

# Four new species related to *Bossiaea bracteosa* F.Muell. ex Benth. in south-eastern Australia

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## Abstract

*Bossiaea bracteosa* F.Muell. ex Benth. has long been regarded as a widely distributed shrub, occurring in Victoria, New South Wales and the Australian Capital Territory. Most of its populations, however, are highly localised, poorly represented in herbaria and occur in disparate habitats. Following re-examination of herbarium collections and further collecting of isolated populations in New South Wales and the Australian Capital Territory, four species are here described as new: *B. bombayensis* K.L.McDougall, *B. fragrans* K.L.McDougall, *B. grayi* K.L.McDougall, and *B. milesiae* K.L.McDougall. The circumscription of *Bossiaea bracteosa* is emended and is here regarded as a Victorian endemic.

## Introduction

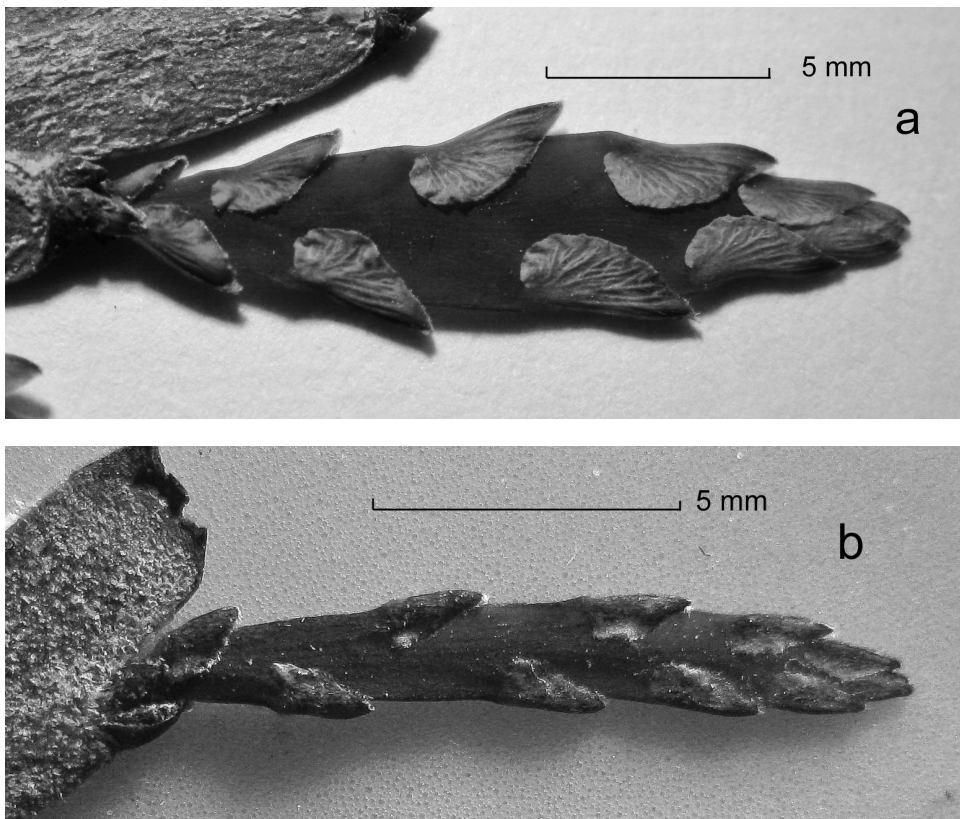
Species of *Bossiaea* (Bossiaeeae: Fabaceae) lacking typical photosynthetic leaves are characterised by flattened branches (cladodes) and leaves that are reduced to scales. A recent review of *Bossiaea* in Western Australia (Ross 2006) identified five new taxa of leafless species in addition to the eight taxa that had previously been recognised. The variability in morphology and habitat within some other currently recognised species suggests that additional new taxa await elucidation.

In south-eastern Australia, many leafless *Bossiaea*s are extremely localised in their distribution and poorly represented in herbarium collections. One species, *Bossiaea bracteosa* F.Muell. ex Benth., characterised by its caducous bracteoles, has been regarded as occurring in Victoria, New South Wales (N.S.W.), and the Australian Capital Territory (A.C.T.). A population from Wombat Forest near Melbourne has recently been described as a new species, *B. wombata* (Ross 2008). Most populations of *Bossiaea bracteosa*, as currently circumscribed, are highly disjunct and occur in a range of habitats: Australian Alps (Victoria; subalpine woodland), Snowy River (Victoria; habitat unknown), Bega area (N.S.W.; riparian), Murrumbidgee River (A.C.T.; riparian), Shoalhaven River (N.S.W.; riparian) and Abercrombie Caves (N.S.W.; dry woodland). Based on leaf scale length and general morphological characters, there are clear differences between populations of *Bossiaea bracteosa* from the Australian Alps (where the Type was collected) and other populations for which adequate herbarium

material is available. Recent collections from N.S.W. and the A.C.T. have clarified the patterns of variation within older herbarium material of what has previously been classified as *B. bracteosa*, leading to the delimitation of four new taxa within this group. These are described below.

### Diagnostic characters

In the species described below, some characters seem to have no diagnostic value or require further investigation before they can be reliably used to distinguish these taxa. For instance, all species are glabrous apart from minute hairs at the nodes, on the apices of floral bracts and on the inner surface of calyx lobes. Scattered, appressed hairs on young cladode branches are found in collections of all species except *B. fragrans* but little material of this species is available to confirm its diagnostic value. An exfoliating waxy coating has been noted in dried specimens of *B. bracteosa sens. lat.* (Ross 1996). This conspicuous feature seems to be common to all species except *B. milesiae*. However, it has limited diagnostic value because not all dried specimens within a species display this character.



