

Five new endemic eucalypts for Victoria

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Introduction

Throughout Victoria large tracts of eucalypt-dominated natural vegetation have been lost to clearing for agriculture and other commercial activities. In many parts of the state only remnant pockets remain in protected reserves, on public land, including state forests and roadside reserves, and on farms. In recent years extensive survey work of accessible remnants of eucalypts has been undertaken by this author and others, the result of which has been the discovery of several markedly restricted, previously overlooked eucalypts worthy of taxonomic consideration. Some new taxa have been described recently, some are still under investigation and five are here given formal treatments as new species.

All the new taxa are Victorian endemics and considered rare or threatened. These are *Eucalyptus bunyip*, a tallish, slender swamp gum from the Bunyip State Park in western Gippsland, *E. conferta*, a scentbark from the Fryers Range near Castlemaine in north-central Victoria, *E. carolaniae*, a mountain grey gum from Mt Martha on the Mornington Peninsula, *E. yarriambiack*, a mallee-box from near Brim in the southern part of the Victorian Mallee region, and *E. aurifodina*, a brown stringybark from the Goldfields region of north-central Victoria (Fig. 1).

Taxonomy

Series *Foveolatae* (Swamp Gum Complex)

As the common name suggests, the swamp gums form a group of eucalypts occurring in moist localities in south-east Queensland, New South Wales, Victoria, Tasmania and south-east South Australia. In this treatment 14 taxa, including the newly described *E. bunyip*, are included in the key. *E. ovata* Labill. was described in 1806 and a large-fruited form of the species, *E. ovata* var. *grandiflora* Maiden was described in 1916. *Eucalyptus aquatica* (Blakely) L.A.S.Johnson & K.D.Hill was first described as a variety of *E. ovata* in 1934 but elevated to a species in 1990. *Eucalyptus camphora* R.T.Baker was described in 1899 and two additional infraspecific taxa, namely subsp. *humeana* L.A.S.Johnson & K.D.Hill and subsp. *relicta* L.A.S.Johnson & K.D.Hill, were erected in 1990.

Abstract

Eucalyptus bunyip, a tall swamp gum from the Bunyip State Park in west Gippsland, *E. conferta*, a small-leaved scentbark from the Fryers Range near Castlemaine in north-central Victoria, *E. carolaniae*, a rough-barked mountain grey gum from Mt Martha on the Mornington Peninsula, *E. yarriambiack*, an umbrageous mallee-box from near Brim in the southern part of the Mallee region, and *E. aurifodina*, a small-fruited brown stringybark from the Victorian goldfields in the Avoca-Castlemaine area, are described as new Victorian endemic species. The affinities, ecologies, distributions and conservation statuses of each new taxon are discussed.

Key words: short-range endemics, swamp gum, scentbark, mallee-box, mountain grey gum, stringybark

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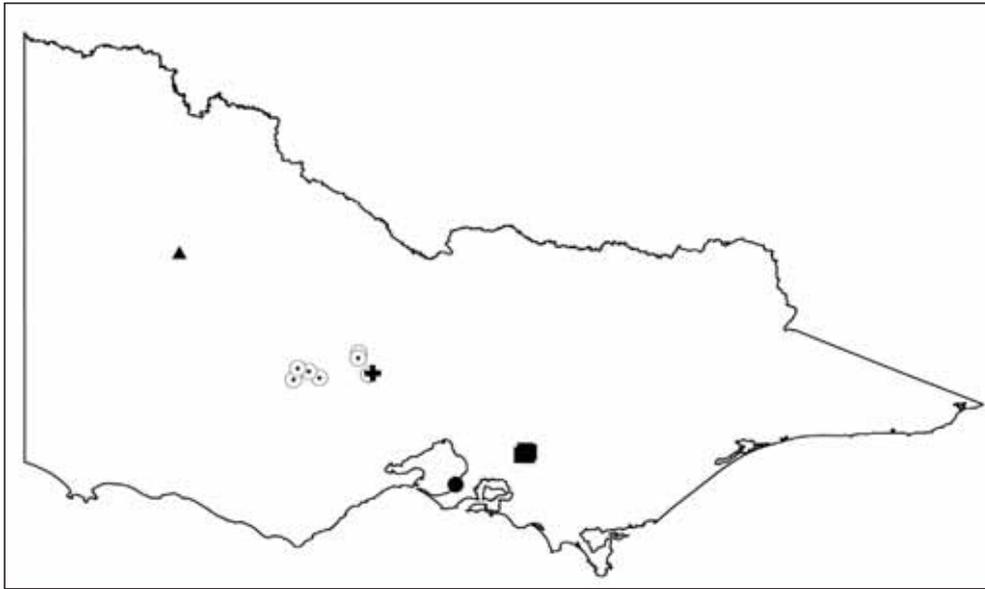


Figure 1. Distribution map for new species: *Eucalyptus bunyip* (closed rectangle), *E. conferta* (cross), *E. carolaniae* (closed circle), *E. yarriambiack* (closed triangle), *E. aurifodina* (open circle).

Eucalyptus aggregata H.Deane & Maiden was described in 1900, *E. rodwayii* R.T.Baker & H.G.Sm. in 1912 and *E. yarraensis* Maiden & Cambage in 1922. *Eucalyptus barberi* L.A.S.Johnson & Blaxell was described in 1972, *E. brookeriana* A.M.Gray in 1979, *E. cadens* J.D.Briggs & Crisp in 1989 and *E. strzeleckii* Rule in 1992. Brooker (2000) included *E. macarthurii* H.Deane & Maiden (1899) in the Series *Foveolatae*. In my view, that species does not belong with the swamp gums and may be better placed elsewhere, possibly within the Series *Viminalis* Blakely on the basis that its seedling morphology and ontogeny are consistent with *E. viminalis* Labill. and its subspecies.

The Series *Foveolatae* is characterised by the following: The habit is usually a tree (small to tall) or rarely a mallee. The bark in most species is smooth, often with a stocking of accumulated loose strips, chunks or plates, or rough, usually box-like, and extending to the major branches. The juvenile leaves are disjunct, petiolate and mostly ovate. The adult leaves are ovate to lanceolate, green and lustrous in most species. The inflorescences are 7-flowered or rarely 7–11-flowered. The buds are usually pedicellate and diamond-shaped, or less often clavate or ovoid. The fruits are pedicellate and mostly obconical.

The species described here as *E. bunyip* was first brought to my attention by the late John Reid and Neville Walsh, both of MEL, whose survey work in the Bunyip State Park led them to regard it as a distinctive entity. Subsequent field studies and progeny trials endorsed their initial assessment and, thus, it is described here as a new species within the Series *Foveolatae*.

***Eucalyptus bunyip* Rule sp. nov.**

Eucalypto strzeleckii affinis habitu elatiore graciliore, foliis juvenilibus minoribus, foliis mediis persistentibus, pedunculo delicato longiore, alabastris minoribus, pedicellis longioribus, fructibus subcampanulatis minoribus differt.

Type: Victoria: Camp Road, Bunyip State Park, on the southern side of the creek crossing; 37° 59' 07" S., 145° 38' 30" E., *K. Rule 10507*, 5.vi.2007. HOLO: MEL; ISO: AD, CANB, NSW.

Trees slender, erect, to c. 40 m tall. *Bark* smooth, whitish to light brown, becoming yellow-orange in spring; a short, compact, corky dark grey stocking present at the base. *Seedling leaves* ovate, at first sessile, becoming shortly petiolate, slightly lustrous and green above, pale green below. *Juvenile leaves* elliptical, ovate or ovate-lanceolate, petiolate, apiculate, disjunct, discolorous, green to blue-green, sub-lustrous above, whitish below, 4–6 cm long, 1.6–3 cm wide; margins entire; nodes relatively remote; petioles 1–2 cm long. *Intermediate leaves* broadly elliptical or broadly-ovate, rarely obovate, dull or sub-lustrous, slightly discolorous or concolorous, blue-green, to 8 cm long, 5.5 cm wide, persisting in large numbers in the mature canopy. *Coppice leaves* with lightly glaucous growth tips. *Adult leaves* ovate, ovate-lanceolate or broadly lanceolate, slightly coriaceous, acuminate, undulate, concolorous, densely reticulate, sub-lustrous or lustrous, green, 10–17 cm long, 1.8–3.2 cm wide; nodes relatively remote; petioles 1.8–3.2 cm long; intramarginal vein 2–3 mm from margin; oil

