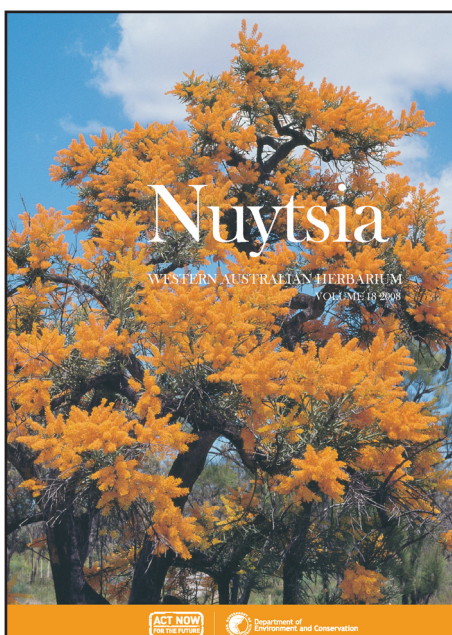


Nuytsia

WESTERN AUSTRALIA'S JOURNAL OF SYSTEMATIC BOTANY

ISSN 0085-4417



Nicolle, D., French, M. & McQuoid, N.
A revision of *Eucalyptus* ser.
Cornutae subser. *Conjunctae*
(Myrtaceae) from the south
coast of Western Australia,
including the description of four
new taxa and comments on the
hybrid origin of *E. bennettiae*

Nuytsia 18: 197–222 (2008)

All enquiries and manuscripts should be directed to:

The Managing Editor – *NUYTSIA*
Western Australian Herbarium
Dept of Environment and Conservation
Locked Bag 104 Bentley Delivery Centre
Western Australia 6983
AUSTRALIA

Telephone: +61 8 9334 0500
Facsimile: +61 8 9334 0515
Email: nuytsia@dec.wa.gov.au
Web: science.dec.wa.gov.au/nuytsia



Department of
Environment and Conservation

Our environment, our future 

All material in this journal is copyright and may not be reproduced except with the written permission of the publishers.

© Copyright Department of Environment and Conservation

A revision of *Eucalyptus* ser. *Cornutae* subser. *Conjunctae* (Myrtaceae) from the south coast of Western Australia, including the description of four new taxa and comments on the hybrid origin of *E. bennettiae*

Dean Nicolle^{1,4}, Malcolm French² and Nathan McQuoid³

¹ Currency Creek Arboretum, 15 Rousillion Promenade, Old Reynella, South Australia, 5161

² 29 Stonesfield Court, Padbury, Western Australia, 6025

³ Greening Australia (WA), 10–12 The Terrace, Fremantle, Western Australia, 6160

⁴ Corresponding author

Abstract

Nicolle, D., French, M. & McQuoid, N. A revision of *Eucalyptus* ser. *Cornutae* subser. *Conjunctae* (Myrtaceae) from the south coast of Western Australia, including the description of four new taxa and comments on the hybrid origin of *E. bennettiae*. *Nuytsia* 18: 197–222 (2008). Eight terminal taxa are recognised in *Eucalyptus* L'Hér. ser. *Cornutae* (Benth.) Brooker subser. *Conjunctae* Brooker. Two new species are described, viz., *E. sinuosa* D.Nicolle, M.E.French & McQuoid, known from only a few populations in the Corackerup Creek area and in Fitzgerald River National Park, and *E. retusa* D.Nicolle, M.E.French & McQuoid, known from one or possibly two populations from near Bremer Bay. New subspecies described are *E. lehmannii* (Schauer) Benth. subsp. *parallela* D.Nicolle & M.E.French, which is the widespread variant of the species, occurring from the Stirling Range area eastwards to Cape Arid, and *E. conferruminata* D.Carr & S.Carr subsp. *recherche* D.Nicolle & M.E.French, the eastern variant of that species apparently endemic to the Recherche Archipelago and the common variant in cultivation across southern Australia. The distribution of *E. arborella* Brooker & Hopper is modified with the discovery of a new population and the exclusion of another population included in this species by others. The hybrid status of *E. bennettiae* D.Carr & S.Carr is discussed. A key to *E.* subser. *Conjunctae* is provided.

Introduction

We recognise eight terminal taxa within *Eucalyptus* L'Hér. subser. *Conjunctae* Brooker. These are unique in the genus due to their fused hypanthia, readily seen in the flower bud and fruit stage. Indeed, the taxon *Symphomyrtus* (Schauer) Brooker, first described as a new genus in 1844 and now universally recognised as the largest subgenus in the eucalypts, and for which *E. lehmannii* (Schauer) Benth. (one of the species of *E.* subser. *Conjunctae*) is the type, literally means 'fused myrtle'. Of course, although the name is most appropriate for *E. lehmannii* and the other taxa of *E.* subser. *Conjunctae*, it is not apt for the majority of taxa now included in *E.* subg. *Symphomyrtus*.

The species in *E.* subser. *Conjunctae* are also distinctive in their variably long and conspicuous opercula, very large inflorescences of yellowish green, erect stamens, and fruits which are fused into

relatively large, woody, more or less rounded clusters with long, sharp and relatively strong style remnants and valves, giving the fruiting inflorescences a ‘spiky’ look and feel.

Eucalyptus subser. *Conjunctae* is restricted to the coastal and subcoastal areas of southern Western Australia, with the distribution centred on Fitzgerald River National Park, which is well-known for its very high taxonomic diversity of vascular plants. Indeed, five of the six species recognised in the subseries occur within the national park (with *E. retusa* D.Nicolle, M.E.French & McQuoid occurring just outside it in a recreation reserve).

Some taxa of the subseries are widely grown in cultivation, at least in southern Australia, particularly *E. conferruminata* D.Carr & S.Carr subsp. *recherche* D.Nicolle & M.E.French and to a lesser extent *E. lehmannii*. Furthermore, *E. mcquoidii* Brooker & Hopper, *E. retusa* and particularly *E. sinuosa* D.Nicolle, M.E.French & McQuoid (the latter two newly described here) have potential for horticultural use, due to their generally diminutive and compact habit, large inflorescences, unusual flower buds and fruits, and tolerance of coastal conditions.

The subseries is placed and defined in the genus as follows (following Brooker 2000): *Eucalyptus* subg. *Symphyomyrtus* (cotyledons folded in seeds; buds bi-operculate; seeds with ventral or terminal hilum; seed coat formed from both integuments) sect. *Bisectae* Maiden ex Brooker (cotyledons bisected; inflorescences axillary) subsect. *Hadrotetes* Brooker (cotyledons coarsely bisected; buds and fruits large and coarse) ser. *Cornutae* (Benth.) Brooker (pith of branchlets with glands; seedling leaves scabrid) subser. *Conjunctae* (hypanthia of flower buds and fruits fused together).

Brooker (2000) recognised two subseries within *E. ser. Cornutae*, of which subser. *Liberiae* Brooker has similarly large inflorescences of yellowish green flowers, but differs from subser. *Conjunctae* primarily in the free (non-fused) hypanthia of the inflorescence. *Eucalyptus* subser. *Liberiae* has four species (*E. burdettiana* Blakely & Steedman, *E. megacornuta* C.Gardner, *E. newbeyi* D.Carr & S.Carr and *E. talyuberlup* D.Carr & S.Carr) with a similar distribution to that of subser. *Conjunctae*.

Key to the taxa of *Eucalyptus* subser. *Conjunctae*

1. Peduncles flattened in flower buds
 2. Peduncles 10–28 mm wide; opercula 8–21 mm wide at base
 3. Opercula mostly >12 mm wide at base **1a. *E. conferruminata* subsp. *conferruminata***
 - 3: Opercula mostly <12 mm wide at base **1b. *E. conferruminata* subsp. *recherche***
 - 2: Peduncles 5–12 mm wide; opercula 3–10 mm wide at base
 4. Obligate seeder; infructescences 44–52 mm diam. **2. *E. arborella***
 - 4: Resprouter; infructescences 32–46 mm diam.
 5. Adult leaves elliptic to ovate, 16–27 mm wide **5a. *E. lehmannii* subsp. *lehmannii***
 - 5: Adult leaves linear to narrowly elliptic, 8–14 mm wide **5b. *E. lehmannii* subsp. *parallela***
- 1: Peduncles terete in flower buds

6. Adult leaves obovate to spatulate, 14–20 mm wide and often retuse at tip.....6. *E. retusa*
- 6: Adult leaves linear to narrowly spatulate, 4–10 mm wide, acuminate at tip
7. Obligate seeder; opercula straight or weakly curved near tip, 50–60 mm long 3. *E. mcquoidii*
- 7: Resprouter; opercula sinuous, 50–95 mm long.....4. *E. sinuosa*

Taxonomy

1. *Eucalyptus conferruminata* D.Carr & S.Carr, *Austral. J. Bot.* 28: 535 (1980).

Type: Middle Mt Barren, Western Australia, 16 July 1970, *A.S. George* 10097 (*iso*: PERTH 01378147, 01378120, 01377728, 01377701, 01378139).

Distinguished within the subseries by its combination of non-lignotuberous habit (obligate seeder); elliptic to elongate-elliptic, acuminate adult leaves; short, strongly flattened peduncles; fully fused hypanthia; large buds with thick, straight and blunt-tipped opercula; and large fruits.

