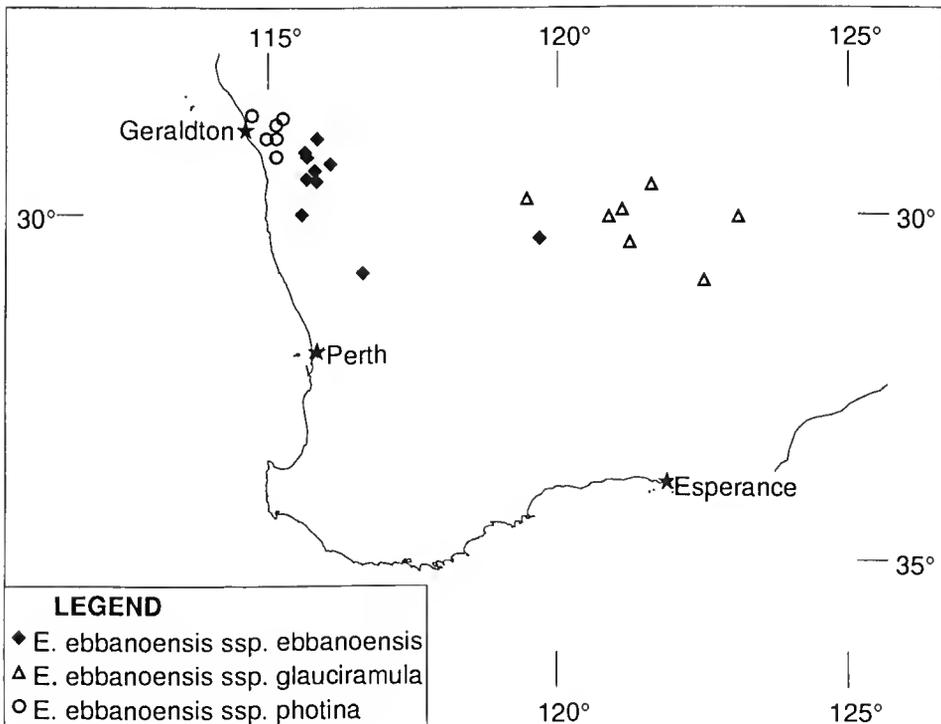


Fig. 11. Distribution of *E. ebbanoensis* subspp. *ebbanoensis*, *pholina*, and *glauciramula*.

### Section Fibraria

Treated as series *Tetrodonta* Chippendale (1988). Chippendale's name is not part of our extracodical system.

Bark wholly persistent, long-fibrous, included oil glands present. Hairs not present on juvenile growth; juvenile leaves disjunct, petiolate. Adult leaves disjunct. Conflorescence simple, axillary, 7-flowered. Calyx reduced, persistent as 4 prominent rounded teeth at top of hypanthium. Stamens in 4 bundles. Filaments cream to yellow.

The sectional name refers to the distinctive long-fibrous bark, which is unique to this taxon within *Eudesia*, and can be regarded as autapomorphic.

#### 15. *Eucalyptus tetrodonta* F. Muell., *J. Linn. Soc., Bot.* 3: 97 (1859).

Type: Cited as: 'Hab. In plagis elevatis nemorosis minus fertilibus terrae Arnheim's Land passim. (Ad Portum Essington, Armstrong; et in ora boreali, A. Cunningham, in hb. Hook.) Anth. Aug., Sept.'

Maiden (*Crit. Revis. Eucalyptus* 5: 152) stated that the Type was a Mueller collection from the entrance to the Victoria River, and he was followed by Blake (1953, plate 9). This can be regarded as a formal lectotypification, although there is no support for this typification in Mueller's citation. However, much of Mueller's citation was added by Black at Kew during editing of the paper, and the specimens cited were not available to Mueller when he was drawing up the protologue.

Tree to 25 m. Bark persistent throughout, thin, long-fibrous with stiff, brittle fibres, grey, dark red-brown on fresh breaks. Juvenile leaves to 35 cm long and 10 cm wide, dull, green to bluish green, disjunct, petiolate, broad-lanceolate to ovate, acuminate strongly falcate, lacking 'stellate hairs'. Adult leaves 10–20 cm long, 1.5–3 cm wide, dull, green to bluish green, disjunct, lanceolate, acuminate, glabrous; petioles 10–20 mm long; lateral veins at c. 30° to midrib, moderately closely spaced; secondary reticulum incomplete; intramarginal vein irregular, c. 1 mm or less from leaf margin. Umbellasters simple, axillary, 3-flowered; peduncles terete or angular, 1–5 mm long; pedicels terete, 5–13 mm long. Mature buds ovoid to pyriform, 10–25 mm long, 6–11 mm diam.; calyx free, distinct and persistent as 4 large rounded teeth at top of hypanthium; calyptra hemispherical, ½ as long as hypanthium. Stamens all fertile, in 4 fascicles; filaments regularly inflexed; anthers oblong, versatile, dehiscing through parallel slits. Fruits 3-locular, cup-shaped to campanulate, 13–22 mm long, 10–14 mm diam.; calyptra scar distinct and raised, disc 2–3 mm wide, level to slightly raised; valves enclosed. Seeds ovoid or cuboid, dull, greyish black, not winged; hilum ventral; chaff angular, dark brown.

**Distribution:** northern Australia, widespread and abundant in the wetter monsoon tropics of Western Australia, Northern Territory and Queensland (Fig. 12).

**Ecology:** a locally abundant species dominating savanna forests on residual sand over laterite and generally sandy soils, frequently associated with *E. miniata* and an understorey often dominated by *Sorghum* or similar annual grasses.

**Conservation status:** not considered to be at risk.

**Selected specimens (from 106 examined):** Northern Territory: Narbarlek, *Hinz* 522, 11 May 1989 (DNA, AD, BRI, CANB, DNA, NSW); SE corner of Arafura Swamp, *Dunlop* 8715 & *White*, 3 July 1990 (DNA, CANB, DNA, NSW); N of Mataranka towards Katherine, along the Stuart Highway, *Munir* 6233, 14 June 1988 (AD, NSW); 17 miles [28 km] W of Wollongorang at Red Bank mines Airstrip, *Carolin* 9233, 13 May 1974 (NSW, NSW); 3.1 km E of Dhalinbuy turn-off, *Hill* 3951 & *Stanberg*, 27 Aug 1991 (NSW, CANB, DNA); 9.2 m. [km] S [of] Danger Point, Cobourg Peninsula, *Chippendale NT* 8229, 20 July 1961 (DNA, NSW); Pickertaramoor, Melville Island, *Brooker* 3189, 23 June 1971 (CANB, NSW); Little Lagoon, Groote Eylandt, Gulf of Carpentaria, *Specht* 444, 30 May

1948 (CANB, NSW); 15 km N [of] Nathan River homestead, *Wightman 1865 & Leach*, 8 May 1985 (DNA, CANB, NSW, NT).

Queensland: 10 km S of Normanton, *Beadle 215*, 8 Sep 1972 (NSW); 9 km W of Gilbert River on Croydon road, *Benson 842*, 19 June 1974 (NSW); Kennedy road, 36 miles [57.6 km] beyond Laura, *Gittins 971*, July 1965 (NSW 304243); 5 miles [8 km] from Telegraph Line on Iron Range Rd, Nth Qld, *Gittins 1784*, July 1968 (NSW); E of Heathland, *Johnson 7763*, 17 Aug 1974 (NSW); Killarney Road, 12 km N of Kimba – Laura road, *Dalliston CC 54*, 28 June 1988 (BRI, CANB, NSW); 5 miles [8 km] S Cooktown on road to Cairns, *Briggs 2015*, 4 Aug 1968 (NSW).

Western Australia: 20 miles [33 km] NW of Beverley Springs station, *Aplin 5678*, 11 July 1973 (PERTH, NSW); old CRA camp on King Edward River, 1 km S of ford crossing of disused Mitchell River station track, N Kimberley, *Edinger 351*, 10 June 1987 (PERTH, NSW); Kalumburu district, ca 200 km NW of Wyndham, *Johuson 2035a*, 23 Aug 1967 (NSW); 24 miles [39 km] SE of Kimberley Research Station, *Perry 2939*, 9 July 1952 (CANB, NSW); 5 miles [8 km] SE of Mt Russ on tributary of Drysdale River, Kimberley, *Banks 1462*, 6 Oct 1968 (NSW).

### Section Apicaria

Bark persistent, long-fibrous with distinctive included flakes, usually shedding on outer to larger branches, oil glands present in bark. Radiating hairs present on juvenile growth; juvenile leaves petiolate. Conflorescence simple, axillary, 3–7–11–many-flowered. Calyx reduced, persistent as teeth at top of hypanthium. Stamens in 4 bundles. Filaments white or cream or orange.

The fibrous bark with included mica-like flakes is similar to that occurring in *Corymbia jacobsoniana* and *Eucalyptus microcorys*. This is clearly a parallel development in *C. jacobsoniana*, but the situation is less clear in the case of *E. microcorys*. One possible explanation is that the latter also represents a parallel development. If so, the bark condition can be viewed as an apomorphy uniting this section.

The sectional name refers to the reduced calyx persisting as teeth at top of hypanthium.

Three series are distinguished.

