

## THE MIENA CIDER GUM, *EUCALYPTUS GUNNII* SUBSP. *DIVARICATA* (MYRTACEAE): A TAXON IN RAPID DECLINE

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(with three plates)

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The new combination *Eucalyptus gunnii* subsp. *divaricata* (McAulay & Brett) B.M.Potts comb. & stat. nov. is introduced for the Miena form of the Tasmanian cider gum *Eucalyptus gunnii* Hook.f., once described as a separate species, *E. divaricata* McAulay & Brett. This subspecies occurs on the Central Plateau of Tasmania, where it intergrades clinally with *E. gunnii* subsp. *gunnii* and *E. archeri*. Core populations of this subspecies are among the most frost-resistant of *E. gunnii* sens. lat., have juvenile foliage of interest for floriculture and have been exploited historically for their sweet sap. However, high mortality of trees in the last decade, coupled with only rare seedling recruitment and poor seed crops, is threatening the long-term survival of this taxon in the wild. *E. gunnii* subsp. *divaricata* qualifies as Endangered under Commonwealth and Tasmanian legislation.

**Key Words:** cider gum, *Eucalyptus gunnii*, *Eucalyptus archeri*, endangered species, Miena, Tasmania.

### INTRODUCTION

The name *Eucalyptus divaricata* McAulay & Brett was introduced by Brett (1938) for an extreme form of *E. gunnii* Hook.f. growing near Miena in the Central Highlands of Tasmania. However, this taxon was subsequently subsumed by taxonomists within *E. gunnii* (Curtis & Morris 1975, Pryor & Johnson 1971, Brooker 2000). It has, however, been shown to be a cline form of *E. gunnii* (Potts & Reid 1985a, b). It is here reinstated as *Eucalyptus gunnii* subsp. *divaricata* (McAulay & Brett) B.M.Potts comb. & stat. nov., a tree of considerable economic and cultural significance. *E. gunnii* sens. lat. is one of the most frost-resistant species of *Eucalyptus* (Davidson & Reid 1985, Cauvin & Potts 1991, Kirkpatrick & Gibson 1998, 1999), and *E. gunnii* subsp. *divaricata* encompasses the most frost-resistant populations (Cauvin & Potts 1991). It is being used in breeding programs overseas where eucalypts are being planted in areas at the limits of cold tolerance for the genus (Potts & Potts 1986). The juvenile foliage of *E. gunnii* is also widely used in floral arrangements both overseas and within Australia; that of the subspecies *divaricata* is most prized by florists because of its durability, glaucousness (Wirthensohn *et al.* 1999) and small, rounded leaves. Aborigines are reported (Plomley 1966) to have collected and drunk the sap from large trees of *E. gunnii* sens. lat. growing in areas that also support *E. gunnii* subsp. *divaricata*. There are also reports of both Aborigines and stockmen drinking the naturally fermented sap, which had an intoxicating effect (Bruce 1857, Plomley 1966); the first report may be the only record of pre-European use of an alcoholic beverage in Australia. The sweet sap produced by the species is also a food source for native insects, birds and marsupials (e.g. Plomley 1966). [In some years the production of manna is copious, presumably following insect browsing of the foliage. The soil under trees then has an almost complete cover of manna pellets. Large flocks of parakeets

have been seen in a “drunken” state picking up manna and drinking from pools of sap and damp areas (W. D. Jackson, pers. com. 2001).] The taxon has been the subject of ongoing scientific study of evolutionary processes in Tasmania (Potts 1985, Potts & Reid 1985a,b) and is therefore of educational significance.

### TAXONOMY

#### *Eucalyptus gunnii* subsp. *divaricata* (McAulay & Brett) B.M.Potts comb. & stat. nov.

Basionym: *Eucalyptus divaricata* McAulay & Brett, *Pap. Proc. Roy. Soc. Tas.* for 1937: 94 (1938).

Lectotype (here designated): Tasmania: Miena, Great Lake, September 1938, *R.G. Brett* (2.221, S3, H130) (HO 16163; Photo 1); isolectotype: (HO 16165).

