

## Studies in Australian Epacridaceae: Changes to *Styphelia*

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### Abstract

J.M. Powell, G. Robertson, B.M. Wiecek and J.A. Scott (National Herbarium of New South Wales, Royal Botanic Gardens, Sydney, NSW, Australia 2000) 1992. *Studies in Australian Epacridaceae: Changes to Styphelia*. *Telopea* 5(1): 207–227. Two new species are described: *Styphelia psiloclada* J. Powell and *S. perileuca* J. Powell and variation within *S. laeta* and *S. viridis* studied. Two subspecies are recognised within *S. laeta* (subsp. *laeta* and subsp. *latifolia* (R. Br.) J. Powell, based on *S. latifolia* R. Br.) and var. *angustifolia* (DC.) Benth. is reinstated at species level as *S. angustifolia* DC. Within *S. viridis* two subspecies are recognised: subsp. *viridis* and subsp. *breviflora* (Benth.) J. Powell, based on *S. viridis* Andr. var. *breviflora* Benth. Notes on the nomenclature, types, distribution and ecology are given.

### Introduction

Currently in Australia the genus *Styphelia* is accepted in the strict sense, as defined by Robert Brown (1810) rather than in the wider interpretation of F. Mueller (1867, 1889). It comprises 12 endemic species (possibly 18 taxa) and is found in all States except the Northern Territory.

The genus is distinguished from other members of the tribe Styphelieae in having revolute corolla lobes, filiform filaments and well-exserted versatile anthers. All *Styphelia* species are shrubby, and all have an erect to spreading habit except *S. adscendens*, which is decumbent. The flowering shoots are auxotelic, the flowers usually solitary with a bract-like rudiment of a second, or rarely two together on a short peduncle. The corolla has a cylindrical tube, hairy inside at the throat and either glabrous or with fine tufts of hair below the middle; the lobes are linear and bearded inside with ornamented hairs. The anthers are free, linear, attached at their midpoint to the filiform filaments that are inserted in the throat. The ovary is five-locular, the style filiform and longer than the corolla tube, the stigma small, lobed; the nectary is annular or in distinct scales. The mesocarp of the fruit can be dry or fleshy, the endocarp always hard and bony.

Bentham (1869) distinguished two sections within the genus on the basis of corolla hair distribution, namely *Eustyphelia* (equivalent to section *Styphelia*), having the corolla-tube with five dense tufts of hair below the middle, sometimes confluent in a ring, and *Soleniscia*, with the corolla-tube glabrous inside except for a few hairs in the throat. In New South Wales nine taxa within six species were described by Bentham (1869), all belonging to section *Styphelia*.

Study of collections held at the National Herbarium of New South Wales undertaken while preparing a treatment for the Flora of New South Wales indicated the presence of two new species and that re-assessment of the status of taxa within *Styphelia laeta* and *S. viridis* was needed.

## Methods

Characters traditionally used in distinguishing taxa within *Styphelia* include leaf shape, surface flatness, leaf margin type and to a lesser extent leaf colour, apex shape, branch hairiness and habit and flower position. These characters were studied together with others, found also to be of value in distinguishing some taxa: leaf size, ratio of leaf length: width, leaf base shape, petiole length, numbers of flowers per inflorescence, bracteole and sepal size, sepal apex shape, corolla tube and lobe length, and the length of the anther and filament. Scanning electron microscopy of branchlet and leaf surfaces, of leaf margins and apices, and of corolla hairs and pollen was also used to provide additional and more detailed information.

In studying variation within each of *S. laeta* and *S. viridis* respectively, ranges of qualitative and quantitative attributes were tabulated, and polygonal graphs of the main discriminatory attributes drawn for the *S. laeta* taxa, to provide a preliminary assessment of the overall similarity of the taxa within each species.

Additionally, the main quantitative attributes were examined using the PATN package (pattern analysis, Belbin 1989a, b). A hierarchical classification was produced using the Gower Metric association measure together with UPGMA (FUSE program). The Gower Metric association measure was chosen as the most appropriate for continuous taxonomic data as it has the advantage of range standardization. The groupings displayed in the dendrogram (DEND) were defined using the group definition program GDEF and the attributes most responsible for forming the groups were determined using the GSTA program.

Ordination of the data was carried out using the SSH multidimensional scaling on the Gower metric association matrix and displayed as a scatter diagram (SCAT program). The principal correlation axes were derived using the PCC routine. These indicate how well the attributes relate to the ordination.

## Results and Discussion

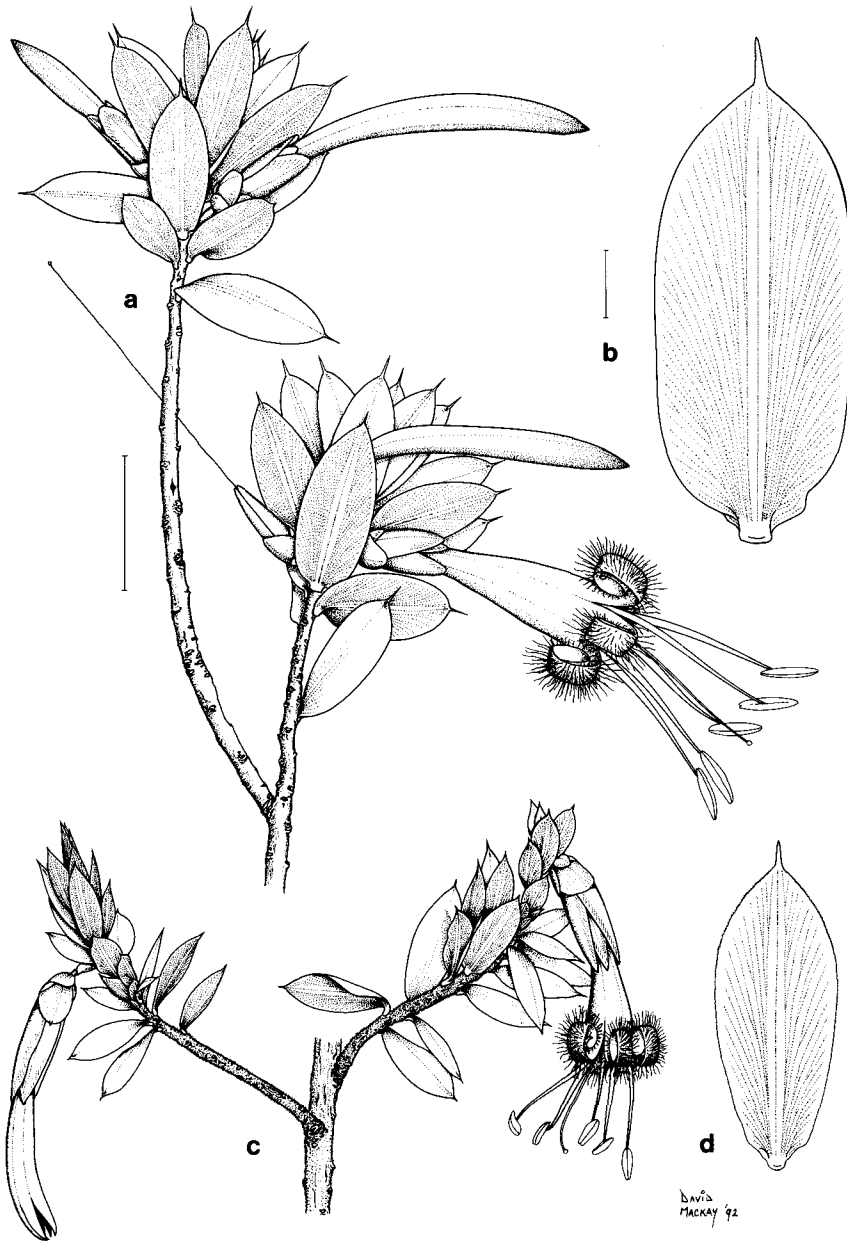
### The new species

Specimens of the two new species had been included in *S. triflora*, or in *S. viridis*, since some of their leaf and floral characters are similar to one or other of these taxa, or intermediate between them. The main characters separating the two new species from *S. triflora* and *S. viridis* are given in Table 1.

*S. psiloclada* is similar to *S. triflora* in having glabrous branchlets and the leaf margins entire; the corollas and anthers of the two species are also of similar size. It differs, however, in leaf shape (being more like *S. viridis*), and in having shorter petioles and sepals. *S. perileuca*, on the other hand, is more distinct. The branchlet indumentum is of stiff hairs rather than soft (as in *S. viridis*), and the leaves are shorter than in either *S. triflora* or *S. viridis*. The flower colour may parallel some *S. triflora* populations but in flower size *S. perileuca* is at the lower end of the range of *S. triflora*. The leaves of both new species are convex adaxially while in *S. triflora* the leaves are usually concave adaxially. The habitats and distributions of the two new species as currently known also differ from *S. triflora* but, as the latter is the most widespread and variable species within *Styphelia*, further study of its populations is warranted. The new taxa are being recognised at the species level as they are morphologically distinct in a number of attributes or in the combination of attributes shown.