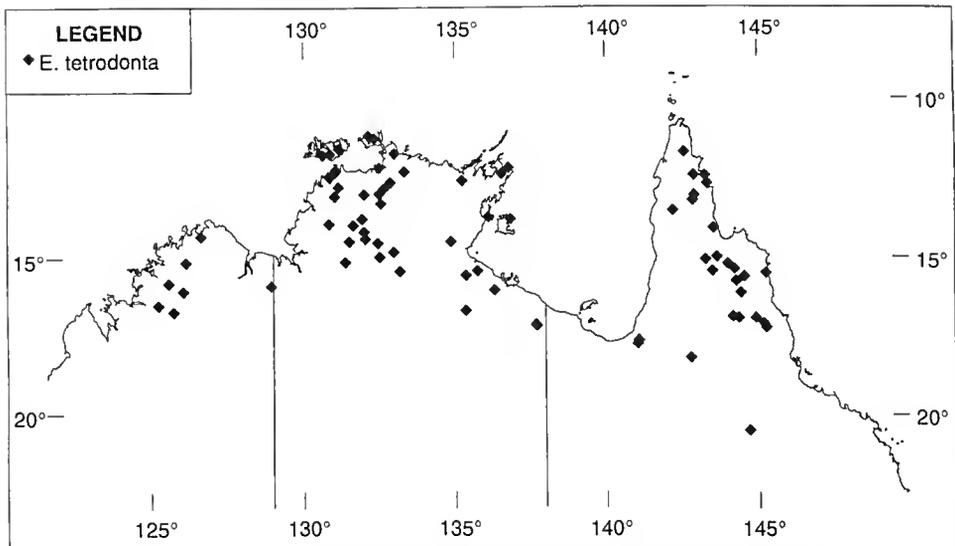


Fig. 12. Distribution of *E. tetradonta*.

### Series Similes

Included in Series *Scutelliformes* Maiden together with *E. baileyana* by Chippendale (1988). This name is not part of our extracodical system.

Small trees, often with several trunks. Bark persistent throughout, soft, pale yellow-brown. Juvenile and adult leaves disjunct (secondarily opposite in *E. ceracea*). Umbellasters 3-flowered. Flowers white. Style long, bent.

**16. *Eucalyptus lirata* W. Fitzg. ex Maiden, *Crit. Revis. Eucalyptus* 5: 111 (1921).**

Type: Western Australia: summit of Bold Bluff, Kimberleys, *W.V. Fitzgerald 843* (holo NSW).

Tree to 12 m, often with several trunks. Bark persistent throughout, fibrous with soft, flexible fibres and included mica-like flakes, yellow to orange-brown. Juvenile leaves to 12 cm long and 3.5 cm wide, dull, green to bluish green, disjunct, petiolate, lanceolate, with 'stellate hairs'. Adult leaves 7–12 cm long, 1.5–2.5 cm wide, dull, green to bluish green, disjunct, lanceolate, acute, glabrous; petioles 10–20 mm long; lateral veins at c. 30° to midrib, moderately closely spaced; secondary reticulum incomplete; intramarginal vein irregular, c. 1 mm or less from leaf margin. Umbellasters simple, axillary, 3-flowered; peduncles terete or angular, 20–30 mm long; pedicels terete, 3–6 mm long. Mature buds fusiform with a distinct median constriction, 8–12 mm long, 4–6 mm diam.; calyx indistinct, ± fused to corolla, evident as 4 small teeth at apex of calyptra; calyptra conical,  $\frac{1}{2}$ – $\frac{2}{3}$  as long as hypanthium. Stamens all fertile, in a continuous ring; filaments regularly inflexed; anthers oblong, versatile, dehiscing through parallel slits. Fruits 3–4-locular, cup-shaped to globular or weakly urceolate, 10–12 mm long, 8–10 mm diam.; calyptra scar distinct and raised, disc 2–3 mm wide, level to slightly raised; valves enclosed. Seeds elliptical, dull, greyish black, not winged; hilum ventral; chaff angular, dark brown.

**Distribution:** northern W.A., restricted to the central Kimberley region (Fig. 13).

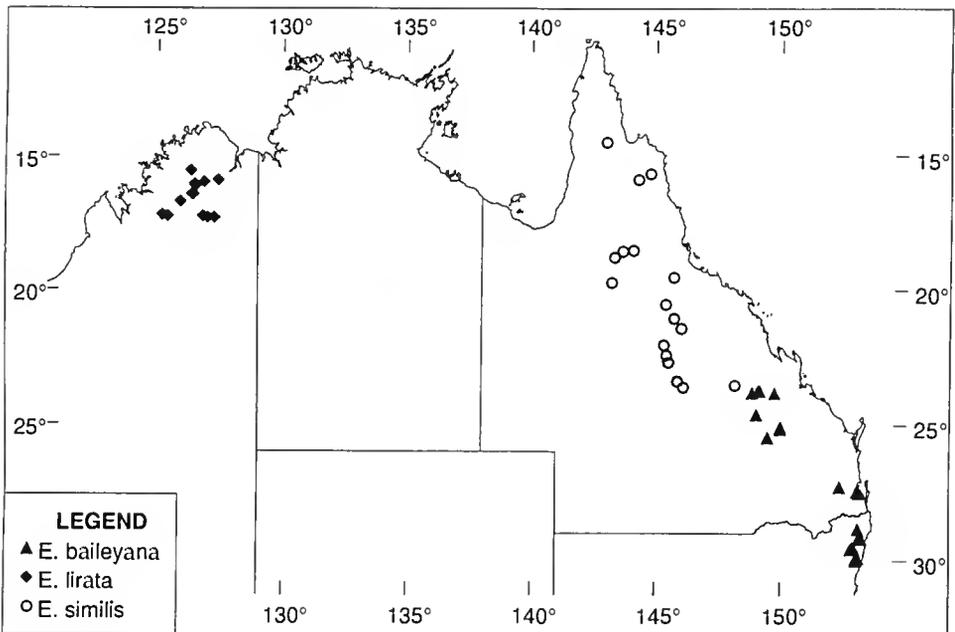


Fig. 13. Distribution of *E. baileyana*, *E. similis* and *E. lirata*.

**Ecology:** a locally abundant species dominating low open savanna woodlands on shallow to skeletal sand over laterite or sandstone, with an understorey often dominated by *Triodia*.

**Conservation status:** not considered to be at risk.

**Selected specimens (from 23 examined):** Western Australia: 2.5 miles [4 km] W of Gibb River Station, *Aplin 5543*, 29 June 1973 (PERTH, NSW); 79 km SW of Pentecost River crossing on Gibb River road, *Hill 942, Johnson & Benson*, 23 July 1984 (NSW, DNA, FRI, PERTH); Teronis Gorge, *Hill 3484, Johnson & Stanberg*, 26 Nov 1988 (NSW, CANB, PERTH); 112.4 miles [180 km] by road W of King River Crossing towards the Gibb River – Kalumburu road, *Brooker 4254*, 1 Nov 1973 (NSW 314697, NSW); Kimberley district – 46 km from Gibb River homestead along Kulumburu road towards Drysdale River, *Telford 6256 & Butler*, 29 July 1977 (CANB, NSW, PERTH).

**17. *Eucalyptus similis*** Maiden, J. & *Proc. Roy. Soc. New South Wales* 47: 90 (1913).

Type: Queensland: from desert country W of Emerald, *G.H. Carr s.n.*, Mar 1908 (holo NSW; iso K).

Tree to 8 m, often with several trunks. Bark persistent throughout, fibrous with soft, flexible fibres and included mica-like flakes, yellow to orange-brown. Juvenile leaves to 9 cm long and 3.5 cm wide, dull, green to bluish green, disjunct, petiolate, broad-lanceolate, with 'stellate hairs'. Adult leaves 8–14 cm long, 1–2 cm wide, dull, green to bluish green, disjunct, lanceolate to broad-lanceolate, acute, glabrous; petioles 10–20 mm long; lateral veins at c. 30° to midrib, moderately closely spaced; secondary reticulum incomplete; intramarginal vein irregular, c. 1 mm or less from leaf margin. Umbellasters simple, axillary, 3-flowered; peduncles terete or angular, 7–10 mm long; pedicels terete, 2–5 mm long. Mature buds cylindrical to fusiform, with a distinct median constriction, 8–14 mm long, 4–6 mm diam.; calyx indistinct, ± fused to corolla, evident as 4 small teeth at apex of calyptra; calyptra hemispherical to broadly conical, ½ as long as hypanthium. Stamens all fertile, in a continuous ring; filaments regularly inflexed; anthers oblong, versatile, dehiscing through parallel slits. Fruits 3-locular, truncate-ovoid to cylindrical or weakly urceolate, 10–13 mm long, 7–9 mm diam.; calyptra scar distinct and raised, disc 2–3 mm wide, level to slightly raised; valves enclosed. Seeds elliptical, dull, greyish black, not winged; hilum ventral; chaff angular, dark brown.

**Distribution:** northern central Queensland, from the Newcastle Range to east of Barcaldine (Fig. 13).

**Ecology:** a locally abundant species dominating low open savanna woodland, usually on sand over laterite or sandstone, with an understorey often dominated by *Triodia*.

**Conservation status:** not considered to be at risk.

**Selected specimens (from 35 examined):** Queensland: 4 km W of Amelia Creek crossing, on Longton – Oxenhope road, *Neldner 3159 & Thompson*, 11 May 1991 (BRI, NSW); 6 miles [9.6 km] NW of Middle Park station, *Pryor 4092 Johnson & Lazarides*, 17 Sep 1953 (NSW); c. 20 km W of Einasleigh on Einasleigh to Forsyth road, *Clarkson 2582 & Byrnes*, 12 Aug 1979 (BRI, NSW); N of Laura River near Early Man site, *Byrnes 3350*, 16 May 1975 (BRI, NSW); 14 km E of Strathburn Homestead (approximately 70 km NNE of Musgrave), *Milne 12 & DeLai*, 17 July 1994 (BRI, MBA, NSW, CANB); 57.9 km E of Barcaldine towards Jericho, *Brooker 7863*, 7 Dec 1982 (CANB, NSW); 47.3 km from Aramac on Eastmere Road, *Hill 1176 & Johnson*, 20 Aug 1984 (NSW); between Pentland & Warrigal, *Hyland 6129*, 18 May 1972 (QRS, NSW); 10 miles [16 km] E of Yarrowmere station, S Kennedy District, *Adams 982*, 24 May 1964 (BRI, NSW).

