

Two new mallee Eucalypts (Myrtaceae) from Gippsland, Victoria

K. Rule^{1*} and W.M. Molyneux²

1. National Herbarium of Victoria, Royal Botanic Gardens Melbourne, Birdwood Avenue, South Yarra, Victoria 3141, Australia; * e-mail: rulelk@optusnet.com.au
2. La Trobe University, Department of Botany, Life Sciences School, Bundoora, Victoria 3083, Australia

Abstract

Two new species of the subgenus *Eucalyptus* are described. *Eucalyptus ornans*, Avon Peppermint, is an extremely rare mallee form of peppermint of the series *Radiatae* occurring at the Avon Channels to the north of Maffra in the Central Gippsland region of Victoria. *Eucalyptus forresterae*, Brumby Sallee, is a restricted, shrubby or whipstick mallee of the series *Longitudinales* occurring near Nunniong Plateau and above Buchan River Falls at Native Dog Flat in East Gippsland. The distribution, ecology, affinity and conservation status of each taxon are discussed, as are the morphological features of the series to which each belongs.

Keywords: mallee, peppermint, series *Radiatae*, series *Longitudinales*

Muelleria 29(1): 16-26 (2011)

Introduction

Eucalyptus ornans Rule & Molyneux (series *Radiatae* Chippend., subgenus *Eucalyptus* L'Hér.) and *E. forresterae* Molyneux & Rule (series *Longitudinales* Blakely, subgenus *Eucalyptus*) are new species that occur in relatively remote and inaccessible areas of eastern Victoria. Both are highly restricted, lignotuberous mallees interpreted as relictual species which evolved in extremely cold conditions in the late Quaternary permafrost period and survived competition from migrating forest species as the climate of south-eastern Australia became warmer in the Holocene.

Terminology

The term 'glaucous', when applied to leaf colour, means whitish and not blue-green. The term 'pruinose' refers to the waxy bloom occurring on seedling and adult structures.

Methods

Seedling trials using selected seedlots of both *Eucalyptus ornans* and *E. forresterae* and their closest relatives (*E. elata* Dehnh. and *E. stellulata* Sieber ex DC. respectively) have been conducted at private nursery facilities and in the nursery of the Royal Botanic Gardens Melbourne. Seedlots for *E. elata* have been drawn from populations in Central and East Gippsland and south-east New South Wales, and for *E. stellulata* from East Gippsland and adjacent areas of New South Wales and from the New England Plateau of that state. Both new species have been studied at the seedling stage and in cultivation as saplings and mature plants. Cultivated adult plants of *E. ornans* were planted in 2000 as advanced seedlings and those of *E. forresterae* in 1994, also as mature seedlings. Our studies of adult materials involved the examination of herbarium specimens and field studies of populations not only of the new species but also of their close relatives. Leaf thickness using fresh adult leaves has been measured using a dial caliper.

Series *Radiatae*

Species of series *Radiatae* are mostly confined to the Australian mainland with only an outlier of *Eucalyptus radiata* Sieber ex DC.



occurring in Tasmania. Brooker (2000) erected series *Insulanae* Brooker for the remaining Tasmanian peppermints, a fundamental difference between the two series being that the species of series *Insulanae* possess raised glands along the margins of the juvenile leaves whereas members of series *Radiatae* do not.

Series *Radiatae* contains the narrow-leaved Peppermints (*E. radiata* subsp. *radiata* Sieber ex DC., *E. radiata* subsp. *sejuncta* L.A.S.Johnson & K.D.Hill, *E. robertsonii* Blakely (syn. *E. robertsonii* subsp. *robertsonii* and *E. radiata* subsp. *robertsonii* (Blakely) L.A.S.Johnson & Blaxell) and *E. croajingolensis* L.A.S.Johnson & K.D.Hill), the shining or broad-leaved peppermints (*E. dives* Schauer, *E. willisii* Ladiges, Humphries & Brooker, *E. molyneuxii* Rule, *E. falciformis* (Newnham, Ladiges & Whiffin) Rule and *E. arenicola* Rule) and the river peppermints (*E. elata* Dehnh. and

E. ornans Rule & Molyneux, the mallee peppermint treated here as a new species). Johnson and Hill (1990) erected *E. robertsonii* subsp. *hemisphaerica* L.A.S.Johnson & K.D.Hill to accommodate populations occurring in the vicinity of Orange, New South Wales. Rankin (1998), in his study of the wider peppermint group concluded, however, that the taxon is a natural hybrid between *E. robertsonii* and *E. dives*. We accept Rankin's interpretation and exclude subspecies *hemisphaerica* from the key below.

