NUYTSIA

WESTERN AUSTRALIA'S JOURNAL OF SYSTEMATIC BOTANY

ISSN 0085-4417

Nicolle, D. and Brooker, M.I.H. Re-assessment of the saline-dwelling *Eucalyptus spathulata* complex (Myrtaceae) from southern Western Australia

Nuytsia 15(3): 403–429 (2005)

All enquiries and manuscripts should be directed to:

The Editor – *NUYTSIA*
Western Australian Herbarium
Conservation and Land Management
Locked Bag 104 Bentley Delivery Centre
Western Australia 6983
AUSTRALIA

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

Re-assessment of the saline-dwelling *Eucalyptus spathulata* complex (Myrtaceae) from southern Western Australia

D. Nicolle[1] and M.I.H. Brooker[2]

[1]School of Biological Sciences, The Flinders University of South Australia, GPO Box 2100, Adelaide, 5001, South Australia
[2]CSIRO Forestry and Forest Products, P.O. Box E4008, Kingston, 2604, ACT, Australia

Abstract

Nicolle, D. and Brooker, M.I.H. Re-assessment of the saline-dwelling *Eucalyptus spathulata* complex (Myrtaceae) from southern Western Australia. *Nuytsia* 15(3) : 403–429 (2005). The circumscription of taxa within the *Eucalyptus spathulata* complex is revised. The status of *E. vegrandis* is resolved and the new species *E. orthostemon* Nicolle & Brooker is described to accommodate populations of mallees previously and erroneously referred to *E. vegrandis*. The new taxon *E. vegrandis* subsp. *recondita* Nicolle & Brooker is described to accommodate coarse, relatively broad-leaved mallees in the Stirling Range area, previously referred under the manuscript name *E.* 'recondita'. *E. suggrandis* is re-circumscribed, with subsp. *alipes* (as to the type – the mallet/obligate seeder variant) raised to specific status as *E. alipes* (L. Johnson & K. Hill) Nicolle & Brooker. *E. mimica* is recircumscribed as an obligate seeder (mallet) species and *E. suggrandis* subsp. *promiscua* Nicolle and Brooker described from the Lake Grace – Pingrup area, previously being confused with both *E. mimica* and *E. suggrandis*. The new subspecies, *E. spathulata* subsp. *salina* Nicolle & Brooker, is described from mallets restricted to the Salt River drainage system of the northern part of the southern wheatbelt. *E. cernua* is recircumscribed as an obligate seeder (mallet) species with resprouter (mallee) populations, previously included under *E. cernua*, published as *E. proxima* Nicolle & Brooker. The manuscript name *E.* 'verruculosa' is considered to be *E. suggrandis* subsp. *suggrandis*, as to the proposed type. A key and distribution maps for the *E. spathulata* complex are provided. The conservation status for some taxa in the complex is critical, owing to their natural saline habitat and the revised (and in many cases much reduced) geographical distribution of taxa as delimited here. One taxon is already included on Western Australia's Schedule of Declared Rare Flora (*E. steedmanii*) and two others are considered as high priority for further survey and nomination to the Schedule (*E. spathulata* subsp. *salina* and *E. mimica* subsp. *continens*).

Introduction

This paper is presented in part to recognise the heterogeneous nature of the specimens attributed to *E. vegrandis* as proposed in the protologue (Hill and Johnson 1992) and to erect the anomalous part of this taxon as a widespread unnamed species, *E. orthostemon*. The paper also aims to clearly describe and delineate the species closely related to *E. vegrandis* (*E.* ser. *Clinatae* Brooker), and those of the *E. spathulata* complex (*E.* supraspecies *Angustae* Brooker) in which we describe three new taxa.

The *E. spathulata* complex is distinguished from related taxa in *E.* subser. *Abundae* Brooker mainly

by the shorter operculum that is often not acute, as opposed to longer and very acute operculum in the related *E. eremophila* complex (*E.* supraspecies *Longae* Brooker).

We have recently recognised and studied two important characters useful for taxon delimitation within the complex. These are:

a) staminal arrangement (erect or inflexed), and

b) growth form (lignotuber present (mallee) or absent (mallet)).

We have used extensive field and herbarium research combined with long-term cultivation trials by one of us (DN) to assess the *E. spathulata* complex for both these characters, as well as used other morphological characteristics considered to be either less useful or more variable. We have re-circumcribed all taxa in the complex and in *E.* ser. *Clinatae*.

The *E. spathulata* complex, as delimited here, consists of part of *E.* ser. *Erectae* Brooker subser. *Abundae* Brooker (the short-operculate taxa of this subseries) as well as the superficially similar but less related *E.* ser. *Clinatae*. Thus the complex as described here is not a natural group, but the conglomeration of two natural groupings, viz. the *E. spathulata* complex *sens. strict. (E. spathulata, E. orthostemon, E. alipes, E. mimica, E. steedmanii* and *E. suggrandis*) and the *E.* ser. *Clinatae* (*E. vegrandis, E. proxima, E. cernua* and *E. vesiculosa*).

Classification of the *Eucalyptus spathulata* complex

E. ser. *Erectae* Brooker
- *E.* subser. *Abundae* Brooker
  - *E.* supraspecies *Angustae* Brooker
    - *E. spathulata* Hook.
      - subsp. *spathulata*
      - subsp. *salina* Nicolle & Brooker
    - *E. orthostemon* Nicolle & Brooker
    - *E. suggrandis* L. Johnson & K. Hill
      - subsp. *suggrandis*
      - subsp. *promiscua* Nicolle & Brooker
    - *E. alipes* (L. Johnson & K. Hill) Nicolle & Brooker
    - *E. mimica* Brooker & Hopper
      - subsp. *mimica*
      - subsp. *continens* Brooker & Hopper
    - *E. steedmanii* C. Gardner

E. ser. *Clinatae* Brooker
- *E. vegrandis* L. Johnson & K. Hill
  - subsp. *vegrandis*
  - subsp. *recondita* Nicolle & Brooker
- *E. proxima* Nicolle & Brooker
- *E. cernua* Brooker & Hopper
- *E. vesiculosa* Brooker & Hopper

The following taxa are here excluded from the *E. spathulata* complex: *E.* subser. *Annulatae* L.A.S. Johnson & K. Hill ex Brooker (3 taxa); *E.* subser. *Pedicellatae* Blakely (c. 10 taxa); *E.* supraspecies *Latae* Brooker (4 taxa); *E.* supraspecies *Longae* Brooker (4 or 5 taxa).

The adult leaves of *E.* ser. *Erectae* subser. *Abundae* (Figure 1A) have numerous densely spaced oil glands obscuring the secondary venation, in contrast to the adult leaves of *E.* ser. *Erectae* subser. *Pedicellatae* (Figure 1B), which are much less densely glandular enabling the secondary and tertiary venation to be clearly seen in transmitted light (Brooker 2002). The adult leaves of *E.* ser. *Clinatae* (Figure 1C), like those of *E.* ser. *Erectae* subser. *Abundae,* are densely glandular, although usually the secondary (but not tertiary) venation can be clearly seen.

All species in *E.* supraspecies *Angustae* except *E. suggrandis* and *E. steedmanii* usually occupy subsaline to saline depressions and drainage lines, with some taxa in the complex restricted to such sites (e.g. *E. spathulata, E. mimica* and *E. alipes*). Conversely, all members of *E.* ser. *Clinatae* occupy non-saline habitats, although often these are on poorly-drained clay soils in up-land sites.

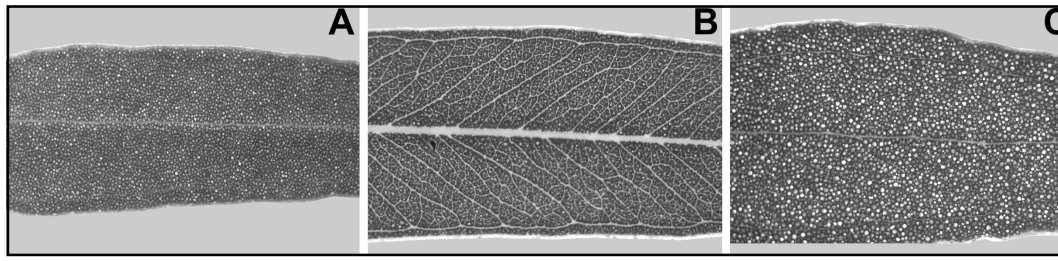

Figure 1. Leaf venation and oil gland pattern typical of: A – *E.* ser. *Erectae* subser. *Abundae* (*E. eremophila*; Burra Rock); B – *E.* ser. *Erectae* subser. *Pedicellatae* (*E. astringens* subsp. *redacta*; *Brooker* 12918); C – *E.* ser. *Clinatae* (*E. vesiculosa*; *Brooker* 9910).

Key to species and subspecies the *E. spathulata* complex[1]

1. Staminal filaments erect
 2. Mallet; lignotuber absent
  3. Buds and fruits terete, 3 and/or 7-flowered
   4. Adult leaves distinctly metallic bluish; inflorescence 7-flowered; fruit small (4–7 mm long x 4–6 mm wide) ..... **1a. E. spathulata subsp. spathulata**
   4. Adult leaves green; inflorescence 3- or 7-flowered; fruit large (6–8 mm long x 6–6.5 mm wide) ..... **1b. E. spathulata subsp. salina**
  3. Buds and fruits angled to square in transverse section, 3-flowered
   5. Fruit small (11–17 mm long x 7–11 mm wide)
    6. Buds and fruits not square, smooth or 2-angled from pedicel ..... **3. E. alipes**
    6. Buds and fruits square and strongly 3- or 4-ribbed
     7. Sepaline structure non-operculate, as four distinct sepals, often shedding before inner operculum ..... **4a. E. mimica subsp. mimica**
     7. Sepaline structure operculate and persisting to flowering ..... **4b. E. mimica subsp. continens**
   5. Fruit large (18–23 mm long x 13–16 mm wide) ..... **5. E. steedmanii**
 2. Mallee; lignotuber present
  8. Pedicel well-defined in fruit, ±terete; fruit smooth; leaves 2 to 7 mm wide ..... **2. E. orthostemon**
  8. Pedicel poorly defined and tapering to fruit, ±flattened; fruit 2-angled near base; leaves 5 to 18 mm wide
   9. Outer operculum shed early and cleanly, sepals not formed ..... **6a. E. suggrandis subsp. suggrandis**
   9. Outer operculate structure either forming persistent sepals or decorticating in scales ..... **6b. E. suggrandis subsp. promiscua**
1. Staminal filaments inflexed
 10. Mallee; lignotuber present
  11. Peduncles erect, flowers cream
   12. Adult leaves narrow (3–13 mm wide) ..... **7a. E. vegrandis subsp. vegrandis**
   12. Adult leaves broad (13–25 mm wide) ..... **7b. E. vegrandis subsp. recondita**
  11. Peduncles rigidly down turned; flowers often red, rarely creamy-yellow ..... **8. E. proxima**
 10. Mallet; lignotuber absent
  13. Adult leaves broadly elliptical to orbicular; operculum prominently warty ..... **10. E. vesiculosa**
  13. Adult leaves broad-lanceolate; operculum smooth ..... **9. E. cernua**

[1] NB. We interpret the sepaline whorl in the flower bud as being either operculate or consisting of distinct sepals or scales.

Taxonomy

1. Eucalyptus spathulata Hook. *Icon. Pl.* 7: t. 611 (1844).

Type: Swan River Colony, *J. Drummond*, Supp. coll. No. 20 (*holo*: K).

Distinguished within the complex by its combination of non-lignotuberous, mallet habit; the narrow, linear adult leaves, the cream, erect staminal filaments and the small, more or less terete buds and fruits.

Mallet (obligate seeder), 6 to 12 m tall. *Lignotuber* absent. *Seedling leaves* shortly petiolate, linear. *Adult leaves* linear, glossy, metallic blue-green to green; lamina 45–75 mm long x 2.5–7 mm wide. *Inflorescences* (3–) 7-flowered; peduncles 4–8 mm long; pedicels terete, 2–6 mm long. *Flower buds* held erect, 9–15 mm long x 2.5–4.5 mm wide; operculum often narrower than hypanthium at join, cylindrical, ±smooth; *flowers* cream; stamens erect. *Fruit* held erect, distinct from pedicel, obconical to cupular-hemispherical, 4–8 mm long x 4–6 mm wide, smooth; valves 3.

The type of *E. spathulata* has presented problems in the application of the name. The type (held at K) has erect staminal filaments, linear leaves and relatively small buds and fruits for the complex. These features and the unhelpful type locality indicate the type could be either the fine-leaved mallet taxon (*E. spathulata* subsp. *spathulata*) or the mallee taxon (*E. orthostemon*), which have overlapping distributions south-east of Perth. The size of the leaves, buds and fruits in the type is in the common range for that of fine-leaved mallet taxon and at the fine-end of the range for the mallee taxon. Both the notes on the type specimen and the protologue give no indication of the habit of the individual or species respectively. Given that the type specimens are (morphologically) more likely to be that of the mallet taxon and the fact that the mallet taxon has been widespread and common in cultivation for many years while the mallee taxon is virtually unknown in cultivation, we have decided that it is reasonable to assume that *E. spathulata* refers to the fine-leaved mallet taxon as recognised here.

Two subspecies can be recognised, geographically separated (Figure 2A) and restricted to different drainage systems, differing in adult leaf, bud and fruit morphology.