### Series *Baileyanae*

Included in Series *Scutelliformes* Maiden together with *E. similis* and *E. lirata* by Chippendale (1988). This name is not part of our extracodical system.

Tall trees. Bark persistent throughout, hard, dark red-brown. Umbellasters 3-flowered. Flowers white. Style short, straight.

**18. *Eucalyptus baileyana*** F. Muell., *Fragm.* 11: 37 (1878).

Type: Queensland: near Moreton Bay, *F.M. Bailey s.n.*, 1869 (holo MEL; iso NSW, BRI, K). Cited as: 'Ad sinum marinum Moreton-Bay rara; Bailey.'

Tree to 25 m, sometimes to 40 m. Bark persistent throughout, fibrous with soft, flexible fibres and included mica-like flakes, red-brown to deep brown. weathering grey. Juvenile leaves to 13 cm long, to 7 cm wide, dull, green to bluish green, disjunct, petiolate, broad-lanceolate to ovate, cordate, with 'stellate hairs'. Adult leaves 8–15 cm long, 1–2.5 cm wide, glossy, green, disjunct, narrow-lanceolate to lanceolate, acute, glabrous; petioles 10–20 mm long; lateral veins at c. 30° to midrib, moderately closely spaced; secondary reticulum incomplete; intramarginal vein irregular, c. 1 mm or less from leaf margin. Umbellasters simple, axillary, 3-flowered; peduncles terete or angular, 15–25 mm long; pedicels terete, 2–11 mm long. Mature buds clavate, 6–8 mm long, 3–4 mm diam.; calyx indistinct, ± fused to corolla, evident as 4 small teeth at apex of calyptra; calyptra hemispherical, apiculate or slightly beaked, ½ as long as hypanthium. Stamens all fertile, in 4 discrete bundles; filaments regularly inflexed; anthers oblong, versatile, dehiscing through parallel slits. Fruits 3-locular, ovoid to globular or weakly urceolate, 8–14 mm long, 8–16 mm diam.; calyptra scar distinct and raised, disc 2–3 mm wide, level to slightly raised; valves enclosed. Seeds elliptical, dull, greyish black, not winged; hilum ventral; chaff angular, dark brown.

**Distribution:** Queensland and northern N.S.W., from the Blackdown Tableland to near Coffs Harbour, somewhat sporadic (Fig. 13).

**Ecology:** an abundant but quite localised species, usually in tall mixed dry sclerophyll forests on infertile sandy soils over sandstone, with a rich mixed shrub understorey.

**Conservation status:** not considered to be at risk.

**Selected specimens (from 63 examined):** New South Wales: North Coast: 41.7 km from Coffs Harbour past Glenreagh, *Brooker 6100*, 28 Jan 1979 (CANB, NSW); Tabulam — Copmanhurst road, c. 6.4 km S of Coaldale, *Johnson 341*, 24 Apr 1969 (NSW); Rocky Creek, c. 2 miles (3.2 km) N of Coaldale-rd [19 miles (30.6 km) NNW of Grafton], *Coveny 4983*, 23 Aug 1973 (NSW); Fortis Creek, 24 km N of Grafton on the road to Coaldale, *Foreman 912*, 23 Aug 1985 (MEL, CANB, NE, NSW, WELTU).

Queensland: Blackdown Tableland, c. 32 km SE of Blackwater (campsite on Mimosa Creek), alt. 600–900 m. c. 6.8 km NNE of campsite, *Henderson 01183*, *Durrington & Sharpe*, 14 Sep 1971 (BRI, NSW); hillcrest on track to Robinson Gorge, NW of Taroom, *Brooker B4845*, 24 Apr 1975 (CANB, NSW); near Stoney Creek, Blackdown Tableland National Park, *Blaxell 89/222 Johnson & D'Aubert*, 8 Aug 1989 (NSW); Brisbane, Toohey Park, Tarragindi, *Telford s.n.*, 20 May 1969 (CANB, NSW); SW of Mt Gravatt (6 miles [9.6 km] S of Brisbane), *Johnson s.n.*, 3 June 1951 (NSW).

### Series *Miniatae*

Treated as Series *Miniatae* Blakely by Chippendale (1988). This name is not part of our extracodical system.

Small to tall trees. Bark shedding on branches. Umbellasters 7- or more-flowered. Flowers orange. Style long, bent.

Although this is a closely coherent series, two species groups can be recognised. These are treated below as subspecies. The brightly orange-coloured flowers are synapomorphic.

### Subseries *Miniatosae*

Umbellasters 7-flowered.

19. *Eucalyptus miniata* A. Cunn. ex Schauer in Walp., *Rep. Bot. Syst.* 2: 925 (1843).

Type: Western Australia: Hunters R., York Sound, *A. Cunningham* 241, 10 Sep 1820 (holo: K; iso BM). Cited as: 'A. Cunn. Herb. no. 241/1820!'

= *E. aurantiaca* F. Muell., *J. Linn. Soc., Bot.* 3: 91 (1859).

Type: Shores of Gulf of Carpentaria; *F. Mueller* (holo MEL). Cited as: 'Hab. In planitiebus arenosis sicuti in plagis elevatioribus petraeis circum sinum Carpentaria, ubi vegetationis ornamentum. Anth. Mai. - Aug.'

Tree to 30 m. Bark persistent on trunk, fibrous with soft, flexible fibres and included mica-like flakes, orange-brown to red-brown, weathering dark brown to black; smooth above, white to pale grey. Juvenile leaves to 12 cm long and 5 cm wide, dull, green to bluish green, disjunct, petiolate, ovate to elliptical, with 'stellate hairs'. Adult leaves 8–16 cm long, 1–3.5 cm wide, dull, green to bluish green, disjunct, narrow- to broad-lanceolate, acute, glabrous; petioles 12–20 mm long; lateral veins at c. 30° to midrib, moderately closely spaced; secondary reticulum incomplete; intramarginal vein irregular, c. 1 mm or less from leaf margin. Umbellasters simple, axillary, 7-flowered; peduncles terete or angular, 10–35 mm long; pedicels absent or terete, 0–5 mm long. Mature buds ovoid, ± strongly ribbed, 18–25 mm long, 10–12 mm diam.; calyx indistinct, ± fused to corolla, evident as 4 small teeth at apex of calyptra; calyptra hemispherical to conical,  $\frac{1}{2}$ – $\frac{2}{3}$  as long as hypanthium. Stamens all fertile, in a continuous ring; filaments regularly inflexed; anthers oblong, versatile, dehiscing through parallel slits. Fruits 3-locular, ovoid to urceolate, strongly to weakly ribbed, 30–50 mm long, 18–40 mm diam.; calyptra scar distinct and raised, disc 2–3 mm wide, level to slightly raised; valves enclosed. Seeds elliptical, dull, greyish black, not winged; hilum ventral; chaff angular, dark brown.

**Distribution:** northern Australia, widespread and abundant in wetter parts of the monsoon tropics of northern Western Australia, Northern Territory and Queensland (Fig. 14).

**Ecology:** a locally abundant species dominating savanna forests on residual sand over laterite and generally sandy soils, with an understorey often dominated by *Sorghum* or similar annual grasses. *E. miniata* is a variable species occurring across a wide range, and close study of regional variation is likely to define additional taxa at specific or subspecific rank. For example, Queensland occurrences display a generally lighter bark, and occurrences on slopes of the Arnhem Land escarpment display more complex ornamentation on buds and fruits

Although hybrids are uncommon in the subgenus, one specimen of a putative hybrid between *E. miniata* and *E. phoenicea* is known (cited below).

**Conservation status:** not considered to be at risk.

**Selected specimens (from 114 examined):** Northern Territory: Nitmiluk National Park, *Wightman* 5841 & *Sirikolo*, 4 Aug 1992 (DNA, NSW); Pine Creek Road 62 km from Park Kakadu National Park, *Boland* 2169 & *Wardman*, 19 Nov 1984 (CANB, NSW); 6 miles [9.6 km] N of Wollongorang station, *Perry* 1183, 2 June 1948 (CANB, NSW); 126.6 km E of Manangoora turn-off on Borroloola — Burketown road, *Hill* 4134 & *Stanberg*, 26 Sep 1991 (NSW, CANB, DNA); 10.3 m [miles] S Danger Point, Cobourg Peninsula, *Chippendale* NT 8228, 20 July 1961 (DNA, NSW); top of escarpment on track to top of Jim Jim Falls, *Hill* 4027 & *Stanberg*, 4 Sep 1991 (NSW, BRI, CANB, DNA, MEL); Bluff W of Victoria River crossing, *Hill* 3349 *Johnson* & *Stanberg*, 17 Nov 1988 (NSW).