**Fig. 1.** Leaf scales on new cladode growth (undamaged). **a**, *Bossiaea bracteosa* (N.G. Walsh 5716) – long leaf scales with broad cordate bases and prominent venation; **b**, *Bossiaea grayi* (K.L. McDougall 1272) – short leaf scales with truncate bases and obscure venation

The most useful diagnostic characters are cladode size and colour; leaf scale size, shape, and venation; pedicel length; equality or not of calyx lobes; flower length and colour; staminal filament colour; and pod size and colour.

### Cladodes

Reproductive cladodes are distinctive in width, margins and colour for most species. *Bossiaea bombayensis* has narrow, dark green, sub-flexuose reproductive cladodes that are predominantly red when young. *Bossiaea bracteosa* and *B. fragrans* have broad, glaucous-green reproductive cladodes. In these species, the margins are typically sinuate and the nodes are sometimes incised. *Bossiaea grayi* and *B. milesiae* have reproductive cladodes of intermediate width. Those of *B. grayi* are grey-green with straight margins (although slightly indented at the nodes), while those of *B. milesiae* are light green with straight to sinuate margins.

### Leaf scales

Leaf scale length and venation is the principal character separating *Bossiaea bracteosa sens. strict.* from the other species. The leaf scales of *B. bracteosa* are > 2.5 mm long with broad cordate bases and prominent venation. The other species have relatively short leaf scales (generally < 1.5 mm long) with truncate bases and obscure venation (Fig. 1). Leaf scales are best viewed on young cladode branches because many become damaged or dislodged on older cladodes.

### Flowers

*Bossiaea bombayensis*, *B. bracteosa* and *B. grayi* appear to have strictly one flower per node whereas *B. fragrans* and *B. milesiae* may have more than one. Multiple flowers seem to be common in *B. fragrans* but very rare in *B. milesiae*. Pedicels are short and hidden by floral bracts in *B. bracteosa*, *B. bombayensis* and *B. grayi*, and longer and exposed at flowering time in *B. fragrans* and *B. milesiae*. Floral bracts are largely persistent in *B. bracteosa*, *B. bombayensis* and *B. grayi*, whereas they are usually caducous in *B. fragrans* and *B. milesiae*. All but the outer few bracts, i.e. those closest to the cladode, are caducous in *B. fragrans* and *B. milesiae*. Calyx lobes are equal or subequal in *B. bracteosa*, *B. bombayensis* and *B. grayi* and distinctly unequal in *B. fragrans* and *B. milesiae*. The calyx of *B. bombayensis* is distinctively heavily tinged with red throughout, except for the tips of the lobes, which are golden brown. The calyces of other species tend to be green throughout. *Bossiaea bombayensis* has shorter corollas than the other species, whereas *B. fragrans* generally has the longest corollas. Although the external colour of the standard can be variable in *B. bracteosa*, *B. grayi* and *B. fragrans*, that of *B. bombayensis* is almost entirely red and that of *B. milesiae* is entirely yellow or apricot (apart from faint red striations). Staminal filaments are red in *B. grayi*, *B. fragrans* and *B. milesiae* or colourless or almost so in *B. bracteosa* (and sometimes *B. milesiae*) but the filaments of *B. bombayensis*, are distinctively alternately red and colourless.

### Pods

Pod size differs between species (see dimensions below). However, abnormally small pods are common in all species and measurements should be made of a range of pods. Typical pods of *B. bombayensis* are smaller in length and width than other species and heavily tinged with red when immature.

### Key to leafless *Bossiaea* with caducous bracteoles in eastern Australia

- 1 Flowers >15 mm long; keel longer than standard; ovules c. 20 ..... *B. walkeri*
- 1 Flowers <15 mm long; keel shorter than or  $\pm$  equal to standard; ovules < 10 ..... 2
- 2 Upper 2 calyx lobes c. quadrangular contrasting strongly with the triangular lower lobes; pedicels exceeding floral bracts at flowering by 1–2 mm ..... 3
- 2 Calyx lobes all triangular; pedicels not or hardly exceeding the floral bracts at flowering ..... 4
- 3 Reproductive branches of cladodes mostly > 8 mm wide, becoming incised; standard 9–10 mm long; stipe of pods < 3 mm long; at least some nodes with > 1 flower ..... *B. fragrans*
- 3 Reproductive branches of cladodes mostly < 8 mm wide, not becoming incised; standard 7–9 mm long; stipe of pods  $\geq$  3 mm long; nodes rarely with > 1 flower ..... *B. milesiae*
- 4 Scales mostly 3–5 mm long ..... *B. bracteosa*
- 4 Scales mostly < 2 mm long ..... 5
- 5 Corolla yellow or whitish, without any other coloration ..... *B. vombata*
- 5 Corolla with some purple, orange or red coloration as well as yellow ..... 6
- 6 Cladodes dark green in fresh material; reproductive branches of cladodes usually < 4 mm wide; calyx lobes < 1.5 mm long ..... *B. bombayensis*
- 6 Cladodes grey green in fresh material; reproductive branches of cladodes usually > 4 mm wide; calyx lobes  $\geq$  1.5 mm long ..... *B. grayi*

1. *Bossiaea bracteosa* F.Muell. ex Benth., *Flora Australiensis* 2: 166 (1864).

**Type:** Victoria, Mitta Mitta (subalpine), *F. Mueller s.n., s.d.* (MEL 20333); lectotype *vide* A.T. Lee, *Contrib. New South Wales Natl. Herb.* 4:98 (1970).