**Table 1.** Comparison of attributes of *S. triflora* and *S. viridis* with the two new taxa

Character	<i>S. triflora</i>	<i>S. viridis</i>	<i>S. psiloclada</i>	<i>S. perileuca</i>
Branchlet indumentum	glabrous	puberulent	glabrous	scabrous to hispid
Leaf shape	elliptic to oblong-elliptic	oblong to oblong-obovate or oblong-elliptic	oblong	broad-elliptic or oblong-elliptic
Leaf-blade length (mm)	14–33	14.8–25.6	8.3–17.4	6.2–11.8
Leaf-blade width (mm)	3–8.3	2.9–7.2	3.9–7.5	2.9–4.9
Leaf apex	acute	more or less obtuse	more or less obtuse	acute
Leaf base	cuneate	obtuse or $\pm$ cuneate	obtuse	$\pm$ cuneate
Leaf indumentum	glabrous	glabrous	scabrous above	glabrous
Leaf margin	entire	denticulate-ciliolate	entire	denticulate-serrulate, hyaline
Lamina in T.S.	flat to concave	flat	flat to convex	slightly convex
Petiole length (mm)	2–4	1–2	0.3–1	0.5–1
Flower position	spreading to pendant	suberect to spreading	spreading to pendant	pendant
Flower no./inflorescence	1–3	1	1–2	1
Flower colour	pink to red, cream or pale yellow-green	translucent green	pink with fine red stripes	translucent yellow-green
Peduncle indumentum	glabrous	pubescent	scabrous	scabrous
Sepal length (mm)	8.2–13.4	12.7–16	5.5–6.6	8.7–10
Sepal apex	$\pm$ obtuse	acute to broadly so	obtuse	$\pm$ obtuse
Sepal indumentum	glabrous	glabrous to puberulent near apex	glabrous	glabrous
Corolla-tube length (mm)	13–29.4	17–23	13.4–18.1	12–13.8
Corolla-lobe length (mm)	12.5–18	19–21	16.1–17.9	11.9–14.3
Anther length (mm)	3–5	5.9–6.3	3.7–4.8	2.4–3
Filament length (mm)	9–17.2	12–16	12.5–15.5	10.5–11.3



**Figure 1.** *S. psiloclada* J. Powell. **a**, habit; **b**, leaf detail (type specimen). *S. perileuca* J. Powell. **c**, habit; **d**, leaf detail (type specimen). Scale for habit = 1 cm; scale for leaf = 2 mm.

***S. psiloclada* J. Powell, sp. nov.**

A *S. triflora* foliis venetis brevibus late oblongis aliquantum convexis, apicibus foliorum subobtusatis atque floribus parvulis differt; a *S. viridi* ramulis glabris et floribus roseis vel carmesinis differt.

TYPE: NEW SOUTH WALES: South Coast: Wadbilliga National Park, near Green Hole, N of Green Creek, c. 12 km ENE of Kydra, 36°25'45"S, 149°31'12"E, 1130 m alt., *P. Beesley* 349 & *D. Binns*, 27 Mar 1985 (holo CBG8502565, iso NSW, MEL; Figure 1a, b).

Erect to spreading shrub, 60–150 cm high; *stems* grey-brown, rounded, glabrous, with pale brown bark, rough and corky towards the base; *branchlets* brown or red-brown, slightly ribbed, glabrous. *Leaves* bluish or greyish green, evenly spaced, suberect to horizontally spreading, non-imbricate, spiral, oblong, rarely broadly ovate or more elliptic, 8.3–17.4 mm long, 3.9–7.5 mm wide (length:width ratio 1.9–2.8:1); apex broadly acute or obtuse, with an aristate tip 0.7–1.7 mm long; base obtuse; lamina flat to slightly convex and glabrous adaxially, discolorous, paler and papillose-scabrid abaxially; venation inconspicuous above, striate below with 3–5 central veins and many branches to the margin; margin very slightly recurved, entire but irregular, almost undulate towards the apex; *petiole* poorly developed to c. 1 mm long. Young seasonal growth leaves are shorter, broader, elliptic or obovate, the margin hyaline and minutely fringed overall. *Flowers* solitary or sometimes two together in the upper leaf axils, spreading to pendant, light pink or darker pinkish crimson outside, paler inside; *peduncles* 1.5–2 mm long, hispid, with a bract-like rudiment above the flower (when solitary) and 3–4 sterile bracts at the base. *Bracts* and *bracteoles* broadly ovate, subobtusate or obtuse, glabrous except for the ciliolate margins; bracts 1–1.9 mm long, 1.5–2.1 mm wide; bracteoles 2.6–3.2 mm long, 2.3–3.4 mm wide. *Sepals* tinged red, ovate, 5.5–6.6 mm long, 3–3.3 mm wide, obtuse, glabrous except for the ciliolate margins. *Corolla tube* exceeding sepals, cylindrical, 13.4–18.1 mm long, 4.6–4.9 mm wide, glabrous outside, sparsely pubescent inside and with a ring of hairs towards the base; *lobes* erect at the base, revolute above, 16.1–17.9 mm long, 2.1–2.5 mm wide, glabrous outside, inside sparsely hairy with the hairs longer over the upper half. *Anthers* fully exerted, 3.7–4.8 mm long, attached above the midpoint to the filament; filaments 12.5–15.5 mm long, glabrous. *Ovary* ovoid, 4–5 mm long, 3–4.2 mm wide, ridged, 5-locular, glabrous; style filiform, 27.5–35.3 mm long, glabrous; *nectary* annular but readily breaking apart into scales, 1–1.2 mm high, with lobed upper margin. *Fruit* not seen.

DERIVATION OF EPITHET: From the Greek *psilos*, bare or smooth and *clada*, branches, reflecting the lack of hairs on the stems and branches.

FLOWERING PERIOD: Flowers January to March.

HABITAT: Recorded as rare or occasional in open forests dominated by *Eucalyptus fastigata* – *E. radiata*, *E. fraxinoides* or *E. pauciflora* – *E. kybeanensis*, on rocky ridges, steep slopes and broad gullies with well- to poorly-drained skeletal sandy soils or sandy loams over granite or other igneous rocks at 900–1300 m altitude.

DISTRIBUTION: Known only from a few locations in the South Coast and Southern Tableland areas of New South Wales: the Northern Budawang Range and further south in Wadbilliga and Nalbaugh National Parks (Figure 2).

CONSERVATION STATUS: Listed in Briggs & Leigh (1988) as *Styphelia* sp.1 and coded as 3RC. While it is conserved in some southern New South Wales National Parks little is known of its abundance or overall distribution.

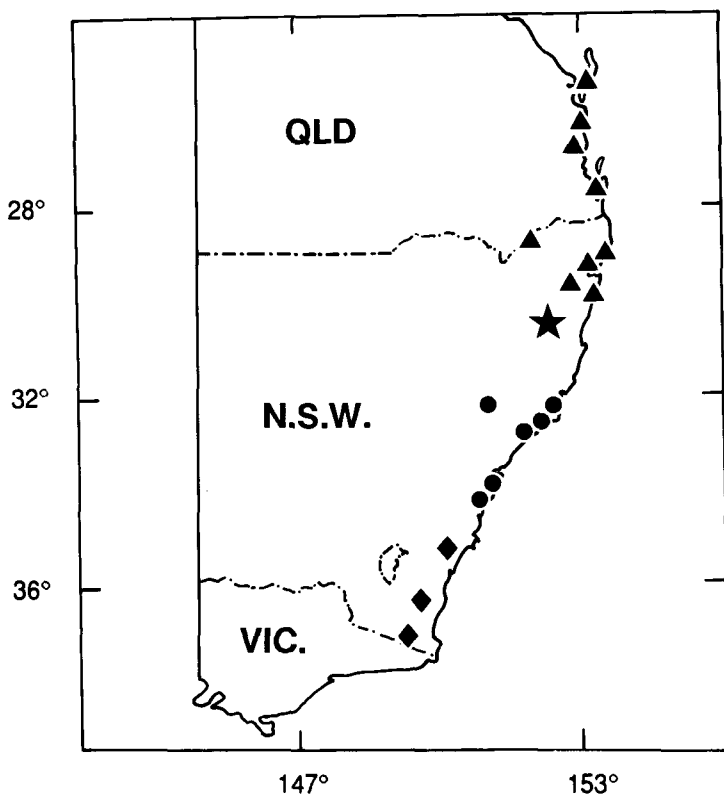
NOTES: The species belongs in section *Styphelia*. The pollen is periporate, scabrate and 'warty' as typical of other species within that section. The corolla hairs are unicellular, twisted and ornamented with short linear tubercles (Figure 3).

SPECIMENS EXAMINED: NEW SOUTH WALES: South Coast: Nalbaugh National Park, 1 km NW of Wog Wog Mt trig, *Albrecht* 3058, 21 Feb 1987 (MEL, NSW); ridge between White Rock and Wog Wog Mountains, *Gilmour* 6169, 21 Feb 1987 (CBG, NSW). Southern Tablelands: Wadbilliga National Park, Wadbilliga Fire Trail, c. 1 km E of Bunberry Ck crossing, *Gilmour*, 8 Mar 1983 (CBG 8313471, NSW); Wadbilliga Track near Tuross River, *Hamilton*, 28 Jan 1985 (CBG 8500846); Bulea Brook, Northern Budawang Range, *Olsen* 2459, Jan 1975 (NSW); c. 0.5 km S of Razorback Fire Trail, 14.6 km from junction with New England Fire Trail, *Rodd* 6170, *Kennedy & Whitehead*, 25 Jan 1991 (NSW, MEL).