Dense *shrub* or bushy-crowned *mallet*, 1–5 m tall, lignotuber absent (obligate seeder). *Bark* smooth throughout, light grey to tan over pale yellow to cream, decorticating in strips and short ribbons. *Seedling leaves* opposite for 1 or 2 pairs then becoming disjunct, ovate to orbicular-ovate, to 50 mm long by 38 mm wide, scabrous, slightly discoloured, dull, light green. *Adult leaves* shortly petiolate, held somewhat erect; lamina elliptic to elongate elliptic, mucronate, 48–93 mm long × 13–32 mm wide, glossy, light green; reticulation sparse to moderate with scattered intersectional oil glands; lenticels absent. *Inflorescences* axillary, unbranched, sessile and fully fused; 7–19-flowered; peduncles distinctly flattened and distally thickened, 22–48 mm long, 10–28 mm wide. *Flower buds* with hypanthia sessile and fully fused; opercula finger-shaped, blunt-tipped, 34–55 mm long × 8–21 mm wide at base, straight, rounded but never swollen at tip. *Flowers* yellow-green. *Fruits* sessile and fused, infructescences to 65 mm in diameter (excluding valves; to 90 mm diameter including valves); individual fruits 14–25 mm wide at rim; disc ascending; valves 3, strongly exerted and with persistent style remnants. (Figure 1)

Two allopatric subspecies are recognised, differing primarily in the size of the buds and fruits.

1a. *Eucalyptus conferruminata* subsp. *conferruminata*

Adult leaf lamina elliptic to elongate-elliptic, 48–93 mm long × 16–32 mm wide. *Inflorescences* 7–15(–17)-flowered; peduncle 20–48 mm long × 12–28 mm wide. *Flower buds* with opercula 36–55 mm long × (10–)12–21 mm wide at base. *Infructescences* to 60 mm in diameter (excluding valves). *Individual fruits* 14–25 mm wide at rim; disc ascending. (Figures 1, 2)

Selected specimens examined (west to east). WESTERNAUSTRALIA: Bald Head, Flinders Peninsula, Torndirrup, 25 km S of Albany, 16 Dec. 1986, *G.J. Keighery* 8610 (PERTH); 1.5 miles SE of Middle Mt Barren, 21 Mar. 1970, *K.R. Newbey* 3136 (PERTH); 200 m E down gully, near Quoin Head, Fitzgerald River National Park, 4 Nov. 2000, *D. Nicolle* 3570 & *M. French* (CANB, PERTH). Bald Head, Flinders Peninsula, S of Albany, 24 Sep. 2004, *D. Nicolle* 4805 & *M. French* (AD, CANB, PERTH).



Figure 1. Isotype of *Eucalyptus conferruminata* subsp. *conferruminata*, scale = 5 cm.

Distribution and habitat. Known only from a few sites on the south coast of Western Australia, at Bald Head south of Albany, and a few small populations between Middle Mount Barren and the Whoogarup Range in the central coastal area of Fitzgerald River National Park. All sites are very coastal and exposed to persistent and at times strong, salt-laden winds (Figure 2). The subspecies often occurs in small pure stands or as the only eucalypt among other coastal taxa, but has also been recorded growing with *Eucalyptus mcquoidii* and *E. preissiana* subsp. *preissiana*.

Eucalyptus conferruminata has been reported from Bald Island, approximately 50 km east-north-east of Albany (Gardner 1960; Sarah Comer, Department of Environment and Conservation, Albany, pers. comm.), hence the occasionally used common name ‘Bald Island marlock’. However, the authors have not seen herbarium specimens collected from the island nor verified the island population in the field. The taxon may also occur at Two Peoples Bay, between Albany and Bald Island, with *E. conferruminata* described as occurring ‘...from Two Peoples Bay east to beyond Esperance...’ by Brooker and Kleinig (2001). A targeted search for the taxon around Mt Gardner in the Two Peoples Bay area by one of us (NMQ) in June 2007 revealed no typical *E. conferruminata*, although populations displaying intermediate morphology between *E. cornuta* and *E. conferruminata* were observed and collected at several sites near Mt Gardner. We consider these populations to represent intergrades between *E. cornuta* and *E. conferruminata* due to the variably intermediate habit, bark and reproductive morphology. Although we cannot confirm ‘pure’ *E. conferruminata* from the Two Peoples Bay area, these variable intermediates indicate that *E. conferruminata* may remain undetected in the general area, and/or that *E. conferruminata* once occurred in the area in the past but has since been genetically swamped by *E. cornuta*, which has a wider but scattered distribution in the area. The latter hypothesis is analogous to the apparent genetic swamping of *E. retusa* by the more common *E. cornuta* at Hood Point.



Figure 2. Habitat and habit of *Eucalyptus conferruminata* subsp. *conferruminata* (Bald Head, Flinders Peninsula, S of Albany, D. Nicolle 4805 & M. French).

Conservation status. Only known from a handful of small populations, mostly or entirely within conserved areas. Recorded from Torndirrup and Fitzgerald River National Parks.

Notes. *Eucalyptus conferruminata* subsp. *conferruminata* is the western variant of the species, differing from subsp. *recherche* in the coarser adult leaves, flower buds and fruits. Natural populations of the two subspecies are geographically separated by approximately 120 km (between Quoin Head, which is the eastern extent of subsp. *conferruminata*, and Sandy Hook Island, which is the western extent of subsp. *recherche*) and intergradation between the two subspecies is therefore not known.

Eucalyptus conferruminata subsp. *conferruminata* is rarely seen in cultivation (*cf.* subsp. *recherche*).

1b. *Eucalyptus conferruminata* subsp. *recherche* D. Nicolle & M.E.French, *subsp. nov.*

A subspecies typica foliis adultis, alabastris fructibusque validioribus et parvioribus differt.

Typus: higher slopes of western section of Woody Island, south-east of Esperance, 33° 58' 03" S, 122° 00' 50" E, 24 February 2001, *M. French* 1263 (*holo:* PERTH 05999596; *iso:* AD, CANB).

Eucalyptus conferruminata subsp. *recherche* Archipelago (D. Nicolle & M. French DN 4585), in Council of Heads of Australasian Herbaria, *Australian Plant Census*, <http://www.chah.gov.au/apc/index.html> [accessed 28 May 2008].

Eucalyptus lehmannii subsp. *rechercheensis* D.Nicolle ms, in Council of Heads of Australasian Herbaria, *Australian Plant Census*, <http://www.chah.gov.au/apc/index.html> [accessed 28 May 2008].

Adult leaf lamina elongate-elliptic, 50–85 mm long × 11–27 mm wide. *Inflorescences* 13–19-flowered; peduncle 18–32 mm long × 10–14 mm wide. *Flower buds* with opercula 34–40 mm long × 8–11 mm wide at base. *Infructescences* to 50 mm in diameter (excluding valves). *Individual fruits* 12–19 mm wide at rim; disc slightly ascending to ascending. (Figure 3)

Selected specimens examined. (west to east). WESTERN AUSTRALIA: Sandy Hook Island, near Esperance, 1 May 1982, *M.I.H. Brooker* 7491 (CANB, PERTH); along path to Skinny Dip Bay, E end of Woody Island, Recherche Archipelago, 18 Nov. 1998, *M. Hislop* 1222 (PERTH); Archipelago of the Recherche, Sandy Hook Island, 1 May 1982, *S.D. Hopper* 2236 (PERTH); slope on S side of peak, North Twin Peak Island, Recherche Archipelago, 5 Mar. 2003, *D. Nicolle* 4585 & *M. French* (AD, CANB, PERTH); E side of Flinders Peak, Middle Island, Recherche Archipelago, 6 Mar. 2003, *D. Nicolle* 4588 & *M. French* (CANB, PERTH); NW side of Mondrain Island, Recherche Archipelago, 8 Mar. 2003, *D. Nicolle* 4596 & *M. French* (PERTH); S side of Sandy Hook Island, Recherche Archipelago, 8 Mar. 2003, *D. Nicolle* 4603 & *M. French* (CANB, PERTH); W side of Woody Island, Recherche Archipelago, 10 Mar. 2003, *D. Nicolle* 4611 & *M. French* (PERTH); Middle Island, 22 Nov. 1973, *A.S. Weston* 8874 (PERTH).

Distribution and habitat. Apparently endemic to the Archipelago of the Recherche, off the south coast of Western Australia (Figure 4). Collections of this subspecies have been made from Middle, Mondrain, North Twin Peak, Sandy Hook and Woody Islands. A search for the subspecies on other islands of the archipelago in March 2003 by two of the authors (DN and MF) indicates that the subspecies is apparently absent from Observatory, Figure of Eight, South Twin Peak, Long and Salisbury Islands.



Figure 3. Holotype of *Eucalyptus conferruminata* subsp. *recherche*, scale = 5 cm.