Erect to spreading, suckering shrub 0.7–2 m high. Cladodes flattened, winged, becoming round or oval in cross-section; reproductive branches of cladodes oblong to narrowly ovate, green to glaucous-green, 7–12 mm wide, winged, rarely incised at the nodes, glabrous apart from minute hairs in the axils of the scale leaves and on the surface of new growth. Leaf scales 2.7–5 mm long, broadly ovate with cordate bases and acuminate to acute apices, reticulate venation prominent, glabrous apart from marginal cilia. Flowers 1 per node; pedicel 1.5–2 mm long, glabrous, obscured by floral bracts. Floral bracts imbricate, increasing in size from outer to inner, glabrous apart from marginal hairs, especially towards the apex, chestnut brown, the largest persistent bract c. 2.5 mm long with a broadly acute to obtuse, lacerated apex. Bracteoles caducous. Calyx glabrous apart from hairs on the margins and inner surface of the lobes apically, green, 4.5–5.5 mm long including 5  $\pm$  equal, triangular lobes 1.4–2 mm long, 1–1.3 mm wide. Corolla with standard 8.5–10 mm long including a claw 2.5–4 mm long, 10.5–11.5 mm wide, exceeding other petals, bright yellow to apricot internally with faint red striations, suffused with red externally; wings 7.5–9.5 mm long including a claw 3–4 mm long, yellow, glabrous; keel 7.5–9.5 mm long including a claw 3–4 mm long,

dark red, glabrous. Ovary 5–6 mm long, (6–)8-ovulate, glabrous; style 4–5 mm long. Staminal filaments 3–4.5 mm long,  $\pm$  colourless; sheath 4–6 mm long,  $\pm$  colourless. Pods oblong, 2.3–3.2 cm long, 0.6–1 cm wide, glabrous, reddish brown when mature; stipe c. 2 mm long, obscured by remains of calyx. Seeds broadly elliptic to slightly reniform, 3–3.5 mm long, 1.5–2 mm wide, reddish brown to mid-brown.

**Flowering:** November—December (rarely in January).

**Vernacular name:** Mountain Leafless Bossiaea.

**Selected specimens examined:** **Victoria:** Eastern Highlands: Mountain Ash Spur between The Crinoline and Mount Skene, *J. Blackburn s.n.*, Dec 1950 (MEL 1529686); Black Range, 40 km NW of Maffra township, *J. Piggin s.n.*, May 1976 (CANB 602968); Snowfields: Mount Hotham area, *S.J. Forbes 410 & L. Ahern*, 20 Nov 1979 (MEL 594573, NSW 567293); c. 6 km SE of Hotham village on the Omeo Rd, *M.G. Corrick 7138*, 25 Jan 1981 (MEL 596957, NSW 567294).

**Distribution and habitat:** *Bossiaea bracteosa* is endemic to the Australian Alps of north-eastern Victoria (between elevations of 1000 and 1600 m), occurring mainly in the Dargo – Hotham area and the headwaters of the Macalister River (Fig. 2). It has been recorded in shrubby Snow Gum woodland, on shallow soils derived from sedimentary or basalt material.

**Conservation status:** this species is regarded as rare in Victoria but not necessarily threatened (Department of Sustainability and Environment 2005). Many collections note that it is common and most populations are in conservation reserves.

**Notes:** *Bossiaea bracteosa* is distinguished from the species described below by its prominent leaf scales, which have cordate bases and distinct venation. It is similar to *B. bombayensis* and *B. grayi* in having calyces with approximately equal lobes, persistent floral bracts and short, obscure pedicels but differs from those species in its relatively short and broad distal cladodes.

## 2. *Bossiaea bombayensis* K.L.McDougall, **sp. nov.**

*B. bracteosa* F. Muell. ex Benth. *affinis sed squamis foliorum brevioribus, cladodiis angustioribus, floribus et fructibus minoribus differt.*

**Type:** New South Wales: Southern Tablelands: Shoalhaven River, Bombay, 9 km W of Braidwood, *K.L. McDougall 1325 & C.L. McDougall*, 10 Oct 2008; holo. NSW 777997; iso. CANB 778404, MEL 2312599.

Wiry shrub to 1 (–1.5) m high. *Cladodes* flattened, winged, glabrous apart from minute hairs in the axils of the scale leaves and scattered hairs 0.2–0.5 mm long on new growth, becoming round or oval in cross-section; reproductive branches of cladodes subflexuose, dark green (predominantly red when young), 2.3–4.5 mm wide, winged, not becoming incised at the nodes. *Leaf scales* 0.7–1.2 mm long, dark brown, glabrous apart from marginal cilia. *Flowers* solitary at the nodes; pedicels 1.5–2.5 mm long, glabrous, obscured by floral bracts. *Floral bracts* imbricate, dark brown to golden brown, mostly persistent, increasing in size from outer to inner, glabrous apart from marginal hairs, especially towards the apex, the largest of the persistent bracts 1.5–2 mm long with a broadly acute apex. *Bracteoles* caducous. *Calyx* glabrous apart from hairs on the margins and inner surface of the lobes apically (occasionally also on the outer surface of lobes), green with red spots, often heavily tinged with red abaxially, 4–5 mm long including the 5  $\pm$  equal, triangular lobes 0.9–1.4 mm long, c. 1 mm

