

Glen Gallic Mallee (*Eucalyptus dealbata* subsp. *aperticola*, Myrtaceae), a new taxon from the sandstone escarpment of the Hunter Valley, New South Wales

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Abstract

Eucalyptus dealbata subsp. *aperticola* S.A.J.Bell & D.Nicolle, a new mallee red gum from Triassic aged sandstone benches in the northern part of Wollemi National Park north-west of Sydney, is described and illustrated, and notes on affinities, distribution, ecology and conservation status provided.

Introduction

The ‘red gums’ (*Eucalyptus* subg. *Symphyomyrtus* sect. *Exsertaria*) are a complex group of eucalypts, with 62 terminal taxa in three series and four subseries (Nicolle and Jones 2018; Nicolle 2019). *Eucalyptus* ser. *Exsertae* subser. *Erythroxylon* (the ‘eastern red gums’) currently consists of 14 species (17 terminal taxa) distributed across most mainland States in Australia, with one also occurring in Papua New Guinea. Six of these (*E. amplifolia* Naudin, *E. blakelyi* Maiden, *E. chloroclada* (Blakely) L.A.S.Johnson & K.D.Hill, *E. glaucina* Blakely, *E. tereticornis* Sm., and *E. terrica* A.R.Bean) are forest or woodland trees occurring in level to undulating terrain, sometimes in winter-wet or riverine habitats, while the other eight species (*E. dealbata* A.Cunn. ex Schauer, *E. dwyeri* Maiden & Blakely, *E. flindersii* Boomsma, *E. infera* A.R.Bean, *E. kabiana* L.A.S.Johnson & K.D.Hill, *E. nandewarica* L.A.S.Johnson & K.D.Hill, *E. nudicaulis* A.R.Bean, *E. vicina* L.A.S.Johnson & K.D.Hill) are small trees or mallees inhabiting often siliceous ridges in drier country.

In the Hunter Valley of New South Wales, 12 terminal taxa of *E.* sect. *Exsertaria* are known: *Eucalyptus amplifolia* subsp. *amplifolia*, *E. blakelyi*, *E. camaldulensis* Dehnh. subsp. *camaldulensis*, *E. dealbata* subsp. *aperticola* (described herein), *E. dealbata* subsp. *dealbata*, *E. dwyeri*, *E. glaucina*, *E. parramattensis* subsp. *decadens* L.A.S.Johnson & Blaxell, *E. parramattensis* E.C.Hall subsp. *parramattensis*, *E. prava* L.A.S.Johnson & K.D.Hill, *E. tereticornis* subsp. *basaltica*, and *E. tereticornis* subsp. *tereticornis*). The Hunter Valley lies to the immediate north of, and is partially included within, the Sydney Basin bioregion, an expanse itself comprising a high diversity of eucalypts. The Greater Blue Mountains World Heritage Area, adjoining the Hunter and covering an area of 1,032,649 ha within the Sydney Basin, supports 96 taxa (81 spp., 15 subsp.) but only five of these are red gums (Hager and Benson 2010). No other red gums in subser. *Erythroxyla* are known from other parts of the Greater Sydney Basin, and the Hunter Valley approximates the south-easterly geographical limit of this group.

Within this context, taxonomic investigations have been undertaken intermittently over the past twenty years on mallee populations of red gum from the northern sandstone escarpment of Wollemi National Park (NP), on the southern rim of the Hunter Valley. Early collections of this glaucous mallee (e.g. Bell *s.n.*, 1997) were noted as potentially novel, but subsequently considered an unusual variant of *Eucalyptus dealbata*. Although not previously known from this part of the Hunter Valley, *E. dealbata* seemed appropriate at that time as the stand showed consistent glaucous traits which differed markedly from the locally more common *E. dwyeri*. Bell (2001) consequently discussed this population as representing a disjunct easterly extension of range for *E. dealbata*, but later alluded to the possibility of it representing a new species (Bell 2008). As part of a revision to the classification and mapping of Wollemi National Park over the last decade, the opportunity arose to again sample the only known stand of this probable novelty. Investigations of this and an additional stand have now led to the description of this taxon as a new subspecies. We have conservatively considered the rank of subspecies as the most appropriate for this taxon as: it occurs at the geographical extremity of the widespread *E. dealbata*; most morphological features are variable despite the limited distribution, and they overlap slightly in size with *E. dealbata* or are difficult to quantify; and some observable differences may be wholly or partly environmentally determined due to markedly differing habitat. Additionally, poor resolution of *Eucalyptus dealbata s. lat.* from *E. dwyeri* and *E. nandewarica* within a wider genetic investigation of sect. *Exsertaria* (Jones *et al.* 2016) suggests caution in applying the rank of species to a group of taxa potentially displaying incomplete speciation.