***Styphelia perileuca* J. Powell, sp. nov.**

A *S. triflora* ramulis hispidulis, foliis brevibus aliquantum convexis, marginibus foliorum denticulato-serrulatis et albidis vel hyalinis atque floribus parvulis differt.

TYPE: NEW SOUTH WALES: Northern Tablelands: Ebor to Guyra road, 5.3 km NW of Armidale road turnoff, *J.M. Powell* 4500, 3 Sep 1987 (holo NSW, iso BRI, MEL, K; Figure 1c,d).



**Figure 2.** Distribution of *S. psiloclada* (◆), *S. perileuca* (★) and *S. viridis* subsp. *viridis* (●) and subsp. *breviflora* (▲).

Erect to spreading shrub 0.6–1.5–(3.3) m high and 1.0–3.6 m across; *stems* branching from the base, thin, grey-brown, rounded, glabrous, with tessellated bark; *branchlets* red-brown, slightly ribbed, scabrous to hispid. *Leaves* evenly spaced, suberect to horizontally spreading, non-imbricate, spiral, broadly elliptic or oblong-elliptic and sometimes obovate, 6.2–11.8 mm long, 2.9–4.9 mm wide (length:width ratio = 3–3.3:1); apex acute, straight, with an aristate tip 0.5–0.8 mm long; base narrowing; lamina thick, slightly convex adaxially, concolorous or slightly paler below, the upper surface glabrous or hispidulous towards the base, the lower glabrous; venation inconspicuous above, finely multiveined below, with three central parallel veins and many branches to the margin; margin slightly recurved, denticulate-serrulate and densely so towards the apex, usually white or hyaline; *petiole* ill-defined, yellowish, 0.5–1 mm long, scabrous above. Young seasonal growth leaves are shorter, broader, obovate and flatter, the margins straight rather than recurved, hyaline and minutely fringed with hairs. *Flowers* solitary in the upper leaf axils, pendant, translucent yellow-green with fine red stripes or pale green; *peduncles* 3.5–5 mm long, hispid, with a bract-like rudiment above the flower and 4–5 sterile bracts at the base. *Bracts* and *bracteoles* broadly ovate to sub-orbicular, obtuse, apiculate, striate-veined and with the midrib thickened towards the apex, glabrous except for the ciliate margins; bracts 1.6–2 mm long, 2.1–2.6 mm wide; bracteoles 3.1–4.5 mm long, 3.2–6 mm wide. *Sepals* often reddish with the margins green, ovate, 8.7–10 mm long, 3.3–3.9 mm wide, sub-obtuse or obtuse, apiculate, glabrous except for the ciliate to ciliate margins. *Corolla tube* exceeding the sepals, cylindrical, 12–13.8 mm long, 3.4–5.3 mm wide, glabrous externally, sparsely pubescent inside with a ring of hairs near the base; *lobes* erect at the base, revolute above, 11.9–14.3 mm long, 1.6–2.6 mm wide, acute, glabrous outside, inside sparsely hairy on the lower half, the hairs becoming denser towards the apex. *Anthers* 2.4–3 mm long, fully exerted, attached at or above the midpoint to the filament; filaments 10.5–11.3 mm, glabrous. *Ovary* ovoid 5–6 mm long, 2–3.5 mm wide, ridged, 5-locular; style filiform, 22–23 mm long; *nectary* annular, 1.4–1.6 mm high, with irregularly lobed upper margin. *Fruit* just exceeding the sepals, 8–11 mm high, 4–7 mm wide, 5-ridged, somewhat fleshy, translucent yellow-green.

**DERIVATION OF EPITHET:** From the Greek *peri*, all round and *leukos*, white, referring to the white margin of the leaves.

**FLOWERING PERIOD:** Flowers and young fruit recorded mainly in September, December and January, with single records of buds and flowers in March and April respectively.

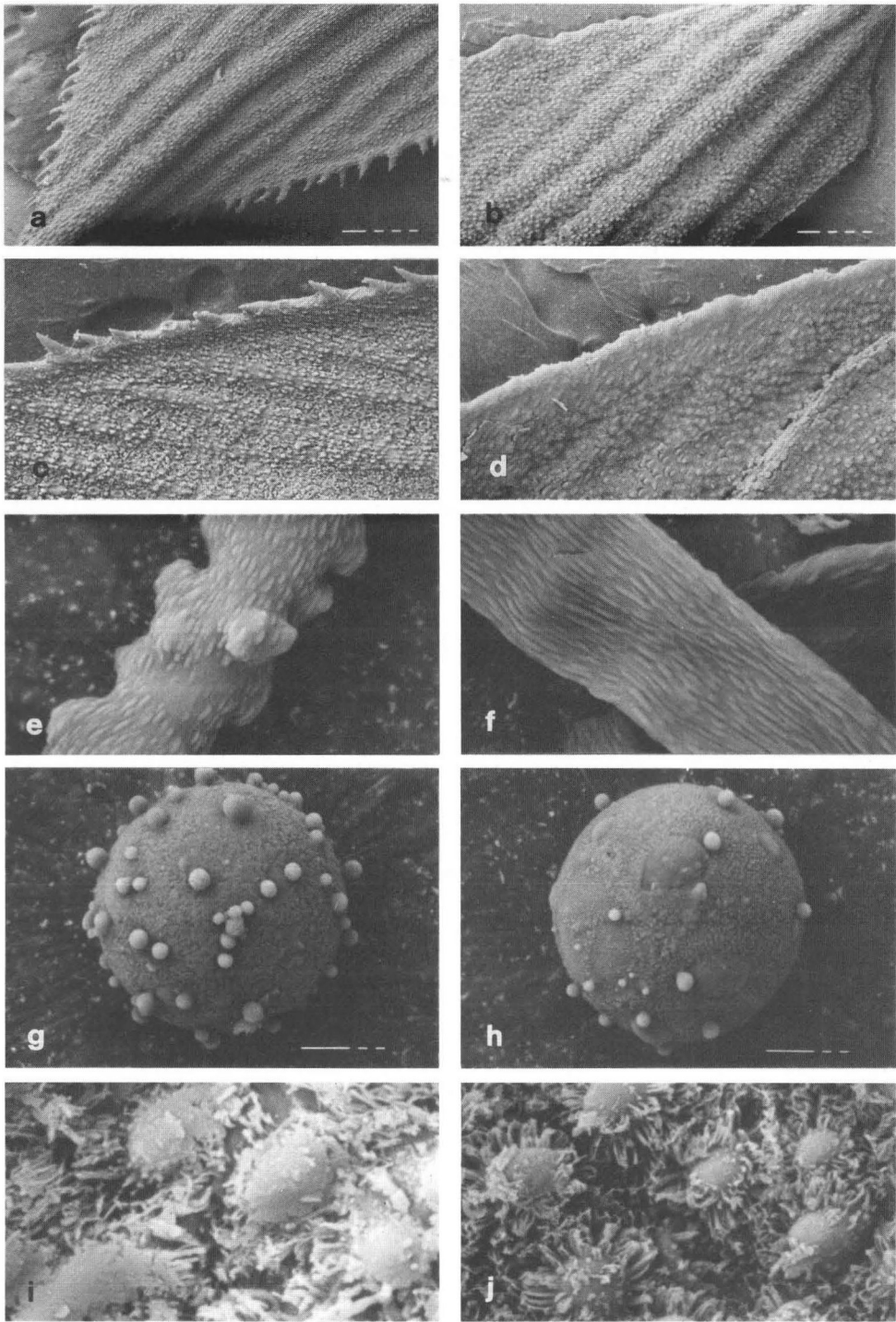
**HABITAT:** Recorded as locally occasional in open eucalypt forests (associated with *E. dalrympleana*, *E. youmanii*, *E. radiata*) on broad ridges and gentle slopes at 1250–1500 m altitude, growing in sandy soils or light brown sandy loams over granite, and one record from heath on trachyte (J.B. Williams, pers. comm.).

**DISTRIBUTION:** Known only from the Snowy Mountain Range and Round Mountain on the Northern Tablelands of New South Wales (Figure 2), and one record from the Lyrebird Track, New England National Park (J.B. Williams, pers. comm.).

**CONSERVATION STATUS:** This species can be classified as 2VC following Briggs & Leigh (1988). It is known to be conserved within Cathedral Rock National Park, but its overall abundance there is low – it is locally common over only 2–3 square kilometres and absent from all other areas visited within that park and from nearby granite areas (J.B. Williams, pers. comm.).

**NOTES:** The species belongs to section *Styphelia*. The pollen is periporate, scabrate and sparsely 'warty', the corolla hairs unicellular, twisted and ornamented with short linear tubercles (Figure 3). It was collected in December 1893 by J.H. Maiden and labelled as *S. viridis* var. *breviflora* on the sheet, but he noted in his report (Maiden





**Figure 3.** Scanning electron micrographs of the leaf apex, leaf margin, corolla hairs, pollen and lower leaf surface of *S. perileuca* (a,c,e,g,i) and *S. psiloclada* (b,d,f,h,j). a,b, leaf apex x 30; c,d, mid-leaf margin x 60; e,f, corolla hair x 900; g,h, pollen x 600; i,j, lower leaf surface x 1200 *S. perileuca*, x 900 *S. psiloclada*.



