

# THREE NEW ENDEMIC SUBSPECIES OF SNOW GUM FOR VICTORIA AND NOTES ON THE TAXONOMY OF THE INFORMAL SUPERSPECIES *PAUCIFLORA* L.D.PRYOR AND L.A.S.JOHNSON

K. RULE\*

## ABSTRACT

Rule, K. Three new endemic subspecies of Snow gum for Victoria and notes on the taxonomy of the informal superspecies *pauciflora* L.D.Pryor and L.A.S.Johnson. *Muelleria* 8(2): 223–233 (1994). — Three new subspecies within *Eucalyptus pauciflora* Sieb. ex Spreng. of restricted distribution in Victoria are described. These are *E. pauciflora* ssp. *acerina* Rule, a small-fruited, non-waxy form of the Baw Baw Plateau and nearby Mt Useful, *E. pauciflora* ssp. *hedraia* Rule, a large-fruited, markedly waxy form of the Falls Creek area and *E. pauciflora* ssp. *parvifructa* Rule, another small-fruited yet waxy form of the Grampians' Mt William Range. These taxa are compared with other snow gums and their conservation statuses discussed. In addition comments concerning taxonomic perspectives and problems of snow gums are given.

## INTRODUCTION

Historically, the taxonomy of alpine snow gums has focussed on populations in New South Wales and the Australian Capital Territory and have been preoccupied with issues regarding the specific integrities of *E. niphophila* Maiden & Blakely and *E. debeuzevillei* Maiden to the extent that divergent forms within the Victorian alpine regions have been overlooked.

Only a recent study by Williams and Ladiges (1985) has provided a Victorian perspective. Although largely concerned with other taxonomic issues, these researchers found considerable diversity within the Victorian alpine populations selected for study. They suggested that these alpine forms had evolved differently in response to localised, severe environmental pressures.

Preliminary investigations using seedling trials and field observations confirmed the presence of a number of divergent alpine snow gums in Victoria and gave rise to the present study. One such form analysed by Williams and Ladiges is of the Mt William Range in the Grampians. The other two alpine snow gums are located on the Baw Baw Plateau and Mt Useful of West Gippsland and at Falls Creek and adjacent localities in north-east Victoria. In this paper, all three forms are regarded as altitudinal variants or 'end-points' of *E. pauciflora* and are recognised as subspecies.

This study also has focussed on problems associated with the level of formal recognition that these snow gums should be given. Appreciable differences in morphology between the typical form of the species and alpine forms and between the alpine forms themselves were identified, but it is the preference of this paper that these forms not be accorded specific statuses. Such a position is consistent with a well-established convention regarding clinal variation. Obviously, the issue of the taxonomy of the snow gums requires urgent attention, particularly in view of recent taxonomic decisions by Hill and Johnson (1991), and is discussed in a later segment.

## TAXONOMY

*Eucalyptus pauciflora* Sieb. ex Spreng. ssp. *acerina* Rule ssp. nov.

A subspecies typica foliis juvenilibus adultisque, alabastris fructibusque parvioribus differt;

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\* 6 Regal Court, Vermont South, Victoria, Australia 3133



a subspecie *niphophila* alabastris fructibusque parvioribus et glaucedinem deficienti differt; a *E. gregsoniana* foliis juvenilibus latioribus et fructibus majoribus differt.

**HOLOTYPE:** The summit of Mt Erica, Jan. 1905, *C.S.Sutton* (MEL).

*Mallee* with robust, erect trunks, from 5 to 12 m; branchlets semi-erect. *Bark* smooth throughout, lustrous, grey-green; old bark shed in light brown ribbons. *Juvenile leaves* broadly lanceolate, ovate-lanceolate or elliptical, petiolate, alternate, semi-erect, dull, blue-green or grey-green, concolorous, moderately glandular, apiculate or acuminate, slightly uncinat, to 10 × 4 cm; petioles rarely waxy, to 1.2 cm long; venation sub-parallel; nodes moderately crowded. *Coppice leaves* similar to the juvenile leaves only slightly larger. *Adult leaves* lanceolate, broadly lanceolate or ovate-lanceolate, semi-pendulous, lustrous, green, concolorous, conspicuously glandular, coriaceous, acuminate or acute, uncinat, to 10 × 3 cm; petioles non-waxy, to 2 cm; venation sub-parallel; canopy crowded. *Inflorescences* 7 or 9-flowered; peduncles terete, 3–6 mm long. *Buds* clavate or slightly pyriform, pedicellate, warty, non-waxy, to 8 × 4 mm; opercula burnished, hemispherical. *Fruits* hemispherical or slightly obconical, subsessile or sessile, 4–5(6) × 5–7(8) mm; disc level with rim or slightly ascending; locules 3(4). *Seeds* black, cuboidal or pyramidal, somewhat smooth on the dorsal surface (as in other subspecies), to 2 mm long. (Fig. 1)