The narrow-leaved peppermints are trees that feature rough bark to the secondary branches, raised glands persisting on the stems throughout the juvenile stage, numerous pairs of opposite, sessile, amplexicaul juvenile leaves, thin adult leaves and smallish, thin-walled fruits. The shining or broad-leaved peppermints as a group are variable in habit (trees or mallees), bark

Key to series *Radiatae*

- | | | |
|-----|---|--|
| 1 | Juvenile leaves petiolate and vertically-oriented | 2 |
| 1: | Juvenile leaves sessile, opposite, amplexicaul and horizontally-oriented for numerous pairs | 3 |
| 2 | Adult leaves 50–100 mm long; fruits 4–6 mm diameter | <i>E. molyneuxii</i> |
| 2: | Adult leaves to 70–170 mm long; fruits 6–8 mm diameter | <i>E. falciformis</i> |
| 3 | Bark smooth throughout or a stocking of compact bark present on the lower trunk | 4 |
| 3: | Bark rough (peppermint type) extending to at least upper trunk | 5 |
| 4 | Mallee; bark smooth throughout; sub-glaucous intermediate leaves persistent in the mature canopy | <i>E. ornans</i> |
| 4: | Tree; a stocking of finely fissured, compact bark present; mature canopy consisting entirely of lustrous and green adult leaves | <i>E. elata</i> |
| 5 | Robust, spreading mallees | 6 |
| 5: | Small to tall trees | 7 |
| 6 | Adult leaves lustrous and green; fruits 6–9 mm diameter | <i>E. arenicola</i> |
| 6: | Adult leaves dull or sub-lustrous and blue-green; fruits 4–6 mm diameter | <i>E. willisii</i> |
| 7 | Juvenile leaves sub-glaucous or glaucous, ovate or broadly ovate; adult leaves to 30 mm wide | <i>E. dives</i> |
| 7: | Juvenile leaves green or blue-green, lanceolate (narrow to broad); adult leaves to 15 mm wide | 8 |
| 8 | Adult leaves slightly blue-green or green | 9 |
| 8: | Adult leaves blue-grey | 10 |
| 9 | Juvenile leaves narrowly lanceolate or lanceolate | <i>E. radiata</i> subsp. <i>radiata</i> |
| 9: | Juvenile leaves broadly lanceolate | <i>E. radiata</i> subsp. <i>sejuncta</i> |
| 10 | Juvenile leaves narrowly lanceolate; operculum sharply conical | <i>E. robertsonii</i> |
| 10: | Juvenile leaves lanceolate; operculum obtuse or hemispherical | <i>E. croajingolensis</i> |

(almost smooth-barked to rough bark extending to the minor branches) and seedling characters (petiolate, vertically-oriented pairs of juvenile leaves or numerous pairs of opposite, sessile, amplexicaul, horizontally-oriented pairs of juvenile leaves). However, their seedlings consistently exhibit prominently raised glands on the stems only in the early stages of development, coarse-textured adult leaves and thick-walled fruits. Lastly, the river peppermints feature either smooth bark throughout, as in *E. ornans*, or smooth bark with a stocking of grey to black, finely fissured, compact bark, as in *E. elata*, numerous pairs of narrowly lanceolate, opposite, sessile, amplexicaul juvenile leaves, seedlings that retain prominently raised glands on the stems for numerous pairs and narrowly lanceolate adult leaves and slightly cupular to globular-truncate, thin-walled fruits.

Taxonomy

Eucalyptus ornans Rule & Molyneux sp. nov.

Eucalypto elatae affinis habitu 'malleiformibus; cortice omnino laevis albescentibus, foliis juvenilibus glaucescentibus, foliis mediis glaucescentibus persistentibus, foliis adultis minoribus et fructibus minoribus differt.

Type: Victoria. Avon Channels, 37° 48' 20" S 146° 52' 34" E, 14.iv.2005, K. Rule 3805 (MEL2328846, AD, CANB, NSW).

Small, slender *mallees*, 4–10 m tall; stems erect; branchlets semi-pendulous. *Bark* smooth, whitish when new; old bark light grey, decorticating in short

