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Eucalyptus wimmerensis revisited and notes on the morphologies and taxonomies of five Victorian mallee-boxes

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Introduction

Taxa previously regarded as mallee-boxes were included in the Series *Subbuxaeales* Blakely (1934). Various taxonomists and commentators, for example, Chippendale (1988), Brooker & Slee (1997), Nicolle (1997) and (2006) and Rule (2004) have maintained this classification. However, Brooker (2000), in his revision of the genus, discarded the series and assigned the mallee-boxes to the Supraspecies *Moluccanae* within the Series *Buxaeales*. Rule (2012) noted that Brooker's construct was an aggregation of morphologically diverse taxa and opted to define a narrower, informal complex of species which possess specific, shared features. This informal collective, here referred to as the *Eucalyptus odorata* Complex, is further used to accommodate the new taxa described below. Such shared features include a mallee or a small, tree-like habit, adult leaves with mostly irregular island glands, inflorescences that are simple and axillary, buds with the outer operculum intact at anthesis and fruits that are 3 or 4-loculed. Species conforming to this prescription include *E. odorata* Behr, *E. polybractea* R.Baker, *E. viridis* R.Baker, *E. wimmerensis* Rule, *E. aenea* K.D.Hill, *E. castrensis* K.D.Hill, *E. walshii* Rule, *E. filiformis* Rule, *E. hawkeri* Rule, *E. yarriambiack* Rule and *E. cajuputea* F.Muell. ex Miq.

Eucalyptus silvestris Rule (1994), a species that has sometimes been confused with *E. wimmerensis* in the field, was erected to accommodate small, box-barked trees or robust mallees occurring in the Wimmera region

Abstract

Four new subspecies of *Eucalyptus wimmerensis* (subsp. *arapilensis*, subsp. *pallida*, subsp. *parviformis* and subsp. *grata*) and a new subspecies of *E. polybractea* (subsp. *subcerea*) are described. Their affinities, ecologies, distributions and conservation statuses are discussed. In all cases the new taxa are regarded as rare and threatened. In addition, notes are provided that clarify the morphologies and taxonomies of five Victorian mallee-boxes, namely *E. silvestris*, *E. hawkeri*, *E. yarriambiack*, *E. walshii* and *E. filiformis* which are related to or confused with *E. odorata*, *E. wimmerensis*, *E. polybractea* or *E. viridis*.

Keywords: Mallee-box, Series *Subbuxaeales*, Series *Buxaeales*, Supraspecies *Moluccanae*, pruinosity, whipstick, mallee.

of western Victoria. Originally it was regarded as having an affinity with *E. odorata* but subsequent research by this author indicates it is better placed with the grey boxes adjacent to *E. woollsiana* R.T.Baker and *E. microcarpa* Maiden. Further comments on the affinities of this species are provided in the attached notes.

Eucalyptus macmahonii Rule (1997) is a smooth-barked, green-leaved mallee that has also been associated with *E. wimmerensis*. It was interpreted as being a member of the series *Rufispermae* Maiden but was regarded as being an intersectional hybrid between *E. wimmerensis* and *E. phenax* subsp. *phenax* Brooker & Slee, for example, by Brooker and Kleinig (2001)

and Nicolle (2006). In the field it is readily separable from *E. wimmerensis* by its adult leaves being densely reticulate with mostly intersectional glands, its maturing buds retaining fragments of the outer operculum, and its fruits being cupular, generally larger and smooth-walled (0.6–0.9 mm long, 0.5–0.8 mm diam.). In more recent times intermittent field observations by this author have found sporadic occurrences of the species throughout the Wimmera region and near Bordertown in South Australia. Nowhere is the species common, but it is best represented in the Mt Arapiles-Nurcoung area and in the Lawloit Range. More study is needed to clarify its origins.

Key to species of the *E. odorata* complex

1	Buds, branchlets and immature fruits copiously pruinose	<i>E. polybractea</i>
1:	Adult structures non-pruinose or, if so, growth tips and buds faintly pruinose at anthesis	2
2	Juvenile leaves ovate, 1.5–4 cm wide	<i>E. castrensis</i>
2:	Juvenile leaves linear to ovate-lanceolate, 0.2–2.5 cm wide	3
3	Growth tips and buds becoming faintly pruinose at anthesis	4
3:	Growth tips and buds not pruinose at any stage	6
4	Slender-stemmed mallees	<i>E. polybractea</i>
4:	Spreading, robust, single or few-stemmed trees	5
5	Juvenile leaves 1–2.5 cm wide; fruits 4–7 mm diam.	<i>E. odorata</i>
5:	Juvenile leaves 0.7–1.1 cm wide; fruits 3–4 mm diam.	<i>E. yarriambiack</i>
6	Juvenile leaves 0.2–0.5 cm wide	7
6:	Juvenile leaves 0.4–2.5 cm wide	8
7	Adult leaves lustrous, green	<i>E. viridis</i>
7:	Adult leaves dull to sub-lustrous, blue-green	<i>E. filiformis</i>
8	Smooth bark throughout	9
8:	Rough bark present at least as a short basal stocking	12
9	Slender trees; adult leaves 1.4–2.6 cm wide	<i>E. walshii</i>
9:	Mallees; adult leaves 0.6–1.8 cm wide	10
10	Buds 3–5 mm diam.; fruits 4–7 mm diam.	<i>E. wimmerensis</i>
10:	Buds 2–3 mm diam.; fruits 3–5 mm diam.	11
11	Adult leaves lettuce-green	<i>E. aenea</i>
11:	Adult leaves greenish with a bluish tinge	<i>E. wimmerensis</i>
12	Basal box bark hard, compact, finely fissured; adult leaves linear, to 16 cm long.....	<i>E. cajuputea</i>
12:	Basal box bark thick, irregularly furrowed or thin and loosely held; adult leaves narrow-lanceolate or lanceolate, to 12 cm long	13
13	Box bark restricted to a short basal stocking	<i>E. wimmerensis</i>
13:	Box bark persistent to mid-stem or higher	14
14	Slender-stemmed trees to 20 m tall; canopy sparse; foliage pendulous	<i>E. hawkeri</i>
14:	Mallees or robust spreading trees to 12 m tall; canopy moderately dense; foliage erect	15
15	Juvenile leaves 0.4–1 cm wide; fruits 4–5 mm diam.	<i>E. wimmerensis</i>
15:	Juvenile leaves 1–2.5 cm wide; fruits 4–7 mm diam.	<i>E. odorata</i>

Within the Wimmera region of western Victoria, including the Little Desert, there are small islands of mallee-box communities which mostly occur on laterite rises both within the Little Desert and within adjoining areas predominantly used for agriculture. Through many years of investigation by this author it has been found that these communities, in addition to *E. wimmerensis*, contain a variety of mallee-box entities which, probably due to isolation, have taken different evolutionary paths. Field observations and progeny trials have shown that several are worthy of taxonomic recognition, with some having been described recently, others being described in this paper and a few still under investigation. This last group includes a whipstick mallee from Mt Jeffcott near Donald, a dwarf, glaucous, linear-leaved mallee from both Mt Elgin to the west of Nhill and Nurcounng near Mt Arapiles, a mallee scattered sparsely throughout the Wimmera and featuring linear, lustrous and green adult leaves and small, ovoid fruits and a weeping mallee, also from Nurcounng, which sheds its outer operculum prior to anthesis. Most of these unnamed entities, including some of those treated here, are regarded as existing in such meagre numbers that they are on the verge of extinction. Whether the circumstances of these rarities can be attributed to the clearing for farming or whether they are naturally in decline is a matter for speculation. It is a view taken here that, if investigations through progeny trials and field studies indicate that an entity meets the necessary criteria for taxonomic recognition, it should be treated as such.

These studies have indicated that *E. wimmerensis* sens. lat. contains a number of identifiable, divergent entities, each of which is considered worthy of taxonomic recognition. In addition to the typical form, which occurs in the north-western part of Wimmera and adjacent areas of South Australia, the Little Desert and in the southern Wimmera near Mt Arapiles at Cooack and Nurcounng, four new subspecies of *E. wimmerensis* are treated here. Two (subsp. *arapilensis* and subsp. *parviformis*) occur in the southern Wimmera and two (subsp. *pallida* subsp. *grata*) occur in the Lawloit Range in the north-western part of the region. In addition, a relatively common mallee-box, which occurs in the southern Wimmera and which has been regarded as a dull-leaved form of *E. wimmerensis*, is here recognised as having a closer affinity with *E. polybractea*. It is thus described as a new subspecies within *E. polybractea* (subsp. *subcerea*).

Terminology:

Glaucous and *pruinose* are regarded as synonymous. In this context, *glaucous* is considered to describe the whitish colour of leaves. It is not to be confused with the colours of blue-grey or grey-green. On the other hand, *pruinose*, is used to describe the waxy bloom occurring on stems, petioles, buds and immature fruits.

Sub-glaucous refers to a leaf colour that is intermediate between blue-green and glaucous.

Linear refers to the length to width ratios being > 12:1.

Lanceolate refers to length to width ratios < 8:1 and with the broadest point being relatively close to the base.

Linear-lanceolate and *narrow-lanceolate* refer to length to width ratios intermediate between linear and lanceolate.

Ovate refers to length to width ratios of < 4:1 and broadest close to the middle of the leaf blade.

Seedling trials

Seedling trials using seed-lots representative of forms of *E. wimmerensis* and related mallee-box taxa were conducted in the nursery of the Royal Botanic Gardens Victoria (RBGV) and in a private facility. The standard procedure was to select 5–7 seedlings representative of each seed-lot for study when they had reached about the 6th pair juvenile leaves. Data, which included leaf shape, length and width, petiole length, level of congestion along the stem (crowded to sparse) and leaf colour and lustre, were collected from perfectly formed leaves at between the 8th and 10th pairs, this being a stage of seedling development at which morphological divergence could be observed. These same seedlings were retained for observations of further developments that might occur as the seedlings matured, particularly with regard to changes in leaf sizes and colour and lustre. The seedling trials had two aims. Given that the seedlings of the identified variants of *E. wimmerensis* have not been previously studied, the trials were designed to determine whether any are sufficiently divergent from the species to warrant specific recognition. The trials were also considered important in providing clarifications of the relationships between *E. wimmerensis* and related taxa, namely *E. polybractea* and *E. viridis*.

A. Trials for presumed forms of *E. wimmerensis* (excluding *E. wimmerensis* subsp. *grata*)

Previous field observations of adult plants identified several forms or variants close to but differing from typical *E. wimmerensis*. As well as the typical form, other entities presumed to be forms of the species included the following: 1. Northern Blue-leaved Form (a rare, shrubby mallee with dull, bluish adult leaves from the Lawloit Range in the north-western part of the Wimmera). 2. Mt Arapiles Box-barked Form (a mallee with a variable stocking of rough bark from the Mt Arapiles area in the southern part of the Wimmera). 3. Nurcoung Green-leaved Form (a small-growing, smooth-barked mallee with greenish, lustrous adult leaves from the Mt Arapiles-Nurcoung area in the southern Wimmera). 4. Southern Dull-leaved Form (a relatively common mallee with dull, blue-green adult leaves and faintly pruinose mature buds from the southern Wimmera). 5. Nurrabiel Box-barked Form (a tallish, rough-barked,

green-leaved form with a tree-like habit which is restricted to a single population in the Lower Norton-Nurrabiel area to the south-west of Horsham).