1a. Eucalyptus spathulata Hook. subsp. **spathulata**

Distinguished from subsp. *salina* by the generally narrower (2.5–5 mm wide), bluish adult leaves, consistently 7-flowered inflorescences and smaller fruits (4–7 mm long x 4–6 mm wide). (Figure 2B)

Selected specimens examined: WESTERN AUSTRALIA: Dumbleyung, 17 June 1920, *C.A. Gardner* 15 (PERTH); Pingrup, 32 mls S of Lake Grace, 21 Sep. 1933, *W.E. Blackall* 3038 (PERTH); 2 mls E of Ongerup, 3 Aug. 1957, *J.W. Green* 1465 (PERTH); Ongerup townsite, May 1969, *B. Rockel* A22 (PERTH); 24 km from Katanning along road to Nyabing, 16 Jan. 1979, *M.D. Crisp* 5195 (CANB, MO, NSW, PERTH); Lake Cobham, Magenta Rd, 3 July 1984, *P. van der Moezel* 393 (PERTH); On Pingrup–Lake Grace Rd, 23 km S of its junction with Lake-Grace–Newdegate Rd, 23 km S of Lake Grace, 14 Oct. 1986, *S.D. Hopper* 5694 (PERTH); 1 km E of Ongerup on main Hwy, 21 Oct. 1992, *P.J. White* 370 (PERTH); Wagin, N edge Flagstaff Nature Reserve, 2.4 km E of Flagstaff Rd, 3 Nov. 1993, *P.J. White* 378 (CANB, PERTH); 3 km W of Lake Grace on road to Kukerin–W side of Lake Grace, 3 Nov. 1993, *P.J. White* 380 (CANB, K, PERTH); 3.7 km S of 129 road along Wishbone South Rd, 8 Nov. 1993, *P.J. White* 370 (CANB, PERTH); 31 km on Ongerup–Pingrup Rd going S, 18 Oct. 1994, *L. Sweedman* 3468 (PERTH); Lake Magenta Nature Reserve, May 1995, *W. O'Sullivan* 198 (PERTH); S of Ongerup on bend in road between golf club and the town, 33° 58' 12"S,

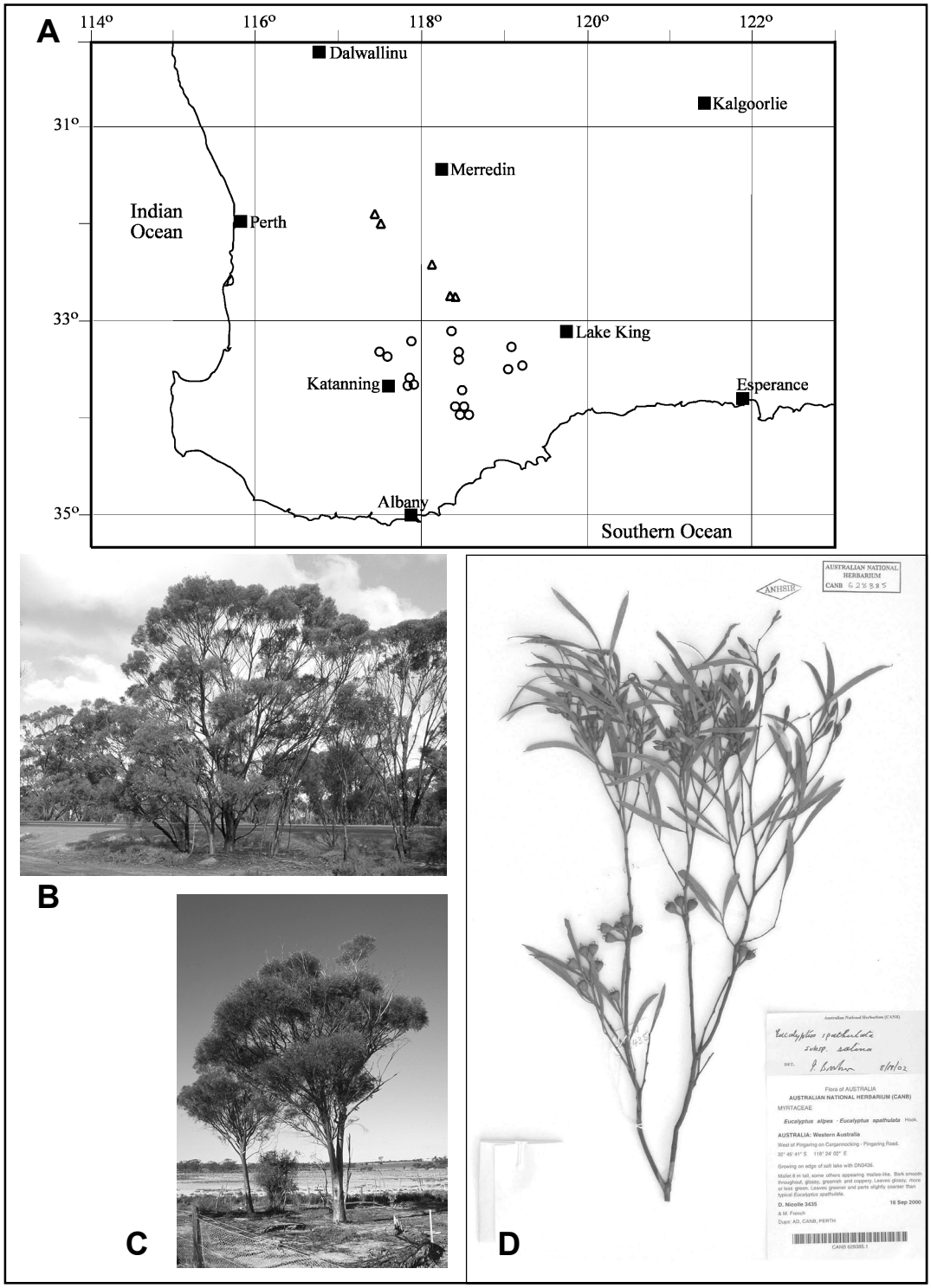

Figure 2. A – Distribution of *E. spathulata* subsp. *spathulata* ○ and subsp. *salina* △ in Western Australia;
B – Habit of *E. spathulata* subsp. *spathulata* (Katanning–Nyabing Rd, 33° 41' 10"S, 117° 45' 19"E);
C – Habit of *E. spathulata* subsp. *salina* (Mt Stirling Road, NE of Quairading, 31° 53' 42"S, 117° 30' 20"E);
D – Isotype of *E. spathulata* subsp. *salina* (*D. Nicolle* 3435 *& M. French*).

118° 30' 03"E, 5 May 1999, *A. Slee* 4138 (CANB, PERTH); Parsons Rd, E of Lee Rd, S of Newdegate, 33° 10' 10"S, 119° 05' 36"E, 30 July 2002, *D. Nicolle* 4420, 4421 *& I. Brooker* (CANB, PERTH); Katanning–Nyabing Rd, 33° 41' 10"S, 117° 45' 19"E, 30 July 2002, *D. Nicolle* 4429 *& I. Brooker* (CANB, PERTH).

Distribution and habitat. Distributed from the Lake Grace and Newdegate areas southwards to Ongerup and west towards Wagin. The distribution is more restricted than that outlined by Hill and Johnson (1992). A collection from 4.5 km W of Tammin (*L. Johnson* 9112 *& M. Johnson*) cited in Hill and Johnson (1992), is considered to be a partially naturalized, planted population of *E. spathulata* (Nicolle and French pers. obs., Sept. 2000). It occurs as several old trees and many younger saplings adjacent to a disused gravel pit on a lateritic rise, growing with both native vegetation and other introduced eucalypt species.

E. spathulata occurs in saline drainage lines and depressions, often fringing salt lakes, in heavy grey clay soils. It often forms ±pure stands, sometimes associated with *E. extensa, E. kondininensis* and *E. occidentalis*.

Conservation status. Under medium to long-term threat from rising saline groundwater, causing salinization of low-lying habitats. Recorded from Flagstaff and Lake Magenta Nature Reserves.

Notes. Hybrids are known with *E. platypus* (common in the Ongerup area, i.e. the type locality of *E. platypus* var. *heterophylla* – Brooker and Hopper 2002) and *E. tenera*.

1b. Eucalyptus spathulata Hook. subsp. **salina** Nicolle & Brooker, *subsp. nov.*

A subspecie typica foliis adultis viridibus plerumque leviter latioribus (3.5–7 mm wide); inflorescentiis 3 vel 7 floribus (constanter 7 floribus in subsp. *spathulata*); et fructibus majoribus (6–8 mm long x 6–6.5 mm wide).

Typus: West of Pingaring on Carganocking–Pingaring road, Western Australia, 32° 45' 41"S, 118° 24' 02"E, 16 Sep. 2000, *D. Nicolle* 3435 *& M. French* (*holo*: PERTH 05788625; *iso*: AD, CANB). (Figure 2D)

Distinguished from subsp. *spathulata* by the generally slightly broader (3.5–7 mm wide), green adult leaves; the 3- and/or 7- flowered inflorescences (consistently 7-flowered in subsp. *spathulata*) and the larger fruits (6–8 mm long x 6–6.5 mm wide). (Figure 2C)

Specimens examined: WESTERN AUSTRALIA: 0.1 km W of Dornock Rd along the Carganocking–Pingaring Rd, 32° 45' 27"S, 118° 30' 13"E, 12 Sept. 1997, *P.J. White* 1049 (PERTH); Carganocking–Pingaring Rd, 6.1 km E of Kulin–Lake King Rd, 32° 44' 41"S, 118° 22' 14"E, 19 Sept. 1997, *P.J. White* 1056 (PERTH); Mt Stirling Road, South Tammin, 31° 53' 33"S, 117° 30' 11"E, 23 Nov. 2000, *N. McQuoid* 563 (PERTH); Cnr Bruce Rock–Quairading Rd and Badjaling South Rd, 31° 58' 53"S, 117° 29' 16"E, 14 July 2001, *D. Nicolle* 3805 *& M. French* (CANB, PERTH); Mt Stirling Road, NE of Quairading, 31° 53' 42"S, 117° 30' 20"E, 14 July 2001, *D. Nicolle* 3806 *& M. French* (CANB, PERTH); 2.7 km east from Koorikin Rd on Corrigin–Kondinin Rd, 32° 27' 21"S, 118° 10' 10"E, 15 July 2001, *D. Nicolle* 3809 *& M. French* (CANB, PERTH); N edge of Yenyening Lakes, Salt River system, SE of Beverley, 32° 13' 56"S, 117° 13' 52"E, 19 Oct. 2002, *M. French* 1461 (PERTH).

Distribution and habitat. *E. spathulata* subsp. *salina* is restricted to the Salt River drainage system in the northern part of the southern wheatbelt, to the north of subsp. *spathulata*. It is known only from scattered populations from the north of Quairading south-east to Pingaring. It occurs in saline drainage

lines and flats, often in small, more or less pure stands, sometimes associated with *E. sargentii* subsp. *sargentii* and *E. myriadena*.

Conservation status. Known from a few, scattered stands, all of which are under threat from spreading and increased salinization. A few individuals are known on the edge of Badjaling Nature Reserve. Further survey is needed to establish the extent of populations following which this subspecies may fulfil the requirements for Western Australia's schedule of Declared Rare Flora. Conservation Codes for Western Australian Flora: Priority Three.

Etymology. From the Latin *salinus*, of salt, alluding to the habitat and also to the Salt River drainage system, on which this subspecies occurs.

Notes. Although differences between this subspecies and typical *E. spathulata* are relatively minor, the two subspecies are separable both in the field and as preserved herbarium specimens. The two subspecies are restricted to different drainage systems, with subsp. *spathulata* restricted to the westerly tending Blackwood River and upper Pallinup River catchments and inland drainage basins, and subsp. *salina* restricted to the more northerly tending Salt River (Avon River) system.

2. Eucalyptus orthostemon Nicolle and Brooker, *sp. nov.*

Affinis *Eucalypto spathulatae* sed habitu pluricauli ('mallee') et praesentia lignotuberis differt.

Typus: East of Yealering towards Kulin, Western Australia, 32° 35' 10"S, 117° 39' 52"E, 16 Sep. 2000, *D. Nicolle* 3426 *& M. French* (*holo*: PERTH 05788684; *iso*: AD, CANB). (Figure 3C)

Distinguished within the complex by its combination of lignotuberous, mallee habit, linear or almost linear, somewhat metallic ('glazed') olive-green adult leaves, erect staminal filaments, cream flowers, and the small to medium-sized, ±terete buds and fruits.

Mallee, 3–6 m tall. *Lignotuber* present. *Seedling leaves* shortly petiolate, linear to very narrow-lanceolate. *Adult leaves* linear or almost so, glossy, metallic blue-green to olive-green; lamina 30–80 mm long x 2–7 mm wide. *Inflorescences* (3-)7-flowered; peduncles very slightly flattened to terete, 3–10 mm long; pedicels terete, 2–5 mm long. *Flower buds* held erect, 11–12 mm long x 3–4 mm wide; operculum often narrower than hypanthium at join, cylindrical, ±smooth; *flowers* cream; stamens erect. *Fruit* held erect, distinct from pedicel, obconical to cupular-hemispherical, 5–7 mm long x 5.5–6.6 mm wide, smooth; valves 3 or 4. (Figure 3B)

Selected specimens examined: WESTERN AUSTRALIA: ¼ mile north of Wongan Hills, 21 May 1970, *M.I.H. Brooker* 2550 (CANB, PERTH); ½ mile north of Wongan Hills, 5 June 1969, *M.I.H. Brooker* 1827 (CANB, PERTH); 3 miles E of Cunderdin, 5 Feb. 1970, *K.R. Newbey* 3100, (CANB, PERTH); Between Pankie and Gabalong, 3 Oct. 1976, *J.S. Beard* 7989 (PERTH); Between Bolgart and Goomalling, 15 June 1977, *J.S. Beard* 8032 (CANB, PERTH); S of Tammin, 13 Oct. 1977, *J.S. Beard* 8088 (CANB, PERTH); Beaufort River crossing, 22 Nov. 1979, *G.J. Keighery* 2610 (PERTH); c. 12 km E of rail crossing at Carani, 26 Aug. 1982, *M.I.H. Brooker* 7584 (CANB, PERTH); 13.2 km NE of Calingiri on Wongan Hills Road, 28 Aug. 1983 *M.I.H. Brooker* 8285 (CANB, PERTH); 9 miles E of Wongan Hills, 31 Jan. 1986, *B.H. Smith* 642 (CANB, PERTH); Mosquito Hill, Bolgart East Road, 3 Sep. 1987, *M.I.H. Brooker* 9751 (CANB, PERTH); 0.9 km from Dowerin–Trayning road, on Minnievale Road, 3 Sep. 1988, *M.I.H. Brooker* 9748 (CANB, NSW, PERTH); 27.4 km S of Moora on Mogumber Road, 7 Aug. 1988, *M.I.H. Brooker* 10022 (AD, CANB,