strips and ribbons; thin, loose bark often accumulating about the base. *Seedling stems* round in cross-section; lignotuber present in seedling stage; prominently raised glands present, persisting until the sapling stage. *Seedling leaves* decussate, narrowly lanceolate, sessile, discolorous, light green above, whitish below. *Juvenile leaves* narrowly lanceolate, opposite, sessile, amplexicaul and horizontally-oriented for numerous pairs, acuminate, strongly discolorous, blue-green above, whitish below, 50–80 mm long, 7–12 mm wide. *Intermediate leaves* slightly broader than juvenile leaves, sessile or shortly petiolate, basally rounded, becoming diagonally-oriented, discolorous, sub-glaucous, dominating the canopy of saplings and persisting in the canopy of mature mallees; growth tips lightly pruinose. *Adult leaves* narrowly lanceolate, disjunct, shortly petiolate, acuminate, sparsely reticulate, concolorous, sub-lustrous, blue-green, 60–110 mm long, 8–12 mm wide; petioles 6–12 mm long; leaf base tapered; venation sparsely reticulate; lateral veins acute, <30° from mid-vein; intramarginal vein <2 mm from margin; faint secondary intramarginal vein present, <1 mm from margin; oil glands numerous, small, regular, island. *Inflorescences* simple, axillary, 17–21-flowered; peduncles slender, slightly angular, 5–12 mm long. *Floral buds* fusiform, unscarred, c. 4 mm long, 2–3 mm diameter; pedicels slender, 6–10 mm long; hypanthium widest just below the abscission zone; operculum single, conical, c. 2 mm long, to 2 mm wide; stamens inflexed, all fertile; filaments white; flowering period summer; anthers versatile, sub-basifixed, reniform, dehiscing through diagonal slits; ovules in 2 vertical rows. *Fruits* globular-truncate, pedicellate, c. 4 mm long, c. 4 mm wide; pedicels 4–7 mm long; disc descending; valves enclosed; locules 3–4. *Fertile seeds* irregularly cuboid or pyramidal, blackish; hilum terminal (Fig. 1).

Distribution and habitat: *Eucalyptus ornans* occurs as a single known population to the north of Maffra on the banks of the Avon River (in the Avon–Mount Hedrick Natural Features Scenic Reserve) in the Central Gippsland region of Victoria. The species grows in coarse gravels around a narrow, lake-like outlet of the Avon Channels (Fig. 2).

Additional specimen examined: VICTORIA. Avon Channels, 37°48'S, 146°52'E, 22.vii.2001, W. Molyneux s.n. (MEL 2330513).



Figure 1. Distribution map of: *E. ornans* (circle); *E. forresterae* (square).

Associated species: *Eucalyptus ornans* grows in association with *E. bridgesiana* R.T.Baker, *E. cephalocarpa* Blakely, *E. consideriana* Maiden, *E. cytellocarpa* L.A.S.Johnson and *E. globoidea* Blakely at its margins on higher, drier sites. Other species, including *E. goniocalyx* F.Muell. ex Miq. subsp. *goniocalyx*, *E. macrorhyncha* F.Muell., *E. melliodora* A.Cunn. ex Schauer, *E. polyanthemus* Schauer subsp. *vestita* L.A.S.Johnson & K.D.Hill, *E. muelleriana* A.W.Howitt, *E. sieberi* L.A.S.Johnson and *E. tricarpa* L.A.S.Johnson & K.D.Hill subsp. *tricarpa*, occur in the immediate vicinity.

Etymology: The epithet is derived from the Latin *ornatus* 'ornate' in reference to the highly ornamental nature of the species.

Recommended English name: Avon Peppermint.

Conservation status: In earlier surveys of *Eucalyptus ornans* by each of the authors, a total of c. 70 mature individuals were recorded from both banks of the Avon River. Following the severe flooding of the river in 2007, all but 10 individuals were washed away. Because of this small population size and area of occupancy less



Figure 2. *Eucalyptus ornans* a) mallees prior to 2007 flooding of the Avon River (Rule, 13/9/06); b) canopy of immature mallee (Rule, 13/9/06); c) buds and fruits (Rule 3805)

than 1 ha, and with ongoing risk of flooding resulting in further population reduction, *E. ornans* is assessed as critically endangered under the IUCN Red List categories and criteria (IUCN 2001) with a threat code of CR B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v); C2a(i,ii); D.

Discussion: *Eucalyptus ornans* is closely related to *E. elata*, which is typically a forest tree (to 45 m tall) occurring along fertile river valleys of Gippsland and the South Coast region of New South Wales, occasionally extending to more elevated sites. Many of the features which the two species share are discussed above. Other shared features include adult leaves with a sparse reticulation and numerous, small, regular island glands, inflorescences with slender peduncles and numerous buds per umbel, small, clavate or fusiform buds with long pedicels and relatively small fruits with a descending disc and 3 or 4 valves.

Apart from its habit, *E. elata* differs from the new species by its pendulous branches, its stocking of compact bark which covers the lower trunk, its longer adult leaves (80–170 mm long), its larger fruits (4–6 mm diameter), which are borne on short, thick pedicels, and its mature canopy of strictly adult leaves (Table 1).