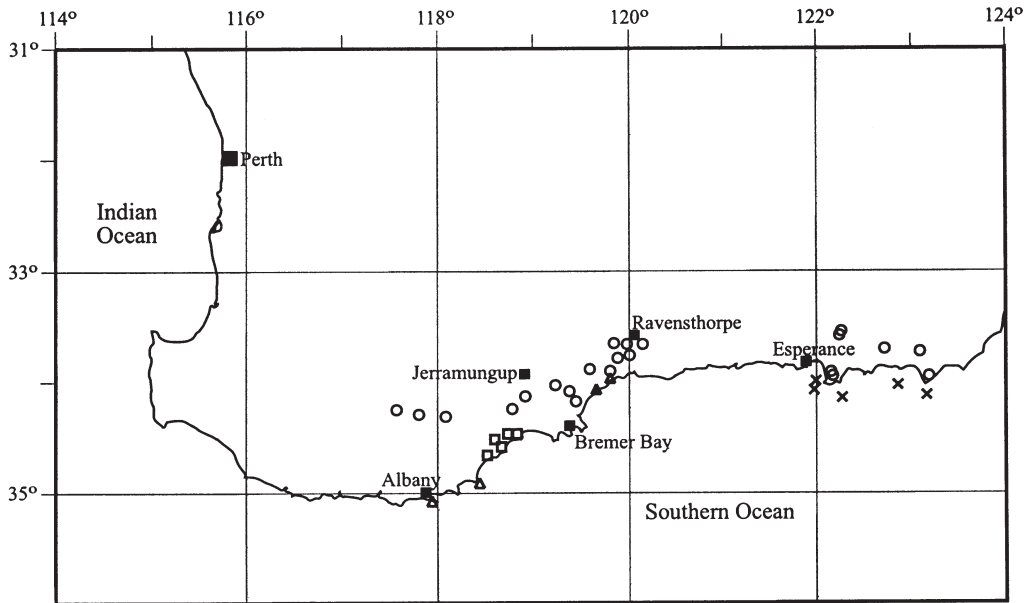


Figure 4. Distribution of *Eucalyptus conferruminata* subsp. *conferruminata* (Δ) and *recherche* (\times) and *E. lehmannii* subsp. *lehmannii* (\square) and *parallela* (\circ) in Western Australia.

The subspecies occurs on thin, sandy, granite-derived soils on undulating terrain and slopes, often below granite domes or hills, and is replaced by *E. utilis* on somewhat more level terrain where limestone is the parent material. The subspecies occurs in dense mallee scrub or occasionally in large pure stands (such as on Mondrain Island). Associated species include *Eucalyptus aquilina* (on Sandy Hook Island), *E. cornuta*, *E. goniantha* subsp. *notactites* (on Sandy Hook Island), *E. incrassata*, *E. insularis* (on North Twin Peak Island), *E. utilis* and *Hakea drupacea*.

Occurrences of this subspecies from the Australian mainland appear to have originated from plantings of the subspecies followed by some natural regeneration from seed (see below).

Conservation status. All known natural populations of this subspecies occur within the Archipelago of the Recherche Nature Reserve. While known from relatively few locations, the subspecies is considered well secure, with only the Woody Island populations at some threat from development associated with tourism on the island. The populations on Mondrain Island are relatively extensive in area.

Etymology. The subspecific epithet (used as a noun in apposition) is from the distribution of the subspecies, which is endemic to, and widespread in, the Archipelago of the Recherche.

Notes. *Eucalyptus conferruminata* subsp. *recherche* is the eastern variant of the species, differing from the typical subspecies in the less coarse adult leaves, flower buds and fruits. Subspecific rather than specific status is preferred for the two variants of the species, as the differences are relatively minor and it is expected that the two variants would interbreed if in geographic contact.

While *E. conferruminata* appears to be consistently killed by wildfire and is therefore an obligate seeder, populations and individuals of subsp. *recherche* occasionally develop a lignotuber, such as on

North Twin Peak Island (*D. Nicolle* 4585 & *M. French*) and more rarely on Mondrain Island (*D. Nicolle* 4596 & *M. French*). All individuals of the subspecies subjected to wildfire on Mondrain Island in 2002 were killed, regardless of presence/absence of a lignotuber (Figure 5). On North Twin Peak Island, live individuals of the subspecies were only seen as post-fire progeny from a wildfire several years earlier. The occasional presence of a lignotuber in this taxon may be caused by past and/or current genetic influence from Mainland populations of the lignotuberous *E. lehmannii*, or be due to incomplete loss of the lignotuber character from a presumably lignotuberous ancestral taxon.

Eucalyptus conferruminata subsp. *recherche* is the commonly cultivated variant of the species in coastal regions of southern Australia, and has been widely planted in farming areas of the Esperance sandplains, as well as in metropolitan areas of Perth and Adelaide. The subspecies is fast-growing and useful in sandy soils on sites subject to persistent salt-laden winds, but is susceptible to wind damage when planted in the open due to its rapid growth, dense crown and lack of a lignotuber. The typical variant of *E. conferruminata* is rarely seen in cultivation.

Under cultivated conditions the species occasionally becomes mildly weedy by short-distance seed dispersal and seedling recruitment, especially on disturbed sites. At least some individuals of this taxon within Cape Le Grand National Park appear to have originated from planted individuals and subsequent natural regeneration, e.g. southern end of Lucky Bay, Cape Le Grand National Park, 33° 59' 39" S, 122° 13' 15" E, 22 Jan. 1996, *D. Nicolle* 1639 (AD). It is possible that *E. conferruminata* subsp. *recherche* also occurs naturally in the Cape Le Grand area, but the authors have not confirmed any natural populations from the mainland.



Figure 5. Seedling regeneration of *Eucalyptus conferruminata* subsp. *recherche* following wildfire (NW side of Mondrain Island, Recherche Archipelago, 8 Mar. 2003).

2. *Eucalyptus arborella* Brooker & Hopper, *Nyctisia* 14(3): 336 (2002). *Type*: Fitzgerald River National Park [precise locality withheld for conservation reasons], 12 March 1989, *S.D. Hopper* 7131 (*holo*: PERTH 07800576; *iso*: AD, CANB, MEL, NSW).

Eucalyptus lehmannii subsp. *arborella* Brooker & Hopper ms, in Council of Heads of Australasian Herbaria, *Australian Plant Census*, <http://www.chah.gov.au/apc/index.html> [accessed 28 May 2008].

Distinguished in the subseries by its combination of non-lignotuberous (obligate seeder) habit; acuminate adult leaves; long, distinctly flattened to almost terete peduncles (in fruit); fully fused hypanthia; medium-sized buds with narrow, straight and apiculate opercula; and medium-sized fruits.

Tree (mallet) 3–7 m tall, lignotuber absent (obligate seeder). *Bark* smooth throughout, dark grey to grey over pinkish-cream to almost white, decorticating in strips. *Seedling leaves* opposite for a few pairs then becoming disjunct, ovate, to 60 mm long by 28 mm wide, scabrous, discolourous, dull, light green. *Adult leaves* petiolate; lamina elongate-elliptic to lanceolate, 60–80 mm long \times 12–19 mm wide, glossy, dark green; reticulation moderate with scattered intersectional oil glands; lenticels absent. *Inflorescences* axillary, fully fused, 13–21-flowered; peduncle flattened to near terete, slightly distally broadened, 50–70 mm long \times 5–12 mm wide. *Flower buds* with hypanthia sessile and fully fused; opercula narrow-cylindrical, conical-tipped, 38–50 mm long \times 5–10 mm wide. *Flowers* yellowish green. *Fruits* sessile and fused, infructescences to 52 mm in diameter (excluding valves; to 65 mm diameter including valves); individual fruits 11–16 mm wide at rim; disc ascending; valves 3, prominently exerted and with persistent style remnants.

Selected specimens examined. WESTERNAUSTRALIA: [localities withheld for conservation reasons] 3 Aug. 1970, *M.I.H. Brooker* 2701 (CANB, MEL, PERTH); 26 Nov. 1991, *M.I.H. Brooker* 10918 (PERTH); 18 Sep. 1999, *M.I.H. Brooker* 13035 (PERTH); 2 Dec. 2003, *M.E. French* 1563 (PERTH); 7 Apr. 1995, *S.D. Hopper* 8325 (PERTH); 23 Nov. 1994, *D. Nicolle* 1127 (PERTH); 23 Sep. 2004, *D. Nicolle* 4803 & *M. French* (CANB, PERTH).

Distribution and habitat. *Eucalyptus arborella* is known from only a few very scattered populations in subcoastal areas south-west and south-east of Jerramungup, in southern Western Australia (Figure 6). The species grows on the sides and tops of Eocene marine plain derived lateritic hills, jump-ups and mesas, on thin sandy soils with outcropping spongolite rock. These sites tend to be less fire prone than surrounding, more subdued topography. It occasionally grows in pure stands or associated with other obligate seeder eucalypts such as *E. astringens* subsp. *redacta*, as well as mallee species such as *E. flocktoniae* subsp. *flocktoniae*, *E. pleurocarpa* and *E. uncinata*.

Conservation status. Known from only three populations, two of which occur in Fitzgerald River National Park and a third, recently discovered population in the Corackerup Creek area. Further unrecorded populations are likely, but remain undocumented due to the species superficial similarity to *E. lehmannii* (especially subsp. *parallela*). Department of Environment and Conservation (DEC) Conservation Codes for Western Australian Flora: Priority Three (Atkins 2008).