PERTH); 4.6 km S of Kondut, 27 Aug. 1988, *K. Hill* 2935 (CANB, NSW, PERTH); E outskirts of Dumbleyung townsite, 33° 18' 47"S, 117° 44' 11"E, 19 Oct. 1992, *P.J. White* 352 (PERTH); 500 m E of junction–Nyabing South Rd and Wallacup Rd, 20 Oct. 1992, *P.J. White* 366 (PERTH); c. 500 m S Manuel Rd along Nyabing South Rd, 200 m W of road, 20 Oct. 1992, *P.J. White* 367 *& W. O'Sullivan* (PERTH); 1.9 km S Peterson Rd along N Datatine Rd, 33° 23'47"S, 117° 51'56"E, 23 Feb. 1993, *P.J. White* 482 (PERTH); Junction of Crosby Rd and Kukerin South Rd, Nature Reserve 26381, 33° 27' 34"S, 118° 07' 06"E, 23 Feb. 1993, *P.J. White* 485 (PERTH); Goomalling, 21 Oct. 1993, *P. White* 670 (CANB, PERTH); 0.7 km N of Watercarrin road along Cunderdin–Wyalkatchem road, 21 Oct. 1993, *P.J. White* 673 (CANB, PERTH); Nature Reserve 15197, 8 km E White Wells Rd/Nippering Rd junction, along White Wells Rd, 33° 12' 20"S, 117° 44' 08"E, 7 Nov. 1993, *P.J. White* 687 (CANB, PERTH); South of Moora, 30° 53' 09"S, 116° 01' 40"E, 25 Jan. 1996, *D. Nicolle* 1657 (PERTH); 0.9 km W of Bullaring along side railway line, 32° 30' 15"S, 117° 44' 10"E, 12 Sep. 1997, *P.J. White* 1043 (PERTH); 1.2 km WNW of Bullaring, 32° 29' 29"S, 117° 43' 44"E, 12 Sep. 1997, *P.J. White* 1045 (PERTH); Yenyenning Lakes Ski Club access rd, 1.7 km from Mears Rd, 32° 13' 46"S, 117° 10' 30"E, 21 Sep. 1997, *P.J. White* 1024 (PERTH); Gravel pit, Wickepin–Kulin Rd, 8.8 km E of Wickepin, 25 Sep. 1997, *P.J. White* 1060 (NSW, PERTH); Peter Valley Rd, NW of Cranbrook, E of Albany Hwy, 34° 10' 58"S, 117° 29' 51"E, 1 Nov. 1997, *M. French* 329 (PERTH); 16 km S of Corrigin–Brookton Road, S of Bullaring, 28 Apr. 1999, *A.V. Slee* 4078 (CANB, PERTH); Gabalong East Road, NW of Wongan Hills, 30° 43' 20"S, 116° 27' 36"E, 25 May 2000, *M. French* 1205 (PERTH); North-east of Calingiri, 31° 03' 51"S, 116° 29' 37"E, 13 Jan. 2001, *D. Nicolle* 3691 *& M. French* (CANB, PERTH); Grays Road, S of Harrismith, 33° 02' 49"S, 117° 53' 33"E, 21 Jan. 2001, *D. Nicolle* 3731 *& M. French* (CANB, PERTH; 7.4 km on Toolbrunup Road from Great Southern Hwy, SE of Tambellup, 34° 05' 25"S, 117° 44' 45"E, 10 Feb. 2001, *D. Nicolle* 3776 *& M. French* (CANB, PERTH); 2.1 km from Yonka Rd on Peter Valley Rd, N of Cranbrook, 34° 11' 01"S, 117° 30' 00"E, 10 Feb. 2001, *D. Nicolle* 3783 *& M. French* (AD, CANB, PERTH); Pingrup–Nyabing Rd, 33° 35' 12"S, 118° 26' 38"E, 30 July 2002, *D. Nicolle* 4428 *& I. Brooker* (PERTH); Damboring West Rd, S of Pithara, 30° 31' 26"S, 116° 40' 02"E, 3 Aug. 2002, *D. Nicolle* 4442 *& M. French* (CANB, PERTH).

Distribution and habitat. Of widespread but scattered distribution in the central wheatbelt of south-west Western Australia, from Miling and south of Pithara in the north, south to the Gordon River north of Cranbrook. It is commonly associated with sub-saline and saline flats or drainage lines, where it may be the dominant mallee species, but also occurs on poorly drained low rises of white to grey loams with ironstone gravel. Associated species include *E. annulata, E. arachnaea* subsp. *arachnaea, E. brachycorys, E. celastroides* subsp. *virella, E. erythronema* var. *erythronema, E. flocktoniae* subsp. *flocktoniae*, *E. hebetifolia, E. kochii* subsp. *kochii, E. kondininensis* sens. lat., *E. latens* sens. lat., *E. neutra, E. occidentalis, E. phenax* subsp. *phenax, E. tenera, E. uncinata, E. vegrandis* and *E. wandoo* subsp. *wandoo*. (Figure 3A)

Conservation status. This species is widespread and relatively common, and has been recorded from several nature reserves. The species is under some long-term threat by dryland salinization caused by large-scale vegetation clearance within the central wheatbelt.

Flowering period. September to February.

Etymology. From the Greek *ortho* (straight) and *stemon* (thread – stamen), referring to the erect stamens in contrast to *E. vegrandis*.

Notes. This species is one of the many variants traditionally included in *E. spathulata* var. *grandiflora*. More significantly, *E. orthostemon* is the common species more recently included in *E. vegrandis*, the type of which is relatively restricted and generally more southerly in distribution.

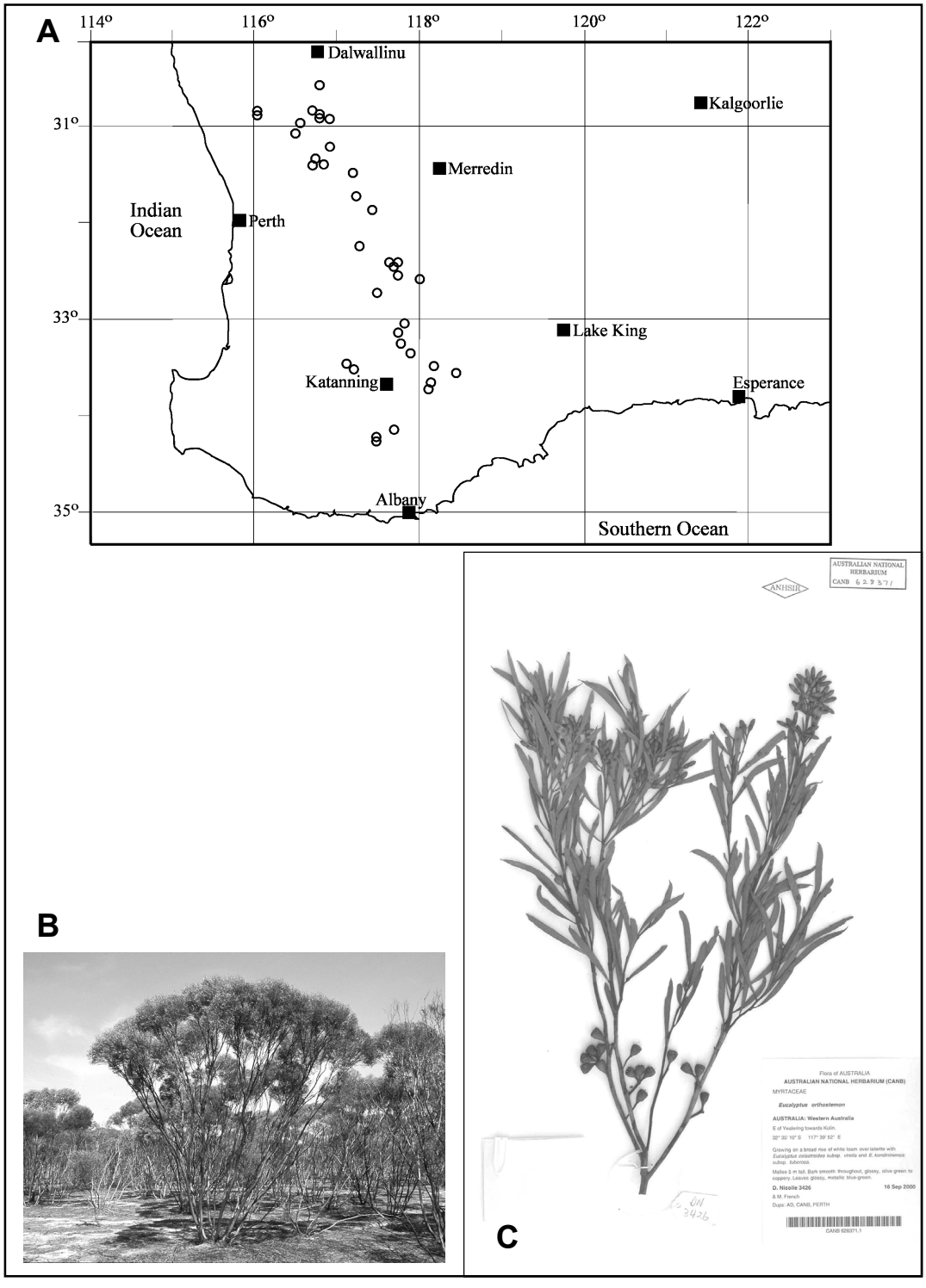

Figure 3. A – Distribution of *E. orthostemon* ○ in Western Australia; B – Habit of *E. orthostemon* at type locality (East of Yealering towards Kulin, 32° 35' 10"S, 117° 39' 52"E); C – Isotype of *E. orthostemon* (*D. Nicolle* 3426 *& M. French*).

E. orthostemon is most closely related to *E. spathulata* subsp. *spathulata* and is distinguished consistently by the lignotuberous, mallee habit (Figure 3B). These two species have a more distant relationship to *E. vegrandis*, which is distinguished most readily by the inflexed staminal filaments.

E. orthostemon can be observed growing sympatrically with *E. vegrandis* south-east of Tambellup. The two species are readily distinguished at this locality on the basis of stamen arrangement. Two putative hybrids between the two species were observed at this site (one collected: see appendix).

Hybrids are also known with *E. arachnaea* subsp. *arachnaea, E. erythronema* var. *marginata* and *E. wandoo* subsp. *wandoo* (see appendix).

3. Eucalyptus alipes (L.A.S. Johnson & K.D. Hill) Nicolle & Brooker, *stat. nov.*

Eucalyptus suggrandis L.A.S. Johnson & K.D. Hill subsp. *alipes* L.A.S. Johnson and K.D. Hill. *Telopea* 4(4): 581 (1992). – *Type*: 46.0 km N of Coolgardie–Hyden road on Southern Cross road, Western Australia, *K.D. Hill* 2894, 26 Aug. 1988 (*holo*: NSW; *iso*: CANB, PERTH 05087910).

Distinguished within the complex by the combination of non-lignotuberous, mallet habit, narrow-elliptical adult leaves, 3-flowered inflorescences, erect staminal filaments, cream flowers and the medium-sized to large, 2-angled buds and fruits.

Mallet (obligate seeder), 3–8 m tall. *Lignotuber* absent. *Seedling leaves* shortly petiolate, narrow-elliptical to lanceolate. *Adult leaves* narrow-elliptic, glossy, olive-green; lamina 35–60 mm long x 4–8 mm wide. *Inflorescences* 3-flowered; peduncles flattened, 8–14 mm long; pedicels angular to flattened, 6–8 mm long. *Flower buds* held erect, 12–16 mm long x 4.5–6 mm wide; operculum narrower than hypanthium at join, cylindrical to hemispherical, ±smooth; *flowers* creamy-white; stamens erect. *Fruit* held erect, tapering from pedicel, obconical, 10–12 mm long x 7–8 mm wide, usually 2-ribbed from pedicel; valves 3 or 4. (Figure 4B)

Distribution and habitat. Distributed from the Hyden scrub (between Hyden, Coolgardie and Norseman) south to east of Lake King and west nearly to Narembeen. *E. alipes* occurs in sub-saline to saline drainage lines and depressions in heavy soils or saline sands, often in pure whipstick mallet stands, or sometimes associated with (especially on the edges of such habitats) *E. celastroides* subsp. *virella*, *E. eremophila*, *E. exigua, E. kondininensis, E. neutra, E. salicola* and *E. sheathiana.* (Figure 4A)

Selected specimens examined: WESTERN AUSTRALIA: 44 km E of Hyden on Norseman track, 3 Oct. 1975, *M.I.H. Brooker* 4978 (NSW, PERTH); 5 km N of Hyden on road to Southern Cross, 13 Sep. 1978 *D.F. Blaxell* 1731 (PERTH); 2.1 km W of Bold Rock on track to Rabbit Proof Fence, 40 km NE of Hyden, 21 Sep. 1978, *S.D. Hopper* 1138 (PERTH); 1 km S of Holland track gate along State Barrier Fence, 32° 26' 43"S, 119° 26' 36"E, 16 Dec. 1992, *P.J. White* 448 (PERTH); 11.5 km SE of the Lake King–Norseman Rd on the E side of the State Barrier Fence, 33° 12' 09"S, 120° 08' 12"E, 16 Dec. 1992, *P.J. White* 450 (PERTH); 14.6 km NW of Hyden–Norseman Rd along Vermin Proof Fence, 32° 29' 54"S, 119° 17' 41"E, 27 Feb. 1993, *P.J. White* 541, 542, 545 (CANB, PERTH); 2.2 km SW of Mount Walker School on E edge of salt lake, 32° 03' 21"S, 118° 41' 52"E, 28 Feb. 1993, *P.J. White* 550, 551 (PERTH); Hewson Rd, 9.9 km N of Newdegate–Ravensthorpe Rd, 33° 00' 53"S, 119° 30' 55"E, 31 Mar. 1993, *P.J. White* 587 (CANB, PERTH); Hewson Rd, 7.4 km N of Newdegate–Ravensthorpe Rd, 33° 00' 53"S, 119° 30' 55"E, 31 Mar. 1993, *P.J. White* 588 (CANB, PERTH); 4.1 km W of Cross Rds between Three Star Lake and Peter Soak, 33° 05' 00"S, 120° 34' 23"E, 2 Apr. 1993, *P.J. White* 631 (CANB, PERTH); Lake King–Norseman Rd, 49.6 km E of Vermin Proof Fence,