Queensland: 29 km W of Einasleigh, *Hind* 2804, 20 Sep 1980 (NSW); 10 miles [16 km] W of Croydon, *Johnson s.n.*, 20 Oct 1964 (NSW); Hells gate near Westmoreland, *Carolyn* 9178, (NSW); 20.4 miles

[32.8 km] from Walsh River Crossing towards Wrotham Park, *Brooker* 3373, 27 Jan 1972 (CANB, NSW); c. 2 km from Lappa on the road to Sunnymount, *Clarkson* 9172, 28 Dec 1991 (BRI, CANB, NSW); Stannary Hills Road 8 miles South of Mutchilba, *Stocker* 728, 31 May 1971 (QRS, NSW); 2.5 km S of the Maitland Downs turn-off on the Peninsula Development Rd, *Clarkson* 6125, 30 July 1985 (BRI, MBA, NSW, PERTH, QRS); 9 km W of Gilbert River on Croydon Road, *Benson* 843, 19 June 1974 (NSW); 36 km from the Walsh River Crossing on the Mungana — Wrotham Park road, *Clarkson* 2810, 7 Feb 1980 (BRI, FRI, MO, NSW); 15 km SW of Pentland towards Lauderdale homestead, *Martensz* 1245, 9 Oct 1978 (BRI, NSW).

Western Australia: 7 km S of Cape Leveque, *Carter* 298, 5 June 1988 (PERTH, NSW); on summit of hills, about the base of Mt Herbert, King Leopold Ranges, *Symon* 5327, 25 June 1967 (AD, NSW); Koolan Island, *Wannan* UNSW 20409, Jan 1974 (UNSW, NSW); 2 km N of King Edward R, *Puttock* UNSW 20678, 13 July 1987 (UNSW, BRI, CANB, NSW); Greville Island, *Cunningham* s.n., 1920 (NSW); Radio Hill, Wyndham, *Johnson* 2049, 24 Aug 1967 (NSW); Beverley Springs, *Beard* 4165, 18 May 1965 (PERTH, NSW); King Edward River, old CRA campsite, 1 km S of ford crossing by track to abandoned Mitchell River homestead, *Edinger* 240, 5 June 1987 (PERTH, NSW); 12 miles [19.2 km] SE of Kimberley Research Station, *Perry* 2931, 7 July 1952 (CANB, NSW).

### *E. miniata* × *E. phoenicea*

Northern Territory: South Alligator River, 27 miles [43.2 km] SW of Jim Jim Crossing, *Adams* 2844, 15 July 1972 (CANB, BRI, CANB, DNA, K, L, NSW, US).

### 20. *Eucalyptus gigantangion* L.A.S. Johnson & K.D. Hill, *Telopea* 4(2): 322 (1991).

Type: Northern Territory: Twin Falls, Kakadu National Park (13°18'S 132°51'E), *C. Dunlop* 6722 & *G. Wightman*, 16 July 1984 (holo NSW, iso DNA).

Tree to 30 m. Bark persistent on trunk, fibrous with soft, flexible fibres and included mica-like flakes, orange-brown to red-brown, weathering dark brown to black; smooth, white above. Juvenile leaves to 12 cm long and 5 cm wide, dull, green to bluish green, disjunct, petiolate, ovate to elliptical, with 'stellate hairs'. Adult leaves 6–14 cm long, 1–2 cm wide, dull, green to bluish green, disjunct, narrow- to broad-lanceolate, acute, glabrous; petioles 12–20 mm long; lateral veins at c. 30° to midrib,

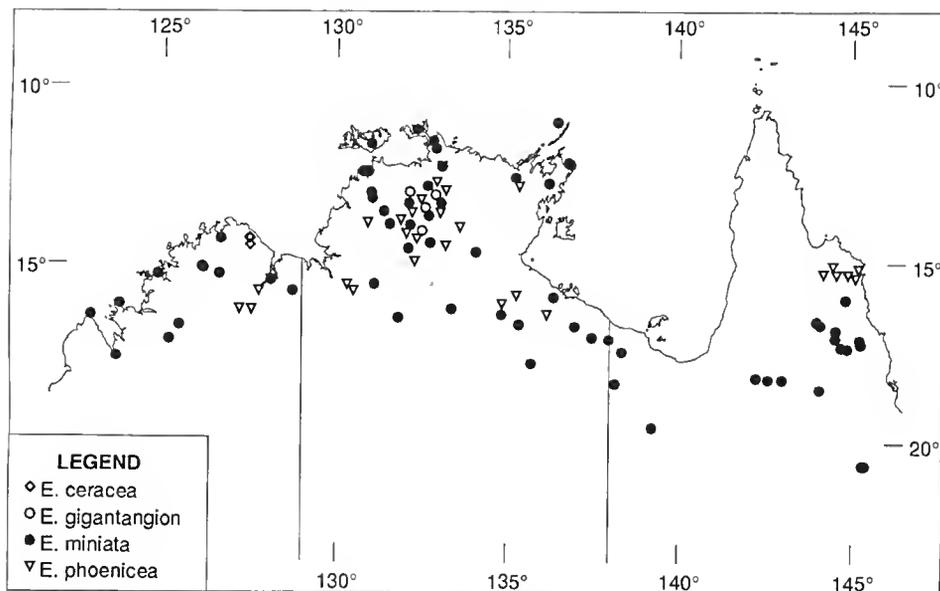


Fig. 14. Distribution of *E. miniata*, *E. gigantangion*, *E. phoenicea* and *E. ceracea*.

moderately closely spaced; secondary reticulum incomplete; intramarginal vein irregular, c. 1 mm or less from leaf margin. Umbellasters simple, axillary, 7-flowered; peduncles terete or angular, 10–35 mm long; pedicels absent or terete, 0–5 mm long. Mature buds fusiform,  $\pm$  strongly ribbed, 18–25 mm long, 10–12 mm diam.; calyx indistinct,  $\pm$  fused to corolla, evident as 4 small teeth at apex of calyptra; calyptra hemispherical to conical,  $\frac{1}{2}$ – $\frac{2}{3}$  as long as hypanthium. Stamens all fertile, in a continuous ring; filaments regularly inflexed; anthers oblong, versatile, dehiscing through parallel slits. Fruits 3-locular, ovoid to urceolate, weakly ribbed, 45–70 mm long, 25–50 mm diam.; calyptra scar distinct and raised, disc 2–3 mm wide, level to slightly raised; valves enclosed. Seeds elliptical, dull, greyish black, not winged; hilum ventral; chaff angular, dark brown.

**Distribution:** locally abundant in Kakadu and north-western Arnhem Land in the N.T. (Fig. 14).

**Ecology:** a highly localised species dominating savanna forests on residual to skeletal sand over sandstone, with an understorey often dominated by *Triodia* and scleromorphic shrubs.

**Conservation status:** not considered to be at risk.

**Selected specimens (from 7 examined):** Northern Territory: Kakadu National Park, top of escarpment on track to top of Jim Jim Falls, *Hill 4026 & Stanberg*, 4 Sep 1991 (NSW, BRI, CANB, DNA); Deaf Adder George. Southern Plateau, Kakadu National Park, *Boland 2143 & Wardman*, 18 Nov 1984 (CANB, NSW); 41 miles [65.6 km] from Pine Creek to UDP Falls, *Gittins 2716*, Aug 1973 (NSW); Top of Twin Falls, *Johnstone 150*, 18 July 1989 (CANB, BRI, DNA); Twin Falls, Kakadu National Park, *Dunlop 6722 & Wightman*, 16 July 1984 (DNA, NSW).

### Subseries Phoeniceosae

Umbellasters more than 7-flowered.

#### 21. *Eucalyptus phoenicea* F. Muell., *J. Linn. Soc., Bot.* 3: 91 (1850).

Type: Northern Territory: Victoria River, near the main camp, *F. Mueller s.n.* (lecto BRI, K, MEL; here designated). Figured by Mueller (*Eucalyptographia*) and Maiden (C.R. 3, plate 96, Fig. 8). This is selected from a number of scattered syntypes (see Blake, 1953 and Chippendale, 1974), as it has been widely distributed and illustrated. The type citation was: 'Hab. In planitiebus elevatioribus collibusque saxosis vel arenosis a fluvio Victoria per terram Arnhem circum sinum Carpentaria. Anth. Jun. - Sept.'

Tree to 10 m, sometimes to 20 m. Bark persistent on trunk and larger branches, fibrous with soft, flexible fibres and included mica-like flakes, orange-brown to red-brown, weathering dark brown; smooth, greyish above. Juvenile leaves to 12 cm long and 6 cm wide, dull, green to bluish green, disjunct, petiolate, ovate to elliptical, with 'stellate hairs'. Adult leaves 7–12 cm long, 1.2–2 cm wide, dull, green to bluish green, disjunct, narrow- to broad-lanceolate, acute, glabrous; petioles 8–15 mm long; lateral veins at c. 30° to midrib, moderately closely spaced; secondary reticulum incomplete; intramarginal vein irregular, c. 1 mm or less from leaf margin. Umbellasters simple, axillary, more than 11-flowered; peduncles terete or angular, 15–30 mm long; pedicels terete, 4–15 mm long. Mature buds ovoid to clavate,  $\pm$  ribbed, 7–10 mm long, 4–5 mm diam.; calyx indistinct,  $\pm$  fused to corolla, evident as 4 small teeth at apex of calyptra; calyptra hemispherical to conical,  $\frac{1}{2}$ – $\frac{2}{3}$  as long as hypanthium. Stamens all fertile, in a continuous ring; filaments regularly inflexed; anthers oblong, versatile, dehiscing through parallel slits. Fruits 3-locular, ovoid to cylindrical, distinctly urceolate, usually weakly ribbed, 20–30 mm long, 9–13 mm diam.; calyptra scar distinct and raised, disc 2–3 mm wide, level to slightly raised; valves enclosed. Seeds elliptical, dull, greyish black, not winged; hilum ventral; chaff angular, dark brown.

