

A revision of *Eucalyptus* ser. *Falcatae* (Myrtaceae) from south-western Australia, including the description of new taxa and comments on the probable hybrid origin of *E. balanites*, *E. balanopelex* and *E. phylacis*

Dean Nicolle^{1,3} and Malcolm E. French²

¹Currency Creek Arboretum, PO Box 808, Melrose Park, South Australia 5039

²29 Stonesfield Court, Padbury, Western Australia 6025

³Corresponding author, email: dn@dn.com.au

Abstract

Nicolle, D. & French, M.E. A revision of *Eucalyptus* ser. *Falcatae* (Myrtaceae) from south-western Australia, including the description of new taxa and comments on the probable hybrid origin of *E. balanites*, *E. balanopelex* and *E. phylacis*. *Nuytsia* 22(6): 409–454 (2012). Twenty terminal taxa (including 18 species) are recognised in *Eucalyptus* ser. *Falcatae*. Brooker & Hopper. We include the monotypic *E. ser. Cooperianae* L.A.S.Johnson ex Brooker (*E. cooperiana* F.Muell.) in the series. The new species *E. annettae* D.Nicolle & M.E.French and *E. opimiflora* D.Nicolle & M.E.French and the new subspecies *E. goniantha* Turcz. subsp. *kynoura* D.Nicolle & M.E.French are described. New combinations made are *E. adesmophloia* (Brooker & Hopper) D.Nicolle & M.E.French, *E. ecostata* (Maiden) D.Nicolle & M.E.French and *E. notactites* (L.A.S.Johnson & K.D.Hill) D.Nicolle & M.E.French. The circumscription of some taxa is significantly modified from previous accounts, including that of *E. falcata* Turcz., *E. goniantha* and *E. obesa* Brooker & Hopper. The name *E. dorrienii* Domin is resurrected to accommodate populations of mallees previously erroneously called *E. falcata*. We reject the status of the following previously accepted taxa: *E. argyphaea* L.A.S.Johnson & K.D.Hill (= *E. falcata*), *E. balanites* Grayling & Brooker (= *E. decipiens* × *E. lane-pooliei*), *E. balanopelex* L.A.S.Johnson & K.D.Hill (= *E. semiglobosa* × *E. kessellii* subsp. *eugnosta*), *E. communalis* Brooker & Hopper (= *E. adesmophloia* – *E. obesa* intergrade), *E. decipiens* subsp. *chalara* Brooker & Hopper (= *E. decipiens* – *E. adesmophloia* intergrade) and *E. phylacis* L.A.S.Johnson & K.D.Hill (= *E. decipiens* × *E. virginea*). Distribution maps and representative images are provided where appropriate. A key to the taxa of *E. ser. Falcatae* is provided.

Introduction

We recognise 20 terminal taxa within *Eucalyptus* L'Hér. ser. *Falcatae* Brooker & Hopper. The series is weakly defined within *E. sect. Bisectae* Maiden ex Brooker, and is particularly closely related to *E. ser. Balladonienses* Brooker & Hopper (with three terminal taxa) and the geographically more widespread *E. ser. Subulatae* Blakely (39 terminal taxa; see Nicolle *et al.* 2006). *Eucalyptus* ser. *Falcatae* was described by Brooker and Hopper in 1993, and while these authors provided a Latin and English diagnosis for the series, they did not comparatively distinguish the newly described series from related taxa. The description of the series in Brooker and Hopper (1993) includes 'Fruits wider than long...', a characteristic which only weakly distinguishes the series from *E. ser. Subulatae*,

in which the fruits are *generally* longer than wide. In the most recent taxonomic classification of all the eucalypts, Brooker (2000: 104) defines *E. ser. Falcatae* with the following combination of characters: ‘Mallees or mallets; leaf venation closely pinnate, the tertiary venation finate; oil glands numerous, intersectional; inflorescences single in axils; ovary roof not lobed’. There appear to be no unique characteristics that define *E. ser. Falcatae*, and although a suite of characteristics may loosely define the series (as described by Brooker & Hopper 1993; Brooker 2000), the same characteristics also variably occur in both *E. ser. Balladonienses* and *E. ser. Subulatae*. In any case, the higher level taxonomy of the series is beyond the scope of this paper, and we do not discuss the matter further. Rather, the purpose of this paper is to describe and delimit lower-level taxa (species and subspecies) within *E. ser. Falcatae* as defined by Brooker and Hopper (1993) and Brooker (2000).

Eucalyptus ser. Falcatae is restricted to the South-West Botanical Province in southern Western Australia, in the area south-west of a line between Geraldton and Eyre Bird Observatory. Most species are of coastal or subcoastal distribution, although some species are restricted to the agricultural wheatbelt of southern Western Australia. Most species are habitat-specific and have a correspondingly restricted and/or sporadic distribution, and some of these species have an associated increased threat from mining activities and exploration (*E. purpurata* D.Nicolle and *E. rugulata* D.Nicolle), urbanisation (*E. petrensis* Brooker & Hopper and *E. goniantha* Turcz. subsp. *goniantha* and *kynoura* D.Nicolle & M.E.French), habitat fragmentation (*E. obesa* Brooker & Hopper, *E. opimiflora* D.Nicolle & M.E.French, *E. ornata* Crisp, *E. recta* L.A.S.Johnson & K.D.Hill and *E. semiglobosa* (Brooker) L.A.S.Johnson & K.D.Hill) and inappropriate fire regimes (*E. annettae* D.Nicolle & M.E.French).

A number of new taxa have been named in the series over the last 20 years, but two publications are of particular note. Johnson and Hill (1992) described six new taxa in the series, of which we accept three here. Brooker and Hopper (1993) described five new taxa in the series, of which we accept three here. In some cases these papers did not provide descriptions for taxa recircumscribed through the removal of newly described taxa; this has resulted in confusion as to the application of names and delimitation of some taxa in *E. ser. Falcatae*.

None of the taxa of *E. ser. Falcatae* is as spectacularly ornamental as some other, more well-known Western Australian taxa (e.g. *E. ser. Contortae* Blakely, *E. ser. Lehmannianae* D.J.Carr & S.G.M.Carr and *E. ser. Curviptera* Maiden) and none of the taxa has become particularly common in cultivation. Nevertheless, many taxa have potential for use in broadscale plantings and as ornamental trees and shrubs, with *E. goniantha* subsp. *kynoura* and *E. annettae* having potential as ornamental garden plants in coastal localities

Methods

All specimens of *E. ser. Falcatae* incorporated in the collections at PERTH and AD have been examined, including type material. Digitised images of type specimens from NSW and K have also been examined where necessary. Descriptive data have been taken from both dried herbarium specimens and cultivated live material (as listed in Table 1). For taxa that are widespread and/or have numerous specimens in herbaria, only selected specimens from the larger collection of examined specimens have been cited here, with specimens preferentially chosen to cover the geographical range and morphological variation within these taxa, and with duplicate specimens in multiple Australian herbaria where available. For taxa with few available specimens, we have cited all examined specimens.

Extensive field observations of wild populations of the new taxa and related taxa have been made

Table 1. *Eucalyptus* ser. *Falcatae* taxa and populations growing at Currency Creek Arboretum.

IG = intergrade.

Taxon	Population	Mother (seed) tree voucher
<i>E. adesmophloia</i>	N of Beaufort Inlet	<i>D. Nicolle</i> 216
<i>E. adesmophloia</i> – <i>E. obesa</i> IG (<i>E. communalis</i>)	Hamersley River, Fitzgerald River N.P.	<i>D. Nicolle</i> 200
<i>E. annettae</i>	SE of Tookle–Jenna Rock	<i>D. Nicolle</i> 6011 & <i>M.E. French</i>
<i>E. cooperiana</i>	N of Eyre Bird Observatory	<i>D. Nicolle</i> 1813
<i>E. cooperiana</i>	W of Condingup	<i>D. Nicolle</i> 168
<i>E. decipiens</i>	Alexander Morrison N.P.	<i>D. Nicolle</i> 3700 & <i>M.E. French</i>
<i>E. decipiens</i>	Bold Park, Perth	<i>D. Nicolle</i> 1153 & <i>M.E. French</i>
<i>E. decipiens</i>	E of Porongurup	<i>D. Nicolle</i> 277
<i>E. decipiens</i> – <i>E. obesa</i> IG	N of Meckering	<i>D. Nicolle</i> 5450 & <i>M.E. French</i>
<i>E. dorrienii</i>	Boyagin Rock N.R.	<i>D. Nicolle</i> 2237 & <i>M.E. French</i>
<i>E. dorrienii</i>	Tarin Rock	<i>D. Nicolle</i> 3725 & <i>M.E. French</i>
<i>E. ecostata</i>	Corackerup N.R.	<i>D. Nicolle</i> 3564 & <i>M.E. French</i>
<i>E. ecostata</i>	Hamersley Inlet	<i>D. Nicolle</i> 2244 & <i>M.E. French</i>
<i>E. ecostata</i>	Hamersley River	<i>D. Nicolle</i> 3568 & <i>M.E. French</i>
<i>E. ecostata</i>	NE of Hopetoun	<i>D. Nicolle</i> 198
<i>E. ecostata</i>	Ravensthorpe Range	<i>D. Nicolle</i> 5496 & <i>M.E. French</i>
<i>E. ecostata</i> – <i>E. notactites</i> IG	Hassell Beach	<i>D. Nicolle</i> 3754 & <i>M.E. French</i>
<i>E. ecostata</i> – <i>E. semiglobosa</i> IG	N of Quaggi Beach	<i>D. Nicolle</i> 3587 & <i>M.E. French</i>
<i>E. falcata</i>	Cargannocking Hill	<i>D. Nicolle</i> 3433 & <i>M.E. French</i>
<i>E. falcata</i>	W of Lake King	<i>D. Nicolle</i> 1113
<i>E. goniantha</i> subsp. <i>goniantha</i>	Manypeaks township	<i>D. Nicolle</i> 1626
<i>E. goniantha</i> subsp. <i>kynoura</i>	Point Hillier	<i>D. Nicolle</i> 3759 & <i>M.E. French</i>
<i>E. kessellii</i> subsp. <i>eugnosta</i>	Dalyup River	<i>D. Nicolle</i> 164
<i>E. kessellii</i> subsp. <i>kessellii</i>	NE of Mount Ridley	<i>D. Nicolle</i> 1101
<i>E. notactites</i>	Cape Le Grand N.P.	<i>D. Nicolle</i> 177
<i>E. notactites</i>	Cape Riche	<i>D. Nicolle</i> 220
<i>E. notactites</i>	Sandy Hook Island	<i>D. Nicolle</i> 4605 & <i>M.E. French</i>
<i>E. obesa</i>	Frank Hann N.P.	<i>D. Nicolle</i> 1109
<i>E. obesa</i>	Lake Grace	<i>D. Nicolle</i> 3724 & <i>M.E. French</i>
<i>E. obesa</i>	Peak Charles	<i>D. Nicolle</i> 5478 & <i>M.E. French</i>
<i>E. opimiflora</i>	E of Badgingarra	<i>D. Nicolle</i> 3515 & <i>M.E. French</i>
<i>E. opimiflora</i>	S of Calingiri	<i>D. Nicolle</i> 5547 & <i>M.E. French</i>
<i>E. opimiflora</i>	Warradarge	<i>D. Nicolle</i> 5078 & <i>M.E. French</i>
<i>E. ornata</i>	NW of Hyden	<i>D. Nicolle</i> 5040 & <i>M.E. French</i>
<i>E. ornata</i>	NW of Kondinin	<i>D. Nicolle</i> 243
<i>E. petrensis</i>	Seabird	<i>D. Nicolle</i> 248
<i>E. purpurata</i>	Bandalup Hill	<i>D. Nicolle</i> 3579 & <i>M.E. French</i>
<i>E. purpurata</i>	Bandalup Hill	<i>D. Nicolle</i> 3580 & <i>M.E. French</i>
<i>E. recta</i>	Cadoux	<i>D. Nicolle</i> 294
<i>E. recta</i>	Mount Yule	<i>D. Nicolle</i> 5074 & <i>M.E. French</i>
<i>E. recta</i>	Wongan Hills	<i>D. Nicolle</i> 4441 & <i>M.E. French</i>
<i>E. rugulata</i>	Hatter Hill	<i>D. Nicolle</i> 3673 & <i>M.E. French</i>
<i>E. rugulata</i>	South Ironcap	<i>D. Nicolle</i> 3671 & <i>M.E. French</i>
<i>E. semiglobosa</i>	Boyatup Hill	<i>D. Nicolle</i> 4570 & <i>M.E. French</i>
<i>E. semiglobosa</i>	Cape Le Grand N.P.	<i>D. Nicolle</i> 4579 & <i>M.E. French</i>
<i>E. semiglobosa</i> – <i>E. kessellii</i> hybrid (<i>E. balanopelex</i>)	W of Condingup	<i>D. Nicolle</i> 169

by us over the past 18 years. All taxa of *E. ser. Falcatae* have been examined and collected in the field, in many cases with an accompanying seed collection. Field studies of wild populations over a number of years have permitted the observation of habit and bark characteristics, habitat preferences, and life histories of taxa following events such as wildfire. Descriptive data for the new taxa include many field-recorded characteristics including habit and bark characteristics, leaf orientation, colour and sheen, inflorescence orientation and flower colour.

Seedlings derived from multiple populations of all *E. ser. Falcatae* taxa have been grown under uniform conditions at Currency Creek Arboretum in South Australia (see www.dn.com.au/Currency_Creek_Arboretum.html) for a number of years, with many taxa having reached maturity (flowered) in the arboretum. All plants at the arboretum have been grown from seed collected from wild populations with accompanying voucher herbarium specimens (see Table 1). Some of the descriptive data for the new taxa have been taken from seedling and adult characteristics obtained from these cultivated plants. Ongoing observations of cultivated plants have enabled the study of developmental morphology in the taxa, including bark ontogeny, leaf ontogeny related to plant maturity, seasonal leaf colour variation, and inflorescence development.

We have provided a description for *E. ser. Falcatae*, with morphological characteristics common to all members of the series not duplicated in each species description. Likewise, morphological characteristics common to a species are not duplicated in the description for each subspecies.

We have preferentially cited specimens from populations we have seen (thus many cited specimens have one of us as the collector or co-collector). We are familiar with all the taxa described in this treatment, including cited hybrids, in the field. We have also grown seedlings and assessed the juvenile morphology of all taxa in the series.

In applying taxonomic category (rank) to terminal taxa, we have considered the morphological distinctiveness of each taxon and the taxon's ability to interbreed with other taxa. Taxonomic resolution within the series has also been considered in determining what taxonomic category is most appropriate for each terminal taxon. Without considering taxonomic resolution, and using a biological species concept (an unsatisfactory species concept for plants in general), all 20 terminal taxa could be regarded as subspecies of a single species on the basis that all taxa have the potential to hybridise with at least one other taxon in the series. We maintain that subspecies within a species are incompletely or more recently evolved (i.e. not fully speciated), and as such are generally less distinctive and often have geographical zones of intergradation with related taxa.

The notes for each taxon generally indicate its most closely related and superficially similar taxa. Hybrids and intergrades involving taxa of *E. ser. Falcatae* are listed under the notes of the relevant species rather than as an appendix. We here briefly define hybrids, hybrid swarms and intergrades in the context of this revision. A hybrid is an individual having morphology intermediate between two parental taxa and presumed to be of F1 origin, occurring as a single plant or rare isolated plants, usually in a vegetation community in which both putative parental taxa are present. A hybrid swarm consists of multiple individuals displaying a range of variation that is generally intermediate between the putative parental taxa, indicating probable backcrossing between hybrid individuals and one or both of the parental taxa. An intergrade is defined as an individual having morphology that is intermediate between two taxa, occurring in a population with many other individuals of similar morphology, but not associated with the two taxa with which it appears intermediate. Intergrades may occur over relatively substantial areas that are generally intermediate in distribution between the two taxa with which it appears intermediate, and may show gradational morphological variation over that area,

grading from one taxon to the other through the intergrading population(s).

Several of the taxa described herein are considered to be of conservation concern and are listed on the *Threatened and Priority Flora list for Western Australia* (*E. goniantha* subsp. *goniantha*, *E. purpurata*, *E. recta*, *E. rugulata* and *E. semiglobosa*; Smith 2012) or will be listed as a result of this research (*E. ornata*, *E. goniantha* subsp. *kynoura* and *E. annettae*).

Taxonomy

Eucalyptus ser. **Falcatae** Brooker & Hopper, *Nuytsia* 9: 15 (1993). Type: *Eucalyptus falcata* Turcz.

Eucalyptus ser. *Cooperianae* L.A.S.Johnson ex Brooker, *Austral. Syst. Bot.* 13: 105 (2000). Type: *Eucalyptus cooperiana* F.Muell.

Trees or *mallees*, lignotuber absent (obligate seeder) or present (lignotuber sprouter). *Bark* persistent or decorticating annually in plates, strips or ribbons. *Cotyledons* deeply bisected. *Branchlets* terete to quadrangular, lacking pith glands, sometimes waxy. *Seedling leaves* opposite for a few pairs then becoming disjunct, first leaves linear but later leaves becoming much broader and elliptical to orbicular to broader than long, acuminate or emarginate, glabrous, \pm concolorous, dull, grey-green to green. *Adult leaves* petiolate, lamina narrow-lanceolate to broad-lanceolate and often falcate; lenticels absent, concolorous, maturing glossy and \pm green; *venation* pinnate, reticulation moderate to dense, tertiary venation sometimes finite, with scattered, irregular-shaped, mainly intersectional oil glands; intramarginal vein visible. *Inflorescences* axillary unbranched umbellasters; umbellasters 3 or more-flowered, erect or rigidly down-curved or loosely pendulous; peduncles present; pedicels present or absent. *Flower buds* cream or yellowish green, sometimes waxy; smooth to strongly longitudinally ribbed; *opercula* hemispherical, horn-shaped or conical. *Flowers* white or pale to mid yellow, stamens inflexed, all fertile; anthers versatile, reniform, \pm basifixed, cuboid or globoid, opening by slits or pores. *Ovules* in 4 vertical rows, ovary roof conical, lacking protuberances (not lobed). *Fruits* sessile or pedicellate, generally wider (broader) than long, smooth to strongly longitudinally ribbed, disc level to ascending; valves 3, 4 or 5, around rim level to strongly exerted and with persistent but slender and fragile style remnants. Seeds ovoid to compressed-ovoid, grey to black, smooth or with a fine reticulum, with longitudinal grooves.

A series of 20 terminal taxa distributed in south-western Australia. We include the monotypic *E.* ser. *Cooperianae* (*E. cooperiana*) in the series on the basis of its seed, seedling, bark, vegetative and inflorescence morphology and ecological preferences, which are all consistent with other taxa in *E.* ser. *Falcatae*. Both Brooker and Hopper (1993) and Brooker (2000) recognise two subseries, viz. *E.* subser. *Rugatae* Blakely (17 species) and *E.* subser. *Decipientes* Brooker & Hopper (3 species).

Key to the taxa of *Eucalyptus* series *Falcatae*

1. Obligat seeder (mallet); lignotuber absent
 2. Flower buds waxy; fruits 14–20 mm diam., valves 5 or 6 **15. E. annettae**
 - 2: No parts waxy; fruits 6–14 mm diam., valves 3 or 4
 3. Buds (hypanthium and operculum) and fruits sharply ribbed longitudinally **3. E. ornata**
 - 3: Buds and fruits smooth to broadly or irregularly ribbed

4. Fruits cupular to barrel-shaped..... **1. E. rugulata**
- 4: Fruits globose to hemispherical to slightly flattened
- 5: Leaves, branchlets and buds distinctly red-purple, crown purple-green;
buds <5 mm wide **5. E. purpurata**
- 5: Leaves, branchlets and buds yellow-green to reddish green,
crown dark green; buds \geq 5 mm wide
6. Buds 6–10 mm diam., opercula >14 mm long; fruits 9–13 mm diam. **2. E. recta**
- 6: Buds 5–7 mm diam., opercula <14 mm long; fruits 6–11 mm diam. **4. E. falcata**
- 1: Resprouter (mallee); lignotuber present
7. Fruits 12–17 mm long; umbellasters 3 or 7-flowered (*E. kessellii*)
8. Fruits strongly ribbed; umbellasters mostly 3-flowered. **14a. E. kessellii** subsp. **kessellii**
- 8: Fruits weakly to moderately ribbed; umbellasters 7-flowered. **14b. E. kessellii** subsp. **eugnosta**
- 7: Fruits 5–12 mm long; umbellasters >9-flowered
9. Opercula flattened, shorter than hypanthia **6. E. cooperiana**
- 9: Opercula hemispherical, conical or beaked, equal in length or
longer than hypanthia
10. Buds and fruits sessile, in tight clusters; umbellasters held
consistently erect
11. Branchlets strongly angular to winged, often waxy **12. E. notactites**
- 11: Branchlets terete to slightly angular, not waxy (*E. subser. Decipientes*)
12. Bark dark-coloured and persistent **16. E. decipiens**
- 12: Bark light-coloured and decortivating in plates or strips
13. Bark decortivating in plates; fruits 5–6 mm diam. **17. E. adesmophloia**
- 13: Bark decortivating in strips; fruits 7–8 mm diam. **18. E. obesa**
- 10: Buds and fruits pedicellate; umbellasters held erect to
down-curved or pendulous
14. Bud and fruit umbellasters held \neq erect
15. Fruits \neq globose, opercula beaked **7. E. petrensis**
- 15: Fruits squat (much broader than long), opercula conical **8. E. opimiflora**
- 14: Bud and fruit umbellasters held \neq pendulously
16. Opercula hemispherical to bluntly conical/beaked,
1–2 times as long as hypanthia
17. Fruits \neq smooth; opercula hemispherical to bluntly beaked;
east from Esperance **11. E. semiglobosa**
- 17: Fruits ribbed; opercula bluntly conical to bluntly beaked;
west from Albany area (*E. goniantha*)
18. Buds and fruits weakly to moderately ribbed **13a. E. goniantha** subsp. **goniantha**

- 18: Buds and fruits strongly ribbed..... 13b. *E. goniantha* subsp. *kynoura*
- 16: Opercula sharply conical to sharply beaked, 2–5 times long as hypanthia
- 19: Bud hypanthia ribbed; fruits hemispherical to globose, ribbed..... 9. *E. dorrienii*
- 19: Bud hypanthia smooth; fruits globose to slightly flattened, usually smooth..... 10. *E. ecostata*

Eucalyptus subser. **Rugatae** Blakely, *Key Eucalypts* 27: 125 (1934). *Type: Eucalyptus kessellii* Maiden & Blakely.

Eucalyptus subser. *Falcatae* Brooker & Hopper, *Nuytsia* 9: 15 (1993). *Type: Eucalyptus falcata* Turcz.