Notes. *Eucalyptus arborella* may be confused with *E. lehmannii* subsp. *parallela* in herbaria, but is easily distinguished from the latter in the field by the absence of a lignotuber. The adult leaves, buds and fruits tend to be larger in *E. arborella* than in *E. lehmannii* subsp. *parallela*. The presence/absence of a lignotuber and consequential difference in regenerative strategy is the most reliable characteristic

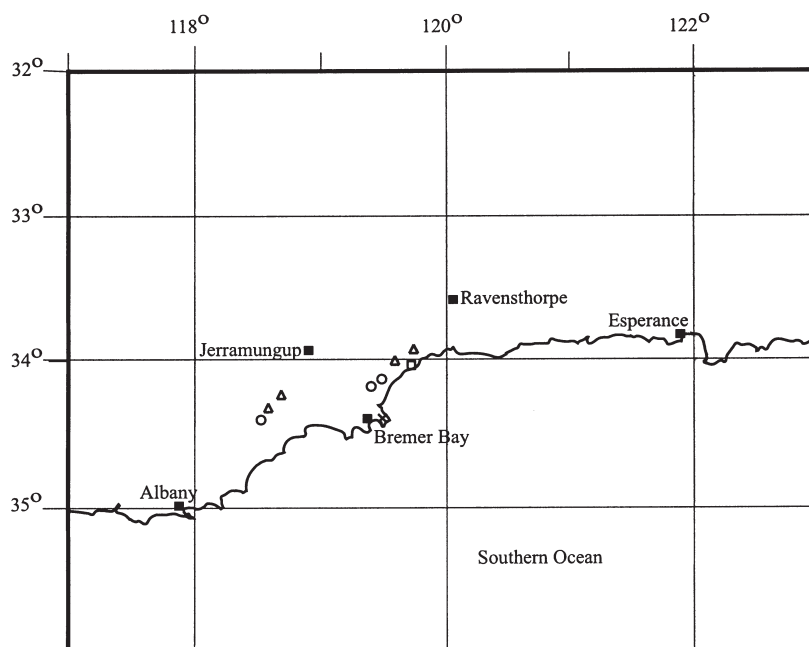


Figure 6. Distribution of *Eucalyptus arborella* (○), *E. mcquoidii* (□), *E. sinuosa* (△) and *E. retusa* (×) in Western Australia.

to distinguish the two species. The two taxa grow in close proximity in the Corackerup Creek area, with *E. arborella* occurring on the breakaways and tops of steep spongolite mesas and *E. lehmannii* subsp. *parallela* growing on more subdued sites on less skeletal soils below these mesas. Apart from the lack of a lignotuber and the somewhat larger adult leaves, buds and fruits, *E. arborella* also differs from *E. lehmannii* subsp. *lehmannii* in the narrower and longer adult leaves.

One of the populations cited as *E. arborella* by Brooker and Hopper (2002) (Fitzgerald River National Park, 500 m S of telegraph track on Quoin Head track, *S.D. Hopper* 7134, 7135) is in fact *E. lehmannii* subsp. *parallela*, as field observations indicate the population recovered from epicormic regrowth from the lignotubers following wildfire. The population occurs in a small creekline, a habitat typical of *E. lehmannii* but not *E. arborella*. This population may have been erroneously determined as *E. arborella* due to its larger status (individuals up to six metres tall prior to wildfire).

3. *Eucalyptus mcquoidii* Brooker & Hopper, *Nuytsia* 14(3): 336 (2002). *Type*: Fitzgerald River National Park, Western Australia [precise locality withheld for conservation reasons], 6 April 1995, *M.I.H. Brooker* 12198W (*holo*: CANB; *iso*: AD, NSW, PERTH).

Eucalyptus macquoidii Brooker & Hopper, in Council of Heads of Australasian Herbaria, *Australian Plant Census*, <http://www.chah.gov.au/apc/index.html> [accessed 28 May 2008].

Distinguished in the subseries by its combination of non-lignotuberous (obligate seeder) habit; linear, acuminate adult leaves with black lenticels (glands) scattered along the margins, long, terete peduncles; fully fused hypanthia; small buds with narrow, straight and apiculate-tipped to somewhat bulbous opercula; and small fruits.

Dense *shrub*, 1–4(–10) m tall, lignotuber absent (obligate seeder). *Bark* smooth throughout, decorticating in strips. *Seedling leaves* opposite for a few pairs then becoming disjunct, green. *Adult leaves* with petiole tapering to lamina, held erect; lamina glossy, green, linear to narrowly spatulate, apiculate, 60–75 mm long × 6–10 mm wide, reticulation sparse to moderate with intersectional and island oil glands, usually with minute blackened lenticels on the margins of the lamina; midrib and intramarginal veins distinct and parallel. *Inflorescences* axillary, unbranched, sessile and fused, up to 45-flowered; peduncles terete to oval in cross section, very slightly distally thickened, 25–35 mm long, 4–5 mm wide at base. *Flower buds* with hypanthia sessile and fully fused; operculum 50–60 mm long × 5–6 mm wide at base, straight or weakly curved near tip, usually swollen at tip. *Flowers* yellow-green. *Fruits* sessile and fused, infructescences 28–35 mm in diameter (excluding valves; to 45 mm diameter including valves); individual fruits 6–12 mm wide at rim; disc ascending; valves 3, strongly exserted and with persistent style remnants. (Figures 7, 8)



Figure 7. Four-year old plants of *Eucalyptus mcquoidii* at Currency Creek Arboretum (S.A.), grown from seed from *D. Nicolle* 3569 & *M. French*.



Figure 8. Mature flower bud inflorescence of *Eucalyptus mcquoidii* (LHS; *D. Nicolle* 3569 & *M. French*) and *E. conferruminata* subsp. *conferruminata* (RHS; *D. Nicolle* 3570 & *M. French*) from Quoin Head, Fitzgerald River National Park.

Selected specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 16 Feb. 1989, *N.K. McQuoid* 113 (PERTH); 8 April 1989, *N.K. McQuoid* 141 (PERTH); 4 Dec. 2000, *D. Nicolle* 3569 & *M. French* (AD, CANB, PERTH); 25 Dec. 1988, *E.M. Sandiford* A; B (PERTH).

Distribution and habitat. Known from a single population spanning several kilometres centred on Quoin Head in Fitzgerald River National Park, on the south coast of Western Australia (Figure 6). The species occurs on steep hillsides and rounded hilltops in quartz-granite sands in coastal mallee shrubland with *Eucalyptus conferruminata* subsp. *conferruminata*, *E. pleurocarpa*, *E. preissiana* subsp. *preissiana*, *E. redunca* and *E. uncinata*.

Conservation status. The only known population consists of at least several thousand individuals and is conserved within Fitzgerald River National Park. As the species is an obligate seeder, it is at risk of population depletion or local extinction from inappropriate fire management. DEC Conservation Codes for Western Australian Flora: Priority Two (Atkins 2008).

Notes. *Eucalyptus mcquoidii* and *E. sinuosa* share the feature of conspicuous blackened lenticels on the margins of the adult leaves, a character recorded elsewhere in the genus such as in the widespread and polymorphic mallee species *E. incrassata* Labill. The adult leaves of *E. mcquoidii* also often have lenticel-like, blackened and swollen tips.

Eucalyptus mcquoidii and *E. conferruminata* are unusual among obligate seeders in the genus in having a dense-crowned, very shrubby habit in exposed sites. Most other Western Australian obligate seeder eucalypts have a more erect habit and are known generally as mallets.

4. *Eucalyptus sinuosa* D.Nicolle, M.E.French & McQuoid, *sp. nov.*

Inter species subseriei *Conjunctarum* Brooker distinguenda habitu pluricauli ('mallee') et praesentia lignotuberis, foliis adultis angustis, lenticellis nigris marginibus dispersis, pedunculis longis teretisque, hypanthiis omnino connatis, alabastris magnis, operculis angustis sinuosisque et plerumque apice bulbosa, fructibus parvis.

Typus: Peniup Nature Reserve, south-west of Jerramungup, Western Australia [precise locality withheld for conservation reasons], 7 January 2007, *D. Nicolle* 5061 & *M. French* (*holo:* PERTH 07220650; *iso:* AD, CANB).

Eucalyptus sp. Fitzgerald River (M.I.H. Brooker 10923); *Eucalyptus petila* L.A.S.Johnson & K.D.Hill ms, in Council of Heads of Australasian Herbaria, *Australian Plant Census*, <http://www.chah.gov.au/apc/index.html> [accessed 28 May 2008].

Eucalyptus 'petila' Brooker & Hopper *ined.* (Kelly *et al.* 1995; 143).

Distinguished in the subseries by its combination of lignotuberous (resprouter) habit; linear adult leaves with black lenticels (glands) scattered along the margins, long and terete peduncles; fully fused hypanthia; large buds with narrow, sinuous and often bulbous-tipped opercula; and small fruits.

Mallee, 1.0–3.5 m tall, lignotuber present. *Bark* smooth throughout (sometimes ribbony-rough at the base), grey to tan over orange-tan, decorticating in strips and short ribbons. *Seedling leaves* not seen. *Adult leaves* with petiole tapering to lamina, held erect; lamina glossy, green, linear, apiculate,

50–75 mm long \times 4–7(–8) mm wide, with up to 6 blackened lenticels on each margin of the lamina; midrib and intramarginal veins distinct and parallel. *Inflorescences* axillary, unbranched, sessile and fused, up to 25-flowered; peduncles terete to oval in cross section, slightly distally thickened, (45–)60–100(–140) mm long, 5–10 mm wide at base. *Flower buds* with hypanthia sessile and fully fused; operculum 50–95 mm long, sinuous, usually swollen to bulbous at tip. *Flowers* yellow-green. *Fruits* sessile and fused; infructescences 25–75 mm in diameter (including valves); individual fruits 6–16 mm wide; disc indistinct, ascending; valves 3, strongly exerted and with persistent style remnants. (Figures 9, 10, 11)

Selected specimens examined (west to east). WESTERN AUSTRALIA: [localities withheld for conservation reasons] 11 June 2003, *S. Barrett* 1097 (PERTH); 25 Nov. 1991, *M.I.H. Brooker* 10923 (CANB, PERTH); 15 June 2002, *J.A. Cochrane* 4200 (PERTH); 11 June 2003, *J.A. Cochrane* 4688, *S. Barrett & M. Grant* (K, PERTH); Feb. 1977, *T. Evans s.n.* (PERTH); 30 March 2006, *M. French* 1782 (PERTH); 30 March 2006, *M. French* 1783 (PERTH); 6 June 1989, *S.D. Hopper* 7261 (PERTH); 7 June 1989, *S.D. Hopper* 7265 (PERTH); 18 Jan. 1989, *A.C. Napier & E. Goble-Garratt* 364 (PERTH); 7 Jan. 2007, *D. Nicolle* 5057 & *M. French* (CANB, PERTH); 4 Nov. 1992, *C.J. Robinson* 997 (PERTH).