1895) '*Styphelia viridis*, Andr. var., *breviflora*, Benth. — Guy Fawkes to Round Mountain (on the very summit). — It is not likely that Bentham's "northern parts of New South Wales" includes this sub-alpine locality in which I found it.' The species was collected again in 1968 by H. Wissman and recognised as a distinct taxon by Wissman and J.B. Williams in April 1970, with specimens in the herbarium at the University of New England (NE) being annotated as such.

SPECIMENS EXAMINED: NEW SOUTH WALES: Northern Tablelands: Round Mountain, Snowy Range, Ebor-Armidale, *Burgess*, 26 Sep 1972 (NSW 245925); Guy Fawkes and Round Mountain, *Maiden*, Dec 1893 (NSW 245929); Ebor - Guyra road, 5.3 km NW from Armidale Road turnoff, *Powell* 4505, 3 Sep 1987 (NSW, CANB, MEL); Snowy Mountain Range, track to Woolpack Rocks, 5 km NNE of Round Mountain, *Telford* 10417, 27 Sep 1987 (CBG, BRI, MEL, NSW); Cathedral Rock National Park, c. 2 km N of Cathedral Rock, *Telford* 10783, 2 Jan 1989 (CBG, NSW); 10 miles [16 km] WSW of Ebor and 1 mile [1.6 km] NW of Round Mountain, *Williams*, 26 Sep 1972 (NE 045342); Hill 0.5 km N of Round Mountain, c. 12 km W of Ebor, *Williams*, 14 Mar 1970 (NE 037390); near Snowy Creek, Ebor, *Williams & Wissman*, 21 Oct 1969 (NE 022139); *Wissman*, Apr 1968 (NE 022138).

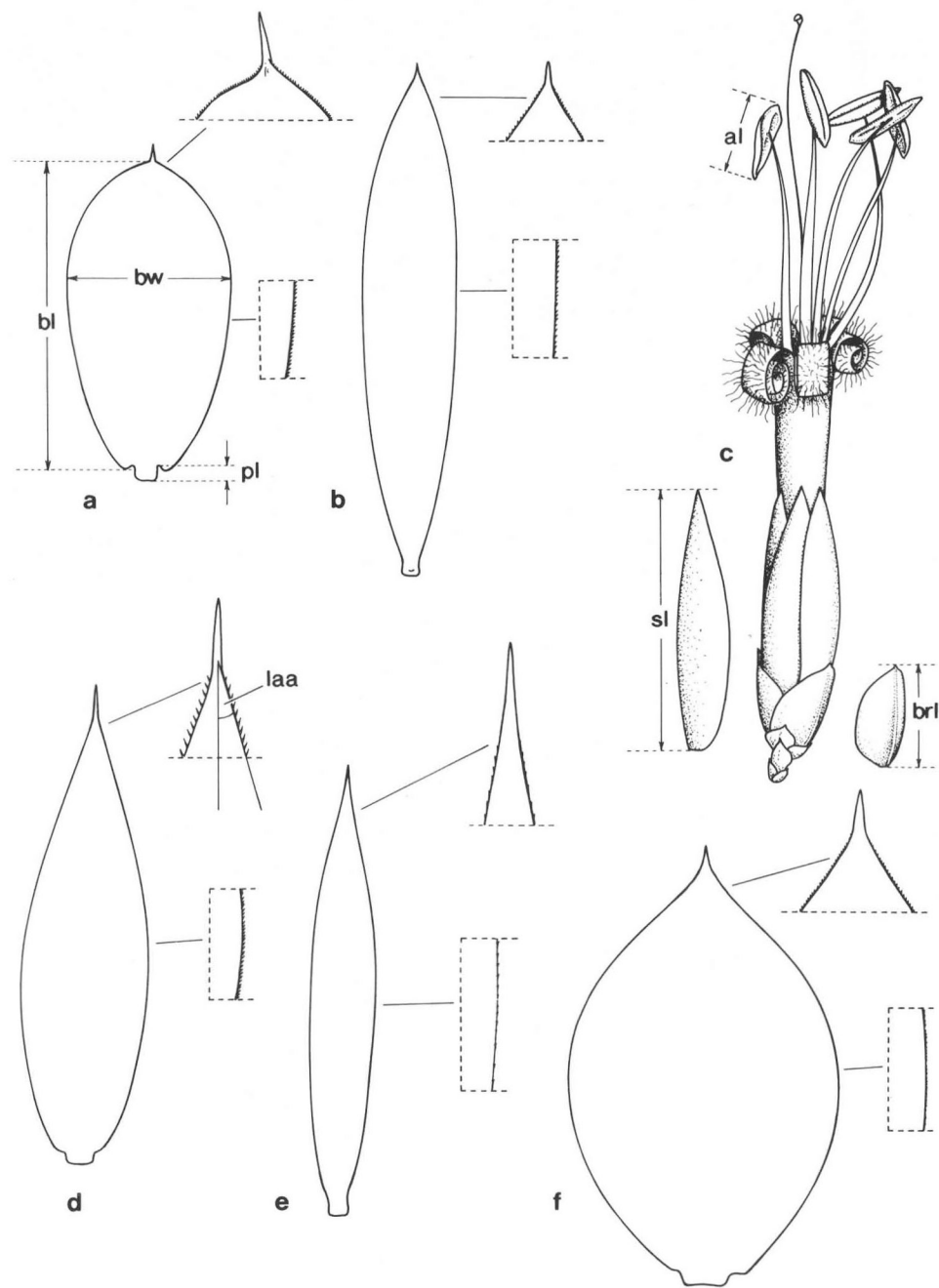
### Variation within *Styphelia laeta* R. Br.

Bentham's (1869) treatment of *Styphelia laeta* as a species with three varieties has been generally accepted, but the two infraspecific taxa, var. *latifolia* (R. Br.) Benth. and var. *angustifolia* (DC.) Benth., were originally considered to be of specific rank and described as such by R. Brown (1810) and de Candolle (1839) respectively. The characters used to distinguish the taxa included leaf shape, surface flatness, and leaf margin type. Descriptions of some of the taxa included also leaf colour, leaf apex, branch hairiness, habit and flower position.

Many of these characters, together with leaf-base shape, sepal-apex shape and measurements of leaf-blade length and width, petiole length, bracteole and sepal length and hairiness, and anther and filament lengths (Figure 4) formed the basis for our reassessment of the variation within the species in the broad sense. Three specimens from Brisbane Water National Park included in *S. laeta* var. *laeta* appeared somewhat distinct in a number of attributes and were treated as a separate entity. The above characters were tabulated (Table 2). The qualitative attributes of importance in separating the taxa are branchlet indumentum and the leaf margin structure (Figures 5, 6), the adaxial leaf surface and the shape of the leaf apex and base. Discontinuities were present also in a number of the quantitative attributes. A preliminary assessment of the overall similarity of the taxa and a polygonal graph of the best discriminatory attributes suggested that *S. laeta* var. *angustifolia* was more distinct from both *S. laeta* var. *laeta* and *S. laeta* var. *latifolia* than they were from each other, and could warrant specific rank.

These observations were examined using PATN (Belbin 1989a, b). The data set consisted of the measurements of leaf-blade length, leaf-blade width, petiole length, sepal length, bracteole length and the angle subtended by the leaf apex (Figure 4) from 35 specimens.