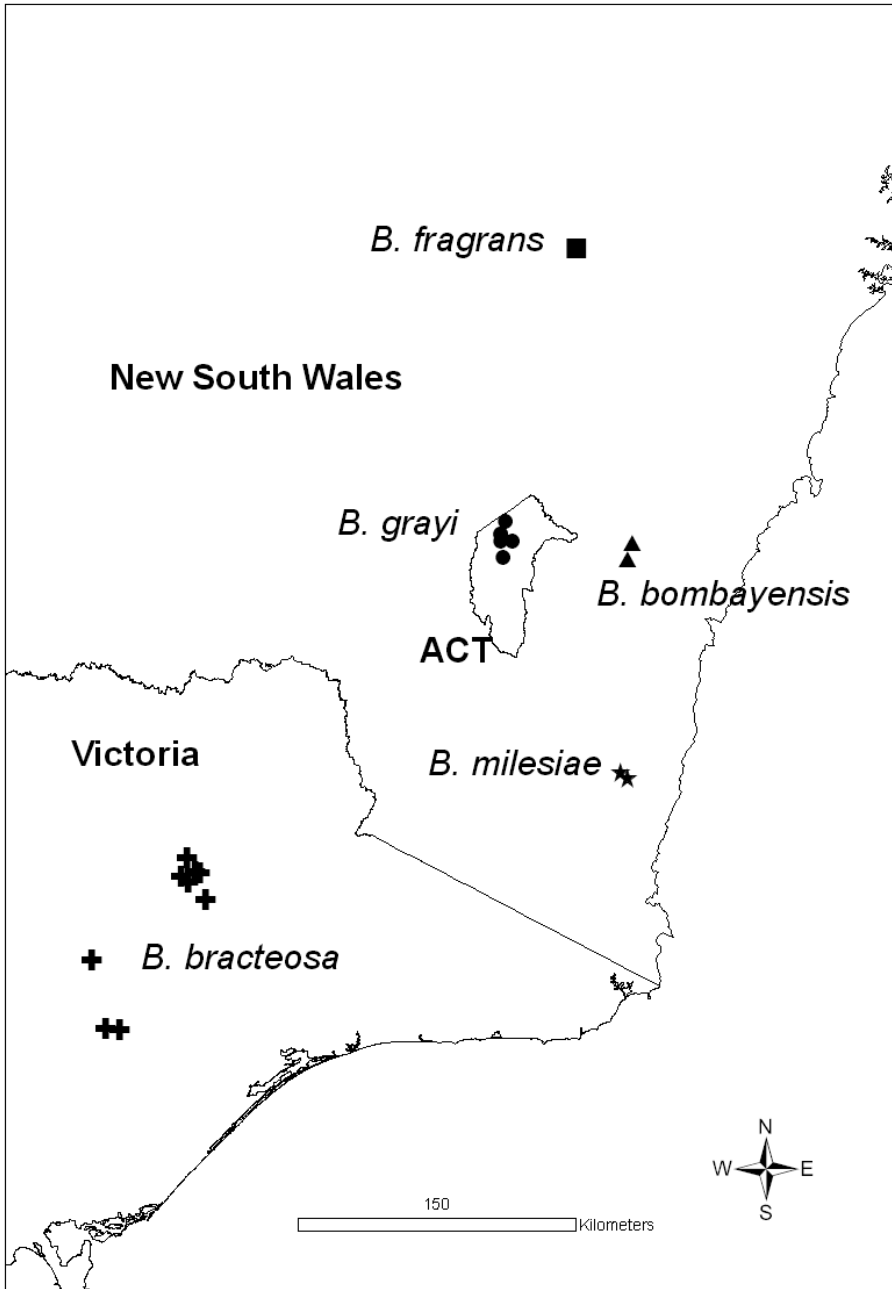
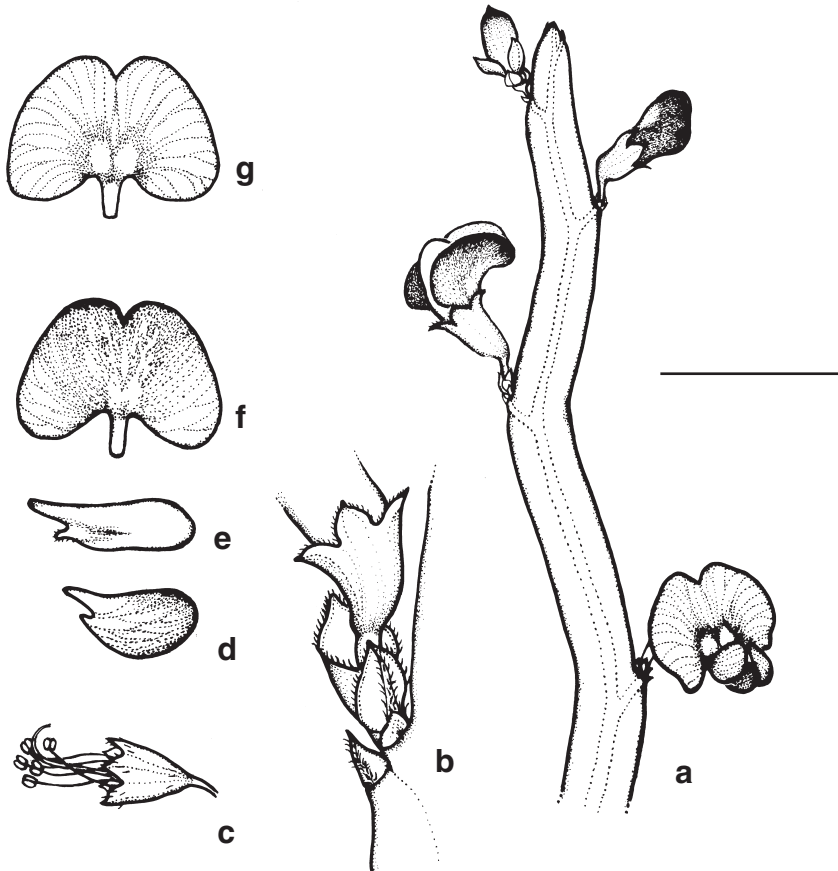


Fig. 2. Location of the five species of *Bossiaea* in south-eastern Australia.

wide, heavily tinged with red, often with golden brown tips. Corolla with standard 6.5–8 mm long including a claw 2–3 mm long, 9.5–11 mm wide, equal to or just exceeding other petals, deep yellow internally with red basal markings and faint red longitudinal striations radiating from the base to the edge of the lamina, predominantly deep red externally; wings 6.5–7.5 mm long including a claw 2.2–2.8 mm long, yellow, with red markings near base internally and externally, glabrous; keel 6.5–7.5 mm long including a claw 2.5–3 mm long, dark red with a pale base, glabrous. *Ovary* c. 5 mm long, 6–7(–8)-ovulate, glabrous; style 3.5–4 mm long. *Staminal filaments* 4–5 mm long, alternately red and colourless; sheath 3.5–4.5 mm long, colourless. *Pods* oblong, (1.4–)2–2.6 cm long, 0.4–0.6 cm wide, glabrous, red at first, ultimately dark green with thickened reddish-brown edges and red markings; stipe 1–2.5 mm long, obscured by remains of calyx. *Seeds* elliptic to subreniform, 2.3–2.5 mm long, 1.3–1.5 mm wide, pale brown with dark mottles (Fig. 3).