In the trials the following seed-lots of the forms of *E. wimmerensis* and related taxa (*E. viridis* and *E. polybractea*) were used: Typical form; north of Bordertown in South Australia, Diapur, Mt Elgin, Gerang Gerung, Little Desert, Kiata South and Cooack. Northern Blue-Leaved Form; 3 km west of Diapur. Mt Arapiles Box-barked Form; the north-east and south-west bases of the mountain and Jane Duff Reserve. Nurcoung Green-leaved Form; the Nurcoung Flora Reserve and the Mitre-Nurcoung Road. Southern Dull-leaved Form; c. 4 km south of Lower Norton, Mitre-Nurcoung Road and the north base of Mt Arapiles. Nurrabiel Box-barked Form; c. 7 km south of Lower Norton. *E. viridis*; south-east of Wedderburn. *E. polybractea*; north-west of Inglewood.

The results indicated that the seedlings across the provenances of typical *E. wimmerensis* exhibited little



Figure 1: *Eucalyptus viridis*, SE of Wedderburn seed-lot. a. tree; b. juvenile leaves; c. foliage.

variation and featured juvenile leaves that were linear-lanceolate, narrow-lanceolate or lanceolate, dull, blue-green to sub-glaucous and petiolate with moderately crowded internodes. Seedlings of the Mt Arapiles box-barked form had slightly narrower juvenile leaves than other forms whilst those of the Nurcoun green-leaved form were generally shorter. Seedlings of the northern blue-leaved form were inseparable from those of the provenances of typical *E. wimmerensis*. Seedlings of *E. polybractea* initially were similar to those of the forms of *E. wimmerensis* but as they matured their new leaves became increasingly glaucous. Seedlings of the southern dull-leaved form, although similar to other forms of *E. wimmerensis* in early juvenile development, also produced glaucous new leaves as they matured. The seedlings of *E. viridis* featured juvenile leaves that were linear, falcate, sessile or sub-sessile with crowded internodes, blue-green then green and lustrous. Lastly, the Nurrabiel box-barked form featured juveniles that were lanceolate to ovate-lanceolate, sub-glaucous and distinctly petiolate with relatively sparse internodes.

The trials of the forms of *E. wimmerensis* and related taxa indicated that, whilst three forms of *E. wimmerensis* (northern dull-leaved, Mt Arapiles and Nurcoun) show an appreciable level of divergence from the typical form in adult morphology, none is considered as having significantly divergent seedlings (see Table 1). On this basis it is considered appropriate that each form be recognised as a subspecies of *E. wimmerensis*. Whilst the seedlings of the southern dull-leaved form were initially similar to those of other forms of *E. wimmerensis*, the expression of glaucousness in more advanced seedling development, as well light seasonal glaucousness in adult leaf growing tips, suggests closer links with *E. polybractea*. This indicates that it is appropriate to recognise the form as a subspecies of *E. polybractea*. The similarities between the seedlings of *E. wimmerensis* and *E. polybractea* in early seedling development suggest that they are closely related taxa which show divergence in adult morphology. In particular, the latter develops blue-grey or glaucous adult leaves and usually conspicuously pruinose branchlets, buds and immature fruits. Despite this apparent divergence future molecular studies appear necessary to clarify this relationship.

With regard to the Nurrabiel box-barked form, seedlings from these trials and additional trials, along

with further field studies, indicate that it is closely related to *E. hawkeri* rather than to either *E. wimmerensis* or *E. polybractea* and best placed within that species. Additional seedling trials of seed-lots of similar plants occurring in the nearby Smith Reserve, which were previously recorded as *E. gracilis* F.Muell. (David Cameron, pers. Comm.), were also found to be close to *E. hawkeri*.

Lastly, these trials highlighted the differences between seedlings of *E. wimmerensis* (and its subspecies) and *E. viridis* and reinforces the case for regarding the two as separate species (Figures 1-6).

B. Trials of *E. wimmerensis* subsp. *grata*

Since the discovery of this taxon, approximately 20 years ago, six sets of trials have been conducted both in private facilities and the RBGV nursery. These trials have confirmed its capacity to produce uniform seedlings and alluded to its links with *E. wimmerensis*. Initially, it was thought to be related to *E. hawkeri*, mainly because of its weeping foliage and, to a lesser extent, its tallish habit and its short basal stocking of box bark. Recent comparative trials, which included seed-lots of four provenances of *E. hawkeri*, confirmed that the new taxon has a closer relationship with *E. wimmerensis*.

Taxonomy

1. *Eucalyptus wimmerensis* Rule, *Muelleria* 7(2): 193 (1990).

Type: VICTORIA. Lawloit Range on the Western Highway between Nhill and Kaniva, *J.H. Willis* sn. 27 Dec. 1964 s.n. (holotype: MEL 1057352)

Rule (1990) described *Eucalyptus wimmerensis* to accommodate mallee-box populations in the western part of the Victorian Wimmera region and adjacent areas of South Australia. Previously, populations of *E. wimmerensis* occurring in the Lawloit Range to the west of Nhill had been considered by Willis (1973) as a large-fruited form of *E. viridis*. However, the species only superficially resembles *E. viridis*, particularly during summer when new adult leaves in most populations become more lustrous and greener than normal. *E. viridis* is distinguished by its variable habit (usually a mallee but less often a small, single-stemmed tree), its

variable stocking of persistent compact, greyish box bark, its linear, sessile or shortly petiolate, lustrous and green, crowded juvenile leaves, its linear, lustrous and green adult leaves, with indistinct lateral veins usually obscured by numerous, crowded island glands, its linear, lustrous and green coppice leaves, its simple,

axillary, 7–11-flowered inflorescences and its distinctly pedicellate buds (pedicels usually being longer than the buds) and distinctly small, more or less cupular, thin-walled fruits (3–5 mm long, 2.5–5 mm diam.). In contrast, *E. wimmerensis* differs from *E. viridis* primarily by its consistent mallee habit, its broader, blue-green,

Table 1. Morphological comparisons of Mallee-box taxa.

Characters	<i>E. wimmerensis</i> <i>subsp. wimmerensis</i>	<i>E. wimmerensis</i> <i>subsp. arapilensis</i>	<i>E. wimmerensis</i> <i>subsp. parviformis</i>	<i>E. wimmerensis</i> <i>subsp. pallida</i>
Habit	mallee 4–10 m, foliage semi-erect	mallee 4–8 m, foliage semi-erect	shrub or mallee 2–5 m, foliage semi-erect	shrub or mallee 2–5 m, foliage semi-erect
Bark	smooth throughout or grey-brown box bark persistent at base	grey box bark to at least mid-stem	Smooth through-out	grey-brown box bark to about mid-stem
Juvenile leaves – shape	narrow-lanceolate to lanceolate	linear-lanceolate to narrow-lanceolate	narrow-lanceolate	narrow-lanceolate
– size (cm)	5–9 x 0.6–1.5	5–9 x 0.4–0.9	4–7 x 0.5–1	5–9 x 0.5–1
– colour/ lustre	blue-green, dull	blue-green, dull	blue-green, dull	blue-green, dull
– petiole length (cm)	0.6–1.2	0.7–1.6	0.6–1.1	0.6–1.4
Adult leaves – shape	narrow-lanceolate to lanceolate	narrow-lanceolate	narrow-lanceolate to lanceolate	narrow-lanceolate to lanceolate
– size (cm)	6–10 x 0.7–1.6	5–10 x 0.6–1	4–8 x 0.8–1.3	5–9 x 0.8–1.4
– colour/lustre	olive-green or green, with a faint bluish tinge, sub-lustrous or rarely lustrous	blue-green to green, sub-lustrous	green with a bluish tinge, sub-lustrous to lustrous	blue-green to sub-glaucous, dull
Petiole length (cm)	0.6–1.7	1–1.6	1–1.6	0.6–1.2
Peduncle length (cm)	0.7–1.2	0.4–1.1	0.3–0.7	0.6–1.1
Bud – Number	7–11	7–11	7–11	7–11
– shape	ovoid, fusiform or slightly clavate	ovoid to fusiform	ovoid	ovoid
– size (mm)	4–7 x 3–5	4–7 x 3–4	4–5 x 2–3	5–6 x 3–4
– pedicel length (mm)	2–4	4–7	1–3	2–3
Fruits – shape	cupular, sub-cylindrical or slightly barrel-shaped	cupular, sub-cylindrical or slightly barrel-shaped	hemi-spherical to cupular	hemi-spherical, cupular or globose-truncate
– size (mm)	4–7 x 4–6(–7)	5–6 x 4–5	4–5 x 3–4	4–6 x 4–5
– ribbing	rarely present	absent	absent	absent
– pedicel length (mm)	1–3	3–6	0–2	1–2
Pruinosity	absent	absent	absent	absent

distinctly petiolate juvenile leaves, its broader, duller, moderately reticulate, adult leaves with larger, irregular, discrete (non-crowded) island glands and its larger buds and larger, thick-walled fruits (fruits 5–7 mm long, 3–6(–7) mm diam.).

Brooker and Slee (1996) formally revised

E. wimmerensis to a subspecies of *E. viridis*. In this revision, to justify their assertion, they focussed on two characters, here regarded as of minor significance (the amount of box bark present as a basal stocking and the presence or absence of ribbing on the fruits), and ignored other, more important differences, such

Table 1. Morphological comparisons of Mallee-box taxa (continued)

Characters	<i>E. wimmerensis</i> <i>subsp. grata</i>	<i>E. polybractea</i> <i>subsp. polybractea</i>	<i>E. polybractea</i> <i>subsp. subcerea</i>	<i>E. viridis</i>
Habit	mallee or small tree 5–12 m, foliage weeping	mallee or slender tree 4–12 m, foliage semi-erect	mallee 4–8 m, foliage semi-erect	small tree or mallee 5–10 m, foliage semi-erect
Bark	stocking of light grey box bark on lower stem	dark grey-brown box bark persistent to various heights	dark grey-brown box bark persistent to various heights	dark grey compact bark on lower stem
Juvenile leaves – shape	narrow-lanceolate to lanceolate, often falcate	narrow-lanceolate to lanceolate	narrow-lanceolate	linear, often falcate
– size (cm)	7–12 x 0.7–1.8	4–10 x 0.8–1.5	5–9 x 0.6–1.2	5–10 x 0.2–0.5
– colour/ lustre	blue-green, dull	sub-glaucous to glaucous	initially sub-glaucous, eventually glaucous	blue-green, eventually green, lustrous
– petiole length (cm)	0.6–1.2	0.5–1.5	0.6–1.3	0–0.4
Adult leaves – shape	narrow-lanceolate to lanceolate, often falcate	narrow-lanceolate to lanceolate	narrow-lanceolate to lanceolate	linear to linear-lanceolate
– size (cm)	7–12 x 1–2	5–10 x 0.8–1.9	5–9 x 0.9–1.6	4–10 x 0.4–0.8
– colour/lustre	green, lustrous	sub-glaucous to glaucous	blue-green to sub-glaucous	green lustrous
Petiole length (cm)	0.6–1.5	1–1.6	1–1.8	0.6–1
Peduncle length (cm)	0.6–1.1	0.6–1.2	0.8–1.4	0.6–1.1
Bud – Number	7	7–11	7–11	7–11
– shape	clavate to sub-pyriform	ovoid to fusiform	ovoid	ovoid to fusiform
– size (mm)	6–8 x 3–4	4–7 x 3–5	5–6 x 3–4	4–6 x 2–3
– pedicel length (mm)	3–5	3–6	2–4	3–5
Fruits – shape	cupular, sub-pyriform or sub-cylindrical	cupular to sub-cylindrical	hemi-spherical to cupular	cupular to sub-cylindrical
– size (mm)	6–8 x 4–6	4–7 x 4–7	4–6 x 4–5	4–5 x 3–4
– ribbing	rarely basally ribbed	absent	absent	absent
– pedicel length (mm)	2–4	2–5	1–3	2–4
Pruinosity	absent	present on seedlings, copious on branchlets, buds and immature fruits	present on seedlings, faint on buds and growth tips at anthesis	absent

as in juvenile and adult leaves, buds and fruits, upon which the erection of *E. wimmerensis* had been based. Nicolle (1997) regarded *E. wimmerensis* as a subspecies of *E. viridis* and incorrectly gave its juvenile leaves as being glossy and green and the buds and fruits being almost identical to *E. viridis*. However, Nicolle (2006) adjusted his assessment of *E. wimmerensis* by regarding it as a species. In doing so he highlighted the differences between it and *E. viridis* in juvenile and adult leaves, buds and fruits. Also Nicolle (2006) suggested that *E. wimmerensis* is most closely related to *E. odorata*, a position that was given when the taxon was erected. A recent assessment of *E. wimmerensis* was made by Walsh and Stajsic (2008) who also accepted it as a species.