32° 52' 41"S, 120° 25' 30"E, 3 Apr. 1993, *P.J. White* 637 (PERTH); 11 km E of Hyden–Ravensthorpe Rd along lake Carmody Rd, 32° 27' 43"S, 119° 09' 44"E, 3 Apr. 1993, *P.J. White* 642 (PERTH); Graham Rock, c. 1 km N of access track along private property boundary, 32° 27' 14"S, 119° 03' 26"E, 24 Nov. 1993, *P.J. White* 757*, 758* (AD, MEL, NSW, PERTH); Newdegate, 1.8 km east of Magenta Rd along Parsons Rd (Hoskins Rd), 33° 09' 15"S, 119° 02' 51"E, 10 Dec. 1993, *P.J. White* 701 (CANB, PERTH); Just SW of Varley Rock which is E of Hyden–Varley road, N of Holt Rock (town), 32° 38' 04"S, 119° 21' 46"E, 1 May 1999, *A.V. Slee* 4101 (CANB, PERTH); 0.7 km from Soldiers Rd on track around salt pan, 3.5 km W of Bailey Rd, E of Narembeen, 32° 02' 13"S, 118° 32' 41"E, 4 Sep. 1999, *W. O'Sullivan* 710 (PERTH); 11.1 km E of Narembeen–Muntadgin Rd along Soldiers Rd, 500 m S of road, 32° 02' 17"S, 118° 32' 14"E, 25 Sep. 1997, *P.J. White* 1065 (PERTH); Lake Gounter Nature Reserve, NW of Hyden on Worland Hill Rd, 32° 23' 49"S, 118° 49' 19"E, 21 Feb. 1999, *M. French* 770 (PERTH); S of crossroads on Forrestania–Southern Cross road, 32° 33' 31"S, 119° 45' 45"E, 6 Nov. 1999 *M. French* 1087 (PERTH); 15.8 km S of Lake Cronin crossroads towards South Ironcap, 32° 33' 40"S, 119° 45' 54"E, 10 Nov. 2000, *D. Nicolle* 3668 *& M. French* (CANB, PERTH); 3.3 km S of Varley towards Lake King, 32° 49' 17"S, 119° 31' 46"E, 11 Nov. 2000, *D. Nicolle* 3675 *& M. French* (AD, CANB, PERTH); NW of Hyden on the Vermin Proof Fence, 32° 20' 14"S, 119° 17' 39"E, 14 Apr. 2001, *M. French* 1305 (PERTH); On Emu Fence Rd, S of Southern Cross, 31° 57' 00"S, 119° 18' 24"E, 15 Apr. 2001, *M. French* 1311 (PERTH); 2.2 km S from Biddy-Cam Rd on Hewson Rd, 33° 00' 41"S, 119° 31' 09"E, 1 Aug. 2002, *D. Nicolle* 4438 *& I. Brooker* (AD, CANB, PERTH); 42.5 km N from Hyden towards Narembeen, 32° 05' 53"S, 118° 49' 15"E, 2 Aug. 2002, *D. Nicolle* 4439 *& I. Brooker* (CANB, PERTH).

Conservation status. Widespread, but of scattered occurrence and restricted to low-lying areas and may be under long-term threat from salinization. Scattered through the western part of the Hyden scrub and known from Lake Gounter Nature Reserve.

Notes: E. alipes is most closely related to *E. mimica*, the main distinguishing feature being degree of bud and fruit ornamentation (2-angled in *E. alipes*; 4-winged and square in *E. mimica*). *E. alipes* also generally lacks the sepals seen in *E. mimica*. These two mallet species show a more distant relationship (although clearly still closely related) to *E. suggrandis*. *E. alipes* is a non-lignotuberous mallet (an obligate seeder; Figure 4B) whereas *E. suggrandis* is a lignotuberous mallee (a resprouter).

E. alipes grades into *E. spathulata* subsp. *salina* in the west of its range, between Narembeen and Kondinin (see appendix*). E. alipes* differs from *E. spathulata* in the broader, narrow-elliptical adult leaves, the consistently three-flowered inflorescences (3- or 7-flowered in *E. spathulata*), and the larger, 2-ribbed buds and fruits (terete in *E. spathulata*) on longer peduncles. *E. alipes* also tends to be a smaller mallet forming whipstick stands (woodland mallet in *E. spathulata*).

4. Eucalyptus mimica Brooker & Hopper, *Nuytsia* 14(3): 344 (2002).

Type: 11.3 km along Old Ravensthorpe Road from Newdegate–Lake King road, Western Australia, 24 Nov. 1987, *M.I.H. Brooker* 9811 (*holo*: PERTH 1391925; *iso*: AD, CANB, MEL, NSW).

Distinguished within the complex by its combination of non-lignotuberous, mallet habit (an obligate seeder), narrow-elliptical adult leaves, loosely-erect, 3-flowered inflorescences, erect staminal filaments, cream flowers and medium-sized, 4-ribbed to winged and square buds and fruits.

Mallet (obligate seeder), 4 to 10 m tall. *Lignotuber* absent. *Seedling leaves* shortly petiolate, narrow-elliptical to lanceolate. *Adult leaves* narrow-elliptic, glossy, olive-green; lamina 50–85 mm long x 5–8 mm

wide. *Inflorescences* held loosely erect, 3-flowered; peduncles slightly flattened, 12–21 mm long; pedicels angular to ribbed in transverse section, 6–14 mm long. *Flower buds* held erect, 14–20 mm long x 4.5–5.5 mm wide; hypanthium 4-ribbed to winged, operculum often narrower than hypanthium at join, cylindrical to bluntly to sharply-conical, ±smooth to ribbed; *flowers* cream; stamens erect. *Fruit* held erect, tapering from pedicel, narrowly obconical, 11–16 mm long x 8–10 mm wide (including ribs), 3 or 4 ribbed; valves 3 or 4.

Brooker and Hopper (2002) describe two subspecies with overlapping distributions based on cited specimens. This is due to specimens of *E. suggrandis* subsp. *promiscua* being included in both subspecies of *E. mimica*. Here, we refine the definition of *E. mimica* to that of non-lignotuberous mallets (obligate seeders) only. Under this revised circumscription, the distribution of the two subspecies do not overlap, but rather form a geographical replacement pattern with the more restricted subsp. *continens* occurring to the south-west of subsp. *mimica.*

The two subspecies are distinguished by operculum structure. Contrary to Brooker and Hopper (2002), we do not recognise habit differences between the two subspecies. Both subspecies are obligate seeders.

4a. Eucalyptus mimica Brooker & Hopper subsp. **mimica**

Distinguished from subsp. *continens* by the sepaline whorl forming distinct sepals which may not be persistent, often being shed before anthesis.

Selected specimens examined: WESTERN AUSTRALIA: 19.6 km SE of highway E of Newdegate on Old Ravensthorpe Rd, 15 May 1988, *L.A.S. Johnson* 9086 *& M. Johnson* (NSW, PERTH); 6 km S of Lee Rd along Old Ravensthorpe Rd, 14 Sep. 1988, *A. Napier & A. Kelly* 303 (PERTH); 23 km E of Newdegate on Lake King Rd, 14 Sep. 1988, *A. Napier & A. Kelly* 304 (PERTH); 8.9 km N of Newdegate-Ravensthorpe Rd on Newdegate North Rd, 15 Sep. 1988, *A. Napier & A. Kelly* 305 (PERTH); 19 km SE from Newdegate along the Old Ravensthorpe Rd, 33° 13' 03"S, 119° 09' 57"E, 23 Oct. 1992, *P.J. White* 398 (PERTH); 26.2 km from Newdegate along the Old Ravensthorpe Rd, 23 Oct. 1992, *P.J. White* 399 (PERTH); Newdegate, 7.1 km E Magenta Rd along Breed Rd, 33° 11' 05"S, 119° 11' 59"E, 10 Nov. 1993, *P.J. White* 703 (PERTH); 11.4 km S of Newdegate-Lake King Rd on Old Ravensthorpe Rd, 33° 09' 40"S, 119° 09' 54"E, 2 May 1999, *A.V. Slee* 4115 (CANB, PERTH); Alymore Rd, just N of Buniche Rd, 32° 56' 53"S, 118° 53' 19"E, 29 July 2002, *D. Nicolle* 4414 *& I. Brooker* (AD, CANB, PERTH); 11.1 km from Lake King–Newdegate Rd on Old Ravensthorpe Rd, 33° 09' 23"S, 119° 09' 41"E, 30 July 2002, *D. Nicolle* 4415, 4416 *& I. Brooker* (CANB, PERTH).

Distribution and habitat. Only known from the Newdegate area, to the north, east and south of Newdegate. It occurs in heavy soils or low-lying sands, often in locally saline depressions or drainage lines. Associated eucalypts include *E. celastroides* subsp. *virella, E. extensa, E.kondininensis, E. myriadena, E. olivina* and *E. sargentii* subsp. *sargentii*. (Figure 4A)

Conservation status. Poorly known and in need of further survey. Many populations exist as remnant roadside stands and it is not recorded from a conservation reserve. Conservation Codes for Western Australian Flora: Priority Three.

Notes. The taxon was recognised as having affinity with *E. steedmanii* (Brooker and Hopper 2002) from which it differs in the narrower adult leaves and the smaller buds and fruit. *E. mimica* subsp. *mimica* is also restricted to low-lying, saline sites, unlike the non-saline habitat of *E. steedmanii.*

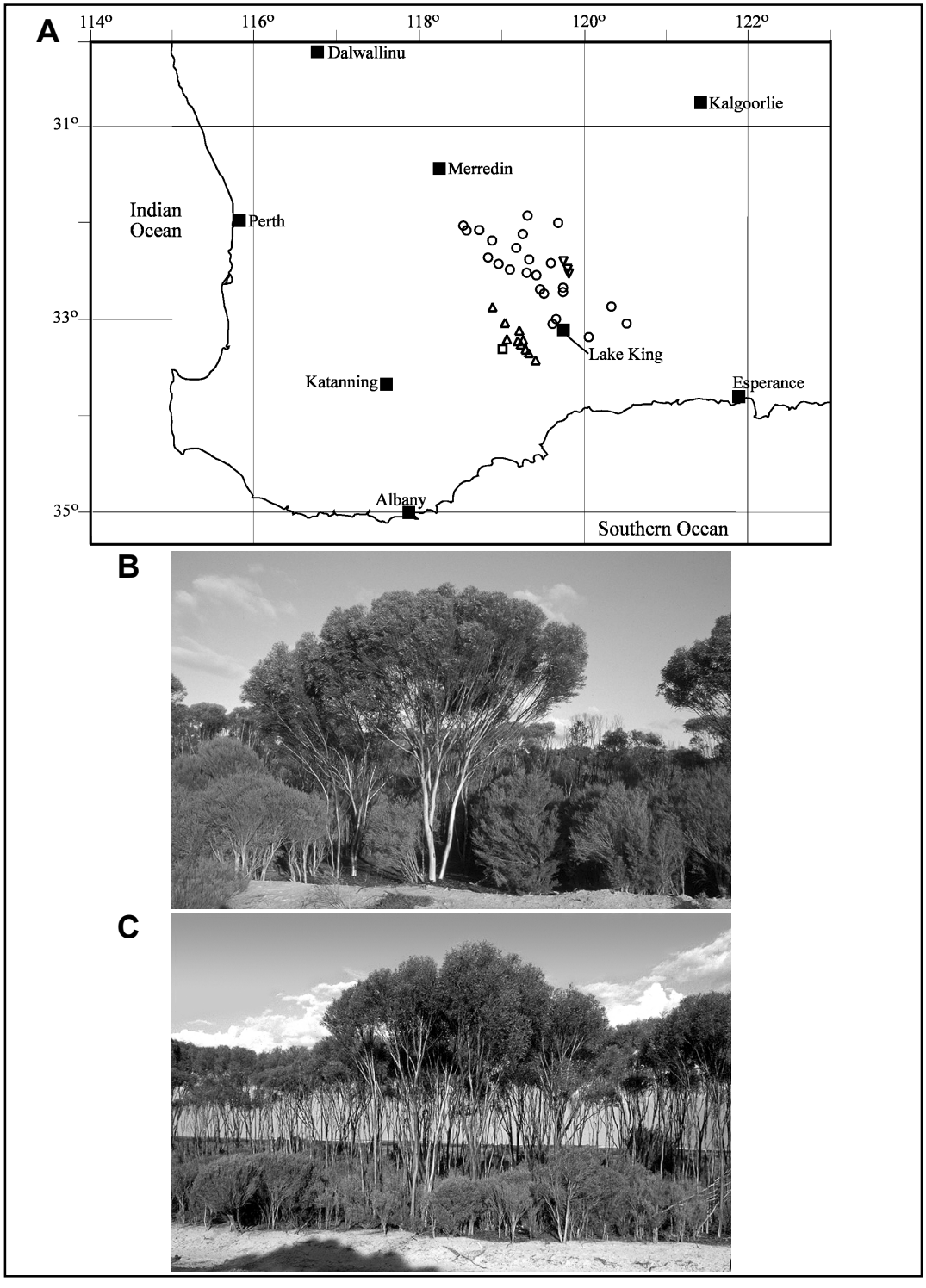

Figure 4. A – Distribution of *E. alipes* ○, *E. steedmanii* ▽, *E. mimica* subsp. *mimica* △ and subsp. *continens* □ in WA; B – Habit of *E. alipes* (2.2 km S from Biddy-Cam Rd on Hewson Rd, 33° 00' 41"S, 119° 31' 09"E); C – Habit of *E. mimica* subsp. *continens* near type locality (Lockhardt Rd, S of Newdegate, 33° 17' 07"S, 119° 01' 23"E).

4b. Eucalyptus mimica Brooker & Hopper **subsp. continens** Brooker & Hopper, *Nuytsia* 14(3): 345 (2002).

Type: 11 km S along Lockhardt Rd from Magenta Rd, Western Australia, 17 Dec. 1987, *M.I.H. Brooker* 9841 (*holo*: PERTH 1378163; *iso*: AD, CANB, MEL, NSW).

Distinguished from subsp. *mimica* by the sepaline whorl in the form of an outer operculum which is persistent to anthesis.

Specimens examined: WESTERN AUSTRALIA: 21.9 km S of hwy at Newdegate on Lockhardt Rd (to Pingrup), 15 May 1988, *L.A.S. Johnson* 9087 *& M. Johnson* (NSW, PERTH); Lockhardt Rd, 11 km S of Magenta Rd, 21 July 1988, *M.I.H. Brooker* 10007 (CANB, PERTH); 21.4 km S of Newdegate, 4.3 km N along Lockhardt Rd from Dykes Rd, 33° 17' 20"S, 119° 01' 15"E, 25 May 1989, *A. Napier & A. Kelly s.n.* (PERTH); Lockhardt Rd, S of Newdegate, 33° 17' 07"S, 119° 01' 23"E, 22 Nov. 1994, *D. Nicolle* 1114 (PERTH).

Distribution and habitat. Known only from the type locality, near Lake Lockhardt, south of Newdegate, occurring in a locally saline depression bordering a salt lake. It occurs in a pure stand abutting *E. sargentii* subsp. *sargentii*. Kelly *et al.* (1995) report (but do not cite) a population from near Mt Holland. This report appears to be erroneous and probably refers to *E. alipes*, which is known from the Mt Holland area. (Figure 4A, C)

Conservation status. Known from a single population spanning several kilometres where it is the dominant overstorey plant. It is certainly endangered from roadworks, inappropriate fire management and, in the longer term, rising saline groundwater. Conservation Codes for Western Australian Flora: Priority One.