Taxonomy

Eucalyptus dealbata* subsp. *aperticola S.A.J. Bell & D. Nicolle, *subsp. nov.*

Type: New South Wales: Central Western Slopes: Glen Gallic Track, Wollemi National Park, 32°33'11"S, 150°39'26"E, 15 Mar. 2012, D. Nicolle 6245 & S.A.J. Bell (holo: AD; iso: CANB).

=*Eucalyptus* sp. Glen Gallic (Nicolle 2015)

Distinguished from *E. dealbata* subsp. *dealbata* by its sprawling, multi-stemmed mallee habit, its more strongly quadrangular branchlets, its more thickened peduncles, its larger buds, and its larger, usually 4- or 5-valved fruits with a broader disc (Figures 1–5); the adult leaves also tend to be greyer, relatively broader, and thicker (see Table 1).

Sprawling, multi-stemmed *mallee*, to 5 metres tall, lignotuber present. *Bark* smooth throughout, grey over pale grey, decorticating annually in strips. *Seedling leaves* petiolate, opposite for a few nodes then becoming disjunct, lamina ovate, ±concolorous, pruinose at first, dull, grey-green, glabrous, 50–70 mm long × 25–40 mm wide. *Seedling stems* strongly quadrangular, glabrous, pruinose. *Adult branchlets* initially strongly angular and quadrangular, pruinose, pith glands absent. *Adult leaves* petiolate, disjunct, ±pendulous; *petiole* 14–20 mm long; *lamina* broad-lanceolate to ovate, concolorous, pruinose at first, dull, grey-green, 105–140 mm long × 17–50 mm wide; *vein reticulation* of moderate density, primary veins 45–50° to midrib, intramarginal vein distinct, 1.5–3 mm from margin; *oil glands* small but numerous, mainly occurring between veins (island-type). *Inflorescences* axillary, unbranched, held erect, 7–9 flowered; *peduncles* thickened, angular, 5–15 mm long; *pedicels* thickened, angular, 1.5–7 mm long. *Flower buds* shortly pedicellate, diamond-shaped, 10–13 mm long × 5–6 mm wide, outer opercula scar present; *opercula* conical to very slightly beaked, longer than hypanthia, 7–10 mm long. *Flowers* creamy white. *Fruits* pedicellate, hemispherical to slightly campanulate (excluding disc and valves), 5.5–8 mm long × 6.5–11 mm wide; *disc* broad, 1.5–2.5 mm wide, level to annular-ascending; *valves* (rarely 3) 4 or 5, erect and exerted above rim. *Seeds* brown-black, pyramidal to cuboid, 1–2 mm long, hilum terminal. Figures 1–5.

Table 1. Comparison of *Eucalyptus dealbata* subsp. *dealbata* and subsp. *aperticola*

Character	<i>E. d. subsp. dealbata</i>	<i>E. d. subsp. aperticola</i>
Habit	Single- or several-trunked tree	Multi-stemmed mallee
Branchlets	Initially somewhat angular and quadrangular	Initially strongly angular and conspicuously quadrangular
Adult leaves	Blue-green to grey-green, lanceolate to broad-lanceolate, to 185 mm long × 11–40 mm wide, relatively lax	Grey-green, lanceolate to ovate, to 140 mm long × 17–50 mm wide, relatively firm
Peduncles	Not thickened, 3–20 mm long	Relatively thickened, 5–15 mm long
Bud size	6–12 mm long × 3–5 mm wide	10–13 mm long × 5–6 mm wide
Fruit size	2.5–6 mm long × 5–7 mm wide	5.5–8 mm long × 6.5–11 mm wide
Fruit disc	<1–1.5 mm wide	ca. 1.5–2.5 mm wide
Fruit valves	3 or 4 (rarely 5) per fruit	(Rarely 3) 4 or 5 per fruit



Fig. 1. *Eucalyptus dealbata* subsp. *aperticola* growing adjacent to Glen Gallic fire trail, Wollemi National Park, in 2013.



Fig. 2. *Eucalyptus dealbata* subsp. *aperticola* resprouting after wildfire in 2013, Wollemi National Park.