#### SPECIMENS EXAMINED

*Victoria* — Mt St Gwinear Car Park, 17 Jan. 1980, *M.I.H. Brooker* 6834 (MEL 648630); Along walking track 2 km west of Mt St Gwinear, 25 Jan. 1986, *S.J. Forbes* 2995 (MEL 557318); Summit of Mt Erica, 20 Mar. 1990, *K. Rule* 9001 (MEL); Mt Baw Baw Ski Village, 23 Apr. 1991, *K. Rule* 9148 (MEL); Summit of Mt Useful, 23 Feb. 1992, *K. Rule* 9224 (MEL).

#### FLOWERING PERIOD

Spring or early summer.

#### DISTRIBUTION

*Eucalyptus pauciflora* ssp. *acerina* is known only from the Baw Baw Plateau and the nearby Mt Useful, both of which are located in Victoria's West Gippsland region. The plateau, which is dominated by several mountains including Baw Baw, Erica and St Gwinear, rises above 1500 m. Mt Useful is of a similar altitude. These sites are geographically segregated from other mountains in the vicinity, for example, Mt Matlock and Lake Mountain, which are a part of the Great Dividing Range and which contain populations of conspicuously waxy snow gums with fruits larger than *E. pauciflora* ssp. *acerina*. Such populations mark the western extremity of *E. pauciflora* ssp. *niphophila*. (Fig 2.)

#### CONSERVATION STATUS

The Baw Baw Plateau is elongated with a somewhat east-west orientation and is relatively extensive, being approximately 12 km long. The populations of *E. pauciflora* ssp. *acerina* are abundant and secure within the Baw Baw National Park. In contrast, however, the Mt Useful population, although secure in a protected flora reserve, is relatively small.

#### ASSOCIATED SPECIES

On the Baw Baw Plateau *E. pauciflora* ssp. *acerina* grows in pure stands. At its lower limits it abuts *E. glaucescens* Maiden and Blakely, *E. delegatensis* R.T.Baker and *E. nitens* (Deane and Maiden) Maiden. On Mt Useful *E. kybeanensis* Maiden and Cambage is an associated species.

#### ETYMOLOGY

The subspecific epithet is derived from Latin and refers to the absence of observable surface wax in the adult stage, a feature which contrasts well with other alpine snow gums.





Fig. 1. *Eucalyptus pauciflora* ssp. *acerina*. a — fruiting branchlet  $\times 1$ . b — buds  $\times 2$ . c — seedling leaves  $\times 0.6$ .