Eucalyptus cajuputea was recently resurrected by Nicolle (2013) to replace South Australian populations regarded as *E. viridis* by Boomsma (1981) and Brooker and Kleinig (1990). These latter authors noted that *E. viridis* is limited to a few restricted remnant populations in the Flinders Ranges and other populations attributed to the species are intergrades involving other box species of the region. Field observations and progeny trials conducted by this author, for the most part, support Nicolle's account of the species. Nicolle has also suggested that *E. cajuputea* may be conspecific with *E. wimmerensis*, a notion which is here rejected on the basis of differences between the two in several important characters. *E. cajuputea* differs from *E. wimmerensis* by being a tree at its optimum development (*E. wimmerensis* is consistently a mallee), having a substantial stocking of hard, dark, grey-brown, compact bark, (the rough bark of *E. wimmerensis*, when present, is thin and often loosely held), having longer, narrower juvenile leaves (linear to linear-lanceolate and to 13 cm long) and having longer,

linear adult leaves (to 16 cm long). In the case of buds and fruits, there is overlap in sizes but generally those of *E. cajuputea* are smaller (buds 2–3 mm wide and fruits 4–6 mm long, 3–5 mm wide).

Five subspecies of *E. wimmerensis* are recognised here.

1a. *Eucalyptus wimmerensis* Rule subsp. *wimmerensis*, *Muelleria* 9: 82 (1996).

Syn: *E. viridis* subsp. *wimmerensis* (Rule) Brooker & Snee

Mallees 4–10 m tall. *Bark* smooth throughout or with a variable stocking of thin, often loosely-attached, box-like bark; old bark deciduous in short ribbons and plates; new upper bark off-white, light grey or light brown, becoming darker with age. *Seedling leaves* narrow-elliptical, decussate, sessile for a few pairs. *Juvenile leaves* narrow-lanceolate to lanceolate, becoming slightly elliptical, broadening as seedlings mature, semi-erect, petiolate, disjunct, moderately crowded, dull, blue-green, slightly discolorous, 5–9 cm long, 0.8–1.5 cm wide; petioles 0.6–1.2. *Intermediate leaves* lanceolate or ovate-lanceolate, disjunct, petiolate, dull, blue-green, slightly discolorous or concolorous. *Adult leaves* narrow-lanceolate to lanceolate, acuminate, uncinata, olive-green, green or green with a bluish tinge, concolorous, sub-lustrous, rarely lustrous, semi-erect, coriaceous, 6–10 cm long, 0.7–1.6 cm wide; petioles to 0.6–1.7 cm long; venation moderately sparse with lateral veins conspicuous and moderately acute; intramarginal vein c. 1 mm from margin; oil glands numerous, large, irregular, island; new season's growth tips light green, sub-lustrous or lustrous. *Coppice leaves* blue-green, dull or sub-lustrous, elliptical to ovate-lanceolate. *Inflorescences* simple, axillary, 7–11-flowered,

Key to the subspecies of *Eucalyptus wimmerensis*

- | | | |
|----|-----------------------------------------------------------------------------------------------------|----------------------------------|
| 1 | Adult leaves dull, blue-green to sub-glaucous | subsp. <i>pallida</i> |
| 1: | Adult leaves sub-lustrous to lustrous, olive-green, green or green with a slight bluish tinge | 2 |
| 2 | Bark smooth throughout | 3 |
| 2: | Box bark present at least on lower stem | 4 |
| 3 | Juvenile leaves 0.5–1 cm wide; fruits 3–4 mm diam. | subsp. <i>parviformis</i> |
| 3: | Juvenile leaves 0.6–1.5 cm wide; fruits 4–7 mm diam. | subsp. <i>wimmerensis</i> |
| 4 | Box bark persistent to at least mid-stem; juvenile leaves 0.4–1 cm wide | subsp. <i>arapilensis</i> |
| 4: | Box bark forming a short basal stocking; juvenile leaves 1–1.8 cm wide | 5 |
| 5 | Adult leaves erect, 6–10 cm long, 0.7–1.6 cm wide | subsp. <i>wimmerensis</i> |
| 5: | Adult leaves pendulous, 7–12 cm long, 1–2 cm wide | subsp. <i>grata</i> |

along the main axis or along leafy terminal branchlets; peduncles slightly angled, 0.7–1.4 cm long. *Floral buds* ovoid to fusiform or clavate, sometimes slightly ribbed, pedicellate, non-scarred (outer operculum intact), 4–7 mm long, 3–5 mm diam.; pedicels 2–4 mm long; operculum conical or slightly obtuse, shorter than the hypanthium; hypanthium basally tapered, faintly angled; filaments white; stamens irregularly flexed, all fertile; anthers adnate, basifixed, globoid, dehiscing through sub-terminal pores; locules 3–4; ovules in 4 vertical rows. *Flowering period* mid-summer to autumn. *Fruits* cupular, sub-cylindrical or slightly barrel-shaped, sub-sessile to distinctly pedicellate sometimes slightly angled, 4–7 mm long, 4–6(–7) mm diam.; pedicels 1–3 mm long; disc descending; valves enclosed. *Fertile seeds* mid to dark brown, ovoid to slightly cuboid; dorsal surface shallowly reticulate; hilum ventral (Figure 2 and Table 1).

Distribution and habitat: The typical subspecies occurs in the north-western part of the Wimmera region and adjacent areas of South Australia, the Little Desert

and south of the Little Desert in the Nurcoung and Coock areas. It is commonly associated with laterite rises and is often the dominant species in the mallee communities in which it grows.

Associated species: *Eucalyptus calycogona* subsp. *trachybasis* Nicolle, *E. dumosa*, *E. phenax* subsp. *phenax*, *E. froggattii* Blakely, *E. leptophylla* F.Muell. ex Miq. *E. costata* F.Muell., *E. macmahonii* and *E. wimmerensis* subsp. *grata* (described below) have been observed growing with the typical subspecies of *E. wimmerensis* whilst it may abut or occur adjacent to *E. leucoxydon* subsp. *stephaniae* Rule, *E. arenacea* Marginson and Ladiges, *E. silvestris* and *E. largiflorens* F.Muell. At Nurcoung there is also contact with *E. wimmerensis* subsp. *parviformis* and *E. polybractea* subsp. *subcerea* (described below).

Conservation status: Field observations suggest that there is in excess of 20,000 plants of *E. wimmerensis* subsp. *wimmerensis* mostly occurring on roadsides, but less frequent in a few protected reserves, including the Little Desert National Park, and on private land.



Figure 2: *Eucalyptus wimmerensis* subsp. *wimmerensis*. a. juvenile leaves (Diapur seed-lot); b. typical mallee form, Little Desert; c. typical branchlet, Little Desert; d. typical coppice leaves, Diapur.

In Victoria the largest numbers of plants occur in the northern Wimmera in the Lawloit Range between Nhill and Kaniva and on the northern fringe of the Little Desert N.P. to the south of Kiata. In other areas of the northern Wimmera, such as at Gerang Gerung, north of Nhill, the Telopea Downs area and to the west of the Lawloit Range it is less common. In the southern Wimmera it is common on the southern edge of the Little Desert in the Cooack-Nurcoung area to the north of Mt Arapiles, mostly confined to roadsides and private land. The taxon has also been observed in the Little Desert at a few sites along the McDonald Highway and along the Nhill-Harrow Road but because of the nature of the terrain, it is impossible to estimate both its occurrence and numbers. In South Australia it is sparsely scattered to the north, north-west, west and south of Bordertown. Given that the taxon occurs in districts suitable for agriculture and that there are extensive sites where roadside remnants occur adjacent to cleared paddocks, it appears that substantial numbers were lost when farms were first established. Whilst field observations over a period of more than 25 years suggest there has been little recent decline in numbers and that seedling recruitment in some areas has been continuing, it is reasonable to anticipate some future losses may occur due to changing climatic conditions and the need for more land for agriculture. Thus, in accordance with IUCN (2001) guidelines the taxon is considered endangered (EN A2bc + 4bc).

Notes: The typical subspecies of *E. wimmerensis* is distinguished by its mallee habit (4–10 m tall), its short stocking of thin, box bark or smooth bark throughout, its dull, blue-green, linear-lanceolate or narrow-lanceolate juvenile leaves, which broaden as the seedlings mature, its green, olive-green or slightly bluish, usually sub-lustrous adult leaves, its relatively large buds (5–7 mm long, 3–5 mm diam.) and its relatively large fruits (5–7 mm long, 4–6(–7) mm diam.).

Field observations indicate that the height of the basal stocking of box bark changes across the seasons. During the winter months the stocking reaches its optimum height but much of it is shed in summer. Whilst some populations may carry a winter stocking of a few metres in height, other populations, some of which occur in the Little Desert and its southern fringes, carry only a modest basal stocking, all or most of which is shed in

summer. There is also seasonal change in the colour of the smooth upper bark of the typical subspecies. Initially, the fresh new bark, which appears in summer, is pale (off-white, light grey or light brown) but, as the year progresses, the bark becomes more colourful and sometimes slightly lustrous.

Field observations also indicate that the typical subspecies of *E. wimmerensis* undergoes changes in canopy colour and lustre. In summer the canopy is dominated by newly produced light green adult leaves following spring new growth that give the canopy an appreciably greener and more lustrous appearance than is seen in winter. This pattern of canopy change is similar in other subspecies of *E. wimmerensis*, particularly subsp. *arapilensis* and subsp. *parviformis*, but only slightly in subsp. *pallida* and subsp. *grata*. Observations further indicate that the colour and lustre of adult leaves of the typical subspecies varies within populations. Occurring in small numbers in some populations are variants that are more lustrous than normal. Despite changes in colour and lustre as the leaves mature, these variants tend to hold their lustre throughout the year. Whilst the significance of these individuals is not fully understood, it is suspected that they are intraspecific hybrids involving subsp. *grata*.

Within the typical subspecies, more than other subspecies, there is a wide range of fruit shapes which include cupular, sub-cylindrical and slightly barrel-shaped. With regard to ribbing, such is slight and infrequent and appears to be confined to the type subspecies. Recent surveys have also found individuals at Diapur and Nurcoung with fruits slightly wider than normal which extends the range of the subspecies to 4–6(–7) mm. diam.

1b. *Eucalyptus wimmerensis* subsp. *arapilensis* Rule sp. nov.

Type: Victoria. South-west side of Mt Arapiles, adjacent to the intersection of McClures Road and the southern access track, 36° 45' 50" S., 141° 48' 24" E. *K.Rule 5410*, 13 v 2010 (holotype: MEL 2419929; isotypes: AD, CANB, NSW).