Eucalyptus subser. *Rugatae* is distinguished in *E. ser. Falcatae* by its rounded to apiculate (non-emarginate) juvenile leaves. Both Brooker and Hopper (1993) and Brooker (2000) use a number of other characteristics to distinguish the series from *E. subser. Decipientes* (including inflorescence orientation, pedicel presence/length and other seedling leaf characteristics); however, we find that none of these other characteristics is mutually exclusive, and although they appear to indicate character ‘trends’ within each subseries, they are not useful in diagnosing the subseries. *Eucalyptus* subser. *Rugatae* contains 15 of the 18 species we recognise in the series.

1. *Eucalyptus rugulata* D.Nicolle, *Nuytsia* 15(1): 79 (2002). *Type: south of Varley turnoff on Forrestania road, Western Australia [precise locality withheld for conservation reasons], 11 November 2000, D. Nicolle 3672 & M. French (holo: PERTH 05783216; iso: CANB).*

Tree to 12 m tall, lignotuber absent (obligate seeder). *Bark* smooth throughout, slightly shiny, dark grey over paler grey to orange-tan, decorticating in strips. *Branchlets* angular, not waxy. *Later seedling leaves* elliptical to almost orbicular, to 30 mm long × 20 mm wide, dull, slightly blue-green. *Juvenile leaves* not waxy. *Adult leaves* lanceolate to broad-lanceolate, 80–140 mm long × 16–28 mm wide, glossy, dark green. *Umbellasters* pendulous, 7–11-flowered; peduncles angular to flattened, 14–18 mm long; pedicels slightly angular, 7–13 mm long. *Flower buds* cream, not waxy, 8–9 mm wide; hypanthia coarsely ribbed; opercula conical to somewhat beaked, almost smooth to coarsely ribbed, 1.5–2.5 times as long as hypanthia, 10–15 mm long. *Staminal filaments* creamy white. *Fruits* tapering to the pedicels, cupular to barrel-shaped, almost smooth to coarsely ribbed, 9–11 mm long × 8–11 mm diam.; disc descending; valves (3)4, around rim level.

Diagnostic features. Distinguished within the series by its combination of tree habit (lignotuber absent; obligate seeder); smooth bark decorticating in strips; angular, non-waxy branchlets; elliptical to almost orbicular seedling leaves; medium-sized to large adult leaves; 7–11-flowered, pendulous umbellasters; long peduncles and pedicels; non-waxy buds; coarsely-ribbed bud hypanthia; almost smooth to coarsely ribbed, conical to somewhat beaked opercula 1.5–2.5 as long as hypanthia; and medium-sized to large, cupular to barrel-shaped, almost smooth to coarsely ribbed fruits which taper to the pedicels.

Selected specimens examined. WESTERN AUSTRALIA: All specimens cited for this species in Nicolle (2002) remain applicable to this species. The species has not been collected from populations substantially distant from those cited in Nicolle (2002) and as such no further specimens are here cited.

Distribution and habitat. Of very restricted distribution east of Varley (north of Lake King) in Western Australia, with a linear range of approximately 26 km (Figure 1). Occurs on locally high hills of orange lateritic gravel, often in more or less pure stands or associated with other eucalypts, including *Eucalyptus densa* subsp. *densa*, *E. flocktoniae* subsp. *flocktoniae*, *E. livida*, *E. phenax* subsp. *phenax*, *E. pileata*, *E. rigidula* and *E. tenera*.

Conservation status. Department of Environment and Conservation (DEC) Conservation Codes for Western Australian Flora: Priority 4 (Smith 2012). We regard this species as being well-defined morphologically and reasonably well surveyed, yet of restricted distribution due to its habitat preferences. The region immediately to the east of its known distribution is largely inaccessible and further populations of the species may occur in that region.

Notes. *Eucalyptus rugulata* is most similar to *E. recta*, differing from the latter in the broader and thicker adult leaves, the more cupular to barrel-shaped, longer fruits, and the broadly and irregularly ribbed flower buds and fruits.

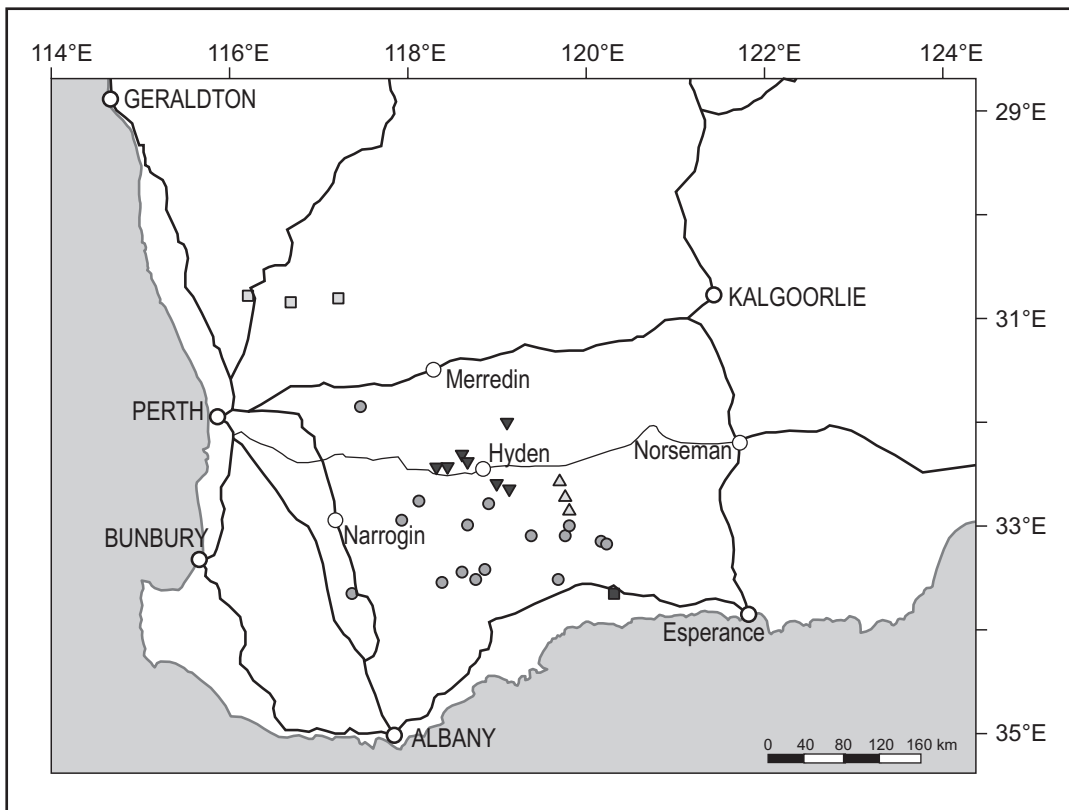


Figure 1. Distribution of *Eucalyptus falcata* (circles), *E. ornata* (inverted triangle), *E. purpurata* (dark square), *E. recta* (light squares) and *E. rugulata* (triangles) in Western Australia.

2. *Eucalyptus recta* L.A.S.Johnson & K.D.Hill, in K.D.Hill & L.A.S.Johnson, *Telopea* 4: 604 (1992). *Type*: [near Cadoux], Western Australia [precise locality withheld for conservation reasons], 16 November 1986, K.D. Hill 2504, L.A.S. Johnson & D.F. Blaxell (*holo*: NSW image seen; *iso*: CANB image seen, CBG *n.v.*, MEL *n.v.*, PERTH 04619846).

Tree to 20 m tall, lignotuber absent (obligate seeder). *Bark* smooth throughout, often shiny, silvery grey over creamy white, decorticating in strips. *Branchlets* angular, not waxy. *Later seedling leaves* elliptical to almost orbicular, to 35 mm long \times 25 mm wide, dull, green to blue-green. *Juvenile leaves* not waxy. *Adult leaves* lanceolate, 80–160 mm long \times 11–20 mm wide, glossy, green. *Umbellasters* pendulous, 7–11-flowered; peduncles terete to angular, 12–22 mm long; pedicels terete to slightly angular, 8–18 mm long. *Flower buds* cream, not waxy, 6–10 mm wide; hypanthia smooth or rarely weakly ribbed; opercula conical to beaked, smooth, 1.2–2 times as long as hypanthia, 15–17 mm long. *Staminal filaments* creamy white. *Fruits* distinct from the pedicels, truncate-globose to hemispherical, smooth or rarely weakly longitudinally ribbed, 7–13 mm long \times 9–13 mm diam.; disc descending; valves 3 or 4, around rim level or exerted.

Diagnostic features. Distinguished within the series by its combination of tree habit (lignotuber absent; obligate seeder); smooth bark decorticating in strips; angular, non-waxy branchlets; elliptical to almost orbicular seedling leaves; medium-sized to large adult leaves; 7–11-flowered, pendulous umbellasters; long and slender peduncles; long and slender pedicels; non-waxy buds; usually smooth bud hypanthia; smooth, conical to beaked opercula, 1.2–2 times as long as hypanthia; and medium-sized to large, truncate-globose to hemispherical, usually smooth fruits which are distinct from the pedicels.

Selected specimens examined (west to east). WESTERN AUSTRALIA: [localities withheld for conservation reasons] 12 Jan. 2007, D. Nicolle 5074 & M.E. French (AD, CANB, PERTH); 14 Oct. 2006, M.E. French 1808 (AD, PERTH); 14 Oct. 2006, M.E. French 1811 (AD, PERTH); 3 Aug. 2002, D. Nicolle 4441 & M.E. French (CANB, PERTH); 21 July 2001, M.E. French 1384 (AD, PERTH); 21 July 2001, M.E. French 1385 (PERTH); 13 Dec. 1992, D. Nicolle 294 (AD).

Distribution and habitat. Of very restricted distribution in Western Australia, confined to three disjunct populations, viz: south-east of Moora, Wongan Hills, and near Cadoux (Figure 1). Occurs on lateritic ridges and breakaways, usually high in the landscape. Occurs in mallet or mixed mallet-mallee vegetation. Associated eucalypts include *E. arachnaea*, *E. astringens* subsp. *astringens*, *E. celastroides* subsp. *virella*, *E. drummondii*, *E. ebbanoensis* subsp. *ebbanoensis*, *E. eudesmioides*, *E. flocktoniae* subsp. *flocktoniae*, *E. gardneri* subsp. *gardneri*, *E. gittinsii* subsp. *illucida*, *E. horistes*, *E. moderata*, *E. obtusiflora*, *E. oldfieldii*, *E. salmonophloia*, *E. tenera* and *E. wandoo* subsp. *pulverea*.

Conservation status. DEC Conservation Codes for Western Australian Flora: Threatened Flora (Smith 2012). The species is not known from any conserved areas, with all populations occurring on private farmland or roadsides.

Notes. The species is morphologically consistent throughout its range, and is not known to hybridise or intergrade with any other species.

3. *Eucalyptus ornata* Crisp, *Nuytsia* 5: 311 (1985). *Type*: north-east of Kondinin, Western Australia [precise locality withheld for conservation reasons], 25 September 1983, J. Taylor 2244 & P. Ollerenshaw (*holo*: CGB *n.v.*; *iso*: CBG *n.v.*, K image seen, MEL *n.v.*, NSW image seen, PERTH 01136771).

Tree to 16 m tall, lignotuber absent (obligate seeder). *Bark* smooth throughout, often shiny, silvery grey over paler grey and cream, decorticating in strips. *Branchlets* angular, not waxy. *Later seedling leaves* elliptical to almost orbicular, to 40 mm long × 28 mm wide, dull, green to blue-green. *Juvenile leaves* not waxy. *Adult leaves* lanceolate, 70–140 mm long × 9–20 mm wide, glossy, dark green. *Umbellasters* pendulous, 7–11-flowered; peduncles terete, 10–25 mm long; pedicels angular, 7–12 mm long. *Flower buds* cream, not waxy, 6–9 mm wide; hypanthia strongly longitudinally ribbed; opercula conical, ribbed, usually narrower than the hypanthium at the join, 2–3 times as long as hypanthia, 12–14 mm long. *Staminal filaments* creamy white. *Fruits* moderately distinct from the pedicels, hemispherical to obconical, strongly ribbed, 4–10 mm long × 9–14 mm diam.; disc descending; valves 3 or 4, around rim level or exserted.

Diagnostic features. Distinguished within the series by its combination of tree habit (lignotuber absent; obligate seeder); smooth bark decorticating in strips; angular, non-waxy branchlets; elliptical to almost orbicular seedling leaves; small to medium-sized adult leaves; 7–11-flowered, pendulous umbellasters; long and slender peduncles; long and slender pedicels; non-waxy buds; strongly ribbed bud hypanthia; ribbed conical to beaked opercula 2–3 times as long as hypanthia; and small to medium-sized, hemispherical to obconical, strongly ribbed fruits which are moderately distinct from the pedicels.

Selected specimens examined (west to east). WESTERN AUSTRALIA [localities withheld for conservation reasons]: 11 Dec. 1992, *D. Nicolle* 243 (AD); 1 Sep. 1989, *A. Napier & A. Kelly* 534 (CANB, PERTH); 24 Sep. 1999, *R. Davis* 9006 (PERTH); 24 Sep. 1999, *R. Davis* 9007 (PERTH); 14 June 1985, *S.D. Hopper* 4418 (CANB, PERTH); 6 Jan. 2007, *D. Nicolle* 5040 & *M.E. French* (PERTH); 15 Feb. 1999, *N. McQuoid* 538 (PERTH); 2 Feb. 2006, *M.E. French* 1761 (PERTH).

Distribution and habitat. Of restricted distribution in the central wheatbelt of Western Australia, from near Kondinin eastwards to north-east of Hyden (Figure 1). Restricted to lateritic rises, where it occurs in mallet or mixed mallet-mallee vegetation. Associated eucalypts include *E. astringens* subsp. *astringens*, *E. capillosa*, *E. densa* subsp. *densa*, *E. gardneri* subsp. *gardneri*, *E. pileata* and *E. rigidula*.

Conservation status. Recently listed as Priority Three under DEC Conservation Codes for Western Australian Flora (M. Smith pers. comm.). The species occurs in an extensively cleared agricultural area and is more restricted in distribution than previously understood.

Notes. *Eucalyptus ornata* and *E. falcata* intergrade where the distribution of the two species adjoins between Hyden and Newdegate (in the vicinity of Harris and Dragon Rocks Nature Reserves; see below). In this area, populations of individuals with features intermediate between the two species can be found, as well as populations attributable to *E. ornata* and *E. falcata* (e.g. in Dragon Rocks Nature Reserve, where populations of *E. ornata* (with prominently ribbed buds and fruits), *E. falcata* (with smooth or weakly ribbed buds and fruits) and *E. ornata* – *E. falcata* intergrades can be found).

***Eucalyptus falcata* – *E. ornata* intergrades**

Selected specimens examined. WESTERN AUSTRALIA: 5.3 km N from Pingaring–Varley Rd on Alymore Rd, 15 July 2001, *D. Nicolle* 3815 & *M.E. French* (PERTH); Buettner Rd, 1.3 km N of Lane Rd (SE of Hyden), 6 Mar. 2003, *W. O'Sullivan* 1998 (PERTH).

4. *Eucalyptus falcata* Turcz., *Bull. Soc. Imp. Naturalistes Moscou* 20(1): 163 (1847). *Type*: Swan River Colony, [Western Australia, July 1844–1847], *J. Drummond* 4: 70 (*holo*: KW *n.v.*; *iso*: CGE *n.v.*, FI *n.v.*, G *n.v.*, K 000279652–53 images seen, MEL *n.v.*, NSW image seen, PERTH 01380834).

Eucalyptus argyphaea L.A.S.Johnson & K.D.Hill, in K.D.Hill & L.A.S.Johnson, *Teloepa* 4: 603 (1992). *Type*: 12 km west of Harrismith on road to Wickepin, Western Australia, 8 November 1983, *K.D. Hill* 659, *L.A.S. Johnson*, *D.F. Blaxell*, *M.I.H. Brooker* & *S.D. Hopper* (*holo*: NSW image seen; *iso*: CANB).

Tree to 20 m tall, lignotuber absent (obligate seeder). *Bark* smooth throughout, often somewhat shiny, dark grey over silvery grey to cream or light tan, decorticating in strips. *Branchlets* angular, not waxy. *Later seedling leaves* elliptical, to 30 mm long × 12 mm wide. *Juvenile leaves* not waxy. *Adult leaves* lanceolate, 70–150 mm long × 9–20 mm wide, glossy, green. *Umbellasters* pendulous, 7–11-flowered; peduncles angular, 8–20 mm long; pedicels terete, 5–13 mm long. *Flower buds* cream, not waxy, 5–7 mm wide; hypanthia smooth to moderately ribbed; opercula conical to long-beaked, smooth to slightly ribbed, usually narrower than the hypanthium at the join, 2–3+ times as long as hypanthia, 11–15 mm long. *Staminal filaments* creamy white. *Fruits* distinct from the pedicels, globose to truncate-globose (to hemispherical), smooth to slightly ribbed, 5–8 mm long × 6–11 mm diam.; disc descending; valves 3 or 4, around rim level or exerted.

Diagnostic features. Distinguished within the series by its combination of tree habit (lignotuber absent; obligate seeder); smooth bark decorticating in strips; angular, non-waxy branchlets; elliptical seedling leaves; small to medium-sized adult leaves; 7–11-flowered, pendulous umbellasters; long and slender peduncles; long and slender pedicels; non-waxy buds; smooth to moderately-ribbed bud hypanthia; smooth to slightly ribbed, conical to long-beaked opercula 2–3+ times as long as hypanthia; and small, globose, smooth to slightly ribbed fruits which are distinct from the pedicels.

Selected specimens examined (west to east). WESTERN AUSTRALIA: Hemstead Hills, 7 June 1996, *M.E. French* 40 (PERTH); 310 m S of the northern boundary of the reserve, 1 km E of Ralston Rd, Charles Gardner Reserve, c. 32 km NNE of Quairading, 20 Sep. 2000, *G.J. Keighery* & *N. Gibson* 3185 (PERTH); E of Harrismith on Lake Grace Rd, 21 Nov. 1999, *M.E. French* 1094 (PERTH); Cargannocking Hill, S of Kulin, 16 Sep. 2000, *D. Nicolle* 3433 & *M.E. French* (PERTH); 19.9 km E of Merilup Rd, 11 Jan. 1988, *M.I.H. Brooker* 9848 (AD, CANB, PERTH); 4.3 km N of Burngup, 8 Sep. 1984, *M.I.H. Brooker* 8685 (AD, CANB, PERTH); Needilup North Rd, E of Pingrup, 16 Feb. 2000, *M.E. French* 1116 (PERTH); 51.4 km E of Pingrup, 17 Dec. 1984, *M.I.H. Brooker* 8758 (AD, CANB, PERTH); Newdegate–Lake King Rd, 22 Nov. 1994, *D. Nicolle* 1113 (AD); 4.6 km W of Hatters Hill Rd on Lake King–Norseman Rd, 8 Sep. 1984, *M.I.H. Brooker* 8682 (AD, CANB, PERTH); Mt Gibbs, road to S, 7 Jan. 2007, *D. Nicolle* 5051 & *M.E. French* (CANB, PERTH); Cascades Rd, 10.1 km S of Lake King–Norseman Rd, 26 Mar. 2002, *W.O'Sullivan* 1562 (NSW, PERTH); 41 km from Lake Tay turnoff on Cascades–Lake King Rd towards Lake King, 21 Jan. 2001, *D. Nicolle* 3716 & *M.E. French* (CANB, PERTH).

Distribution and habitat. Distributed in the wheatbelt region of Western Australia, from east of Kojonup north-westwards to south-west of Tammin and eastwards to north-west of Cascade (Figure 1). Restricted to lateritic hills and ridges, where it occurs in mallet or mixed mallet-mallee vegetation. Associated eucalypts include *E. astringens* subsp. *astringens*, *E. clivicola*, *E. densa* subsp. *densa*, *E. dorrienii*, *E. flocktoniae* subsp. *flocktoniae*, *E. gardneri* subsp. *gardneri*, *E. incrassata*, *E. longicornis*, *E. olivina*, *E. phaenophylla*, *E. pileata*, *E. pleurocarpa*, *E. pluricaulis*, *E. phenax*, *E. salmonophloia*, *E. singularis*, *E. tenera*, *E. urna* and *E. wandoo* subsp. *wandoo*.

Conservation status. Not considered to be at risk. Recorded from Charles Gardner, Dragon Rocks and Lake Magenta Nature Reserves.

Notes. The type specimens of *Eucalyptus falcata* consist of branchlets bearing adult leaves, mature flower buds and flowers. The relatively narrow adult leaves, delicate flower buds and especially the very slender peduncles and pedicels on the type specimens are typical of the mallet (obligate seeder) variant of *E. falcata s. lat.* and distinguish the type specimens from the mallee (resprouter) variants of *E. falcata s. lat.* which we here include in *E. dorrienii* Domin, *E. ecostata* (Maiden) D.Nicolle & M.E.French and *E. opimiflora*. Hill and Johnson (1992) recognised the distinctiveness of the mallet and mallee variant of *E. falcata s. lat.* and attempted to distinguish the two taxonomically by describing *E. argyphaea* to accommodate the mallet variants (and therefore presumably ascribing the type of *E. falcata* to one of the mallee variants). Unfortunately, Hill and Johnson (1992) did not discuss the type specimens of *E. falcata* nor provide a revised description of it when they published *E. argyphaea*, and it is therefore unknown why these authors presumed the type of *E. falcata* belonged to the mallee variant. In any case, it is now clear that *E. falcata s. str.* is applicable to the mallet (obligate seeder) variant and that *E. argyphaea* is taxonomically synonymous with *E. falcata s. str.*

Other than habit and regenerative strategy, *E. falcata s. str.* differs from the mallee variants of *E. falcata s. lat.* (i.e. *E. dorrienii*, *E. ecostata* and *E. opimiflora*) in various vegetative and reproductive characteristics. Of the mallee taxa, *E. falcata s. str.* is certainly most closely related to *E. dorrienii*, differing in the more slender peduncles and pedicels and more delicate buds and fruits. *Eucalyptus falcata* and *E. dorrienii* have partly overlapping distributions but are ecologically separated, with *E. falcata* being restricted to lateritic hills and rises.

Intergrading populations are known with *E. ornata* (see under *E. ornata*).

5. *Eucalyptus purpurata* D.Nicolle, *Nuytsia* 15: 81 (2002). *Type:* east of Ravensthorpe, Western Australia [precise locality withheld for conservation reasons], 5 November 2000, *D. Nicolle* 3579 & *M. French* (*holo:* PERTH 05766400; *iso:* AD, CANB, NSW).