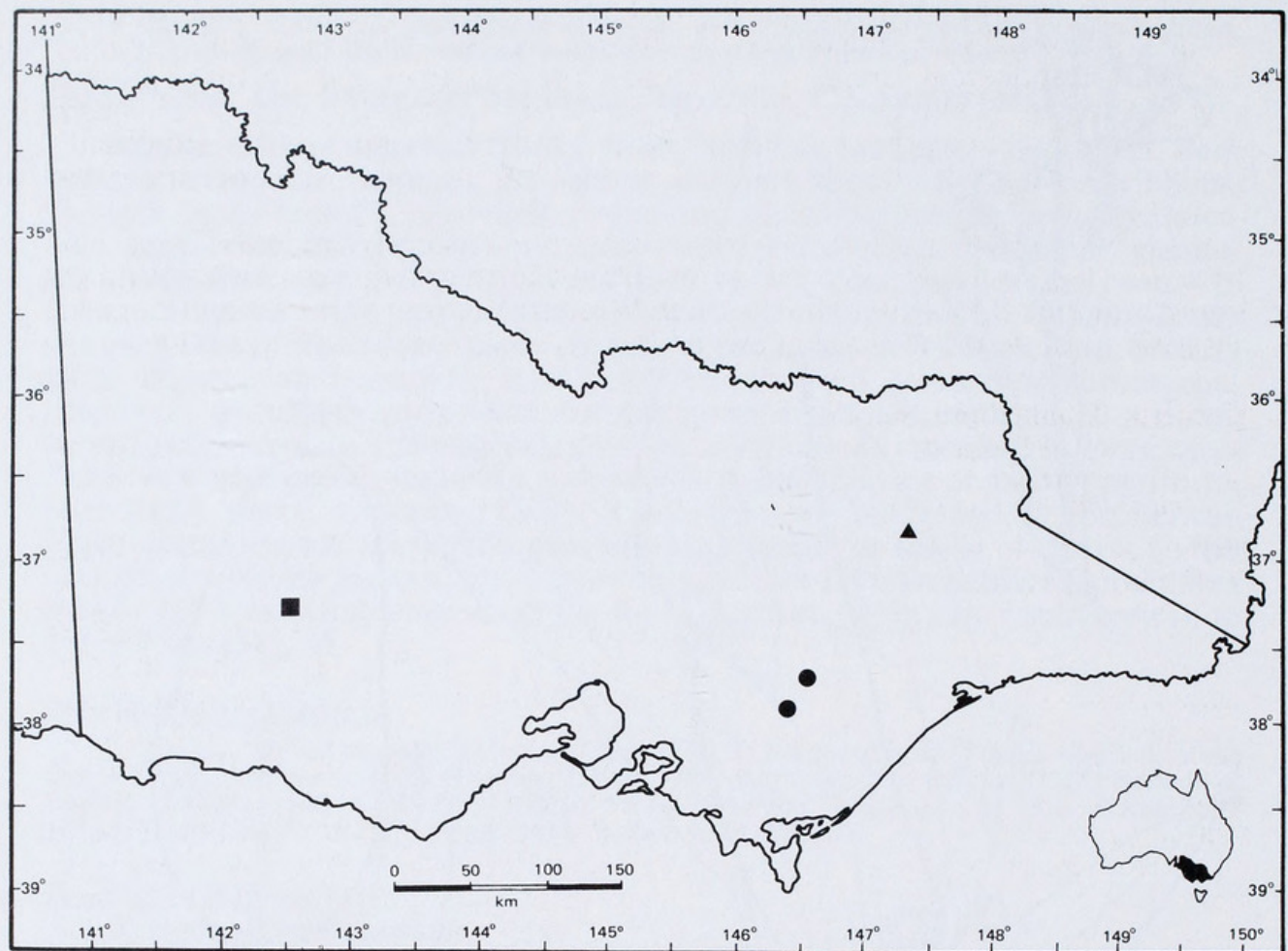


Fig. 2. Distribution of *Eucalyptus pauciflora* ssp. *acerina* (●), *Eucalyptus pauciflora* ssp. *hedraia* (▲), and *Eucalyptus pauciflora* ssp. *parvifructa* (■).

## DISCUSSION

Collections of *E. pauciflora* ssp. *acerina* in herbaria are few. It is surprising that it has been ignored until recently, particularly as it occurs on the popular Mt Baw Baw snowfield which is relatively close to Melbourne. A few local observers have given it attention by incorrectly referring to it as 'var. *nana*', a name originally applied to *E. gregsoniana* Johnson & Blaxall. Such confusion appears to be derived from inaccurate comparisons of fruit sizes as those of ssp. *acerina* are generally smaller. Other differences include ssp. *acerina* having broader yet shorter juvenile leaves and having inflorescences borne on shorter peduncles.

*E. pauciflora* ssp. *acerina* has been mistaken for *E. pauciflora* ssp. *niphophila* because of its alpine, mallee habit, small coriaceous adult leaves and crowded canopy. Yet it is readily separable from that form in being completely non-waxy in adult characters and rarely do its seedlings display a hint of wax around the nodes (observed only in the Mt Useful population). Most conspicuous is its glossy-green canopy which contrasts markedly from the bluish one of *E. pauciflora* ssp. *niphophila* (resulting from the copious amounts of wax on buds, fruits and branchlets). The *E. pauciflora* ssp. *acerina* also is different in having shorter peduncles, smaller buds with hemispherical opercula and smaller fruits. The shortness of the peduncles sometimes causes the fruits to become stem-clasping as they mature. A further difference is in seedling morphology with the stems of *E. pauciflora* ssp. *niphophila* becoming markedly waxy as the seedlings mature.