Key to the Swamp gums

- 1 Adult leaves dull, blue-green to glaucous *E. cadens*
- 1: Adult leaves sub-lustrous or lustrous, green or slightly blue-green 2
- 2 Rough, box-like bark persistent to at least major branches 3
- 2: Rough bark, if present, extending only to mid-trunk 5
- 3 Adult leaves ovate, to 3 cm wide *E. yarraensis*
- 3: Adult leaves narrowly lanceolate or lanceolate, to 2 cm wide 4
- 4 Intramarginal vein remote (to 3 mm from margin); peduncles to 4 mm long *E. aggregata*
- 4: Intramarginal vein close to margin (c. 1 mm from margin); peduncles 5–8 mm long *E. rodwayi*
- 5 Fruits 9–12 mm long, 9–12 mm diam *E. ovata* var. *grandiflora*
- 5: Fruits 4–8 mm long, 4–8 mm diam 6
- 6 Oil glands sparse or apparently absent from adult leaves *E. ovata* var. *ovata*
- 6: Adult leaves abundantly glandular 7
- 7 Juvenile leaves crenulate; adult leaves discolourous *E. brookeriana*
- 7: Juvenile leaves with entire margins; adult leaves concolourous 8
- 8 Mallees or small, slender trees 9
- 8: Robust, umbrageous trees or medium to tall upright trees 12
- 9 Adult leaves lanceolate; fruits more or less cupular *E. barberi*
- 9: Adult leaves ovate or sub-orbicular; fruits obconical 10
- 10 Petioles of adult leaves > 2 cm long *E. camphora* subsp. *relicta*
- 10: Petioles of adult leaves to 2 cm long 11
- 11 Juvenile leaves to 5 cm long, 3 cm wide; petioles of juvenile leaves to 5 mm long;
petioles of adult leaves < 1 cm long *E. aquatica*
- 11: Juvenile leaves to 11 cm long, 5 cm wide; petioles of juvenile leaves > 2 cm long;
petioles of adult leaves 1–2 cm long *E. camphora* subsp. *camphora*
- 12 Habit often an umbrageous tree, to 20 m tall; new season's growth tips non-pruinose;
juvenile leaves to 8 cm wide *E. camphora* subsp. *humeana*
- 12: Erect trees to 40 m tall; new season's growth tips pruinose; juvenile leaves to 4 cm wide 13
- 13 Mature canopy a mixture of broadly ovate intermediate leaves and ovate or broadly
lanceolate adult leaves; pedicels equal to or longer than fruits; fruits 4–5 mm diam *E. bunyip*
- 13: Mature canopy composed of ovate adult leaves; pedicels shorter than fruits; fruits 4–8 mm diam *E. strzeleckii*

glands numerous, regular, island; new season's growth tips glaucous. *Inflorescences* simple, axillary, 7-flowered; peduncles slender and delicate, terete or angular, 9–14 mm long, c.1 mm thick, thickening slightly and contracting when bearing mature fruits. *Floral buds* clavate or slightly diamond-shaped, pedicellate, scarred, often faintly pruinose in early development, 7–9 (–10) mm long, 2.5–3.5 mm wide; pedicels slender, as long as buds or to 1.2 times longer; hypanthium tapered; operculum shortly rostrate, equal to or longer than the hypanthium; locules 3 or 4; ovules in 4 vertical rows; stamens irregularly flexed, all fertile; filaments white; anthers dorsifixed, versatile, oblong, dehiscing through longitudinal slits. *Fruits* sub-campanulate, distinctly pedicellate, 5–6 mm long, 4–5 mm diam; pedicels delicate and slender, longer than fruits, 6–10 mm long; disc slightly elevated and rolled; valves usually slightly exerted. *Fertile seeds* dark grey, elongated, flattened, finely pitted; hilum ventral (Fig. 2).

Flowering Period: Autumn.

Distribution and Habitat: *Eucalyptus bunyip* occurs in the narrow valleys of the Diamond and Black Snake creeks in the Bunyip State Park approximately 60 km to the east of Melbourne. Its habitat is highly specific, being along the narrow valley floors which are subject to seasonal inundation and prolonged impeded drainage. The mean annual rainfall of the catchment which feeds both the creeks exceeds 1200 mm (Fig. 1).

Additional specimens examined: VICTORIA: Bunyip State Park, 30 m S of Gembrook-Tonimbuc Road, 0.9 km E of Camp Road intersection, *J.C. Reid 2195*, 13.xi.1996 (MEL2109207); 100 m in a north-westerly direction from the intersection of the Black Snake Creek Road and Towt Road, *K. Rule 10707*, 5.vi.2007 (MEL); Tonimbuc Road, 3.8 km from Tonimbuc Hall towards Gembrook, *K. Rule, 10307*, 5.vi.2007 (MEL); Dyers Picnic Ground, Black Snake Creek Road, *K. Rule 10607*, 5.vi.2007 (MEL).

Associated Species: *E. bunyip* grows in pure stands and abuts forests of *E. cypellocarpa* L.A.S.Johnson,



Figure 2. *Eucalyptus bunyip* (a) tree; (b) adult leaf; (c) seedling; (d) buds and fruits.

E. obliqua L'Her. and a tallish form of *E. ignorabilis* L.A.S.Johnson & K.D.Hill which is currently under study. Other species occurring in the vicinity include *E. dives* Schauer, *E. cephalocarpa* Blakely, *E. radiata* Sieber ex DC. subsp. *radiata*, *E. fulgens* Rule, *E. ovata* var. *ovata*, *E. viminalis* subsp. *viminalis*, and *E. sieberi* L.A.S.Johnson.

Conservation Status: *Eucalyptus bunyip* has a distribution spread along several linear kilometres and entirely within a protected reserve, the Bunyip State Park, where an estimated 4000 mature trees exist. According to IUCN criteria (IUCN 2001) a recommended status for the species is 'vulnerable' (VU).

Etymology: The epithet, of Aboriginal origin, is used as a noun in apposition and refers to the Bunyip State Park, the locality to which the species is restricted.

Discussion: *Eucalyptus bunyip* is distinguished within the swamp gums by its tallish, slender habit, smooth bark with a short stocking that is compact and corky, its sub-lustrous green to blue-green, elliptical, ovate or ovate-lanceolate juvenile leaves, its relatively broad, blue-green intermediate leaves, which persist in the inner canopy of mature trees, its abundantly glandular, relatively narrow adult leaves, its lightly pruinose immature buds and growth tips, its relatively long, slender peduncles, its small, clavate to diamond-shaped buds with a rostrate operculum and long, slender pedicels and its small, sub-campanulate fruits. The species is regarded as being a part of a narrow complex within the swamp gums comprising *E. camphora* (and its subspecies) and *E. strzeleckii*, whose features include

Table 1. Comparisons between *E. bunyip* and related species.

Characters	<i>E. strzeleckii</i>	<i>E. camphora</i> subsp. <i>humeana</i>	<i>E. bunyip</i>
Habit	erect, robust trees to 40 m tall	usually umbrageous trees to 20 m tall	slender trees to 40 m tall
Bark	smooth	smooth with a box-like basal stocking often extending to mid-trunk	smooth with a short, compact, corky basal stocking
Juvenile Leaves			
Shape	lanceolate, ovate or ovate-lanceolate	broadly ovate to orbicular, often emarginate	elliptical, ovate or ovate-lanceolate
Size	5–8 cm long, 1.6–4 cm wide	4–8 cm long, 4–8 cm wide	4–6 cm long, 1.6–3 cm wide
Colour, lustre	green to blue-green, sub-lustrous	sub-glaucous, dull	green to blue-green, sub-lustrous
Adult leaves			
Shape	ovate	broadly ovate to sub-orbicular	broadly lanceolate to ovate
Size	8–20 cm long, 1.5–3 cm wide	8–15 cm long, 2.8–6.4 cm wide	10–17 cm long, 1.8–3.2 cm wide
Petiole length	1.6–3 cm long	2.2–4 cm long	1.8–3.2 cm long
Growth tips	pruinose	non-pruinose	pruinose
Canopy composition	adult leaves	adult leaves	inner canopy of intermediate leaves, outer canopy of adult leaves
Peduncle length	7–14 mm long	10–18 mm long	9–14 mm long
Buds			
Shape	ovoid or slightly diamond	diamond	clavate or slightly diamond
Size	5–8 mm long, 3–5 mm diam	5–7 mm long, 3–4 mm diam	7–10 mm long, c. 3 mm diam
Pedicel length	3–5 mm long	3–5 mm long	7–12 long
Operculum shape	shortly rostrate	conical	shortly rostrate
Fruits			
Size	4–6 mm long, 5–8 mm diam	4–6 mm long, 4–6 mm diam	5–6 mm long, 4–5 diam
Shape	obconical to sub-campanulate	obconical	sub-campanulate
Pedicel length	2–4 mm long	2–4 mm long	6–10 mm long

adult leaves that possess an abundance of island glands. *Eucalyptus strzeleckii* is considered to be its closest relative, but it also shares features with *E. camphora* subsp. *humeana*. Both of these taxa occur in the same region as *E. bunyip* (Table 1).

Eucalyptus strzeleckii has a more extensive distribution than *E. bunyip*, occurring in south and west Gippsland and in the western part of the Otway Ranges. Like *E. bunyip*, its growth tips are pruinose during the spring growing period, it has similar juvenile leaves (except those of *E. strzeleckii* are longer), abundantly glandular adult leaves and similar shaped fruits. However, it differs from *E. bunyip* by its preference for deep, fertile, intermittently wet soils in a variety of sites, including river banks, valley floors and slopes, rather than sites of constantly impeded drainage preferred by *E. bunyip*. It also differs by its more robust habit with a stout trunk and branches, the absence of the short stocking of compact, corky bark, its mature canopy consisting entirely of ovate-lanceolate or ovate adult leaves, its shorter peduncles, its broader, more or less ovoid buds with shorter pedicels and its generally larger fruits with shorter pedicels.