**Flowering:** September–October. Fruits dehisce: by mid-December.



**Fig. 3.** *Bossiaea bombayensis*. **a**, cladode; **b**, floral bracts; **c**, calyx, stamens and style; **d**, keel; **e**, wing; **f**, standard (adaxial); **g**, standard (abaxial) (*K.L. McDougall 1200*). Scale bar: **a**, **c**–**g** = 10 mm; **b** = 15 mm.

**Selected specimens examined:** New South Wales: Southern Tablelands: Shoalhaven River, west of Braidwood, *R.H. Cambage s.n.*, 30 Oct 1908 (NSW 44157); Shoalhaven River, Warri Bridge, 13 km NNW of Braidwood, *M.D. Crisp 7724 & I.R. Telford*, 14 Feb 1986 (CBG 8600454); Crown Reserve, Shoalhaven River, Bombay west of Braidwood, *K.L. McDougall 855*, 11 Oct 2000 (MEL 2097557); Shoalhaven River, Little Bombay, *K.L. McDougall 1198*, 21 Sep 2006 (NSW).

**Distribution and habitat:** *Bossiaea bombayensis* grows in a steeply incised valley of the Shoalhaven River, near Braidwood on the Southern Tablelands (Fig. 2). It is mainly found on sandy, rocky slopes and terraces above the frequent flood line in a shrubland of *Callitris endlicheri*, *Grevillea arenaria*, *Lomandra longifolia*, *Micrantheum hexandrum*, *Pomaderris andromedifolia* and *Leptospermum polygalifolium*. *Bossiaea bombayensis* rarely extends into dry sclerophyll woodland (comprising *Eucalyptus mannifera*, *E. rubida* and *E. dives*) on upper slopes above the river. Recruitment appears to be continuous as there is a range of plant sizes including seedlings. There have been no fires in this part of the Shoalhaven River valley in recent times so the species is not reliant on fire for regeneration. Scarification and dispersal of seed by floodwater may be important in the survival and spread of *B. bombayensis*.

**Conservation status:** although locally abundant, this species is restricted to a narrow, riparian corridor of about 12 km on the Shoalhaven River between Bombay and Warri, west of Braidwood. Competitive weeds (especially *Cytisus scoparius*, *Salix* spp. and *Rubus* spp.) are common and a significant threat to *Bossiaea bombayensis* and other native species along this section of river.

**Etymology:** *Bossiaea bombayensis* is named after the location in which most of the population is found. The Shoalhaven River at Bombay is a significant place of recreation for people of the Braidwood area and an important refuge for native flora and fauna within a largely cleared landscape.

**Notes:** *Bossiaea bombayensis* is distinguished from *B. fragrans* and *B. milesiae* by its equal to almost equal calyx lobes, from *B. bracteosa* by its much shorter, truncate leaf scales, and from *B. grayi* by its narrow, dark green cladode branches, smaller flowers and pods, alternating red and colourless staminal filaments, and general reddish appearance (of its flowers, new growth, calyx and pods).

### 3. *Bossiaea grayi* K.L.McDougall, *sp. nov.*

*B. bracteosa* F. Muell. ex Benth. *affinis sed squamis foliorum brevioribus et cladodiis angustioribus cinereis differt.*

**Type:** Australian Capital Territory: Murrumbidgee River, 1 km downstream from Kambah Pool, *I.R. Telford 8553*, Sep 1980; holo. CBG 8007070; iso. BISH 599975, MEL 641512, NSW 567291.

Erect shrub to 1.5 m high. *Cladodes* flattened, winged, glabrous apart from minute hairs in the axils of the scale leaves and scattered hairs on new growth, becoming round or oval in cross-section; reproductive branches of cladodes grey-green, linear, (3–)4–6 mm wide, winged, not becoming incised at the nodes. *Leaf scales* 1–2.2 mm long, dark brown, glabrous apart from marginal cilia. *Flowers* solitary at the nodes; pedicels 1–2 mm long, glabrous, obscured by floral bracts. *Floral bracts* imbricate, dark brown, mostly persistent, increasing in size from outer to inner, glabrous apart from marginal hairs, especially towards the apex, the largest of the persistent bracts c. 2.5 mm long with a broadly acute apex (often lacerated). *Bracteoles*



caducous. *Calyx* glabrous apart from hairs on the margins and inner surface of the lobes apically, green, 5–6.5 mm long; lobes triangular,  $\pm$  equal, 1.5–2.5 mm long, 1.2–1.5 mm wide, sometimes tinged with red. Corolla with standard 9.5–11 mm long including a claw 3–3.5 mm long, 11–12.5 mm wide, exceeding other petals, deep yellow internally with red basal markings and faint red longitudinal striations radiating from the base to the edge of the lamina, suffused with red externally; wings 9–10 mm long including a claw 3–3.5 mm long, yellow, with red markings near base, glabrous; keel 9–10 mm long including a claw 3–3.5 mm long, dark red, glabrous. *Ovary* 5–6.5 mm long, 6-ovulate, glabrous; style c. 4.5 mm long. *Staminal filaments* 3.5–4 mm long, tinged with red; sheath 4–5 mm long, mostly colourless. *Pods* oblong, 2–2.9 cm long, 0.6–1 cm wide, glabrous, dark reddish brown when mature; stipe 2.4–3.7 mm long. *Seeds* 2.8–3 mm long, 1.7–1.8 mm wide, tan to dark brown (Fig. 1).