Tree to 12 m tall, lignotuber absent (obligate seeder). *Bark* smooth throughout, light grey over cream, decorticating in strips. *Branchlets* angular, not waxy, red-purple when new. *Later seedling leaves* elliptical, to 30 mm long × 15 mm wide, dull, slightly blue-green. *Juvenile leaves* not waxy. *Adult leaves* lanceolate, 45–95 mm long × 6–15 mm wide, glossy, maturing dark olive-green. *Umbellasters* pendulous, 7–11-flowered; peduncles terete to slightly angular, 7–15 mm long; pedicels terete, 3–6 mm long. *Flower buds* reddish, not waxy, 4–4.5 mm wide; hypanthia weakly ribbed; opercula long-conical to long-beaked, smooth, 2–3 times as long as hypanthia, 10–13 mm long. *Staminal filaments* creamy white. *Fruits* distinct from the pedicels, globose or truncate-globose to slightly flattened, smooth, 5–6 mm long × 6–7 mm diam.; disc descending; valves 3, around rim level.

Diagnostic features. Distinguished within the series by its combination of tree habit (lignotuber absent; obligate seeder); smooth bark decorticating in strips; angular, non-waxy, dark reddish-purple branchlets; elliptical seedling leaves; small adult leaves; 7–11-flowered, pendulous umbellasters; long and slender peduncles; medium-length and slender pedicels; non-waxy buds; weakly-ribbed bud hypanthia; smooth, long-conical to beaked opercula 2–3 times as long as hypanthia; and small, globose or truncate globose to slightly flattened, smooth fruits which are distinct from the pedicels.

Selected specimens examined. WESTERNAUSTRALIA: All specimens cited for this species in Nicolle (2002) remain applicable to this species. The species has not been collected from any population other than the one cited in Nicolle (2002), and as such no further specimens are here cited.

Distribution and habitat. Known from a single population east of Ravensthorpe in south-western Western Australia (Figure 1). The species grows on a broad ridge of white, magnesite-influenced powdery loam, mainly in pure stands with an understory of *Melaleuca haplantha* and *Leptomeria pachyclada* and some *E. brachycalyx* and *E. indurata*.

Conservation status. DEC Conservation Codes for Western Australian Flora: Threatened Flora (Smith 2012). Despite the conspicuousness of the species in the field and the recently extensive vegetation surveys conducted in its region of occurrence, the species is not known outside the type population.

Notes. A distinctive species in the field due to its purplish crown of foliage. Despite the species being naturally restricted to a magnesite-influenced soil, the species grows well in cultivation on other soil types.

6. *Eucalyptus cooperiana* F.Muell., *Fragm.* 11: 83 (1880). *Type:* south-western Australia, *s. dat.*, *G. Maxwell s.n.* (*holo:* MEL *n.v.*; *iso:* NSW image seen).

Mallee to 7 m tall, lignotuber present (resprouter). *Bark* sometimes rough on lower stems up to a metre or two, thin-fibrous, grey; smooth above or often completely smooth, light pink-grey over white, often powdery, decorticating in strips. *Branchlets* terete to angular, not waxy. *Later seedling leaves* orbicular, to 70 mm long × 70 mm wide, dull, green. *Juvenile leaves* not waxy. *Adult leaves* lanceolate, 80–120 mm long × 18–31 mm wide, glossy, slightly blue-green when young, aging dark green. *Umbellasters* pendulous, 11–21+-flowered; peduncles terete to slightly flattened, 10–18 mm long; pedicels terete to angular, 4–8 mm long. *Flower buds* cream, not waxy, 4–7 mm wide; hypanthia smooth or very weakly ribbed; opercula flattened, smooth, shorter than hypanthia, usually wider than the hypanthium at the join, 2–4 mm long. *Staminal filaments* creamy white. *Fruits* well-defined from pedicels, globose to urceolate, smooth or somewhat ribbed (especially upon drying), 7–10 mm long × 6–8 mm diam.; disc descending; valves 4, deeply enclosed.

Diagnostic features. Distinguished within the series by its combination of mallee habit (lignotuber present; resprouter); mostly smooth bark decorticating in strips (some rough bark may occur on the lower part of older and larger stems); terete to angular, non-waxy branchlets; orbicular seedling leaves; small to medium-sized adult leaves; 11–21+-flowered, pendulous umbellasters; long slender terete peduncles, short to medium-length terete pedicels; non-waxy buds; smooth or very weakly ribbed bud hypanthia; smooth flattened opercula shorter than hypanthia; and small to medium-sized, globose to urceolate, smooth or very weakly ribbed fruits which are distinct from the pedicels.

Selected specimens examined (west to east). WESTERN AUSTRALIA: just N of Fisheries Rd on Coolinup Rd, 8 Dec. 1992, *D. Nicolle* 168 (AD); Cape Arid N.P., Thomas River West, 16 Mar. 1998, *M.E. French* 413 (PERTH); 126 km S of Balladonia, SW of Mt Ragged, 3 Apr. 1977, *M.I.H. Brooker* 5636 (AD, CANB, MEL, NSW, PERTH); 1.4 miles S of Mt Ragged on track to Israelite Bay, 16 Sep. 1971, *K.M. Allan* 754 (AD, CANB, PERTH); old telegraph track S of Wattle Camp, 6 Apr. 2011, *D. Nicolle* 5999 & *M.E. French* (PERTH); old telegraph track between Toolinna Cove and Pt Culver, 5 Apr. 2011, *D. Nicolle* 5984 & *M.E. French* (AD); track to Toolinna Cove, 7 Oct. 1993, *D. Nicolle* 556 (PERTH); old telegraph track between John Baxter Memorial and Toolinna Cove, 5 Apr. 2011,

D. Nicolle 5979 & *M.E. French* (AD, PERTH); near Twilight Cove, Nuytsland N.R., 4 Apr. 2011, *D. Nicolle* 5973 & *M.E. French* (AD, PERTH); 19 km S of Eyre Hwy towards Eyre Bird Observatory, 5 Oct. 1996, *D. Nicolle* 1816 (AD); 15 km S of Eyre Hwy towards Eyre Bird Observatory, 5 Oct. 1996, *D. Nicolle* 1812 (AD); 15.3 km S of Eyre Hwy towards Eyre Bird Observatory, 5 Oct. 1996, *D. Nicolle* 1813 (AD); 16.3 km S of Eyre Hwy towards Eyre Bird Observatory, 5 Oct. 1996, *D. Nicolle* 1815 (AD); 10.8 km N from Eyre Bird Observatory, 13 July 1983, *S.D. Hopper* 3019 (AD, PERTH).

Distribution and habitat. Of scattered but more or less continuous distribution from 22 km west of Condingup eastwards towards Point Malcolm and north-eastwards to near Eyre Bird Observatory in Western Australia (Figure 2). The species grows on thin calcareous loams overlying limestone in mallee shrubland. Associated eucalypts include *Eucalyptus angulosa*, *E. annettae*, *E. brachycalyx*, *E. conglobata* subsp. *conglobata*, *E. discreta*, *E. diversifolia* subsp. *hesperia*, *E. extrica*, *E. gracilis*, *E. incrassata*, *E. leptocalyx*, *E. oleosa* subsp. *ampliata*, *E. tumida*, *E. sp.* Southern Wheatbelt (*D. Nicolle* & *M. French* DN 5507), *E. semiglobosa*, *E. sweedmaniana*, *E. uncinata* and *E. yalatensis*.

Conservation status. Widespread in Cape Arid National Park and the vast Nuytsland Nature Reserve, and not considered to be at risk.

Notes. Brooker (2000) erected the monotypic series *Eucalyptus* ser. *Cooperianae* for *E. cooperiana*, which he defined by the following characteristics: 'Mallees; bark smooth or loosely flaky-fibrous at base; leaves pendulous; tertiary venation non-finite; inflorescences finally pendulous; anthers globose'. All these morphological features occur in some of the other taxa of *E. ser. Falcatae*. We regard the species as part of *E. ser. Falcatae* based on similarities in seed, seedling, bark, vegetative and inflorescence morphology. Ecological preferences in *E. cooperiana* are also similar to other species of *E. ser. Falcatae*.

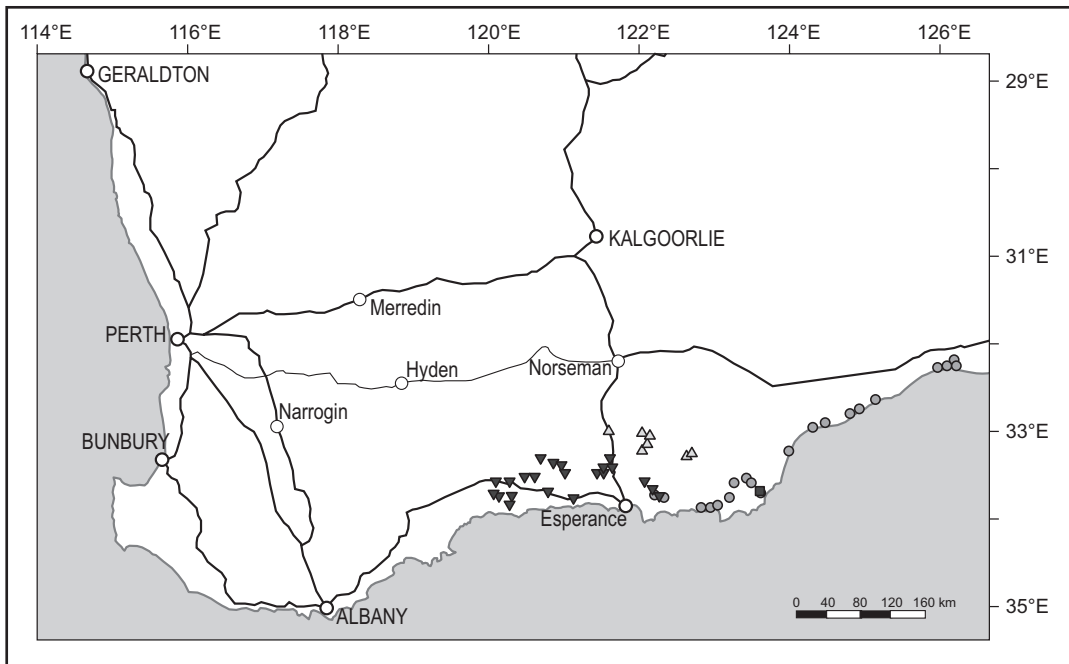


Figure 2. Distribution of *Eucalyptus annettae* (squares), *E. cooperiana* (grey circles), *E. kessellii* subsp. *kessellii* (triangles) and *E. kessellii* subsp. *eugnosta* (inverted triangles) in Western Australia.

Brooker and Kleinig (2001) regarded the Eyre Bird Observatory population of *E. cooperiana* to be a disjunct outlier of the species. Our recent fieldwork in the coastal shrublands between Esperance and Eucla indicate that the species is common and has a more- or- less continuous distribution along the Wylie Scarp south-west from Eyre Bird Observatory (see Figure 2).

7. *Eucalyptus petrensis* Brooker & Hopper, *Nuytsia* 9: 16 (1993). *Type: c.* 1.5 km south-south-east of Seabird, Western Australia, 2 November 1988, *M.I.H. Brooker* 10139 (*holo:* PERTH 01178695; *iso:* AD, CANB, MEL *n.v.*, NSW image seen).

Mallee to 5 m tall, lignotuber present (resprouter). *Bark* smooth throughout, light grey, decorticating in strips. *Branchlets* angular, not waxy. *Later seedling leaves* elliptical, not waxy. *Juvenile leaves* not waxy. *Adult leaves* lanceolate, 80–120 mm long × 10–27 mm wide, glossy, green. *Umbellasters* loosely erect, 7–13-flowered; peduncles angular to slightly flattened, 5–10 mm long; pedicels terete, 2–3(–5) mm long. *Flower buds* cream, not waxy, 4–5 mm wide; hypanthia smooth or weakly- to moderately-ribbed; opercula beaked, more or less smooth, 2(–3) times as long as hypanthia, 7–10 mm long. *Staminal filaments* creamy white. *Fruits* moderately distinct from or slightly tapering to the pedicels, globose to truncate-globose, smooth, 6–8(–9) mm long × 6–8(–9) mm diam.; disc ±level; valves 3 or 4, around rim level or exerted due to fragile style remnants.

Diagnostic features. Distinguished within the series by its combination of mallee habit (lignotuber present; resprouter); smooth bark decorticating in strips; angular, non-waxy branchlets; elliptical seedling leaves; small to medium-sized adult leaves; 7–13-flowered, loosely erect umbellasters; medium-length peduncles; short to medium pedicels; non-waxy buds; weakly to moderately ribbed bud hypanthia; smooth, beaked opercula 2–3 times as long as hypanthia; and medium-sized, globose to truncate-globose, smooth fruits which are moderately distinct from the pedicels.

Selected specimens examined (north to south). WESTERN AUSTRALIA: new Greenhead–Jurien Rd, Grigson Lookout, 200 m on slope from below, 23 Nov. 1997, *M.E. French* 521 (PERTH); new Greenhead–Jurien Rd, 23 Nov. 1997, *M.E. French* 523 (PERTH); Seabird, low hill along ‘Ambulance’ rd, 13 Apr. 1988, *M.I.H. Brooker* 9930, 9931 (AD, CANB, PERTH); corner of McCormick Pde and Edwards St, Seabird, S of Lancelin, 27 Sep. 2001, *A.S. George* 17594 (AD, CANB, NSW, PERTH); just S of Seabird, 11 Dec. 1992, *D. Nicolle* 248 (AD); Wesco Rd, NE of Quinns Rocks, 9 Apr. 1987, *M.I.H. Brooker* 9583 (AD, CANB, PERTH); E of Quinns Rocks, 25 Jan. 1996, *D. Nicolle* 1648 (AD); Yalgorup N.P., 27 Aug. 2008, *P. Foreman* YG 543 (AD, PERTH).

Distribution and habitat. Restricted to the west coast of Western Australia, from south of Dongarra southwards to Yalgorup National Park (Figure 3). The species is restricted to thin sandy soils on coastal limestone ridges, where it grows as a component of shrubland dominated by *Acacia* species. Associated eucalypt species include *E. argutifolia*, *E. decipiens*, *E. foecunda* and *E. obtusiflora*.

Conservation status. Although restricted to the coastal strip north and south of Perth where many populations are threatened by urban expansion and limestone quarrying, this species is recorded from Yalgorup and Yanchep National Parks and is not currently considered to be at risk.

Notes. Brooker and Hopper (1993) compared this species to *E. falcata* (presumably the commonly held but erroneous application of the name to the mallee variants at the time, i.e. the taxa here recognised as *E. dorrienii*, *E. ecostata* and *E. opimiflora*), and distinguished it from ‘*E. falcata*’ by its more effuse habit and much shorter pedicels and peduncles. We agree that *E. petrensis* is most closely related to the

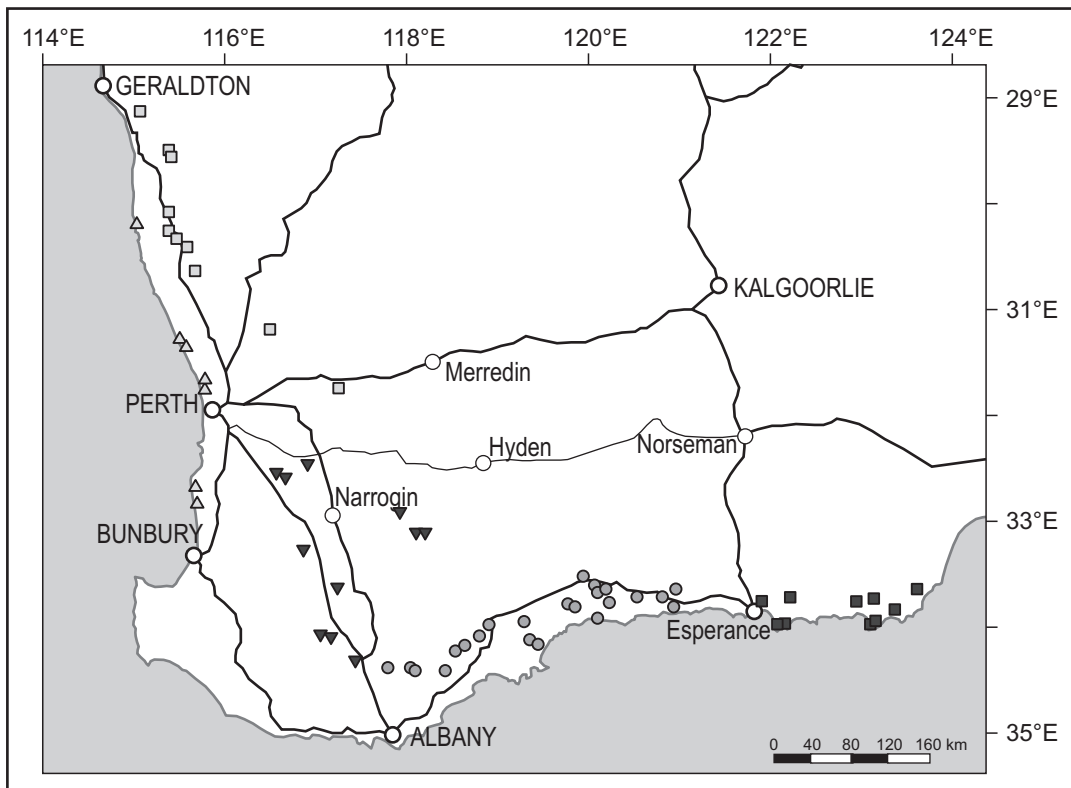


Figure 3. Distribution of *Eucalyptus dorrienii* (inverted triangles), *E. ecostata* (grey circles), *E. opimiflora* (light squares), *E. petrensis* (triangles) and *E. semiglobosa* (dark squares) in Western Australia.

mallee concept of *E. falcata* (i.e. *E. dorrienii*, *E. ecostata* and *E. opimiflora*) but we consider that the more effuse habit often evident in the field for *E. petrensis* is likely to be environmentally determined and it is therefore of limited diagnostic value. We consider that *E. petrensis* is most closely related to *E. opimiflora*, differing from the latter most readily in its more erect umbellasters, stouter peduncles, shorter and stouter pedicels, beaked opercula, and the equal-dimensional (about equal length and width), globose to truncate-globose fruits. The habitat of *E. petrensis* also differs from that of *E. opimiflora*, with the latter occurring on lateritic soils rather than coastal limestone dunes.

A hybrid has been recorded with *E. decipiens* (see below).

Eucalyptus decipiens* × *E. petrensis

Specimen examined. WESTERN AUSTRALIA: Lime Peaks, Guilderton Rd, 24 Jan. 1989, *M.I.H. Brooker* 10161 (AD, CANB, PERTH).

8. *Eucalyptus opimiflora* D.Nicolle & M.E.French, *sp. nov.*

Typus: north-east of Badgingarra (near old town site), Western Australia, 28 October 2000, *D. Nicolle* 3515 & *M.E. French* (*holo:* PERTH 05784778; *iso:* AD, CANB).

Eucalyptus sp. Badgingarra (D. Nicolle & M. French DN 3515), Western Australian Herbarium, in *FloraBase*, <http://florabase.dec.wa.gov.au/> [accessed May 2012].

Eucalyptus falcata subsp. *opima* D.Nicolle ms, Commonwealth Heads of Australasian Herbaria, in *Australian Plant Census*, <http://www.chah.gov.au/apc/index.html> [accessed May 2012].

Mallee to 7 m tall, lignotuber present (resprouter). *Bark* smooth throughout, grey over paler grey to orange-tan-cream, decorticating in strips. *Branchlets* angular, not waxy. *Later seedling leaves* elliptical, to 35 mm long × 25 mm wide, dull, green to slightly blue-green. *Juvenile leaves* not waxy. *Adult leaves* lanceolate, 60–110 mm long × 15–25 mm wide, slightly glossy to glossy, slightly blue-green to green. *Umbellasters* loosely erect to down-curved, 7–15-flowered; peduncles angular to slightly flattened, 8–14 mm long; pedicels terete to angular, 2–5(–7) mm long. *Flower buds* cream, not waxy, 5–8 mm wide; hypanthia smooth to weakly ribbed; opercula conical, smooth or rarely weakly ribbed, 1.2–2.2 times as long as hypanthia, 8–12 mm long. *Staminal filaments* creamy white. *Fruits* distinct from the pedicels, broadly obconical to flattened-hemispherical, smooth to weakly ribbed, 5–7 mm long × 7–11 mm diam.; disc ±level to descending; valves 3 or 4, around rim level or exerted due to style remnants.

Diagnostic features. Distinguished within the series by its combination of mallee habit (lignotuber present; resprouter); smooth bark decorticating in strips; terete to slightly angular, non-waxy branchlets; elliptical seedling leaves; relatively small adult leaves; 7–15-flowered, loosely erect to down-curved umbellasters; medium-length, slender peduncles and pedicels; non-waxy buds; smooth to weakly ribbed bud hypanthia; ±smooth, conical opercula 1.2–2.2 times as long as hypanthia; and medium-sized, broadly obconical to slightly hemispherical, ±smooth fruits which are distinct from the pedicels.

Selected specimens examined (north to south). WESTERNAUSTRALIA: Burma Rd, SE of Geraldton, 28 Mar. 2010, *D. Nicolle 5566 & M.E. French* (CANB, PERTH); 8.5 km down Burma Rd ex Walkaway–Nangetty Rd, 30 Aug. 1998, *M.E. French 663* (PERTH); 8.6 km S of Walkaway–Casuarinas Rd on Burma Rd, 26 Jan. 1983, *M.I.H. Brooker 7941* (CANB, PERTH); 32 km SSW of Mingenew, Moorlaby Rd, 22 km S of Midlands Rd, 30 Sep. 1984, *B. Briggs 7509 & L. Johnson* (NSW, PERTH); 28 km SSW of Mingenew, 12 km SE of Mt Adams, 10 Sep. 1980, *S.D. Hopper 1674* (CANB, K, PERTH); 0.6 km N along Natta Rd from Tompkins Rd, 200 m W near gravel pit, 23 Nov. 1989, *A. Napier & A. Kelly 547* (PERTH); c. 200 m NW of Green Head turnoff on Brand Hwy, 17 Nov. 1981, *M.I.H. Brooker 7219* (CANB, PERTH); Indian Ocean Drv, near Brand Hwy, 16 Jan. 2007, *D. Nicolle 5078* (CANB, PERTH); Hi Vallee property (D. & J. Williams), Warradarge track along E side of main valley, 16 May 1998, *M. Hislop 1050* (CANB, PERTH); 45 miles E of Jurien Bay on road to Marchagee, 18 Sep. 1976, *J.S. Beard 7879* (PERTH); 1.2 km S of Boothendara Creek bridge on Brand Hwy, 55.2 km N of Cataby on Brand Hwy, 8 Sep. 1980, *S.D. Hopper 1671* (PERTH); 6.9 km ex Hwy 1 W on Cadda Rd, NW of Badgingarra, 29 Aug. 1998, *M.E. French 662* (PERTH); Calcarra West Rd, S of Calingiri, 27 Mar. 2010, *D. Nicolle 5547 & M.E. French* (CANB, PERTH); 16 km S of Cunderdin on Quairading Rd in private reserve, 21 June 2011, *M.E. French 2179* (PERTH).