Outliers of *E. elata* have been recorded in Central Gippsland along the Macalister and Avon Rivers. In fact, it is worth noting that a small, but typical, population of *E. elata* occurs along the Avon River a few kilometres downstream of the new species.

In cultivation, plants of more than 10 years old of *E. ornans* retain those features which characterise

the species, particularly the development of the lignotuber, the mallee habit and the sub-glaucous pre-adult leaves which dominate the canopy of saplings and more mature plants.

Depauperate trees and mallee forms of *E. elata*, often with adult features generally smaller than typical and canopies consisting entirely of adult leaves are found on dry ridges and slopes in Central Gippsland, East Gippsland and South Coast New South Wales. Hill (2002), Brooker and Slee (1996, 1997) and Nicolle (2006) included these forms with the typical riparian form of the species. The taxonomic status of these populations requires further investigation. Our study of these was postponed when many populations were severely burnt in the 2003 bushfires that swept over large areas of East Gippsland.

The riparian location of *E. ornans* on the Avon River, its small population size, now of about 10 mature individuals, and its mallee habit, which contrasts with a number of sympatric species of *Eucalyptus* of tree form, raise interesting questions regarding its evolution.

In our description of *E. forresterae* (below) we suggest that that species developed a mallee habit as a survival strategy in response to late Quaternary permafrost associated with Kosciuszko periglacial conditions. We suggest it is equally plausible that *E. ornans* also evolved as a mallee in the same period. Hope (1994), in his discussion regarding the evolution of the mallee habit in eucalypts under dry arid conditions, states that the development of lignotubers in cold mountain

Key to series *Longitudinales*

- | | | |
|----|--|---|
| 1 | Single or few-stemmed trees to 20 m tall | 2 |
| 1: | Multi-stemmed, whipstick or shrubby mallees to 6 m tall | 4 |
| 2 | Bark compact and black at the base, olive-green above; juvenile leaves broadly ovate | <i>E. stellulata</i> |
| 2: | Bark smooth throughout; juvenile leaves narrowly elliptical | 3 |
| 3 | Fruits 4–6 mm long, 4–5 mm diam | <i>E. copulans</i> |
| 3: | Fruits 5–7 mm long, 5–7 mm wide | <i>E. mitchelliana</i> |
| 4 | Juvenile leaves orbicular or cordate, amplexicaul | <i>E. forresterae</i> |
| 4: | Juvenile leaves narrowly lanceolate, lanceolate, elliptical or ovate, basally discrete | 5 |
| 5 | Adult leaves erect, 40–100 mm long, 8–20 mm wide | <i>E. moorei</i> subsp. <i>moorei</i> |
| 5: | Adult leaves semi-pendulous, 40–120 mm long, 4–10 mm wide | <i>E. moorei</i> subsp. <i>serpenticola</i> |

regions during the Quaternary reflects a common strategy that enhances regeneration and survival under growth-limiting conditions.

The Avon River (the only known locality for *E. ornans*) rises on the southern flanks of the Mount Wellington massif which, even now, has an extensive snow cover in winter. This would have been a much colder environment during the Quaternary. As we note below with some populations of *E. forresterae*, *E. ornans* is now associated with a number of common tree-form eucalypts which have apparently migrated into its habitat in response to warming conditions during the Holocene.

Series *Longitudinales*

Mallees of the series *Longitudinales* occur on and north of the Nunniong Plateau at several sites including Brumby Point, along Diggers Hole Spur Road, near Brumby Rocks and above the Buchan River Falls. Earlier collectors had regarded these as distinctive from *E. stellulata* and referred to them as *E. moorei* Maiden & Cambage (*D. Parkes*, 23.i.1984, MEL 1529442), *E. aff. stellulata* (*Molyneux*, 3.v.1991, MEL 227622) or *E. stellulata* 'mallee form' (*J.H. Willis* & *K.C. Rogers*, 14.xi.1964, MEL 704360 and *A.M. Lyne* 1195, 25.iv.1993, MEL 717800). Nicolle (2006) regarded the Brumby Point and Diggers Hole Spur mallees as a distinct species and suggested an affinity with *E. moorei* Maiden & Cambage. Whilst we concur that these