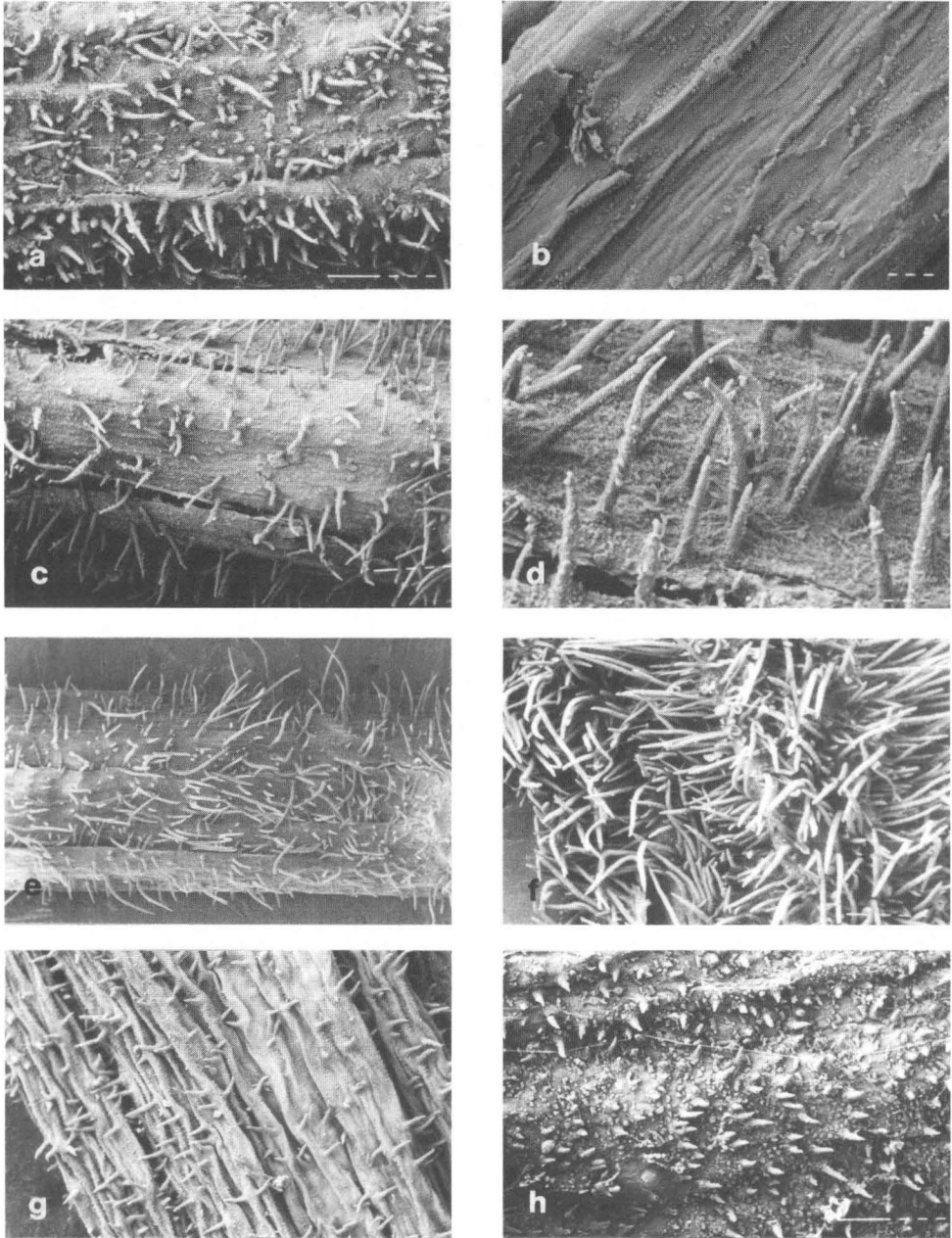
The classification analysis indicated four groupings. The group 'statistics' (GSTA) showed that leaf-blade width separated the var. *angustifolia* taxon completely from the other three groups and var. *latifolia* from the other two groups. The leaf-apex angle and bracteole length both partly separated the groups although the ranges overlapped. Sepal length and blade length separated the Brisbane Water taxon from the other three groups. The ordination confirmed the presence of four groups and the distinctiveness of both the var. *angustifolia* and the Brisbane Water specimens.



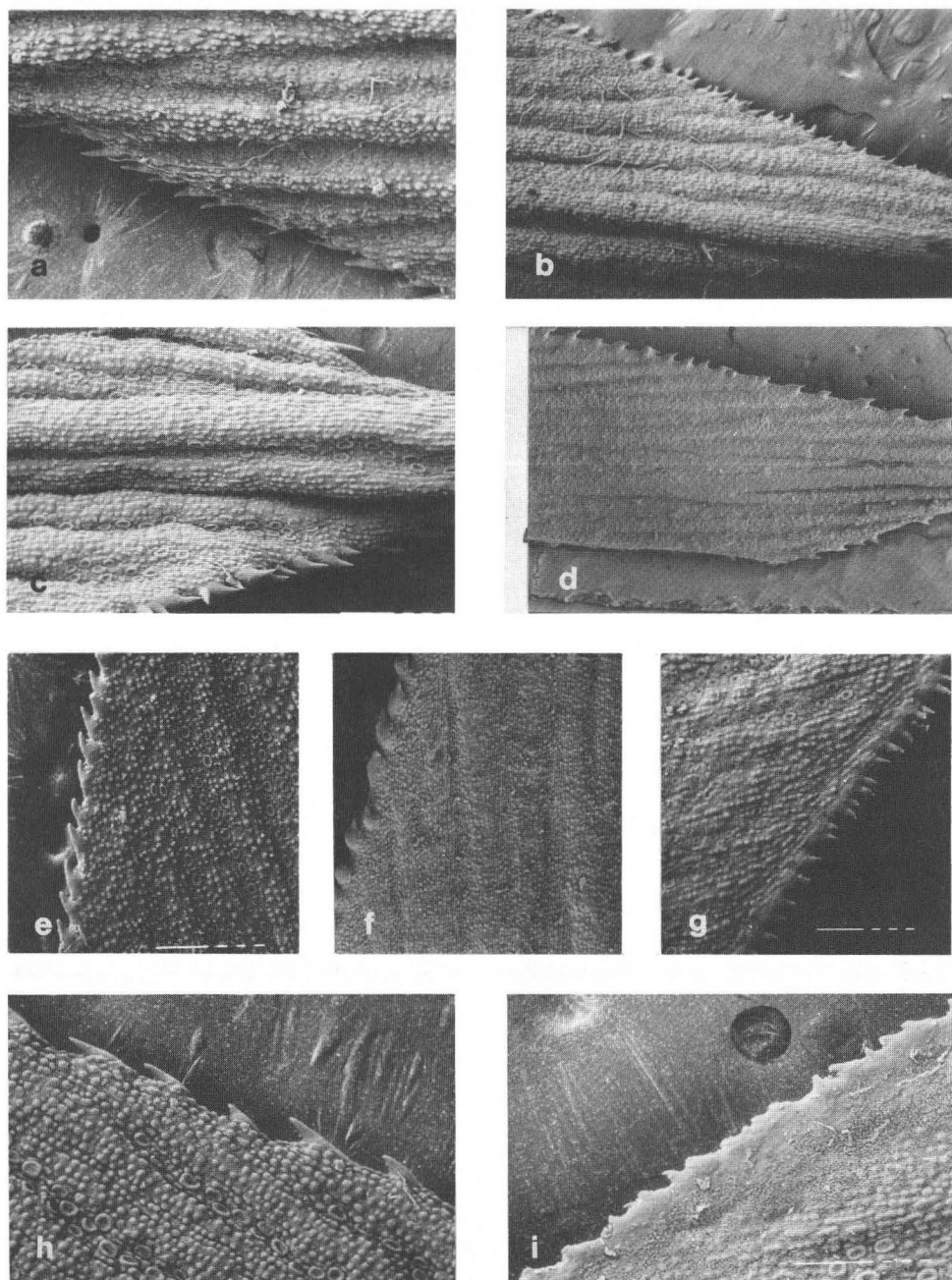
**Figure 4.** Attributes of *Styphelia* studied and measured. **a**, *S. viridis* subsp. *viridis*; **b,c**, *S. viridis* subsp. *breviflora*; **d**, *S. laeta* subsp. *laeta*; **e**, *S. angustifolia*; **f**, *S. laeta* subsp. *latifolia*; bl: blade length; bw: blade width; pl: petiole length. al: anther length; sl: sepal length; brl: bracteole length; laa: leaf apex angle.