Distribution and habitat. Of very scattered distribution in a subcoastal north-south strip from south-east of Geraldton southwards to south of Cunderdin in Western Australia (Figure 3). Usually occurs on or near lateritic breakaways or rises, often in low heath vegetation. Associated eucalypts include *Corymbia calophylla*, *Eucalyptus arachnaea*, *E. drummondii*, *E. erythronema*, *E. gittinsii* subsp. *illucida*, *E. wandoo* subsp. *wandoo* and *E. todtiana*.

Etymology. From the Latin *opimus* (well-fed; fat) and *flores* (flowers), referring to its fattened buds, especially in comparison to the closely related *E. dorrienii* and *E. ecostata*.

Conservation status. The distribution occurs largely in agricultural areas that have been extensively cleared and populations are scattered and generally very small in size (even in conserved areas); however, this species is not currently considered to be at risk. Recorded from Alexander Morrison National Park and Burma Road, Eneabba and Wongamine Nature Reserves.

Notes. *Eucalyptus opimiflora* is here described to accommodate northern populations of plants previously included in the mallee variant of *E. falcata* s. lat. (Brooker & Kleinig 2001). It is distinguished from *E. falcata* s. str. in its lignotuberous mallee habit and generally coarser buds and fruits.

Eucalyptus opimiflora is most closely related to *E. petrensis*, differing from the latter in its more loosely-held, often pendulous umbellasters, more slender peduncles, longer and more slender pedicels, conical opercula, and shorter, broadly obconical to flattened-hemispherical fruits. The habitat of *E. opimiflora* also differs from that of *E. petrensis*, with the latter being restricted to coastal limestone dunes.

9. *Eucalyptus dorrienii* Domin, *Repert. Spec. Nov. Regni Veg.* 12: 388 (1913). *Type:* Cranbrook to Warrunup, Western Australia, 1910, *A. Dorrien-Smith* 7087 (*holo:* PR image seen; *iso:* K image seen).

Mallee to 8 m tall, lignotuber present (resprouter). *Bark* smooth throughout, grey over paler grey to tan to yellow cream, decorticating in strips. *Branchlets* terete to slightly angular, not waxy. *Later seedling leaves* elliptical, not waxy. *Juvenile leaves* not waxy. *Adult leaves* (narrow-lanceolate to) lanceolate, 60–130 mm long × 10–23 mm wide, maturing glossy and dark green. *Umbellasters* pendulous, 7–19-flowered; peduncles terete, 7–16 mm long; pedicels terete, 3–10 mm long. *Flower buds* yellowish, not waxy, 5–9 mm wide; hypanthia ribbed (rarely ±smooth); opercula conical to beaked, smooth, 2–3 times as long as hypanthia, 8–12 mm long. *Staminal filaments* creamy white. *Fruits* well-defined from pedicels, hemispherical to globose, ribbed (rarely almost smooth), 5–9 mm long × 7–10 mm diam.; disc ±level; valves 3 or 4, around rim level or exserted due to fragile style remnants.

Diagnostic features. Distinguished within the series by its combination of mallee habit (lignotuber present; resprouter); smooth bark decorticating in strips; terete to slightly angular, non-waxy branchlets; elliptical seedling leaves; relatively small adult leaves; 9–19-flowered, pendulous umbellasters; long slender peduncles and pedicels; non-waxy buds; ribbed bud hypanthia; smooth, conical to beaked opercula 2–3 times as long as hypanthia; and small to medium-sized, hemispherical to globose, ribbed fruits which are distinct from the pedicels.

Selected specimens examined (north to south). WESTERN AUSTRALIA: Boyagin Nature Reserve, c. 3.5 km WSW of Boyagin Rock, 8 Nov. 1983, *K. Hill* 660, *L. Johnson & D. Blaxell* (CANB, NSW, PERTH); Boyagin Rock Rd, 25 Mar. 2010, *D. Nicolle* 5540 & *M.E. French* (CANB, PERTH); Boyagin Rock area, 19 Apr. 1998, *D. Nicolle* 2237 (PERTH); Wearne Rd, c. 1 km E of cross roads (Pikes Rd?), 22 Oct. 2000, *D. Nicolle* 3513 & *M.E. French* (CANB, PERTH); on S side of track, 1 km NE of Gura Rd, track starts at end of Gura Rd, Peters State Forest Block, c. 6 km NW of Dryandra settlement, 26 Aug. 1997, *G.J. Keighery & N. Gibson* 3188 (PERTH); 8 miles E of Harrismith, 3 Nov. 1969, *M.I.H. Brooker* 2265 (CANB, MEL, NSW, PERTH); opposite Tarin Rock grain bins, 21 Jan. 2001, *D. Nicolle* 3725 & *M.E. French* (CANB, PERTH); 250 m W of the eastern boundary of Duggan Water Reserve along the track running on the S side of the railway line, 12 Oct. 2005, *A. Coates* 4992 (AD, PERTH); 0.9 km from Dardadine Rd south on O'Connor Rd, 26 Jan. 2001, *D. Nicolle* 3736 & *M.E. French* (AD, CANB, PERTH); on E side of Carters Rd, 1.5 km N of Orchard Rd, Wingedynne N.R. (Res. 28471), c. 20 km WSW of Woodanilling, 1 May 1999, *G.J. Keighery &*

N. Gibson 6356 (MEL, PERTH); W of Albany Hwy, W of Cranbrook, 15 Oct. 1997, *M.E. French* 321 (PERTH); c. 1 km N of Randell Rd on Poorrarecup Rd, Menzies Subdistrict, 13 Nov. 1986, *K. Hill* 2450, *L.A.S. Johnson & D.F. Blaxell* (NSW, PERTH); Woojenilup Rd, 24 Mar. 2010, *D. Nicolle* 5525 & *M.E. French* (CANB, PERTH).

Distribution and habitat. Occurs on the eastern fall of the Darling Range and the adjacent wheatbelt in south-western Western Australia, in the area approximately bounded by Beverley in the north, Lake Grace in the east and Mount Barker in the south (Figure 3). Occurs as small, scattered populations on lateritic gravels in the jarrah and wandoo forests in the west of its distribution and as a component of mallee shrublands on sandy soils further east. Associated eucalypts include *Corymbia calophylla*, *E. accedens*, *E. aspersa*, *E. astringens* subsp. *astringens*, *E. angulosa*, *E. decipiens*, *E. drummondii*, *E. incrassata*, *E. latens*, *E. marginata* subsp. *marginata*, *E. pachyloma*, *E. pluricaulis* subsp. *pluricaulis*, *E. thamnoides*, *E. uncinata* and *E. wandoo* subsp. *wandoo*.

Conservation status. Not currently considered to be at risk. Although widespread, the species is uncommon and often occurs as small, well-separated populations. Recorded from Boyagin and Tarin Rock Nature Reserves.

Notes. *Eucalyptus dorrienii* belongs to the complex of species previously included in the ‘mallee’ concept of *E. falcata* s. lat. (i.e. *E. dorrienii*, *E. ecostata* and *E. opimiflora*), and the name is here resurrected to accommodate plants previously and erroneously considered to represent the ‘typical’ mallee variant of *E. falcata* (Johnson & Hill 1999; Brooker & Kleinig 2001; Nicolle 2005). Chippendale (1988) included *E. dorrienii* in his broader concept of *E. falcata* at the time (i.e. including mallet/obligate seeder variants). *Eucalyptus dorrienii* is distinguished from *E. falcata* s. str. by its lignotuberous mallee habit and coarser buds and fruits.

Eucalyptus dorrienii appears to be most closely related to *E. opimiflora* and *E. petrensis*, differing from both these species mainly in its pendulous umbellasters and ribbed bud hypanthia and fruits. *Eucalyptus dorrienii* is also similar to *E. ecostata*, differing in the ribbed bud hypanthia (smooth in *E. ecostata*) and the more hemispherical, ribbed fruits (smooth, globular fruits in *E. ecostata*). The two species are largely geographically separated (see Figure 3), although their distributions abut in the area from the west Stirling Range to the Pingrup area, and the two species may intergrade along this strip.

Hybrids are known with *Eucalyptus aspersa* (of *E. ser. Subulatae*), *E. decipiens* and *E. obesa* (see below).

Eucalyptus aspersa* × *E. dorrienii

Eucalyptus × *intrasilvatica* L.A.S.Johnson & K.D.Hill, *Telopea* 8: 214 (1999). *Type*: 1.5 km south of Pikes Rd on south Metro Rd, Western Australia, 17 November 1986, *K.D. Hill* 2526, *L.A.S. Johnson & D.F. Blaxell* (*holo*: NSW image seen; *iso*: PERTH 05900476).

Selected specimens examined (north to south). WESTERN AUSTRALIA: 7.8 km N of Wearne Rd on Metro Rd, 22 Oct. 2000, *D. Nicolle* 3510 & *M.E. French* (CANB, PERTH); 7.2 km N of Wearne Rd on Metro Rd, 22 Oct. 2000, *D. Nicolle* 3509 & *M.E. French* (CANB, PERTH); 2.8 km from Narrakine Rd on Zilkos Rd, 26 Jan. 2001, *D. Nicolle* 3733 & *M.E. French* (CANB, PERTH); 1.9 km from Dardadine Rd south on O’Connor Rd, 26 Jan. 2001, *D. Nicolle* 3737 & *M.E. French* (PERTH).

Notes. Johnson and Hill (1999) described two clumps (each probably representing single genets) of this putative hybrid as *E. intrasilvatica*. Several more individuals of this hybrid have since been discovered (Nicolle 2005; where described as *E. aspersa* × *E. falcata*) and others are likely to be scattered throughout the overlapping part of the distribution of *E. dorrieni* and *E. aspersa*. Some of these clumps (populations) do not occur close to either putative parent and may represent very old ‘phantom’ hybrids (Pryor & Johnson 1971), given the large size of all known clumps.

Eucalyptus decipiens* × *E. dorrieni

Specimen examined. WESTERNAUSTRALIA: property Killawarra, 27 km S of Kojonup, off Wattle Dale Rd and Eight Mile Rd, 20 Mar. 1997, *M.E. French* 143, 144 (PERTH).

Eucalyptus dorrieni* × *E. obesa

Specimens examined. WESTERN AUSTRALIA: 7.9 km W of Hills Rd on Tarin Rock Rd, 16 Dec. 1987, *M.I.H. Brooker* 9834 (CANB, PERTH); 4.7 km from Hills Rd on Tarin Rock Rd, 21 Jan. 2001, *D. Nicolle* 3728 & *M.E. French* (CANB, PERTH).

10. *Eucalyptus ecostata* (Maiden) D.Nicolle & M.E.French, *comb. et stat. nov.*

Eucalyptus falcata var. *ecostata* Maiden, *J. Nat. Hist. Soc. Western Australia* 3: 173 (1911). *Type:* Hopetoun, Western Australia, November 1909, *J.H. Maiden s.n. (lecto, fide J.H. Maiden, Crit. Revis. Eucalyptus* 2: 184 (1912): NSW image seen; *iso:* G *n.v.*, K image seen, L *n.v.*).

Eucalyptus falcata subsp. *Jerramungup* (Canning CBG 038636), Western Australian Herbarium, in *FloraBase*, <http://florabase.dec.wa.gov.au/> [accessed May 2012].

Eucalyptus falcata subsp. *extenta* L.A.S. Johnson & K.D. Hill ms, Commonwealth Heads of Australasian Herbaria, in *Australian Plant Census*, <http://www.chah.gov.au/apc/index.html> [accessed May 2012]. Probable synonym – in the absence of a type or reference specimen, and considering that both authors of the manuscript name are deceased, we cannot with certainty determine the concept of this name.

Mallee to 6 m tall, lignotuber present (resprouter). *Bark* smooth throughout, grey over paler grey to orange-tan to cream, decorticating in strips. *Branchlets* terete to slightly angular, not waxy. *Later seedling leaves* elliptical, to 30 mm long × 20 mm wide, dull, green to slightly blue-green. *Juvenile leaves* not waxy. *Adult leaves* (narrow-lanceolate to) lanceolate, 70–110 mm long × 13–17 mm wide, glossy, dark green. *Umbellasters* pendulous, 11–15-flowered; peduncles terete, 10–15 mm long; pedicels terete, 5–8 mm long. *Flower buds* yellowish, not waxy, 13–19 mm long × 4–7 mm wide; hypanthia smooth; opercula long-conical, smooth, 2–5 times as long as hypanthia, 9–13 mm long. *Staminal filaments* creamy white. *Fruits* well-defined from pedicels, globose to slightly flattened, smooth (sometimes becoming wrinkled or slightly ribbed upon drying), 6–12 mm long × 7–12 mm diam.; disc level to descending; valves 3 or 4, around rim level or somewhat exerted due to fragile style remnants.

Diagnostic features. Distinguished within the series by its combination of mallee habit (lignotuber present; resprouter); smooth bark decorticating in strips; terete to slightly angular, non-waxy branchlets; elliptical seedling leaves; relatively small adult leaves; 11–15-flowered, pendulous umbellasters; long slender peduncles and pedicels; non-waxy buds; smooth bud hypanthia; smooth, long-conical opercula

2–5 times as long as hypanthia; and medium-sized, globose to slightly flattened, generally smooth fruits which are distinct from the pedicels.

Selected specimens examined (west to east). WESTERN AUSTRALIA: Red Gum Pass, Stirling Range N.P., 15 Sep. 2004, *D. Nicolle* 4771 (PERTH); Camel Lake N.R., 1.5 km W of E boundary and 5.8 km W of Formby South Rd along Salt River Rd, 23 Mar. 1982, *S.D. Hopper* 2116 (PERTH); S of Wedge Hill, Stirling Range N.P., 27 Sep. 1975, *J.S. Beard* 7561, 7562 (PERTH); Oakdale Rd, near Corackerup N.R., 4 Nov. 2000, *D. Nicolle* 3564 & *M.E. French* (CANB, PERTH); on E side of Corackerup Rd, 2 km N of Boxwood Hill–Ongerup Rd junction, Corackerup N.R., c. 35 km N of Wellstead, 10 June 1999, *G.J. Keighery* & *N. Gibson* 3187 (PERTH); Gairdner, 7.6 km on Carney Rd near Peniup N.R., 5 Dec. 2002, *L. Sweedman* 6001 (PERTH); Jerramungup, 13 Nov. 1981, *M.I.H. Brooker* 7160 (CANB, PERTH); 12 miles S of Fitzgerald crossing towards Fitzgerald Reserve, 5 Apr. 1974, *M.I.H. Brooker* 4438 (CANB, PERTH); Hamersley Drv, Fitzgerald River N.P., 4 Nov. 2000, *D. Nicolle* 3568 & *M.E. French* (CANB, PERTH); 3.1 km from Hamersley Drv on Hamersley Inlet track, Fitzgerald River N.P., 20 Apr. 1998, *D. Nicolle* 2244 (AD); Fitzgerald River track, Fitzgerald River N.P., 23 Mar. 2010, *D. Nicolle* 5516 & *M.E. French* (CANB, PERTH); East Mt Barren, 31 Aug. 1968, *E.M. Bennett* 2427 (CANB, PERTH); 9.6 km E of Ravensthorpe. N of Jerdacuttup River where South Coast Hwy cuts through Ravensthorpe Range, 9 Nov. 2000, *G.F. Craig* 5228 (AD, PERTH); Elverdton Rd near Mt Desmond, Eyre Botanical District, 18 Nov. 1993, *L. Sweedman* 3068 (KPBG, PERTH); 2 km E of Hopetoun on W edge of limestone pit at S end of old railway formation, 30 Aug. 1988, *N. McQuoid* 33 (PERTH); Elverdton Rd, near Mt Desmond, SE of Ravensthorpe, 22 Mar. 2010, *D. Nicolle* 5496 & *M.E. French* (AD, CANB, PERTH); Ravensthorpe Range, survey site R122, 17.8 km SE of Ravensthorpe, located approximately 1 km E of Kundip mining area along old track (Road No. 8432), 5 Sep. 2007, *S. Kern*, *R. Jasper* & *H. Hughes* 17315 (PERTH); corner of Middle Rd and Tamerine Rd, N of Hopetoun, 9 Dec. 1992, *D. Nicolle* 198 (AD); coastal salt lake, 28 km E of Hopetoun within Jerdacuttup Lakes N.R. A40156, 1.2 km NW of intersection of Southern Ocean Rd and Mason Bay Rd, 29 Oct. 1998, *M.N. Lyons* & *S.D. Lyons* 4311 (AD, PERTH); E of Ravensthorpe, 38 km W of Munglinup, 10 May 1975, *G.J. Keighery* 621 (KPBG, PERTH); Cheadanup Reserve, Munglinup, 15 Apr. 2007, *G. Byrne* 2624 (PERTH); South Coast Hwy, E of Munglinup River, 22 Mar. 2010, *D. Nicolle* 5495 & *M.E. French* (CANB, PERTH); South Coast, 25 km N of Shoal Cape and 80 km W of Esperance, 24 Sep. 1968, *P.G. Wilson* 7767 (CANB, MAAS, PERTH).

Distribution and habitat. Occurs in the south coastal region of Western Australia, from the Stirling Range eastwards to near Stokes Inlet, inland to south of Pingrup and through the Ravensthorpe Range (Figure 3). Occurs as a component of mallee shrubland vegetation on level to hilly topography in a variety of well-drained soil types including white sands and lateritic gravels. Associated eucalypts include *E. angulosa*, *E. brandiana*, *E. clivicola*, *E. conglobata* subsp. *perata*, *E. decipiens*, *E. decurva*, *E. densa* subsp. *improcera*, *E. flocktoniae* subsp. *flocktoniae*, *E. hebetifolia*, *E. incrassata*, *E. lehmannii* subsp. *parallela*, *E. ligulata* subsp. *stirlingica*, *E. marginata* subsp. *marginata*, *E. megacornuta*, *E. obesa*, *E. phaenophylla*, *E. pleurocarpa*, *E. preissiana* subsp. *preissiana*, *E. redunca*, *E. sporadica*, *E. suggrandis* subsp. *suggrandis*, *E. talyuberlup*, *E. uncinata* and *E. wandoo* subsp. *wandoo*.

Conservation status. Common in its area of occurrence and not considered to be at risk. A common component of mallee shrubland vegetation throughout its distribution and recorded from a number of reserved areas including Fitzgerald River and Stirling Range National Parks.

Notes. *Eucalyptus ecostata* was previously included in *E. falcata* (as *E. falcata* var. *ecostata*); however, the species belongs to the complex of species previously included in the ‘mallee’ concept of *E. falcata* s. lat. (*E. dorrieni*, *E. ecostata* and *E. opimiflora*), and is more distantly related to the mallet (obligate

seeder) species *E. falcata* s. str. *Eucalyptus ecostata* is distinguished from *E. falcata* s. str. by its lignotuberous mallee habit, larger flower buds with smooth hypanthia and the larger, more globose and smooth fruits.

Despite its previous inclusion in the ‘mallee’ concept of *E. falcata* s. lat., *E. ecostata* appears to be most closely related to *E. semiglobosa*, differing from the latter in its smaller, thinner leaves, smaller flower buds with a longer, conical to beaked operculum and the larger, consistently smooth and more globose fruits. Intergrades between *E. ecostata* and *E. semiglobosa*, distinguished by their intermediate morphological characteristics, have been collected between Stokes Inlet and Esperance, which is geographically between the distribution of the two species (see specimens cited below). Extensive and variable intergrading populations with *E. goniantha* and *E. notactites* (L.A.S. Johnson & K.D. Hill) D. Nicolle & M.E. French also occur to the south-west of the distribution of *E. ecostata* and these are discussed separately below.

To the south-west of the distribution of *E. ecostata*, the species forms extensive intergrading populations with *E. goniantha* (south of the Stirling Range towards the south coast near Albany, see specimens cited below) and *E. notactites* (to the north-east of Albany, but mainly restricted to the area from south of Manypeaks to the Green Range; see specimens cited below). Some of these intergrading populations were previously included in *E. goniantha* (e.g. Hill & Johnson 1992; Brooker & Kleinig 2001). The intergrading populations are morphologically very variable, with the variation between populations generally associated with their relative geographical proximity to ‘pure’ *E. ecostata* (to the north and east of the intergrading populations), ‘pure’ *E. goniantha* (restricted to coastal localities to the south and south-west of the intergrading populations) and ‘pure’ *E. notactites* (restricted to coastal localities to the south and south-east of the intergrading populations). In the area from near Manypeaks township towards the Porongurup Range, these intergrading populations may also have some genetic influence from *E. dorrieni*, as suggested by their morphological and geographical approach towards this species. Scattered populations also considered representative of *E. ecostata* – *E. notactites* intergrades are also known much further east along the south coast (to east of Ravensthorpe) where the two species are in genetic contact.

A putative hybrid with *E. decipiens* Endl. is known (see below).

Eucalyptus decipiens* × *E. ecostata

Specimen examined. WESTERN AUSTRALIA: Talyuberlup [Peak], 1 Oct. 1975, J.S. Beard 7619 (PERTH).

***Eucalyptus ecostata* – *E. goniantha* subsp. *goniantha* intergrades**

Selected specimens examined (west to east). WESTERN AUSTRALIA: Palmdale Rd, just S of Johnson Rd, 24 Mar. 2010, D. Nicolle 5524 & M.E. French (PERTH); Green Range, South Coast Hwy, Hassell N.P., 24 Mar. 2010, D. Nicolle 5522 & M.E. French (PERTH).

***Eucalyptus ecostata* – *E. notactites* intergrades**

Selected specimens examined (west to east). WESTERN AUSTRALIA: Nioka Farm, Green Range, 20 Oct. 1996, M.E. French 88 (PERTH); Nioka farm, NE of Manypeaks town, 27 Jan. 2001, D. Nicolle 3754 & M.E. French (CANB, PERTH); Whalebone to Quoin Head, 13 Dec. 1988, M.I.H. Brooker

10152 (CANB, PERTH); track to Shelly Beach, 22 Mar. 2010, *D. Nicolle* 5494 & *M.E. French* (CANB, PERTH); Rose Beach Rd (extension of Murray Rd), 22 Mar. 2010, *D. Nicolle* 5491 & *M.E. French* (PERTH).

***Eucalyptus ecostata* – *E. semiglobosa* intergrades**

Specimens examined (west to east). WESTERN AUSTRALIA: limestone bluffs to E of Stokes Inlet, 20 Jan. 2001, *D. Nicolle* 3709 & *M.E. French* (CANB, PERTH); Quaggi Beach Rd, E of Young River Inlet, Esperance Plains, 14 Dec. 1998, *M.E. French* 762, 765 (PERTH); 7.2 km from South Coast Hwy on Farrells Rd to Quaggi Beach, 6 Nov. 2000, *D. Nicolle* 3587 & *M.E. French* (AD, CANB, PERTH).