Table 1. Morphological characters for River Peppermints

Character	<i>Eucalyptus elata</i>	<i>Eucalyptus ornans</i>
Habit	medium to tall tree, 10-45 m tall, rarely a mallee	mallee to 10 m tall
Branch orientation	Pendulous	semi-erect
Bark	stocking of finely fissured, compact bark present on lower trunk	smooth throughout
Juvenile leaves		
Colour and lustre	green above, pale green below, slightly lustrous	blue-green above, whitish below, dull
Shape	narrowly lanceolate	narrowly lanceolate
Size	60-120 mm long, 10-25 mm wide	50-80 mm long, 7-12 mm wide
Intermediate leaf colour	green	sub-glaucous
Adult leaves		
Colour	lustrous, green	sub-lustrous, blue-green
Shape	narrowly lanceolate	narrowly lanceolate
Size	80-170 mm long, 8-15 mm wide	60-110 mm long, 8-12 mm wide
Petiole length	10-15 mm	6-11 mm
Canopy composition	entirely of adult leaves	a mixture of adult leaves and intermediate leaves
Buds per umbel	Variable between populations, 17-40+	17-21
Peduncle length	5-10 mm	6-12 mm
Buds		
Shape	Clavate	fusiform
Size	4-5 mm long, 2-3 mm wide	c. 4 mm long, 2 mm wide
Operculum shape	hemispherical or beaked	conical
Pedicel length	2-6 mm	6-10 mm
Fruits		
Size	4-6 mm long, 4-6 mm diameter	c. 4 mm long, c. 4 mm diameter
Shape	slightly cupular to globular-truncate	slightly cupular to globular-truncate

mallees represent an unnamed species, we consider them more closely related to *E. stellulata* than *E. moorei*. Nicolle also regarded a population of stunted trees on the upper slopes of Mount Useful as conspecific with the Brumby Point mallees. We do not accept this diagnosis and regard the Mount Useful population as a stunted form of *E. stellulata*.

The series *Longitudinales* is a narrowly defined complex comprising eight taxa (*E. stellulata*, *E. mitchelliana* Cabbage, *E. moorei*, *E. latiuscula* (Blakely) L.A.S. Johnson & K.D. Hill, *E. serpentinicola* L.A.S. Johnson & Blaxell, *E. copulans* L.A.S. Johnson & K.D. Hill, *E. dissita* K.D. Hill and the species treated here, *E. forresterae* Molyneux & Rule, all of which have similar buds and fruits but differ in habit, bark and leaf morphology. *Eucalyptus latiuscula*, *E. dissita* and *E. serpentinicola* are closely related to *E. moorei*. In fact, the first two are regarded as being synonymous with *E. moorei* by Brooker and Kleinig (1999), while *E. serpentinicola* was renamed *E. moorei* subsp. *serpentinicola* Brooker & Kleinig in that text. We accept that both *E. latiuscula* and *E. dissita* are morphologically close to *E. moorei* and have not included them in the key. We also accept that *E. serpentinicola* is best regarded as a subspecies of *E. moorei*. With regard to *E. latiuscula*, Hill (2002) considered that it occurred in Victoria. As far as we are aware, the only Victorian eucalypt which could be mistaken for *E. latiuscula* is *E. forresterae*.

Taxonomy

Eucalyptus forresterae Molyneux & Rule sp. nov.

Eucalypto stellulata affinis habitu 'malleiformibus' fruticosis, cortice omnino laevis, foliis juvenilibus hebetibus cineraceis minoribus, foliis adultis glaucescentibus nitentibus minoribus, petiolis brevioribus et fructibus minoribus differt.

Type: Victoria. 6.2 km along Brumby Point Track from Diggers Hole Spur Road, 37°03'30" S 148°04'33" E, 15.xi.2008, W. Molyneux & S. Forrester s.n., (MEL 2828603, AD, CANB, HO, NSW).

Dwarf, whipstick, shrubby mallees, 2–5 m tall. Bark smooth throughout, off-white or light grey, shedding to green in summer; old bark decorticating in brown to grey sheets and strips. Seedling stems round in cross-section; prominently raised glands present,

persisting throughout the seedling stage. Seedling leaves decussate, ovate, discolorous. Juvenile leaves cordate or orbicular, opposite, sessile, amplexicaul, horizontally-oriented, discolorous, dull, glaucous for numerous pairs, 20–40 mm long, 20–40 mm wide; apex mucronate; nodes extremely crowded. Intermediate leaves ovate, sessile or shortly petiolate, opposite, sub-opposite or disjunct, slightly discolorous, blue-green. Adult leaves narrowly ovate or lanceolate, disjunct, shortly petiolate, acuminate or apiculate, uncinete, coriaceous, concolorous, sub-lustrous or lustrous, olive-green or blue-green, 40–60 mm long, 12–20 mm wide, 0.4–0.55 mm thick; petioles 2–6 mm long; leaf base rounded; lateral veins prominent, parallel to mid-vein, forming a prominent tri-veined pattern; intramarginal veins faint or obscure, 1–2 mm from margin, reticulation sparse; oil glands numerous, moderately sized, regular, island. Inflorescences simple or sometimes paired, axillary, 11–21-flowered; buds forming a small, stellate cluster; peduncles 1–3 mm long in the bud stage, sometimes absent in the fruiting stage. Floral buds horn-shaped, sessile, unscarred, orange to burgundy when mature, 4–6 mm long, c. 2 mm diameter; operculum single, horn-shaped, c. as long as hypanthium; stamens erect, all fertile; filaments white; flowering period irregular over the summer months; anthers versatile, sub-basifixed, reniform, dehiscing through diagonal slits; ovules in 2 vertical rows. Fruits cupular or globose-truncate, sessile, 2.5–4 mm long, 2.5–3.5 mm wide; disc slightly descending; valves enclosed; locules 3. Fertile seeds irregularly cuboid or pyramidal, blackish; hilum terminal (Fig 3).