**Flowering:** September–October. Fruit dehisces: December.

**Selected specimens examined: Australian Capital Territory:** Murrumbidgee and Cotter junction, *R.H. Cambage s.n.*, 5 Nov 1911 (NSW 44156); Molonglo River, directly south of Lower Molonglo Sewage Treatment Plant, *N. Taws 310 & A. Scott*, 18 Dec 1993 (CBG 9316417, MEL 2086950); Murrumbidgee River, 1 km downstream from Kambah Pool, *I.R. Telford 8553*, Sep 1980 (MEL 641512); west bank of Paddys River, *A.V. Slee 3123 & J. Johnston*, 3 Mar 1991 (CANB404588); cultivated, Australian National Botanic Gardens (Origin: Cotter Pumping Station), *K.L. McDougall 1271*, 24 Sep 2007 (NSW).

**Distribution and habitat:** known only from the banks of the Murrumbidgee River and its tributaries in the Australian Capital Territory (Fig. 2). *Bossiaea grayi* grows in sand amongst boulders on river banks dominated by *Casuarina cunninghamiana* or occasionally in shrubland of rock outcrops close to the river.

**Conservation status:** although this species has been recorded from several locations in the A.C.T. and, according to herbarium label notes, was locally common at some, it could not be found at any of the sites during surveys in spring 2006 and 2007. All sites were severely burnt in January 2003. The regeneration of exotic species (e.g. *Rubus* spp., *Conium maculatum*, *Eragrostis curvula*) was prolific after the fires and may have hindered the recruitment of *B. grayi*. Three small populations have since been located (Luke Johnston, A.C.T. Department of Parks, Conservation and Lands & Paul Carmen, Australian National Botanic Gardens, pers. comm.).

**Etymology:** the species is named in honour of Max Gray, retired CSIRO taxonomist, co-author of the “Flora of the A.C.T.” and an early collector of this species. During my career, Max has given me invaluable encouragement and inspiration. As a homophone, the name is also highly descriptive of the cladode colour and general appearance of *B. grayi*.

**Notes:** *Bossiaea grayi* is distinguished from *B. fragrans* and *B. milesiae* by its equal to almost equal calyx lobes, from *B. bracteosa* by its much shorter, truncate leaf scales, and from *B. bombayensis* by its broader, grey green cladode branches, larger flowers and pods, and red staminal filaments.

In cultivation in the Canberra Botanic Gardens, *Bossiaea grayi* suckers vigorously. This behaviour was not evident in the wild, perhaps because of the lack of soil (and opportunity for suckering) in the one natural population seen.

A specimen from the Snowy River, in eastern Victoria (*L. Hodge s.n.*, Nov 1957, MEL 1529684) may also be *B. grayi*. This specimen is small and has only one flower with equal to almost equal calyx lobes and a pale-coloured standard. In its dimensions of cladode width, leaf scale length and flower length it is at the lower end of the range for *B. grayi*. Its identification will await relocation of the population and collection of good fertile material.

#### 4. *Bossiaea fragrans* K.L.McDougall, *sp. nov.*

*B. bracteosae* F.Muell. ex Benth. *affinis sed squamis foliorum brevioribus, pedicellis longioribus, lobis calycis inaequalibus et floribus saepe ultra unum per axillam differt.*

**Type:** New South Wales: Central Tablelands: Abercrombie Karst Conservation Area, *K.L. McDougall 1268*, 21 Sep 2007; holo. NSW 785656; iso. CANB 766110, MEL 2318267.

Erect shrub 1–2.5 m high. *Cladodes* flattened, winged, becoming round or oval in cross-section but retaining remnants of wings; reproductive branches of cladodes glaucous green, oblong-linear to narrowly oblanceolate or irregular, (6–)8–14 mm wide, winged, glabrous apart from minute hairs in the axils of the scale leaves, becoming incised at the nodes. *Leaf scales* 1.5–1.9 mm long, dark brown, glabrous apart from marginal cilia. *Flowers* 1(–6) per node; pedicels 2.5–3 mm long, glabrous, exceeding persistent floral bracts by 1–2 mm at anthesis. *Floral bracts* imbricate, narrowly ovate, increasing in size from outer to inner, the largest of the persistent bracts c. 1.5 mm long with an acute apex, glabrous apart from marginal hairs, especially towards the apex, chestnut brown, all but a few bracts caducous prior to anthesis. *Bracteoles* caducous but rarely one or both present at anthesis. *Calyx* glabrous apart from hairs on the margins and inner surface of the lobes apically, green, 4.5–5 mm long; lobes c. 1 mm long, the 2 upper lobes c. 1.5 mm wide, rounded-truncate with acute, diverging apices, the lower 3 triangular, c. 1 mm wide, with acute apices. Corolla with standard 10.5–12 mm long including a claw 3–4 mm long, 12.5–15 mm wide, exceeding other petals, yellow internally and heavily tinged with red externally, with red basal markings and red longitudinal striations radiating from the base to the edge of the lamina; wings 10–11 mm long including a claw 3–4 mm long, yellow, with red markings near base and occasionally extending to edge of lamina, glabrous; keel 10–11 mm long including a claw 3–4 mm long, dark red, glabrous. *Ovary* 5.5–6 mm long, 5–6-ovulate, glabrous; style 2.5–4 mm long. *Staminal filaments* 4–5 mm long, red; sheath 4–5 mm long, red. *Pods* oblong, 2.4–3.8 cm long, 0.8–1 cm wide, glabrous, dark green with reddish-brown markings when mature; stipe 2.5–3 mm long. *Seeds* elliptic to sub-reniform, 3.0–3.2 mm long, 1.8–2 mm wide, dark brown (Fig. 4).