11. *Eucalyptus semiglobosa* (Brooker) L.A.S.Johnson & K.D.Hill, in K.D.Hill & L.A.S.Johnson, *Telopea* 4: 608 (1992). *Eucalyptus goniantha* subsp. *semiglobosa* Brooker, *Nuytsia* 2: 110 (1976). *Type*: between Mt Le Grand and Frenchmans Peak, Western Australia, 22 April 1972, *M.I.H. Brooker* 3613 (*holo*: CANB; *iso*: AD, BRI *n.v.*, K image seen, MEL *n.v.*, NSW image seen, PERTH 01389815, PERTH 01389823).

Mallee to 6 m tall, lignotuber present (resprouter). *Bark* smooth throughout, grey over paler grey to tan, decorticating in strips. *Branchlets* angular, not waxy. *Later seedling leaves* orbicular, to 50 mm long × 50 mm wide, not waxy. *Juvenile leaves* not waxy. *Adult leaves* lanceolate to broad-lanceolate, 95–120 mm long × 20–40 mm wide, glossy, dark green. *Umbellasters* pendulous, 7–13-flowered; peduncles angular, 14–22 mm long; pedicels 5–10 mm long. *Flower buds* cream, not waxy, 8–10 mm wide; hypanthia smooth to weakly ribbed; opercula hemispherical to bluntly conical, smooth, 1–2 times as long as hypanthia, 6–9 mm long. *Staminal filaments* creamy white. *Fruits* distinct from or slightly tapering to the pedicels, hemispherical to globose, smooth to weakly ribbed, 8–10 mm long × 11–14 mm diam.; disc ±level; valves 4, around rim level.

Diagnostic features. Distinguished within the series by its combination of mallee habit (lignotuber present; resprouter); smooth bark decorticating in strips; angular, non-waxy branchlets; orbicular seedling leaves; medium-sized adult leaves; 7–13-flowered, pendulous umbellasters; long slender peduncles; medium-length pedicels; non-waxy buds; smooth to weakly ribbed bud hypanthia; smooth hemispherical to bluntly conical opercula 1–2 times as long as hypanthia; and medium-sized to large, hemispherical to globose, smooth to weakly ribbed fruits which are distinct from, or slightly tapering to, the pedicels.

Selected specimens examined (west to east). WESTERN AUSTRALIA [localities withheld for conservation reasons]: 4 May 2012, *D. Nicolle* 6379 & *M.E. French* (AD, PERTH); 14 May 1988, *L.A.S. Johnson* 9067 & *M. Johnson* (CANB, MEL, NSW, PERTH); 27 Apr. 1972, *M.I.H. Brooker* 3615 (CANB, PERTH); 4 Mar. 2003, *D. Nicolle* 4579 & *M.E. French* (CANB, PERTH); 21 Mar. 2010, *D. Nicolle* 5486 & *M.E. French* (PERTH); 19 Apr. 1993, *G.F. Craig* 2505, 2506 (PERTH); 7 May 2003, *J.A. Cochrane* 4594 & *A. Crawford* (PERTH); 3 Mar. 2003, *D. Nicolle* 4570 & *M.E. French* (PERTH); 7 May 2003, *J.A. Cochrane* 4595 & *A. Crawford* (K, PERTH); 4 Mar. 2003, *D. Nicolle* 4577 & *M.E. French* (CANB, PERTH); 31 Oct. 1989, *G.J. Keighery* 11931 (PERTH); 20 Sep. 1976, *R. Hnatiuk* 761183 (PERTH); 2 May 2012, *D. Nicolle* 6366 & *M.E. French* (AD, PERTH); 2 May 2012, *D. Nicolle* 6358 & *M.E. French* (AD, PERTH).

Distribution and habitat. Distributed on the south coast of Western Australia, from Esperance eastwards to near Point Malcolm and the Russell Range (Figure 3). The species grows in low mallee shrubland on sandy or loamy soils, often below granite hills and ledges where rainfall is supplemented by runoff. Associated eucalypt species include *E. angulosa*, *E. cooperiana*, *E. doratoxylon*, *E. extrica*, *E. incrassata*, *E. leptocalyx*, *E. micranthera*, *E. pleurocarpa* and *E. uncinata*.

Conservation status. DEC Conservation Codes for Western Australian Flora: Priority Three (Smith 2012). We regard the species as well defined both morphologically and geographically. It is known from relatively few populations but occurs in Cape Le Grand and Cape Arid National Parks.

Notes. *Eucalyptus semiglobosa* is morphologically most similar to *E. ecostata*, but differs from the latter most conspicuously in the much shorter, hemispherical to bluntly conical opercula. Apparent intergrades between the two species occur between their respective distributions, between Stokes Inlet and Esperance (see under *E. ecostata*). Hybrids are known with *E. kessellii*, and includes the type of *E. balanopelex* L.A.S.Johnson & K.D.Hill. These hybrids are discussed separately below.

Eucalyptus semiglobosa and *E. notactites* occur nearly sympatrically in Cape Le Grand and Cape Arid National Parks (although they appear to be spatially separated ecologically), but without apparent interbreeding. These two species were each originally described as subspecies of *E. goniantha* (Brooker 1976; Hill & Johnson 1992); however, we consider that specific recognition of both is more appropriate and more informative to indicate a closer relationship between the two subspecies of *E. goniantha* than the relationship between *E. goniantha* and either of *E. semiglobosa* and *E. notactites*. We also believe that *E. semiglobosa* and *E. notactites* are specifically distinct from each other (and other taxa), especially considering their lack of interbreeding where occurring near-sympatrically.

Eucalyptus kessellii* subsp. *eugnosta* × *E. semiglobosa

Eucalyptus balanopelex L.A.S.Johnson & K.D.Hill, in K.D.Hill & L.A.S.Johnson, *Telopea* 4: 605 (1992). *Type*: [E of Esperance], Western Australia [precise locality withheld for conservation reasons], 6 November 1986, K.D. Hill 2285 & L.A.S. Johnson (*holo*: NSW image seen; *iso*: CANB, CBG *n.v.*, MEL *n.v.*, PERTH 01876147).

Selected specimens examined. WESTERNAUSTRALIA: [localities withheld for conservation reason] 8 Dec. 1992, D. Nicolle 169 (AD); 21 Mar. 2010, D. Nicolle 5485 & M.E. French (PERTH).

Notes. The type locality of *E. balanopelex* consists of disturbed and degraded remnant overstorey vegetation in and around what appears to be an old gravel scrape on the road verges between extensive cleared agricultural paddocks. The site supports remnant mallees of *E. cooperiana*, *E. pleurocarpa* Schauer and *E. uncinata* Turcz., as well as some *E. occidentalis* Endl. (which we presume have naturally regenerated from remnant trees on slightly lower and more swampy ground adjacent to the site) and between 10 and 20 mallees which we here regard as a hybrid swarm between *E. kessellii* subsp. *eugnosta* L.A.S.Johnson & K.D.Hill and *E. semiglobosa*. There is a large amount of variation in adult leaf width, flower bud shape, size and ornamentation and fruit size between the 10 to 20 plants, with some plants typical of the type specimen of *E. balanopelex*, some plants displaying features more typical of *E. semiglobosa* and some with features tending more towards *E. kessellii*. While *E. semiglobosa* and *E. kessellii* do not presently occur at the site, both species are known in the general locality (within a few kilometres of the site) and it is likely that both species occurred at or very close to the site prior to the clearing of vegetation either side of the road verge in the early 1960s. Prior to agricultural clearing, road

construction and gravel extraction, the site appears to be an ecotone between subdued swampy ground supporting *E. occidentalis*, level topography of sandy-loam (largely cleared but otherwise typical habitat for *E. kessellii*) and low granite shelf habitat (a typical habitat for *E. semiglobosa*). We hypothesise that one or a few *E. kessellii*–*E. semiglobosa* hybrids occurred on the ecotone site prior to its disturbance, and that the site's disturbance has resulted in progeny from these hybrids (including backcrosses with *E. semiglobosa*) regenerating on and around the gravel scrape (along with regeneration of *E. occidentalis*). Hill and Johnson (1992) cite a second locality under *E. balanopelex*, which is to the south-west of the type locality. The relevant specimen (*L.A.S. Johnson* 9067 & *M. Johnson*) matches *E. semiglobosa*; however, we have some doubts as to the authenticity of the locality data for this specimen. The locality, again a road verge with extensive cleared paddocks either side of the road, has been largely cleared of vegetation, with some much-degraded remnant mallees remaining (mainly *E. pleurocarpa*). We have not been able to find any plants of *E. ser. Falcatae* at this locality or on the road verge either side for many kilometres, despite several searches. *Eucalyptus balanopelex* is currently listed as Priority One under DEC Conservation Codes for Western Australian Flora (Smith 2012). We regard it as a variable hybrid swarm and recommend that it be delisted.

12. *Eucalyptus notactites* (L.A.S.Johnson & K.D.Hill) D.Nicolle & M.E.French, *comb. et stat. nov.*

Eucalyptus goniantha subsp. *notactites* L.A.S.Johnson & K.D.Hill, in K.D.Hill & L.A.S.Johnson, *Telopea* 4: 610 (1992). *Type*: Mt Melville garbage tip, 16.5 km from highway, Western Australia, 12 November 1986, *K.D. Hill* 2429, *L.A.S. Johnson*, *D.F. Blaxell* & *M.I.H. Brooker* (*holo*: NSW image seen; *iso*: PERTH 04880072).

Mallee to 6 m tall, lignotuber present (resprouter). *Bark* smooth throughout, grey over paler grey to reddish tan, decorticating in strips. *Branchlets* strongly angular to winged, often waxy. *Later seedling leaves* broadly-elliptical to orbicular, to 45 mm long × 35 mm wide, dull, green to slightly blue-green. *Juvenile leaves* not waxy. *Adult leaves* lanceolate to broad-lanceolate, 90–135 mm long × 20–40 mm wide, glossy, dark green to slightly blue-green. *Umbellasters* erect, 11–15-flowered; peduncles flattened, 7–11 mm long; pedicels absent or to 1 mm long. *Flower buds* yellowish, sometimes waxy, 6–8 mm wide; hypanthia angled; opercula conical to near hemispherical (usually bluntly conical), smooth, 1–1.5 times as long as hypanthia, 5–7 mm long. *Staminal filaments* creamy white. *Fruits* ±sessile, crowded, globose to truncate-globose, angled or flat-sided due to crowding, 6–9 mm long × 8–11 mm diam.; disc level to descending; valves 3 or 4, around rim level.

Diagnostic features. Distinguished within the series by its combination of mallee habit (lignotuber present; resprouter); smooth bark decorticating in strips; strongly angular to winged, often waxy branchlets; broadly-elliptical to orbicular seedling leaves; medium-sized adult leaves; 11–15-flowered, erect umbellasters; short to medium-length, flattened peduncles; absent or very short pedicels; sometimes waxy buds; angled bud hypanthia; smooth, near hemispherical to bluntly conical opercula 1–1.5 times as long as hypanthia; and small to medium-sized, globose to truncate-globose, angled or flat-sided, crowded fruits.

Selected specimens examined (west to east). WESTERN AUSTRALIA: walking track on Flinders Peninsula, 20 July 1988, *M.I.H. Brooker* 9993 (CANB, PERTH); Mt Gardner, E of Albany, 29 May 1964, *A.S. George* 6326 (PERTH); West Ridge, Two Peoples Bay Reserve, 15 Nov. 1981, *M.I.H. Brooker* 7191 (CANB, NSW, PERTH); gully from Normans Inlet, E side, 300 m from beach, 30 June 1994, *C.J. Robinson* 1113 (PERTH); Waychincup Inlet, 3 Oct. 1986, *G.J. Keighery* 9913 (PERTH); Cheyne Beach, 28 Dec. 1979, *M.I.H. Brooker* 6688 (CANB, PERTH); Wellstead Rd to Cape Riche, at the Mt Maxwell [sic; Mount Melville] rubbish tip with a view to the sea, 3 May 1999, *A.V. Slee* 4116 (CANB,

PERTH); Mt Melville garbage tip, 10 Dec. 1992, *D. Nicolle* 220 (AD); Swan Gully, 8.5 km NNW of Cape Riche, 6 Oct. 1987, *S.D. Hopper* 6193 (PERTH); c. 1 km from the mouth of the Beaufort Inlet along Pallinup Estuary rd, 15 Oct. 1991, *P.J. White* 280 (PERTH); Pallinup River Estuary, 19 Nov. 1982, *H. Demarz* 9456 (PERTH); 3 km NW of Mt Melville, 23 Jan. 1997, *R. Davis* 2271 (PERTH); Dillon Bay track, off the end of Dillon Bay Rd, W of Bremer Bay, 5 Nov. 1991, *N. McQuoid* 236 (PERTH); Pt Henry, S of Bremer Bay, 27 Jan. 2001, *D. Nicolle* 3747 & *M.E. French* (PERTH); Sandy Hook Is. near Esperance, 1 May 1982, *M.I.H. Brooker* 7492, 7493 (CANB, PERTH); above beach on NE side of Sandy Hook Is., Recherche Archipelago, 8 Mar. 2003, *D. Nicolle* 4605 & *M.E. French* (CANB, PERTH); Cape Le Grand, c. 400 m due NE of *E. insularis* site, 8 Sep. 1988, *K. Hill* 3156 (CANB, NSW, PERTH); Cape Le Grand N.P., 4 km E of access road to Frenchmans Peak, 15 Dec. 2000, *W. O'Sullivan* 1192 (PERTH); Cape Le Grand Rd, 8 Dec. 1992, *D. Nicolle* 177 (AD); Mondrain Is., 21 Nov. 2002, *S.D. Hopper* 8575 (PERTH); Lucky Bay, 1.5 miles S of Frenchmans Peak, 6 June 1969, *D.J. Carr* & *S.G.M. Carr* 1161 (CANB, PERTH); N of Mt Arid, Cape Arid N.P., 3 May 2012, *D. Nicolle* 6369 & *M.E. French* (PERTH).

Distribution and habitat. Restricted to the south coast of Western Australia, where the species is strictly coastal, occurring from Flinders Peninsula south of Albany eastwards to Cape Arid and the islands of the Recherche Archipelago (including Sandy Hook and Mondrain Islands; Figure 4). The species occurs in (often dense) mallee shrubland on loamy soils. Associated eucalypt species include *Eucalyptus adesmophloia*, *E. angulosa*, *E. aquilina*, *E. calcicola* subsp. *unita*, *E. conferruminata* subsp. *recherche*, *E. cornuta*, *E. extrica*, *E. incrassata*, *E. lehmannii* subsp. *lehmannii*, *E. occidentalis*, *E. pleurocarpa*, *E. preissiana* subsp. *preissiana*, *E. redunca* and *E. tetraptera*.

Conservation status. Many populations occur in reserved areas and the species is not considered to be at risk. Collections have been made from Cape Arid, Cape Le Grand and Waychinicup National Parks and Recherche Archipelago and Two Peoples Bay Nature Reserves.

Notes. A distinctive species in the series, especially in the angular to winged, sometimes waxy branchlets (waxiness is otherwise known in the series only in *E. annettae*). It also differs from other species of *E.* subser. *Rugatae* in its sessile, crowded buds and fruits.

Hill and Johnson (1992) described this taxon as *E. goniantha* subsp. *notactites*, but we consider that specific status is more appropriate, especially considering that *E. goniantha* and *E. notactites* occur sympatrically (although they may be spatially separated ecologically) on Flinders Peninsula, south of Albany, without any significant interbreeding. *Eucalyptus notactites* intergrades extensively with *E. ecostata* north-east of Albany (especially between Two Peoples Bay and the Green Range; see specimens cited under *E. ecostata*), but these two species are otherwise morphologically distinct and consistent throughout their respective distributions. A putative hybrid is known with *E. adesmophloia* (Brooker & Hopper) *D. Nicolle* & *M.E. French* (see below).

Eucalyptus adesmophloia* × *E. notactites

Specimen examined. WESTERN AUSTRALIA: c. 3 km from Bremer Bay Rd on Reef Beach Rd, 27 Jan. 2001, *D. Nicolle* 3749 & *M.E. French* (CANB, PERTH).

13. *Eucalyptus goniantha* Turcz., *Bull. Soc. Imp. Naturalistes Moscou* 20(1): 163 (1847). *Eucalyptus incrassata* Labill. var. *goniantha* (Turcz.) Maiden, *Crit. Revis. Eucalyptus* 1: 103 (1904). *Type*: Swan River Colony, [Western Australia], 1843, *J. Drummond* 3: 71 (*holo*: KW; *iso*: BM *n.v.*, CGE *n.v.*, E *n.v.*, FI *n.v.*, G *n.v.*, K image seen, NSW image seen, W *n.v.*).

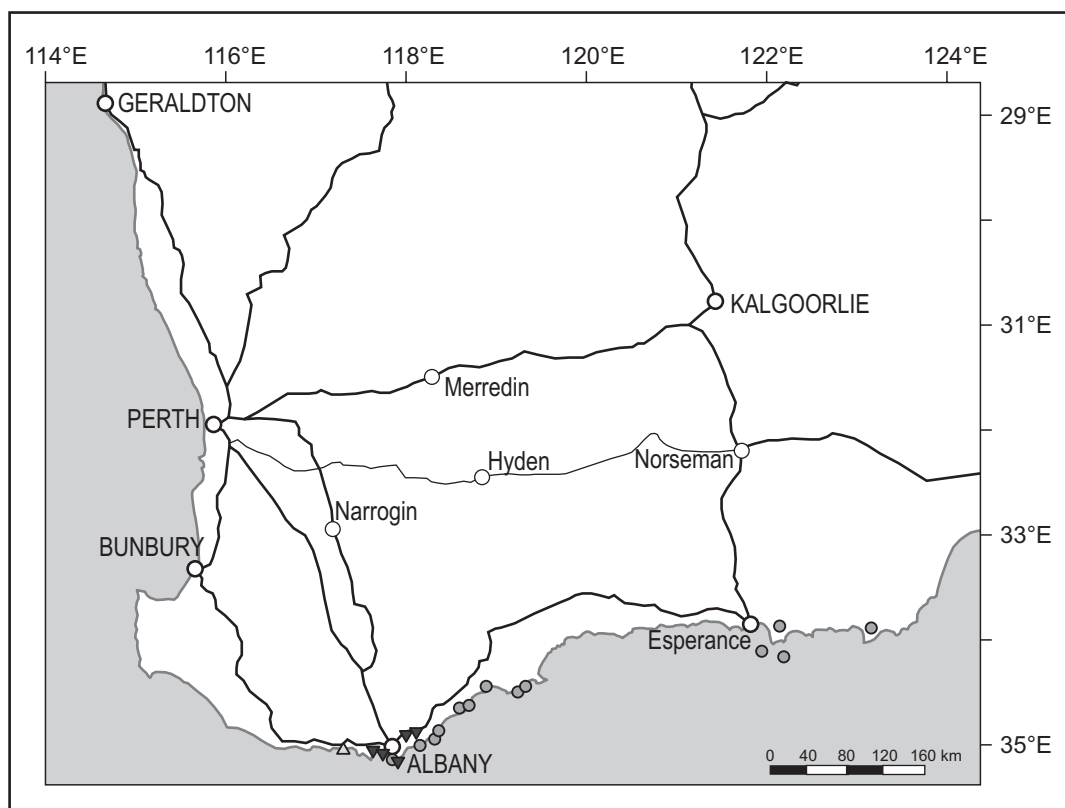


Figure 4. Distribution of *Eucalyptus goniantha* subsp. *goniantha* (inverted triangles), *E. goniantha* subsp. *kynoura* (triangle) and *E. notactites* (grey circles) in Western Australia.

Mallee to 6 m tall, lignotuber present (resprouter). *Bark* smooth throughout, pale grey to brown, decorticating in strips. *Branchlets* terete to slightly angular, not waxy. *Later seedling leaves* elliptical to orbicular. *Juvenile leaves* not waxy. *Adult leaves* lanceolate, 80–135 mm long \times 20–32 mm wide, glossy, green. *Umbellasters* pendulous, 7–11-flowered; peduncles angular to slightly flattened, 11–15 mm long; pedicels angular, 2–10 mm long. *Flower buds* creamy yellow, not waxy, 6–11 mm wide; hypanthia weakly to strongly ribbed; opercula bluntly conical to bluntly beaked, smooth to strongly ribbed, 1.5–2 times as long as hypanthia, 9–13 mm long. *Staminal filaments* creamy white. *Fruits* moderately distinct from pedicels, truncate-globose, weakly to strongly ribbed, 7–11 mm long \times 8–14 mm diam.; disc level to descending; valves 3 or 4, around rim level or exerted due to fragile style remnants.

Diagnostic features. Distinguished within the series by its combination of mallee habit (lignotuber present; resprouter); smooth bark decorticating in strips; terete to slightly angular, non-waxy branchlets; elliptical to orbicular seedling leaves; medium-sized adult leaves; 7–11-flowered, pendulous umbellasters; medium to long, angular to slightly-flattened peduncles; short to medium-length pedicels; non-waxy buds; ribbed bud hypanthia; slightly to strongly ribbed, beaked opercula 1.5–2 times as long as hypanthia; and medium-sized, truncate-globose, slightly to strongly ribbed fruits which are moderately distinct from the pedicels.

Notes. Our concept of *E. goniantha* differs somewhat from previous accounts (e.g. Hill & Johnson 1992; Brooker & Kleinig 2001), and we restrict the species to coastal and near-coastal sites from Point

Hillier (west of Denmark) eastwards along the coast to near Manypeaks township. We regard many populations of mallees that have previously been included in *E. goniantha* to the south, east and north of Manypeaks township (and extending from south of the Stirling Range towards the south coast near Two Peoples Bay) as morphologically variable intergrades between *E. goniantha* and *E. ecostata*, *E. goniantha* and *E. dorrienii*, and *E. ecostata* and *E. notactites* (see discussion under *E. ecostata*).

We recognise two subspecies that form a geographical replacement pattern and differ from one another in the degree of flower bud and fruit ornamentation. Both subspecies are known from relatively few populations and both may be threatened from coastal development.

13a. *Eucalyptus goniantha* subsp. *goniantha*

Flower buds with hypanthia weakly to moderately ribbed; opercula smooth to slightly ribbed. *Fruits* weakly to moderately ribbed.