Notes. Only one specimen cited in the protologue is not from the type population (Sullivan Soak – *D.L. Serventy* 229). Examination of this population in the field reveals a mallee habit and indicates it is *E. suggrandis* subsp. *promiscua*.

The retention of the intact, completely formed outer operculum till anthesis in *E. mimica* subsp. *continens* is a feature of many unrelated eucalypts, e.g. *E.* subser. *Continentes* Brooker (some of the box group of eucalypts, mainly of eastern Australia), but is otherwise unknown in *E.* sect. *Bisectae*.

5. Eucalyptus steedmanii C. Gardner, *J. Proc. Roy. Soc. W. Australia* 19: 87 (1933).

Type: Forrestania, S of Southern Cross, Western Australia, Feb. 1928, *H. Steedman s.n.* (*holo*: PERTH 1005960).

Distinguished within the complex by the combination of non-lignotuberous, mallet habit (an obligate seeder), somewhat erect to loosely pendulous 3-flowered inflorescences, erect staminal filaments, the cream or very rarely pink flowers and large, 4-winged buds and fruits.

Mallet (obligate seeder), 6–12 m tall. *Lignotuber* absent. *Adult leaves* narrow-elliptical to elliptical, often coarsely crenulate, glossy, olive-green; lamina 52–70 mm long x 11–16 mm wide. *Inflorescences* 3-flowered; peduncles slightly flattened, 17–26 mm long; pedicels angular to ribbed in transverse section, 8–13 mm long. *Flower buds* held somewhat erect to loosely pendulous, 22–25 mm long x 10–14 mm wide (including wings); hypanthium strongly 4-winged, operculum appearing narrower than hypanthium at join due to less prominent ornamentation, bluntly conical, ±smooth to slightly ribbed; *flowers* cream or

very rarely pink; stamens erect. *Fruit* held erect to loosely pendulous, tapering from pedicel, obconical, prominently 4-winged, 18–23 mm long x 13–16 mm wide (including wings); valves 4.

Specimens examined: Specimen data have been omitted due to the rarity of this species.

Distribution and habitat. Known from a small area between Wattle Rocks and Middle Ironcap, east of Hyden in Western Australia. It grows on low, broad rises in mallet woodland with other obligate seeders such as *E. salubris* and *E. urna*. (Figure 4A)

Conservation status. Declared as Rare Flora under Western Australian Government Legislation. The entire distribution of *E. steedmanii* suffered a wildfire in 1995, following which seedling regeneration and subsequent flowering has occurred. This species is well known and relatively common in cultivation in southern Australia.

Notes. Distinguished from *E. mimica* in the broader adult leaves and larger buds and fruits. It occupies somewhat elevated, non-saline sites unlike *E. mimica,* which is restricted to saline drainage lines and fringing salt lakes.

6. Eucalyptus suggrandis L.A.S. Johnson & K.D. Hill, *Telopea* 4(4): 580 (1992).

Type: Hamersley Drive, 32.5 km from Old Ongerup Rd, Fitzgerald River National Park, Western Australia, *K.D. Hill* 3147, 7 Sept. 1988 (*holo*: NSW; *iso*: CANB).

Distinguished within the complex by the combination of lignotuberous, mallee habit (resprouter), erect, 3- and/or 7-flowered inflorescences, erect staminal filaments and medium-sized buds and fruits continuous with and tapering to the 2-angled pedicel.

Mallee 1.5–6 m tall. *Lignotuber* present. *Seedling leaves* petiolate, narrow-lanceolate to ovate. *Adult leaves* narrow-elliptical to elliptical, glossy, slightly metallic blue-green to olive green; lamina 35–70 mm long x 5–18 mm wide. *Inflorescences* 3 or 7-flowered; peduncles slightly flattened to flattened, 7–23 mm long; pedicels angular to flattened, 1–5 mm long. *Flower buds* held erect, 10–18 mm long x 5–6.5 mm wide; operculum usually narrower than hypanthium at join, bluntly conical to cylindrical, ±smooth to densely minutely warty; *flowers* cream, very rarely pink to red; stamens erect. *Fruit* held erect, tapering from pedicel, obconical to somewhat barrel-shaped, 8–14 mm long x 6–10 mm wide, smooth to 2-ribbed from pedicel; valves 3 or 4.

E. suggrandis is distinguished most readily from the above related taxa by the mallee habit (*E. mimica, E. alipes* and *E. steedmanii* are all non-lignotuberous mallets – obligate seeders).

Two subspecies can be recognised differing primarily in bud morphology, with intergradation occurring in the Dragon Rocks area.

6a. Eucalyptus suggrandis L.A.S. Johnson & K.D. Hill subsp. **suggrandis**

Distinguished from subsp. *promiscua* primarily by the absence of sepals and early and clean shedding of an outer operculum. The adult leaves tend to be broader in this subspecies, the pedicels generally shorter and the buds and fruits less tapering to the pedicels.

Selected specimens examined: WESTERN AUSTRALIA: 20 km N of Hopetoun, 5 Oct. 1966, *P.G. Wilson* 5514 (CANB, PERTH); Lucy Rock, ca. 3 miles N of Holt Rock, 21 Sep. 1971, *K.M. Allan* 802 (CANB, MEL, PERTH); 106 km from Esperance along road to Ravensthorpe, Munglinup River crossing, 8 Jan. 1979, *M.D. Crisp* 4938 (CANB, PERTH); Ravensthorpe Range, 1.5 km SW of Mount Desmond, 9 Jan. 1979, *M.D. Crisp* 4974 (CANB, PERTH); 15 km E of Dunn Swamp, ca. 90 km ENE of Ravensthorpe, 15 Nov. 1980, *K.R. Newbey* 8130 (PERTH); 38 km W of Bald Rock, 33° 23' 53"S, 120° 58' 02"E, 3 Oct. 1983, *M.A. Burgman* 2654 & *S. McNee* (PERTH); Eldverton via Ravensthorpe, 4 Sep. 1984, *M.I.H. Brooker* 8659 (CANB, PERTH); 13.5 km from highway on Fitzgerald Rd, 18 Jan. 1985, *M.I.H. Brooker* 8808 (CANB, PERTH); 6 km S of highway on Fuss Rd, 11 Apr. 1985, *M.I.H. Brooker* 8930 (CANB, PERTH); 44 km W of Ravensthorpe–Albany Rd on Lake King Rd, 9 Nov. 1986, *K. Hill* 2381, *L.A.S. Johnson & D.F. Blaxell* (NSW, PERTH); 7.6 km from Ravensthorpe–Hopetoun Rd on Jerdacuttup Rd, 16 July 1987, *M.I.H. Brooker* 9718, 9719 (CANB, PERTH); Devil's Creek Rd, 10 km NW of Fitzgerald River National Park entrance, 6 Sep. 1988, *K. Hill* 3111 (CANB, NSW, PERTH); 2.2 km S of highway on Farrells Rd, 25 Nov. 1991, *M.I.H. Brooker* 10908 (CANB, PERTH); Ravensthorpe–Hopetoun Rd, 33° 44' 05"S, 120° 11' 28"E, 9 Dec. 1992, *D. Nicolle* 197 (PERTH); Track to Dragon Rocks, S of Hyden, 32° 46' 02"S, 119° 05' 26"E, 13 Dec. 1992, *D. Nicolle* 311 (PERTH); 9.2 km E of Hopetoun–Ravensthorpe Rd along Jerdacuttup Rd, 33° 44' 06"S, 120° 16' 47"E, 25 Feb. 1993, *P.J. White* 509 (CANB, PERTH); 7.1 km N of Jerdacuttup Rd along track past W side of Bandalup Hill, 33° 40' 09"S, 120° 22' 15"E, 25 Feb. 1993, *P.J. White* 510 – 514 (CANB, PERTH); 1.5 km W of West Point Rd along Bandalup Rd, 33° 33' 00"S, 120° 31' 17"E, 26 Feb. 1993, *P.J. White* 517, 519, 520 (CANB, PERTH); Foothills of Ravensthorpe range, Mount Short Rd, 0.2 km N of junction with Floater Rd, 33° 28' 23"S, 120° 01' 11"E, 31 Mar. 1993, *P.J. White* 600 (CANB, PERTH); 8 km from South Coast Hwy along Carlingup Rd, 33° 34' 47"S, 120° 02' 36"E, 1 Apr. 1993, *P.J. White* 603 (CANB, PERTH); SE corner Bradfords property/Dunn Rock Nature Reserve 36445, 1.8 km S Old Newdegate Rd, 33° 17' 21"S, 119° 35' 44"E, 11 Nov. 1993, *P.J. White* 704, 706, 707 (CANB, PERTH); Truslove area on Coolgardie–Esperance Hwy, 33° 22' 03"S, 121° 41' 36"E, 22 Nov. 1994, *D. Nicolle* 1100 (PERTH); Twertup Cottage, Fitzgerald River National Park, 34° 01' 29"S, 119° 22' 31"E, 23 Nov. 1994, *D. Nicolle* 1128 (PERTH); 5 km S of Telegraph Track on way to Quoin Head, Fitzgerald River National Park, 33° 57' 08"S, 119° 48' 09"E, 6 Apr. 1995, *M.I.H. Brooker* 12196W (AD, CANB, NSW, PERTH); SE Cascades on Cascades Rd, 33° 30' 59"S, 121° 10' 35"E, 15 Nov. 1997, *M. French* 342 (PERTH); Cocanarup Rd, 0.3 km from Albany–Esperance Hwy, 33° 38' 26"S, 119° 49' 51"E, 9 Nov. 1999, *W. O'Sullivan* 798 (PERTH); ca. 5 km SW of Cascades Rd on West Point Rd, 33° 21' 29"S, 120° 49' 32"E, 20 July 2001, *D. Nicolle* 3962 & *M. French* (CANB, PERTH); Collets Rd, Fitzgerald River National Park, 34° 07' 25"S, 119° 26' 54"E, 31 July 2002, *D. Nicolle* 4433 & *I. Brooker* (AD, CANB, PERTH); Hamersley Drive, Fitzgerald River National Park, 33° 53' 26"S, 119° 55' 41"E, 31 July 2002, *D. Nicolle* 4435 & *I. Brooker* (PERTH); 5.2 km from the new Cascade–Lake King road on the road to Lake Tay, 33° 10' 23"S, 120° 42' 44"E, 1 Aug. 2002, *D. Nicolle* 4436 & *I. Brooker* (AD, CANB, PERTH).

Distribution and habitat. Distributed from north of Bremer Bay eastwards to Truslove, north of Esperance, usually within approximately 80 km of the coast, but occurring inland towards Lake Tay and Dragon Rocks. Occurs in mixed mallee communities on sandplain to lateritic clays. Associated eucalypts include *E. proxima, E. astringens* subsp. *redacta, E. calycogona* subsp. *calycogona, E. cernua, E. cylindriflora, E. densa* subsp. *improcera, E. depauperata, E. flocktoniae* subsp. *flocktoniae, E. forrestiana, E. incrassata sens. lat., E. leptocalyx, E. micranthera, E. perangusta, E. phaenophylla, E. pileata, E. platypus* subsp. *platypus, E. pleurocarpa, E. quadrans, E. redunca, E. scyphocalyx, E. sporadica, E. tetraptera, E. tumida, E. valens* and *E. uncinata.* (Figure 5A)

Conservation status. This subspecies is widespread and well conserved in conservation reserves, including Fitzgerald River National Park.

Notes. The manuscript name *E.* 'verruculosa' has been used (Brooker and Kleinig, 1990) for populations of this taxon in the western part of Fitzgerald River National Park. These populations usually have slightly

broader adult leaves and marginally coarser buds and fruits than from populations further inland, but are consistent with *E. suggrandis* at the type locality. The coarser coastal populations of *E. suggrandis* follow a similar pattern to that seen in many other eucalypt taxa. At Twertup Cottage, *E. suggrandis* subsp. *suggrandis* appears to form hybrid swarms with *E. platypus* subsp. *platypus*. Six year old progeny from the *E. suggrandis* hybrid swarm at Twertup segregates towards both putative parents in cultivation (D. Nicolle, unpublished research). Putative hybrids are also known with *E. proxima* and *E. phaenophylla* (see appendix).

6b. Eucalyptus suggrandis L.A.S. Johnson & K.D. Hill **subsp. promiscua** Nicolle & Brooker, *subsp. nov.*

A subspecie typica structura operculata exteriore sero dehiscenti non perfecte in squamis, vel saepe sepala formanti differt.

Typus: NW corner of Harris Nature Reserve, E of Pingaring, Western Australia, 32° 48' 30"S, 118° 47' 19"E, 15 July 2001, *D. Nicolle* 3814 & *M. French* (*holo*: PERTH 06721060; *iso*: AD, CANB, NSW). (Figure 5B)

Distinguished from subsp. *suggrandis* primarily by the persistence of the outer operculum, which is either shed late or not cleanly and in scales, or by the common presence of sepals in the buds. The adult leaves are generally narrower in this subspecies, the pedicels longer and the buds and fruits tend to be more angled.