Eucalyptus camphora subsp. *humeana*, also a relative of *E. bunyip*, is a widespread swamp gum occurring along more or less elevated water courses of north-east Victoria and adjacent areas of New South Wales. It is less common in central and east Gippsland, but abundant in the Yarra Valley which is about 20 km to the north-west of the western-most population of *E. bunyip*. Prior to this study *E. bunyip* had been regarded by local observers as a forest form of *E. camphora*. The confusion between the two was understandable as the mature canopies of both contain relatively broad, richly glandular leaves and have similar sized buds and fruits. However, the mature canopy of *E. camphora* subsp. *humeana* consists entirely of broadly ovate or sub-orbicular adult leaves, whereas *E. bunyip* contains relatively broad intermediate leaves in the inner canopy and much narrower ovate or broadly lanceolate adult leaves at the ends of its branchlets. *Eucalyptus camphora* subsp. *humeana* further differs by its smaller, usually umbrageous habit (to 20 m tall), its often substantial stocking of persistent, compact, box-like bark, its larger, broadly ovate or orbicular, dull, bluish juvenile leaves, its broader, distinctly pendulous adult leaves borne on longer petioles, its non-pruinose buds and new season's growth tips and its obconical fruits borne on shorter, less delicate pedicels.

Series *Acaciiformes* (Scentbark Complex)

The first descriptions for scentbarks, Series *Acaciiformes* Maiden, were for two species occurring in the New England region of New South Wales. They were for *E. acaciiformis* H.Deane & Maiden (1899) and *E. nicholii* Maiden & Blakely (1929). *E. aromaphloia* L.D.Pryor & J.H.Willis (1954) was described to accommodate populations in central Victoria and *E. corticosa* L.A.S.Johnson (1962) for populations near Rylstone to the north-west of Sydney and in the Grampians Ranges of western Victoria. In 1971 Pryor and Johnson, placed *E. corticosa*, under *E. aromaphloia*. It was not until 1989 that a study by Chappill *et al.* (1986) resurrected *E. corticosa* and identified three morphological and geographical forms within the populations which had been long-regarded as *E. aromaphloia* (as well as the typical form, forms for eastern Victoria and adjacent areas of New South Wales and for the Victorian Wimmera region). *Eucalyptus ignorabilis* L.A.S.Johnson & K.D.Hill was described in 1991 and *E. splendens* Rule (occurrences to the north-west of Portland), *E. sabulosa* Rule (populations in the Little Desert of the Wimmera region and the Grampians) and *E. fulgens* Rule (populations in west Gippsland) were described in 1996. In the case of *E. sabulosa*, Brooker and Slee (1996) redefined it as a subspecies within *E. aromaphloia* but Nicolle (2006) regarded it a distinct species. *E. arcana* (D.Nicolle & Brooker) Rule (restricted to the Carpenter Rocks area of Lower south-east South Australia) was first described as a subspecies of *E. splendens* in 2000 but was elevated to a species in 2009. The classification of both *E. splendens* and *E. arcana* have been somewhat controversial. Both were placed within the Series *Viminalis* adjacent to *E. viminalis*, the former by Brooker and Slee (1997), and the latter by Nicolle and Brooker (1998), but Nicolle (2006) regarded them as a part of the Series *Acaciiformes*. On the basis of their seedling ontogeny being consistent with members of the Series *Acaciiformes*, despite being lustrous and green as in *E. viminalis*, they are regarded here as allies of that series and thus are included in the key provided. In more recent times further studies have shown that the small but scattered population of scentbarks occurring in the Fryers Range near Castlemaine in central Victoria is sufficiently unique to be regarded as a separate species. These populations are treated here as *E. conferta*.

Key for Scentbarks (Series *Acaciiformes*)

- 1 Small, straggly trees with mature stems <20 cm diam; fruits tightly sessile***E. arcana***
 1: Robust trees with mature stems >50 cm diam; fruits pedicellate**2**
- 2 Juvenile leaves lustrous and green; seedling stems square in cross-section and winged***E. splendens***
 2: Juvenile leaves dull, pale green, blue or glaucous; seedling stems neither square in cross-section nor winged.....**3**
- 3 Juvenile leaves narrow (linear, narrow-elliptical, linear-lanceolate or narrow-lanceolate), <1 cm wide**4**
 3: Juvenile leaves broad (elliptical, elliptical-ovate or elliptical-lanceolate), 1.5–3 cm wide**7**
- 4 Juvenile leaves pale green; seedling growth tips lustrous and green***E. sabulosa***
 4: Juvenile leaves blue-green or glaucous; seedling growth tips dull, blue-green or glaucous.....**5**
- 5 Adult leaves to 1 cm wide; fruits with a flat disc***E. nicholii***
 5: Adult leaves to c. 2 cm wide; fruits with an ascending disc.....**6**
- 6 Juvenile leaves linear, falcate, crenulate; fruits 3–4 mm diam***E. conferta***
 6: Juvenile leaves linear-lanceolate or narrowly lanceolate; fruits 4–6 mm diam.....***E. corticosa***
- 7 Outer rough bark dark brown; adult leaves lustrous and green; new season's growth tips bright green***E. fulgens***
 7: Outer rough bark light grey; adult leaves dull or sub-lustrous, blue-green or grey-green;
 new season's growth tips blue-green to glaucous**8**
- 8 Fruits hemispherical or slightly obconical; disc flat***E. acaciiformis***
 8: Fruits ovoid or sub-globular; disc ascending**9**
- 9 Adult leaves sub-lustrous, blue-green; fruits with short, thick pedicels***E. aromaphloia***
 9: Adult leaves dull, blue-grey; fruits with slender pedicels (often as long as fruits).....***E. ignorabilis***

The adult features of taxa within the Series *Acaciiformes* show only subtle differences in bark textures, adult leaves (size, colour, lustre and oil gland density), and fruits (shape and size and pedicel length and thickness), which might suggest to some observers that some entities, particularly those occurring in Victoria, would be better placed as subspecies within *E. aromaphloia*. However, to the contrary, progeny studies have shown that the juvenile leaves of each contribute significantly to its distinctiveness; glaucous, elliptical to ovate in *E. aromaphloia*, sub-glaucous or glaucous, elliptical-lanceolate to narrow-ovate and falcate in *E. ignorabilis*, pale green, lanceolate to narrow-ovate, often falcate in *E. fulgens*, pale green, linear-elliptical and falcate in *E. sabulosa*, lustrous, green, lanceolate or ovate-lanceolate in *E. splendens*, lustrous, green, broadly ovate in *E. arcana*, sub-glaucous, elliptical in *E. acaciiformis*,

sub-glaucous, linear in *E. nicholii*, sub-glaucous, linear-lanceolate in *E. corticosa* and glaucous, linear and falcate in *E. conferta*.

***Eucalyptus conferta* Rule sp. nov.**

Eucalypto aromaphloiae affinis habitu minore, foliis juvenilibus angusto-falcatis subcrenatis confertis, foliis adultis minoribus, pedunculo delicato, fructibus minoribus differt.

Type: Victoria: Fryers Range, Vaughan Springs Road, c 700 m S of intersection with Green Gully Road, 37°12'53" S., 144°14'32" E., *K. Rule 0210*, 7.iv.2010. HOLO: MEL; ISO: AD, CANB, NSW.

Smallish, slender trees, to c. 15 m tall. Bark grey-brown or light brown, sub-fibrous, persistent to the upper trunk, longitudinally furrowed, often loosely attached

in short strips; bark on the lower trunk usually thick, moderately furrowed, crusty; inner bark light brown; upper bark decorticating in short ribbons; branches smooth, whitish to pale brown. *Seedling leaves* elliptical, sub-sessile, blue-green, discoloured; lower surface white. *Juvenile leaves* linear, moderately to markedly falcate, moderately crenulate, apiculate, sessile and opposite, becoming shortly petiolate, disjunct, crowded along the stem (not ericoid), slightly discoloured, dull, glaucous, 4–8 cm long, 0.5–0.9 cm wide; petioles 0–5 mm long; growth tips lightly pruinose. *Intermediate leaves* narrow-lanceolate or slightly ovate, often falcate,

crowded, petiolate, crenulate, slightly discoloured to concolorous, dull, blue-green to glaucous. *Adult leaves* narrow-lanceolate or lanceolate, sometimes falcate, acuminate, moderately reticulate, dull, blue-green or pale green, thin (0.18–0.27 mm thick), 7–11(–13) cm long, 1.2–1.8 cm wide; petioles 1.2–1.8 cm long; intramarginal vein <2 mm from margin; oil glands regular, numerous, mostly island; new season's growth tips light green to sub-glaucous. *Inflorescences* simple, axillary, 7-flowered; peduncles slender, slightly angular, 7–11 mm long. *Floral buds* ovoid, pedicellate scarred, 6–7 mm long, 2–3 mm wide; pedicels slender,



Figure 3. *Eucalyptus conferta* (a) foliage; (b) trunk with coppice leaves; (c) seedling; (d) buds; (e) fruits.