Fig. 3. Branchlet detail of *Eucalyptus dealbata* subsp. *aperticola* (a, b: progeny of *D. Nicolle* 6242 & *S. Bell*, Currency Creek Arboretum (CCA), ex. Glen Gallic, NSW) and subsp. *dealbata* (c, d: progeny of *D. Nicolle* 6171, CCA, ex. North-east of Texas, Qld; e: progeny of *D. Nicolle* 723, CCA, ex. Inverell, NSW; f: progeny of *D. Nicolle* 724, CCA, ex. Killarney Gap, NSW). Scale bar = 40 mm (upper) 10 mm (lower).



Fig. 4. Buds and fruit of *Eucalyptus dealbata* subsp. *aperticola* (a – e: progeny of *D. Nicolle* 6242 & *S. Bell*, Currency Creek Arboretum (CCA), ex. Glen Gallic, NSW) and subsp. *dealbata* (f – g: progeny of *D. Nicolle* 723, CCA, ex. Inverell, NSW; h – i: progeny of *D. Nicolle* 724, CCA, ex. Killarney Gap, NSW). Scale bar = 20 mm.



Fig. 5. Seedlings of *Eucalyptus dealbata* subsp. *aperticola* grown from seed of D. Nicolle 6242.

Flowering: Flowering is likely to be erratic, although buds have been observed in June and flowers in August (the latter in post-fire regrowth).

Distribution and Habitat: Currently known from two ridge systems in the northern section of Wollemi National Park, near Denman in the upper Hunter Valley, c. 150 km north-west of Sydney (Figure 6). Both ridgelines predominantly run east–west, and form a low sandstone escarpment above Martindale Creek, which ultimately drains into the Hunter River.

Known stands occur on near-level Triassic Narrabeen sandstone benches in elevated country on the southern rim of the Hunter Valley, between elevations of 450 and 500 m above sea level. In long unburnt areas, a dense scrubby heath develops with the new taxon shortly emergent over the shrubs *Calytrix tetragona*, *Leptospermum parvifolium*, *Acacia triptera*, *Leucopogon muticus*, *Boronia anethifolia*, *Isopogon dawsonii*, *Harmogia densifolia*, *Grevillea montana*, *Cryptandra spinescens*, *Gompholobium aspalathoides* and *Allocasuarina gymnanthera*, while on the ground occur *Lepidosperma concavum*, *Hibbertia circumdans*, *Oxylobium pultenaea*, *Eragrostis brownii*, *Cheilanthes sieberi* subsp. *sieberi*, *Dampiera purpurea* and *Platysace ericoides*. Surrounding vegetation comprises taller open forest of *Eucalyptus sparsifolia* and *E. punctata*, a common association in northern Wollemi National Park (Bell 1998; NSW Office of Environment and Heritage 2012), and either species may occur sporadically within stands of *E. dealbata* subsp. *aperticola*.

Following wildfire in 2013, regeneration of burnt habitat also revealed the presence of *Commersonia rosea* and *Monotaxis macrophylla*, both endangered fire ephemeral taxa under New South Wales threatened species legislation. *Commersonia rosea* is itself a significant find, and represents the largest known population (tens of thousands of plants) and the first for Wollemi National Park (Bell and Holzinger 2015). Field observations at this time showed vigorous resprouting of *E. dealbata* subsp. *aperticola* approximately 12 months after the fire (Figure 2).

Mapping of vegetation communities within Wollemi National Park revealed over 500 hectares of rockplate heath in the northern sections of the reserve (NSW Office of Environment and Heritage 2012), although it is unclear how much of this supports *E. dealbata* subsp. *aperticola*. Several other heath and scrub communities have been surveyed and mapped within Wollemi National Park, but to date none have supported the new subspecies.

Conservation status: All known stands of *Eucalyptus dealbata* subsp. *aperticola* occur within Wollemi National Park and are not under any perceivable threat. The entire known population suffered an extreme bushfire event in October 2013, but recovery has been swift. A second wildfire in the area in December 2019 potentially impacted part of the population. The Glen Gallic fire trail bisects the type locality in the more northern stand, but it is not envisaged that further threats will occur because of this. Passive management practices undertaken within the national park are considered acceptable for the taxon's long-term requirements. A conservation risk code (ROTAP: Briggs & Leigh 1996) of 2KC is proposed for this taxon. Under IUCN (2001) criteria, a code of DD (Data Deficient), is appropriate as detailed assessment has not been undertaken.