Selected specimens examined: WESTERN AUSTRALIA: 16 miles E of Pingrup, 6 miles W of Greenshield Soak, Feb. 1953 *D.L. Serventy* 183 (PERTH); 15 miles E Newdegate, 23 Apr. 1953, *R.D. Royce* 4185 (PERTH); Junction of Needilup Rd North and Newdegate Rd, 33° 24' 20"S, 118° 47' 40"E, 23 May 1989, *A Napier & A Kelly* 435 (PERTH); 14.5 km E of Lake Grace on road to Newdegate, 33° 06' 05"S, 118° 36' 54"E, 23 Oct. 1992, *P.J. White* 392 (PERTH); 1.9 km S of junction of Mallee Hill Rd along 14 Mile Rd, 33° 15' 03"S, 118° 44' 15"E, 13 Dec. 1992, *P.J. White* 436 (PERTH); 3.9 km N Reserve Rd along Lake Magenta Rd, 33° 32' 13"S, 119° 15' 17"E, 24 Feb. 1993, *P.J. White* 495 (PERTH); Junction of Kerr Rd and E boundary of Dragon Rocks Nature Reserve, 32° 49' 30"S, 119° 08' 25"E, 30 Mar. 1993, *P.J. White* 574, 575 (CANB, PERTH); Newdegate, Mallee Hill Rd, 3 km E of Beynon Rd, 33° 09' 18"S, 118° 55' 23"E, 10 Nov. 1993, *P.J. White* 699, 700 (CANB, PERTH); 1.8 km W of eastern boundary along track dividing CALM Reserve 29018 and Newdegate Research Station, 33° 08' 55"S, 118° 48' 56"E, 16 Sep. 1996, *P.J. White* 970 (PERTH); Pingrup–Townsend Rd, 23 May 1994, *T. Overheu* 647b (PERTH); 0.3 km W of Quiss Rd between Jerramungup and Ravensthorpe, 29 Aug. 1998, *M.I.H. Brooker* 12917 & *A.V. Slee* (AD, CANB, PERTH); Tarin Rock North Rd, NW of Lake Grace, 33° 03' 26"S, 118° 14' 32"E, 8 Sep. 1998, *M. French* 670 (PERTH); W of Newdegate on Lake Grace Rd, 33° 06' 08"S, 118° 52' 26"E, 12 Nov. 1998, *M. French* 759 (PERTH); Near Buniche Siding, road verge and railway reserve, 1.5 km along the Biddy-Cam Rd, 33° 00' 03"S, 118° 50' 38"E, 16 Aug. 1999, *E. Bishop* 108 (PERTH); Hyden–Newdegate Rd, S of Pingrup–Lake King Rd, 45 km NW of Newdegate, 4 Sep. 1999, *A.V. Slee* 4191 (AD, CANB, NSW, PERTH); Stewart Property, Loc. No. 1178, Lake Grace Shire, Aug. 2000, *J. & M. Stewart* 65 (PERTH); Between Lake Grace and Newdegate, 33° 06' 19"S, 118° 52' 31"E, 21 Jan. 2001, *D. Nicolle* 3720, 3721 & *M. French* (CANB, PERTH); Burngup North Road, north of Pingaring, 32° 43' 45"S, 118° 39' 38"E, 15 July 2001, *D. Nicolle* 3812 & *M.French* (CANB, PERTH); 17.6 km from Koornong Rd on Fitzgerald Rd, 33° 36' 43"S, 119° 31' 06"E, 21 July 2001, *D. Nicolle* 3974, 3975 & *M. French* (CANB, PERTH); 20.6 km W from Fitzgerald Rd on South Coast Hwy, 33° 50' 03"S, 119° 15' 34"E, 21 July 2001, *D. Nicolle* 3977 & *M. French* (CANB, PERTH); North Rd, NE of Pingaring, 32° 44' 41"S, 118° 39' 35"E, 29 July 2002, *D. Nicolle* 4413 & *I. Brooker* (CANB, PERTH); Ryan Rd, SW of Newdegate, 33° 24' 30"S, 118° 56' 43"E, 30 July 2002, *D. Nicolle* 4422 & *I. Brooker* (AD, CANB, PERTH); Sullivan Soak, Lake Magenta Nature Reserve, 33° 29' 05"S, 118° 59' 11"E, 30 July 2002, *D. Nicolle* 4425 & *I. Brooker* (CANB, PERTH).

Distribution and habitat. Distributed to the north and west of subsp *suggrandis*, in the area bounded approximately by Pingaring, Pingrup, Lake King and Jerramungup. It occurs as a component of mallee shrublands on pale brown or grey sandy loams. Associated species include *E. calycogona* subsp. *calycogona*, *E. depauperata, E. latens sens. lat., E. loxophleba* subsp. *gratiae, E. neutra, E. phaenophylla, E. pileata, E. salmonophloia* and *E. sheathiana.* (Figure 5A)

Conservation status. Well conserved in conservation reserves such as Lake Magenta Nature Reserve, Dragon Rocks Nature Reserve, Dunn Rock Nature Reserve and Harris Nature Reserve.

Etymology. From the Latin *promiscuus* (promiscuous, mixed), referring to the apparent morphological links of this taxon with *E. suggrandis* subsp. *suggrandis, E. mimica, E. alipes, E. orthostemon* and *E. goniocarpa* (the latter being part of the *E. eremophila* complex and is not discussed here).

Notes. Adult material of this subspecies is superficially similar to that of *E. mimica*, and indeed at least two specimens cited under *E. mimica* by Brooker and Hopper (2002) have proved to be *E. suggrandis* subsp. *promiscua* based on follow-up field examination. *E. suggrandis* is distinguished from *E. mimica* by is lignotuberous, mallee habit and its generally non-saline habitat.

7. Eucalyptus vegrandis L.A.S. Johnson & K.D. Hill, *Telopea* 4(4): 577 (1992).

Type: 5 km NW of Ongerup, Western Australia, *K.D. Hill* 337*, L.A.S. Johnson & D.F. Blaxell*, 23 Oct. 1983 (*holo*: NSW; *iso*: CANB, PERTH 1562088).

Distinguished within the complex by its combination of non-lignotuberous, mallet habit (obligate seeder), the linear to elliptical adult leaves, the erect, 7-flowered inflorescences, inflexed staminal filaments, creamy-white flowers and relatively small, 4 or 5-valved fruits.

Mallee, 2–6 m tall. *Lignotuber* present. Seedling leaves shortly petiolate, linear to elliptical. *Adult leaves* linear–elliptical, glossy, green to olive-green; lamina 30–60 mm long x 3–25 mm wide. *Inflorescences* 7-flowered; peduncles slightly flattened, 6–16 mm long; pedicels slightly angular, 1–3 mm long. *Flower buds* held erect, 7–12 mm long x 3–5 mm wide; operculum equal in width to slightly narrower than hypanthium at join, hemispherical to shortly cylindrical, ±smooth; *flowers* cream; stamens inflexed. *Fruit* held erect, relatively distinct from pedicel, obconical to cupular, thin-rimmed, 5–12 mm long x 5–8 mm wide, smooth; valves 4 or 5.

Two subspecies are recognised on the basis of adult leaf, bud and fruit morphology; subsp. *vegrandis* represents the narrow-leaved extreme of the species, while subsp. *recondita* is the more south-western, broad-leaved variant of *E. vegrandis*. The two subspecies form a geographical replacement pattern, with subsp. *recondita* occurring to the south and west of subsp. *vegrandis*. They form intermediate populations (intergrades) in geographically intermediate zones.

E. vegrandis is clearly distinguished from *E. orthostemon*, which has been included in *E. vegrandis* in the past, by the inflexed staminal filaments. Hill and Johnson (1992) erroneously described the stamen arrangement of *E. vegrandis* as erect, perhaps because their concept of *E. vegrandis* included the more northerly material described here as *E. orthostemon*. The staminal arrangement is correctly described for *E. vegrandis* by Brooker and Hopper (2002), however these authors had only assessed the type population at the time and made no comment with regard to more northerly *E. vegrandis* material (=*E. orthostemon*). *E. vegrandis* generally occurs to the south of *E. orthostemon*, although the two are

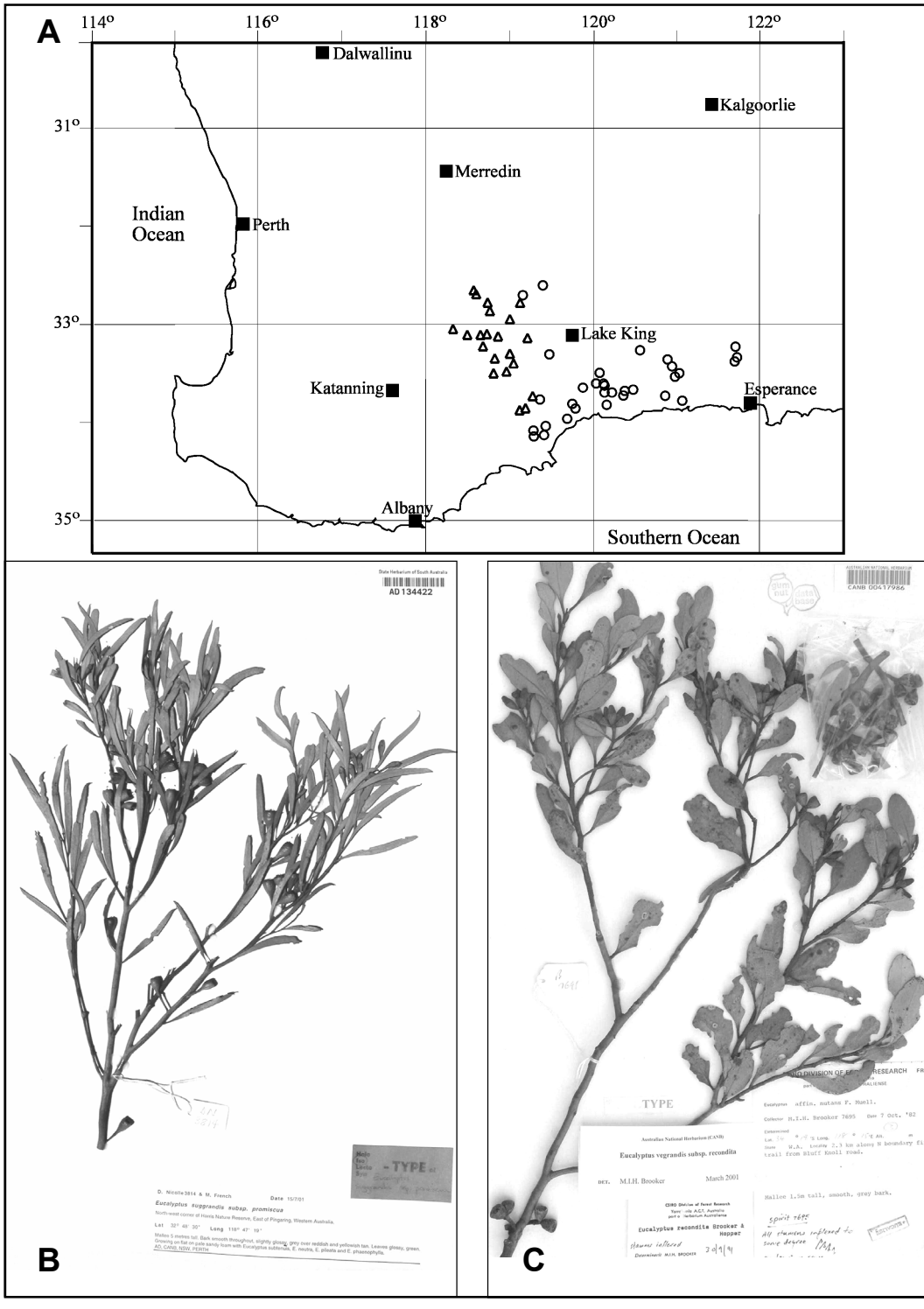

Figure 5. A – Distribution of *E. suggrandis* subsp. *suggrandis* ○ and subsp. *promiscua* △ in Western Australia;
B – Isotype of *E. suggrandis* subsp. *promiscua* (*D. Nicolle* 3814 *& M. French*);
C – Isotype of *E. vegrandis* subsp. *recondita* (*M.I.H. Brooker* 7695).

sympatric in the northern part of the range of *E. vegrandis* and the far south-western part of the range of *E. orthostemon* (from north of Cranbrook to near Nyabing).

Two subspecies are recognized differing primarily by adult leaf morphology and also, less reliably, by bud and fruit size.

7a. Eucalyptus vegrandis L.A.S. Johnson & K.D. Hill subsp. **vegrandis**

Distinguished from subsp. *recondita* by the narrower, linear to narrowly elliptical adult leaves (30–55 mm long x 3–13 mm wide) and the generally smaller buds and fruits.

Selected specimens examined: WESTERN AUSTRALIA: 0.5 miles N of Gnowangerup, 31 Mar. 1956, *J.W. Green* 385 (PERTH); 2 miles NW of Ongerup, 9 Dec. 1961, *K.R. Newbey* 118 (PERTH); Due 3 miles NW of Ongerup, 12 Mar. 1962, *K.R. Newbey* 154 (PERTH); 9 miles E Ongerup, 7 Oct. 1962, *K.R. Newbey* 556 (PERTH); 6 miles E of Ongerup, 12 Jan. 1973, *H. Demarz* 4277 (PERTH); 6 km N of Borden, Stirling district, 15 Jan. 1979, *M.D. Crisp* 5174 (CANB, NSW, PERTH); 1.5 km ENE of Jerramungup, 96 km W of Phillips River Bridge, 4 May 1982, *S.D. Hopper* 2286, 2287 (PERTH); 2.2 km N of Bremer Bay turnoff on Jerramungup–Albany road, 8 June 1983, *M.I.H. Brooker* 8180 (CANB, PERTH); Needilup, almost opposite loading shed, 13 Jan. 1988, *M.I.H. Brooker* 9865 (CANB, PERTH); 5.9 km S along Carlawillup South Rd, 9 Mar. 1988, *M.I.H. Brooker* 9905 (CANB, PERTH); 19.9 km SE of Gnowangerup on Ongerup Rd, 31 Oct. 1988, *L.A.S. Johnson* 9165 *& B.G. Briggs* (NSW, PERTH); Gnowangerup townsite, W side – in vacant block, 15 Oct. 1991, *P.J. White* 270 (PERTH); Opposite loading shed at Needilup, 33° 57' 16"S, 118° 46' 11"E, 9 Dec. 1992, *D. Nicolle* 201 (PERTH); Due S of Gairdner, 34° 04' 21"S, 119° 02' 43"E, 9 Dec. 1992, *D. Nicolle* 207 (PERTH); Needilup, 29 Aug. 1998, *M.I.H. Brooker* 12915 (AD, CANB, PERTH); Hassell Highway, 15 km from Jerramungup towards Boxwood Hill, 34° 03' 59"S, 118° 56' 10"E, 5 May 1999, *A.V. Slee* 4131 (CANB, PERTH); Ongerup, NW edge of town on road to Gnowangerup, 33° 57' 48"S, 118° 28' 49"E, 5 May 1999, *A.V. Slee* 4139 (CANB, PERTH); Monjebup Rd, 10 km S of Ongerup–Boxwood Hill Rd, 34° 17' 39"S, 118° 36' 37"E, 19 Sep. 1999, *M.I.H. Brooker* 13042 (CANB, PERTH); Fence Rd, 0.2 km from Pingrup–Ongerup Rd, 33° 34' 47"S, 118° 28' 44"E, 16 Feb. 2000, *M.E. French* 1118 (PERTH); On Monjebup Rd, 4.8 km S at Telstra tower site, 34° 15' 10"S, 118° 37' 50"E, 4 March 2000, *M.E. French* 1166 (PERTH); Ca. 17 km north of Ongerup towards Lake Grace, 33° 49' 56"S, 118° 28' 47"E, 4 Nov. 2000, *D. Nicolle* 3563 *& M. French* (PERTH); 200 m from Katanning–Nyabing Rd on Shaw Rd, 33° 38' 19"S, 117° 54' 48"E, 26 Jan. 2001, *D. Nicolle* 3741 *& M. French* (PERTH); Communication tower on Monjebup Rd, 34° 15' 19"S, 118° 38' 00"E, 26 Jan. 2001, *D. Nicolle* 3745 *& M. French* (CANB, PERTH).