Distribution and habitat. Known from about six populations scattered in subcoastal areas of southern Western Australia, from the Corackerup Creek catchment south-east of Ongerup eastwards to the lower West River catchment in Fitzgerald River National Park, south-west of Ravensthorpe (Figure 6). Although the known populations are well scattered, the species is usually locally common or dominant where it occurs. *Eucalyptus sinuosa* grows in white granitic sands with scattered gravel on slight slopes or undulating topography in mallee or open mallee communities with other eucalypt species including *E. conglobata* subsp. *perata*, *E. pleurocarpa*, *E. aff. rigidula*, *E. sporadica*, *E. uncinata* and *E. xanthonema* subsp. *apposita*.

Etymology. From the Latin *sinuosus* (full of bendings; winding) referring to the distinctive and conspicuous opercula of the species.

Conservation status. Most of the known populations occur in conserved areas, including several populations in Fitzgerald River National Park and at least one population occurring in each of Peniup and Corackerup Nature Reserves. DEC Conservation Codes for Western Australian Flora: Priority Two, as *Eucalyptus* sp. Fitzgerald River (M.I.H. Brooker 10923) (Atkins 2008).

Notes. A distinctive species, both in the genus and within *E.* subser. *Conjunctae*, due to its narrow adult leaves and large flower bud inflorescences with long and narrow, sinuous opercula that are often bulbous at the tip. The species has considerable horticultural potential because of its small, fine-leaved crown, unusual flower buds (the species has the longest opercula in the genus) and large, greenish yellow flowers.

Eucalyptus sinuosa is not likely to be confused with any other species in the subseries, but is probably most closely related to *E. mcquoidii*, differing from the latter in the presence of a lignotuber (lignotuber absent in *E. mcquoidii*) and the much longer, sinuous and often bulbous-tipped opercula (shorter, straight and more apiculate opercula in *E. mcquoidii*).

Eucalyptus sinuosa and *E. mcquoidii* share the feature of conspicuous blackened lenticels on the margins of the adult leaves, a character recorded elsewhere in the genus such as in the widespread and polymorphic mallee species *E. incrassata*. This characteristic has also been observed in some populations of *E. lehmannii* subsp. *parallela* (e.g. *D. Nicolle* 4802 & *M. French*), and its diagnostic value may be limited.

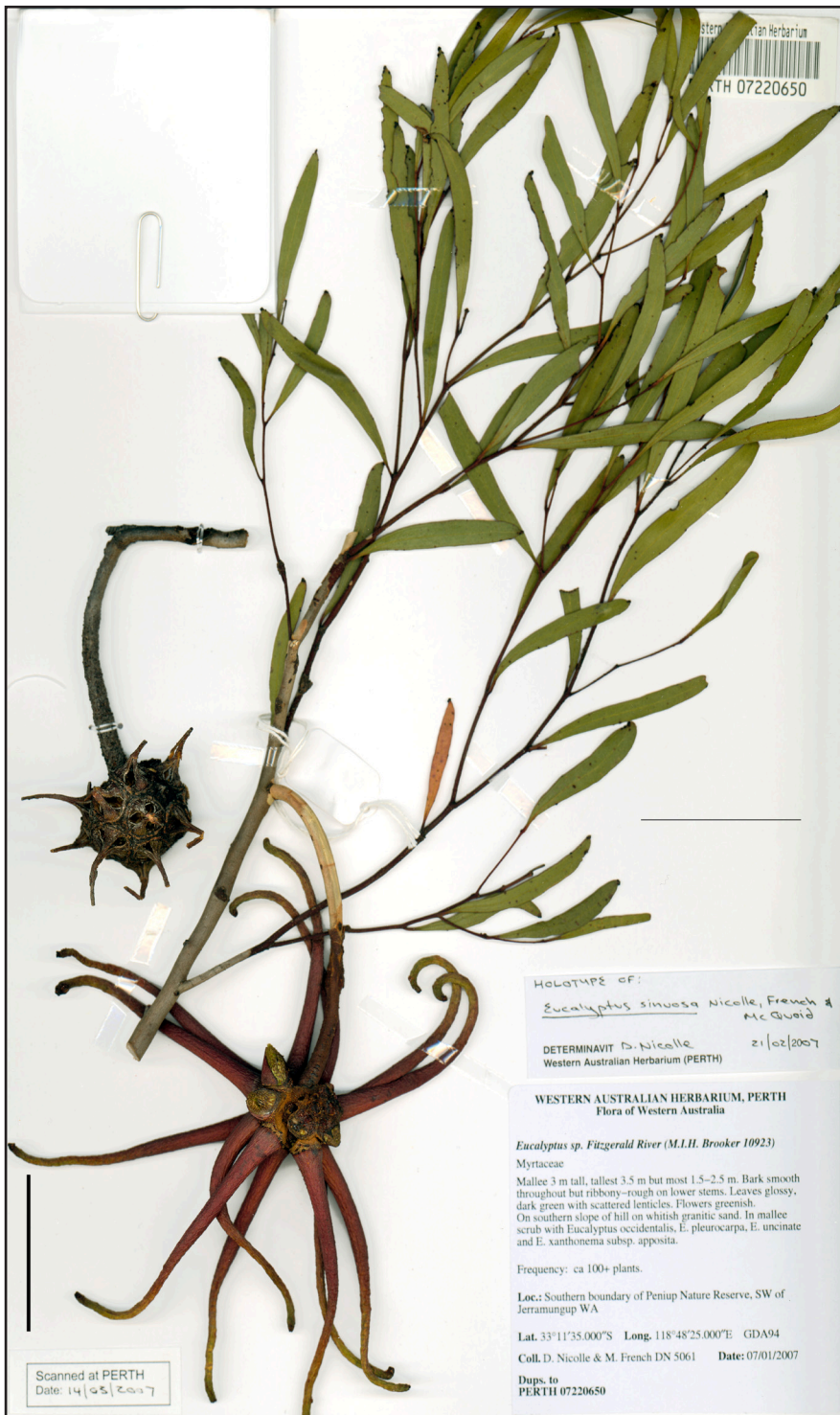


Figure 9. Holotype of *Eucalyptus sinuosa*, scale = 5 cm.



Figure 10. Flowering branch of *Eucalyptus sinuosa* from the type plant.



Figure 11. Habitat and habit of *Eucalyptus sinuosa* (c. 1 km due south-east of 33° 47' 1" S, 119° 46' 18" E, Fitzgerald River National Park, D. Nicolle 5057 & M.E. French

5. *Eucalyptus lehmannii* (Schauer) Benth., *Fl. Austral.* 3: 233 (1867). *Type*: Cape Riche, Western Australia, 19 November 1840, *L. Preiss* 227 (*lecto*: LD n.v., *fide* D.J. Carr & S.G.M. Carr, *Austral. J. Bot.* 28: 531 (1980); *isolecto*: G, MEL).

Symphomyrtus lehmannii Schauer in J.G.C. Lehmann, *Pl. Preiss.* 1: 127 (1844).

Distinguished within the subseries by its combination of lignotuberous (resprouter) habit; linear to ovate, acuminate adult leaves; long, near-terete to distinctly flattened peduncles; fully fused hypanthia; relatively small buds with narrow, straight and apiculate opercula; and the relatively small fruits.

Mallee to 4(–6) m tall; lignotuber present (resprouter). *Bark* smooth throughout, grey over tan to cream, decorticating in strips and short ribbons. *Seedling leaves* opposite for a few pairs then becoming disjunct, ovate to narrowly ovate, to 60 mm long by 34 mm wide, scabrous, slightly discoloured, dull to slightly glossy, green. *Adult leaves* shortly petiolate; lamina glossy, green to dark green, linear to narrow-lanceolate to elliptic to ovate, apiculate, 40–75 mm long × 8–27 mm wide, reticulation moderate with few to numerous intersectional oil glands; lenticels rarely recorded. *Inflorescences* axillary, up to 21-flowered; peduncles flattened, becoming more terete at fruiting stage, slightly distally broadened, 30–55 mm long, 5–8 mm wide at base. *Flower buds* with hypanthia sessile and fully fused; opercula narrowly cylindrical, straight, 29–45 mm long × 3–10 mm wide at base, apiculate. *Flowers* yellow-green. *Fruits* sessile and fused; infructescences 32–46 mm in diameter (excluding valves; 40–55 mm diameter including valves); individual fruits sessile and fully fused, 10–15 mm wide at rim; disc level to ascending; valves 3, prominently exerted and with persistent style remnants.

Two parapatric subspecies are recognised in the species, differing primarily on adult leaf morphology.

5a. *Eucalyptus lehmannii* subsp. *lehmannii*

Adult leaves shortly petiolate; lamina elliptic to ovate, 40–57 mm long × 16–27 mm wide.