*Eucalyptus pauciflora* ssp. *acerina* has been mistaken for *Eucalyptus pauciflora* ssp. *pauciflora*, most likely because it is non-waxy. However, it differs from that form in being a mallee with erect trunks and a dense canopy (the effect of



crowded nodes) rather than a spreading tree with a somewhat pendulous, open canopy. It is also different in having shorter peduncles, smaller buds with regularly hemispherical opercula, smaller fruits and shorter, coarser, more glandular adult leaves. Further, as alluded to above, the seedling leaves of *Eucalyptus pauciflora* ssp. *acerina* are more crowded along the axis and its juvenile leaves are usually smaller and do not become pendulous as the seedlings mature, as occurs in the typical form.

The only other snow gum to have fruits as consistently small as *Eucalyptus pauciflora* ssp. *acerina* is a waxy, narrow-leaved form growing on the Mt William Range and the Major Mitchell Plateau in Western Victoria's Grampian Ranges, a description of which is given below as *E. pauciflora* ssp. *parvifructa* Rule.

***Eucalyptus pauciflora* Sieb. ex Spreng. ssp. *hedraia* ssp. nov. Rule.**

A subspecie typica alabastris fructibusque majoribus et sessilis et glaucedine copiosa differt; a subspecie *debeuzevillei* alabastris sessilis, fructibusque sessilis majoribus, et a subspecie *niphophila* alabastris fructibusque majoribus sessilis differt.

**HOLOTYPE:** Victoria, Falls Creek Ski Village, 36°51'S, 147°16'E, 14 Jan. 1982, S. Forbes 821 (MEL 612462).

*Mallee*, shrubby or robust, upright or spreading, from 5–10 m high; branchlets semi-erect. *Bark* smooth throughout, grey or brown; old bark shed in grey-brown ribbons. *Juvenile leaves* broadly ovate, oblong or elliptical, alternate, petiolate, semi-erect, dull, grey-green, concolorous, moderately glandular, acuminate or apiculate, uncinata, to 12 × 5 cm; venation conspicuous, sub-parallel; petioles waxy, to 1.5 cm long; nodes moderately crowded or crowded. *Coppice leaves* similar to juvenile leaves. *Adult leaves* broadly lanceolate, ovate or elliptical, dull or semi-lustrous, blue-green or grey-green, glandular, coriaceous, acuminate or acute, uncinata, to 13 × 4 cm; petioles waxy, slightly angular, to 2 cm long; venation conspicuous, sub-parallel; canopy moderately crowded or crowded. *Inflorences* 7–11-flowered; peduncles slightly angled, to 7 mm long. *Buds* ovoid, sessile, markedly waxy, warty, round in cross-section or sometimes angular, to 8 × 7 mm; opercula conical or hemispherical. *Fruits* hemispherical or slightly cupular, sessile, non-angled, waxy, 7–10 × 10–14(15)mm; diam. level with rim; peduncle 2–4mm long; locules 3 (4). *Seed morphology* as in other subspecies, to 3 mm long. (Fig. 3.)

**FLOWERING PERIOD**

Spring or early summer.

**SPECIMENS EXAMINED**

Victoria — Mt Bogong, 22 Oct. 1944, *Brig. Chapman* (MEL); Mt Mackay, 3 km west of Falls Creek, L.G. Adams and G.C. Pierson 2646 (MEL 571904); Falls Creek Village, 17 Dec. 1981, H. van Rees 285 (MEL 617716); Summit of Mt Arthur, 3 Jan. 1980, N.T. Rossiter 101 (MEL 6947580); Falls Creek Village, 19 Feb. 1986, D.E. Albrecht 2478 (MEL 1124700); Above Rocky Valley Dam, along track to Mt Mackay, 13 Apr. 1982, K. Rule 9233 (MEL).

**DISTRIBUTION**

The known concentration of populations of *E. pauciflora* ssp. *hedraia* occupies several square kilometres around the site of the Falls Creek Ski Village which is located in the Victorian Alps. The altitude of the village is approximately 1700 m and its aspect is a mountainside facing northwards. Other collections have been made in the vicinity; on Mt Bogong and Mt Arthur. (Fig. 2)

**ASSOCIATED SPECIES**

*Eucalyptus pauciflora* ssp. *hedraia* grows in pure stands except along its boundaries where it mixes with *E. pauciflora* ssp. *niphophila*. A small number of individuals intermediate between the two subspecies have been observed. This





Fig. 3. *Eucalyptus pauciflora* ssp. *hedraia*. a — flowering branchlet  $\times 1$ . b — fruits  $\times 1$ . c — seedling leaves  $\times 1$ .



suggests some previous yet limited interbreeding. At its lower limits of altitude it abuts *E. aff. dalrympleana* Maiden.