Distinguished within *Eucalyptus wimmerensis* by the combination of its stocking of persistent box bark, which may extend to the upper stem, its variable mallee habit (erect and slender to modestly robust and spreading),

its linear-lanceolate to narrow-lanceolate juvenile leaves, its relatively small, blue-green adult leaves, its buds being borne on long pedicels and its relatively small fruits.

Mallees 4–8 m tall, habit variable, ranging from erect and slender to modestly robust and spreading. **Bark** grey, box type, as a variable stocking extending to upper stem on larger mallees or confined to about mid-stem on smaller mallees; upper smooth bark light brown; old bark decorticating in short strips and small plates. **Juvenile leaves** linear to linear-lanceolate, disjunct, petiolate, moderately crowded, dull, blue-green, slightly discolorous, 5–9 cm long, 0.4–0.9 cm wide; petioles 0.6–1 cm long. **Adult leaves** narrow-lanceolate, semi-erect, concolorous, sub-lustrous, blue-green, 5–10 cm long, 0.6–1 cm wide; petioles 0.7–1.6 cm long. **Inflorescences** 7–11-flowered; peduncles 0.4–1.1 cm long. **Floral buds** ovoid or fusiform, 4–7 mm long, 3–4 mm wide; operculum conical, c. half the length of the hypanthium; pedicels, 4–7 mm long. **Flowering period** autumn. **Fruits** cupular, sub-cylindrical or slightly barrel-shaped, basally tapered, 5–6 mm long, 4–5 mm diam.; pedicels, 3–6 mm long; disc descending; valves enclosed. (Figure 3 and Table 1)

Distribution and habitat: The new taxon is known from two locations; in the mallee communities which occur around northern and western bases of Mt Arapiles and in Jane Duff Reserve which is located about 7 km to the west of Mt Arapiles. Its preferred soils are shallow, well-drained gravels and sands.

Additional specimens examined: Victoria: Mt Arapiles, between access track and north-east base, c. 800 m south of McClures Road entrance, 36° 45' 00" S, 141° 50' 20" E., *K. Rule* 2910, 11 iv 2010 (MEL); Jane Duff Reserve 36° 43' 50" S., 141° 43' 18" E. *K. Rule* 5610, 13 v 2010 (MEL)

Etymology: The epithet refers to type locality of the new subspecies.

Associated species: *Eucalyptus hawkeri*, *E. leptophylla*, *E. macmahonii*, *E. costata* and *E. dumosa* occur as associates of the new taxon whilst *E. microcarpa*, *E. leucoxylon* subsp. *stephaniae* and *E. largiflorens* often about the mallee communities in which the new subspecies occurs. At Mt Arapiles it occurs close to *E. wimmerensis* subsp. *parviformis* and *E. polybractea* subsp. *subcerea* (described below) and at Jane Duff Reserve it occurs with the former. Hybrids between the new subspecies and *E. hawkeri*, which display slightly larger leaves than typical, have been confirmed through recent progeny trials. These occur both near the north-east base of Mt Arapiles and at two sites on its south-western side.

Conservation status: Whilst the new taxon is common where it occurs, field surveys suggest that it may be represented by between 400 and 600 plants, all of which occur within the complex of protected reserves of the Mt Arapiles-Tooan State Park. Whilst these numbers are low by national standards their continued protection indicates a secure future. In accordance with ICUN (2001) guidelines a status of vulnerable is recommended (VU D 1+2).



Figure 3: *Eucalyptus wimmerensis* subsp. *arapilensis*, NE of Mt Arapiles. a. mallee form; b. foliage.

Notes: *Eucalyptus wimmerensis* subsp. *arapilensis* differs from the typical subspecies by its substantial stocking of persistent box-like bark, its narrower juvenile leaves, its narrower, blue-green adult leaves and its relatively small buds and fruits borne on relatively long pedicels

Eucalyptus wimmerensis subsp. *arapilensis* differs from *E. polybractea* subsp. *subcerea* primarily by its lighter coloured persistent box bark, its narrower juvenile leaves, its greener adult leaves, its non-pruinose buds and growth tips and its distinctly pedicellate buds and fruits. From *E. wimmerensis* subsp. *parviformis* the new subspecies differs by its larger habit, its persistent box bark, its narrower juvenile leaves, its duller adult leaves and its fruits borne on longer pedicels (Table 1).

1c. *Eucalyptus wimmerensis* subsp. *parviformis* subsp. nov. Rule

Type: Victoria. Nurcoung Flora Reserve, along north-south boundary track, c. 800 m S of the east-west access track, 36° 41' 10" S., 141° 43' 20" E., *K.Rule 14006*, 3 x 2010 (holotype: MEL 2419926; isotypes: AD, CANB, NSW).

Distinguished within *Eucalyptus wimmerensis* by the combination of its relatively small habit, its smooth bark throughout, its generally smaller, greener and more lustrous adult leaves, and its small buds and fruits.

Shrubby, slender-stemmed *mallees* 2–5 m tall, *Bark* smooth throughout off-white, becoming light grey or brown with age; old bark decorticating in short strips and plates, loosely held on lower stem. *Juvenile leaves*

narrow-lanceolate, disjunct, petiolate, moderately crowded, dull, blue-green, slightly discolorous, 4–7 cm long, 0.5–1 cm wide; petioles 0.6–1.1 cm long. *Adult leaves* narrow-lanceolate or lanceolate, semi-erect, concolorous, sub-lustrous to lustrous, green with a bluish tinge, 4–8 cm long, 0.6–1.1 cm wide; petioles 0.6–1.2 cm long. *Inflorescences* 7–11-flowered; peduncles slender, terete, 0.3–0.7 cm long. *Floral buds* ovoid, shortly pedicellate, 4–5 mm long, 2–3 mm diam.; opercula conical, c. half the length of the hypanthium; pedicels 1–3 mm long. *Flowering period* summer. *Fruits* hemispherical to cupular, basally tapered, thick-walled, 4–5 mm long, 3–4 mm diam.; pedicels 0–2 mm long; disc descending; valves enclosed (Figure 4 and Table 1).

Distribution and habitat: *Eucalyptus wimmerensis* subsp. *parviformis* known from the Nurcoung area where it exists in moderate numbers and nearby from small stands at Jane Duff Reserve and on the southern and northern edges of the Mt Arapiles section of the Mt Arapiles-Toosan S.P. It is highly likely that other remnants exist in the district. It occurs in shallow sands or gravels on laterite rises.

Additional specimens examined: Victoria: Jane Duff Reserve 36° 43' 50" S., 141° 43' 18" E. *K. Rule 2112* and *L. Rule*, 24 iii 2012 (MEL); Nurcoung F.R., north-south boundary track, c. 200 m S from east-west access track 36° 40' 45" S. 141° 43' 22" E. *K. Rule 2512* and *L. Rule*, 24 iii 2012 (MEL); Mitre-Nurcoung Road, c. 700 m from Fullers Road towards Mitre, 36° 41' 20" S. 141° 44' 30" E. *K. Rule 2612* and *L. Rule*, 24 iii 2012 (MEL); Start of access track to Nurcoung F.R., 36° 40' 50" S., 141° 44' 15" *K. Rule 11112* and *L. Rule*, 18 xi 2012 (MEL); Golf Course Road, on boundary of the Mt Arapiles section of the Mt Arapiles-Toosan S.P., 36° 46' 25" S., 141° 48' 30" E., *K. Rule 4913* and *J. Dowling*, 13 xi 2013 (MEL);



Figure 4: *Eucalyptus wimmerensis* subsp. *parviformis*. a. mallee form, Nurcoung F.R.; b. fruits, Nurcoung F.R.

Adjacent to Nurcoung F.R. on private land, 36° 41' 00" S., 141° 43' 40" E., *K. Rule* 99103, 11 xi 1999 (MEL); Access track on northern side of Mt Arapiles, 36° 44' 30" S.: 141° 50' 00" E., *K. Rule* 5305, 24 ix 2005 (MEL).

Etymology: The specific epithet is derived from the Latin *parvius* 'small' and *formosus* 'form' which alludes to the many relatively small features of the subspecies.

Associated species: *Eucalyptus dumosa*, *E. leptophylla*, *E. phenax* subsp. *phenax*, *E. costata*, *E. calycogona* subsp. *calycogona* Turcz., *E. froggattii*, *E. macmahonii*, *E. wimmerensis* subsp. *wimmerensis*, *E. wimmerensis* subsp. *arapilensis*, *E. hawkeri* and the newly described *E. polybractea* subsp. *subcerea* have been observed as associated taxa. Along the Mitre-Nurcoung Road, to the west of the access track to the Nurcoung Flora Reserve, is a thicket of a large-fruited mallee-box which is morphologically consistent with the typical subspecies. On private land adjacent to the flora reserve small clumps of an unnamed mallee-box with glaucous, linear leaves occurs. Similar mallees are known from Mt Elgin. Also, in the Nurcoung Flora Reserve and in adjacent private land numerous apparent hybrids are present and appear to involve white mallees (*E. dumosa* or *E. phenax* subsp. *phenax*) and at least one of the associated subspecies of *E. wimmerensis*, *E. goniocalyx* subsp. *goniocalyx* F.Muell. ex Miq. and *E. leucoxydon* subsp. *stephaniae* also occur in close proximity to the new taxon. At Duff Reserve it occurs with *E. wimmerensis* subsp. *arapilensis*, *E. hawkeri* and *E. leptophylla* whilst at Mt Arapiles it occurs close to *E. arenacea*, *E. leucoxydon* subsp. *stephaniae*, *E. largiflorens*, *E. hawkeri* and *E. microcarpa*.

Conservation status: The new taxon occurs in small clumps or as individuals in the Nurcoung Flora Reserve and on adjoining private land, as well as along the adjacent Mitre-Nurcoung Road. Outliers occur at Jane Duff Reserve and Mt Arapiles. In the Nurcoung area the taxon is moderately abundant and estimated numbers are as high as 400 plants. Elsewhere its numbers are meagre but some unobserved plants may occur on adjacent private land that has not been accessed. Field observations suggest that within the area encompassed by Nurcoung, Mt Arapiles Jane Duff Reserve considerable habitat favoured by the taxon appears to have been lost to agriculture. Despite most of its numbers occurring within protected reserve, in accordance with IUCN (2001) guidelines, a status of endangered is recommended (EN A 2bc).

Notes: *Eucalyptus wimmerensis* subsp. *parviformis* is distinguished from the typical subspecies by its small, shrubby or whipstick habit, its smooth white to light grey bark, its smaller, more lustrous adult leaves and its smaller buds and fruits.

Eucalyptus wimmerensis subsp. *parviformis* closely resembles the associated, unrelated *E. leptophylla*, particularly as they are similar in habit, bark and adult leaves, as well as bud and fruit sizes. A close examination of their juvenile leaves, buds and fruits permits the two to be distinguished from each other. *Eucalyptus leptophylla* is distinctive in the field by its ovate, glaucous juvenile leaves, its reddish mature buds and its fruits featuring a descending whitish disc.

Eucalyptus wimmerensis subsp. *parviformis* could also be mistaken for a shrubby form of *E. viridis*, particularly because of its small, seasonally lustrous and greenish adult leaves and its small fruits. However, the two are separable at the seedling stage as *E. viridis* features narrower, greener more lustrous juvenile leaves and at the adult stage by *E. viridis* having a compact stocking of box-like bark, a generally taller habit, buds borne on longer pedicels and thinner-walled fruits. There are also similarities between the new subspecies and *E. aenea*, which occurs in the Goulburn River National Park of central New South Wales. However they differ by *E. aenea* having bark that is more colourful (copper-coloured), broader leaves at all stages, the adult leaves being lettuce-green, and fruits that are as wide as long (see Table 1).