Selected specimens examined. (west to east). WESTERN AUSTRALIA: Millars Point Road, 3.9 km S of Bremer Bay Road, 17 Feb. 2000, *M.I.H. Brooker* 13092 (CANB, PERTH); 1 km NW of Mount Melville, near Cape Riche, 14 Jan. 1979, *M.D. Crisp* 5108 (PERTH); 3 km NW Mount Melville, 23 Jan. 1997, *R. Davis* 2270 (PERTH); on rough track 1.6 km N of Cape Riche, 18 Mar. 1997, *R. Davis* 2881 (PERTH); Millars Point Road, 1.1 km N of camp site, 3 Feb. 1998, *R. Davis* 4926 (PERTH); Mount Melville garbage tip, 16.5 km from highway, 12 Nov. 1986, *K. Hill* 2431, *L.A.S. Johnson & D.F. Blaxell* (NSW, PERTH); Warriup, 17 Nov. 1982, *G.J. Keighery* 5802 (PERTH); Mount Melville road from Wellstead, 10 Dec. 1992, *D. Nicolle* 222 (PERTH); between Pallinup Estuary road and Black Head, 27 Jan. 2001, *D. Nicolle* 3752 & *M. French* (CANB, PERTH); Nioka farm, NE of Manypeaks, 27 Jan. 2001, *D. Nicolle* 3755 & *M. French* (CANB, PERTH); remnant vegetation, N area Plantagenet Loc 6499, ITC Cheynes Tree Farm, Cheynes Beach Road, 28 May 2003, *E.M. Sandiford* 765 (PERTH); remnant vegetation Plantagenet Loc 6489/6812, ITC Wimbush Tree Farm, South Coast Highway, NW of Manypeaks, 29 July 2003, *E.M. Sandiford* 845 (PERTH).

Distribution and habitat. Distributed in coastal and subcoastal areas on the southern coast of Western Australia from near Manypeaks eastwards to Beaufort Inlet (Figure 4). Occurs on undulating topography, in minor creeklines, on slopes and on broad, subdued ridges, in thin sandy to clayey soils, often over laterite. The subspecies occurs as a component of mallee shrubland. Associated eucalypt species

include *Eucalyptus cuspidata*, *E. doratoxylon*, *E. goniantha* subsp. *notactites*, *E. marginata* subsp. *marginata* and *E. pleurocarpa*.

Conservation status. Although of much more restricted distribution compared to subsp. *parallela*, the typical subspecies is relatively common and not considered to be under threat. Not recorded from any conservation parks. Conservation vesting would assist in the conservation status of the subspecies.

Notes. *Eucalyptus lehmannii* subsp. *lehmannii* is distinguished from subsp. *parallela* by the shorter and generally broader, consistently elliptic to ovate adult leaves that are less than twice as long as wide.

Eucalyptus lehmannii subsp. *lehmannii* occurs to the south of the more widespread subsp. *parallela*, and while the distributions of the two subspecies are likely to be parapatric, intergrades are not known. Coarser-leaved populations and individuals of *E. lehmannii* from east of the distribution of subsp. *lehmannii* are considered to represent coastal forms of subsp. *parallela* rather than subsp. *lehmannii*, as although the adult leaves of such populations are broader, they are still relatively long and are never consistently elliptic to ovate as consistently the case in subsp. *lehmannii*.

5b. *Eucalyptus lehmannii* subsp. *parallela* D.Nicolle & M.E.French, *subsp. nov.*

A subspecies typica foliis adultis longioribus et angustioribus (plerumque <14 mm latis) differt.

Typus: John Forrest track near No Tree Hill, Western Australia, 33° 46' 57" S, 120° 03' 06" E, 20 January 2001, D. Nicolle 3704 & M. French (*holo:* PERTH 05810442; *iso:* CANB).

Eucalyptus lehmannii subsp. *Narrow Leaf* (D. Nicolle & M. French DN 4806); *Eucalyptus lehmannii* subsp. *linearifolia* D.Nicolle ms; in Council of Heads of Australasian Herbaria, *Australian Plant Census*, <http://www.chah.gov.au/apc/index.html> [accessed 28 May 2008].

Eucalyptus lehmannii subsp. *modifolia* D. Nicolle ms, in Council of Heads of Australasian Herbaria, *Australian Plant Census*, <http://www.chah.gov.au/apc/index.html> [accessed 28 May 2008].

Eucalyptus lehmannii subsp. *Northern* (M. French 425), in Council of Heads of Australasian Herbaria, *Australian Plant Census*, <http://www.chah.gov.au/apc/index.html> [accessed 28 May 2008].

Distinguished from subsp. *lehmannii* by its longer and generally narrower (generally <14 mm wide), linear to narrow-lanceolate to narrowly elliptic adult leaves, that are at least twice as long as wide.

Adult leaves shortly petiolate; lamina linear to narrow-lanceolate, 55–75 mm long × 8–14 mm wide. (Figure 12)

Selected specimens examined (west to east). WESTERN AUSTRALIA: 1.7 km along track Elverdton–Moir Road, from Hopetoun Road, 30 Jan. 1998, M. Bennett 62 (AD, PERTH); Mount Burdett, Summit, 10 Nov. 1981, M.I.H. Brooker 7086 (CANB, NSW, PERTH); at the Whalebone Rock, north side of Mount Le Grand, 15 Jan. 1985, M.I.H. Brooker 8788 (PERTH); S slope of Ravensthorpe Range, due N of Ravensthorpe, 7 Apr. 1995, M.I.H. Brooker 12202 W (AD, CANB, NSW, PERTH); Quiss Road, S of Ranger's House, Fitzgerald National Park Headquarters, 18 Sep. 1999, M.I.H. Brooker 13034 (AD, CANB, PERTH); Eyre district; Ravensthorpe Range, Mount Desmond, 11 km SE of Ravensthorpe,



Figure 12. Holotype of *Eucalyptus lehmannii* subsp. *parallela*, scale = 5 cm..

9 Jan. 1979, *M.D. Crisp* 4970 (PERTH); S of Condingup, very exposed W slope of Mt Belches, 50 m from the summit, 15 Mar. 1998, *M. French* 403 (PERTH); NE of Ravensthorpe Ranges on Nindbillup Road, 16 March 1998, *M.E. French* 425 (PERTH); c. 6 km SW of Kundip, S of Ravensthorpe, 23 Nov. 1999, *M.E. French* 1104 (PERTH); No. 62 hill, E of Esperance, 9 Dec. 1960, *A.S. George* 2158 (PERTH); 30 miles W of Ravensthorpe, 13 March 1957, *J.W. Green* 1190 (PERTH); SW side of Howick Hill, just below main area of outcropping granite, 8 Nov. 1983, *L. Haegi* 2608 & *P.S. Short* (PERTH); Reynolds Hill, 8 June 1989, *S.D. Hopper* 7269 (PERTH); S side of hill c. 4 km SE of Mount Baring, 21 Nov. 1994, *D. Nicolle* 1096 (CANB, PERTH); north of Mt Trio, Stirling Range National Park, 4 Nov. 2000, *D. Nicolle* 3561 & *M. French* (CANB, PERTH); near Mt Desmond, S of Ravensthorpe, 300 m west down steep slope, 20 July 2001, *D. Nicolle* 3967 & *M. French* (PERTH); 6.3 km west from Hopetoun road on Road 11, 20 July 2001, *D. Nicolle* 3970 & *M. French* (PERTH); near summit of Mt Barren West, Fitzgerald River National Park, 31 July 2002, *D. Nicolle* 4432 & *M.I.H. Brooker* (PERTH); granite dome c. 500 m SE of Mt Arid, Cape Arid National Park, 4 Mar. 2003, *D. Nicolle* 4575 & *M. French* (PERTH); south-western boundary of Corackerup Nature Reserve on Boxwood Hill–Ongerup Rd, 23 Sep. 2004, *D. Nicolle* 4802 & *M. French* (PERTH); east of Hamilla Hill, 24 Sep. 2004, *D. Nicolle* 4806 & *M. French* (PERTH).

Distribution and habitat. By far the most widespread taxon in the subseries, occurring from the Stirling Range eastwards to the Ravensthorpe Range and as very scattered populations east of Esperance from the Wittenoom Hills and Cape Le Grand eastwards to Cape Arid National Park (Figure 4). The apparent disjunction in the distribution of this subspecies, of at least 150 km between populations in the Ravensthorpe area and scattered populations to the east and north-east of Esperance, is possibly due to the generally level topography in this region, resulting in a lack of suitable habitats for the species. The subspecies grows in undulating topography in a variety of sites from subdued valleys to hillslopes and ridges. Restricted to the fringes of granite hills and outcrops east of Esperance, and also common on granite or spongolite soils elsewhere to the west. Associated with a wide variety of coastal eucalypt species, including *Eucalyptus clivicola*, *E. cooperiana*, *E. decipiens* subsp. *adesmophloia*, *E. decurva*, *E. doratoxylon*, *E. extrica*, *E. falcata*, *E. hebetifolia*, *E. incrassata*, *E. pachyloma*, *E. phaenophylla*, *E. pleurocarpa*, *E. preissiana* subsp. *preissiana*, *E. redunca*, *E. sporadica*, *E. thamnoides*, *E. tetraptera*, *E. uncinata* and *E. utilis*.

Conservations status. This subspecies is widespread and locally common and is not considered to be at risk. Well represented in conserved areas and recorded from Cape Arid, Cape Le Grand, Fitzgerald River and Stirling Range National Parks and Corackerup and Wittenoom Hills Nature Reserves.

Etymology. From the Latin *parallelus* (side by side equidistantly), referring to the narrower and more parallel-sided adult leaves in comparison to the elliptic to ovate adult leaves of the typical subspecies.

Notes. *Eucalyptus lehmannii* subsp. *parallela* is distinguished from subsp. *lehmannii* by the longer and generally narrower, linear to narrow-lanceolate to narrowly elliptic adult leaves, that are at least twice as long as wide.