#### ETYMOLOGY

The name is derived from Greek and refers to the sessile nature of the species' buds and fruits.

#### CONSERVATION STATUS

*Eucalyptus pauciflora* ssp. *hedraia* is regarded as restricted although its numbers are locally abundant. The species does not appear to be threatened as it is secure in the Alpine National Park, even though the area is exploited for skiing. However, it is recommended that the authorities controlling the area give careful consideration to the effect of future clearing programs.

#### DISCUSSION

*Eucalyptus pauciflora* ssp. *hedraia*, being markedly waxy and possessing fruits that are appreciably large by snow gum standards, has been confused with *E. pauciflora* ssp. *debeuzevillei* Johnson & Blaxall, for example, Chippendale (1988). However, it differs from that subspecies in both bud and fruit morphology. It has shorter peduncles, ovoid, sessile buds instead of clavate, angular, pedicellate ones and has hemispherical or slightly cupular, non-angular, sessile fruits rather than cupular or subcylindrical, lightly angled, shortly pedicellate ones. The occurrence of angled buds in *E. pauciflora* ssp. *hedraia* is inconsistent and random and appears to be derived from their compaction in the early stages of development. Angled buds also have been observed in the snow gum populations of the Mt Buffalo Plateau which also have been referred to as *E. pauciflora* ssp. *debeuzevillei*. These populations differ from *E. pauciflora* ssp. *hedraia* in having pedicellate buds and elongated fruits. Their morphology appears intermediate between *E. pauciflora* ssp. *debeuzevillei* and *E. pauciflora* ssp. *niphophila*.

*Eucalyptus pauciflora* ssp. *hedraia* also has been confused with ssp. *niphophila*. However, it is distinguished from that subspecies by its larger juvenile leaves. Its adult leaves also are generally larger and duller. *E. pauciflora* ssp. *hedraia* is further different in having larger, sessile, ovoid buds and markedly larger, hemi-spherical or slightly cupular fruits.

#### ***Eucalyptus pauciflora* Sieb. ex Spreng. ssp. *parvifructa* Rule ssp. nov.**

A subspecies typica foliis juvenilibus adultisque, alabastris fructibusque parvioribus differt; a subspecie *acerina* petiolis pruinosis et foliis juvenilibus angustioribus differt; a subspecie *niphophila* alabastris et a *E. gregsoniana* glaucescens et alabastris fructibusque parvioribus differt.

**HOLOTYPE:** Near the summit of Mt William, 37°18'S, 142°36'E, Nov. 1970, R. Turner (MEL).

*Small trees and mallees*, to 5 m high rarely taller; *branchlets* semi-erect. *Bark* smooth, whitish, with limited basal debris. *Juvenile leaves* lanceolate or broadly lanceolate, alternate, petiolate, semi-erect, dull, grey-green, concolorous, acuminate or acute, to 11 × 3 cm; petioles waxy, to 10 mm long; venation sub-parallel; nodes moderately crowded. *Coppice leaves* similar to juvenile leaves. *Adult leaves* narrowly lanceolate, lanceolate or ovate-lanceolate, lustrous, green, glandular, sub-coriaceous, acuminate or acute, uncinata, semi-erect, to 10 × 2 cm; venation sub-parallel but mid-vein usually conspicuous; petioles sometimes lightly waxy, slightly angular, to 15 mm long; canopy crowded. *Inflorescences* 7 rarely 9-flowered; peduncles slender, flattened, to 8 mm long. *Buds* clavate, subsessile, lightly warty, sometimes lightly waxy, to 9 × 3.5 mm; opercula conical or hemispherical. *Fruits* hemispherical, slightly obconical or cupular, sessile or subsessile, 5–8 × 6–8 mm; disc level with rim; locules 3 (4). *Seed morphology* as in other subspecies, to 2.5 mm long. (Fig. 4)





Fig. 4. *Eucalyptus pauciflora* ssp. *parvifructa*. a — branchlet with buds  $\times 1$ . b — fruits  $\times 1$ . c — seedling leaves  $\times 0.5$ .