**Table 2.** Comparison of attributes of taxa within *Styphelia laeta*

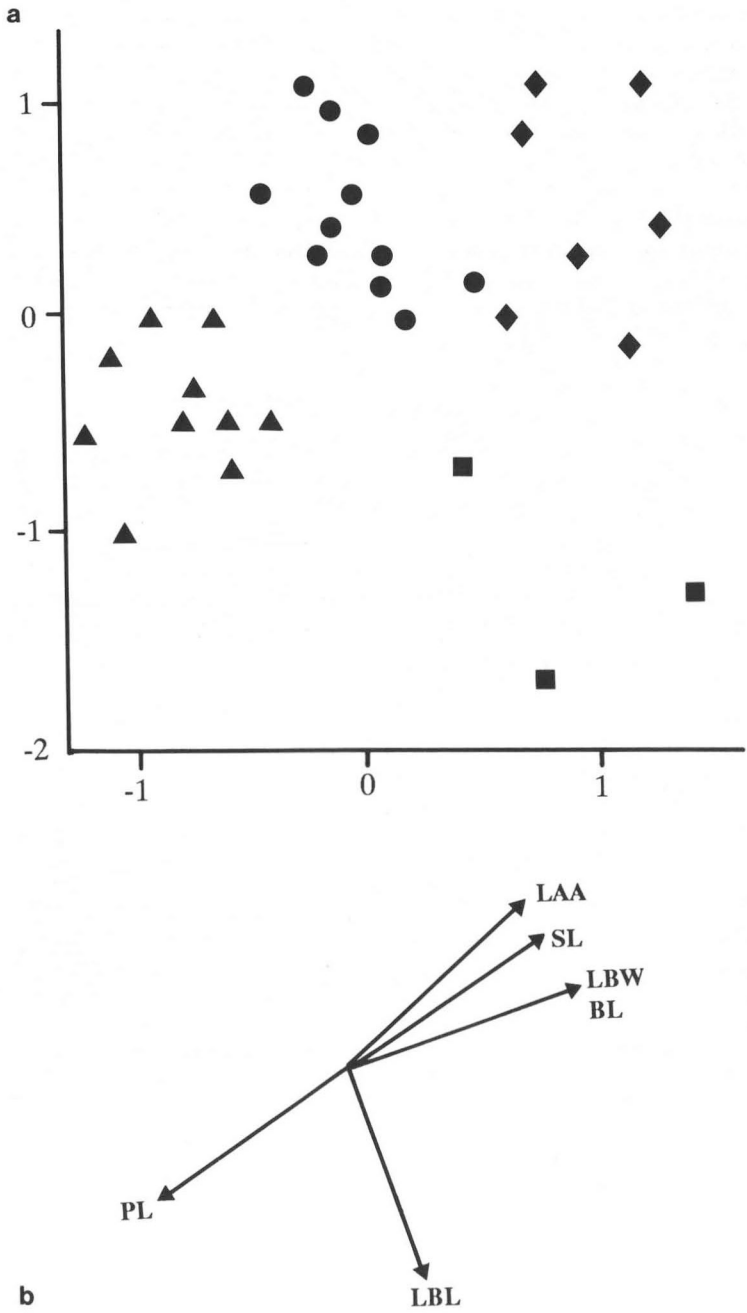
Character	<i>var. laeta</i>	<i>var. laeta</i> (Brisbane Water)	<i>var. latifolia</i>	<i>var. angustifolia</i>
Branchlet indumentum	sparsely velutinous	velutinous	woolly	densely velutinous
Leaf shape	elliptic to ovate-elliptic	narrowly ovate-elliptic	ovate	elliptic
Leaf margin	denticulate-ciliolate	ciliolate	fine-ciliolate	sparsely denticulate-serrulate
No. teeth/mm margin	9–17 (–34)	10–24	22–35	3.6–7.8
mean	14.8	15.2	27.2	5.1
Leaf-blade length (mm)	17.4–24.3	27.9–31	15.8–24.8	18.9–25.1
Leaf-blade width (mm)	5.0–7.2	6.5–7.5	8.8–11.3	2.7–4.5
Leaf length:width ratio	2.5–3.8	4–4.3	1.6–2.4	3.8–8.3
Leaf apex	acute-acuminate	acuminate	cuspidate-acute	narrow-acute
Leaf-apex angle	32–48	21–37	45–75	14–27
Leaf indumentum adaxial surface	scabridulous	hispidulous or tuberculate	tuberculate	scabrous at midline
Leaf base	truncate	truncate	truncate	± cuneate
Petiole length (mm)	0.5–1	0.5–1.2	0.5–1.2	0.5–2
Bracteole length (mm)	2.3–4	4.2–6.5	4–5	3–4
Sepal length (mm)	8.5–10.5	12.3–15.5	10–12.5	8.5–11.5
Sepal apex	acute-obtuse	acute	acute	acute-obtuse
Sepal margin	ciliate	ciliolate	ciliate overall or towards apex	±glabrous or very sparse-ciliolate
Sepal indumentum	glabrous to pubescent	pubescent	glabrous or antrorse pubescence at apex	glabrous, tip pubescent



**Figure 5.** Scanning electron micrographs of branchlets hairs of *Styphelia*. **a**, *S. perileuca*  $\times 60$ ; **b**, *S. psiloclada*  $\times 120$ ; **c,d**, *S. laeta* subsp. *laeta*  $\times 30$ ,  $\times 150$ ; **e**, *S. angustifolia*  $\times 30$ ; **f**, *S. laeta* subsp. *latifolia*  $\times 30$ ; **g**, *S. viridis* subsp. *breviflora*  $\times 60$ ; **h**, *S. viridis* subsp. *viridis*  $\times 60$ .



**Figure 6.** Scanning electron micrographs of the leaf apex margin (a–d) and mid-leaf margin (e–i) of *S. laeta* subsp. *laeta* (a x 60, e x 60); *S. laeta* subsp. *latifolia* (b x 30, g x 60); *S. viridis* subsp. *breviflora* (c x 60, h x 60); *S. angustifolia* (d x 30, f x 60) and *S. viridis* subsp. *viridis* (i x 60).



**Figure 7.** Morphometric analysis of *Syphelia laeta*. **a**, scatter diagram of ordination of *S. laeta* and *S. angustifolia* specimens. *S. laeta* subsp. *laeta* (●), Brisbane Water National Park specimens (■), *S. laeta* subsp. *latifolia* (◆), *S. angustifolia* (▲); **b**, vectors showing direction of maximum linear correlation between each of the six attributes and the ordination space. LBL: leaf-blade length; LAA: leaf-apex angle; LBW: leaf-blade width; BL: bracteole length; SL: sepal length; PL: petiole length. Note that the vectors for leaf-blade width and bracteole length have the same direction.

The groups resulting from the analyses (Figure 7) correspond well to the taxa defined previously and support our earlier conclusions based on both qualitative and quantitative measures. We consider that var. *angustifolia* warrants specific rank (because of its distinct morphology and distribution), but var. *laeta* and var. *latifolia* should be treated as subspecies; they have a number of morphological attributes that show overlapping ranges, but appear to be ecologically, if not geographically distinct. The Brisbane Water specimens differ from the other material studied in leaf-blade length, sepal length, in the adaxial leaf surface sometimes being hispidulous (two specimens out of three) and the margin ciliate rather than denticulate-ciliate; they appear to represent a new taxon, but further material is needed for study before their status can be determined. Because of recent devastating fires in the area it has not been possible to obtain further collections.

### Ecological notes

The *S. laeta* subspecies are probably parapatric if not sympatric, while *S. angustifolia* is parapatric or allopatric with them. *S. laeta* subsp. *laeta* is found in the Sydney region and the lower Blue Mountains (Central Coast and Central Tablelands), growing in the understorey of open dry sclerophyll forest on sandstone. It flowers between February and August but mainly in March and May. Its conservation status is 2RC; it is conserved in Brisbane Water National Park and Yengo National Park and has been recorded recently from the Cumberland Plain Woodlands and Castlereagh Woodlands as well as Hawkesbury Sandstone areas (Benson & McDougall 1991). *S. laeta* subsp. *latifolia* is found north of the Hawkesbury River from Mt White north to Ourimbah and west to Kulnura (Central Coast), and has been recorded also from the North Western Slopes at Warialda. It grows in open sites in mixed shrublands, on the margins of low open eucalypt woodland or swamps and appears to be tolerant of some disturbance. It flowers between March and June. Its conservation status is 3RC; in the Mt White to Kulnura area it is locally common but vulnerable as it often grows on the road margins; it is conserved in the Brisbane Water National Park.

*Styphelia angustifolia* is found at lower elevations in the Blue Mountains (CC) and has been collected also from Pigeon House Range in the Southern Tablelands and from Warialda (North Western Slopes). It is found in open rocky areas in open sclerophyll forest. Flowers are recorded in July, August, November and December, with fruit recorded in April, May and August. Its conservation status is 3V?C; the lack of recent collections suggest that the species is now rare; it is possibly conserved in Morton National Park.

The single specimen records from Warialda for *S. laeta* subsp. *latifolia* and for *S. angustifolia* require field investigation as they indicate a very considerable disjunction in the distribution range of each taxon.

### Nomenclatural notes

*S. laeta* R. Br.

(Brown 1810: 537).

TYPE CITATION: '(J.) v.v.'

LECTOTYPE (here designated): NEW SOUTH WALES: in sylvis prope Parramatta versus Sydney, R. Brown (Bennett No. 2395), desc 23 May 1802, '*Styphelia glauca* Nob' (BM); isolectotype NSW. The typed label of the lectotype has the date of the collection as 19 May 1802. The date of 23 May 1802 in Brown's hand refers to the description, as 'desc' precedes the date. Another sheet at BM has 'Port Jackson' in Brown's hand.



Two subspecies are recognised:

**S. laeta** R. Br. subsp. *laeta*

TYPE: as cited above.

ILLEGITIMATE NAME: *S. laeta* R. Br. var. *typica* Domin (Domin 1928: 1050); this is the type variety, *S. laeta* R. Br. var. *laeta*.

SELECTED SPECIMENS EXAMINED: NEW SOUTH WALES: Central Coast: Londonderry Road near Rickaby Creek, *Burgess*, 4 Dec 1962 (NSW 143347); Blakehurst, *Camfield*, Apr 1893 (NSW 246705); Dural, *Debenham*, Apr 1959 (NSW 246702); Brisbane Water National Park, *Fallding & Benson*, 3 May 1979 (NSW 246699); Warrah to Patonga track, *Fallding & Benson*, 23 May 1979 (NSW 246701); Revesby to Georges River, *Foster*, 9 Apr 1956 (NSW 36659); Mellong Range, 1 mile [1.6 km] N of Grassy Hill, *Johnson*, 9 Apr 1953 (NSW 23446); Yerrinbool, *Johnson* 15 Apr 1951 (NSW 143344); Bucketty, 12 miles [c. 19 km] by road north west from Kulnura, *McGillivray* 1243, 5 July 1965 (NSW); Lawson Ridge Road, *Powell* 420, 6 Dec 1975 (NSW); Lawson area, *Reilly*, 11 Nov 1975 (NSW 246704); Pearl Beach, *Whaite* 688, 31 May 1950 (NSW).

**S. laeta** R. Br. subsp. *latifolia* (R. Br.) J. Powell, **comb. et stat. nov.**

BAIONYM: *Styphelia latifolia* R. Br. (Brown 1810: 537).

TYPE CITATION: '(J.) v.v.'