**Distribution:** northern Australia, widespread and abundant in W.A., N.T. and Queensland north of 15°30' (Fig. 14).

**Ecology:** a locally abundant species although somewhat sporadic in distribution, dominating low open savanna woodlands on residual to skeletal sandy soils over sandstones, with an understorey often dominated by *Triodia*.

**Conservation status:** not considered to be at risk.

**Selected specimens (from 61 examined):** Northern Territory: 1.7 km W Koongarra Saddle, *Tindale 10027 & Munnis*, 27 July 1989 (NSW, CANB, NT, PERTH, BRI, MEL); 28 miles [44.8 km] SW of Katherine, *Speck 1657*, 21 Sep 1961 (CANB, NSW); between Ferguson & Edith River, *Brooker 3137*, 17 June 1971 (CANB, NSW); 49 miles [78.4 km] by road NE of Maranboy Police Station, *Brooker 4168*, 18 Oct 1973 (CANB, NSW); 52.2 km E of Ramangining turn-off on Gove road, *Hill 3923 & Stanberg*, 25 Aug 1991 (NSW, CANB, DNA); near the turn-off to Edith Falls, N of Katherine, *Symon 5139*, 9 June 1967 (AD, CANB, NSW, NT); 11 m [miles][17.6 km] S of Pine Creek, *Jacobs 102*, 25 July 1933 (NSW); Crest of hill on turn-off 5.4 km W of Timber Creek roadhouse, c 5 km along track to E, *Hill 3355 Johnson & Stanberg*, 18 Nov 1988 (NSW); 9 miles W of Timber Creek, *Gittins 1361*, July 1967 (NSW).

Queensland: ca. 2.6 km from the beach S of South Cape Bedford on the track to Elim. Vegetation site BED 6, *Clarkson 8700 & Neldner*, 23 May 1990 (BRI, K, MBA, MEL, NSW, QRS); 25 km from Old Laura towards Battle Camp, *Hill 1918 Hind & Healey*, 2 Aug 1986 (NSW, BRI, FRI, PERTH); 14 km NW of New Laura Ranger Station, *Neldner 4000*, 25 May 1992 (BRI, MBA, NSW).

Western Australia: ca 4 km E of Bindoola Ck., on Gibb River–Wyndham road, *George 15223*, 27 June 1978 (PERTH, NSW); 55 miles [88 km] SW of Wyndham Township, *Perry 3081*, 28 July 1952 (CANB, NSW); 182 km W Kununurra, Gibb rd, Kimberleys, *Guynmer 558*, 31 Aug 1976 (BRI, NSW); 27 miles [43.2 km] NE of Karunjie station, *Speck 5016*, 15 Sep 1954 (CANB, NSW); 50 m (80 km) SW of Wyndham pumping station, *Maconochie 142*, 19 May 1967 (DNA, NSW).

**22. *Eucalyptus ceracea* Brooker & Done, *Nuytsia* 5(3): 382 (1986).**

**Type:** Western Australia: 33 km SE of King George Falls, Kimberley district (14°18'S, 127°29'E), 14 July 1982, *C. Done 612* (holo PERTH; iso CANB, NSW).

Tree to 4 m, usually with several trunks. Bark persistent throughout, fibrous with soft, flexible fibres and included mica-like flakes, orange-brown to red-brown. Juvenile leaves to 12 cm long and 6 cm wide, dull, green to bluish green, opposite, sessile, ovate to elliptical, with 'stellate hairs'. Adult leaves 7–10 cm long, 3–5.5 cm wide, dull, green to bluish green, opposite, sessile, ovate, obtuse, glabrous; lateral veins at c. 30° to midrib, moderately closely spaced; secondary reticulum incomplete; intramarginal vein irregular, c. 1 mm or less from leaf margin. Umbellasters simple, axillary, 7–9-flowered; peduncles terete or angular, 20–40 mm long; pedicels terete, 2–7 mm long. Mature buds clavate to pyriform, ribbed, 11–15 mm long, 7–9 mm diam.; calyx indistinct, ± fused to corolla, evident as 4 small teeth at apex of calyptra; calyptra hemispherical to conical,  $\frac{1}{2}$ – $\frac{2}{3}$  as long as hypanthium. Stamens all fertile, in a continuous ring; filaments regularly inflexed; anthers oblong, versatile, dehiscing through parallel slits. Fruits 3-locular, cylindrical to ovoid, distinctly urceolate, 20–25 mm long, 10–15 mm diam.; calyptra scar distinct and raised, disc 2–3 mm wide, level to slightly raised; valves enclosed. Seeds elliptical, dull, greyish black, not winged; hilum ventral; chaff angular, dark brown.

**Distribution:** northern W.A., northern Kimberley region (Fig. 14).

**Ecology:** a rare and restricted species occurring in mixed open savanna woodlands with a range of associated species including *Corymbia arenaria* on skeletal sandy soils over sandstones, with an understorey dominated by *Triodia*.

**Conservation status:** not immediately threatened, but restricted in distribution. Conservation status 2R– (Briggs & Leigh 1988).

**Selected specimens (from 6 examined):** Western Australia: 103.2 km W of King George River Crossing, *Hill 954, Johnson & Beuson*, 25 July 1984 (NSW); Kimberley Casurin Ck, King George 1 12 km E of King George River, *Brooker 7771*, 1 Nov 1982 (CANB, NSW); Seppelt Range, 13 km by track from King George River Crossing, *Done 796*, 10 July 1989 (NSW).

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# The reduction of *Acacia burkittii* to *Acacia acuminata* subsp. *burkittii* (*Acacia* sect. *Juliflorae*: Fabaceae, Mimosoideae)

P.G. Kodela and Mary D. Tindale

## Abstract

Kodela, P.G. and Tindale, M.D. (National Herbarium of New South Wales, Royal Botanic Gardens, Mrs Macquaries Road, Sydney, N.S.W. 2000, Australia) 1998. The reduction of *Acacia burkittii* to *Acacia acuminata* subsp. *burkittii* (*Acacia* sect. *Juliflorae*: Fabaceae, Mimosoideae). *Telopea* 7(4): 415–417. *Acacia burkittii* is here transferred to *A. acuminata* as subsp. **burkittii**. *Acacia acuminata* subsp. *acuminata* is endemic to south-west Western Australia, while *A. acuminata* subsp. *burkittii* extends from south Western Australia to western New South Wales.

## Introduction

*Acacia burkittii* has long been separated from *A. acuminata* mostly on the basis of phyllode shape and width, as well as other phyllode characteristics which are less consistent or useful such as phyllode curvature and indumentum. An investigation of flowers, legumes and other characters of the two species, however, found them comparable or sufficiently similar that species rank for both is not justified. For example, in both taxa the 4-merous flowers have a calyx dissected by  $\frac{1}{2}$  or more with the  $\pm$  keeled, usually narrow lobes clothed with white or yellowish hairs (mostly on the base, midrib and margins) and having rounded obtuse apices.

*A. randelliana* is considered to be conspecific with *A. burkittii* (see also Maslin 1981, Whibley & Symon 1992).

***Acacia acuminata* Benth. subsp. *burkittii* (F. Muell. ex Benth.) Kodela et Tindale, comb. et stat. nov.**

Basionym: *A. burkittii* F. Muell. ex Benth., Fl. Austral. 2: 400 (1864).

Holotype: Lake Gilles in the interior, [S.A.], *Burkitt* (K); isotypes: MEL *n.v.*, PERTH (fragment) *n.v.*

*A. randelliana* W. Fitzg., J. W. Austral. Nat. Hist. Soc. 1: 14 (1904).

Lectotype: Mount Malcolm, W.A., July 1899, W.V. Fitzgerald *s.n.* (NSW 359347, flowering specimen), *fide* Maslin & Cowan (1994); isolectotype: PERTH 00769991. Paralectotype (fruiting specimen): 12 miles [19.2 km] north-east of Kanowna, W.A., Nov 1903, W.V. Fitzgerald *s.n.* (NSW 359348 & 359369, PERTH 00769983 — not ex herb. W.V. Fitzgerald).

**Illustrations:** Maiden (1917: pl. 224), Rotherham et al. (1975: fig. 486), Armitage (1978: 136 & pl. 46), Costermans (1981: 303), Cunningham et al. (1981: 348), Morrison & Davies (1991: 347), Tame (1992: 58 & pl. 38), Whibley & Symon (1992: 275); all as *A. burkittii*.

Bushy, rounded, spreading or erect shrub or tree to 4 m high, rarely to 10 m high; bark dark brown and slightly fissured on main trunks, otherwise smooth, greenish grey, silvery grey or grey. Branchlets  $\pm$  terete, glabrous. Young shoots golden-sericeous (more

often seen in specimens of subsp. *acuminata*). *Phyllodes* linear-filiform, usually upright, terete or subterete to rarely somewhat flattened (broader phyllodes, mainly in S.A. & W.A.), (2-)5-16 cm long (rarely longer), 0.5-1.3 mm wide (rarely to 1.5 mm wide), finely multistriate, with central vein sometimes slightly more prominent (in broader phyllodes), normally ciliate (mainly on upper c. 1/2) especially towards apex; apex delicately curved, non-pungent, usually puberulous especially along the margins with appressed to suberect, white hairs. *Spikes* (4-)5-15(-17) mm long, (1-)2-3 in phyllode axils, mostly  $\pm$  sessile, densely flowered, bright or golden yellow. *Flowers* 4-merous. *Legumes* linear, moniliform, convex over seeds, chartaceous. Burkitt's Wattle, Gunderbluey, Pin Bush, Sandhill Wattle, Fine Leaf Jam.