2–5 mm long; operculum conical, as wide as hypanthium, 3–4 mm long; stamens irregularly flexed, all fertile; filaments white; anthers dorsifixed, oblong-cuneate, versatile, dehiscing through longitudinal slits; locules 3 or 4; ovules in 4 vertical rows. *Fruits* slightly obconical to sub-globoid, pedicellate, 3–4 mm long, 3–4 mm wide; pedicels, slender, 1–3 mm long; disc ascending; valves slightly exserted. *Fertile seeds* black, irregularly oblong, flattened, lacunose; hilum ventral (Fig. 3).

Flowering Period: Autumn.

Distribution and Habitat: The new taxon is restricted to the Glenluce State Forest in the Fryers Range, about 17 km to the south of Chewton (Fig. 1). The population is disjunct from other scentbarks, particularly *E. aromaphloia*, which is known to occur approximately 20 km to the south in the Daylesford area. The species occurs on hilly terrain and favours dry, shallow skeletal soils that are sedimentary in origin. It is possible that other stands of the taxon occur on similar sites in the district. The mean annual rainfall of nearby Castlemaine is approximately 550 mm, most of which falls in winter.

Additional specimens examined: VICTORIA: c. 5 km SE of Vaughan, 0.5 km S of Sebastopol Ck., 10 m E of road on Crown land, *B. Kemp s.n.*, 11.v.1986 (MEL686536); Fryers Range, Vaughan Springs Road c. 100 m N of intersection with Green Gully Road, *K. Rule 11007*, 25.vi.2007 (MEL); Fryers Range, Vaughan Springs Road, at the end of the bitumen, *K. Rule 11207*, 25.vi.2007 (MEL); Fryers Range, Green Gully Road, 700 m from Vaughan Springs Road, *K. Rule 11407*, 25.vi.2007 (MEL); Fryers Range, Green Gully Road, 1.1 km from Vaughan Springs Road, *K. Rule 11507*, 25.vi.2007 (MEL).

Associated Species: *Eucalyptus dives*, *E. nortonii* (Blakely) L.A.S.Johnson, *E. melliodora* A.Cunn. ex Schauer, *E. polyanthemos* Schauer subsp. *vestita* L.A.S.Johnson & K.D.Hill, *E. macrorhyncha* F.Muell. ex Benth. and *E. obliqua* all occur within the range of *E. conferta*.

Etymology: The name is from the Latin *confertus* 'crowded' in reference to the numerous pairs of leaves occurring along the axis in the juvenile and intermediate stages of development.

Conservation Status: The number of mature trees of *E. conferta* is estimated to be between 400 and 500. Even though they occur in a state forest, which has no apparent value for timber extraction, its long-term security is not guaranteed. In accordance with IUCN criteria (IUCN 2001) a status of 'vulnerable' (VU) is suggested.

Discussion: *Eucalyptus conferta* is distinctive by its smallish, sometimes spindly habit, its often loosely

attached, usually crusty lower bark, its linear, falcate, glaucous, crenulate juvenile leaves, which become crowded in the advanced seedling stage, its smallish, thin, dull, blue-green to sub-glaucous adult leaves, its delicate peduncles and its small buds and small, sub-globular fruits that are borne on short, delicate pedicels.

Eucalyptus conferta is regarded as being closely related to *E. aromaphloia* which differs by its generally larger habit (stout-trunked, spreading trees), its thicker, more deeply furrowed bark, its broader, ovate to elliptical, non-falcate, non-crenulate, less crowded juvenile leaves, its more glossy, thicker, larger adult leaves, its generally shorter peduncles, its generally thicker, shorter pedicels and its larger buds and fruits (Table 2).

The narrow juvenile leaves of *E. conferta* resemble those of *E. nicholii*, a species from northern New South Wales, as do its delicate peduncles and pedicels. However, the appearance of its canopy differs from that species by its generally broader adult leaves. Further, the fruits of *E. conferta* are generally larger and more globoid than those of *E. nicholii* and have a shape similar to other southern scentbarks including *E. aromaphloia*, *E. sabulosa*, *E. ignorabilis* and *E. fulgens*. Similarly, it shares features with *E. corticosa*, namely its general appearance, particularly its mature canopy and its delicate peduncles and pedicels. However, *E. corticosa* differs from the new species by its broader, non-falcate, non-crenulate, less crowded juvenile leaves and its larger buds and fruits.

Series *Globulares* (Mountain Grey Gum Complex)

In recent years several taxa regarded as mountain grey gums have been described. The complex features medium to tall or less often small trees, smooth bark or box-type bark on the lower trunk, seedling stems usually square in cross-section and sometimes winged, juvenile leaves usually opposite, sessile and amplexicaul for numerous pairs, green and glossy or glaucous in one species, long, glossy and green adult leaves, long, strap-like peduncles, pedicellate, usually cigar-shaped buds that are waisted at the mid-point and elongated fruits with the valves enclosed. This group is closely related to the long-leaf boxes (*E. goniocalyx* F. Muell. ex Miq. and its allies) which usually feature species with smaller habits, box-type bark over most of the trunk, orbicular, usually glaucous juvenile leaves, generally shorter adult leaves, shorter peduncles and mostly sessile buds and fruits.

Table 2. Comparisons between *E. conferta* and *E. aromaphloia*

Characters	<i>E. aromaphloia</i>	<i>E. conferta</i>
Habit	umbrageous tree to 25 m tall	slender tree to 15 m tall
Bark	sub-fibrous, thick, deeply furrowed	sub-fibrous, moderately furrowed
Juvenile leaves		
Size	2–6 cm long, 1–4 cm wide	4–8 cm long, 0.5–0.9 cm wide
Shape	elliptical to ovate	linear, falcate
Colour	glaucous	glaucous
Margins	entire	moderately crenulate
Density along the axis	not crowded	crowded
Adult leaves		
Shape	lanceolate	lanceolate
Size	8–18 cm long, 1–2.5 cm wide	7–13 cm long, 1.2–1.8 cm wide
Petiole length	1.2–2.2 mm	1.2–1.8 mm
Colour, lustre	blue-green, sub-lustrous	blue-green or pale green, dull
Thickness	0.24–0.39 mm	0.18–0.27 mm
Peduncle		
Length	4–9 mm	7–11 mm
Buds		
Size	4–7 mm long, 3 mm diam	3–5 mm long, 2–3 mm diam
Pedicel length	1–3 mm long	2–5 mm long
Fruits		
Shape	hemispherical to sub-globular	sub-globular
Size	4–7 mm long, 4–7 mm diam	3–4 mm long, 3–4 mm diam
Pedicel length	0–2 mm long	1–3 mm long

The name *E. goniocalyx* was previously incorrectly applied to tall forest trees which were named *E. cypellocarpa* in 1962. Until recently all known populations of mountain grey gums occurring in coastal and sub-coastal regions from northern New South Wales to western Victoria, were included with *E. cypellocarpa*. *Eucalyptus alaticaulis* R.J.Watson & Ladiges (1987) was described to cater for populations occurring in the Grampians Ranges of western Victoria and near Anglesea to the south-west of Melbourne. *Eucalyptus retinens* L.A.S.Johnson & K.D.Hill, *E. volcanica* L.A.S.Johnson & K.D.Hill (both 1990), *E. oresbia* J.T.Hunter & J.J.Bruhl and *E. quinniorum* J.T.Hunter & J.J.Bruhl (both 1999) are names applied to mountain grey gums occurring in northern New South Wales. *Eucalyptus litoralis* Rule was described to accommodate the Anglesea 'form' of *E. alaticaulis* and *E. pyreneae* Rule to cater for the disjunct occurrences of mountain grey gums on Mt Avoca in the Pyrenees Range of west-central Victoria (Rule 2004).

The mountain grey gum complex has been marked by controversy as there is no consensus regarding the acceptance of several of the taxa. In fact, Brooker and Slee (1997) did not accept *E. alaticaulis* and Brooker and Kleinig (2006) rejected *E. retinens*, *E. oresbia*, *E. quinniorum* and *E. pyreneae* as distinct taxa, all of which were regarded as synonymous with *E. cypellocarpa*. Nicolle (2006) chose to accept *E. alaticaulis* as a distinct taxon, but regarded *E. pyreneae* as a form of that species. He further regarded *E. oresbia* and *E. quinniorum* as forms of *E. cypellocarpa*. On the other hand, Hill (2002) accepted all taxa occurring in New South Wales whilst all Victorian taxa, including *E. alaticaulis* and *E. pyreneae*, were accepted by Walsh and Stajsic (2007). Obviously, a formal revision of the complex is required to eliminate this controversy. At this point, however, all taxa listed above are accepted and included in the key.