#### Description

Small to medium woodland tree, 12–15 m high, often with markedly divaricating branching. Juvenile leaves opposite, glaucous, cordate-orbicular to elliptical, subcrenulate, sessile, 2.5 x 2 cm. Mature leaves green or subglaucous, alternate, petiolate, narrow to broad-lanceolate 4–8 x 1.5–3 cm. Umbels axillary, three-flowered. Peduncles 5–10 mm. Buds sessile to shortly pedicellate, glaucous, obovate to cylindrical, 6–8 x 5 mm. Operculum shorter than calyx tube. Fruit often glaucous, cylindrical to suburceolate; often urceolate when immature, 7–9 x 6 mm. Branchlets covered in a heavy waxy bloom that often extends onto flower buds and young capsules.

Brett (1938) did not formally designate a holotype for his new taxon. However, his specimens, now held in the Tasmanian Herbarium (HO), are well annotated and it is clear which sheets were considered by him to be typical for the taxon. Accordingly, one of these (HO 16163) is here designated as the lectotype (pl. 1).



PLATE 1

Lectotype of *Eucalyptus gunnii* subsp. *divaricata* collected by R.G. Brett in September 1938 from Miena, Great Lake (HO16163).

#### Specimens examined

Tasmania: West side of Great Lake, 20 km from Miena, H.N. Barber 2536, 15.ii.1953 (HO 16188); Great Lake, H.N. Barber 2537, 15.ii.1953 (HO 16248); Bakers Tier, R.G. Brett, 15.viii.1935 (HO 16154); Bakers Tier, R.G. Brett, 15.viii.1937 (HO 16158); Miena, Great Lake, R.G. Brett, 15.ix.1938 (HO 16163 & HO 16165); east side of Great Lake, M.I.H. Brooker 5750, 21.xi.1977 (HO 28752); Tods Corner, A.M. Buchanan 15012, 9.xii.1997 (HO 323958); Great Lake, N.T. Burbidge 3440, 28.i.1949 (HO 16252); Great Lake, W.M. Curtis, 28.i.1970 (HO 51578); Lake Highway, at intersection of Tods Corner Road, F. Duncan 23, 12.x.1983 (HO 68582); Lake Highway, 53.8 km northwest of Bothwell, southern end of Great Lake, A.M. Gray 381, 4.vi.1979 (HO 30186); Barren Tier, Great Lake, M.J. Hood 18, 26.iii.s.year (HO 16221); Miena, Shannon Lagoon, B. Potts, ii.1990 (HO 511233 to HO 511236 & HO 511239); Great Lake, L. Rodway, 15.v.1893 (HO 16183).

## DISCUSSION

*Eucalyptus gunnii* subsp. *divaricata* is phenotypically (Potts & Reid 1985a) and genetically (Potts 1985, Potts & Reid 1985a, Cauvin & Potts 1991) differentiated from other members of the *E. gunnii*–*E. archeri* complex. Five clinal morphs have been identified in the complex, including *E. gunnii* subsp. *divaricata*, *E. archeri*, southern *E. gunnii* subsp. *gunnii*, north-

western *E. gunnii* subsp. *gunnii* and localised intermediates between *E. archeri* and *E. gunnii* subsp. *divaricata*.

*Eucalyptus gunnii* subsp. *divaricata* can be distinguished from *E. gunnii* subsp. *gunnii* by its smaller, broader juvenile and adult leaves, and by a greater degree of glaucousness that extends from both juvenile and adult leaves onto the young stems and often onto flower buds and capsules (Potts & Reid 1985a, b). It has a more cylindrical to sub-urceolate capsule (pl. 1) than the typical companulate or ovoid-truncate capsule of other members of the *E. gunnii*–*E. archeri* complex (Potts & Reid 1985a). It is also differentiated from *E. gunnii* subsp. *gunnii* by a greater retention of the juvenile foliage (Potts 1985), greater lignotuber development (Potts 1985), an absence of marked oil glands in the juvenile leaves, and by the composition of leaf volatile oils (Li *et al.* 1996) and the surface wax (Li *et al.* 1997). Its leaf volatile oil is dominated by *p*-cymene and spathulenol and contains virtually no 1,8 cineole, the dominant component in five populations of *E. gunnii* subsp. *gunnii* (17–57%) examined. Its leaf waxes also have a higher percentage of  $\beta$ -diketones and triterpenoids and a lower percentage of alkanals. Mature trees of *E. gunnii* subsp. *divaricata* usually have more branched (hence the epithet “*divaricata*”), rounder crowns (pl. 2) than lower-altitude tree forms of *E. gunnii* subsp. *gunnii*, although this feature is likely to be partly a consequence of the more exposed habitat.