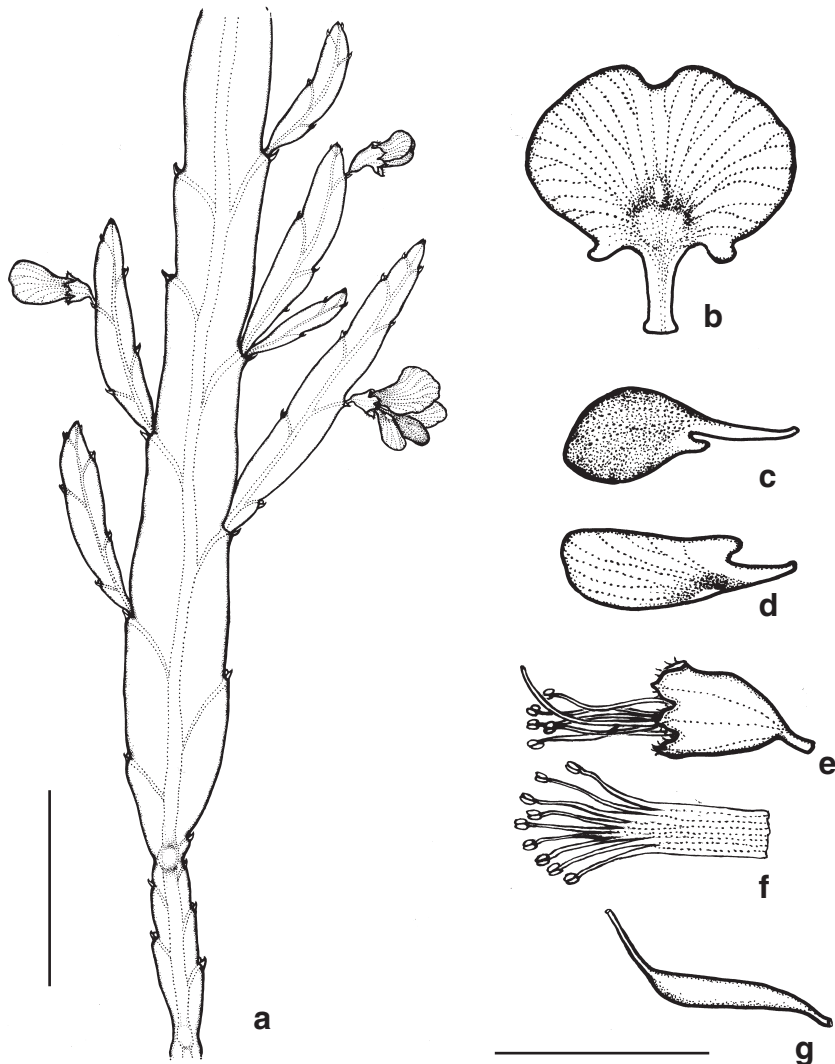
**Flowering:** September–October. Fruits dehisce: by December.

**Specimens examined:** New South Wales: Central Tablelands: Abercrombie Caves, *E.F. Constable s.n.*, 24 Mar 1955 (NSW44119); Abercrombie Caves, east of Grove Creek, *K.L. McDougall 999* & *D. Monahan*, 25 Oct 2001 (MEL 2210156); Abercrombie Caves, east of Grove Creek, *K.L. McDougall 1270*, 21 Sep 2007 (NSW 785652).

**Distribution and habitat:** known from two populations in Abercrombie Karst Conservation Area, south of Bathurst (Fig. 2). The species occurs in open White Box (*Eucalyptus albens*) woodland. Despite their occurrence near Abercrombie Caves, a limestone feature, the populations occur on slate and volcanic substrates. Seeds are heavily predated by insects and few pods have been found with fully developed seeds.

**Conservation status:** there are currently fewer than 20 plants known of this species. The populations are threatened by competition from the introduced grass Serrated Tussock (*Nassella trichotoma*) and grazing by goats.

**Etymology:** the epithet of this species refers to its fragrant flowers. This feature was very obvious when sample bags containing specimens were opened. Collections of other leafless *Bossiaea*s from the A.C.T. and N.S.W. that I have made have not displayed this attribute. The diagnostic value of this character is uncertain but the fragrance of the *B. fragrans* collections was very strong and pleasant.



**Fig. 4.** *Bossiaea fragrans*. **a**, cladodes; **b**, standard; **c**, keel; **d**, wing; **e**, calyx, stamens and style; **f**, staminal filaments and sheath; **g**, ovary (K.L. McDougall 1268). Scale bar: a = 20 mm; b–g = 10 mm.

**Notes:** of the five taxa described in this paper, *Bossiaea fragrans* is most similar to *B. milesiae* in having asymmetrical lobes, longer pedicels and largely caducous floral bracts. It differs from *B. milesiae* in its broader, glaucous cladode branches, longer corollas and darker coloured standards. The two species also occupy very different habitat.

One collection of *B. fragrans* (K.L. McDougall 1270), made in 2007 from a population containing a single plant, has as many as six flowers per node. Some flowers of this collection are also irregular (e.g. with two ovaries and corollas per calyx, with four wings or with a wing fused to the calyx). Collections in the same year from plants of a second, larger population, however, had only 1 or 2 flowers per node. Type material (K.L. McDougall 1268) for this species was taken from the second population.

The collection by Constable (NSW 44119) describes plants as being 1.8–2.8 m in height. The tallest extant plant is about 1.3 m tall while most are less than 1 m in height.

**5. *Bossiaea milesiae* K.L.McDougall, sp. nov.**

*B. bracteosae* F. Muell. ex Benth. *affinis sed squamis foliorum brevioribus, pedicellis longioribus, floribus majoribus saepe luteis et lobis calycis inaequalibus differt.*

**Type:** New South Wales: South Coast: Brogo River, c. 25 km NNW of Bega (c. 1 km downstream from Brogo Dam), K.L. McDougall 1193, J. Miles & P. Jeuch, 12 Sep 2006; holo. NSW 785654; iso. CANB 766111, MEL 2318264.