Distribution and habitat: *Eucalyptus forresterae* is only known from four sites in the Alpine National Park in East Gippsland, Victoria. Three sites are at elevations of 1399–1450 m, with the type locality on the Brumby Point Track separated by c. 5 km from the second site (c. 1 km north of Diggers Hole Spur Road above Diggers Hole Creek) to the south-west, and c. 10 km from the third site on the Nunniong Road to the west. The fourth site, located on a rocky hill above the falls on the Upper Buchan River at Native Dog Flat, is c. 16 km NNE of the type locality at an elevation of 1200 m. Approximately 30 m below this rocky site, *E. stellulata* grows as a large tree beside and in the vicinity of the Buchan River in moister conditions. At Horse Flat (c.

1.5 km south of *E. forresterae* on the Nunningong Road), and at Blue Shirt Creek. (c. 11.5 km further south), stunted forms of *E. stellulata* occur in moist to wet conditions. By contrast, the four known populations of *E. forresterae* are restricted to high rocky or well-drained elevated sites (Fig. 2).

Additional specimens examined: VICTORIA. Above Buchan Falls, 36°54'16" S 148°05'13" E, 3.v.1991, W.M. Molyneux s.n. (MEL 227622); 1 km N of Diggers Hole Spur Road on western slope above Diggers Hole Creek, 37°05'04" S 148°01'03" E, 12.xi.2009, W.M. Molyneux & S. Forrester s.n.

(MEL); Nunningong Road, c. 4.5 km S of Brumby Rocks, 2.5 km N of Jam Tin Track turnoff, 37°03'42" S 147°56'23" E, 12.xi.2009, W.M. Molyneux & S. Forrester s.n. (MEL).

Associated species: *Eucalyptus* sp. aff. *dives* Schauer, *E. elaeophloia* Chappill, Crisp & Prober, *E. glaucescens* Maiden & Blakely, *E. kybeanensis* Maiden & Cabbage, *E. mannifera* Mudie, *E. pauciflora* Sieber ex Sprengel subsp. *niphophila* (Maiden & Blakely) L.A.S. Johnson & Blaxell, *E. perriniana* F. Muell. ex Rodway, *E. rubida* H. Deane & Maiden, *E. viminalis* Labill. subsp. *viminalis* and *Hakea asperma* Molyneux & Forrester have been



Figure 3. *Eucalyptus forresterae* a) regenerating mallee at Brumby Point post 2003 fires (Molyneux, 15/11/08); b) buds and adult leaves at Brumby Point (Molyneux, 15/11/08); c) fruits from type locality (Rule, 6/2/10)

observed growing in association with the new species. A form of *E. dalrympleana* Maiden also occurs in the general vicinity of the new species. The only known site where *E. forresterae* and *E. stellulata* occur in close proximity is along the Buchan River valley near Native Dog Flat where the former occurs on the ridge overlooking the Buchan River Falls and the latter occurs along the valley floor.

Etymology: The specific epithet honours Sue Forrester of Dixons Creek, co-collector of the type specimen and major contributor to field survey work and progeny trials.

Recommended English name: Brumby Sallee.

Conservation status: The new species is restricted to four known isolated populations with an estimated extent of occurrence of approximately 100 km² and an estimated area of occupancy (AO) of 6.5 ha based on the estimated AOs of the four populations (2.5 ha, 2.5 ha, 1.0 ha and 0.5 ha respectively). The species is also assessed as naturally severely fragmented at the landscape scale on account of the small disjunct populations and limited seed dispersal capacity. The species is also arguably subject to continuing decline in the quality of its habitat as a consequence of the inferred and projected impact of climatic drying and elevated temperature thresholds on the recruitment potential of almost all montane to subalpine Victorian eucalypts including *E. stellulata* and, by inference, *E. forresterae* (Nitschke & Hickey 2007). The species is therefore assessed as critically endangered under the IUCN Red List categories and criteria (IUCN 2001) with a threat code of CR B1ab(iii)+2ab(iii).