Core populations of *E. gunnii* subsp. *divaricata* at Miena and on the western shores of Great Lake are also differentiated by up to 1.5 months in peak flowering time from higher altitude populations of other members of the *E. gunnii*–*E. archeri* complex and lower altitudes populations of *E. gunnii* subsp. *gunnii* on the Central Plateau (Potts & Reid 1985a). For example, in the 1979–80 and 1980–81 flowering seasons, flowering in the Miena population peaked in December and January, whereas nearby *E. gunnii* subsp. *gunnii* populations in more sheltered, lower altitude sites peaked in February and March. It is not known whether this difference in flowering time has a genetic basis or is environmentally induced. Regardless, such differences appear to be stable across seasons and would act as a barrier to gene flow between the two subspecies when they are in close geographic proximity.

## Distribution and Ecology

*Eucalyptus gunnii* subsp. *divaricata* is a woodland tree adapted to the edges of treeless flats and hollows (often termed “frost hollows”) in the general vicinity of Great Lake on the Central Plateau, Tasmania (Jackson 1973, Kirkpatrick & Gibson 1998, 1999). These sites tend to be poorly drained, and exposed to the early morning sun, both of which may accentuate the damaging effects of frost (Davidson & Reid 1987, Close *et al.* 2001). Nevertheless, in winter, these sites tend to be covered by cloud and mist; the ability of *E. gunnii* sens. lat. to tolerate frosts under such wet conditions is believed to have allowed it to dominate high-altitude sites (Potts & Reid 1985b, Kirkpatrick & Gibson 1999).

*E. gunnii* subsp. *divaricata* is known from several major occurrences in a 40 x 40 kilometre area stretching from west of Miena to Interlaken. Key localities are Miena (east of Shannon Lagoon), South Brandum, Jimmys Marsh (Alma Tier), Arthurs Lake, Jacks Marsh (Steppes), St Patricks Plain, north of Lake Echo, and the shores of the southern half of Great Lake. The populations to the immediate south of



PLATE 2

*Typical form of the large E. gunnii ssp. divaricata trees in the Miena population. The specimen Brett used to describe the taxon E. divaricata in 1938 is thought to have been near the above tree on the side of the Lake Highway, overlooking Shannon Lagoon near Miena (W.D. Jackson, pers. com.).*



PLATE 3

*The western end of the Miena population of E. gunnii ssp. divaricata in 2000. The last decade has seen a major increase in the mortality of these old trees on the Central Plateau. The surviving trees in this population are virtually devoid of seed crops, and established seedlings and saplings are rare (photo T. Jones).*

Great Lake include the stand at Miena, which exhibits the most extreme morphology within the taxon and has been designated as the type locality. This extreme is believed to represent Brett's view of typical *E. divaricata* (W. D. Jackson, pers. comm.). Unfortunately this population has shown the greatest decline, with the authors estimating that more than 60% of the mature trees have died in the last ten years. From this core area, the taxon clinally intergrades into (1) *E. gunnii* subsp. *gunnii* with decreasing altitude to the southeast, (2) a small tree or mallee form on exposed sites at higher altitudes with close affinities to *E. gunnii* subsp. *divaricata*, and (3) the closely related *E. archeri* Maiden & Blakely at the northern end of Great Lake where rainfall is higher (Potts & Reid 1985a, b).