Specimens examined (west to east). WESTERN AUSTRALIA: [localities withheld for conservation reasons] 22 Oct. 1992, *C.J. Robinson* 965 (PERTH); 21 Jan. 1994, *L. Sweedman* 3257 (KPBG, PERTH); 27 May 1982, *S.D. Hopper* 2183 (PERTH); 22 July 2005, *S. Barrett* 1364 (PERTH); 20 July 1988, *M.I.H. Brooker* 9993 (CANB, PERTH); 5 Dec. 1986, *G.J. Keighery* 8662 (PERTH); 2 Apr. 2002, *M.E. French* 1394 (PERTH); 29 Nov. 1984, *M.I.H. Brooker* 8738 (CANB, PERTH); 20 Jan. 1996, *D. Nicolle* 1626 (PERTH); 26 Nov. 1987, *M.I.H. Brooker* 9822 (CANB, PERTH).

Distribution and habitat. Restricted to the far south coast of Western Australia, from Mutton Bird Island (west of Albany) eastwards to Flinders Peninsula (south of Albany) and north-east towards Manypeaks (Figure 4). The species is restricted to exposed coastal or subcoastal sites, where it grows on thin sandy soils overlying limestone or rarely granite, often on limestone ridges or cliffs in low mallee shrubland. Associated species include *E. angulosa* and *Agonis flexuosa*.

Conservation status. DEC Conservation Codes for Western Australian Flora: Priority Four (Smith 2012). The species is restricted in distribution and known from relatively few sites. Recorded from Torndirrup National Park.

Notes. Intergrades between *E. goniantha* subsp. *goniantha* and subsp. *kynoura* are not known, but may occur in the region between known populations of the two subspecies (between Mutton Bird Island and Point Hillier). *Eucalyptus goniantha* subsp. *goniantha* is sympatric with *E. notactites* on Flinders Peninsula (although they may be spatially separated ecologically) without apparent interbreeding.

Inland of the distribution of *E. goniantha* subsp. *goniantha*, the subspecies forms extensive intergrading populations with *E. ecostata* (south of the Stirling Range towards the south coast near Albany; see specimens cited under *E. ecostata*).

13b. *Eucalyptus goniantha* subsp. *kynoura* D.Nicolle & M.E.French, *subsp. nov.*

Typus: west of Denmark, Western Australia [precise locality withheld for conservation reasons], 28 January 2001, *D. Nicolle* 3759 & *M.E. French* (*holo:* PERTH 05810647; *iso:* CANB).

Eucalyptus sp. Point Hillier (D. Nicolle & M. French DN 3759), Western Australian Herbarium, in *FloraBase*, <http://florabase.dec.wa.gov.au/> [accessed May 2012].

Eucalyptus kynoura D.Nicolle ms, Commonwealth Heads of Australasian Herbaria, in *Australian Plant Census*, <http://www.chah.gov.au/apc/index.html> [accessed May 2012].

Flower buds with hypanthia strongly ribbed; opercula strongly ribbed. *Fruits* strongly ribbed. (Figure 5)

Specimen examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons]: 28 Jan. 2001, D. Nicolle 3760 & M.E. French (CANB, PERTH).

Distribution and habitat. Known only from the type population, growing in low shrubland on a very steep, crumbling limestone slope at Point Hillier, west of Denmark on the far south coast of Western Australia (Figures 4, 5).

Etymology. From the Greek *kynouron* (sea-cliff), referring to the habitat of the only known population.

Conservation status. Recently listed as Priority One under DEC Conservation Codes for Western Australian Flora, under the name *E. sp.* Point Hillier (D. Nicolle & M. French DN 3759) (M. Smith pers. comm.). Known only from the type population, which consists of only a few mallees on a very steep slope of crumbling limestone. Further survey is required.

Notes. This is the western subspecies of *E. goniantha*, and is distinctive in its strongly ribbed flower buds and fruits.

14. *Eucalyptus kessellii* Maiden & Blakely, *J. & Proc. Roy. Soc. New South Wales* 59: 187 (1925). *Type*: Salmon Gums, 66 miles north of Esperance, Western Australia, 25 May 1924, W.P. Brown per C.A. Gardner 944a (*holo*: NSW image seen; *iso*: PERTH 01007726).

Mallee to 10 m tall (rarely single-stemmed and tree-like), lignotuber present (resprouter). *Bark* rough on lower stems in thicker-stemmed plants, hard but relatively thin, dark grey; smooth above or commonly smooth throughout (in smaller and/or more frequently burnt plants), light grey to tan over pale yellow to cream, decorticating in strips. *Branchlets* angular, not waxy. *Later seedling leaves* orbicular, to 80 mm long × 75 mm wide, dull, green, not waxy. *Juvenile leaves* not waxy. *Adult leaves* lanceolate to broad-lanceolate, 90–130 mm long × 23–50 mm wide, glossy, dark green. *Umbellasters* rigidly down-turned, 3- or 7-flowered; peduncles flattened and apically broadening, 10–22 mm long × 9–13 mm wide apically; pedicels absent or to 5 mm long. *Flower buds* creamy yellow, not waxy, 10–14 mm wide; hypanthia nearly smooth to strongly ribbed; opercula conical to slightly beaked, smooth to strongly ribbed, 1–2 times as long as hypanthia, usually wider than the hypanthium at the join, 7–10 mm long. *Staminal filaments* pale to mid-yellow. *Fruits* sessile or tapering to the pedicels, obconical, nearly smooth to strongly ribbed, 12–17 mm long × 11–17 mm diam.; disc ±level; valves 4 or 5, around rim level or exerted due to fragile style remnants.

Diagnostic features. Distinguished within the series by its combination of mallee habit (lignotuber present; resprouter); smooth bark throughout or rough bark on the lower stems; angular, non-waxy branchlets; orbicular, apiculate seedling leaves; relatively large adult leaves; 3- or 7-flowered, rigidly down-turned umbellasters; long, broadly flattened peduncles, angular pedicels; nearly smooth to ribbed bud hypanthia; smooth, conical to slightly beaked opercula 1–2 times as long as hypanthia; and large, obconical, nearly smooth to strongly ribbed fruits which taper to the pedicels.

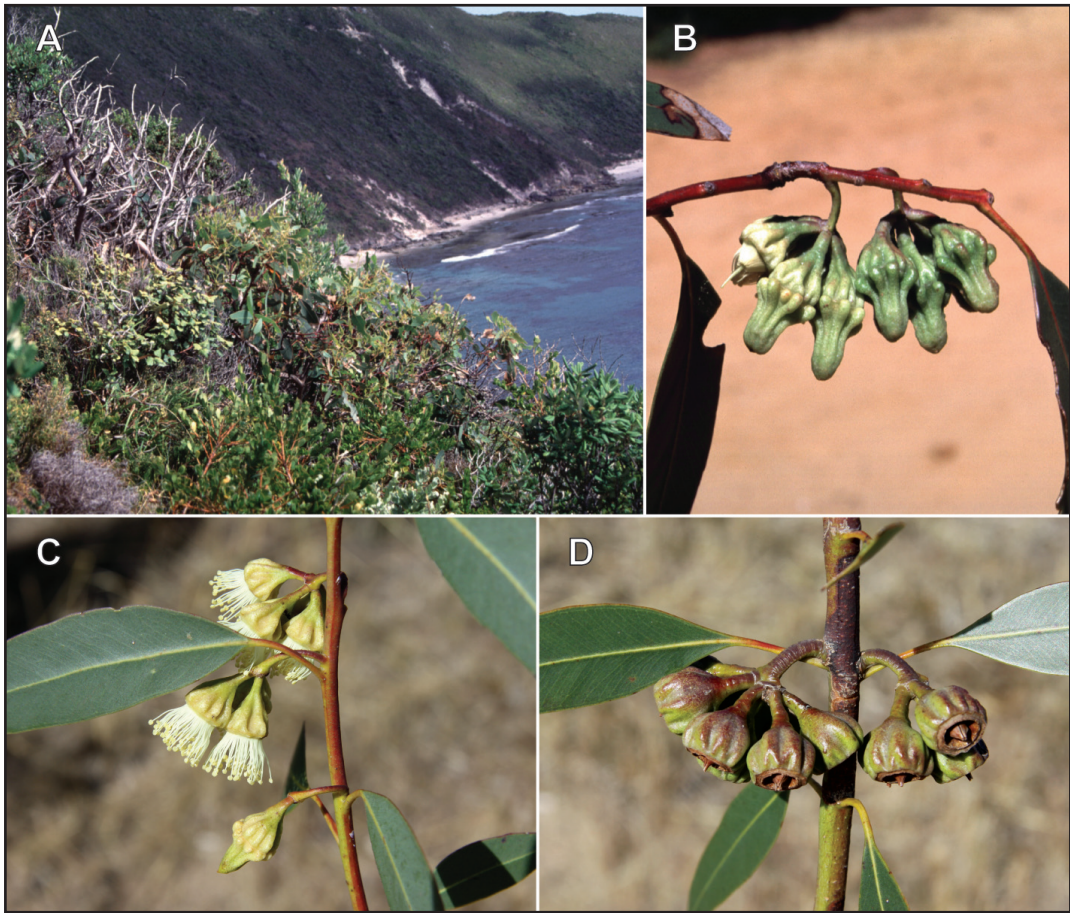


Figure 5. *Eucalyptus goniantha* subsp. *kynoura*. A – habitat and habit at type locality, D. Nicolle 4277 & M.E. French; B – flower buds, D. Nicolle 3760 & M.E. French; C – buds and flowers, F1 of D. Nicolle 3759 & M.E. French; D – fruits, F1 of D. Nicolle 3759 & M.E. French.

Notes. Two weakly defined subspecies are recognised, forming a geographical replacement pattern, and differing from one another primarily in the ornamentation of the flower buds and fruits. There are other trending (but non-exclusive) morphological characteristics that tend to differentiate the two subspecies, most notably the number of flowers in each umbellaster (mostly 3-flowered with some 7-flowered umbellasters in subsp. *kessellii* and consistently 7-flowered umbellasters in subsp. *eugnosta*). The two subspecies appear to intergrade in an area south of Salmon Gums (on the Kalgoorlie–Esperance highway).

In addition to flower bud and fruit ornamentation and flower number per umbellaster, Hill and Johnson (1992) differentiated the two subspecies by the persistence of bark on the lower trunk (bark persistent on lower trunk in subsp. *kessellii* vs. bark smooth in subsp. *eugnosta*). Our field observations indicate that both subspecies can be rough-barked in individuals with larger-diameter stems (i.e. older or larger-sized individuals). Our field observations also indicate that subsp. *kessellii* more commonly has rough bark on the lower stems, but that this appears to be related to subsp. *kessellii* more commonly growing larger in the field, associated with its occurrence more inland and in habitats less subject to frequent wildfire compared to subsp. *eugnosta*. We conclude that the presence and extent of persistent bark in *E. kessellii* is determined by stem diameter (and therefore the age of the individual), which

in turn is environmentally determined by coastal exposure and fire frequency. We therefore cannot distinguish the two subspecies using bark characteristics. We note that in *Euclid* (Slee *et al.* 2006), the two subspecies of *E. kessellii* were not recognised, primarily because the authors of the electronic key could not correlate the bark characteristics described by Hill and Johnson (1992) with the other ‘real’ differences in flower bud and fruit ornamentation and flower number per umbellaster between the two subspecies.

14a. *Eucalyptus kessellii* subsp. *kessellii*

Umbellasters 3 (rarely 7)-flowered. *Flower buds* strongly ribbed; opercula strongly ribbed. *Fruits* strongly ribbed, ribs (1–)2–3 mm high.

Selected specimens examined (west to east). WESTERN AUSTRALIA: 28 km NE of Salmon Gums, 7 Mar. 1980, *K. Newbey* 6677 (PERTH); Sunrise Hill Rd, E of Salmon Gums, 4 May 2012, *D. Nicolle* 6382 & *M.E. French* (PERTH); Dempster Rd N of Ridley Rd, 22 Nov. 1994, *D. Nicolle* 1101 (AD); 7.1 km NE from Mt Ridley t/o on Dempster Rd, 9 Apr. 1985, *M.I.H. Brooker* 8919 (CANB, PERTH); on track which is a continuation of Dempster Rd 13.9 km N of Mt Ridley turnoff, 17 Nov. 1999, *W. O’Sullivan* 855 (PERTH); 28 km NE of Mt Ridley, NE of Esperance, Roe district, 5 Nov. 1986, *D.F. Blaxell* 86-091, *K. Hill*, *L.A.S. Johnson* & *M.I.H. Brooker* (NSW, PERTH); 23 km NE of Mt Ney, 6 May 1983, *M.A. Burgman* 1238 & *S. McNee* (PERTH).

Distribution and habitat. Occurs from north-east of Salmon Gums eastwards to the north of Mt Ridley and Mt Ney, north-east of Esperance in Western Australia (Figure 2). The subspecies is not known from the cleared agricultural lands of the Esperance plains. The subspecies grows in calcareous loams on level topography in tall mallee shrubland. Associated eucalypt species include *E. balladoniensis* subsp. *balladoniensis*, *E. delicata*, *E. dielsii*, *E. eremophila*, *E. extensa*, *E. flocktoniae* subsp. *hebes*, *E. kumarlensis*, *E. leptocalyx*, *E. ovularis*, *E. oleosa* subsp. *cylindroidea*, *E. platycorys*, *E. quadrans*, *E. tumida*, *E. uncinata*, *E. urna* and *E. valens*.

Conservation status. Not currently considered to be at risk. Largely confined to crown land although is known from Scadden Nature Reserve.

Notes. *Eucalyptus kessellii* subsp. *kessellii* is distinguished from subsp. *eugnosta* by the mostly 3-flowered (rarely 7-flowered) umbellasters and the strongly ribbed flower buds and fruits. The subspecies occurs inland of subsp. *eugnosta*, from the Salmon Gums area eastwards. South of Salmon Gums, in the area between Circle Valley and Scadden, subsp. *kessellii* grades into subsp. *eugnosta*, with such intergrades being distinguished by their intermediate morphology (having variably 3- and 7-flowered umbellasters and variable or moderately-ribbed buds and fruits).

Eucalyptus kessellii subsp. *eugnosta* – subsp. *kessellii* intergrades

Selected specimens examined (north to south). WESTERN AUSTRALIA: Circle Valley, 7 Nov. 1953, *C.A. Gardner* 11168 (PERTH); 10 miles N of Scadden, Apr. 1929, *G.E. Brockway s.n.* (PERTH); 5.5 miles N of Scadden, 10 Apr. 1966, *E.M. Scrymgeour* 457 (PERTH); 2 miles N of Scadden, Apr. 1929, *G.E. Brockway s.n.* (PERTH); Scadden, 1 Apr. 1968, *D.J. Carr* & *S.G.M. Carr* 647 (AD, CANB, MEL, NSW, PERTH); Scadden, 13 June 2000, *B. Archer* 1596 (CANB, MEL, PERTH).

14b. *Eucalyptus kessellii* subsp. *eugnosta* L.A.S.Johnson & K.D.Hill, in K.D.Hill & L.A.S.Johnson, *Telopea* 4: 613 (1992). *Type*: 15.2 km west of highway on Speddingup West Road, Western Australia, 7 November 1986, K.D. Hill 2297, L.A.S. Johnson, D.F. Blaxell & M.I.H. Brooker (*holo*: NSW image seen; *iso*: CANB, CBG *n.v.*, MEL *n.v.*, PERTH 01931717).

Umbellasters 7-flowered. *Flower buds* weakly to moderately ribbed; opercula smooth or weakly ribbed. *Fruits* weakly to moderately ribbed, ribs <1 mm high.

Selected specimens examined (west to east). WESTERN AUSTRALIA: Ravensthorpe Range, 10 June 1969, A. Kessell 879 (PERTH); S edge of Laurina Rd, 0.9 km W of Steere River crossing, 30 June 1988, N. McQuoid 18 (PERTH); Hopetoun–Ravensthorpe Rd, 23 Oct. 1978, D.J. Carr & S.G.M. Carr 2264 (AD, BRI, CANB, DNA, MEL, NSW, PERTH); 19 miles E of Ravensthorpe, 15 Mar. 1957, J.W. Green 1225 (PERTH); Ravensthorpe Range, survey site R193, 30.1 km ESE of Ravensthorpe, E slope of Bandalup Hill, c. 800 m E of Mason Bay Rd, 9 Oct. 2007, S. Kern & R. Jasper 18186 (PERTH); 14.6 km N of Springvale Rd, on Mason Bay Rd, 11 Apr. 1985, M.I.H. Brooker 8938 (CANB, PERTH); 5.2 km E of Coujinup Rd along Bandalup Rd, 26 Feb. 1993, P.J. White 516 (CANB, PERTH); c. 0.2 km from Rockhole Rd [along Rawlinson Rd towards West Point Rd – NW of Munglinup], 26 Sep. 1985, L.J. Nunn 353 (CANB, PERTH); Cascade Rd, c. 13 km N of Cascade Rd–Rolland Rd corner, 13 Aug. 2000, E. Tink 512 (PERTH); Cascades, 113 km NW of West Point Rd, Roe District, 19 Sep. 1999, S. Donaldson 2243, G.T. Chandler & A. Monro (CANB, NSW, PERTH); Hwy 1, halfway between Esperance and Ravensthorpe, 29 Sep. 1996, C.E. Ecroyd 224 (PERTH); 1 km on Rowlands Rd from Carmody Rd (before Clare Rd), 20 Jan. 1981, G.J. Keighery 3743 (PERTH); Esperance Road just opposite Fanny Cove, 10 Sep. 1969, D.J. Carr & S.G.M. Carr 1150 (CANB, PERTH); Speddingup Rd West, E of Dalyup Rd, 6 Dec. 1992, D. Nicolle 164 (AD); 4.5 miles S of Grass Patch, 25 Mar. 1968, G.M. Chippendale 396 (CANB, PERTH); 29.7 miles E of Esperance, 15 Feb. 1970, M.I.H. Brooker 2506 (PERTH); 30 miles E of Esperance, 24 Feb. 1966, A.S. George 7632 & S.G.M. Carr (PERTH); 30 miles E of Esperance on the Fisheries Rd, 9 Apr. 1974, M.I.H. Brooker 4478 (CANB, PERTH); Savage Rd, Esperance Plains, E of Esperance, 14 Nov. 1997, M.E. French 340 (PERTH); 35.6 km along Howick Rd to NW of Muntz Rd crossing, E of Esperance, 21 Oct. 1983, K. Hill 287 & L. Johnson (CANB, NSW, PERTH); Howick Rd, between Mt Ney Rd and Coolinup Rd, 4 May 2012, D. Nicolle 6376 & M.E. French (AD, PERTH).

Distribution and habitat. Occurs in subcoastal areas of southern Western Australia, from the Ravensthorpe Range eastwards to near Condingup and including the Gibson and Scadden areas north of Esperance (Figure 2). The subspecies grows in calcareous loams on level or slightly undulating topography in mallee shrubland. Associated eucalypt species include *E. cylindriflora*, *E. eremophila*, *E. forrestiana*, *E. incrassata*, *E. indurata*, *E. leptocalyx*, *E. micranthera*, *E. obesa*, *E. oleosa* subsp. *cylindroidea*, *E. phaenophylla*, *E. pleurocarpa*, *E. stoatei*, *E. sweedmaniana*, *E. tetraptera*, *E. tumida*, *E. uncinata* and *E. valens*.

Conservation status. Not currently considered to be at risk. Although a common component of mallee shrubland vegetation over its area of occurrence, the area is mostly within cleared agricultural area and the subspecies has not been recorded from a conservation reserve.

Notes. *Eucalyptus kessellii* subsp. *eugnosta* is distinguished from subsp. *kessellii* by the consistently 7-flowered umbellasters and the weakly ribbed flower buds and fruits. To the north-east of its distribution, in an area south of Salmon Gums, subsp. *eugnosta* grades into subsp. *kessellii*, with such intergrades being distinguished by their intermediate morphology (having variably 3- and 7-flowered umbellasters and variable or moderately-ribbed buds and fruits).

At the eastern end of the distribution of *E. kessellii* subsp. *eugnosta* (Wittenoom Hills and south of Mt Ney), the subspecies can have weakly and variably waxy branchlets and/or new growth (e.g. *K. Hill* 287 & *L. Johnson*; *D. Nicolle* 6376 & *M.E. French*). The weakly and variably waxy branchlets and/or new growth within these populations may suggest some past or contemporary genetic influence from *E. annettae*; however, in all other features this population is consistent with *E. kessellii* subsp. *eugnosta*, including its lignotuberous mallee habit. We regard these populations to be within our concept of *E. kessellii* subsp. *eugnosta*.

Putative hybrids are known with *E. semiglobosa* (see under *E. semiglobosa*) and *E. obesa* (see below).

Eucalyptus kessellii* subsp. *eugnosta* × *E. obesa

Specimen examined. WESTERN AUSTRALIA: 150 m NE of corner Backmans Rd & Scadden Rd, 21 Mar. 2010, *D. Nicolle* 5484 & *M.E. French* (PERTH).

15. *Eucalyptus annettae* D.Nicolle & M.E.French, sp. nov.

Typus: [Cape Arid National Park], Western Australia [precise locality withheld for conservation reasons], 7 April 2011, *D. Nicolle* 6011 & *M.E. French* (*holo:* PERTH 08262136; *iso:* AD, CANB, NSW).

Eucalyptus sp. Point Malcolm (*D. Nicolle* 6011 & *M.E. French*), Western Australian Herbarium, in *FloraBase*, <http://florabase.dec.wa.gov.au/> [accessed May 2012]; *D. Nicolle*, *M.E. French* & *K.R. Thiele*, *Nuytsia* 22(3): 109 (2012).

Tree (mallet) to 8 m tall, lignotuber absent (obligate seeder). *Bark* rough on lower stems in thicker stemmed plants, hard but relatively thin, dark grey; smooth above or commonly smooth throughout (in smaller/younger plants), dull, grey over cream, decorticating in strips. *Branchlets* angular, waxy. *Later seedling leaves* orbicular, dull, grey-green, waxy. *Juvenile leaves* waxy. *Adult leaves* lanceolate to broad-lanceolate, 90–130 mm long × 23–50 mm wide, dull, bluish and waxy when young, maturing glossy, green. *Umbellasters* rigidly down-turned, 7-flowered; peduncles flattened and apically broadening, 20–26 mm long × 8–13 mm wide apically; pedicels absent or to 5 mm long. *Flower buds* waxy, 14–16 mm wide; hypanthia ribbed; opercula conical to slightly beaked, smooth to weakly ribbed, 1–2 times as long as hypanthia, wider than the hypanthium at the join, 10 mm long. Staminal filaments mid-yellow. *Fruits* waxy, sessile or tapering to the pedicels, obconical, weakly to moderately ribbed (ribs to 1 mm high), 12–17 mm long × 14–20 mm diam.; disc ±level; valves 5 or 6, around rim level or exerted due to fragile style remnants. (Figure 6)

Diagnostic features. Distinguished within the series by its combination of tree habit (lignotuber absent; obligate seeder); smooth bark throughout or rough bark on the lower stems; angular, waxy branchlets; orbicular, apiculate seedling leaves; large adult leaves; 7-flowered, rigidly down-turned umbellasters; broadly flattened peduncles, angular pedicels; ribbed bud hypanthia; smooth to weakly ribbed, conical to slightly beaked opercula 1–2 times as long as hypanthia; and large, obconical, weakly to moderately ribbed fruits which taper to the pedicels.