1d. *Eucalyptus wimmerensis* subsp. *pallida* subsp. nov. Rule

Type: Victoria. c. 3.1 km west of Diapur on Nhill-Miram Road, 36° 19' 00" S. 141° 25' 05" E. *K. Rule* 1012 and *L. Rule*, 24 iii 2012 (holotype: MEL 2419931; isotypes: AD, CANB, NSW).

Distinguished within *Eucalyptus wimmerensis* by the combination of its small, shrubby habit, its persistent, brownish box bark, which extends to mid-stem, its dull, bluish adult leaves and its generally smaller buds and fruits.

Small, shrubby, spreading *Mallees* 2–5 m tall, *Bark* grey-brown, box-like, flaky, persistent on the lower

stem; smooth bark off-white, light grey or light brown, decortivating in short strips and plates. *Juvenile leaves* narrow-lanceolate, disjunct, petiolate, moderately crowded, dull, blue-green, slightly discolorous, 5–9 cm long, 0.5–1 cm wide; petioles 0.5–1 cm long. *Adult leaves* narrow-lanceolate to lanceolate, slightly falcate, semi-erect, concolorous, dull, blue-green to sub-glaucous, slightly lustrous and greenish when new, 5–9 cm long, 0.9–1.4 cm wide; petioles terete, 0.6–1.2 cm long. *Inflorescences* 7–11-flowered; peduncles slender, 0.6–1.1 cm long. *Floral buds* ovoid, non-pruinose, 5–6 mm long, 3–4 mm wide; operculum conical, c. half the length of the hypanthium; pedicels short, slender, 2–3 mm long; filaments white. *Flowering period* autumn. *Fruits* hemispherical, cupular or slightly globular-truncate, thin-walled, 4–6 mm long, 4–5 mm diam.; pedicels slender, 1–2 mm long; disc descending; valves enclosed (Figure 5 and Table 1).

Distribution and habitat: *Eucalyptus wimmerensis* subsp. *pallida* is known from the Lawloit Range between Nhill and Kaniva in the north-western part of the Victorian Wimmera region where it grows on the slopes of laterite rises. A small number of shrubby mallee-boxes with sub-lustrous, bluish adult leaves has been observed in the Nurcoung area. Further investigation is required to determine whether these represent a southern disjunction of this taxon.

Additional specimen examined: **Victoria:** Diapur, Nhill-Miram Road, c. 50 m west of Diapur-Lawloit Road intersection, *K. Rule* 0913 and *L. Rule*, 22 iii 2013, 36° 19' 13" S., 141° 27' 00" E (MEL)

Etymology: The subspecific epithet is derived from

the Latin *pallidus* 'pale' and refers to the colour of the taxon's adult leaves.

Associated species: *Eucalyptus wimmerensis* subsp. *wimmerensis* and subsp. *grata*, *E. leptophylla*, *E. costata*, *E. dumosa* and *E. macmahonii*, have been observed as associated taxa. *E. arenacea*, *E. leucoxydon* subsp. *stephaniae*, *E. largiflorens* and *E. silvestris* also occur in the vicinity of the new taxon. Mallees believed to be intergrades between this new taxon and the typical subspecies have been observed at Mt Elgin, about 2 km to the south of Diapur.

Conservation status: *Eucalyptus wimmerensis* subsp. *pallida* is known only from two small occurrences in the Lawloit Range; about 3 km to the west of Diapur and at Diapur, with the total number of plants observed being approximately 40. It is highly likely that the taxon occurs on private land between Diapur and Mt Elgin where extensive areas of mallee-box exist. In accordance with IUCN (2001) guidelines, given the taxon's small numbers and restricted distribution, a status of critically endangered is recommended (CR B1ab (I, ii, iii, iv, v) + 2ab (I, ii, iii, iv, v) C2a(i): D).

Notes: *Eucalyptus wimmerensis* subsp. *pallida* could be mistaken for a form of *E. odorata*, given its persistent box bark and its dull, bluish foliage. However, it is considered here as closer to *E. wimmerensis* mainly on the basis of its smaller mallee habit (*E. odorata* usually being a tree or large mallee), its narrower juvenile leaves, which are inseparable from those of typical *E. wimmerensis*, and its smaller adult leaves, buds and fruits (fruits of *E. odorata* to 8 mm long, 7 mm diam.).



Figure 5: *Eucalyptus wimmerensis* subsp. *pallida*. a. mallee, W of Diapur; b. branchlet, Diapur.

Eucalyptus wimmerensis subsp. *pallida* differs from the typical subspecies primarily by its smaller, more shrubby habit, its substantial stocking of brownish box bark, its duller, bluish adult leaves and generally smaller fruits.

Initially, the new taxon was considered an outlier of *E. polybractea* subsp. *subcerea*, particularly as its canopy consists of dull, bluish leaves. However, its buds and growth tips are never pruinose. It further differs from that taxon which has more colourful bark, the stocking of persistent box bark being greyish and the smooth bark becoming coppery and lustrous (see Table 1).

***Eucalyptus wimmerensis* subsp. *grata*
subsp. nov. Rule**

Type: Victoria: 3.2 km west of Diapur on Nhill-Miram Road, 36° 19' 01" S., 141° 25' 02" E., *K. Rule* 2508, 15 viii 2008 (holotype: MEL 2419936; isotypes: AD, CANB, NSW).

Distinguished within *Eucalyptus wimmerensis* by its tallish habit, its short stocking of box bark, its relatively large, often falcate, juvenile leaves, its relatively long, lustrous and green, pendulous adult leaves, its consistently 7-flowered inflorescences and its elongated fruits.

Habit mallee or rarely a single-stemmed slender tree, 5–12 m tall. **Bark** dark smooth light brown, darkening with age; persistent light, grey-brown, flaky, box-type bark forming a short basal stocking or rarely smooth throughout; old smooth bark decorticating in dark brown strips. **Juvenile leaves** narrow-lanceolate to lanceolate, falcate, disjunct, petiolate, discolorous, dull blue-green, 7–12 cm long, 0.7–1.8 cm wide; nodes moderately crowded; petioles 0.6–1.2 cm long. **Adult leaves** narrow-lanceolate to lanceolate, often falcate, pendulous, acuminate, uncinata, lustrous, green, coriaceous, 7–12 cm long, 1–2 cm wide; petioles terete, 0.6–1.5 cm long; new season's growth tips lustrous and green. **Inflorescences** 7-flowered; peduncles angular or terete, slender, 0.6–1.1 cm long. **Floral buds** clavate to sub-pyriform, basally ribbed and tapered, often lustrous, red-brown at maturity, 6–8 mm long, 3–4 mm wide; operculum conical, c. half the length of the hypanthium; pedicels angular, 3–5 mm long. **Flowering period** autumn. **Fruits** cupular, sub-pyriform, sub-cylindrical, tapering into the pedicel, basally ribbed, 6–8 mm long, 4–6 mm diam.; pedicels angular, 2–4 mm long; disc descending; valves enclosed (Figure 6 and Table 1).



Figure 6: *Eucalyptus wimmerensis* subsp. *grata*, W of Diapur. a. tree; b. branchlet; c. basal bark.

Distribution and habitat: *Eucalyptus wimmerensis* subsp. *grata* is known from a few locations in the north-western Wimmera in the Lawloit Range, namely west of Diapur and from Diapur and Mt Elgin, where it grows on shallow sandy soils over a laterite substrate.

Additional specimens examined: **Victoria:** Diapur, near the intersection of the Nhill-Miram Road and the Diapur-Lawloit, 36° 19' 14" S., 141° 27' 07" E, *K.Rule 5413*, 14 xi 2013 (MEL); Mt Elgin, west of Nhill, on the southern side of the Western Highway, 36° 24' 00" S., 141° 29' 30" E., *K.Rule 5813* and *J. Dowling*, 14 xi 2013 (MEL); Diapur-Lawloit Road, south of Rogers Road, 36° 21' S., 141° 26' E, *K.Rule 0216*, 17 iii 2002 (MEL)

Associated species: At the type locality for *E. wimmerensis* subsp. *grata* and at Diapur it grows with *E. dumosa*, *E. costata*, *E. wimmerensis* subsp. *wimmerensis* and subsp. *pallida*, *E. macmahonii*, and *E. leptophylla*. A suspected hybrid with *E. wimmerensis* subsp. *pallida* was detected in one of the early seedling trials. Other species including *E. arenacea*, *E. leucoxyton* subsp. *stephaniae*, *E. silvestris*, *E. calycogona* subsp. *trachybasis* and *E. goniocalyx* subsp. *goniocalyx* also occur in the immediate area. At Diapur it is associated with *E. wimmerensis* subsp. *wimmerensis* and subsp. *pallida* and *E. leptophylla*. At Mt Elgin *E. wimmerensis* subsp. *wimmerensis*, *E. costata*, *E. dumosa*, *E. phenax* subsp. *phenax* and an unnamed, low-growing, glaucous mallee-box, which is currently under study, are associates.

Etymology: The subspecific epithet is derived from the Latin *gratis* 'pleasing' which alludes to elegant appearance of the taxon.

Conservation status: The type population occurs to the west of Diapur, both at the edge of the Nhill-Miram Road and on private property in a block about 2 hectares of a well-preserved natural, mallee-dominated community. Whilst only about 35 plants have been observed at the type locality, it is possible that other occurrences exist on private property in the area. From Diapur and Mt Elgin its numbers are also meagre and not fully known. In accordance with IUCN(2001) guidelines a status of critically endangered is recommended (CR A2ce; B1 (i,ii,iii,iv,v) + C2a (I,ii):D)

Notes: *Eucalyptus wimmerensis* subsp. *grata* is distinguished in the field from the type subspecies of

E. wimmerensis mostly by its tallish habit and its relatively broad, falcate, green, coarse, lustrous, pendulous adult leaves. Also, whilst its juvenile leaves are larger than those of other subspecies, they are considered not fundamentally divergent from the species. Thus, the new taxon is here assigned the rank of subspecies.

Similarities between *E. wimmerensis* subsp. *grata* and *E. hawkeri*, particularly in the pendulous nature of their adult foliage, necessitated a re-examination of the latter. Whilst there is some overlap in juvenile leaf morphology, with those of the latter being broader, sub-glaucous and rarely falcate, the two differ appreciably in habit, bark, adult leaves, buds and fruits. *E. hawkeri* is taller and usually a tree (some recently located trees grow up to 20 tall) with substantially more rough bark, adult leaves that have a bluish tinge and become duller in winter and slightly smaller buds and fruits (fruits of *E. hawkeri* 5–7 mm long, 3–5 mm diam.).

Initially, because of its lustrous and green adult leaves *E. wimmerensis* subsp. *grata* was considered to be an aberrant broad-leaved, large-fruited form of *E. viridis*. However, close examinations both in the field and of nursery-grown seedlings discounted that connection. *Eucalyptus viridis* differs from *E. wimmerensis* subsp. *grata* by its stocking of thin, dark grey, compact, box-type bark, its narrower, more lustrous juvenile leaves, its smaller, semi-erect adult leaves and its smaller buds and fruits.

2. *Eucalyptus polybractea* R.T. Baker, *Proc. Lin. Soc. New South Wales* 25, 692 (1901)

Type: **New South Wales.** West Wyalong, Dec. 1900 R.H. Cambage s.n. (holotype: NSW 333432 isotypes: K).

Syn. *E. fruticetorum* auct. non F.Muell. ex Miq W.F. Blakely, *Key Eucalyptus* 228 (1934).