## FLOWERING PERIOD

Late Spring or early summer.

## OTHER SPECIMENS EXAMINED

*Victoria* — Summit of Mt William, 25 Sept. 1955, *S.Kelly* (MEL 2000855); Major Mitchell Plateau, 10 Dec. 1967, *A.C.Beauglehole 16517* (MEL 532467); Major Mitchell Plateau, 30 Oct. 1971, *J.H.Willis* (MEL 501858); Mt William Range, 20 Mar. 1975, collector unknown (MEL); the extreme southern edge of the Major Mitchell Plateau, 8 Mar. 1987, *D.Albrecht 3116* (MEL 705255); 200 m south-west of the Telecom station, Mt William, *K.Rule 9249* (MEL).

## DISTRIBUTION

*Eucalyptus pauciflora* ssp. *parvifructa* is known only from the Mt William Range, which is a linear sandstone formation in the Grampians of Western Victoria and which includes the relatively broad Major Mitchell Plateau. The populations of snow gum occur at altitudes between 900 m and 1100 m. (Fig. 2)

## CONSERVATION STATUS

Although restricted in its distribution, *E. pauciflora* ssp. *parvifructa* is locally abundant and secure within the Gariwerd (Grampians) National Park. It is most common on the southern extremity of the Major Mitchell Plateau.

## ASSOCIATED SPECIES

*Eucalyptus baxteri* (Benth.) Maiden & Blakely ex Black and *E. alpina* Lindley are associated species, neither of which are known to hybridise with *E. pauciflora* ssp. *parvifructa*.

## ETYMOLOGY

The subspecific epithet refers to the size of the fruits in relation to the typical form and is derived from Latin.

## DISCUSSION

This subspecies is clearly an altitudinal cline which shows considerable divergence from lowland populations in the region. It has smaller buds, fruits and leaves than the typical form and is always smaller in habit. Furthermore, its semi-erect, branchlets and markedly crowded nodes are features that separate the two forms.

*Eucalyptus pauciflora* ssp. *parvifructa* has been referred to as *E. pauciflora* ssp. *niphophila*. For example, Chippendale (1988) included it within that form's distribution. However, *E. pauciflora* ssp. *parvifructa* is different in having shorter peduncles, smaller, less waxy buds and fruits and narrower juvenile and adult leaves.

*Eucalyptus gregsoniana* and *E. pauciflora* ssp. *acerina* are two other small-fruited snow gums with which *E. pauciflora* ssp. *parvifructa* could be confused. From the former it is different in having observable wax on the petioles, particularly in pre-adult leaf stages (although surface wax is markedly abundant on dried adult branchlets). It is further different in having generally smaller buds, fruits and adult leaves. From *E. pauciflora* ssp. *acerina*, also a non-waxy form, it differs in having narrower juvenile and adult leaves, generally a dwarf rather than a robust habit and whitish rather than grey-green bark.

## KEY TO THE SNOW GUMS

- 1 Wax present on adult structures .....2
- 2 Branches markedly pendulous ..... *E. lacrimans*
- 2: Branches not markedly pendulous .....3



- 3 Buds sessile ..... **E. pauciflora** ssp. **hedraia**
- 3: Buds pedicellate ..... 4
- 4 Buds angular ..... **E. pauciflora** ssp. **debeuzevillei**
- 4: Buds not angular ..... 5
- 5 Longest adult leaves 12–22 cm long, relatively sparse on the axis  
..... **E. pauciflora** ssp. **pauciflora**
- 5: Longest adult leaves less than 12 cm long, crowded on the axis ..... 6
- 6 Adult leaves narrow-lanceolate, lanceolate or ovate-lanceolate, less than 2 cm  
wide ..... **E. pauciflora** ssp. **parvifructa**
- 6: Adult leaves broad-lanceolate, ovate or elliptical, wider than 2 cm  
..... **E. pauciflora** ssp. **niphophila**
- 1: Wax absent from adult structures ..... 7
- 7 Fruits 8–12 × 7–11 mm ..... **E. pauciflora** ssp. **pauciflora**
- 7: Fruits 4–7 × 5–9 mm ..... 8
- 8 Juvenile leaves with conspicuously waxy petioles  
..... **E. pauciflora** ssp. **parvifructa**
- 8: Juvenile leaves not as above ..... 9
- 9 Juvenile leaves lanceolate, with a long-tapered apex, to 12 × 2.5 cm  
..... **E. gregsoniana**
- 9: Juvenile leaves broadly lanceolate, ovate or elliptical, apex not long-tapered, to  
10 × 4 cm ..... **E. pauciflora** ssp. **acerina**