Selected specimens examined (north to south). WESTERN AUSTRALIA: [localities withheld for conservation reasons] 2 May 2012, *D. Nicolle* 6359 & *M.E. French* (AD, PERTH); 6 Nov. 1980, *K. Newbey* 7884 (PERTH); 20 Apr. 1993, *C.F. Craig* 2532 (PERTH); 2 May 2012, *D. Nicolle* 6362



Figure 6. *Eucalyptus annettae*. A – habitat and habit, D. Nicolle 6359 & M.E. French. This site was apparently subject to wildfire one to two years ago, with the mature individuals of *E. annettae* killed by the fire now evident as slender emergent sticks and with post-fire seedlings of *E. annettae* evident as lower bluish-leaved plants; B – bark, D. Nicolle 6014 & M.E. French; C – seedlings north of Tookle-Jenna Rock; D – flowers, D. Nicolle 3759 & M.E. French; E – buds, D. Nicolle 6014 & M.E. French; F – fruits, D. Nicolle 6014 & M.E. French.

& M.E. French (AD, PERTH); Aug. 1985, *K. Tiedemann s.n.* (PERTH); 7 Apr. 2011, *D. Nicolle* 6013 & M.E. French (CANB, PERTH); 8 Apr. 1985, *M.I.H. Brooker* 8914 (CANB, PERTH).

Distribution and habitat. All collections are in the vicinity of Tookle-Jenna Rock, about 15 km south-west of Israelite Bay on the south coast of Western Australia (Figure 2). The species grows as an emergent in low shrubland on grey clay or thin sand over clay soils on level or very slightly sloping ground, sometimes with outcropping limestone (Figure 6). Associated eucalypt species include *E. brachycalyx*, *E. conglobata* subsp. *conglobata*, *E. cooperiana*, *E. extrica*, *E. incrassata*, *E. leptocalyx*, *E. tumida* and *E. uncinata*

Etymology. Named for Annett Börner, geo-ecologist, nature photographer and scientific publication editor, and the wife of one of us (DN). Annett was a field companion at the time we first encountered the species and on our subsequent field trip to collect the species. Our serendipitous discovery of this special and unusual species perfectly parallels our initial chance meeting and ‘discovery’ of Annett in the field on an earlier field expedition.

Conservation status. Recently listed as Priority Two under DEC Conservation Codes for Western Australian Flora under the name *E. sp.* Point Malcolm (D. Nicolle & M.E. French DN 6011) (M. Smith pers. comm.). All collections are within Cape Arid National Park and Nuytsland Nature Reserve, but are severely burnt frequently and are within a 10 km linear range.

Notes. *Eucalyptus annettae* is a distinctive species in the field due to its mallet (obligate seeder) habit, waxy adult features and large adult leaves, flower buds and fruits. The species has obvious affinities to *E. kessellii*, from which it can be distinguished by the lack of a lignotuber (obligate seeder; mallet habit), waxy branchlets, waxy juvenile leaves, waxy young adult leaves, very broad, flattened peduncles, waxy flower buds and large waxy fruits.

Hill and Johnson (1992) included several specimens of *E. annettae* in their concept of *E. kessellii* subsp. *eugnota*, but did not collect the species in the field themselves and were therefore unaware of the important difference in life-form which is distinctive in the field.

Eucalyptus subser. **Decipientes** Brooker & Hopper, *Nuytsia* 9: 18 (1993). *Type:* *Eucalyptus decipiens* Endl.

Eucalyptus subser. *Decipientes* is distinguished in *E. ser. Falcatae* by its emarginate juvenile leaves. Both Brooker and Hopper (1993) and Brooker (2000) use a number of other characteristics to distinguish the series from *E. subser. Rugatae* (including umbellaster orientation, pedicel presence/length and other seedling leaf characteristics); however, we find that none of these other characteristics are mutually exclusive, and although they appear to indicate character ‘trends’, they are not useful in distinguishing the subseries. *Eucalyptus* subser. *Decipientes* includes 3 of the 17 species we recognise in the series.

16. Eucalyptus decipiens Endl., in Endl., Fenzl, Benth. & Schott, *Enum. Pl.* 49 (1837). *Type:* King George Sound, Western Australia, *K. Hügel s.n. (holo: W n.v.)*.

Eucalyptus concolor Schauer, in Lehm., *Pl. Preiss.* 1: 129 (1844). *Type:* ‘prope coloniam Freemantle’ [near Fremantle, Western Australia], December 1838, *L. Preiss* 225 (*syn: n.v.*); ‘interionum Australiiae meridionali-occidentalis’ [interior, south-western Western Australia], *s. dat.*, [*L. Preiss*] 243 (*syn: n.v.*).

Mallee to 10 m tall, lignotuber present (resprouter). *Bark* rough up to small to medium-sized branches, thick, hard-fibrous, grey, smooth above, pale grey to tan to cream. *Branchlets* terete, not waxy. *Later seedling leaves* orbicular or broader than long, emarginate, to 40 mm long × 50 mm wide, dull, blue-green. *Juvenile leaves* not waxy. *Adult leaves* lanceolate to broad-lanceolate, 50–80 mm long × 10–30 mm wide, dull and slightly blue-green at first, aging to glossy and dark green. *Umbellasters* erect, 9–27-flowered; peduncles terete, 3–12 mm long; pedicels absent or to 1 mm long. *Flower buds* greenish, not waxy, 3–4 mm wide; hypanthia smooth to slightly angled; opercula conical to slightly beaked, smooth, 1–2 times as long as hypanthia, 5–8 mm long. *Staminal filaments* white. *Fruits* sessile, obconical to hemispherical, smooth, 5–6 mm long × 6–7 mm diam.; disc ±level; valves 3 or 4, around rim level.

Diagnostic features. Distinguished within the series by its combination of mallee habit (lignotuber present; resprouter); hard, tightly held, persistent bark; terete, non-waxy branchlets; ±orbicular, emarginate seedling leaves; small adult leaves; 9–27-flowered, erect umbellasters; short to medium-length, terete peduncles, pedicels absent or very short; non-waxy buds; smooth bud hypanthia; smooth, conical to slightly beaked opercula 1–2 times as long as hypanthia; and small, obconical to hemispherical, smooth, sessile fruits.

Selected specimens examined (north to south). WESTERN AUSTRALIA: Turkey Flat Rd, SW of Three Springs, 21 May 2000, *M.E. French* 1204 (PERTH); Coorow–Green Head Rd, SW of Coorow, 13 Jan. 2001, *D. Nicolle* 3700 & *M.E. French* (CANB, PERTH); 25 km N on Mimegarra Rd, starts 18 km E of Lancelin, 16 Oct. 1981, *G.J. Keighery* 4141 (PERTH); coastal block S of Seabird, about 9 km N of Guilderton, 27 Oct. 1993, *B.J. Keighery* & *N. Gibson* 533 (PERTH); near Parrot Ridge, NE of Yancheep, 25 Jan. 1996, *D. Nicolle* 1649 (PERTH); S side of Bold Park, Perth, 25 Nov. 1994, *D. Nicolle* 1153 & *M.E. French* (AD, PERTH); Yalgorup N.P., *s. dat.*, *M.I.H. Brooker* 1738 (AD, CANB, MEL, PERTH); Gardiner Rd in Roseneath Forest Block, SE of Collie, 19 Apr. 2004, *R. Smith* 1069 (PERTH); remnant vegetation at peppermint park development W of Vasse River diversion drain and S side of Busselton bypass road, Busselton, 22 Nov. 2005, *A. Webb* 2173 (AD, CANB, PERTH); S side of Greenbushes Loop Rd at 3.15 km W of Greenbushes townsite, 23 Mar. 2005, *A. Webb* 2175 (PERTH); Potts Rd, SE Kojonup, 300 m S of Bilney Rd turnoff, 3 Apr. 1996, *M.E. French* 2128 (PERTH); Flat Rocks Rd, SW of Broomehill, 3 Apr. 2009, *M.E. French* 2130 (PERTH); O'Neill Rd, SW of Broomehill, 3 Apr. 2009, *M.E. French* 2129 (PERTH); Pearce Rd, 100 m off Albany Hwy, NW of Cranbrook, 19 Feb. 2000, *M.I.H. Brooker* 13098 (AD, CANB, PERTH); Cranbrook, *C.A. Gardner* 329 (PERTH); 6.5 km on North Muir Rd and Lake Muir to Mordalup, 4 Apr. 1996, *M.E. French* 33 (PERTH); 40 m N of the junction of Redmond–Hay River Rd and Davey Rd, Walpole Region, 12 Mar. 1997, *K. Kershaw* & *N. Casson* W 184.8 (PERTH); on highway between Albany and Denmark, 38 km W of Lower Denmark Rd, 21 Mar. 2009, *M.E. French* 2125 (PERTH).

Distribution and habitat. Occurs from south-west of Three Springs in the north, southwards primarily along the coastal and subcoastal areas and through the southern Darling Range region and associated coastal plains to the Denmark area, west of Albany on the south coast. It extends inland marginally into the southern wheatbelt, eastwards to the west of Wagin and Katanning, to the south-east of Tambellup and east of Mt Barker (Figure 7). The species occurs on deep, pure white sands to grey loams, often overlying limestone, in mallee shrublands and open woodlands. Associated eucalypt species include *Corymbia calophylla*, *E. cornuta*, *E. dorrieni*, *E. erectifolia*, *E. foecunda*, *E. gomphocephala*, *E. hebetifolia*, *E. incrassata*, *E. marginata* subsp. *marginata*, *E. pachyloma*, *E. petrensis*, *E. preissiana*, *E. todtiana* and *E. wandoo* subsp. *wandoo*.

Conservation status. Widespread and not considered to be at risk. Recorded from Porongurup, Stirling Range and Yalgorup National Parks and from Bootine, Nilgen and Sheepwash Nature Reserves.

Notes. *Eucalyptus decipiens* is distinctive in the series in its rough, thick and hard, grey to dark grey bark, which extends up to the small branches.

Eucalyptus decipiens intergrades with the smoother-barked *E. adesmophloia* on the northern slopes of the Stirling Range and the immediately adjacent plain (representative of the type of *E. decipiens* subsp. *chalaria*); and with the smooth-barked *E. obesa* at two isolated localities in the wheatbelt. These intergrading populations are discussed below.

Sporadic putative hybrids have been recorded with *E. petrensis* (see under *E. petrensis*), *E. dorrieni* (see under *E. dorrieni*), *E. ecostata* (see under *E. ecostata*), *E. lane-poolei* Maiden of *E. ser. Curvipterae* (representative of *E. balanites* Grayling & Brooker, see discussion below) and *E. virginea* Hopper & Ward.-Johnson of *E. ser. Curvipterae* (representative of *E. phylacis* L.A.S.Johnson & K.D.Hill, see discussion below).

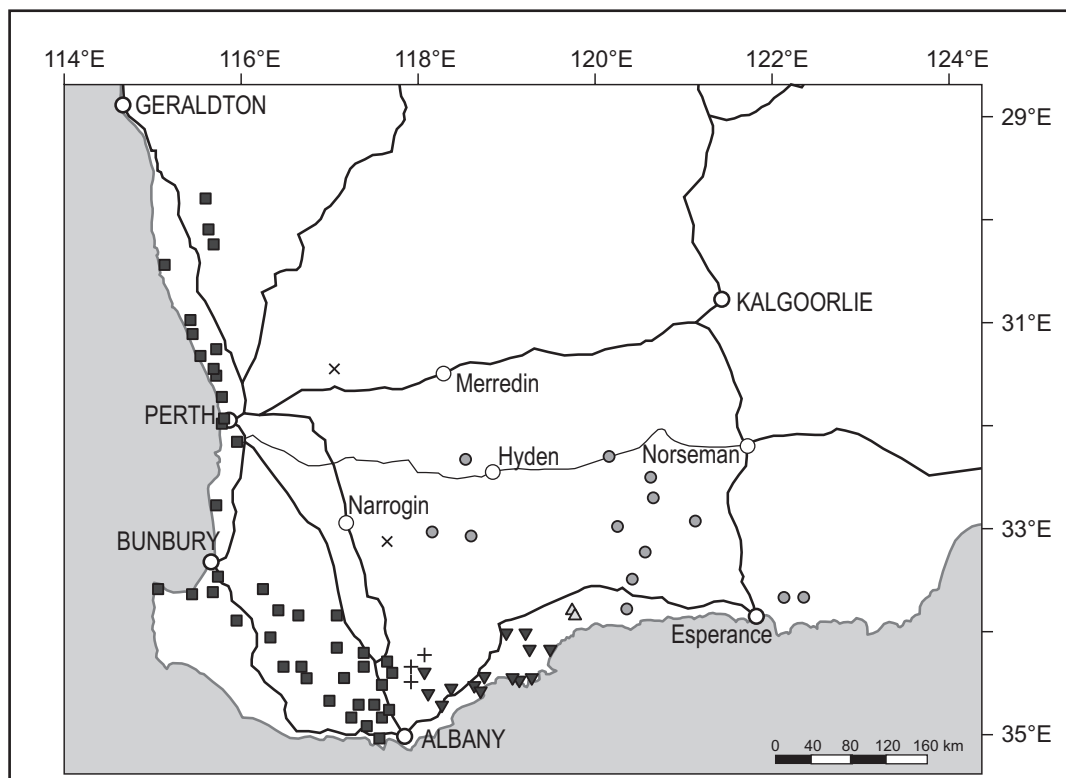


Figure 7. Distribution of *E.* subser. *Decipientes* in Western Australia. *Eucalyptus adesmophloia* (inverted triangles), *E. adesmophloia* – *E. decipiens* intergrades (= *E. decipiens* subsp. *chalaria*; plus signs), *E. adesmophloia* – *E. obesa* intergrades (= *E. communalis*, triangles), *E. decipiens* (squares), *E. decipiens* – *E. obesa* intergrades (crosses) and *E. obesa* (grey circles).

Eucalyptus adesmophloia – E. decipiens intergrades

Eucalyptus decipiens subsp. *chalara* Brooker & Hopper, *Nuytsia* 9(1): 23 (1993). *Type*: Stirling Range Caravan Park, near Bluff Knoll, Western Australia, 6 May 1979, *G.J. Keighery* 2292 (*holo*: PERTH 01344218; *iso*: CANB, NSW image seen).

Specimens examined (north to south). WESTERN AUSTRALIA: 3.6 km W of Bluff Knoll lookout, 27 Mar. 1968, *G.M. Chippendale* 431 (PERTH); Stirling Range N.P., Chester Pass campsite, 25 Sep. 1975, *J.S. Beard* 7434 (PERTH); Chillinup Rd, E of highway, 14 Nov. 1981, *M.I.H. Brooker* 7181 (CANB, PERTH, NSW); Stirling Range N.P., on east Pillenorup Track, S of Youngermere, 27 Sep. 1975, *J.S. Beard* 7543 (PERTH); 10 km S along Chester Pass Rd from intersection with Stirling Range Drv, Stirling Range, 25 Oct. 1985, *N. Hoyle* 1271 (PERTH); N of Kalgan River to Stirling Range, 22 Oct. 1975, *D.F. Blaxell* W75/217 & *A.S. George* (PERTH, NSW); Woodland Rd, Porongurup N.P., 30 km NNE of Albany, 26 Oct. 1986, *G.J. Keighery* 8465 (PERTH).

Notes. Brooker and Hopper (1993) described *E. decipiens* subsp. *chalara* to accommodate populations of *E. decipiens* with ‘a more erect habit, looser, paler, rough bark decorticating in flakes, and preference for acidic sands’ than the ‘typical’ subspecies. Brooker and Hopper (1993) described the distribution of subsp. *chalara* as ‘East of the Darling scarp between about Boyup Brook and the Stirling Range’. We regard the type of *E. decipiens* subsp. *chalara* (collected from a campground on the lower northern slopes of the Stirling Range) to represent an intergrade between *E. decipiens* and *E. adesmophloia*, with plants at the type locality having bark morphology intermediate between these species (Figure 8). We also regard such intergrades to be restricted to the Stirling Range and the plain immediately south (between the Stirling and Porongurup Ranges), with *E. adesmophloia* occurring to the south and east of this (eastwards from the Porongurup and Stirling Ranges), and with *E. decipiens* occurring to the west of this (i.e. west of Albany and west and north of the Stirling Range). All other populations included in subsp. *chalara* by Brooker and Hopper (1993; south of Bunbury east to the wheatbelt and south to the Stirling Range), we regard as representative of typical *E. decipiens*. These *E. decipiens* populations have rough, hard and thick, grey to dark grey bark consistently extending to the branchlets, albeit perhaps not as ‘hard looking’ as coastal forms to the north of Bunbury. Populations with less ‘hard looking’ rough bark also occur elsewhere throughout the range of *E. decipiens*, including in the far north part of its distribution (e.g. Chatfield Clarke Rd, W of Coorow). We regard Brooker and Hopper’s (1993) distinction of their subsp. *chalara* as ‘having more erect stems than typical *E. decipiens*’ as being environmentally determined (primarily depending on fire history and coastal exposure) and we consider their distinction of the subspecies based on its preference for acidic sands to be non-diagnostic.

Eucalyptus decipiens – E. obesa intergrades

Specimens examined (north to south). WESTERN AUSTRALIA: corner Maisey Rd – Quelagetting Rd, N of Meckering, 19 Mar. 2010, *D. Nicolle* 5450 & *M.E. French* (CANB, PERTH); NE boundary Nature Reserve No. A19089, Dongolocking Reserve System, 19 Dec. 2000, *P. White* 1251 (PERTH); Corner Angwins Rd – Dongolocking Rd, 19 Feb. 2000, *M.I.H. Brooker* 13101 (AD, CANB, PERTH); 0.1 km W from Angwins Rd on Dongolocking Rd, 21 Jan. 2001, *D. Nicolle* 3732 & *M.E. French* (CANB, PERTH).

Notes. The above-cited specimens represent two widely separated populations of plants displaying morphology intermediate between *E. decipiens* and *E. obesa*. The Meckering population represents less than 50 individuals occurring in white sand on a very broad rise and is situated geographically



Figure 8. *Eucalyptus decipiens* – *E. adesmophloia* intergrade near the type location for *E. decipiens* subsp. *chalara*, on Chester Pass Road near the Stirling Range camp ground.

in between the nearest *E. decipiens* near the coast west of Gingin, about 130 km to the west, and the nearest *E. obesa* on Billericay Rd (north-west of Hyden), about 180 km to the south-east. The Dongalocking populations have numerous individuals occurring on thin white sand over laterite and are situated geographically in between the nearest *E. decipiens* south-west of Katanning, about 90 km to the south-west, and the nearest *E. obesa* north-west of Tarin Rock, about 50 km to the east. The two populations may be of conservation interest due to their geographical isolation both from one another and from other populations of *E.* subser. *Decipientes*.

Eucalyptus decipiens* × *E. lane-polei

Eucalyptus balanites Grayling & Brooker, *Nuytsia* 8: 216 (1992). *Type*: [west of Badgingarra], Western Australia [precise locality withheld for conservation reasons], 3 February 1985, *M.I.H. Brooker* 8810 & *P.M. Grayling* (*holo*: PERTH 01044710; *iso*: CANB, NSW seen)

Specimens examined (north to south). WESTERN AUSTRALIA: [localities withheld for conservation reasons] 2 June 1985, *M.I.H. Brooker* 9025 (CANB, PERTH); 4 Nov. 1985, *M.I.H. Brooker* 9064 (CANB, PERTH); 10 July 1986, *M.I.H. Brooker* 9390 (CANB, PERTH); 7 Oct. 1986, *P. Grayling* 60 (PERTH); 1 Sep. 1994, *L. Sweedman* 3343 (KPBG, PERTH); 11 Dec. 1992, *D. Nicolle* 254 (AD); 21 Feb. 2000, *M.I.H. Brooker* 13113 (CANB, PERTH); 2 Aug. 2002, *D. Nicolle* 4440 & *M.I.H. Brooker* (PERTH); 3 Sep. 2002, *D. Papenfus* 2000 & *N. Willers* (CANB, PERTH).

Notes. Two hybrid ‘genets’ between *E. decipiens* and *E. lane-polei* (of *E.* ser. *Curvipterae*) are known, including one from west of Badgingarra, which has been described as *E. balanites* (Grayling & Brooker 1992). This individual displays morphology intermediate between the two putative

parents, both of which occur in the area (the hybrid individual is not associated with any eucalypts; however, both *E. decipiens* and *E. lane-poolei* grow elsewhere in the vicinity). Another individual with morphology intermediate between *E. decipiens* and *E. lane-poolei* is known from near Armadale (*M.I.H. Brooker* 13113), some 200 km south of the Badgingarra (*E. balanites*) individual, but still within the distribution of both the putative parents. The Armadale individual is associated with *E. lane-poolei* and a putative backcross between the hybrid and *E. lane-poolei* has also been observed at this site. Both the Badgingarra and the Armadale hybrid plants appear to be sterile, with seeds we have collected from both localities proving non-viable. We envisage that other hybrid individuals of the same parentage may be found where the distributions of the two species overlap, although they are likely to be rare considering the interserial taxonomy of the hybrid. *Eucalyptus balanites* is currently listed as Threatened Flora in Western Australia (Smith 2012). We recommend that it be delisted due to its probable hybrid status and seed sterility.

Eucalyptus decipiens* × *E. virginea

Eucalyptus phylacis L.A.S.Johnson & K.D.Hill, in K.D.Hill & L.A.S.Johnson, *Telopea* 4: 591 (1992). *Type*: [west of Busselton], Western Australia [precise locality withheld for conservation reasons], 31 May 1983, *D.F. Blaxell* 2000, *L.A.S. Johnson & M.I.H. Brooker* (*holo*: NSW image seen; *iso*: CANB, K image seen, PERTH 02824965).

Selected specimens examined. WESTERNAUSTRALIA: [localities withheld for conservation reasons] 25 Nov. 1994, *D. Nicolle* 1145 (AD); 25 Mar. 2010, *D. Nicolle* 5537 & *M.E. French* (PERTH).