Distribution and habitat. Of scattered occurrence from between Katanning and Nyabing, south-east to the Bremer River area. It typically occurs in diverse mallee communities on sands to clay-loams. Associated eucalypt species include *E. annulata, E. calycogona* subsp. *calycogona, E. celastroides* subsp. *virella, E. extensa, E. longicornis, E. loxophleba* subsp. *loxophleba, E. neutra, E. phaenophylla, E. phenax* subsp. *phenax, E. platypus* subsp. *platypus, E. pleurocarpa, E. sporadica*, *E. thamnoides*, *E. vesiculosa*, and *E. xanthonema*. (Figure 6A)

Conservation status. Of scattered occurrence in highly fragmented agricultural land. Not known to occur in a nature reserve.

Notes. This subspecies occurs to the north and east of subsp. *recondita*, and is distinguished most readily by its narrower, linear to narrowly-elliptical leaves and also by its generally smaller buds and fruits.

7b. Eucalyptus vegrandis L.A.S. Johnson & K.D. Hill **subsp. recondita** Nicolle & Brooker, *subsp. nov.*

Ab subspecie *vegrands* foliis adultis latioribus et alabastris fructibusque majoribus distinguitur.

Typus: 2.3 km along N boundary fire trail from Bluff Knoll Rd, Stirling Range National Park, Western Australia, 7 Oct. 1982, *M.I.H. Brooker* 7695 (*holo*: CANB; *iso*: PERTH 1488368). (Figure 5C)

= *E.* 'recondita' *ined*. Brooker and Kleinig (1990).

Distinguished from subsp. *vegrandis* by the broad, elliptical adult leaves (42–60 mm long x 13–25 mm wide) and the generally larger buds and fruits.

Selected specimens examined: WESTERN AUSTRALIA: Tachalarup Rd, S of Stirling Range, 13 Apr. 1985, *M.I.H. Brooker* 8948 (CANB, PERTH); Sandalwood Rd, c. 3 km E of Amelup, 13 Apr. 1985, *M.I.H. Brooker* 8952 (CANB, PERTH); Kamballup Nature Reserve, SW corner, 27 Jan. 1988, *A. Napier & A. Taylor* 205 (CANB, PERTH); E of Amelup, N of Stirling Range, 34° 15' 49"S, 118° 14' 35"E, 8 Oct. 1996, *D. Nicolle* 1883 (PERTH); Formby South Rd, N of Stirling Range, 34° 11' 40"S, 118° 04' 24"E, 20 Jan. 1996, *D. Nicolle* 1621 *& P. Dunlop* (CANB, PERTH); 4.4 km from Hassel Rd on Yetermerup Rd, NE of Cranbrook, 34° 12' 43"S, 117° 54' 23"E, 10 Feb. 2001, *D. Nicolle* 3780 *& M. French* (CANB, PERTH); Off Climie Rd, W of Albany HW at Cranbrook, 34° 18' 43"S, 117° 30' 08"E, 10 Feb. 2001, *D. Nicolle* 3782 *& M. French* (PERTH).

Distribution and habitat. Occurs from the Cranbrook area in the west, eastwards through the Stirling Range and adjacent areas, although not on the range itself. It occurs in a variety of sites, although usually on heavy, poorly drained soils, from clayey lateritic rises to winter-wet depressions, often on somewhat saline sites. Associated eucalypt species include *E. annulata, E. astringens* subsp. *astringens, E. phaenophylla, E. pleurocarpa, E. thamnoides* and *E. wandoo* subsp. *wandoo*. (Figure 6A)

Conservation status. Although relatively widespread, this taxon is of scattered distribution, with many populations occurring as roadside populations or as fragmented remnants near salt lakes or saline drainage lines. It has been recorded from Stirling Range National Park.

Flowering period. Early spring.

Etymology. From the Latin *reconditus* (hidden, concealed), alluding to the fact that this taxon was assumed to be part of the *E. spathulata* complex and merely a broad-leaved form. Its distinction was only recognised in the field by flower bud dissections.

Notes. This is the south-westerly distributed subspecies of *E. vegrandis*, distinguished most readily from the typical subspecies by the broader, elliptical adult leaves and also by the generally larger buds and fruits.

8. Eucalyptus proxima Nicolle & Brooker, *sp. nov.*

Inter complexum habitu pluricauli (mallee), lignotuber formanti, foliis adultis ovatis vel late lanceolatis, inflorescentiis 7 floribus rigide inflexis, staminibus inflexis, floribus rubris vel rare cremeis, operculis non verrucatis et fructibus 4 valvis mediocribus distinguitur.

Typus: c. 6 km N of Jerdacuttup W. Rd on Hopetoun–Ravensthorpe road, 33° 39' 14"S, 120° 09' 47"E, 1 Aug. 2002, *M.I.H. Brooker* 13240 & *D. Nicolle* (*holo*: PERTH 07212836; *iso*: AD, CANB, MEL, NSW). (Figure 6D)

Distinguished within the complex by the combination of lignotuberous, mallee habit (resprouter), ovate to broad-lanceolate adult leaves, rigidly down-curved, 7-flowered inflorescences, inflexed and red or rarely creamy-yellow staminal filaments, non-warty operculum and medium-sized, 4-valved fruits.

Mallee 1–3 m tall. *Lignotuber* present. *Seedling leaves* distinctly petiolate, ovate to broad lanceolate. *Adult leaves* elliptical to broad-lanceolate, glossy, olive green; lamina 50–80 mm long x 15–20 mm wide. *Inflorescences* 7-flowered; peduncles strongly flattened, 13–18 mm long; pedicels stout, 1–4 mm long. *Flower buds* mostly rigidly down-turned, 9–13 mm long x 6–7 mm wide; operculum often narrower than hypanthium at join, hemispherical, ±smooth; *flowers* red, rarely creamy-yellow; stamens inflexed. *Fruit* rigidly down-curved, ±sessile to shortly pedicellate, obconical, 10–13 mm long x 9–12 mm wide ribbed; valves 3–5. (Figure 6C)

Selected specimens examined: WESTERN AUSTRALIA: 8.1 mls S Ravensthorpe on Hamersley River Rd, *s.dat.*, *R. Bowyer* 620802 (PERTH); Eyre Range, 2 Nov. 1965, *A.S. George* 7260 (PERTH); 1 km S of Ravensthorpe, 21 May 1967, *P.G. Wilson* 5877 (PERTH); 6.7 miles SE of Ravensthorpe, 26 Mar. 1968, *G.M. Chippendale* 415 (CANB, PERTH); 17.5 km SE of Ravensthorpe, Kundip, 9 Jan. 1979, *M.D. Crisp* 4979 (CANB, PERTH); Fitzgerald River National Park, 4 km W of Annie Peak, 11 Jan. 1979, *M.D. Crisp* 5030, 5031 (CANB, PERTH); 2.3 km along firebreak from Moir Rd, 33° 40' 30"S, 119° 58' 10"E, 10 Sep. 1987, *A. Napier & A. Taylor* 48 (PERTH); 18.6 km S of Ravensthorpe on Hopetoun Rd in Kundip area, 9 Nov. 1997, *M. Bennett* 21 (PERTH); 36.9 km N of Hopetoun towards Ravensthorpe, 33° 38' 16"S, 120° 09' 01"E, 5 Nov. 2000, *D. Nicolle* 3571 *& M. French* (PERTH).

Distribution and habitat. Restricted to the southern part of the Ravensthorpe Range and southwards to the Eyre Range and near Hamersley Inlet, over a maximum linear range of approximately 40 km. It occurs on broad rises in mallee shrubland vegetation. Associated eucalypt species include *E. astringens* subsp. *redacta, E. clivicola, E. densa* subsp. *improcera*, *E. flocktoniae* subsp. *flocktoniae, E. incrassata, E. phaenophylla, E. scyphocalyx* and *E. suggrandis* subsp. *suggrandis*. (Figure 6A)

Conservation status. Recorded from Fitzgerald River National Park. Conservation Codes for Western Australia Flora: Priority Four.

Flowering period. October–November.

Etymology. From the Latin *proximus* (nearest) referring to the species relationship to *E. cernua*.

Notes. Included in the concept of *E. cernua* by Brooker and Hopper (2002), but clearly distinguished by the lignotuberous mallee habit (Figure 6C). The distribution of *E. proxima* and *E. cernua* overlap in the southern part of the Ravensthorpe Range although generally *E. proxima* is more southern and western in distribution compared to *E. cernua*.

Flower colour cannot be used as a reliable distinguishing feature between *E. proxima* and *E. cernua* as both species can have red and pale yellow flowers on different individuals within a single population. *E. proxima* is commonly red-flowered and only occasionally pale-yellow-flowered, while *E. cernua* more often has pale yellow flowers.

9. Eucalyptus cernua Brooker & Hopper, *Nuytsia* 14(3): 342 (2002).

Type: 4.6 km N of Ravensthorpe–Albany road on Lake Grace Rd, Western Australia, 4 Sep. 1987, *M.I.H. Brooker* 8657 (*holo*: CANB; *iso*: AD, MEL, NSW, PERTH 1289519).

Distinguished within the complex by its combination of non-lignotuberous, mallet habit (obligate seeder); the narrow-ovate to broad-lanceolate adult leaves; the down-curved, 7-flowered inflorescences; the inflexed, red or creamy-yellow staminal filaments; the non-warty operculum and the medium-sized, 5–6-valved fruits.

Mallet (obligate seeder) 4–12 m tall. *Lignotuber* absent. *Seedling leaves* distinctly petiolate, ovate. *Adult leaves* narrow-ovate to broad-lanceolate; glossy, olive-green; lamina 50–95 mm long x 18–25 mm wide. *Inflorescences* 7-flowered; peduncles strongly flattened, 20–28 mm long; pedicels angular in transverse section, 0–4 mm long. *Flower buds* down-curved, 10–16 mm long x 6–10 mm wide; operculum narrower than hypanthium at join, hemispherical, ±smooth; *flowers* pale yellow or less commonly red; stamens inflexed. *Fruit* down-curved, tapering from pedicel, obconical to cupular, 12–17 mm long x 11–15 mm wide, coarsely ribbed; valves 5 or 6. (Figure 6B)

Selected specimens examined: WESTERN AUSTRALIA: 6 miles NW of Ravensthorpe, 5 Nov. 1969, *M.I.H. Brooker* 2290 (PERTH); Valley on N side of Mt McMahon, ca. 9 km direct NE of Ravensthorpe, 14 Sep. 1978, *L.D. Pryor & J.D. Briggs* 103 (CANB, PERTH); N side of Mt McMahon, NE of Ravensthorpe, 14 Sep. 1978, *D. Blaxell* 1737 (NSW, PERTH); 4.7 km NW of Highway 1 on Ravensthorpe–Lake King Rd, 10 Oct. 1984, *B. Briggs* 7717 *& L. Johnson* (AD, CANB, MEL, NSW, PERTH); 6.5 km along track near Bandalup Hill, 15 Jan. 1985, *M.I.H. Brooker* 8786 (CANB, PERTH); 8.4 km S of highway on Mason Bay Rd (S of Bandalup Hill),, 9 Nov. 1986, *K. Hill* 2364*, L.A.S. Johnson, D.F. Blaxell & M.I.H. Brooker* (NSW, PERTH); 3.1 km W of Ravensthorpe–Hopetoun road on Road 11, 9 Nov. 1986, *K. Hill* 2370*, L.A.S. Johnson, D.F. Blaxell & M.I.H. Brooker* (NSW, PERTH); Bandalup Hill area, 33° 41' 46"S, 120° 21' 58"E, 8 Dec. 1992, *D. Nicolle* 182 (PERTH); 5.4 km from Ravensthorpe on Lookout Rd to north, 7 Apr. 1995, *M.I.H. Brooker* 12201 (AD, CANB, NSW, PERTH); 0.4 km W of Carlingup Rd in Ravensthorpe Range on track leading to Vineyard Block, 33° 33' 42"S, 120° 07' 01"E, 9 Nov. 1997, *M. Bennett* 22 (PERTH); Bandalup Hill, ca. 31 km ESE of Ravensthorpe, 33° 39' 41"S, 120° 24' 02"E, 18 Feb. 1998, *G.F. Craig* 3616 (PERTH); Bandalup Hill, c. 31 km ESE of Ravensthorpe, 33° 37' 35"S, 120° 22' 47"E, 19 Feb. 1998, *G.F. Craig* 3645 (PERTH); N of Ravensthorpe on road to Lake King, 33° 32' 31"S, 120° 00' 16"E, 5 Nov. 2000, *D. Nicolle* 3574 *& M. French* (AD, CANB, PERTH).

Distribution and habitat. Restricted to the Ravensthorpe Range and Bandalup Hill and adjacent undulating areas in Western Australia, over a maximum linear range of less than 50 km. It grows in clayey soils, often in minor creeklines and depressions in undulating topography. Associated eucalypt species include *E. extensa, E. flocktoniae* subsp. *flocktoniae, E. leptocalyx, E. phenax* subsp. *phenax* and *E. stoatei*. (Figure 6A)

Conservation status. Relatively frequent and locally dominant and not considered to be at risk.

Flowering period. October to December.

Notes. Although the type of *E. cernua* clearly represents the non-lignotuberous mallet taxon often with pale yellow flowers, the notes in the protologue of the species (Brooker and Hopper 2002) indicate that these authors concept of the new species included that of *E. proxima*. The Latin diagnosis, description

and specimens cited in the protologue of *E. cernua* indicate both mallet variants (*E. cernua*) and mallee, commonly red-flowered variants (*E. proxima*) were included in the Brooker and Hopper concept of the new species. Here, we restrict the application of the name *E. cernua* to the type form i.e. the non-lignotuberous, mallet populations often with pale yellow but occasionally with red flowers. (Figure 6B)

Under the note of *E. vesiculosa*, Brooker and Hopper (2002) state that *E. cernua* (unlike *E. vesiculosa*) does not occur in pure stands. While *E. proxima* occurs as a component of mallee shrubland and as such is not known to occur in pure stands, *E. cernua*, as delimited here, often occurs in pure or almost pure mallet stands.