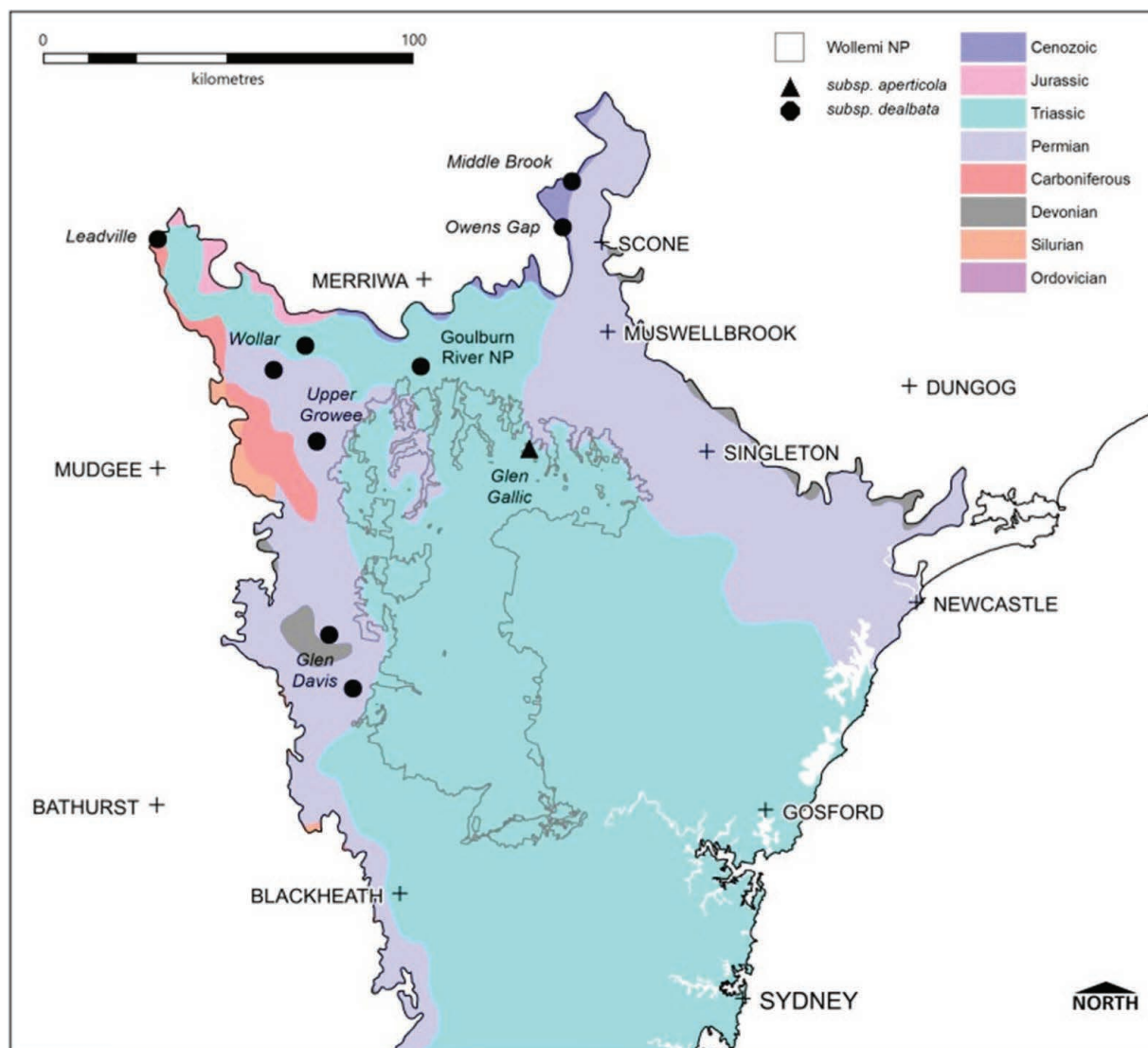


Fig. 6. Location of *Eucalyptus dealbata* populations (subsp. *dealbata* and subsp. *aperticola*) within the Sydney Basin bioregion, showing broad surface geology and Wollemi National Park. Note that remnant basalt flows of Cenozoic age over older Triassic sediments in the Goulburn River NP and Wollar districts (where *E. dealbata* subsp. *dealbata* occurs) are too small to show.

Etymology: The subspecific epithet is taken from the Latin *apertus* (open) and *-cola* (dwelling), referring to the open and exposed sandstone benches atop ridgelines that the subspecies inhabits. Although the northern parts of Wollemi National Park are known for their rugged sandstone topography, the new species has been found only in the Martindale – Glen Gallic locality, on these level or near-level sandstone benches.