An additional taxon, which has long been regarded as a form of *E. goniocalyx*, is not only treated here as a new

Key to the Mountain Grey Gums

1 Juvenile leaves lanceolate (narrow to broad).....	2
1: Juvenile leaves elliptical or ovate to orbicular.....	3
2 Mallees or rarely small, single-stemmed trees to 16 m tall; buds with operculum wider than hypanthium	<i>E. quinniorum</i>
2: Single-stemmed trees to 60 m tall; buds with operculum narrower than or as wide as the hypanthium	<i>E. cypellocarpa</i>
3 Bark smooth throughout; buds not waisted at the mid-point	<i>E. oresbia</i>
3: Rough bark persistent on lower trunk or higher; buds waisted at the mid-point	4
4 Juvenile leaves glaucous	<i>E. volcanica</i>
4: Juvenile leaves green or blue-green.....	5
5 Seedling stems without prominent wings.....	6
5: Seedling stems prominently winged	7
6 Longest adult leaves to 29 cm long	<i>E. carolaniae</i>
6: Longest adult leaves to 18 cm long	<i>E. retinens</i>
7 Fruits 5–6 mm diam	<i>E. pyrenea</i>
7: Fruits 7–11 mm diam	8
8 Operculum 4–8 mm long; fruits 9–13 mm long, 8–11 mm diam.....	<i>E. litoralis</i>
8: Operculum 3–4 mm long; fruits 6–10 mm long, 6–9 mm diam	<i>E. alaticaulis</i>

species, but is regarded as belonging to the mountain grey gum complex on the basis of both seedling and adult characters. It occurs on the Mornington Peninsula to the south-east of Melbourne and was first brought to my attention in the early 1990s by the late Ms. Pat Carolan, after whom it is named.

***Eucalyptus carolaniae* Rule sp. nov.**

*Eucalypto cypellocarpae affinis habitu minore, cortice persistenti buxiformi, foliis juvenilibus latioribus griseo-
viridibus, foliis adultis majoribus, fructibus sessilibus vel subsessilibus differt.*

Type: Victoria: Norfolk-Hopetoun Reserve, Mt Martha, 38°16' S, 145°01' E., *P Carolan s.n.*, 9.vi.1989. HOLO: MEL (3 sheets: MEL 117392, MEL 117393, MEL 117394).

Small-medium, robust, often spreading trees to 20 m tall. Bark sub-fibrous, box-like, grey-brown, deeply furrowed, often crusty, persisting on lower trunk or higher, graduating to thin, finely furrowed bark above; branches usually smooth, pale grey-brown; old bark

decorticating in ribbons. *Seedling leaves* broadly ovate, discolourous, pale green, sub-lustrous on the upper surface, whitish on the lower surface. *Seedling stems* initially square in cross section, becoming round by the 6th node. *Juvenile leaves* broadly ovate to broadly elliptical or sub-orbicular, opposite, sessile, amplexicaul for numerous pairs, apiculate, discolourous, lustrous and light green, becoming dull or sub-lustrous and blue-green with age, 6–10 cm long, 4–7 cm wide; growth tips faintly glaucous throughout the seedling stage. *Intermediate leaves* broadly ovate or ovate-lanceolate, shortly petiolate, disjunct, lustrous, green to blue-green, longer than juvenile leaves. *Adult leaves* lanceolate, falcate, pendulous, acuminate, concolorous, lustrous, green, 16–29 cm long, 2–4 cm wide; petioles 1.7–3.2 cm long; venation conspicuous, moderately dense; intramarginal vein remote, 3–5 mm from the margin; glands regular, scattered, island and intersectional. *Inflorescences* simple, axillary, 7-flowered; peduncles flattened, thickening with age, 12–20 mm long, 3–4 mm wide. *Floral buds* ovoid-cylindrical, waisted at

mid-point, scarred (outer operculum shed in early bud development), ribbed, shortly pedicellate, 7–10 mm long, 3–5 mm wide; pedicels 1–3 mm long; operculum sharply conical 3–4 mm long, flush with the hypanthium at the abscission zone; stamens inflexed; filaments white, all fertile; anthers oblong, sub-basifixed, versatile, dehiscing through longitudinal slits; locules (3) 4, each with 4 ovular rows. *Fruits* cupular, sub-cylindrical or slightly obconical, basally-tapered, sessile or subsessile, moderately or prominently ribbed, thin-walled,

8–11 mm long, 6–9 mm diam, pedicels 0–2 mm long; disc descending; valves (3–) 4, enclosed. *Fertile seeds* dark brown or black, flattened, ovoid, 2–3 mm long, tapered at one end, lacunose; hilum ventral (Fig. 4).

Flowering Period: Summer.

Distribution and Habitat: The new taxon is known only from a single population located above Mt Martha township on the Mornington Peninsula approximately 60 km south-south-east of Melbourne (Fig. 1). It grows along a sheltered gully in deep soils derived from granite.



Figure 4. *Eucalyptus carolaniae* (a, b) trees; (c) bark; (d) juvenile leaves; (e) fruits.

The mean annual rainfall of the area is approximately 650 mm, most of which falls in winter.

Additional specimens examined: VICTORIA: Norfolk–Hopetoun Reserve, Mt Martha, *K. Rule 0201*, 20.i.2001 (MEL); Mt Martha Golf Course, *K. Rule 0252*, 15.v.2002 (AD, CANB, MEL, NSW).

Associated Species: *Eucalyptus radiata* subsp. *radiata*, *E. viminalis* subsp. *viminalis* and *E. ovata* var. *ovata* are sympatric with *E. carolaniae*, whilst *E. obliqua*, and *E. pauciflora* Sieber ex Spreng. subsp. *pauciflora* occur in the vicinity. Hybrids with *E. viminalis* have been observed in the field.

Etymology: The epithet honours the late Ms Pat Carolan who collected the type specimen of the new taxon and who first brought the existence of the population to my attention. She is further recognised for her contributions to the understanding of Victoria's eucalypts, having been an enthusiastic collector and having lodged numerous specimens with MEL.

Conservation Status: An ecological study by Picone and McCaffrey (2006) estimated the population of *E. carolaniae* as approximately 500 naturally occurring trees and saplings, nearly all of which occur along a linear strip of bushland forming the Norfolk–Hopetoun Reserve and extending on to a section of the lower extremity of the Mt Martha Golf Course. A large proportion of the population is sandwiched along a narrow easement between housing blocks between Norfolk and Hopetoun Roads. The habitat until recently has been infested with blackberries and other weeds. Its close proximity to the golf course and houses remains a concern as the long term impact of changes to nutrient levels and to drainage patterns is unknown. A revegetation program has reintroduced several hundred seedlings to an area of the golf course which abuts naturally occurring trees. The reserve and the golf course, which are managed by the Mornington Shire Council, offer some protection to the species. As the taxon's numbers are critically low and there are threats from changes to drainage patterns and nutrient levels, in accordance with IUCN criteria (IUCN 2001) a status of 'endangered' (EN) is considered appropriate.

Discussion: The combination of features which distinguish *E. carolaniae* are its relatively small habit, its rough, box-type bark which usually extends to the upper trunk and sometimes to the major branches, its seedling stems that are square in cross-section in early

seedling development, its juvenile leaves that are ovate to broadly elliptical or sub-orbicular and initially lustrous and light green but become dull and blue-green with age, its large adult leaves, its long, flattened peduncles, its shortly pedicellate, cigar-shaped buds and its basally-tapered, sessile or sub-sessile, thin-walled fruits.

Eucalyptus carolaniae shares features with both *E. cypellocarpa* and *E. goniocalyx* which may raise the possibility that it is derived from hybrid stock. Initially the proposition of hybridism had some merit as the adult trees exhibit slight variation in the amount of persistent rough bark on the trunk. Despite this, other adult features within the population are uniform and repeated seedling trials have consistently produced uniform seedlings, all of which supports *E. carolaniae* as a true-breeding, distinct species (Table 3).

Eucalyptus cypellocarpa differs from *E. carolaniae* by its taller, straighter habit, its smooth bark, except for strips and plates of old bark often remaining attached to the base or lower trunk, its more lustrous, greener, narrower (lanceolate) juvenile leaves, its generally shorter, narrower adult leaves and its consistently pedicellate buds and fruits.

Eucalyptus carolaniae resembles *E. goniocalyx* in habit and bark and the type specimens were initially held under that name at MEL. However, it is here regarded as being a part of the mountain grey gum complex and closely related to *E. cypellocarpa*. It differs from *E. goniocalyx* by its seedling stems being initially square in cross-section in early seedling development (stems round in cross-section in *E. goniocalyx*), its broadly ovate to broadly elliptical, apiculate juvenile leaves (seedlings with some orbicular and emarginate juvenile leaves in *E. goniocalyx*), its longer adult leaves, its longer peduncles, its shortly pedicellate buds and its consistently basally-tapered fruits.

Series *Buxuales* (The Mallee-boxes)

A new box species, *E. yarriambiack*, is described below. It has close affinities with several other box species, some of which, until recently, had been referred to as mallee-boxes and placed in the Series *Subbuxuales* Blakely (1934) by various commentators, for example, Chippendale (1988), Brooker and Slee (1997), Nicolle (2000) and Rule (2004). Such species include *E. odorata* Behr, *E. polybractea* R.T.Baker, *E. viridis* R.T.Baker,

Table 3. Comparisons between *E. carolaniae* and related species. Included in the key are references to various subspecies of *E. goniocalyx*, three of which were described by Rule (2011).