LECTOTYPE (here designated): NEW SOUTH WALES: Banks of the Hawkesbury [River], R. Brown (Bennett No. 2398), [1802–5], (BM).

SYNONYM: *S. laeta* R. Br. var. *latifolia* (R. Br.) Benth. (Bentham 1869: 147).

The lectotype has mature and old flowers present. Another sheet at BM has a typed label 'Brown, 19 May 1802, Banks of Hawkesbury river'; the specimen has old flowers only, but may be an isolectotype.

NOTES: Bentham (1869) in reducing *S. latifolia* to varietal level stated 'Var. *latifolia* Leaves short, very broadly ovate and very concave — *S. latifolia*, R. Br. Prod. 537; ... — Hawkesbury river, R. Brown.'

SPECIMENS EXAMINED: NEW SOUTH WALES: Central Coast: Gurrakool, Brisbane Water National Park, *Bishop* 226 & *Gunnell*, 10 June 1984 (NSW); Ourimbah State Forest, *de Beuzeville*, Apr 1918 (NSW 35709); Somersby, *Fallding*, 30 Mar 1979 (NSW 245291); Lake Womberall, *Fletcher*, Aug 1888 (NSW 245281); Point Clare [Gosford], *Forsyth* 23 June 1897 (NSW 35633); 3 miles [c. 5 km] north of Kulnura store, *Foster*, 26 Apr 1956 (NSW 36656); 7 miles [c. 11 km] south of Central Mangrove, *Foster*, 26 Apr 1956 (NSW 35633); Kulnura, *Johnson*, 29 June 1954 (NSW 154799); 3 miles [c. 5 km] north of Peats Bridge, *Salasoo*, 20 July 1969 (NSW 245286). North West Slopes: Warialda, *McCusker*, June 1957 (NSW 245288).

**S. angustifolia** DC.

(Candolle 1839: 735).

TYPE CITATION: 'St. laeta Sieb.! pl. exs. n. holl. n. 79 non Brown'.

TYPE: *Sieber* n. 79 (holo G-DC; iso BM).

SYNONYM: *S. laeta* var. *angustifolia* Benth. (Bentham in Endlicher 1837). TYPE CITATION: 'Styphelia laeta Sieb. Pl. Nov. Holl. exs. n. 79 est ejusdem varietas angustifolia'.

SPECIMENS EXAMINED: NEW SOUTH WALES: Central Coast: [Royal] National Park, *Betche*, Dec 1889 (NSW 35704); Loftus, *Camfield*, May 1899 (NSW 35705), Aug 1897 (NSW 35706); Hill Top, *Cheel*, 10 Nov 1923 (NSW 245202); Rocky Creek, near Hill Top, *Cheel*, Jan 1912 (NSW 245206); Valley

Heights, Fletcher, —, (NSW 245198); Falconbridge, Fletcher, 29 Dec 1886 (NSW 35703); Linden, Hamilton, Jan 1915 (NSW 237906). Southern Tablelands: c. 1 mile [1.6 km] east of Endrick River on road from Braidwood to Nowra, Hoogland 11370, 4 Feb 1968 (NSW). North West Slopes: Warialda, Boorman, July 1905 (NSW 143343), Paterson, 10 Aug 1958 (NSW 245204).

### **Status of *Styphelia laeta* R. Br. var. *glabra* R. Baker**

(Baker 1896: 456).

TYPE: 'Camboon; October.' Baker states 'I am in doubt about the specimens placed here under a new variety, but I prefer this to proposing a new species. The flowers are red, the sepals acute, and the leaves narrow-lanceolate, — characters not included under Benthams' description of the species'. The specimens were collected 'during the months of September, October, November and December, in the years 1895, 1893, 1892 and 1890 respectively ...'

Three sheets of specimens collected by R.T. Baker at Camboon in September and October, 1893 are lodged at NSW; they have been re-determined as *Styphelia triflora* Andr. They have the glabrous branchlets, glabrous leaves, entire leaf margins, cuneate leaf base and more or less distinct petiole characteristic of this species.

### **Variation within *Styphelia viridis* Andr.**

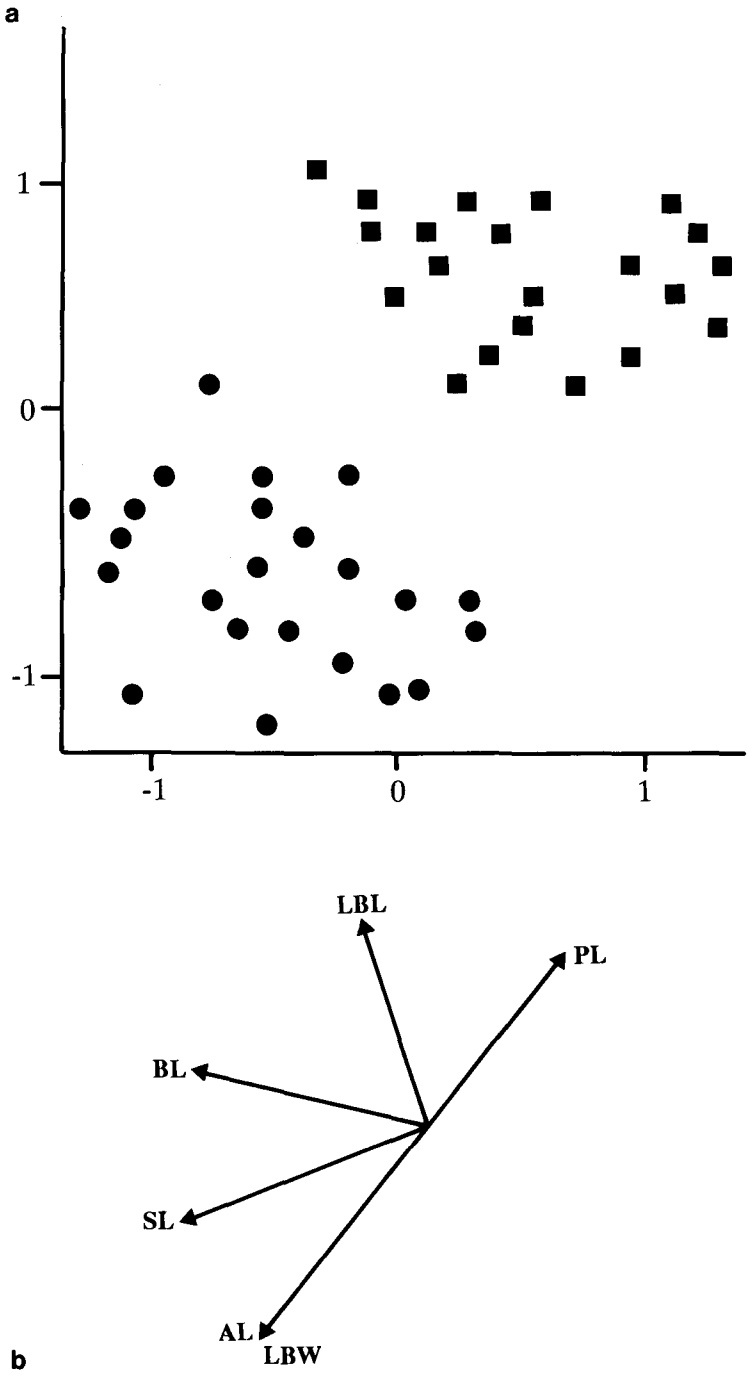
This species was described and illustrated by Andrews (1803) using a cultivated plant as his basis. Robert Brown (1810) used the name *S. viridiflora* R. Br. for the same species and referred to Andrews' publication as well as his own specimens. Brown's name, although more appropriate for this green-flowered species, is superfluous.

Benthams (1869) described a new variety, *S. viridis* Andr. var. *breviflora* Benth. This variety had 'leaves narrower. Sepals more obtuse, about 4 lines [8 mm] long. Corolla-tube about 1/2 in. [12 mm] long'. He noted that 'To this belong the specimens from Queensland and from the northern parts of N. S. Wales'.

Stanley & Ross (1986) in their treatment for the Flora of SE Queensland place *S. viridis* var. *breviflora* Benth. in synonymy under *S. viridis* Andr. stating that 'a few specimens with short obtuse sepals and short corolla tube have been called *S. viridis* var. *breviflora* Benth. but there is no apparent discontinuity in the population to justify varietal status for them.'

Specimens held at NSW under the name *S. viridis* Andr. exhibit considerable variation in the shape of the leaf-blade, apex and base, in petiole length and in corolla lobe length: tube length ratios. Measurements and descriptions of the following attributes were tabulated as a basis for re-assessment of taxa within the species: leaf blade length and width, length of petiole, bracteole, sepal, corolla-tube and -lobe, anther and filament, and the overall shape of the leaf, its apex and base (Table 3). The qualitative attributes that separate the taxa were mainly the shape of the leaf-blade and the leaf base, the branchlet indumentum (Figure 6) and to some extent the leaf apex and margin (Figure 7). In quantitative attributes the variation appeared at least partly discontinuous in leaf blade length, blade width, petiole length, sepal length and anther length and these attributes were used in the morphometric analyses.