Populations of the species occur in three markedly disjunct regions; in New South Wales in the West Wyalong area, Victoria in the North-central, West-central and Wimmera regions and South Australia in the Northern Flinders Ranges. Various authorities including Brooker and Kleinig (1990) and Nicole (1997) regarded the South Australian populations as a separate species

Key to the subspecies of *Eucalyptus polybractea*

- 1 Adult parts conspicuously pruinose subsp. ***polybractea***
 1: Growth tips and buds faintly pruinose at anthesissubsp. ***subcerea***

but Nicolle (2013) reassessed them as *E. polybractea*.

Eucalyptus polybractea is distinguished within the mallee-boxes by its often few-stemmed mallee habit, its variable stocking of grey to brown persistent box bark and off-white to copper-coloured upper smooth bark, its linear-lanceolate to narrow-lanceolate, moderately crowded, glaucous juvenile leaves, its narrow-lanceolate to lanceolate, blue-grey or glaucous adult leaves, its pedicellate, ovoid or fusiform buds and its cupular, sub-cylindrical or barrel-shaped fruits (4–7 mm long, 4–7 mm diam.). Above all, the species is distinguished by its glaucous juvenile leaves, its copiously pruinose branchlets, petioles, buds and immature fruits and its dull, blue-grey to glaucous adult leaves.

Eucalyptus polybractea is closely related to *E. odorata* which is mostly a spreading, rough-barked, dull-leaved tree confined to South Australia. As well as habit, bark and leaf morphology, *E. odorata* differs from *E. polybractea* by rarely having lightly pruinose buds and having generally larger buds and fruit. Further, on the basis of seedling morphology, it is my view that *E. polybractea* is also a close relative of *E. wimmerensis*.

Rule (2011) alluded to a form of mallee-box occurring in the southern Wimmera, which has been regarded as a form of *E. wimmerensis*, as having links with *E. polybractea*. Further research, as described above, has confirmed this and it is here described as a subspecies of *E. polybractea*. The rationale for this decision rests with its development of glaucous pre-adult leaves and it showing faint pruinosity in its buds and growth tips during the flowering period. Its taxonomic treatment as

a form of *E. polybractea* further facilitates the clarification of the *E. wimmerensis* complex.

2a. *Eucalyptus polybractea* subsp. *polybractea*

Few-stemmed *Mallees*, occasionally dense and shrubby, or rarely slender trees 4–15 m tall. *Bark* variable, usually persistent dark, grey-brown, box-type present on lower stem, rarely higher, or rarely smooth throughout; smooth bark light grey or brown, seasonally lustrous, grey to pink or copper-coloured; old bark deciduous in short ribbons and plates. *Seedling leaves* narrow-elliptical, decussate, sessile for a few pairs. *Juvenile leaves* narrow-lanceolate to lanceolate, semi-erect, petiolate, disjunct, moderately crowded, dull, sub-glaucous to glaucous, 4–10 cm long, 0.8–1.5 cm wide; petiole length 0.5–1.5. *Intermediate leaves* usually broader than juvenile leaves, sub-glaucous to glaucous. *Adult leaves* narrow-lanceolate or lanceolate, acuminate, uncinata, concolorous, dull, blue-grey or glaucous, semi-erect, coriaceous, 5–10 cm long, 0.8–1.8 cm wide, petioles to 0.9–1.6 cm long; venation moderately sparse with conspicuous lateral veins; intramarginal vein c. 1 mm from margin; oil glands irregular, island. *Inflorescences* simple, axillary, 7–11-flowered, along the main axis or along leafy terminal branchlets; peduncles slightly angled, 0.6–1.2 cm long. *Floral buds* ovoid to fusiform, shortly pedicellate, non-scarred (petaline and sepaline opercula intact), conspicuously pruinose at maturity, 4–7 mm long, 3–4 mm diam.; pedicels 3–6 mm long;



Figure 7: *Eucalyptus polybractea* subsp. *polybractea*, Inglewood. a. adult foliage; b. seedling, Inglewood.

operculum conical or slightly obtuse, shorter than the hypanthium; hypanthium basally tapered, faintly angled; filaments white, irregularly flexed, all fertile; anthers adnate, basifixed, globose, dehiscent through sub-terminal pores; locules 3–4; ovules in 4 vertical rows. *Flowering period* early autumn. *Fruits* cupular or sub-cylindrical, shortly pedicellate, round in cross-section, 4–7 mm long, 4–7 mm diam.; walls moderately thick; immature fruits pruinose; mature fruits often burgundy-coloured; pedicels 2–5 mm long; disc descending; valves enclosed. *Fertile seeds* mid to dark brown, ovoid to slightly cuboid; dorsal surface shallowly reticulate; hilum ventral (Figure 7, Table 1).

Distribution and habitat: The typical subspecies occurs in New South Wales in the West Wyalong area, in Victoria it is widespread in the North-central and West-central regions, where it is usually a common species on dry, stony rises, and in South Australia it is restricted to similar sites in the northern Flinders Ranges.

Associated species: In New South Wales the species is often associated with other mallee species including *E. viridis*, *E. behriana* F. Muell., *E. dumosa* and *E. dwyeri* Maiden & Blakely and the species occurs close to *E. dealbata* Cunn. ex Schauer and *E. sideroxylon* Cunn. ex Woolls subsp. *sideroxylon*. In Victoria, where it is much more widespread it has contact with *E. viridis*, *E. froggattii*, *E. behriana*, *E. leptophylla*, *E. calycogona* subsp. *trachybasis*, *E. porosa* F. Muell. ex Miq., *E. tricarpa* subsp. *tricarpa* (L.A.S. Johnson) L.A.S. Johnson and K.D. Hill, *E. microcarpa*, *E. macrorhyncha* F. Muell. ex Benth and *E. polyanthemos* subsp. *marginalis* K. Rule. In South Australia its associates include *E. odorata*, *E. socialis* subsp. *socialis* F. Muell. ex Miq., *E. flindersii* Boomsma, *E. percostata* Brooker and Lang, *E. dumosa*, *E. porosa* and *E. cajuputea*.

Conservation status: In South Australia Nicolle (2013) indicates that *E. polybractea* subsp. *polybractea* is rare and in New South Wales it is reported as rare but in abundance where it occurs. In Victoria the taxon is both the dominant species and in abundance in areas such as Bendigo, Inglewood, Wedderburn and St Arnaud, its numbers being estimated as in excess of 50,000 plants. Elsewhere it exists in small fragments. Few data are available regarding the reduction of its range since European settlement but in Victoria, at least, significant losses to farming are apparent. At this stage there are no

indications that its numbers will decline in the immediate future. However, should any catastrophic events occur, such as regular wildfires or habitat degradation due to climatic change or changed conservation policies in the face of a demand for more farming land, its numbers may come under threat. In accordance with IUCN (2001) guidelines a status of vulnerable is recommended (VU A2bc+4bc).

Notes: Victorian populations of typical *E. polybractea* occurring in the Bendigo, Kamarooka and Inglewood areas, as well as parts of Wedderburn, are morphologically consistent with those of the type locality. However, at the western fringes of this distribution at locations such as at St Arnaud, Tottington, Bolangum, Boort and the Jeffcott Range are several forms showing varying levels of divergence in habit, bark and fruit size. Some tallish forms, such as at Bolangum and Tottington have been erroneously regarded as *E. odorata*. Others, such as near Boort, to the south-east of Wedderburn and at St Arnaud, have substantial stockings of box bark. Also at Boort are some mallees with greenish adult leaves which are suspected as being intergrades involving *E. viridis*. In the St Arnaud area there are a few stands with relatively large fruits (to 7 mm diam.). A form occurring at Moorl Moorl is almost smooth-barked and has broader juvenile leaves than typical, whilst a remnant stand of mallees on the ridge of the Jeffcott Range is substantially box-barked and dwarf and shrubby in habit, together with relatively small adult leaves, buds and fruits. All of these forms exhibit conspicuous pruinosity in seedlings and adult structures consistent with the typical form and are currently considered a part of that taxon. None of these forms should be confused with *E. yarriambiack* which is a spreading, thick-stemmed tree with faintly pruinose buds and growth tips at anthesis and normally a canopy dominated by lustrous and green adult leaves. Nor should they be confused with *E. filiformis* which, although being box-barked and having bluish adult leaves, has linear, blue-green juvenile leaves and non-pruinose adult structures.

2b. *Eucalyptus polybractea* subsp. *subcerea* subsp. nov. Rule

Type: Victoria. Lower Norton-Nurrabiel Road, 3.7 km S of Lower Norton, 36° 49' 07" S., 142° 04' 21" E., K. Rule 0231,

5 iv 2002 (holotype: MEL 2419944; isotypes: AD, CANB, NSW).

Distinguished from the type of *Eucalyptus polybractea* by its dull, blue-green adult leaves, its faintly pruinose growth tips and mature buds at anthesis, and its generally smaller more compact buds and fruits.

Mallees slender-stemmed, occasionally dense and shrubby, 4–8 m tall. *Bark* box-like, thin, dark grey-brown, often crusty, usually persistent to at least mid-stem; shrubby forms almost smooth-barked; smooth bark light brown to copper-coloured and lustrous; old bark deciduous in short ribbons and plates. *Juvenile leaves* linear-lanceolate to narrow-lanceolate, semi-erect, petiolate, disjunct, moderately crowded, discolourous, initially sub-glaucous; becoming increasingly glaucous as the seedlings develop, 5–9 cm long, 0.6–1.3 cm wide; petioles 0.6–1.3. *Adult leaves* narrow-lanceolate or lanceolate, acuminate, uncinata, concolorous, dull, blue-green, new spring growth slightly lustrous and green but becoming dull and blue-green by anthesis,

semi-erect, coriaceous, 5–9 cm long, 0.9–1.6 cm wide, petioles 1–1.6 cm long. *Inflorescences* 7–11-flowered; peduncles slightly angled, to 0.8–1.4 cm long. *Floral buds* ovoid, shortly pedicellate, faintly pruinose at maturity, 5–6 mm long, 3–4 mm diam.; pedicels 2–4 mm long; operculum conical or slightly obtuse, shorter than the hypanthium; hypanthium basally tapered, faintly angled; filaments white. *Flowering period* early autumn. *Fruits* hemispherical to cupular, shortly pedicellate, 4–6 mm long, 4–5 mm diam.; walls moderately thick; mature fruits often burgundy-coloured; pedicels 1–2 mm long; disc descending; valves enclosed (Figure 8 and Table 1).

Distribution and habitat: *Eucalyptus polybractea* subsp. *subcerea* occurs in the Wimmera region of Victoria on laterite rises in most mallee communities to the south of the Little Desert. Its numbers far exceed those of other mallee-boxes in the areas where it occurs.

Additional specimens examined: Victoria. Smith Reserve, SW of Horsham, 36° 50' 13" S., 142° 05' 30" E., *K.Rule* 0234, 5 iv 2002 (MEL); Lower Norton-Nurrabiel Road, 6.8 km S of Lower Norton, 36° 50' 41" S., 142° 03' 47" E., *K.Rule* 0230, 5 iv 2002 (MEL); Tooan Scrub, 36° 47' 05" S. 141° 43' 15" E. *K.Rule* 9445, 8 iv 1994



Figure 8: *Eucalyptus polybractea* subsp. *subcerea*. a. mallee, Nurcoung F.R.; b. coppice leaves, Nurcoung F.R.; c. buds, Lower Norton.