10. Eucalyptus vesiculosa Brooker & Hopper, *Nuytsia* 14(3): 341 (2002).

Type: Boxwood Hill–Ongerup Rd, 4 km W of Norman Rd, E of Monjemup Rd, Western Australia, 8 Apr. 1995, *M.I.H. Brooker* 12213 *& S.D. Hopper* (*holo*: CANB; *iso*: AD, NSW, PERTH 05698952).

Distinguished within the complex by its combination of non-lignotuberous, mallet habit (obligate seeder), elliptical to orbicular adult leaves; rigidly down-curved, 7-flowered inflorescences; inflexed staminal filaments, red flowers, warty operculum and large, 5 to 7-valved fruits.

Mallet (obligate seeder) 3–6 m tall. *Lignotuber* absent. *Seedling leaves* distinctly petiolate, ovate. *Adult leaves* broad-elliptical to almost orbicular, glossy, olive-green; lamina 40–45 mm long x 20–35 mm wide. *Inflorescences* 7-flowered; peduncles broadly flattened, 15–18 mm long; pedicels angular, 0–4 mm long. *Flower buds* rigidly down-turned, 15–18 mm long x 8–11 mm wide; operculum narrower than hypanthium at join, hemispherical, prominently warty; *flowers* red; stamens inflexed. *Fruit* rigidly down-turned, tapering from pedicel, obconical to cupular, 13–18 mm long x 14–19 mm wide, coarsely ribbed; valves 5 to 7.

Specimens examined: WESTERN AUSTRALIA: Between Ongerup and Borden, June 1972, *Schoolteacher s.n.* (PERTH); Boxwood Hill–Ongerup Rd, between Norman Rd and Monjemup Rd at edge of Corackerup Nature Reserve, 34° 13' 06"S, 118° 39' 14"E, 5 May 1999, *A.V. Slee* 4133 (CANB, PERTH); Southern boundary of Corackerup Nature Reserve, 34° 13' 18"S, 118° 39' 21"E, 4 Nov. 2000, *D. Nicolle* 3565 *& M.E. French* (CANB, PERTH).

Distribution and habitat. Known from a few populations in a small area of the Corackerup Creek catchment between Ongerup and Bremer Bay in Western Australia. Grows in clayey soils in undulating topography. Associated eucalypt species include *E. annulata, E. calycogona* subsp. *calycogona, E. neutra, E.conglobata* subsp .*perata* and *E. vegrandis* subsp. *vegrandis*. (Figure 6A)

Conservation status. Known from Corackerup Nature Reserve. Conservation Codes for Western Australian Flora: Priority Two.

Flowering period. September to October (Brooker and Hopper 2002).

Notes. Superficially similar to *E. platypus* subsp. *platypus*, particularly in habit, differing in the larger adult leaves, the larger buds with a hemispherical, prominently warty operculum; the red, inflexed staminal filaments and the larger, 5 to 7- valved fruits.

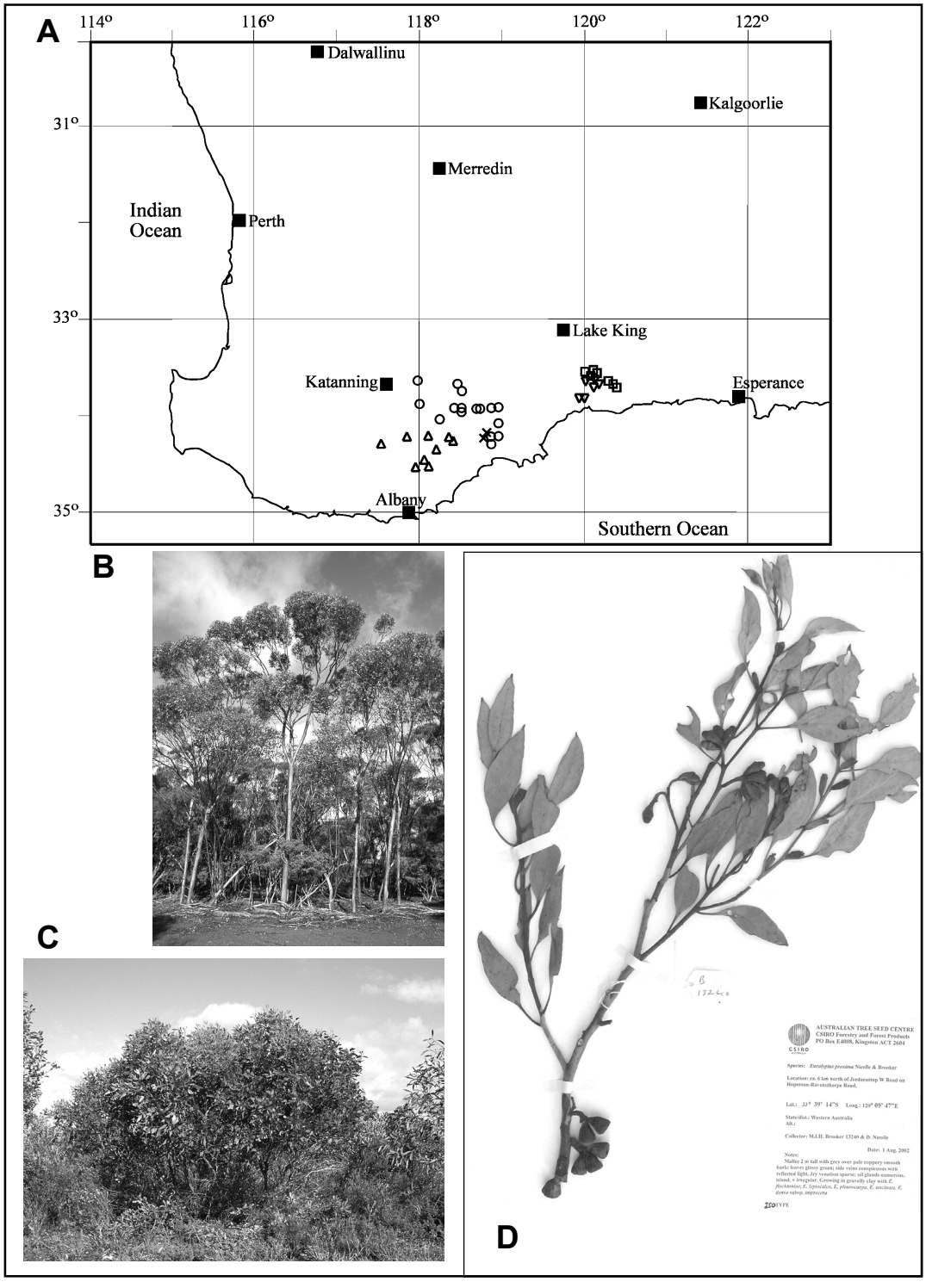

Figure 6. A – Distribution of *E. vesiculosa* ×, *E. cernua* □, *E. proxima* ▽, *E. vegrandis* subsp. *vegrandis* ○ and subsp. *recondita* △ in WA; B – Habit of *E. cernua* at type locality (4.6 km N of Ravensthorpe–Albany rd on Lake Grace rd); C – Habit of type individual of *E. proxima* (*M.I.H. Brooker* 13240 & *D. Nicolle*); D – Isotype of *E. proxima* (*M.I.H. Brooker* 13240 & *D. Nicolle*).

Appendix of hybrids and intergrades involving the *E. spathulata* complex

***E. alipes – E. spathulata* subsp. *salina* intergrades**
Selected specimen: 32.3 km from Kondinin towards Hyden, 32° 30' 00"S, 118° 35' 52"E, 15 July 2001, *D. Nicolle* 3811 & *M. French* (CANB, PERTH).

***E. alipes – E. suggrandis* subsp. *suggrandis* intergrades**
Selected specimens: 3.1 km from Neds Corner Rd on Pyramid Rd, 33° 10' 07"S, 121° 04' 07"E, 20 July 2001, *D. Nicolle* 3959, 3960 & *M. French* (CANB, PERTH).

E. proxima* × *E. suggrandis* subsp. *suggrandis
Selected specimen: 36.9 km N of Hopetoun towards Ravensthorpe, 33° 38' 16"S, 120° 09' 01"E, 5 Nov. 2000, *D. Nicolle* 3572 & *M. French* (CANB, PERTH).

E. arachnaea* subsp. *arachnaea* × *E. orthostemon
Selected specimen: NE of Calingiri, 31° 03' 51"S, 116° 29' 37"E, 13 Jan. 2001, *D. Nicolle* 3693 & *M. French* (CANB, PERTH).

E. cernua* × *E. platypus* subsp. *congregata
Selected specimen: Ca. 3 km SE of Bandalup Hill trig and 4.5 km S of Mason Bay Rd on N–S track E of Hill, 33° 39' 41"S, 120° 24' 02"E, 18 Feb. 1998, *G.F. Craig* 3617–2 (PERTH).

E. cernua* × *E. sporadica
Selected specimen: 1.7 km N of Jerdacuttup North Rd, Old Kundip townsite, 29 June 1988, *N. McQuoid* 17 (CANB, PERTH).

E. erythronema* var. *erythronema* × *E. orthostemon
Selected specimen: 0.95 miles E of Manmanning, 11 Mar. 1989, *B.H. Smith* 1158 (AD, BRI, CANB, MEL, NSW, PERTH).

E. erythronema* var. *marginata* × *E. orthostemon
Selected specimen: NE of Calingiri, 31° 03' 51"S, 116° 29' 37"E, 13 Jan. 2001, *D. Nicolle* 3692 & *M. French* (CANB, PERTH).

E. loxophleba* subsp. *loxophleba* × *E spathulata* subsp. *spathulata
Selected specimens: 0.6 km W of Eldridge Street, Ongerup, on main road, 18 May 1987, *M.I.H. Brooker* 9638 (CANB, PERTH); 5 km E of Ongerup on Gnowangerup–Jerramungup road, 3 Dec. 1999, *N. McQuoid* 550 (PERTH).

***E. orthostemon – E. suggrandis* subsp. *promiscua* intergrades**
Selected specimen: 22.8 km from Kondinin towards Hyden, 32° 30' 47"S, 118° 29' 58"E, 15 July 2001, *D. Nicolle* 3810 & *M. French* (CANB, PERTH).

E. orthostemon* × *E. wandoo* subsp. *wandoo
Selected specimens: 0.2 km from Johnston Rd–Nyabup Rd junction towards Tambellup, 34° 05' 58"S, 117° 35' 55"E, 10 Feb. 2001, *D. Nicolle* 3774 & *M. French* (CANB, PERTH); 2.1 km from Yonka Rd on Peter Valley Rd, N of Cranbrook, 34° 11' 01"S, 117° 30' 00"E, 10 Feb. 2001, *D. Nicolle* 3784 & *M. French* (CANB, PERTH)

***E. orthostemon* × *E. vegrandis* (subspp. *vegrandis <–> recondita*):**
Selected specimen: 7.4 km on Toolbrunup Rd from Great Southern Hwy, SE of Tambellup, 34° 05' 25"S, 117° 44' 45"E, 10 Feb. 2001, *D. Nicolle* 3777 & *M. French* (CANB, PERTH).

E. phaenophylla* × *E. suggrandis* subsp. *suggrandis
Selected specimen: 37.4 km N of Hopetoun towards Ravensthorpe, 33° 38' 03"S, 120° 08' 49"E, 5 Nov. 2000, *D. Nicolle* 3573 & *M. French* (CANB, PERTH).

E. platypus* subsp. *platypus* × *E spathulata* subsp. *spathulata
[Representative of the type of *E. platypus* var. *heterophylla*]
Selected specimens: 4.8 km N of Ongerup on road to Pingrup, 21 Oct. 1992, *P.J. White* 371 (PERTH); 2.3 km N of Ongerup–Jerramungup road on Ongerup–Pingrup road, 8 Apr. 1995, *M.I.H. Brooker* 12210 (AD, CANB, NSW, PERTH); 7 km N of Ongerup on North Ongerup Rd, 10 July 2000, *N. McQuoid* 556 (PERTH).

E. platypus* subsp. *platypus* × *E suggrandis* subsp. *suggrandis
Selected specimen: Twertup Field Studies Centre, ca. 35 km from junction of South Coast Hwy and Quiss Rd in Fitzgerald River National Park, 12 Mar. 1989, *S.D. Hopper* 7130 (PERTH).

E. spathulata* subsp. *spathulata* × *E. tenera
Selected specimen: 13 mls N of Pingrup on road to Lake Grace, 4 Apr. 1968, *S.G.M. Carr* 677 (PERTH).

***E. suggrandis subsp. suggrandis* – subsp. *promiscua* intergrades**
Selected specimen: 50 miles E of Ongerup, 13 Mar. 1957, *J.W. Green* 1185 (PERTH).

***E. vegrandis* subsp. *recondita* – subsp. *vegrandis* intergrades**
Selected specimen: 7.4 km on Toolbrunup Rd from Great Southern Hwy, SE of Tambellup, 34° 05' 25"S, 117° 44' 45"E, 10 Feb. 2001, *D. Nicolle* 3778 *& M. French* (CANB, PERTH).

E. vegrandis* subsp. *recondita* × *E. xanthonema
Selected specimens: c. 80 m E of firebreak & 10 m N of E–W firebreak running off E, (i.e. in the NE corner of junction of tracks), Stirling Range National Park, adjacent to caravan park, N boundary of park, 23 Nov. 1983, *S.D. Hopper* 3588, 3589, 3590 (PERTH).

Acknowledgements

The senior author is most grateful to Malcolm French for accompaniment on many 'vegrandis' field trips and general discussions about the complex, as well as welcomed hospitality in Perth. We thank Peter White (CALM) for continued input towards resolving the *E. spathulata* complex. We are grateful to CSIRO Forestry and Forest Products for financial assistance in the later part of the study.

References

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. and Kleinig, D.A. (1990). *Field Guide to Eucalypts* Vol. 2, 428 pp. (Inkata Press: Melbourne.)

Hill, K. D. and Johnson, L.A.S. (1992). Systematic studies in the eucalypts. 5. New taxa and combinations in *Eucalyptus* (Myrtaceae) in Western Australia. *Telopea* 4(4): 561–634.

Kelly, A.E., Napier, A.C. and Hopper, S.D. (1995). Survey of rare and poorly known eucalypts of Western Australia. *CALMScience* Supplement 2: 1–207.