#### NOTES ON THE TAXONOMY OF THE INFORMAL SUPERSPECIES PAUCIFLORA L.D.PRYOR & L.A.S.JOHNSON

The first description of *E. pauciflora* Sieb. ex Spreng occurred in 1827. The type specimen is believed to have been collected in New South Wales relatively close to Sydney but its exact origins remain uncertain. Blakely's 1934 descriptions included two alpine species; *E. debeuzevillei* and *E. niphophila*. However, researchers such as Pryor (1957) and Green (1969) concluded that both these snow gums were high-altitudinal clines of *E. pauciflora*.

On this basis, Pryor and Johnson (1971) suggested they be reduced to subspecies within *E. pauciflora* and this was formalised by Johnson and Blaxall (1973). Later, with particular reference to these snow gums, Pryor (1976) noted, 'There is, of course, no discontinuity in morphological variation between the form described as *E. niphophila* and *E. pauciflora* and it is not biologically acceptable to separate snow gums into two species on this basis.'

These infraspecific taxa prevailed until recently when Hill and Johnson (1991), in their treatment of *E. lacrimans* Johnson & Hill, reinstated *E. niphophila* and *E. debeuzevillei* as species. However, it was extremely unfortunate that no published justification was provided for the reassessments. On that basis, and in view of the much-documented evidence provided by Pryor and others, it is preferred herein that both *E. niphophila* and *E. debeuzevillei* not be accepted as species. Furthermore, in that context, it is preferred that the taxa treated above also be accorded subspecific statuses.

To some experts, Hill and Johnson (1991) have eliminated a taxonomic anomaly which has plagued the snow gums in recent years, at the centre of which has been the much-publicised continuous variation between lowland and alpine forms. The extent of this variation is such that the extremities are sufficiently divergent that it is extremely difficult to recognise them as one species. This is particularly evident in juvenile morphology. Conversely, however, the old



anomaly surrounding the so-called 'intermediates', which Pryor and others sought to eliminate, has been resurrected.

Like Pryor's 'var. *montana*', Victoria has its share of 'intermediate' populations which occur in Central Victoria along the Great Dividing Range at medium altitudes (between 800 m and 1100 m). Such sites include Mt Buangor, Mt Macedon and Sugarloaf Peak in the Cathedral Range. In most respects these populations conform to *E. pauciflora* ssp. *pauciflora* but exhibit varying amounts of surface wax in the seedling stage and sometimes on buds and fruits. Similar populations exist in Tasmania. At higher altitudes, populations such as on Mt Matlock and Lake Mountain are somewhat closer to typical *E. pauciflora* ssp. *niphophila* in adult morphology but possess juvenile leaves consistent with the populations of lower peaks.

No doubt in the near future other botanists will accept the lure of the snow gums. Obviously a study that has a wider focus than this one is required. Such a study should re-examine the specific integrities of both *E. gregsoniana* and *E. lacrimana*. Unfortunately and inescapably, any such study will be confronted with the dilemma of how to treat the forms occupying the 'middle' altitudes. Ultimately, decisions regarding taxonomic status will depend upon the philosophical positions of the researchers or even perhaps upon the standards they wish to exercise.

Obviously, the level at which these new taxa are treated has some value, particularly to taxonomists, but of considerably more importance is the fact that their genetic diversity be recognised.

#### ACKNOWLEDGEMENTS

Sincere thanks are given to Ian Brooker of the CSIRO, Canberra, for his advice during this project and for the Latin descriptions. Special acknowledgements are given to Don Foreman of the National Herbarium of Victoria, Melbourne, for his assistance in the preparation of this manuscript and to Anita Barley and Mali Moir for their excellent line drawings. David Albrecht, formerly of MEL, is thanked for his continued support and advice, as is Don McMahon of Melbourne whose intimate knowledge of Victorian eucalypts has been invaluable. The contributions of Alf Salkin, Sheryl Thompson and Peter Maggart and Lesley Rule, all of Melbourne, have been greatly appreciated.

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<https://doi.org/10.5962/p.198483>.

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