(MEL) west base of Mt Arapiles, 36° 42' 00" S., 141° 53' 00" E. *K. Rule 0221* and *V. Stajsic* (MEL); Mitre-Nurcoun Road 36° 41' 14" S. 141° 44' 32" E. *K. Rule 2412 24 iii 2012* (MEL); Blake's Road, SW of Tooan, 4.2 km E of Womimera Hwy, 36° 50' 55" S., 141° 46' 05" E. *K. Rule 13706 3 x 2006* (MEL).

Etymology: The epithet is derived from the Latin *sub* 'less than' and *cereus* 'waxy' which alludes to faint level of glaucousness which develops during the flowering season.

Associated species: *Eucalyptus wimmerensis* subsp. *wimmerensis*, *arapilensis* and *parviformis*, *E. hawkeri*, *E. behriana*, *E. calycogona* subsp. *calycogona* and *trachybasis*, *E. dumosa*, *E. macmahonii*, *E. phenax* subsp. *phenax*, *E. leptophylla*, *E. costata*, *E. goniocalyx* subsp. *goniocalyx* and *E. leucoxydon* subsp. *stephaniae* are associates whilst *E. microcarpa*, *E. arenacea* and *E. largiflorens* often occur nearby. In the Nurcoun area, in the Nurcoun Flora Reserve and in adjacent private land, as confirmed by progeny trials, numerous hybrids involving *E. dumosa* and/or *E. phenax* subsp. *phenax* and constituent mallee-boxes occur, as do two other unnamed entities with mallee habits that are currently being investigated.

Conservation status: Where *E. polybractea* subsp. *subcerea* occurs it is usually the dominant mallee species. Despite this, its numbers appear to have been drastically reduced by clearing for agriculture to the extent it is now confined to remnants along roadsides, on farms and in a few protected reserves such as the Mt Arapiles-Tooan State Park, Nurcoun Flora Reserve and Smith's Reserve. The exact numbers are not known but it is estimated that as many as 4500 plants exist. In accordance with IUCN (2001) guidelines, on the basis its numbers having been severely depleted by clearing for agriculture, the taxon is considered endangered (EN A2ce)

Notes: The morphology of the new subspecies might suggest it occupies a position that is intermediate between *E. wimmerensis* and *E. polybractea*. There is a reasonable case on historical grounds for recognising it as a subspecies of the former as it has been regarded as a southern extension of that species from the time of its erection. Without knowledge of the light pruinosity of its growth tips and buds at anthesis and its seedlings, this new taxon could be mistaken for a dull-leaved form of *E. wimmerensis*. Further, the examination of dried herbarium materials may be of little use, particularly if

the collections were made at a times other than when flowering occurred. Despite this, the glaucous seedlings and the display of light seasonal pruinosity of the adult plants indicate a link with *E. polybractea*. Thus, the taxon is more appropriately recognised as a subspecies of that species.

As stated above, the seedlings of the new taxon raised in seedling trials are not morphologically separable from those of forms of *E. wimmerensis* in early seedling development. However, as the seedlings mature they follow similar patterns of typical *E. polybractea* by producing glaucous new leaves. In the field, where its seedlings are subjected to more rigorous environmental pressures, the display of glaucousness is more apparent (see Figure2).

Where *E. polybractea* subsp. *subcerea* coexists with subspecies of *E. wimmerensis* (subsp. *wimmerensis* and subsp. *parviformis*), it is usually distinguished from those mallee-boxes by its duller adult leaves and substantial stocking of grey, box bark and lustrous, copper-coloured upper bark, which contrasts appreciably from their smooth or mostly smooth off-white or light grey bark.

Notes on the taxonomies of Victorian Mallee-boxes

There has been a reluctance in some quarters outside Victoria not to accept any of the recently described Victorian rare and threatened mallee-box entities, namely *E. wimmerensis*, *E. silvestris*, *E. hawkeri*, *E. walshii*, *E. filiformis* and *E. yarriambiack*, despite there being sufficient evidence to support their erections. In many cases assessments have been published without adequate comment, particularly with reference to whether they are underpinned by rigorous field studies and progeny trials. Although these taxa have been widely accepted in Victoria, their legitimacies have been brought into question in texts published for popular consumption. This situation has the potential for confusion, particularly for those who work with eucalypts in areas of conservation, vegetation survey and revegetation. Thus, notes clarifying the morphologies and taxonomies of these contentious taxa are provided below. These notes are also considered relevant to the study reported here as all are related to or associated with *E. wimmerensis*. As the integrity of *E. wimmerensis*

and its relationship with *E. viridis* have been discussed above, the notes focus on *E. silvestris*, *E. hawkeri*, *E. walshii*, *E. filiformis* and *E. yarriambiack*.

Eucalyptus silvestris

Eucalyptus silvestris was erected to accommodate box-barked, small trees and robust mallees occurring in the north-western Wimmera and adjacent areas of South Australia in the vicinity of Bordertown. In the initial description comparisons were made with *E. odorata* on the basis of these populations having been regarded as eastern outliers of that species. In its treatment *E. silvestris* was given as being related to *E. odorata*, not only because of similarities in habit and bark, but because of its simple, axillary inflorescences, and was given as differing from *E. odorata* primarily by its greener adult leaves and its generally smaller buds and fruits. Brooker and Slee (1997) regarded *E. silvestris* as a depauperate, narrow-leaved form of *E. microcarpa* and merged it with that species, despite differences in inflorescence structure, those of *E. microcarpa* being terminal panicles. It should be noted that Brooker and Slee (1997) in their account of *E. microcarpa* did not acknowledge the distinctiveness of *E. silvestris* by making reference to *E. microcarpa* only having compound, terminal panicles. Their interpretation was adopted by EUCLID (2006). Subsequent investigations by this author found that the adult leaf venation patterns and oil glands of *E. silvestris* are similar to those of *E. microcarpa*, being densely reticulate with scattered intersectional glands, and differing from the moderately sparse reticulation with numerous island glands present in the adult leaves of *E. odorata*, as given by Brooker and Kleinig (1990). Although *E. silvestris* appears to be related to *E. microcarpa* on the basis of leaf morphology, it is regarded as being different, not only in its inflorescence structure but in its smaller, sometimes mallee-like habit, its narrower juvenile leaves (1.5–3 cm wide compared with 3–6 cm wide) and its narrower, greener, more lustrous adult leaves (to 2 cm wide compared with to 3 cm wide).

Nicolle (1997), (2006) (2013) and (2015) regarded *E. silvestris* as conspecific with *E. odorata* without addressing any of the differences between the two given in the original description by Rule (1994 and 2012), particularly with regard to adult leaves and fruits.

Nor did he address the assessment of *E. silvestris* being a form of *E. microcarpa* given by Brooker and Slee (1997).

More recent investigations have shown a further difference between *E. silvestris* and *E. odorata* in their adult leaves with regard to the colour and lustre of new leaves produced in growing periods. Nicolle (2006) and (2013) and Brooker and Kleinig (1990) noted that the new adult leaves of *E. odorata* are dull and bluish and in time age to become sub-lustrous and green. In contrast, the new leaves of *E. silvestris*, being similar to those of *E. microcarpa*, are lustrous and green and become duller and slightly bluish as they age. This dullness is particularly apparent in winter. These differences in leaf morphology, along with differences in bud and fruit sizes, are considered sufficient to continue to regard *E. silvestris* as separate from and distantly related to *E. odorata*. At the same time, for the reasons given above, it is seen as being related to but separate from *E. microcarpa*.

Within western Victoria, in the Inglewood area, at Mt Jeffcott and in the southern part of the Wimmera, there are small populations of a grey box with narrow, seasonally glossy adult leaves and minute buds and fruits which might be interpreted as *E. silvestris*, or even *E. odorata*. These, however, have paniculate inflorescences and, although more or less consistent with the recently resurrected *E. woollisiana*, require more study to determine their identity.

Eucalyptus hawkeri

Eucalyptus hawkeri Rule (2004) was erected to accommodate populations of box-barked trees occurring at Mt Arapiles and in the nearby Jane Duff Reserve. More recently, however, it has been located in many mallee communities in the southern Wimmera. The combination of features which distinguish *E. hawkeri* from other box species in the region include its slender, erect, tree-like habit, its substantial stocking of rough bark, its narrow-lanceolate to ovate-lanceolate, blue-green or sub-glaucous juvenile leaves, its narrow-lanceolate to lanceolate, pendulous adult leaves, which when new are lustrous and green with a bluish tinge, its simple, axillary inflorescences and its relatively small buds and fruits. In the field the species is distinguished from related mallee-box taxa by its habit, bark and foliage.

EUCLID (2006) listed *E. hawkeri* as conspecific with *E. viridis*. This assessment was confusing as the two do not even remotely resemble each other in seedling and adult characters. Perhaps the authors have confused one of the segregates of *E. wimmerensis* occurring at Mt Arapiles with *E. viridis*.

Nicolle (2006) assessed *E. hawkeri* as being a hybrid between *E. microcarpa* and *E. wimmerensis* and supported his assessment by referring to trees along the access road to the summit of Mt Arapiles as hybrids and representative of *E. hawkeri*. It must be pointed out that, prior to the species being published, those same trees were examined, along with countless others in and adjacent to the Mt Arapiles reserve, and were regarded as being *E. microcarpa*. Further, no reference to those particular trees was made in the manuscript for the treatment of the species.

Recently, Nicolle (2015) adjusted the status of *E. hawkeri* to that of being an intergrade between *E. wimmerensis* and *E. microcarpa*. This implies that the many small occurrences that occur both at Mt Arapiles and adjacent sites should exhibit a range of forms that do not diverge beyond the morphological boundaries set by the two reputed parents. None of this fits *E. hawkeri* which has a combination of distinctive features, as described above, is uniform both within and between its populations. As well, repeated progeny trials of seed-lots from its well dispersed populations have overwhelmingly indicated that it is true-breeding. Furthermore, *E. wimmerensis* and *E. microcarpa* are not only distantly related box species but have markedly contrasting morphologies; one being a medium-sized tree with broad leaves at all stages and paniculate inflorescences and the other a mallee with narrow leaves at all stages and simple, axillary inflorescences. It is highly likely that any population derived from these taxa would consist of an assortment of individuals and stands exhibiting a diverse range of features.

However, since the discovery of *E. hawkeri*, small occurrences of hybrids with *E. wimmerensis* subsp. *arapilensis* have been identified through field observations and seedling trials at Mt Arapiles near its north-eastern base and on the south-west side of the mountain and with *E. microcarpa* to the north-east of the mountain, including the Mitre Rock area. Also a small stand of suspected hybrids with *E. microcarpa*, which

feature paniculate inflorescences, has been observed at Lower Norton. A seedling trial indicated that a single spreading mallee occurring in Jane Duff Reserve is a hybrid with *E. wimmerensis* subsp. *arapilensis*. No hybrids have been observed at other sites where the species occurs.

Recent surveys have located populations of *E. hawkeri* in mallee-box dominated communities in the southern Wimmera in addition to Mt Arapiles and Jane Duff Reserve, where the species was originally observed. Such locations include Nurcoung, Lower Norton, Smith's Reserve, the Toaan Mallee and south-east of Toaan along Blakes Road. As well, additional stands have been located at Mt Arapiles where the species was reported as occurring in relative abundance in 2004. These include a small stand of trees growing on the south-western side of the mountain, where some individuals are up to 20 m tall, and a large stand of scores of spindly trees less than 10 m tall growing on a rocky rise on its northern side. The estimated number of plants of *E. hawkeri* now exceeds 1000.