Discussion: *Eucalyptus forresterae* is distinguished within the Series *Longitudinales* by the following combination of features: its dwarf mallee habit, smooth bark, crowded, small orbicular or cordate, glaucous juvenile leaves, small ovate, shortly petiolate, bluish adult leaves with parallel venation and its relatively dense canopy. We regard *E. stellulata* as its nearest relative on the basis of the adult leaves of both species having similar venation patterns, both having a sparsely reticulate network dominated by a mid-vein and two conspicuous parallel lateral veins arising at the leaf base. However, *E. forresterae* differs from *E. stellulata* by the latter species being a relatively large, umbrageous tree (to 20 m tall and 15 m wide) and having a substantial stocking of blackish, cracking

compact bark with smooth olive-green bark above, larger, relatively sparse, greenish juvenile leaves (to 70 mm long and 70 mm wide), lustrous, green, semi-pendulous adult leaves with relatively long petioles, generally larger buds and fruits and an open canopy in contrast to the extremely compact and congested canopy of *E. forresterae* (Table 2).

We agree with Nicolle (2006) that *E. forresterae* is related to *E. moorei* but believe that *E. stellulata* is its closest relative primarily on the basis of the venation patterns of the adult leaves. The adult leaves of both *E. forresterae* and *E. stellulata* are tri-veined, that is, having lateral veins arising from the base of the mid-vein and running unbroken between it and the intramarginal veins for the length of the leaf. This contrasts to the adult leaves of *E. moorei*, which exhibit a form of parallel venation consisting of a dominant mid-vein and visible, somewhat remote intramarginal veins that are connected by extremely faint, sparse, markedly acute lateral veins. Plants of *E. forresterae* raised to maturity in cultivation in metropolitan Melbourne and at Dixons Creek in the Yarra Valley retain diagnostic vegetative features of the species, notably the smooth bark, dwarf mallee habit, glaucous juvenile leaves and small, ovate, crowded, rigid adult leaves.

Molyneux and Forrester (2008) postulate that three highly restricted *Acacia* species endemic to the Wombargo Range evolved their dwarf habit, reduced organ size and strictly vegetative reproductive strategies through adaptation to the late Quaternary permafrosts associated with a glacial event on the Kosciuszko Plateau. Hills (1975) states that these conditions would have extended to the Wombargo and Cobberas Ranges, the southern end of which is only c. 5 km from the northerly population of *E. forresterae*. As the main populations of *E. forresterae* occur c. 16–22 km further south, it is reasonable to suggest that the effect of permafrost events extended to the Nunniong district.

Hakea asperma, a dwarfed infecund shrub persisting by ramets, is notably sympatric with *E. forresterae* above Native Dog Falls, providing a further illustration of the synchronous adaptation by these local endemics to permafrost events (Molyneux and Forrester 2009).

As climate warmed during the Holocene (McKenzie 1997), vegetation succession involved the upslope migration of a suite of *Eucalyptus*, *Acacia* and associated lower elevation species which progressively replaced

the cold-adapted montane flora of the region with some limited persistence of taxa which managed to adapt to the climatic warming of the late Quaternary.

These upslope migrations resulted in some interesting associations with, and adaptations by, *E. forresterae* populations. While the eucalypts sympatric with *E. forresterae* at the type locality are of mallee habit, the other three populations are variously sympatric with tall tree forms of *E. dalrympleana*, *E. pauciflora*, *E. perriniana*, *E. rubida* and *E. viminalis*, and with *E. stellulata* in the general vicinity.

At the Diggers Hole site stunted but not strictly mallee-form stands of *E. pauciflora* and *E. perriniana* 2–2.5 m tall are sympatric with the southernmost known stand of *E. forresterae*, while c. 50 m further south 15–25 m tall forest trees of the two associated species occur. It could well be that the early colonising stands of *E. pauciflora* and *E. perriniana* encountered much lower temperatures at the conclusion of

the permafrost events and underwent adaptive modification during the Holocene warming while later immigrants retained their characteristic tree form.

Acknowledgements

We thank Neville Walsh of the National Herbarium of Victoria (MEL) for his advice regarding many aspects of the project and for his assistance with the Latin diagnoses. We also thank other MEL staff including Jeff Jeanes for his assistance in the field, Alison Vaughan for providing the distribution maps and Catherine Gallagher for facilitating access to the herbarium collections. Chris Jenek, David Robbins and Dermot Molloy of the Royal Botanic Gardens Melbourne are thanked for their work in the seedling trials. Thanks are also given to David Cameron and Sue Forrester for their editorial assistance and for many aspects of the research undertaken with the described taxa.