**Distribution:** extends  $\pm$  from eastern margin of subsp. *acuminata* in south-eastern Western Australia, through inland South Australia to the western plains of New South Wales. Its distribution (as *A. burkittii*) is illustrated by Hall et al. (1964), Maslin & Pedley (1982), Tame (1992) and Whibley & Symon (1992).

**Habitat:** often in red earths and calcareous red or brown earths, also sandy soils, in low open woodlands and shrublands, often with mallee, eucalypts or Mulga. Occurs on flat plains (often in areas subject to flooding) or on dunes (sandhills), often forming dense clumps.

**Selected specimens:** Western Australia: Cosmo Newberry, 23 Oct 1992, *M. Hancock* 500 (NSW, PERTH); 20 km S of Paynes Find on Great Northern Hwy, 3 Sep 1984, *B.R. Maslin* 5587 (NSW, PERTH); near cemetery, Menzies, 8 Nov 1990, *M. Hancock* 314 (NSW, PERTH); 64 miles [103 km] W of Coolgardie, 13 Feb 1971, *M.G. Brooker* 6004 (NSW); 57 km E of Hyden on Hyden Norseman track, 28 Nov 1990, *M. Hancock* 293 (NSW).

South Australia: along track Cook-Vokes Corner, 21 Aug 1980, *J.Z. Weber* 6394 (AD, NSW); c. 102 km N of Cook, 28 km N of Abundant Well, 18 Aug 1980, *N.N. Donner* 7241 (AD, NSW); c. 3 km S of 'Koonamore' on road to Yunta, 29 Aug 1984, *E.H. Norris* 199 (NSW, MQU); between Hesso and Tent Hill, 19 Aug 1968, *B.J. Blaylock* 937 (AD, NSW); 21 miles [33.8 km] S of Port Augusta, towards Whyalla, 11 Sep 1970, *M.D. Tindale* 426 (AD, CANB, K, L, NSW, US).

New South Wales: 164.7 km E of Tibooburra on road to Wanaaring, 8 Sep 1989, *R.G. Coveny* 13644, *B. Wiecek* & *M. Savio* (AD, BRI, MEL, NSW, PERTH); 'Allundy', Wanaaring, 8 Nov 1977, *D.F. Thompson* 1879 (NSW); along Cobar-Wilcannia road, 45 miles [72 km] from Wilcannia, 1 Jan 1956, *J. Martin* (NSW 359259); 'Willgareena', N of Cobar, 4 Sep 1968, *E. D'Arny* 674 & *K. Wells* (CANB, NSW); 'Tundulya', c. 25 miles [40 km] SE of Louth, 16 Aug 1968, *C.W.E. Moore* 5264 (CANB, NSW); Cobar, 20 Aug 1973, *G.M. Cunningham* 840 (NSW); Broken Hill, 2 Dec 1919, *A. Morris* 82 (NSW); Lake Cargellico, Oct 1906, *J.L. Boorman* (B, BRI, CANB, CHR, LE, MEL, MO, NSW 171624, NY, P, PERTH, PRE, TL, US); Dareton, 19 Dec 1958, *C. Sparke* (NSW 359326).

**Notes:** *Acacia acuminata* subsp. *burkittii* differs from subsp. *acuminata* mainly in its narrower, terete to subterete (rarely flattened) phyllodes, normally shorter spikes and often more bushy, shrub habit. In subsp. *acuminata* the cilia on the linear to very narrowly elliptic (tapered both ends) or rarely narrowly oblanceolate phyllodes are more often visible without a 10 times lens than in subsp. *burkittii*. Intermediates occur between the subspecies, possibly reflecting clinal variation in Western Australia, e.g. 96.5 km from Meekatharra to Cue, *I.B. Armitage* 244 (NSW); 46 km W of Meekatharra, *M. Hancock* 502 (NSW, PERTH); Meekatharra-Mt Margaret region, at Cue on Great Northern Hwy, the Day-David Mine, *I.V. Newman* 725 (NSW); 5 miles [8 km] W of Meekatharra, *N.H. Speck* 580 (CANB, NSW).

Specimens from South Australia and New South Wales with slightly broader (to 2 mm wide) and  $\pm$  flat phyllodes warrant further investigation, e.g. S.A.: 5 miles [8 km] E of Ooldea, *B. Copley* 3175 (NSW); 80 miles [c. 130 km] N of Yalata, *B. Copley* 2654 (AD, NSW); crossing of Phillips R., c. 15 km SW of Ravensthorpe on main road to Ongerup, *L. Haegi* 1041 (AD, NSW); N.S.W.: Umberumberka Road, 16 miles [25.7 km]

SW of Broken Hill, *E. Baker* (NSW 256165). Notes on distribution, ecology, cultivation, and the impacts of sheep and rabbit grazing are provided by Whibley & Symon (1992).

### Key to subspecies of *A. acuminata*

- 1 Phyllodes mostly 1.5–9 mm wide, flat. Spikes 10–30 mm long .... subsp. *acuminata*  
 1\* Phyllodes 0.5–1.3(–1.5) mm wide, terete to subterete (rarely  $\pm$  flat). Spikes mostly 5–15 mm long ..... subsp. *burkittii*

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# Notes on types of some *Acacia* species (Fabaceae, Mimosoideae) at the National Herbarium of New South Wales (NSW)

P.G. Kodela

## Abstract

Kodela, P.G. (National Herbarium of New South Wales, Royal Botanic Gardens, Mrs Macquaries Road, Sydney, N.S.W. 2000, Australia) 1998. Notes on types of some *Acacia* species (Fabaceae, Mimosoideae) at the National Herbarium of New South Wales (NSW). *Telopea* 7(4): 419–423. The typification of eight species of *Acacia* is discussed, and lectotypes are here selected for six of these species: *Acacia adsurgens*, *A. ancistrocarpa*, *A. cambagei*, *A. carolae*, *A. rhodoxylon* and *A. shirleyi*. The previously designated neotype of *A. cambagei* is now unnecessary.

## Introduction

While editing species treatments for the *Flora of Australia* it became apparent that the typification of a number of *Acacia* species required clarification. Lectotypes are selected here for several species to obviate further confusion and maintain the traditional and current usage of the names.

1. *Acacia adsurgens* Maiden & Blakely, *J. Roy. Soc. Western Australia* 13: 28, pl. 20, figs 6–10 (1928)

T: 35 miles [56 km] NE of Camp 2, N.T., 7 June 1911, *G.F. Hill 261* (in late flower); lecto (here chosen): NSW 359728; isolecto: MEL 2046228 *n.v.*; 40 miles [64 km] W of Camp 4, Lander Ck, N.T., 21 June 1911 [1914 on NSW & MEL specimen labels, 1911 on an original label with a MEL specimen as well as being in the protologue confirms that 1911 was the collection year], *G.F. Hill 360* (protologue: in late flower & very early fruit); paralecto: K *n.v.*, MEL (2 sheets) *n.v.*, NSW 359729.

Lectotypification follows the earlier but unpublished selection by M.D. Tindale as deduced from her determinavit slips dated '21 Apr 1988' on the sheets at NSW. The above specimens were cited by Maiden and Blakely who would have seen the NSW sheets when preparing the protologue. The specimen with the better flowering material has been selected as the lectotype, i.e. NSW 359728. Original sketches and notes at NSW show that *G.F. Hill 360* (probably NSW 359729) was used by the artist Miss E. King for figs 6 (branchlet with flowering spike) and probably 7 (attached phyllode base showing pulvinus and gland) in Plate 20, while *G.F. Hill 261* (probably NSW 359728) was used for the ovary and flowers illustrated in figs 8–10. If NSW 359729 was the basis for fig. 6, the spicate inflorescence has since been detached from the specimen and lost. Both NSW specimens have a pale blue 'National Herbarium of Victoria, Melbourne' label as well as a NSW label. At MEL one of the of sheets of *Hill 360* (ex NSW), containing rather poor specimens, was seen by Maiden while the other material of *Hill 360* and *Hill 261* appears not to have been seen by the authors (J. Ross, pers. comm.).

2. *Acacia ancistrocarpa* Maiden & Blakely, *J. Roy. Soc. Western Australia* 13: 31, pl. 21, figs 1–6 (1928)

T: between Minderero and Globe Hill, Ashburton R., W.A., 29 Sep 1905, *A. Morrison*; lecto (here chosen): NSW 371987; isolecto: E *n.v.*, K *n.v.*, PERTH *n.v.*; Barrow Creek, N.T., May 1922, *S.A. White* 81; paralecto: K *n.v.*, MEL *n.v.*, NSW 371986; Darwin to Pine Creek, N.T., Aug 1914, *H.I. Jensen per C.E.F. Allen* 209; paralecto: NSW 371985.

Of the above three collections cited by Maiden & Blakely, the specimen NSW 371987 collected by Morrison has been selected as the lectotype, because: (i) it would have been seen by the authors; (ii) it fits the protologue description; (iii) it was illustrated by Margaret Flockton for Plate 21 (top half of branchlet with legumes and broader phyllode in fig. 1 and part of an open legume showing a seed in fig. 6); and (iv) the specific epithet refers to the more or less hooked apex of the fruit which this specimen shows best. The specimen collected by White (NSW 371986) was also used to illustrate *A. ancistrocarpa* in Plate 21, i.e. the lower half of the branchlet with spikes and narrower phyllode (fig. 1) and figs 2–5.

3. *Acacia cambagei* R.T. Baker, *Proc. Linn. Soc. New South Wales* 25: 661, pl. 42 (1900, published 1901)

T: Bourke, [N.S.W.], May 1900, *R.H. Cambage*; lecto (here chosen): NSW 358545 (ex Cambage Herbarium, Sydney).