Data from 44 specimens were analysed using PATN. The resultant classification indicated the presence of two groupings and separated the Central Coast and near North Coast specimens from those found on the far North Coast and in Queensland. The group 'statistics' (GSTA) indicated that it was a combination of attributes that separated the taxa, the most important being petiole length, sepal length, anther length,



**Figure 8.** Morphometric analysis of *Styphelia viridis*. **a**, scatter diagram of ordination of *S. viridis* subsp. *viridis* (●) and subsp. *breviflora* (■); **b**, vectors showing direction of maximum linear correlation between each of the six attributes and the ordination space. LBL: leaf-blade length; PL: petiole length; AL: anther length; LBW: leaf-blade width; SL: sepal length; BL: bracteole length. Note that the vectors for leaf-blade width and anther length have the same direction.

and leaf-blade width. The ordination (Figure 8) confirmed the presence of the two groups and their relative distinctiveness.

Given that the ranges of many of the morphological attributes overlapped it was concluded that the two taxa distinguished should be treated as subspecies. Study of the specimens from Queensland regions showed that they belonged to subsp. *breviflora*. The name 'breviflora' is somewhat inappropriate as corolla tube lengths in the two taxa overlap to a considerable extent (Table 3). However, Bentham's description is correct with regard to the leaves being narrower and the distribution of the taxa.

### Ecological notes

The subspecies appear to be allopatric. *S. viridis* subsp. *viridis* is found on the Central and near North Coast of New South Wales in coastal scrub-heath and in the understorey of open forest and woodlands on sandy soils over sandstone. It flowers between April and August. Its conservation status is 3RC; it is locally common but widespread habitat destruction in recent years makes it vulnerable. *S. viridis* subsp. *breviflora* occupies much the same habitat on the far North Coast of New South Wales and extends into Queensland as far north as Fraser Island. It is found in coastal scrub-heaths, on sand dunes with open forests of *Angophora costata* and *Eucalyptus pilularis*. It flowers mainly between May and July and occasionally also in September. This subspecies appears to be adequately conserved in National Parks in New South Wales and Queensland.

**Table 3.** Comparison of attributes of taxa in *S. viridis*

Character	var. <i>viridis</i>	var. <i>breviflora</i>
Leaf shape	oblong to oblong-obovate	oblong to oblong-elliptic
Leaf-blade length (mm)	14.8–22.4	19.6–25.6
Leaf-blade width (mm)	4.7–7.2	2.9–4.9
Leaf length:width ratio	2.3–4.1	4.5–7.3
Leaf apex	broadly acute to obtuse	acute to broadly acute
Leaf base	obtuse	narrowing
Petiole length (mm)	0.5–1.1	1.0–2.1
Bracteole length (mm)	3.6–4.8	3–5
Sepal length (mm)	12.4–18	8.5–13.3
Corolla-tube length (mm)	16–21.5	14–23
Corolla-lobe length (mm)	13.5–18	12–16
Anther length (mm)	4.8–6.8	3.2–4.5
Filament length (mm)	9.5–17.5	10–16

## Nomenclatural notes

### ***S. viridis* Andr.**

(Andrews 1803: t. 312)

TYPE CITATION: 'Our figure was taken from a plant in the Hibbertian collection, in the month of April, 1803.'

Stafleu & Cowan (1976) suggest that the text was 'probably written by John Kennedy', but Andrews is the botanical artist and engraver and is generally accepted as the author.

SYNONYM: *S. viridiflora* R. Brown (Brown 1810: 537). TYPE CITATION: '(J.) v.v.'

LECTOTYPE (here designated): NEW SOUTH WALES: Port Jackson, R. Brown (*Bennett No.* 2396), [17 May 1802], (BM); isolectotype NSW. The specimen is in flower. A second BM sheet has the same annotation.

Two subspecies are recognised:

### ***S. viridis* Andr. subsp. *viridis***

TYPE: as cited above.

SPECIMENS EXAMINED: NEW SOUTH WALES: North Coast: Port Stephens, *Boorman*, May 1912 (NSW 143359); Tuncurry State Forest, *Burgess*, 22 June 1961 (NSW 241789); Tuncurry, *Cheel*, 11 May 1925 (NSW 241787); Seal Rocks, *Fox* 7907039, 7 July 1979 (NSW), *Tate*, 6 Aug 1977 (NSW 241785); Nelson Bay, *Lithgow* 156, 10 May 1965 (NSW); Tomago sandbeds, *McDonald* 23 Aug 1966 (NSW 241791); Belmont, *McReadie*, June 1961 (NSW 241790). Central Coast: Kurnell, *Boorman*, May 1906 (NSW 241783); La Perouse, *Camfield*, July 1898 (NSW 143360); *Coveny* 11129 & *J. Thomas*, 7 July 1982 (NSW); Lady Robinson Beach, *Fletcher*, 30 Apr 1887 (NSW); Rose Bay, *Helms*, 22 June 1901 (NSW); Vacluse to Bondi, *Maiden* Aug 1887 (NSW 241778); Port Jackson district, *Maiden*, July 1896 (NSW 35717); Bundeena, *Oxenford*, 16 May 1948 (NSW 35719); Waterfall, *G. Rodway*, 23 July 1933 (NSW 241782); Port Hacking, *Whaite* 1178, 9 Aug 1952 (NSW).

### ***S. viridis* Andr. subsp. *breviflora* (Benth.) J. Powell comb. et stat. nov.**

BASIONYM: *S. viridis* Andr. var. *breviflora* Benth. (Bentham 1869: 148), as 'Var. ?*breviflora*.'

TYPE CITATION: 'To this belong the specimens from Queensland and from the northern parts of N.S. Wales'. Queensland specimens cited under the name *S. viridis* included 'Morton island, *F. Mueller*' and 'Darling Downs, *F. Law*'. The other specimens cited belong to the type subspecies.

LECTOTYPE (here designated): QUEENSLAND: Moreton Island, *F. Mueller* (MEL 226791); isolectotype K.

SPECIMENS EXAMINED: NEW SOUTH WALES: North Coast: 3 km west of Red Rock, *Foreman* 937, 24 Aug 1985 (MEL); Bunjalung National Park, *Powell* 4529, 4 Sep 1987 (NSW), *Powell* 4593, 1 May 1989 (NSW); Coaldale Road, *Powell* 4587, 1 May 1989 (NSW); Diggers Camp, *Powell* 4551, 5 Sep 1987, (NSW); 9 km NE of Evans Head, Broadwater National Park, *Powell* 4602, 2 May 1989 (NSW). Queensland: Moreton: Nambour, *Ward*, July 1964 (NSW 241795); Stradbroke Island, *White* 1701, July 1922 (NSW, BRI, MEL). Wide Bay: 22 miles [c. 35 km] E of Gympie, *Smith* 12111, 12 May 1964 (BRI, NSW); Cooloolah sand hills, *Thorne* 21292, *Coaldrake & Ridley*, 18 May 1959 (BRI, NSW); Fraser Island, *Willis*, Aug 1953 (NSW 241794).

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## References

- Andrews, H.C. (1803) *The botanist's repository for new and rare plants*, vol. 5 (Bensley: London).
- Baker, R. (1896) On the botany of Rylstone and the Goulburn River districts. *Proc. Linn. Soc. N.S.W.* 21, Part I: 427–466.
- Belbin, L. (1989a) *Technical reference PATN pattern analysis package* (CSIRO: Canberra).
- Belbin, L. (1989b) *Users guide PATN pattern analysis package* (CSIRO: Canberra).
- Bentham, G. (1869) *Flora Australiensis*, vol. 4 (L. Reeve & Co.: London).
- Benson, D. & McDougall, L. (1991) *Rare bushland plants of western Sydney* (Royal Botanic Gardens: Sydney).
- Briggs, J.D. & Leigh, J.H. (1988) *Rare or threatened Australian plants*. Australian National Parks & Wildlife Service Special Publication no. 14.
- Brown, R. (1810) *Prodromus Florae Novae Hollandiae et Insulae Van Diemen*, vol. 1 (J. Johnson & Co.: London).
- Candolle, A.P. de (1839) *Prodromus systematis naturalis regni vegetabilis* (Treuttel & Wurtz: Paris).
- Domin, K. (1928) Beiträge zur Flora und Pflanzengeographie Australiens. *Bibliotheca Botanica*, 89(VI): 479–574.
- Endlicher, S.L. (1837) *Enumeratio plantarum quas in Novae Hollandiae ora austro-occidentali ad fluvium Cygnorum et in Sinu Regis Georgii collegit Carolus Liber Baro de Hugel* (Fr. Beck: Vienna).
- Maiden, J.H. (1895) The Dorrigo Forest Reserve Part II – A list of the plants collected, with descriptive notes of those of economic or botanical interest. *Agricultural Gazette of N.S.W.* 5: 599–633.
- Mueller, F. (1867) *Fragmenta phytographiae Australia*, vol. 6 (Government Printer: Melbourne).
- Mueller, F. (1889) *Second systematic census of Australian plants Part I – Vasculares* (McCarron Bird: Melbourne).
- Stafleu, F.A. & Cowan, R.S. (1976) *Taxonomic Literature* edn 2, vol. 1. (Bohn, Scheltema & Holkema: Utrecht).
- Stanley, T.D. & Ross, E.M. (1986) *Flora of south-eastern Queensland*, vol. 2. (Queensland Dept. of Primary Industries, Brisbane, Misc. Publ. QM84007).

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