Eucalyptus yarriambiack

Eucalyptus yarriambiack Rule (2012) was described as occurring on well-drained loams adjacent to the Yarriambiack Creek to the north of Brim. Its morphology is generally consistent with the mallee-boxes of the *E. odorata* complex and includes the following distinguishing features; its small, robust, single or few-stemmed, spreading tree with a substantial stocking of box bark, its narrow-lanceolate to elliptical, dull, blue-green juvenile leaves, its small, seasonally lustrous, green adult leaves with a moderately sparse reticulation and island glands, its simple, axillary inflorescences, its small, unscarred buds, which become faintly pruinose at anthesis, and its small, thick-walled fruits. Largely, on the basis of its juvenile leaves, it was regarded as being closest to *E. wimmerensis*. However, with a more recent evaluation of its morphology, it appears to have a closer affinity with *E. polybractea*. The species, which consists only of about 150 plants, is relatively isolated from other so-called mallee-box taxa, with populations of *E. wimmerensis*, the contentious *E. silvestris* and *E. polybractea* being absent from the area where it occurs. *E. odorata*, with which has been associated is not considered to occur in Victoria (Rule 1994).

The distribution of *E. yarriambiack* is more or less parallel to stands of *E. largiflorens* which grow exclusively in heavy soils along the Yarriambiack Creek. However, scattered occurrences along minor roads off the Henty Highway, including Wardles Road East, Wardles Road West and Starrocks Road, suggest that the pre-settlement range was more extensive.

As was given in its treatment, *E. yarriambiack*, is superficially similar to *E. largiflorens* in habit and bark, as well as adult leaf, bud and fruit sizes. In other characters, however, the two are readily separable with *E. largiflorens* having seedlings with longer, linear juvenile leaves, duller, bluish rather than green adult leaves, which are densely reticulate with small intersectional glands, compound inflorescences, buds with an operculum scar and thin-walled fruits.

Nicolle (2015) listed *E. yarriambiack* as a hybrid between *E. largiflorens* (black box) and *E. odorata* (peppermint box) with the footnote, 'based on the type plant'. The statement is ambiguous. If, as was claimed, he conducted field studies and seedling trials, it is puzzling as to why he did not make an assessment based on the entire population whose plants are located in close proximity to the type plant and easily accessible?

Whilst it is unclear, from Nicolle's assessment, whether *E. yarriambiack* is meant to be a hybrid swarm of recent origin or a long-established, stabilised hybrid, it is maintained here, on the basis of progeny testing, that the designated type plant of *E. yarriambiack* is typical of the population and does not reflect hybridism. If the taxon is a recent hybrid it would be expected that the population would be highly variable with an assortment of forms whose morphologies reflect both mallee-box and black box influences both in its seedlings and adult plants. The decisions regarding the taxonomy of *E. yarriambiack* were based on observations gathered from comprehensive field work and progeny trials, all of which indicated that it is a morphologically uniform and true-breeding entity with only mallee-box features. Within the entire population no individual has been observed that could be construed as a hybrid, despite the close proximity of *E. largiflorens*.

Eucalyptus yarriambiack as a stabilised hybrid has slightly more credence, given its uniformity, morphological distinctiveness and its capacity to replicate itself. However, even this line of speculation

is questionable. To achieve its current mallee-box state, it would have needed a lengthy period of selection and divergence, whereby many traces of *E. largiflorens* were eradicated and its current morphological state and its capacity to breed true were achieved. As well, during this period, breeding barriers must have been established, given there is no evidence of recent, chance hybridisation.

The involvement of *E. odorata* as the other reputed parent presumably refers to *E. silvestris* which, as stated elsewhere, Nicolle claims is conspecific with *E. odorata*. The closest population of *E. silvestris* occurs about 70 km to the west, between Nhill and Yanac but it is conceivable that it may have been present in the Yarriambiack area at a time when different environmental conditions prevailed. However, to consider that *E. silvestris* is one of the reputed parents of a presumed hybrid is inappropriate as its adult leaves, like those of *E. largiflorens*, are densely reticulate with intersectional glands and not consistent with those of the mallee-boxes of the *E. odorata* complex. Thus, it seems unlikely that *E. yarriambiack* could have inherited an adult leaf morphology which would have been absent in both the reputed parents at the time of the hybridisation event.

Eucalyptus walshii

Eucalyptus walshii Rule (2004) is regarded as a relictual species being represented by about 30 plants which occur in two small stands near Broughton's Waterhole in the central section of the Little Desert National Park. It is distinguished by its habit of a small, slender, single-stemmed tree with no apparent lignotuber to about 10 m tall, its sparse crown, its smooth bark throughout, the bark being off-white to slightly yellow, its relatively broad, dull, blue-green juvenile leaves (to 2.3 cm wide), its lanceolate or ovate-lanceolate, blue-green, dull to sub-lustrous adult leaves (to 2.6 cm wide), the adult leaves also having a venation pattern with faint areoles and small, mostly island glands, and its relatively small, clavate buds and cupular fruits with a relatively broad orifice. Differences between *E. walshii* and typical *E. wimmerensis* are most apparent in a range of vegetative structures, the latter being a true mallee, not tree-like, having a dense rather than an open canopy, usually having some basal box-type bark with the upper smooth bark being grey or brown and darker,

having narrower juvenile leaves (to 1.5 cm wide) and narrower, greener, adult leaves (to 1.6 cm wide) with a moderately sparse venation pattern and relatively large island glands.

Initially, the habit of *E. walshii* was problematical, as to whether it is a tree or a mallee. Field observations indicated that the population contains a few seedlings and saplings, several immature trees and a few apparently mature trees to about 10 m tall, all of which are haphazardly distributed with some plants occurring close to each other and others being well segregated individuals. This is not consistent with a typical mallee pattern where several, usually symmetrically distributed stems arise from a large underground lignotuber. All the naturally occurring plants of *E. walshii* appear to be single-stemmed and despite the conditions in which they grow, are not dependent on lignotubers for regeneration.

It has been considered that *E. walshii* might be a hybrid between *E. wimmerensis* and another box species occurring in the Wimmera region, possibly *E. microcarpa*, *E. silvestris* or *E. porosa*. None of these are known to occur in the Little Desert proper and all have attributes not found in *E. walshii*, for example, substantial stockings of box bark and, as with *E. wimmerensis*, the ability to develop lignotubers. If the hybrid scenario were correct, it would be expected that *E. walshii* would be variable across a range of characters in both seedlings and adult plants and reflect influences derived from its antecedents. Of course, it might be argued that to achieve its current disposition it would have had to undergone a lengthy period of selection and divergence. Whatever, its origins, the fact remains that *E. walshii* is a distinctive entity that is capable of replicating itself.

Nicolle (2006), in claiming that *E. walshii* is a minor variant of *E. wimmerensis* noted, 'A few abnormally broad-leaved individuals of *E. wimmerensis* from Broughton's Waterhole in the Central Block of the Little Desert have been recently named as *E. walshii* (Rule 2005), but it is not considered distinct here. The slight differences from *E. wimmerensis* may be related to environmental factors'. This assertion is flawed as both *E. wimmerensis* and *E. walshii* grow adjacent to each other in the same soil on the same sandy rise. In this context *E. walshii* is clearly distinctive by its habit, crown density, bark and leaves. In contrast, the adjacent plants

of *E. wimmerensis* are true mallees with the morphology that characterises that species. Furthermore, differences between the two, particularly in juvenile leaf width, have been confirmed by progeny trials and in cultivated plants, one which is displayed in Melbourne Gardens, Royal Botanic Gardens Victoria. Lastly, Nicolle (2015) is inconsistent in not accepting *E. walshii* as being separate from *E. wimmerensis* on the basis of differences in habit and other characters when he accepts the segregation of other taxa; *E. dendromorpha* (Blakely) L.A.S. Johnson & Blaxell from *E. obstans* L.A.S. Johnson & K.D. Hill (previously incorrectly known as *E. obtusiflora* DC.) on the basis of being a tree rather than a mallee, *E. gregsoniana* L.A.S. Johnson & Blaxell from *E. pauciflora* Sieber ex Sprengel on the basis of being a mallee rather than a tree, and *E. proluxa* D.Nicolle (2000) from *E. calycogona* on the basis of it being a mallet rather than a mallee.

EUCLID (2006) also placed *E. walshii* under *E. viridis*, presumably on the basis that it regarded the taxon as synonymous with *E. wimmerensis* which it recognised at a subspecific level. On the basis of the evidence presented in this paper, *E. viridis*, *E. wimmerensis* and *E. walshii* are here regarded as separate species.

Eucalyptus filiformis

Eucalyptus filiformis Rule (2004) is also a relictual species which consists of a stand of only seven plants. It occurs on the southern slope of Mt Jeffcott in a largely cleared remnant of a rare and unique habitat, described as metamorphic slopes scrubby woodland. Whether its current numbers are due to clearing or genetic decline is unknown. It is distinguished within the mallee-boxes by its small, few-stemmed mallee habit, its thin, light grey box bark, which covers most of the stem, and whitish smooth branches, its linear (or filiform), crowded, rigidly-erect, bluish juvenile leaves, its relatively small, bluish adult leaves, that are sub-lustrous when new but become duller with age, its relatively small buds and fruits, the fruits being sub-cylindrical to slightly barrel-shaped. Cultivated plants grown in RBGV have developed distinctive intermediate leaves that are bluish, coarse and rigidly erect.

EUCLID (2006) included *E. filiformis* with *E. viridis* which lacks merit as the two only resemble each other in some aspects of their seedling morphology, that is, their juvenile leaves are linear and crowded along the stem.

However, *E. viridis* differs from *E. filiformis* by its dark greyish, compact bark that rarely extends above mid-stem, its greener and more lustrous leaves at all stages and its generally smaller buds and fruits.

Nicolle (2006) claimed that *E. filiformis* is synonymous with *E. polybractea* by noting that, 'These mallees are generally characteristic in adult morphology of *E. polybractea* occurring elsewhere and not considered sufficiently distinct nor forming a sufficiently large or uniform population to be regarded as a distinct species here'. This claim that the adult morphologies of *E. filiformis* and *E. polybractea* are inseparable is inaccurate. The barks of the two differ with the latter having a dark, grey-brown box bark with seasonally more colourful smooth bark above (coppery, brown or dark grey prior to shedding). Further, whilst it can be construed that the adult leaves of both species are similar, both being dull and bluish, in other adult structures, namely buds, branchlets and immature fruits, *E. polybractea* is copiously pruinose whereas *E. filiformis* is non-pruinose. It is only the coppice leaves that are sub-glaucous, a condition that also occurs elsewhere in forms of both *E. odorata* and *E. wimmerensis*, neither of which Nicolle (2006) regards as synonymous with *E. polybractea*. In delivering his assessment of *E. filiformis* Nicolle makes no mention of the differences between *E. filiformis* and *E. polybractea* in seedling morphology. *Eucalyptus filiformis* was regarded as being closest to *E. viridis* on the basis of similarities in their juvenile leaves, despite those of *E. viridis* eventually becoming lustrous and green. Nicolle's reference to the species lacking uniformity is also inaccurate as the plants within the stand are markedly similar and, without slight differences in leaf widths between plants shown in seedling trials, they would be regarded as being vegetative clones derived from a common parent. Lastly, with regard to the number of plants of *E. filiformis* being too few to warrant it being a species, it is contended here that an entity meets important criteria for being a species if there is morphological uniformity across its range, regardless of its numbers or extent, it differs significantly from its relatives in both its seedling and adult forms and, through progeny trials, it is found to be true-breeding. To use the small size of the population of *E. filiformis* to support an assessment of its status is a questionable strategy as it implies knowledge of its evolutionary

history and ignores the possibility that its numbers may have been significantly reduced by the extensive clearing of natural vegetation for the grazing of sheep that has occurred at Mt Jeffcott and similar sites in the region.

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