This sheet consists of two mounted branchlets with inflorescences and an attached packet of legumes. The legumes were contained in an envelope labelled 'Pera Bore, Bourke 12.01' (now in a plastic bag with original envelope), but are not part of the type material, since they appear to have been collected in December 1901 which is after the publication date of this species. However, the flowering specimens are believed to be type material that would have been seen by Baker because: (i) location details cited by Baker as 'Bourke, N.S.W., and northward to Queensland (R.H. Cambage)' imply that the type material was collected by R.H. Cambage near Bourke; (ii) the specimens collected in May 1900 pre-date the publication of Part IV of Vol. 25 of the Proceedings (i.e. May 20th 1901) in which *A. cambagei* was published; and (iii) although somewhat stylised, the line illustration of a flowering branchlet in Plate 42 drawn by Baker appears to have been based on part of the right-hand specimen of NSW 358545 (though possibly a reversed image to the mounted specimen). Other material would have been available for the description and illustration of the legume(s).

Because a type could not be located at one stage, L. Pedley, *Taxon* 33: 523 (1984), designated a neotype (*viz.* 10 miles [16.1 km] W of Bourke on Wanaaring Rd, May 1971, *G.M. Cunningham* 574 (NSW 265597)) in his proposal to conserve *A. cambagei* against *A. georginae* F.M. Bailey. See Pedley, *loc. cit.*, for further discussion of Cambage's specimens and Baker's original description. The neotype is now superfluous with the finding of original type material (ICBN Art. 9: 13).

4. *Acacia caroleae* Pedley, *Austrobaileya* 1: 132, fig. 9I (1978)

Based on *A. doratoxylon* A. Cunn. var. *angustifolia* Maiden, *J. & Proc. Roy. Soc. New South Wales* 53: 217 (1920). T: Eidsvold, Qld, Nov 1918, *T.L. Bancroft* 32 (fruiting specimen); lecto (here chosen): NSW 417151; isolecto: BRI, K; Eidsvold, Qld, *Bancroft* 32; paralecto: ?K (Aug 1918) *n.v.*, NSW 417155 (May 1917), NSW 417142 (Nov [?Aug] 1918), NSW 417148 (Aug [?Nov] 1918); Eidsvold, Qld, *T.L. Bancroft s.u.*, Aug 1918; possible paralecto: BRI, NSW 417137 & 417140.

Pedley cited the type of *A. caroleae* as 'Eidsvold, Aug 1918, *Bancroft* (NSW, holo; K, iso)', while Maiden cited 'Eidsvold, Queensland (Dr T.L. Bancroft, No. 32, with photo)' for the taxon on which Pedley based *A. caroleae*. At NSW there are seven sheets of

*A. caroleae* collected from Eidsvold by Bancroft, four of which include the number '32', but covering three collection dates: May 1917, August 1918 and November 1918. Because of the no. 32 being used in this way for different collections of the same species, there appears to have been confusion in the past when writing labels where a flowering specimen (NSW 417142) has been stamped 'NOV 1918' (which should probably be August since the main flowering time for this species is July to October) and a sheet with bagged legumes and seeds (NSW 417148) is dated '8-1918' (which should probably be November). Although Pedley cited 'Aug 1918' as the type there are a number of possible syntypes covered by Maiden's reference to *Bancroft 32*, thus it was felt desirable to lectotypify the species to avoid confusion.

The earliest collection of *Bancroft 32* at NSW is May 1917 (NSW 417155), which is possibly associated with the photo referred to in Maiden's description. The specimen is practically sterile (only small, very immature buds present), more or less agreeing with the black and white photo of a shrub which appears to show few signs of flowers or fruit (though the quality of the photo makes it difficult to distinguish what might possibly be legumes). If this specimen came from the shrub photographed it could be considered the holotype of *A. doratoxylon* var. *angustifolia* (and therefore *A. caroleae*) if one was to take the view that Maiden intended only to refer to *Bancroft 32* with the photo as the type. However, the origin of the photograph is uncertain and I interpret Maiden's citation of *Bancroft 32* as reference to a collection of Bancroft specimens which includes photos showing the habit of the species (a view reinforced by the fact that the photos are not included in any of the sheets).

The sheet NSW 417151 is selected as the lectotype because it has mature legumes and seeds and a tag tied onto a branchlet with the note 'No. 32 shrub 8 ft in height ...' in Bancroft's hand (agreeing with the reference to 'shrub eight feet in height' in the protologue).

At K there is a *Bancroft 32* sheet (ex NSW) dated '8/1918' with flowering and fruiting specimens (K. Hill, pers. comm.), which is probably a mixed collection of August flowering material (?paralectotype) and November fruiting material (?isolectotype), but this requires further investigation. A flowering specimen (NSW 136982 ex BRI) with no collection number or date is of uncertain status.

##### 5. *Acacia cheelii* Blakely, *Proc. Linn. Soc. New South Wales* 42: 441 (1917)

T: Manilla, N.S.W., Sep 1916, L.H. Preston; lecto (flowering specimen): NSW 260043, *vide* M.D. Tindale *et al.*, *Austral. Syst. Bot.* 5: 651 (1992); Manilla, N.S.W., Dec 1916, L.H. Preston; paralecto (fruiting specimen): K *n.v.*, NSW 260044; Manilla, c. 10 miles [16 km] from town, H. Stoddart, Sep 1916; paralecto (flowering specimen): K, NSW 260061.

In the protologue Blakely cited the type locality as 'Manilla, New South Wales (L.H. Preston and H. Stoddart; flowers, September; and fruits, December, 1916)', thus covering all three specimens cited above which match the description and were presumably seen by Blakely. Although not explicitly stated 'chosen here' the lectotype NSW 260043 was cited by M.D. Tindale *et al.*, *loc. cit.*, with the remaining type specimens as syntypes (here referred to as paralectotypes).

Further flowering material collected from Manilla by Stoddart in October 1916 (K *n.v.*, MEL & MEL *n.v.*, MO, NSW 34465, PERTH) includes an ex NSW label with the words 'Portion of Type', possibly in Blakely's hand. However, this is not treated here as type material since the October date is not mentioned in the protologue. However, because (i) this material is very similar to the material collected by Stoddart in September 1916, (ii) it is unusual that it was not cited by Blakely (i.e. flowering to include October), and (iii) the ex NSW label has 'Manilla' and '10-1916' written in a hand other than Blakely's, there is a possibility that it is duplicate type material (belonging to NSW

260061) that was meant for distribution but has the wrong date and an abbreviated location on the label. There appears to be a duplicate of this material in the type folder for *A. cheelii* at K (K. Hill, pers. comm.) and MEL (*n.v.*, with 'Type' on ex NSW label).

6. *Acacia rhodoxylon* Maiden, J. & Proc. Roy. Soc. New South Wales 53: 223, pl. 16, figs 5–12 (1919, published 1920)

T: Eidsvold, Qld, Mar 1918, *T.L. Bancroft 19*; lecto (here chosen): NSW 416912; isolecto: K *n.v.*; Eidsvold, Qld, Nov 1918, *T.L. Bancroft 19*; paralecto: BRI (without legumes), NSW 416916.

Maiden in the protologue cites the type as 'Dr. T.L. Bancroft, No. 19, Eidsvold, Queensland'. At NSW there are three sheets of *Bancroft 19* collected on three different dates, i.e. March, August and November 1918. The number '19' is therefore likely to refer to Bancroft's species/plant number rather than to an individual collecting number. Because there has been confusion in the past (e.g. 'Eidsvold, *Bancroft 19*' was cited as the holotype at NSW by L. Pedley, *Austrobaileya* 1: 149, 1978 it was considered desirable to choose a lectotype from the relevant material at NSW.

The sheet NSW 416912 (containing two flowering branchlets) is chosen as the lectotype, as it fits the protologue description and details of a phyllode and flower from this specimen were drawn by Margaret Flockton for Plate 16 (fig. 6 – phyllode, figs 7–10 – spike, flower, ovary & bracteole), as indicated by the artist inside the specimen folder as well as on the original pencilled line illustration (both dated 17 Oct 1919).

The November 1918 specimen contains only a few (immature or poor) legumes, with NSW 416916 including a branchlet with juvenile phyllodes. Margaret Flockton indicated inside the specimen folder of NSW 416916 that she used this material to draw the juvenile phyllode and pod, Plate 16, figs 5 and 11, respectively. The seed (Plate 16, fig. 12) was probably based on this material.

The August 1918 specimen (BRI, K, NSW 416913) contains mature legumes and seeds, as well as a few old flowers. On the NSW sheet there is an attached envelope containing old legumes of this species collected by Bancroft on 10 November 1921; this element thus has no type status since the collection date is after publication of the species. However, it also appears that Maiden had not seen the August 1918 material at the time of writing the protologue. This is deduced from the fact that Maiden describes *A. rhodoxylon* as 'a shy fruiter and the pods not seen fully ripe', the pod 'about 3 cm long' and seeds 'shiny black'. This does not account for the August 1918 material which contains mature legumes to 5.5 cm long with shiny brown seeds, hence it is not accepted here as type material.

7. *Acacia rothii* F.M. Bailey, *Queensland Agric. J.* 6: 39, pl.161 (1900)

T: mouth of the Batavia River, Qld, *W.E. Roth*; holo: BRI *n.v.*, *vide* L. Pedley *Austrobaileya* 1: 222 (1978); iso: NSW 416904.