The rapid decline of *E. gunnii* subsp. *divaricata* throughout its geographic range is likely to be due to a combination of factors brought to a head by droughts in this region over the last two decades, and coincides with severe tree decline in the rain shadow east of the Central Plateau, particularly in the Midlands (Neyland 1996, Kirkpatrick *et al.* 2001). It has also been accompanied by significant crown decline (many trees are now regenerating from epicormics) in extensive areas of subalpine forests south and west of Great Lake dominated by *E. delegatensis* and *E. coccifera*. Indeed, in the case of *E. gunnii* subsp. *divaricata*, we may be witnessing an impact of long-term global warming on the Tasmanian eucalypt gene pools — the loss of resistance to extreme frost. There appears to have been a 1.5°C increase in mean daily maximum temperature in this general region between 1945 and 1995 (Kirkpatrick & Gibson 1999). Field trials have also shown that over the last decade climatic conditions near Great Lake have been sufficiently mild to potentially allow an increase in the altitudinal limit of *E. rodwayi* (Kirkpatrick & Gibson 1998, 1999), a species that normally replaces *E. gunnii* on the margins of poorly drained, treeless flats at mid-altitudes on the Central Plateau.

The large trees of *E. gunnii* subsp. *divaricata* are no doubt ancient, and many were already overmature in the late 1970s, with numerous fire scars and moribund branches. The surviving trees are often in poor health, and flower buds or capsules are rarer than in previous decades. When such trees resprout from epicormic buds, the succulent new growth in the upper canopy is often browsed intensively by brushtail possums (*Trichosurus vulpecula*), which favour trees of *Eucalyptus gunnii* sens. lat. (Scott *et al.* in press, Dungey & Potts in press); the browsing may well hasten the death of mature trees. Less eucalypt foliage, more nesting sites in dead trees, and the increase in possum numbers in the Central Highlands following the cessation of the possum fur trade may well increase browsing pressure beyond what the surviving trees can support. The felling of many large, mature trees on the Central Plateau over the last 20 years, when raising the level of Great Lake and clearing roadsides, has compounded the decline in mature *E. gunnii* subsp. *divaricata*. Around Great Lake there is, however, regrowth of coppice and advanced saplings.

The recent high mortality of mature trees is particularly significant, as many stands have very few immature individuals available to replace this mature cohort (pl. 3). Established seedlings are rare, and most surviving saplings appear to be associated with shrubbery. The insulated, open-woodland site occupied by typical *E. gunnii* subsp. *divaricata* (Potts & Reid 1985a; pls 2, 3 present study) is extremely harsh for seedling establishment, due to exposure to both frost and drought (Potts 1985). Over the last century this has

been aggravated by browsing pressure from sheep, rabbits and native marsupials, coupled with frequent firing of the vegetation to reduce the shrub component of the vegetation (Jackson 1973, Gibson & Kirkpatrick 1989). Gibson & Kirkpatrick (1989) noted that, if summer grazing were not removed or reduced dramatically at Miena, the site would inevitably change from woodland to grassland at the end of the life span of the existing trees.

The canopy seed crops have been dramatically reduced with either the death of the mature trees or severe loss of the reproductive capacity of surviving trees. The threat to the regeneration potential of these stands is further exacerbated by the increased isolation of flowering trees, which is likely to increase the rate of self-fertilisation in the open-pollinated seed crop and hence reduce the fitness of the subsequent seedling cohort (Borrhalho & Potts 1996, Hardner *et al.* 1996). *Eucalyptus gunnii* sens. lat. seedlings derived from self-fertilisation have poorer vigour and survival than seedlings derived from unrelated crossing (Potts *et al.* 1987).

## Conservation Status

*Eucalyptus gunnii* subsp. *divaricata* qualifies as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and the Tasmanian *Threatened Species Protection Act 1995*. Qualifying criteria are a restricted distribution; the number of reproductive individuals being possibly fewer than 2500; a continuing decline in the number of mature individuals; and a decline of greater than 20% in the total population over five years. At the time of submission of this paper the taxon has been nominated formally for listing under Commonwealth and Tasmanian legislation.

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