Table 2. Morphological and habitat characters for two Victorian species of the series *Longitudinales*.

Character	<i>Eucalyptus stellulata</i>	<i>Eucalyptus forresterae</i>
Habitat	sites of poor drainage	well-drained, rocky ridge-tops
Habit	medium to large tree to 20 m tall, single or multi-stemmed	whipstick or shrubby mallee to 4 m tall
Bark	blackish, compact basal stocking usually present, olive-green above	smooth, greyish throughout, shedding to olive green in summer; no basal stocking
Juvenile leaves		
Size	40-70 mm long, 40-70 mm wide	20-40 mm long, 20-40 mm wide
Shape	cordate or orbicular	cordate or orbicular
Colour	dull, green or blue-green	blue-grey
Adult leaves		
Size	50-100 mm long, 12-25 mm wide	40-60 mm long, 12-20 mm wide
Shape	Lanceolate or ovate	narrowly ovate or lanceolate
Colour and lustre	olive-green or green, lustrous	olive-green or blue-green, sub-lustrous
Venation	parallel (tri-veined)	parallel (tri-veined)
Petiole length	3-10 mm	2-6 mm
Buds per umbel	11-15	11-21
Peduncle length	3-6 mm	1-3 mm
Buds		
Shape	horn-shaped	horn-shaped
Length	4-7 mm	4-6 mm
Fruits		
Size	4-6 mm diameter	2.5-4 mm diameter
Shape	slightly cupular to globular-truncate	slightly cupular to globular-truncate

References

- Brooker, M.I.H. (2000). A new classification of the genus *Eucalyptus* L'Her. (Myrtaceae). *Australian Systematic Botany* **13**, 79–148.
- Brooker, M.I.H. and Kleinig, D.A. (1999). *Field guide to eucalypts*, vol. 1, south-eastern Australia, 2nd edn. Bloomings Books: Melbourne.
- Brooker, M.I.H. and Slee, A.V. (1996). New taxa and some new nomenclature in *Eucalyptus*. *Muellerio* **9**, 7585.
- Brooker, M.I.H. and Slee, A.V. (1997). *Eucalyptus*. In N.G. Walsh and T.J. Entwisle (eds), *Flora of Victoria*, vol. 3, *Dicotyledons: Winteraceae to Myrtoceae*, pp. 946–1009. Inkata Press: Melbourne.
- Hill, K.D. (2002). *Eucalyptus*. In G.J. Harden (ed), *Flora of New South Wales*, vol. 2, revised edn. New South Wales University Press: Sydney.
- Hills, E.S. (1975). *Physiography of Victoria: an introduction to geomorphology*, 8th edn. Whitcombe & Tombs Pty Ltd: Melbourne.
- Hope, G.S. (1994). Quaternary vegetation in Hill, R.S. (ed) *History of the Australian Vegetation, Cretaceous to Recent*, p 379. Cambridge University Press: UK.
- International Union for the Conservation of Nature (2001). *IUCN Red List categories and criteria*, version 3.1. IUCN Species Survival Commission. IUCN: Gland, Switzerland.
- Johnsan, L.A.S. and Hill, K.D. (1990). New taxa and combinations in *Eucalyptus* and *Angaphara* (Myrtaceae). *Telopea* **4**, 37–108.
- McKenzie, G.M. (1997). The late Quaternary vegetation history of the south-central highlands of Victoria, Australia. 1. Sites above 900 m. *Australian Journal of Ecology* **22**, 19–36.
- Malyneux, W.M. and Farrester, S.G. (2008). Three new *Acocia* species (Mimosaceae) from East Gippsland, Victoria. *Muellerio* **26**(1), 51–56.
- Malyneux, W.M. and Farrester, S.G. (2009). A new *Hokea* species (Prataceae: Grevilleaioideae) from East Gippsland, Victoria. *Muellerio* **27**, 224–226.
- Nicalle, D. (2006) *Eucalypts of Victoria and Tasmania*. Bloomings Books: Melbourne.
- Nitschke, C.R. and Hickey, G.M. (2007). *Assessing the vulnerability of Victoria's Central Highlands forests to climate change*. Technical report for the Victorian Department of Sustainability and Environment (DSE). Peer reviewed and unpublished.
- Rankin, D.J.W. (1998). *Patterns of variation and relationships in the peppermint eucalypts (Eucalyptus L'Her. ser. Radiatae Chippendale)*. Unpublished Ph.D. thesis, LaTrabe University: Bundoora.