Eucalyptus lehmannii subsp. *parallela* is the widespread variant of the species, and occurs to the north and east of subsp. *lehmannii*. The distributions of the two subspecies are likely to be parapatric, however intergrades are not known.

Populations of *E. lehmannii* subsp. *parallela* from east of Esperance, particularly coastal populations (e.g. Cape Le Grand and Mt Howick) are often coarser-leaved than populations of the subspecies

from Ravensthorpe westwards. Similarly coarse-leaved populations of the subspecies are known from some sites west of Ravensthorpe, notably where growing on the slopes and summit of West Mount Barren. Such coarser-leaved populations are likely to be a result of local site adaptation (particularly coastal influences) and are not considered worthy of taxonomic recognition, at least pending further field study. The adult leaves of such coarse-leaved populations of subsp. *parallela* are still relatively long and are never consistently elliptic to ovate in shape as in subsp. *lehmannii*.

Eucalyptus lehmannii subsp. *parallela* occasionally hybridises with *E. sporadica* Brooker & Hopper, with the type of *E. bennettiae* D.Carr & S.Carr representing one such hybrid. The type plant of *E. bennettiae*, from Mt Desmond near Ravensthorpe, occurs in dense mallee shrubland with both *E. lehmannii* subsp. *parallela* and *E. sporadica* common at the site. Individuals with morphology consistent with *E. bennettiae* at Mt Desmond have been recorded from a number of scattered localities to the south-west, including on Road 11 (west of Kundip) and near Quoin Head and at Twin Bays in Fitzgerald River National Park.

Progeny grown at Currency Creek Arboretum (Nicolle 2003) from seed taken from the type individual of *E. bennettiae* segregate between the putative parent species in seedling morphology (*E. lehmannii* has broader, scabrid seedling leaves; *E. sporadica* has narrower, glabrous seedling leaves). Adult morphology of the same progeny is also variable between individuals, though more intermediate between the parental species (i.e. more *E. bennettiae*-like rather than segregating towards the typical adult morphology of *E. lehmannii* and *E. sporadica*). Molecular studies (M. Byrne, DEC Science Division, unpublished data) of *E. bennettiae* from the Mt Desmond and Road 11 sites indicate that at each locality the population of *E. bennettiae* consists of a single genetic entity (genet), and shares all molecular markers with the surrounding *E. lehmannii* and *E. sporadica* populations (i.e. having no unique molecular markers).

A single putative hybrid individual of *Eucalyptus lehmannii* subsp. *parallela* × *E. megacornuta* C.A.Gardner also occurs at the type site of *E. bennettiae*. The individual displays morphological characteristics intermediate between the two putative parental taxa, and progeny grown from the putative hybrid individual (Currency Creek Arboretum; Nicolle 2003) display segregating seedling and adult morphology between the two putative parental taxa.

6. *Eucalyptus retusa* D.Nicolle, M.E.French & McQuoid, *sp. nov.*

Inter species subseriei *Conjunctarum* Brooker distinguenda habitu pluricauli ('mallee') et praesentia lignotuberis, foliis adultis obovatis et saepe retusis, pedunculis longis teretisque, hypanthis partim connatis, alabastris parvis, operculis angustis erectisque, et apice minute bulboso, fructibus parvis.

Typus: Hood Point [precise locality withheld for conservation reasons], 23 September 2004, *D. Nicolle* 4801 & *M. French* (*holo*: PERTH 06877109; *iso*: AD, CANB).

Eucalyptus sp. Bremer Bay (L.M. Sandiford. PERTH 01137484); *Eucalyptus retusa* D.Nicolle ms; *Eucalyptus jinungurdu* McQuoid & Hopper ms, in Council of Heads of Australasian Herbaria, *Australian Plant Census*, <http://www.chah.gov.au/apc/index.html> [accessed 28 May 2008].

Distinguished in the subseries by its combination of lignotuberous (resprouter) mallee habit; obovate, often retuse adult leaves; long, terete peduncles; partially fused hypanthia; small buds with narrow, straight and apiculate to bulbous opercula; and small fruits.

Mallee 0.5–4 m tall; lignotuber present. *Bark* smooth throughout, pale grey-tan over cream. *Seedling leaves* opposite for one to three pairs then becoming disjunct, ovate to orbicular-ovate, often becoming slightly retuse, to 50 mm long by 40 mm wide, scabrous, slightly discolorous, dull, pale green. *Adult leaves* with petiole tapering to lamina; lamina glossy, green, obovate to spatulate, often retuse, 30–55 mm long × 14–20 mm wide. *Inflorescences* axillary, unbranched, partially fused (lower half only of hypanthia fused), 13–19-flowered; peduncles terete, distally thickened, 20–35 mm long. *Flower buds* fused; operculum 40–42 mm long, 4–6 mm wide at base, straight to slightly curved, apiculate or slightly swollen at tip. *Flowers* yellow-green. *Fruits* fused for basal half only, infructescences 30 mm in diameter (including valves); individual fruits obconical, 7–10.5 mm wide; disc level to ascending; valves 3 (rarely 4), rim level to strongly exerted. (Figures 13, 14)

Selected specimens examined. WESTERNAUSTRALIA: [localities withheld for conservation reasons] 9 March 1988, *M.I.H. Brooker* 9920 (AD, CANB, PERTH); 21 Jan. 2005, *J.A. Cochrane & S. Comer* 140 (PERTH); Feb. 1989, *L.M. Sandiford s.n.* (PERTH).

Distribution and habitat. Known from a single population at Hood Point, east of Bremer Bay on the south coast of Western Australia (Figure 6), where the species is common on a rocky headland in low scrubland. Associated species include *E. cuspidata* and *Melaleuca nesophila*. A second population may occur at Cape Knob, south-west of Bremer Bay and approximately 35 km to the south-west of the known population at Point Hood; however this population requires further study to ascertain its identity and relationship to the type population.

Conservation status. The single known population consists occurs over several hectares on a recreation reserve vested in the Shire of Jerramungup. The unconfirmed Cape Knob population is also on a recreation reserve vested in the Shire of Jerramungup. Recommended listing as Priority One under DEC Conservation Codes for Western Australian Flora (K. Atkins, pers. com.).

Etymology. From the Latin *retusus* (blunted, rounded, notched at the apex), referring to the retuse adult leaves which distinguish the species from other taxa in the subseries.

Notes. *Eucalyptus retusa* is distinct and unique in the series due to its variably notched (retuse) adult leaves. The species is also distinctive within *E.* subser. *Conjunctae* in its partly fused hypanthia in the bud and fruit inflorescences, perhaps as a result of past or current hybridisation with *E. cornuta* Labill. (see below). All other taxa of *E.* subser. *Conjunctae* have hypanthia fused for their entirety.

The small buds and fruits and less fused hypanthia of *E. retusa* in comparison to other taxa of *E.* subser. *Conjunctae* may be a result of some past and/or current genetic influence from *E. cornuta*, which occurs nearby at Gordon Inlet. Seedlings of *E. retusa* grown from the type population show some morphological segregation in the shape of the seedling leaves (particularly in the degree of emargination), which also suggests introgression from *E. cornuta*. Nonetheless, the populations at Hood Point are distinctive and largely uniform and we are satisfied that species recognition is justified. Further study of the evolutionary origin and genetic variability of *E. retusa* is warranted.

Hybrids between *E. retusa* and *E. cuspidata* occur at Hood Point and are similar in morphology to *E. × missilis* Brooker & Hopper (= *E. cornuta* × *E. cuspidata* Turcz.).

The anomalous population from Cape Knob has narrower adult leaves than typical *E. retusa*, and this population requires further study to ascertain its identity.