Characters	<i>E. goniocalyx</i>	<i>E. cypellocarpa</i>	<i>E. carolaniae</i>
Habit	single or few-stemmed trees to 15 m tall or mallees in subsp. <i>exposa</i> , to 25 m in subsp. <i>fallax</i>	trees to 60 m tall	single or few-stemmed trees to 20 m tall
Bark	box-type to minor branches or smooth in subsp. <i>exposa</i> , non-fractured in subsp. <i>fallax</i> , loosely attached in subsp. <i>laxa</i>	smooth except for old strips and plates on lower trunk	usually box-type to upper trunk
Seedling stems	round in cross-section	square in cross-section in Victorian populations	square in cross-section for a few pairs
Juvenile leaves			
Shape	broadly ovate to orbicular	lanceolate	broadly ovate to broadly elliptical or sub-orbicular
Apex	apiculate and emarginate	apiculate	apiculate
Size	14–11 cm long, 4–10 cm wide	10–17 cm long, 3–7 cm wide	6–10 cm long, 4–7 cm wide
Colour, lustre	blue-green to glaucous, dull or green, lustrous in subsp. <i>viridissima</i>	green, lustrous	green or blue-green, sub-lustrous
Adult leaves			
Size	8–20cm long, 1.5–3.5 wide, to 25 cm long in subsp. <i>laxa</i>	11–20 cm long, 1–2.5 cm wide	16–29 cm long, 2–4 cm wide
Petiole length	1.6–3.3 cm	1.5–2.7 cm	1.7–3.2 cm
Peduncle length	6–15 mm long, to 18 mm long in subsp. <i>fallax</i>	8–22 mm long	12–20 mm long
Buds			
Shape	ovoid to cylindrical	ovoid to cylindrical	ovoid to cylindrical
Size	8–13 mm long, 3–6 mm diam	7–11 mm long, 3–5 mm diam	7–10 mm long, 3–5 mm diam
Pedicel length	sessile, rarely sub-sessile in subsp. <i>laxa</i>	2–3 mm	1–3 mm
Fruits			
Shape	cupular or cylindrical	cupular to barrel-shaped	cupular or slightly obconical
Size	5–10 mm long, 5–10 mm diam	5–10 mm long, 6–9 mm diam	8–11 mm long, 6–9 mm diam
Pedicel length	sessile, rarely sub- sessile in subsp. <i>laxa</i>	1–2 mm	0–2 mm

E. wimmerensis Rule, *E. aenea* K.D.Hill, *E. castrensis* K.D.Hill, *E. walshii* Rule, *E. filiformis* Rule and *E. hawkeri* Rule. Their shared features include a mallee or small, tree-like habit, either smooth bark throughout or persistent box-like bark present to various heights on the stems, adult leaves with numerous large, 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.

Brooker (2000) in his revision of *Eucalyptus* discarded the Series *Subbuxales* and assigned the mallee-box species to the Supraspecies *Odoratae* within the Series *Buxales*. In the key provided, this treatment only partly adheres to Brooker's classification as it excludes

some species contained in his Supraspecies *Odoratae* (*E. albopurpurea* (Boomsma) D.Nicolle and *E. persistens* L.A.S.Johnson & K.D.Hill subsp. *persistens*, including *E. persistens* subsp. *tardecidens* L.A.S.Johnson & K.D.Hill) and other species that have been previously regarded as mallee-boxes (*E. porosa* F.Muell. ex Miq., *E. bosistoiana* F.Muell., *E. froggattii* Blakely and *E. silvestris* Rule) as they do not comply totally with the criteria for the mallee-box complex set out above. *Eucalyptus albopurpurea* has adult leaves with a dense reticulation with intersectional glands and paniculate inflorescences. Both subspecies of *E. persistens* have paniculate inflorescences. *E. porosa* has 5- or 6-loculed fruits and a uniquely remote intramarginal vein. *Eucalyptus bosistoiana* has paniculate

Key to *E. odorata* and its allied Mallee-boxes

1 Juvenile leaves <0.6 cm wide	2
1: Juvenile leaves 0.7–3.2 cm wide.....	3
2 Adult leaves lustrous and green; coppice leaves green.....	<i>E. viridis</i>
2: Adult leaves sub-lustrous and blue-green; coppice leaves glaucous	<i>E. filiformis</i>
3 Bark smooth throughout or rough bark as a short basal stocking on larger stems.....	4
3: Rough bark extending to upper stem or higher.....	8
4 Seedlings and buds pruinose	<i>E. polybractea</i>
4: Seedlings and buds non-pruinose	5
5 Juvenile leaves lustrous, green; fruits 2–4 mm diam.....	<i>E. aenea</i>
5: Juvenile leaves dull, blue-green; fruits 4–6 mm diam	6
6 Slender, pole-like trees	<i>E. walshii</i>
6: Mallees	7
7 Juvenile leaves 1–1.5 cm wide; adult leaves dull or sub-lustrous, blue-green	<i>E. wimmerensis</i>
7: Juvenile leaves 1.5–4 cm wide; adult leaves lustrous, green	<i>E. castrensis</i>
8 Mallees; juvenile leaves glaucous; immature fruits pruinose	<i>E. polybractea</i>
8: Trees; juvenile leaves green or blue-green; immature fruits non-pruinose.....	9
9 Slender, single or few-stemmed erect trees; adult leaves weeping; new season's growth tips lustrous, green	<i>E. hawkeri</i>
9: Robust, few-stemmed, spreading trees: adult leaves erect; new season's growth tips dull, blue-green or sub-glaucous.....	10
10 Buds lightly pruinose; fruits 3–4 mm diam.....	<i>E. yarriambiack</i>
10: Buds non-pruinose; fruits 4–7 mm diam	<i>E. odorata</i>

inflorescences and 5- or 6-loculed fruits. *Eucalyptus froggattii* has paniculate inflorescences and lateral veins that do not connect with the intramarginal vein. Lastly, *E. silvestris* has adult leaves with a dense reticulation and sparsely distributed intersectional glands and in this respect is allied to *E. microcarpa* Maiden.

***Eucalyptus yarriambiack* Rule sp. nov.**

Eucalypto wimmerensi affinis habitu arborescenti majore, cortice buxiforme, foliis juvenilibus viridibus, alabastris subpruinosis, fructibus minoribus differt et Eucalypto odorata affinis foliis juvenilibus angustioribus viridibus minoribus, foliis adultis angustioribus subnitentibus, alabastris subpruinosis minoribus, fructibus minoribus differt.

Type: Victoria: Henty Highway, 1.6 km N of Brim, 36° 03' 41" S., 142° 25' 13" E., *K. Rule 2605*, 18.iii.2005. HOLO: MEL.

Robust, spreading small trees, usually with a few thick trunks, to 10 m tall, 10 m wide. *Bark* light grey-brown, box type, persisting to at least to the upper trunk, smooth, light grey-brown above; old bark decorticating in broad strips. *Seedling leaves* narrowly elliptical, petiolate, opposite for 3 or 4 pairs, green, discolorous. *Juvenile leaves* narrowly lanceolate or elliptical-lanceolate, alternate, shortly petiolate, rigid, coriaceous, slightly discolorous, sub-lustrous, green, becoming blue-green with age, 5–9 cm long, 0.7–1.1 cm wide; petioles 0.2–1.0 cm long. *Intermediate leaves* lanceolate, concolorous, lustrous, slightly blue-green, slightly

broader than the juvenile leaves. *Adult leaves* narrowly lanceolate or lanceolate, sometimes falcate, semi-erect, acuminate, uncinata, coriaceous (0.5–0.65 mm thick), erect along the axis, sub-lustrous olive-green or with a bluish tinge, 5–10 cm long, 0.8–1.5 cm wide; new season's growth tips sub-glaucous; petioles terete, 0.9–1.4 cm long; venation moderately acute (35° – 45°), moderately reticulate; intramarginal vein c. 1 mm from the margin; oil glands large, numerous, irregular, island. *Inflorescences* simple, axillary, 7–11-flowered, along the main axis or along terminal, leafy branchlets; peduncles angular or terete, slender, 0.6–1.1 cm long. *Floral buds* ovoid to slightly clavate, petiolate, lightly pruinose at anthesis, unscarred (petaline and sepaline opercula intact), 4–6 mm long, c.3 mm wide; pedicels 2–4 mm long, operculum conical, c. 2/3 the

length of and as wide as the hypanthium; locules 3 or 4; ovules in 4 vertical rows; filaments white; stamens irregularly inflexed, all fertile; anthers sub-basifixed, adnate, globoid, dehiscing through lateral pores. *Fruits* hemispherical to cupular, rarely barrel-shaped, pedicellate, 4–6 mm long, 3–4 mm diam; pedicels 1–3 mm long; disc descending; valves 3 or 4, enclosed. *Fertile seeds* ovoid, slightly flattened, finely reticulate, dark brown; hilum ventral (Fig. 5).

Flowering Period: Autumn.

Distribution and Habitat: *Eucalyptus yarriambiack* is known from a single location between Brim and Beulah in the southern part of the Victorian Mallee region (Fig. 1). Its occurrence is on well-drained mallee loams close to the Yarriambiack Creek which, due to low rainfall of the area, is usually a dry water course.



Figure 5. *Eucalyptus yarriambiack* (a) tree; (b) bark; (c) seedling; (d) buds; (e) fruits

Additional specimens examined: VICTORIA: NNE of Brim, Wardles Road East, c. 200 m E of the railway line, *K. Rule 1108*, 1.vii.2008 (MEL); NW of Brim, Wardles Road West, c. 1.1 km W of Henty Hwy, *K. Rule 1208*, 1.vii.2008 (MEL); NNW of Brim, Starrocks Road, c. 600 m W of the Henty Hwy, *K. Rule 1308*, 1.vii.2008 (MEL); Henty Hwy N of Brim, c. 0.8 km S of creek crossing, *K. Rule 1408*, 1.vii.2008 (MEL); Henty Hwy, N of Brim, c. 2.7 km S of creek crossing, *K. Rule 1608*, 1.vii.2008 (MEL).