Additional specimens: New South Wales: Central Western Slopes: Glen Gallic Trail, Wollemi NP, 32°32'S, 150°35'E, 6 Jun 1997, S. Bell *s.n.* (NSW); Wollemi National Park: Martindale area, 32°30'S, 150°40'E, 4 Aug 1997, S. Bell *s.n.* (CANB); Glen Gallic Track, Wollemi National Park, 32°33'12"S, 150°39'51"E, 15 Mar 2012, D. Nicolle 6242 & S.A.J. Bell (AD, CANB); Seedlings grown from D. Nicolle 6242 & S.A.J. Bell, 16 Feb 2013, D. Nicolle 6579 (AD).

Discussion

In their recent revised classification of *Eucalyptus* subg. *Symphyomyrtus* sections *Maidenaria*, *Exsertaria* (the red gums), *Latoangulatae* and related smaller sections, Nicolle and Jones (2018) placed *E. dealbata* in *E. ser. Exsertae* subser. *Erythroxyllon* along with 13 other eastern Australian red gum species. Their classification was partly informed by a large-scale genetic study of the group (Jones *et al.* 2016), which included three populations of *E. dealbata* subsp. *dealbata* as well as a single population of *E. dealbata* subsp. *aperticola* (D. Nicolle 6242). In that genetic study, *E. dealbata* was not well resolved as a species, being grouped with all populations of

E. dwyeri and *E. nandewarica* as well as with some populations of *E. blakelyi* and *E. vicina*, all part of *E.* subser. *Erythroxyton*. This poor genetic resolution of *E. dealbata* from related species demonstrates the close affinities shared by many species within subser. *Erythroxyton*, with Jones *et al.* (2016) suggesting inconsistencies such as this may occur due to incomplete speciation or hybridisation within the group. Observations of variable morphology within the new taxon (e.g. adult leaves 17–50 mm wide, fruit 6.5–11 mm wide), despite its limited distribution, implies that incomplete speciation may also apply to *E. dealbata* subsp. *aperticola*.

Morphologically, *E. dealbata* is relatively well-defined and readily distinguished from the other 13 species of *E.* subser. *Erythroxyton* by its small tree or mallee habit, its ovate to orbicular, grey-green, pruinose juvenile leaves, its dull, blue-green to grey-green adult leaves, its pruinose branchlets, its pruinose buds with relatively short opercula, and its initially pruinose fruits. The species is distributed widely on the tablelands and western slopes of NSW, from about Grenfell and Cowra northwards to far southern Queensland. It invariably occupies rocky sites on hilltops and slopes. Two other species of *E.* subser. *Erythroxyton* can have pruinose buds (rarely in *E. blakelyi* and consistently in *E. glaucina*). *Eucalyptus blakelyi*, another widespread species occurring along the Great Dividing Range from west of Bendigo in Victoria northwards to the Stanthorpe area on the NSW – Queensland border, differs from *E. dealbata* in its greener, non-pruinose juvenile leaves, its longer opercula and its non-pruinose branchlets and fruits. Intergrades between *E. blakelyi* and *E. dealbata* subsp. *dealbata* occur in some areas and are characterised by their intermediate habitat and morphology (Brooker and Slee 2000; Slee *et al.* 2015). *Eucalyptus glaucina*, a more restricted, subcoastal species from fertile flats in the lower Hunter Valley and in the Casino district in northern NSW, differs from *E. dealbata* in its taller habit, its larger juvenile and adult leaves, and its much longer opercula. The distribution of *E. glaucina* and *E. dealbata* do not overlap, and the two species grow in very different habitats. Intergrades have also been recorded between *E. dealbata* subsp. *dealbata* and both *E. dwyeri* and *E. vicina* (Brooker and Slee 2000). Both of these species differ from *E. dealbata* most conspicuously in their relatively narrower, greener and non-pruinose juvenile leaves and their non-pruinose adult features.

The more distantly related *E. prava* is another red gum with pruinose features that may also be confused with *E. dealbata*. The species is largely restricted to the New England Tableland, occurring as far south as the Murrurundi area within the upper Hunter Valley. Nicolle and Jones (2018) place *E. prava* in *E.* ser. *Liberivalvae* with five other species. This series differs most notably from *E.* ser. *Exsertae* in its somewhat granular smooth bark, its fruits, in which the disc is annular and free of the ovary roof, and its red-brown seeds.