Shrub to 2 m high. *Cladodes* flattened, winged, glabrous apart from minute hairs in the axils of the scale leaves (and scattered hairs on new growth), becoming round or oval in cross-section; reproductive branches of cladodes light green, oblong-linear to narrowly oblanceolate, 4–8(–10) mm wide, winged, not becoming incised at the nodes. *Leaf scales* 1.2–1.8 mm long, glabrous, dark brown apart from marginal cilia. *Flowers* 1(–3) per node; pedicels 2.5–3 mm long, glabrous, exceeding persistent floral bracts by 1–2 mm. *Floral bracts* imbricate, narrowly ovate, increasing in size from outer to inner, the largest of the persistent bracts c. 1.5 mm long with an acute apex, glabrous apart from marginal hairs, especially towards the apex, chestnut brown, all but a few of the bracts caducous prior to anthesis. *Bracteoles* caducous. *Calyx* glabrous apart from hairs on the margins and inner surface of the lobes apically, bright green, 4.5–5.3 mm long; lobes 1–1.2 mm long, the 2 upper lobes c. 1.5 mm wide, rounded-truncate with acute, diverging apices, the lower 3 triangular, c. 1 mm wide, with acute apices. Corolla with standard 9.5–11 mm long including a claw 3.5–4 mm long, c. 12 mm wide, exceeding other petals, deep yellow to apricot internally with red basal markings and distinct red longitudinal striations radiating from the base to the edge of the lamina, yellow to apricot externally; wings 8.5–10 mm long including a claw 2.5–3.5 mm long, yellow, with red markings near base internally, glabrous; keel 9–10 mm long including a claw 3–3.5 mm long, red with a pale base, glabrous. *Ovary* 5–5.5 mm long, 6–7-ovulate, glabrous; style 3.5–4 mm long. *Staminal filaments* 3.5–4.5 mm long, red towards the stamens; sheath 4–5 mm long, colourless. *Pods* oblong, 2.7–3.5 cm long, 0.7–0.9 cm wide, glabrous, dark reddish-brown when mature; stipe 3–4.7 mm long. *Seeds* elliptic to subreniform, 2.5–3.5 mm long, 2–2.5 mm wide, tan (Fig. 5).

**Flowering:** August–September. Fruits dehisce: December–January.

**Selected specimens examined:** New South Wales: South Coast: Lower banks of Brogo River, 0.5 km downstream from wall of Brogo Dam, *J. Miles s.n.*, 9 Sep 1997 (MEL 2040660); upper end of Brogo Dam on banks of Brogo River, *J. Miles s.n.*, 29 Dec 2001 (MEL 2114662).

**Distribution and habitat:** *Bossiaea milesiae* appears to be confined to the Brogo River catchment near Bega (South Coast) in the vicinity of Brogo Dam (Fig. 2). It is locally abundant in riparian vegetation at the break of slope above the river and, in places, in the rocky and sandy river beds. Associated species include *Acacia mearnsii*, *Allocasuarina littoralis*, *Angophora floribunda*, *Bursaria spinosa*, *Eucalyptus viminalis*, *Eucalyptus tereticornis*, *Imperata cylindrica*, *Lomandra longifolia* and *Tristaniopsis laurina* (Jackie Miles, pers. comm.).

**Conservation status:** rare but not obviously threatened at present. Locally abundant.

**Etymology:** *Bossiaea milesiae* is named after Jackie Miles, a botanist from Brogo, who alerted me to this species. Jackie has made numerous collections from south-eastern N.S.W. and contributed greatly to knowledge about rare and threatened plants in this region.

**Notes:** *Bossiaea milesiae* differs from *B. bombayensis*, *B. bracteosa* and *B. grayi* in having unequal calyx lobes. From *Bossiaea fragrans* it is distinguished by its narrower, green cladode branches, shorter corollas and the absence of red markings on the outer surface of the standard.

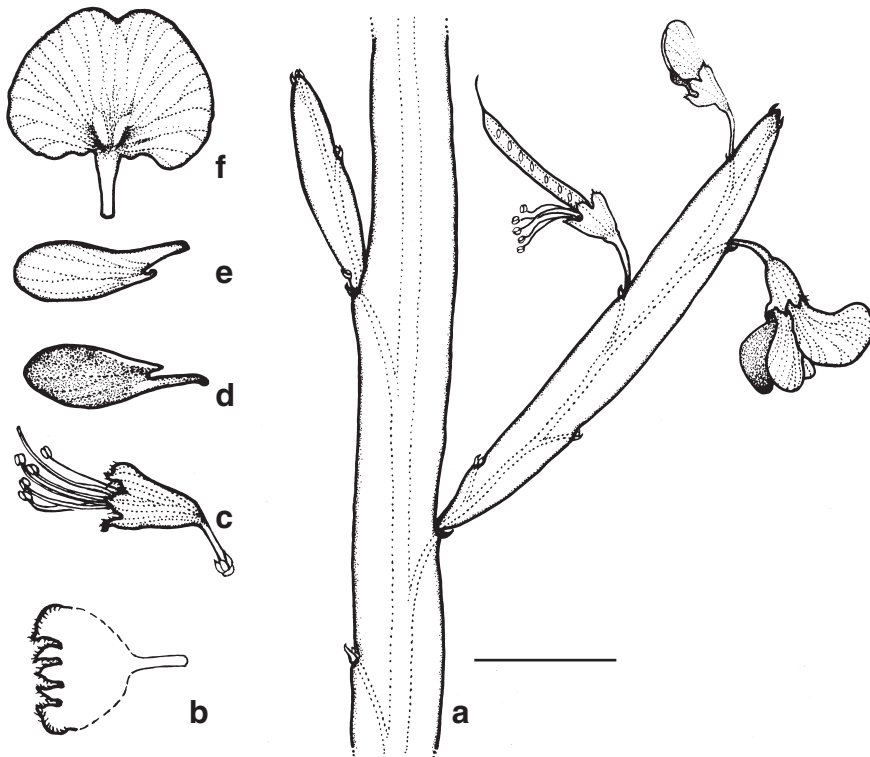


Fig. 5. *Bossiaea milesiae*. a, cladode; b, calyx (opened); c, calyx, stamens and style; d, keel; e, wing; f, standard (K.L. McDougall 1194). Scale bar: a = 10 mm; b–f = 10 mm.

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