Notes. A single interserial hybrid between *E. decipiens* and *E. virginea* (of *E. ser. Curvipterae*) is known from west of Busselton. This individual was described as *E. phylacis* by Hill and Johnson (1992), who described the new species as having an affinity with *E. decipiens*. The individual is sterile (it flowers profusely but does not produce viable seeds). *Eucalyptus phylacis* consists of numerous stems covering an area of approximately 10 × 10 metres, but it has been demonstrated to represent a single genetic individual presumably of very old age (Rossetto *et al.* 1999). The bark, vegetative and reproductive morphology of *E. phylacis* is intermediate between that of *E. decipiens* (which occurs within 5 km of the *E. phylacis* genet) and *E. virginea*, a recently described close relative of *E. lane-poolei* (Hopper & Wardell-Johnson 2004), which at the time of its description was known only from a few populations near Denmark on the south coast of Western Australia. Rossetto *et al.* (1999) investigated the possibility of *E. phylacis* being of F1 hybrid origin (with *E. decipiens* as one of the parents), but rejected the hypothesis due to the lack of a suitable second parental species in the area (i.e. *E. lane-poolei* or a related species). In 2010, following an earlier wildfire which burnt the *E. phylacis* genet and allowed easier access through, and visibility within, surrounding vegetation, a population of *E. virginea* consisting of about ten clumps of plants was discovered approximately 250 m south of the *E. phylacis* genet (Figure 9). We conclude that *E. phylacis* is a very old individual of F1 hybrid origin between *E. virginea* (most likely the seed parent, based on its close proximity) and *E. decipiens* (most likely the pollen parent, based on its further proximity). *Eucalyptus phylacis* is currently listed as Threatened Flora in Western Australia (Smith 2012). We recommend that it be delisted due to its probable hybrid status and seed sterility.

17. *Eucalyptus adesmophloia* (Brooker & Hopper) D.Nicolle & M.E.French, *comb. et stat. nov.*

Eucalyptus decipiens subsp. *adesmophloia* Brooker & Hopper, *Nuytsia* 9: 22 (1993). *Type*: 8.2 km south along Carlawillup Road, Western Australia, 9 March 1988, *M.I.H. Brooker* 9907 (*holo*: PERTH 01379755; *iso*: AD, CANB, MEL *n.v.*, NSW image seen).



Figure 9. Part of the population of *Eucalyptus virginea* occurring about 250 m south of the *E. phylacis* genet west of Busselton.

Eucalyptus decipiens var. *angustifolia* Schauer, in Lehm., *Pl. Preiss.* 1: 130 (1840). *Type*: Cape Riche, Western Australia, November 1840, *L. Preiss* 241 (*syn*: *G n.v.*).

Mallee to 7 m tall, lignotuber present (resprouter). *Bark* variable depending on its stage of decortication, loosely rough throughout (prior to decortication) to completely smooth (following decortication), grey to pale grey over cream, decorticating in plates and short strips. *Branchlets* terete, not waxy. *Later seedling leaves* orbicular, emarginate, dull, blue-green. *Juvenile leaves* not waxy. *Adult leaves* lanceolate (to broad-lanceolate), 50–80 mm long \times 16–20 mm wide, dull and slightly blue-green at first, aging to glossy and dark green. *Umbellasters* erect, 9–27-flowered; peduncles angular to slightly flattened, 8–10 mm long; pedicels absent or to 1 mm long. *Flower buds* greenish, not waxy, 3–5 mm wide; hypanthia smooth; opercula conical, smooth, 1–1.5 times as long as hypanthia, 4–6 mm long. *Staminal filaments* white. *Fruits* sessile or on pedicels to 1 mm long, obconical to hemispherical, smooth, 5–6 mm long \times 5–6 mm diam.; disc level; valves 3 or 4, around rim level.

Diagnostic features. Distinguished within the series by its combination of mallee habit (lignotuber present; resprouter); bark loosely rough to smooth (depending on its stage of decortication), decorticating in plates and short strips; terete, non-waxy branchlets; \pm orbicular, emarginate seedling leaves; small adult leaves; 9–27-flowered, erect umbellasters; short to medium-length, terete peduncles, pedicels absent or very short; non-waxy buds; smooth bud hypanthia; smooth conical opercula 1–1.5 times as long as hypanthia; and small, obconical to hemispherical, smooth, sessile fruits.

Selected specimens examined (west to east). WESTERNAUSTRALIA: 0.5 km ENE of Warriup Hill, 60 km ENE of Albany, 20 Sep. 1976, *R. Story* 8265 (CANB, PERTH); 4.8 km NNW of Mt Melville, 31 Jan. 1988, *A. Napier & A. Taylor* 225 (PERTH); Millers Point Rd to Beaufort Inlet, 9 Dec. 1992, *D. Nicolle* 216 (AD); 12.3 km N of Bremer Bay–Borden Rd on Jerramungup Rd, 25 Nov. 1987, *M.I.H. Brooker* 9819 (AD, CANB, PERTH); Carlawillup Rd, N of Marnigarup Rd, 9 Dec. 1992, *D. Nicolle* 209 (AD); towards Bremer Bay, along Gairdner South Rd, 4 Sep. 1969, *D.J. Carr & S.G.M. Carr* 1112 (AD, CANB, MEL, NSW, PERTH); Bremer River, 22 Feb. 1994, *T. Overhue* 458A (PERTH); Gairdner River crossing near Quaalup, 9 Mar. 1988, *M.I.H. Brooker* 9915 (AD, CANB, PERTH); south-west Australia, near Fitzgerald N.P., Quaalup Walk, 30 Sep. 1996, *C.E. Ecroyd* 230 (PERTH); Pt Anne, 500 m S of car park at end of road, Fitzgerald River N.P., 3 Dec. 1991, *N. McQuoid* 217 (PERTH).

Distribution and habitat. Occurs from the southern slopes of the Stirling Range southwards to the Manypeaks area and eastwards towards Middle Mount Barren in the Fitzgerald River National Park; endemic to Western Australia (Figure 7). Restricted to white sands, generally on plains in mallee shrubland, where it is often associated with a number of eucalypt species, including *E. angulosa*, *E. calcicola* subsp. *unita*, *E. notactites*, *E. lehmannii* subsp. *parallela*, *E. occidentalis*, *E. pachyloma*, *E. phaenophylla*, *E. pleurocarpa*, *E. preissiana* subsp. *preissiana*, *E. staeri* and *E. uncinata*.

Conservation status. Not currently considered to be at risk. Common in the western parts of Fitzgerald River National Park.

Notes. *Eucalyptus adesmophloia* is geographically and morphologically intermediate between *E. decipiens* and *E. obesa*. In morphology, its intermediate characteristics are most obvious in the bark, but are also apparent in the flower bud and fruit morphology. As such, *E. adesmophloia* may represent an ancestral species from which *E. decipiens* and *E. obesa* have evolved in opposite directions (primary evolution), and/or represent an ‘intergrade’ between *E. decipiens* and *E. obesa*, having originated from gene-flow between these two species when they came into geographical contact (secondary evolution). Either way, we regard *E. adesmophloia* as equally related to both *E. decipiens* and *E. obesa* (no closer to one than the other), and therefore consider that specific status is more appropriate than subspecific status to one or the other of these related species. Although *E. adesmophloia* may have originated through gene flow between *E. decipiens* and *E. obesa*, the species occurs over a large area and is morphologically consistent throughout its distribution – hence we believe that its taxonomic recognition is appropriate. We do not include the Meckering and Dongalocking populations (here cited as *E. decipiens* – *E. obesa* intergrades) in *E. adesmophloia*, as they occur far from the distribution of *E. adesmophloia* and have subtly different bark morphology.

Although *E. adesmophloia* occurs over a relatively large area and is morphologically consistent across its distribution, intermediates with *E. decipiens* (to the west) and *E. obesa* (to the east) do occur over small areas at each end of its distribution. *Eucalyptus adesmophloia* intergrades with the rough-barked *E. decipiens* on northern slopes of the Stirling Range and the immediately adjacent plain (representative of the type of *E. decipiens* subsp. *chalara*), and a discussion of these intergrades is provided under *E. decipiens*. *Eucalyptus adesmophloia* also intergrades with the smooth, ribbon-barked *E. obesa* in the eastern part of the Fitzgerald River National Park (representative of the type of *E. communalis* Brooker & Hopper) and this intergrading population is discussed separately below.

A putative hybrid is known with *E. notactites* (see under *E. notactites*). Intergrading populations occur with *E. decipiens* (see under *E. decipiens*) and with *E. obesa* (discussed below).

***Eucalyptus adesmophloia* – *E. obesa* intergrades**

Eucalyptus communalis Brooker & Hopper, *Nuytsia* 9: 19 (1993). *Type*: 20 km south-east of Hamersley River Bridge, 14.9 km south down Hamersley Drive [in Fitzgerald River National Park], Western Australia, 1 August 1982, *S.D. Hopper* 2413A (*holo*: PERTH 01377647).

Selected specimens examined (west to east). WESTERN AUSTRALIA: Fitzgerald River N.P., along Fitzgerald Drv, 30 Aug. 1998, *M.I.H. Brooker* 12920 & *A.V. Slee* (CANB, PERTH); Hamersley Drv, Fitzgerald River N.P., 9 Dec. 1992, *D. Nicolle* 200 (AD); Fitzgerald River N.P., Hamersley Drv 19 km S of Old Ongerup Rd, 9 Oct. 1984, *B. Briggs* 7697 & *L. Johnson* (CANB, NSW, PERTH).

Notes. Brooker and Hopper (1993) described *E. communalis* to accommodate populations of plants previously attributed to *E. decipiens* occurring along the south coast of Western Australia between Bremer Bay and east of Esperance. Their diagnosis of the species lacks detail, but it appears that the species is distinguished from closely related species primarily in its ‘erect-stemmed emergent habit’ (Brooker & Hopper 1993). Extensive field observations of all the taxa in the series suggests that the erect-stemmed emergent habit in some populations is entirely related to fire frequency (i.e. vegetation type) and the time elapsed since the plant was last burnt (i.e. the size and form of the plant’s stems). We find that populations of plants included in *E. communalis* by Brooker and Hopper (1993) between Hopetoun and north-east of Esperance are indistinguishable from *E. obesa* occurring elsewhere. Indeed, Brooker and Hopper (1993) cited specimens from Cheadanup Reserve (between Ravensthorpe and Esperance) as both *E. communalis* and *E. obesa*, despite the Cheadanup Reserve population clearly belonging to a single taxonomic entity. Likewise, we consider populations of plants included in *E. communalis* by Brooker and Hopper (1993) in the western part of the Fitzgerald River National Park to be indistinguishable from *E. adesmophloia* occurring elsewhere. Brooker and Hopper (1993) cited specimens of both *E. communalis* and *E. adesmophloia* (as *E. decipiens* subsp. *adesmophloia*) from the western part of the Fitzgerald River National Park, apparently based on habit differences which we consider to be environmentally determined. The type population of *E. communalis*, from the eastern part of the Fitzgerald River National Park, is geographically intermediate between *E. adesmophloia* (to the west) and *E. obesa* (to the east and north), and is morphologically variable but generally intermediate between these two species. In summary, we regard the type population of *E. communalis* as being an intergrade between *E. adesmophloia* and *E. obesa*, and regard all other populations cited in *E. communalis* by Brooker and Hopper (1993) as representative of *E. adesmophloia* (where to the west of the type population of *E. communalis*) or *E. obesa* (where to the east of the type population of *E. communalis*).

18. *Eucalyptus obesa* Brooker & Hopper, *Nuytsia* 9: 21 (1993). *Type*: 7.9 km west of Hills Road on Tarin Rock Road, Western Australia, 16 December 1987, *M.I.H. Brooker* 9832 (*holo*: PERTH 01392905; *iso*: AD, CANB, MEL *n.v.*, NSW image seen).

Mallee to 10 m tall, lignotuber present (resprouter). *Bark* smooth throughout (but decorticated ribbons of bark sometimes accumulating on the lower stems), dull, pale grey to pink-tan over white and often powdery, decortivating in strips and ribbons. *Branchlets* ±terete, not waxy. *Later seedling leaves* orbicular to broader than long, usually emarginate, to 35 mm long × 35 mm wide, dull, blue-green. *Juvenile leaves* not waxy. *Adult leaves* lanceolate (to broad lanceolate), 65–115 mm long × 12–20 mm wide, dull and slightly blue-green at first, aging to glossy and dark green, whole crown green to somewhat purplish. *Umbellasters* erect, 9–27-flowered; peduncles terete, 3–11(–20) mm long; pedicels absent. *Flower buds* greenish, not waxy, 5 mm wide; hypanthia smooth or flat-sided due to crowding; opercula hemispherical to conical, smooth, about as long as hypanthia, 5 mm long. *Staminal filaments* white.

Fruits sessile, globose to truncate-globose, smooth or flat-sided due to crowding, 5–7 mm long × 7–8 mm diam.; disc ±level to slightly descending; valves 3 or 4, around rim level.

Diagnostic features. Distinguished within the series by its combination of mallee habit (lignotuber present; resprouter); smooth bark decorticating in strips; ±terete, non-waxy branchlets; orbicular, emarginate seedling leaves; small to medium-sized adult leaves; 9–27-flowered, erect umbellasters; short to medium-length, terete peduncles, pedicels absent; non-waxy buds; smooth or slightly flat-sided (due to crowding) bud hypanthia; smooth, hemispherical to conical opercula about as long as hypanthia; and small to medium-sized, globose to truncate-globose, smooth or flat-sided (due to crowding), sessile fruits.

Selected specimens examined (west to east). WESTERN AUSTRALIA: 7.9 km W of Jipsons Rd on Tarin Rock Rd, 24 Nov. 1987, *M.I.H. Brooker* 9810 (CANB, PERTH); Harrismith–Lake Grace Rd, 16 Feb. 2000, *M.E. French* 1113 (PERTH); E of Lake Grace towards Newdegate, 21 Jan. 2001, *D. Nicolle* 3724 & *M.E. French* (CANB, PERTH); Billercay Rd, NW of Hyden, 22 Mar. 2006, *M.E. French* 1773 (AD, PERTH); Hyden–Norseman Rd, 1 Mar. 2003, *M.E. French* 1500 (PERTH); Lake King–Norseman Rd, Frank Hann N.P., 22 Nov. 1994, *D. Nicolle* 1109 (AD); Middle Rd, Jerdacuttup, Esperance Plains, 17 Feb. 2000, *M.E. French* 1128 (PERTH); Middle Rd, McDougal’s eastern paddock to S of road, 10 Mar. 1988, *M.I.H. Brooker* 9925 (CANB, PERTH); Cheadanup Reserve, 12 Nov. 1981, *M.I.H. Brooker* 7139 (CANB, NSW, PERTH); Bremer Range, 12 May 1989, *S.D. Hopper* 7237 (PERTH); S of Lake Tay on Lake Tay Rd, ex new Cascade road, NW of Cascade 26 Feb. 2001, *M.E. French* 1277 (PERTH); Southern foot of Peak Charles, 21 Mar. 2010, *D. Nicolle* 5478 & *M.E. French* (CANB, PERTH); corner of Backmans Rd and Scadden Rd, 18 Mar. 1998, *M.E. French* 416 (PERTH); 4.5 km SW of Lanes Rd on Backmans Rd, NE of Esperance, 12 Aug. 1982, *M.I.H. Brooker* 7557 (CANB, PERTH); 150 m NE of corner Backmans Rd and Scadden Rd, 21 Mar. 2010, *D. Nicolle* 5483 & *M.E. French* (CANB, PERTH); 6 km SW along Savages Rd from E.L.D. Rd, 12 Aug. 1982, *M.I.H. Brooker* 7556 (CANB, PERTH); Ridgeland Rd, N of Condingup, 4 May 2012, *D. Nicolle* 6374 & *M.E. French* (PERTH).

Distribution and habitat. Of widespread but extremely scattered distribution in the wheatbelt region of southern Western Australia, from north-west of Tarin Rock and north-west of Hyden south-westwards to near the south coast near Hopetoun and east to Condingup (Figure 7). The species usually occurs on pure and often deep white sands on plains or broad rises, with populations generally being distinct, small and well distanced from other populations. The species often occurs in pure stands or may be associated with *Callitris* sp., *E. albida*, *E. ecostata*, *E. incrassata*, *E. litorea* (syn. *E. famelica*), *E. sporadica*, *E. pleurocarpa* and *E. uncinata*.

Conservation status. Not considered to be at risk. Despite the widespread distribution of the species, populations are very scattered and the species must be regarded as uncommon. Recorded from Frank Hann and Peak Charles National Parks.

Notes. Although *E. obesa* is a distinctive and generally well defined species, its population structure (a large total distribution with populations generally being distinct, small and well-spaced) has led to some morphological variation within the species. In particular, plants from Peak Charles (at the foot of the peak and surrounding plains, but not on the peak itself) are distinctive in the field due to the purplish tone to the crowns of the plants, which is especially noticeable from above (i.e. from the slopes of Peak Charles). The purplish colour of the leaves, and particularly the new growth, appears to be genetically determined, as seedlings grown from this population also display the same colouration—in this respect the population parallels the distinctive purple crowns of *E. purpurata*.

(also described in this treatment). However, unlike in *E. purpurata*, the purplish colouration of the leaves of *E. obesa* from Peak Charles is somewhat variable between plants and is not noticeable on dried specimens and has not been noted by the collectors of other specimens from this population. Furthermore, there appear to be no other distinguishing characteristics which distinguish the Peak Charles population from other populations of *E. obesa*. While at this stage we do not regard the Peak Charles populations of *E. obesa* to be worthy of taxonomic distinction, we anticipate that further research is likely to elucidate its status.

Brooker and Hopper (1993) included populations of *E. obesa* between Hopetoun and north-east of Esperance in their concept of *E. communalis* (see under *E. adesmophloia* for a discussion of the status of *E. communalis*, the type of which we regard as an intergrade between *E. adesmophloia* and *E. obesa*). Other than the habit differences used by Brooker and Hopper to distinguish *E. obesa* and *E. communalis*, which we believe are environmentally determined, these authors erroneously state that *E. obesa* differs from *E. communalis* in its non-emarginate (entire) juvenile leaves. Having sampled and/or grown juvenile leaves across the range of all taxa in the series, we can find no significant difference between the juvenile leaves of *E. decipiens*, *E. adesmophloia* and *E. obesa* (and intergrades between these species), and have found that these species can all have emarginate leaves during their juvenile leaf phase.

Eucalyptus obesa intergrades with the rough-barked *E. decipiens* at two very isolated localities in the wheatbelt and a discussion of these intergrades is provided under *E. decipiens*. *Eucalyptus obesa* also intergrades with the platy-barked *E. adesmophloia* in a small area in the eastern part of the Fitzgerald River National Park (representative of the type of *E. communalis*) and a discussion of these intergrades is provided under *E. adesmophloia*.

Hybrids are known with *E. dorrieni* (see under *E. dorrieni*), *E. kessellii* (see under *E. kessellii*) and with *E. sp.* Southern Wheatbelt (see Nicolle *et al.* 2012 for a discussion of the application of *E. sp.* Southern Wheatbelt; specimen cited below).

***Eucalyptus obesa* × *E. sp.* Southern Wheatbelt (D. Nicolle & M. French DN 5507)**

Specimen examined. WESTERN AUSTRALIA: 1.5 km from Cascades to Lake King road on Lake Tay road, 21 Jan. 2001, D. Nicolle 3714 & M.E. French (CANB, PERTH).

Acknowledgements

We are grateful to staff at the State Herbarium of South Australia and at the Western Australian Herbarium for ongoing access to the herbarium facilities. More specifically, we thank Katrina Knight, Cheryl Parker and Skye Coffey at the Western Australian Herbarium for allowing access during their move of premises and for help with finding and photographing types, and the editors of *Nuytsia* for their efficiency in publishing this paper to allow validation of several new taxon names for a field guide being prepared by one of us (MEF). A number of people have collaborated in field work which involved studying the new species, including Bob Nicolle and Annett Börner. We thank Andrew Webb (DEC, Busselton) for bringing the population of *E. virginea* west of Busselton to our attention. Annett Börner kindly drew the distribution maps. Again we thank Ian Brooker for ongoing discussion regarding eucalypt taxonomy, and for checking and commenting on the manuscript.

References

- Brooker, M.I.H. (1976). Six new taxa of *Eucalyptus* from Western Australia. *Nuytsia* 2: 103–117.
- 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. & Hopper, S.D. (1993). New series, subseries, species and subspecies of *Eucalyptus* (Myrtaceae) from Western Australia and South Australia. *Nuytsia* 9: 1–68.
- Brooker, M.I.H. & Kleinig, D.A. (2001). *Field guide to eucalypts. Vol. 2. South-western and southern Australia*. 2nd edn (Bloomings Books: Melbourne.)
- Chippendale, G.M. (1988). *Eucalyptus, Angophora* In: George, A.S. (ed.) *Flora of Australia. Vol.19, Myrtaceae - Eucalyptus, Angophora*. (Australian Government Publishing Service: Canberra.)
- Grayling, P.M. & Brooker, M.I.H. (1992). Four new species of *Eucalyptus* (Myrtaceae) from Western Australia. *Nuytsia* 8: 209–218.
- Hill, K.D. & Johnson, L.A.S. (1992). Systematic studies in the eucalypts. 5. New taxa and combinations in *Eucalyptus* (Myrtaceae) in Western Australia. *Telopea* 4: 561–634.
- Hopper, S.D. & Wardell-Johnson, G. (2004). *Eucalyptus virginea* and *E. relictata* (Myrtaceae), two new rare forest trees from south-western Australia allied to *E. lane-poolei*, and a new phantom hybrid. *Nuytsia* 15: 227–240.
- Johnson, L.A.S., & Hill, K.D. (1999). Systematic studies in the eucalypts. 9. A review of series *Sociales* (*Eucalyptus* subgenus *Symphyomyrtus*, Section *Bisectaria*, Myrtaceae). *Telopea* 8: 165–218.
- Nicolle, D. (2002). Two new species of silver mallet (*Eucalyptus* – Myrtaceae) of very restricted distribution in south-western Western Australia. *Nuytsia* 15: 77–83.
- Nicolle, D. (2005). A taxonomic revision and morphological variation within *Eucalyptus* series *Subulatae* subseries *Decussatae* and *Decurrentes* (Myrtaceae) of Australia. *Australian Systematic Botany* 18: 473–524.
- Nicolle, D., French, M.E. & Thiele, K. (2012). Notes on the identity and status of Western Australian phrase names in *Corymbia* and *Eucalyptus* (Myrtaceae). *Nuytsia* 22: 93–110.
- Nicolle, D., Whalen, M.A. & Mackay, D.A. (2006). Morphological variation and phylogenetic relationships within *Eucalyptus* series *Subulatae* (Myrtaceae) of southern Australia. *Australian Systematic Botany* 19: 59–86.
- Rossetto, M., Jezierski, G., Hopper, S.D. & Dixon, K.W. (1999). Conservation genetics and clonality in two critically endangered eucalypts from the highly endemic south-western Australian flora. *Biological Conservation* 88: 321–332.
- Slee, A.V., Brooker, M.I.H., Duffy, S.M. & West, J.G. (2006). *Euclid, eucalypts of Australia*. 3rd edn (CSIRO Publishing, Australia.)
- Smith, M.G. (2012). *Threatened and Priority Flora list for Western Australia*. (Department of Environment and Conservation: Kensington, Western Australia.)