The type material previously was only cited for BRI. However, a specimen sent to NSW stamped 'COLONIAL BOTANIST, Brisbane' with the annotation 'Queensland 7.1904' can be considered an isotype. This material was sent after the publication date of the species, therefore Bailey is likely to have seen this specimen when preparing the description. It consists of three phyllodes, as well as part of a phyllode and a legume with two immature seeds (now separated from pod). Although the label provides the location as 'Batavia River' with no collector, it is likely to be part of the type material; it was possibly sent as such and the legume is an excellent match for the one illustrated in Plate 161 of the protologue. In fact, the legume of NSW 416904 is very likely to be the one used for the illustration, but BRI material would need to be checked to confirm this.

8. *Acacia shirleyi* Maiden, J. & Proc. Roy. Soc. New South Wales 53: 218, pl. 15, figs 8–14 (1919, published 1920)

T: Mt Rose, Eidsvold, Qld, 7 Nov 1912, T.L. Bancroft 14 (fruiting specimen); lecto (here chosen): NSW 371836; isolecto: BRI; *ditto* (young tree); paralecto: NSW 417184; [Mt Rose], Eidsvold, Qld, Mar 1918, T.L. Bancroft 14 (flowering specimen); paralecto: K *n.v.*, NSW 371834 & 371835; possible paralecto: see below.

Maiden cites the type 'from Mount Rose, Eidsvold, Queensland (Dr. T.L. Bancroft, No. 14)', which covers a range of specimens with Bancroft's number '14'. There are flowering specimens collected in March 1918 and fruiting specimens collected on 7 November 1912 and again in November 1918. The NSW 371836 specimen has been selected as lectotype because: (i) it fits the protologue description; (ii) it would have been seen by Maiden, (iii) it contains labels annotated by Bancroft; and (iv) Maiden (page 20 of protologue) cites 'No. 14 of 7th November, 1912' quoting the collector's notes on the specimen. L. Pedley in *Austrobaileya* 1: 152 (1978) cited this specimen as a holotype with isotypes at BM and K. There are two sheets at NSW of fruiting material collected by Bancroft in November 1918: *Bancroft s.n.* containing branchlets, legumes and seeds (NSW 371903) and *Bancroft 14* containing a large bag of legumes and seeds (NSW 371837), both being possible paralectotypes as would the BM and K specimens if they are November 1918 collections. The K sheet is a mixed collection of '3-1918 Flowers/11-1918 Pods' (K. Hill, pers. comm.). A fruiting specimen (NSW 371904 ex BRI) and a flowering specimen (MEL 257638 ex BRI, *n.v.*), neither of which have a collection number or date, are of uncertain status.

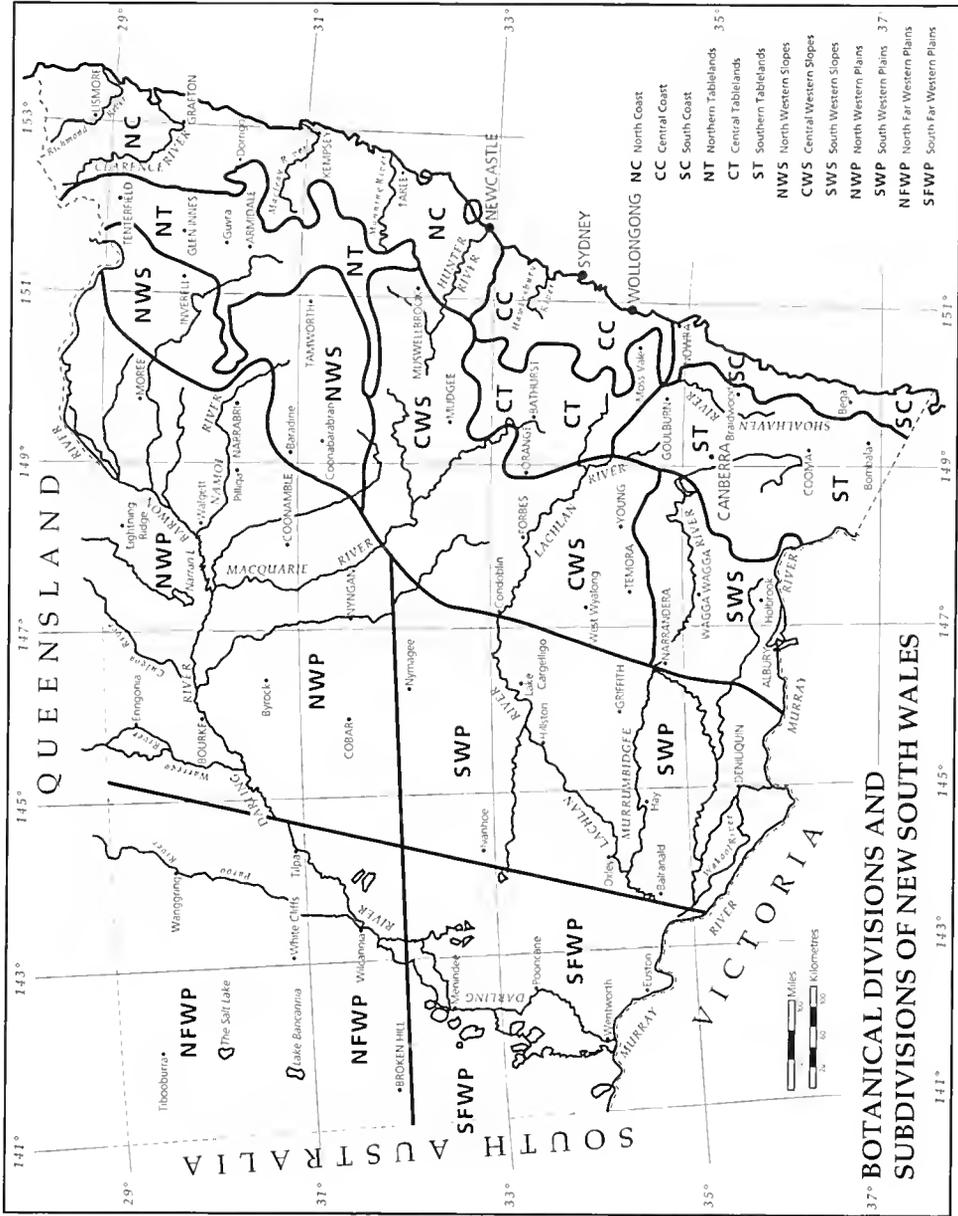
A branchlet from a 'young tree', originally placed with the fruiting 1912 material, and the flowering material collected in March 1918 (cited by Maiden on page 20) have been designated as paralectotypes.

### Acknowledgments

These notes were compiled during the editing of the *Flora of Australia* manuscript on *Acacia*, funded by Australian Biological Resources Study, Canberra. I am grateful for the advice of Drs Peter Wilson, Mary Tindale and Barry Conn. Ken Hill (A.B.L.O., Kew) kindly provided information on specimens at K. I thank Dr Jim Ross (MEL) for investigating and providing details on specimens at MEL, and for commenting on the manuscript.

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For explanation and description of the Botanical Divisions and Subdivisions of New South Wales see Anderson, R.H. (1961). Introduction. *Cont. New South Wales. Natl. Herb. Fl. New South Wales* Nos 1-18, pp. 1-15.

## NOTICE TO AUTHORS

*Telopea* is published twice-yearly, in March and September. Preference will be given to papers relating to the flora of New South Wales. Brief papers may be published as Short Communications.

Deadlines for the submission of papers are **1 June** (for the March issue the following year) and **1 November** (for the following September issue). Authors are expected to have had their papers peer-reviewed before submission. All papers will be refereed. Two copies of the manuscript should be submitted along with originals of photographs and clear photocopies of all other figures. The full postal address (plus telephone and fax numbers) of the author who will check the proofs and receive correspondence should be included. Once a paper has been accepted for publication the author should provide the paper on a computer disk along with final artwork. The disk should be in IBM compatible (MS-DOS) or Macintosh format and clearly labelled with the word processing program used and the file name(s).

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*Organisation of the paper* The title should be explicit and descriptive of the content. Include the family name and broad geographic region where appropriate. Abstracts (except for Short Communications) should be included. Check most recent issue for format. Bracketed keys are preferable especially for long keys, but indented keys are acceptable. Long indented keys should be divided into groups. When giving authors of botanical names follow the forms in the Kew Draft Index of Author Abbreviations. But note unabbreviated use in references below.

*Types* Cite details in full, giving details from protologue and from specimen label separately if there are important differences. Type citations should be in a consistent format, e.g. Type: New South Wales: North Western Plains: 10 km W of Moree (29°08' S 129°48' E), *B. Wiecek* 1250, 2 Jan 1989; lecto NSW (Weston 1990: 21); isolecto K, MO.

*Selected specimens* Cite no more than 20 (except for very widely distributed species) and arrange by Botanical Divisions. Use accepted format: locality, collector & number, date (herbarium code plus institutional number if there is no collector's number) and omit the initials of collectors, unless confusion is likely. Only latitudes and longitudes on the original labels should be included. Give dates in the following format: 12 Jan 1987, 2 June, 30 July, 10 Dec etc.

*References* In formal taxonomic citations use the fully abbreviated (Harvard) form: author (year: page) e.g. Bentham (1878: 234). The traditional ± abbreviated form, e.g. Bentham, Fl. Austral. 7: 234 (1878), may be used in shorter papers. Authors' names in these citations should be given unabbreviated. References to books published before 1900 need not include the publisher and place of publication, but be consistent.

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*Captions* Use lower case letters for the parts of a figure e.g. Fig. 1. *Jacksonia michaeliana*. a, stem tissue (× 10); b, calyx lobes (× 0.5). (a from holotype; b from *Barson* 234.)

*Tables* should preferably be portrait rather than landscape shape.

More detailed instructions are available on request from the editors.

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