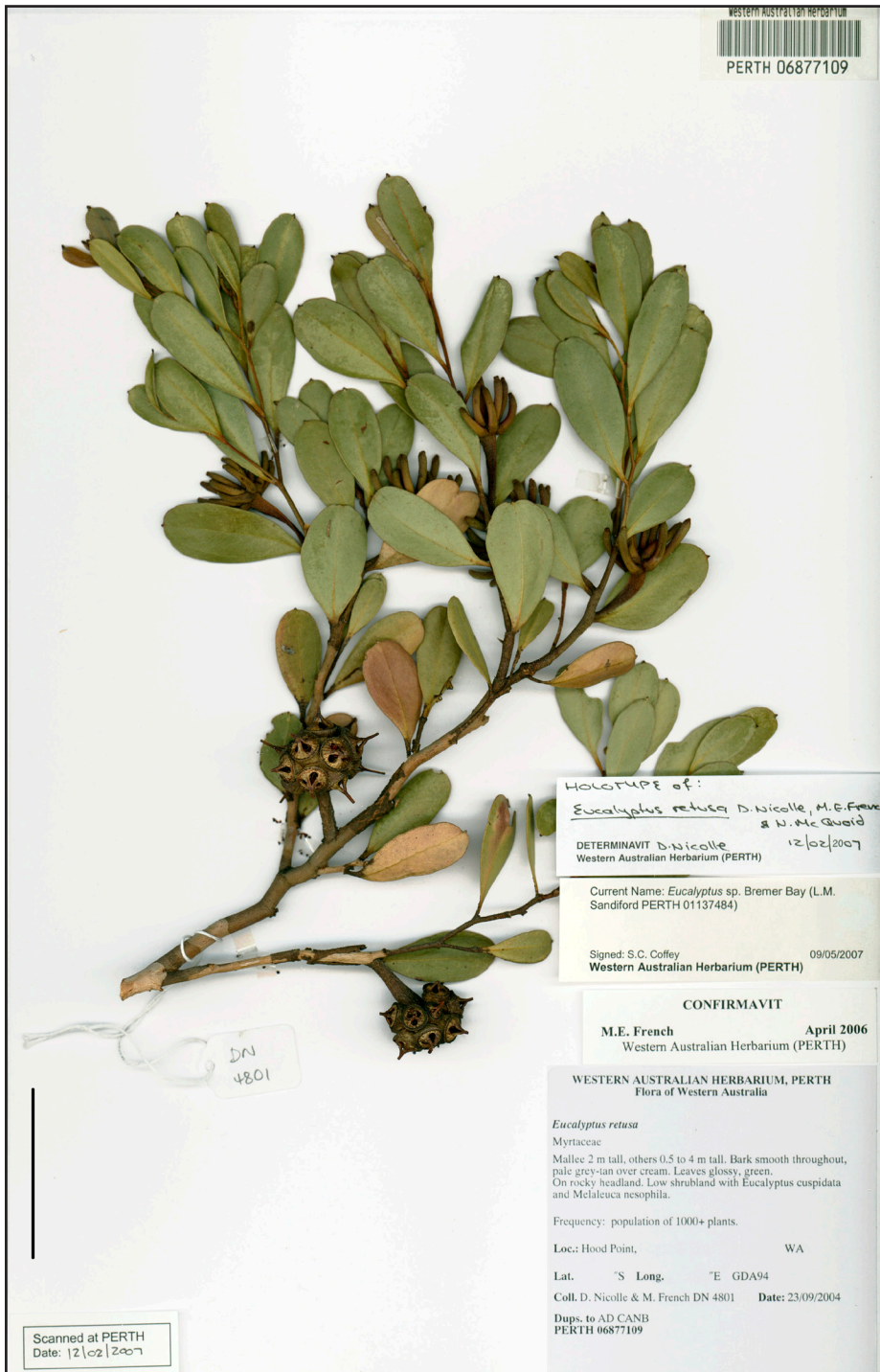


Figure 13. Holotype of *Eucalyptus retusa*, scale = 5 cm.



Figure 14. Habitat and habit of *Eucalyptus retusa* (Point Hood, Fitzgerald River National Park, 34° 23' S, 119° 34' E, D. Nicolle 4801 & M. French).

Natural hybrids involving *Eucalyptus* subser. *Conjunctae*

Eucalyptus conferruminata* subsp. *recherche* × *E. incrassata

Selected specimens examined. WESTERNAUSTRALIA: Lower coastal slopes at the W windward side of Woody Island, SE of Esperance, 24 Feb. 2001, *M.E. French* 1265 (PERTH); West side of Woody Island, Recherche Archipelago, Western Australia, 10 March 2003, *D. Nicolle* 4610 & *M. French* (PERTH).

Eucalyptus conferruminata* subsp. *conferruminata* × *E. cornuta

Selected specimens examined. WESTERN AUSTRALIA: between CSIRO hut and Robinson Bay, Noisy Scrub-bird Sanctuary, Two Peoples Bay, E of Albany, 25 Jan. 1973, *N.T. Burbridge* 8133 (CANB, PERTH); Two Peoples Bay Nature Reserve, at old Jeemaluk hut site, 10 May 2007, *N.K. McQuoid* 617 (PERTH); eastern slopes of Mt Gardner, 10 May 2007, *N.K. McQuoid* 618, 619, 620 (all at PERTH).

Eucalyptus cornuta* × *E. lehmannii* subsp. *lehmannii

Selected specimens examined. WESTERN AUSTRALIA: remnant vegetation Plantagenet Loc 6489/6812 ITC Wimbush Tree Farm, South Coast Highway, NW of Manypeaks, 19 Aug. 2003, *E.M. Sandiford* 858 (PERTH).

Eucalyptus cornuta* × *E. lehmannii* subsp. *parallela

Selected specimens examined. WESTERN AUSTRALIA: SW of Orleans Bay Caravan Park, E slope of Mount Belches, 15 Mar. 1998, *M. French* 404 (PERTH); Stirling Range National Park, 8 June 1972, *A.S. Weston* 7749 (PERTH).

Eucalyptus cuspidata* × *E. retusa

Selected specimens examined. WESTERN AUSTRALIA: Hood Point, 9 Mar. 1988, *M.I.H. Brooker* 9919 (CANB, PERTH).

Eucalyptus lehmannii* subsp. *parallela* × *E. megacornuta

Selected specimens examined. WESTERN AUSTRALIA: 300 m west down steep slope from below coordinates; near Mt Desmond, S of Ravensthorpe, 33° 36' 50" S, 120° 09' 05" E, 5 Nov. 2000, *D. Nicolle* 3577 & *M. French* (CANB, PERTH).

Eucalyptus lehmannii* subsp. *parallela* × *E. sporadica

Typus: NW slope of Mt Desmond, 33° 37' S, 127° 07' E, Western Australia., 15 August 1979, *D.J. Carr* & *S.G.M. Carr* 2304f (*holo:* PERTH 01174606, 01174614; *iso:* PERTH 05959578, 01174622).

Eucalyptus bennettiae *D.Carr* & *S.Carr*, *Austral. J. Bot.* 28: 541 (1980).

See *Notes* under *E. lehmannii* subsp. *parallela* for discussion on the hybrid origin of *E. bennettiae*.

Selected specimens examined. WESTERNAUSTRALIA: Ravensthorpe Range, Aug. 1979, *E.M. Bennett s.n.* (PERTH); Ravensthorpe Range, NW of Mount Desmond, 13 Nov. 1981, *M.I.H. Brooker* 7142; 7144 (PERTH); Mount Desmond, W side, *s. dat.*, *R.J. Hnatiuk* 790026 (PERTH); 2.5 km NE of Quoin Head; on Whalebone track, Fitzgerald River National Park, 15 Dec. 1988, *N. McQuoid s.n.* (PERTH); Twin Bays, Fitzgerald River National Park, 10 Jan. 1994, *N. McQuoid* 413 (PERTH); 300 m west down steep slope from below coordinates; near Mt Desmond, S of Ravensthorpe, 5 Nov. 2000, *D. Nicolle* 3576 & *M. French* (PERTH); 6.3 km down track from Hopetoun to Ravensthorpe road opposite Jerdacuttup Road junction, 5 Nov. 2000, *D. Nicolle* 3582 & *M. French* (AD, CANB, PERTH); 300 m west down steep slope from below coordinates; near Mt Desmond, S of Ravensthorpe, 33° 36' 50" S, 120° 09' 05" E, 20 July 2001, *D. Nicolle* 3964; 3965; 3966 & *M. French* (PERTH); 6.3 km west from Hopetoun road on Road 11, 20 July 2001, *D. Nicolle* 3969 & *M. French* (PERTH).

***Eucalyptus lehmannii* subsp. *parallela* × *E. tetraptera* Turcz.**

Selected specimens examined. WESTERN AUSTRALIA: No specimens collected, but observed by one of us (NMQ) on the southern slopes of Thumb Peak and north of Mt Drummond in Fitzgerald River National Park, and on Mt Burdett, north-east of Esperance.

Eucalyptus macrandra F.Muell. ex Benth. × **E. sinuosa**

Selected specimens examined. WESTERN AUSTRALIA: 3 km E from Drummond Track on the southern of parallel firebreaks, 18 Jan. 1989, A. Napier & D. Goble-Garratt 365 (PERTH).

Acknowledgements

We are grateful to staff at the Western Australian Herbarium and the Biodiversity Conservation Initiative team in Perth for their assistance in preparing this paper. Ryonen Butcher (BCI) has been particularly helpful in providing images of type specimens. We thank Sarah Comer of the Department of Environment and Conservation in Albany for her assistance with *E. conferruminata* and *E. retusa*. The senior author thanks Ian Brooker for ongoing discussion regarding eucalypt taxonomy as well as for checking the Latin diagnoses and suggesting the scientific epithet for *E. retusa*.

References

- Atkins, K.J. (2008). *Declared Rare and Priority Flora List for Western Australia* (Department of Environment and Conservation: Kensington, WA.)
- Brooker, M.I.H. (2000) A new classification of the genus *Eucalyptus* L'Hér. (Myrtaceae). *Australian Systematic Botany* 13: 79–148.
- Brooker, M.I.H. and Hopper, S.D. (2002). Taxonomy of species deriving from the publication of *Eucalyptus* subseries *Cornutae* (Myrtaceae). *Nuytsia* 14(3): 325–360.
- Brooker, M.I.H. & Kleinig, D.A. (2001). *Field Guide to Eucalypts* Vol. 2. South-western and southern Australia. 2nd ed. (Bloomings Books: Melbourne.)
- Carr, D.J. and Carr, S.G.M. (1980). The *Lehmannianae*: a natural group of Western Australian eucalypts. *Australian Journal of Botany* 28: 525–550.
- Gardner, C.A. (1960). Trees of Western Australia. *The Journal of Agriculture of Western Australia* 1(7): 234–235.
- Kelly, A.E., Napier, A.C. & Hopper, S.D. (1995). Survey of rare and poorly known eucalypts of Western Australia. *CALMScience* Supplement 2: 1–207.
- Nicolle, D. (2003). *Currency Creek Arboretum eucalypt research*. Vol. 2. (D. Nicolle: Adelaide.)
- Nicolle, D. (2006). A classification and census of regenerative strategies in the eucalypts (*Angophora*, *Corymbia* and *Eucalyptus* – Myrtaceae) with special reference to the obligate seeders. *Australian Journal of Botany* 54(4): 391–407.