Two subspecies are now recognised in *E. dealbata*; subsp. *dealbata* distributed throughout the range of the species, and subsp. *aperticola* from northern Wollemi NP and environs. Only subsp. *aperticola* occurs on Triassic-aged Narrabeen sandstone geology, all others are found on older sediments. Intermediates between the two subspecies are not known, with subsp. *aperticola* occurring approximately 40 km to the south-east of the nearest known stand of subsp. *dealbata*. Several other stands of *E. dealbata*, all attributable to subsp. *dealbata*, are extant in the Sydney Basin bioregion (Table 2, Figure 6), most within the broader Hunter region. A search of the Atlas of Living Australia (ALA), Australia's Virtual Herbarium (AVH) and the NSW Office of Environment and Heritage Bionet database was undertaken to collate and audit all known populations of *E. dealbata* in the Sydney Basin bioregion (records with geospatial accuracies of >10 km excluded). Inspection of these populations between 2014 and 2019 confirmed differences between the two subspecies. All stands of subsp. *dealbata* supported mostly single stemmed small trees (Figure 7), but no individuals displayed the characteristic sprawling, multi-stemmed mallee habit, strongly quadrangular branchlets, or large buds and fruits of subsp. *aperticola*.

Co-occurring vegetation at sites supporting subsp. *dealbata* commonly included *Eucalyptus crebra* and *Callitris endlicheri*, over shrubs such as *Cassinia quinquefaria*, *Allocasuarina verticillata*, *Cassinia sifton*, *Lissanthe strigosa*, *Dodonaea viscosa* subsp. *cuneata*, *Indigofera adesmiifolia*, *Leucopogon muticus*, *Baeckea diosmifolia* and *Bursaria spinosa*. Some sites, such as at Wollar and Owens Gap, have been previously partially cleared for grazing and trees have coppiced from cut stumps. A few sites within the Goulburn River National Park area support *E. dealbata* subsp. *dealbata* on remnant basalt flows within a wider Triassic Narrabeen geological landscape, and here the species co-occurs with *E. albens* and *Callitris glaucophylla*, occasionally over *Triodia scariosa*. Further west near Leadville, *E. dealbata* subsp. *dealbata* occurs within a largely cleared landscape of *E. microcarpa*, *E. melliodora* and *E. albens*. At Mt Stormy, in the Upper Growee area, single-stemmed but stunted *E. dealbata* subsp. *dealbata* grow with *Acacia doratoxylon*, *E. goniocalyx* and *Callitris* sp. over an understorey of *Monotoca scoparia*, *Boronia anethifolia*, *Grevillea ramosissima*, *Allocasuarina* sp., *Triodia scariosa* and *Xanthorrhoea johnsonii* (G. Taseski pers. comm. 2019).



Fig. 7. Representative stands of *Eucalyptus dealbata* subsp. *dealbata* within the Sydney Basin bioregion: a, Owens Gap, Scone; b, Wollar Rd, Wollar; c, Ringwood Rd, Wollar; d, Leadville; e, Glen Davis Rd, Glen Davis; f, Port Macquarie Rd, Glen Davis.

Table 2. Known naturally occurring populations of *Eucalyptus dealbata* within the Sydney Basin bioregion, showing geology, elevation and habit. Geological units follow the Australian Stratigraphic Units Database (<https://asud.ga.gov.au/>).

Taxon	Population	Lat Long	Geology	Elevation	Growth form
subsp. <i>dealbata</i>	Middle Brook	31.9000S 150.7833E	Liverpool Range Volcanics (unmapped)	520	single-trunked trees
	Owens Gap	32.0129S 150.7573E	Permian Newcastle Coal Measures	312	single-trunked trees
	Wollar	32.3611S 149.9223E	Permian Illawarra Coal Measures	465	Single & multiple-trunked trees
	Goulburn River NP	32.3030S 150.0122E	Liverpool Range Volcanics (unmapped)	379	single-trunked trees
	Leadville	32.0422S 149.5863E	Silurian Tannabutta Group (volcanics)	505	single-trunked trees
	Upper Growee	32.5352S 150.0453E	Cenozoic volcanics	750	single-trunked trees
	Glen Davis	32.9882S 150.0945E	Permian Shoalhaven Group	478	single-trunked trees
subsp. <i>aperticola</i>	Glen Gallic	32.5537S 150.6604E	Triassic Narrabeen Group	480	Multi-stemmed mallee

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