Associated Species: *Eucalyptus yarriambiack* occurs in pure stands but has contact with *E. dumosa* A.Cunn. ex J.Oxley and *E. largiflorens* F. Muell. on the boundaries of its distribution.

Etymology: The epithet, which is Aboriginal in origin, is used as a noun in apposition and refers to the Yarriambiack Creek close to where the new species occurs.

Conservation Status: The total known number of plants of *E. yarriambiack* is about 150, most of which are mature trees. Seedling recruitment is minimal and seedlings are absent along the stretch of the Henty Highway where several of the mature trees occur. As far as is known, all plants occur along roadside reserves and thus are exposed to a variety of threats. In accordance with IUCN criteria (IUCN 2001) the species is regarded as 'critically endangered' (CR).

Discussion: In habit and bark *E. yarriambiack* resembles *E. largiflorens*, black box, which occurs nearby in heavy soils along the Yarriambiack Creek. However, the two differ markedly in a wide range of features, particularly with the latter having duller, pendulous

foliage, terminal, compound inflorescences and scarred buds.

Eucalyptus yarriambiack, whose features include adult leaves with moderately reticulate venation and large, irregular island glands, simple, axillary inflorescences and 3–4-loculed fruits, clearly place it with the mallee-boxes, a large group of taxa within the Series *Buxaeales*. The combination of features which distinguish the new species from its relatives are its robust, often spreading habit, its persistent box bark, its relatively narrow, greenish juvenile leaves, its sub-lustrous, blue-green or olive-green adult leaves, its sub-glaucous new growth during the growing season, its lightly pruinose buds and its small, pedicellate fruits.

Of the mallee-boxes, *E. wimmerensis*, which occurs approximately 50 km to the west of *E. yarriambiack*, is considered a close relative. Both have similar juvenile leaves in shape and size and similar adult leaves in shape, size and colour, as well as in venation and oil gland patterns. However, *E. wimmerensis* differs by its true mallee habit, its reduced amount of box bark or being completely smooth-barked and its generally larger fruits (Table 4).

The tree-like habit and persistent box bark also suggest *E. yarriambiack* has an affinity with *E. odorata*. However, that species differs by its broader leaves at all stages, its non-pruinose, larger buds and its larger fruits. Recent surveys of mallee-boxes in the Wimmera have revealed that small, rough-barked mallees, previously included within *E. wimmerensis*, are now considered

Key to the Brown Stringybarks

1 Operculum smooth or slightly scurfy (non-warty); locules 3 or 4	2
1: Operculum warty; locules 4–7	3
2 Adult leaves lanceolate, to 13 cm long; fruits 8–11 mm diam	<i>E. arenacea</i>
2: Adult leaves elliptical to ovate, to 8 cm long; fruits 5–8 mm diam.	<i>E. aurifodina</i>
3 Bark stringy, extending to the secondary branches; buds shortly pedicellate	<i>E. baxteri</i>
3: Bark on trunk smooth or flaky (box-type); buds sessile	4
4 Bark flaky, box-like; adult leaves broadly lanceolate; fruits 11–13 mm diam.	<i>E. victoriana</i>
4: Bark mostly smooth; adult leaves ovate to orbicular; fruits 11–25 mm diam.	5
5 Disc steeply ascending; fruits 11–16 mm diam.	<i>E. serraensis</i>
5: Disc more or less level with the rim; fruits 16–25 mm diam.	<i>E. verrucata</i>

to be forms of *E. polybractea*. These and other forms of *E. polybractea* differ from *E. yarriambiack* by their mallee habit and their strongly pruinose seedlings.

Series *Pachyphloiae* (Brown Stringybark Complex)

Until 1988 the brown stringybark complex had consisted of only two recognised taxa; the widespread, variable *E. baxteri* (Benth.) Maiden & Blakely ex J.M.Black, which occurs from Kangaroo Island to the south coast of New

South Wales, and the similarly variable *E. alpina* Lindley, which was regarded as being restricted to ridge-tops in the Grampians Ranges. In 1988 *E. arenacea* Marginson & Ladiges was segregated from *E. baxteri* to cater for populations of robust, spreading mallees occurring on inland sandy sites of western Victoria and adjacent areas of South Australia. With regard to *E. alpina*, studies by Marginson (1984), Ladiges and Humphries (1986) and Marginson and Ladiges (1988) indicated that it consisted of three species rather than one. Marginson (1984)

Table 4. Comparisons between *E. yarriambiack* and related species.

Characters	<i>E. wimmerensis</i>	<i>E. yarriambiack</i>	<i>E. odorata</i>	<i>E. polybractea</i>
Habit	mallee to 8 m tall	single or few-stemmed tree to 10 m tall	mallee or small tree to 15 m tall	mallee to 10 m tall
Bark	smooth or often with box-type stocking	box-type to major branches	box-type to major branches	smooth or a box-type stocking to various heights
Juvenile leaves				
Size	5–8 cm long, 0.8–1.6 cm wide	5–9 cm long, 0.7–1.1 cm wide	5–8 cm long 1–3 cm wide	4–10 cm long, 0.8–1.5 cm wide
Colour, lustre	dull, blue-green or sub-glaucous	sub-lustrous, green or blue-green	dull, blue-green or sub-glaucous	dull, blue-green or glaucous
Petiole length	0.6–1.2 cm	0.2–1 cm	0.4–1.2 cm	0.2–1.3 cm
Adult leaves				
Size	5–11 cm long, 0.8–1.5 cm wide	5–10 cm long, 0.8–1.5 wide	6–12 cm long, 0.9–2 cm wide	5–9 cm long, 0.9–1.7 cm wide
Colour, lustre	sub-lustrous or lustrous, green, blue-green or olive-green	sub-lustrous, blue-green or olive-green	dull or sub-lustrous, green or olive green	dull, glaucous or sub-glaucous
Intramarginal vein (distance from margin)	c. 1 mm	c. 1 mm	1–2 mm	c.1 mm
Petiole length	0.8–1.5 cm	0.9–1.4 cm	0.6–1.5 cm	0.6–1.5 cm
Colour of growth tips during growing season	dull, blue green	sub-glaucous	blue-green	glaucous
Buds				
Pruinosity	absent or light in one southern form	light	absent	strongly present
Shape	ovoid to slightly clavate	ovoid to slightly clavate	ovoid to clavate,	ovoid to slightly clavate
Size	4–6 mm long, 3–4 mm diam	4–6 mm long, c.3 mm diam	5–8 mm long, 3–5 mm diam	4–7 mm long, 3–5 mm diam
Pedicel length	2–4 mm	2–4 mm	2–4 mm	2–5 mm
Fruits				
Shape	cupular or sub-cylindrical	hemispherical to cupular, rarely barrel-shaped	cupular or barrel-shaped	cupular, sub-cylindrical or barrel-shaped
Size	6–8 mm long, 4–6 mm diam	4–6 mm long, 3–4 mm diam	6–9 mm long, 5–7 mm diam	4–7 mm long, 3–5 mm diam
Pedicel length	1–3 mm	1–3 mm	1–3 mm	1–4 mm

asserted that the materials used for the type specimen of *E. alpina*, collected from the summit of Mt William, were from a hybrid between *E. baxteri* and an unnamed, related taxon and that the name *E. alpina* could no longer be sustained. Chemical studies by Ladiges and Whiffin (1993) confirmed the findings of previous researchers and *E. serraensis* Ladiges & Whiffin, *E. verrucata* Ladiges & Whiffin (referred to as *E. verrucosa* in the paper) and *E. victoriana* Ladiges & Whiffin were subsequently erected in 1993. The earlier name *E. verrucosa* Colla rendered *E. verrucosa* Ladiges & Whiffin illegitimate and was replaced by *E. verrucata* Ladiges & Whiffin in 1995. In a concluding comment on *E. baxteri*, Whiffin and Ladiges (1995) were of the opinion that *E. baxteri* held no other segregate worthy of taxonomic recognition.

The distinguishing features upon which *E. arenacea* was segregated from *E. baxteri* included its juvenile leaves becoming glabrous later in seedling development (hispid leaves persisting to at least 13 pairs in the former and to 8 pairs in the latter), its leaves at all stages being narrower, with the adult leaves more tapering to the apex, its flower buds being non-warty with longer, narrower pedicels, its peduncles also being longer and narrower and its fruits being generally smaller, with a less raised disc.

Further research into the variable nature of *E. baxteri* has identified a new taxon occurring in the Victorian Goldfields, a region whose populations were not included in any of the studies of previous researchers (cited above). A treatment of this new taxon is provided below.

***Eucalyptus aurifodina* Rule sp. nov.**

Eucalypto arenaceae affinis foliis juvenilibus minoribus, foliis intermediis ovatis vel sub-orbicularibus minoribus, foliis adultis ovatis vel ellipticis minoribus, alabastris ovoideis minoribus, fructibus minoribus differt et Eucalypto baxteri affinis foliis juvenilibus et adultis minoribus, pedunculis angustioribus longioribus, alabastris minoribus, operculis obtuso-conicis non-verrucatis, fructibus pedicellatis minoribus differt.

Type: Victoria: Maldon Historical Reserve, c. 200 m N of Smiths Reef Track along Tatt Town Track, 37° 01' 04" S, 144° 06' 02" E, *K. Rule 3905* & *E. Perkins 30.iv.2005*. HOLO: MEL.

Habit small, single or multi-stemmed trees to 12 m tall. *Bark* grey, stringy, sometimes latticed, extending to secondary branches; inner bark reddish-brown. *Seedling leaves* ovate, sessile, discolorous, lustrous and green above, whitish below; hispid (hairs arising from raised oil glands); margins hispid; seedling stems hispid. *Juvenile leaves* ovate to broadly ovate, symmetrical, apiculate, opposite for a few pairs, petiolate, hispid for less than the 10th pair then becoming glabrous, discolorous, lustrous and green above, pale green below, 3–5.5 cm long, 2–4 cm wide; petioles 0.4–1.1 cm long. *Intermediate leaves* broadly elliptical to broadly ovate, often basally oblique, slightly discolorous, lustrous and green, regularly persisting in the mature canopy. *Adult leaves* elliptical or ovate, rarely ovate-lanceolate, often basally oblique, apiculate, coriaceous, moderately reticulate, lustrous and green, 4–8 cm long, 1.5–3 cm wide; petioles 1.2–2 cm long; lateral veins moderately acute, 35°–40° to the mid-vein; intramarginal vein c. 2 mm from the margin; oil glands numerous, regular, island. *Inflorescences* simple, axillary, 7–11-flowered; peduncles slender, terete or slightly angular, 5–12 mm long, contracting and thickening when bearing mature fruits. *Floral buds* ovoid or slightly clavate, pedicellate, unscarred (only a single operculum present), 5–7 mm long, 2.5–3 mm wide; pedicels 3–5 mm long; operculum conical (obtuse to moderately acute), smooth or slightly scurfy (non-warty), flush with the hypanthium at the abscission zone, 2.5–3.5 mm long, 2–3 mm wide; locules 3 or 4; ovules in 2 vertical rows; stamens inflexed, all fertile; filaments white; anthers sub-basifixed, versatile, reniform, dehiscing through oblique, confluent slits. *Fruits* hemispherical, shortly pedicellate, 5–7 mm long, 5–7(–8) mm wide; pedicels 1–3 mm long; disc broad, 1.5–2 mm wide, slightly ascending, rarely flat; valves 3 or 4, triangular slightly exserted or level with the disc. *Fertile seeds* black, irregularly sub-pyramidal, finely pitted; hilum terminal (Fig. 6).

Flowering Period: Early autumn.

Distribution and Habitat: *Eucalyptus aurifodina* occurs in dry woodland communities in north-central Victoria between Castlemaine and Avoca in areas once exploited for their gold deposits (Fig. 1). Its preferred habitat features gravelly soils on dry, stony slopes and rises.



Figure 6. *Eucalyptus aurifodina* (a) tree; (b) adult leaves and buds; (c) seedling; (d) fruits; (e) buds.

Additional specimens examined: VICTORIA: Dunach Nature Reserve, E of the Ballarat-Maryborough Road, *K. Rule 15107*, 2.xi.2007 (MEL); SW of Talbot, c. 700 m NW along Norburys Road from Lexton-Talbot Road, *K. Rule 15207*, 2.xi.2007 (MEL); 2.4 km NE of Lexton on Lexton-Talbot Road, *K. Rule 15307*, 2.xi.2007 (MEL); 1.8 km WNW of Lexton on Lexton-Ararat Road, *K. Rule 15407*, 2.xi.2007 (MEL); 100 m N of Lillicur West Road-Sunraysia Hwy intersection, *K. Rule 15507*, 2.xi.2007 (MEL); Muckleford Flora Reserve, 31.viii.1981, *A.C. Beaglehole ACB68968* & *E. Perkins* (MEL); Porcupine Ridge Road, *K. Rule 4105* & *E. Perkins*, 3.v.2005 (MEL).

Associated Species: *Eucalyptus microcarpa*, *E. nortonii*, *E. macrorhyncha*, *E. tricarpa* (L.A.S.Johnson) L.A.S.Johnson & K.D.Hill subsp. *tricarpa*, *E. melliodora*, *E. dives*, *E. polyanthemos* (subsp. *vestita* and subsp. *marginalis* Rule) and *E. leucoxylon* subsp. *pruinosa* (F. Muell. ex Miq.) Boland have been observed occurring with or adjacent

to the new species. Hybrids with *E. macrorhyncha* occur to the north-east of Lexton.

Etymology: The name is derived from the Latin *aurifer* 'gold-bearing' in reference to the new taxon being located in the goldfields of north-central Victoria.

Conservation Status: In the western part of the distribution the species has been collected from only small remnant populations whose numbers appear to have suffered from clearing for agriculture. A small population occurs in the Dunach Flora Reserve, which is administered by Parks Victoria. A second small population occurs in the Lillicur State Forest whilst the other western populations occur on roadside easements or in small pockets scattered on private land. On the other hand, the entire eastern part of the distribution occurs in reserves under the management

of Parks Victoria, namely the Smiths Reef Forest (Maldon Historical Reserve), the Muckleford Nature Conservation Reserve and the Castlemaine Diggings Nature Conservation Park. The Smiths Reef Forest population is by far the largest of the species, with numbers estimated at more than 200 trees. The total number of mature trees of the species in the known populations is estimated at between 800 and 1000.

Given that its numbers are sparsely scattered and probably amount to no more than a thousand plants, in accordance to IUCN criteria (IUCN 2001), a status of 'vulnerable' (VU) is recommended.

Discussion: *Eucalyptus aurifodina* is distinguished by its dry, gravelly, inland habitat, its habit of a small, single or multi-stemmed tree, its relatively small leaves at all stages, its slender, terete or slightly angular peduncles to 12 mm long, its pedicellate, small, ovoid buds with a smooth or slightly scurfy (non-warty), obtuse-conical operculum and its relatively small, hemispherical fruits with a moderately elevated disc and 3 or 4 valves. It is considered to have some features intermediate between *E. arenacea* and *E. baxteri* (Table 5).

The relatively long, slender peduncle, the non-warty, thinly pedicellate buds and 3–4-loculed fruits of

Table 5. Comparisons between *E. aurifodina* and related species.

Characters	<i>E. arenacea</i>	<i>E. baxteri</i>	<i>E. aurifodina</i>
Habitat	sub-coastal and inland sandy soils	coastal and sub-coastal heavy soils	inland gravelly soils
Habit	usually robust spreading mallees to 8 m tall	multi-stemmed coastal shrubs to trees to 40 m tall	small, often multi-stemmed trees to 12 m tall
Juvenile leaves			
Shape	broadly ovate	broadly elliptical to broadly ovate	broadly ovate
Size	6–10 cm long, 2–4 cm wide	6–13 cm long, 3–9 cm wide	3–5.5 cm long, 2–4 cm wide
Transition to glabrous leaves	by 14th node	by 8th node	by 10th node
Adult leaves			
Shape	lanceolate or ovate-lanceolate	broadly ovate or ovate-lanceolate	elliptical or ovate
Size	7–13 cm long, 2–3.5 cm wide	7–15 cm long, 2–5 cm wide	4–8 cm long, 1.5–3 cm wide
Peduncles			
Length	6–12 mm long	2–4 mm long	5–12 mm long
Thickness	1.5–2.5 mm thick	2–3.5 mm thick	1.5–2 mm thick
Buds			
Shape	clavate or slightly ovoid	clavate	ovoid or slightly clavate
Size	7–10 mm long, 3–4 mm diam	5–8 mm long, 4–5 mm diam	to 5–7 mm long, c. 3 mm diam
Pedice length	3–5 mm long	0–4 mm long	3–4 mm long
Operculum shape	hemispherical or obtuse conical	hemispherical or obtuse-conical	obtuse-conical, rarely conical
Operculum surface	non-warty	warty	non-warty
Fruits			
Shape	hemispherical	hemispherical or globose-truncate	hemispherical
Size	7–9 mm long, 9–11 mm diam	7–15 mm long, 8–15 mm diam	5–7 mm long, 5–8 mm diam
Disc orientation	level or slightly ascending	slightly to prominently ascending	slightly ascending
No of valves	3 or 4	4 or 5	3 or 4

E. aurifodina suggest a close relationship with *E. arenacea*. However, that species differs from the new taxon by its sandy habitat, its delayed transition from hispid to glabrous leaves during the seedling stage, its longer, narrower (lanceolate), tapering adult leaves, its larger buds and its larger fruits.

The new taxon shares some features with *E. baxteri*, namely the similar shaped pre-adult leaves and a similar period of transition from hispid to glabrous leaves during the seedling stage. However, *E. baxteri* differs by its wetter habitat (coastal and sub-coastal), its larger leaves at all stages, its thicker peduncles, its warty buds, which are often constricted at the abscission zone and its larger fruits that are either sessile or shortly pedicellate and have 4 or 5 valves.

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