

A revision of *Bedfordia* DC. (Asteraceae)

A.E. (Tony) Orchard

Abstract

Variation and distribution of the three species of *Bedfordia* DC. are reviewed. Extensive hybridisation between *B. salicina* and *B. linearis* is noted. *B. linearis* is divided into two subspecies, *B. linearis* subsp. *linearis* and *B. linearis* subsp. *oblongifolia*. The latter is further divided into two varieties, var. *oblongifolia* and var. *curvifolia*. The relationship of *Bedfordia* to *Brachyglottis brunonis* is briefly discussed.

Introduction

The genus *Bedfordia* consists of 3 species, all aromatic shrubs or rarely small trees, found in south-eastern Australia from New South Wales to Tasmania. The Tasmanian species have the reputation of being very variable, and this study re-examines that variation, on the basis of field studies made in 1992 and earlier. These studies have shown that two of the Tasmanian species, *B. linearis* and *B. salicina*, currently overlap in distribution, particularly on the slopes of Mt Wellington, and form extensive hybrid swarms. In addition, *B. linearis* is shown to be far more complex in its variation than previously reported, and is here considered to comprise two subspecies, one of which is further subdivided into two varieties.

The first two species of what is now *Bedfordia* were described by Labillardière (1806), from Tasmanian collections. He described them as species within the broadly circumscribed genus *Cacalia* (*C. salicina* and *C. linearis*). De Candolle (1833, 1838) separated these two taxa as the distinct genus *Bedfordia*, on the basis of their shrubby habit, yellow florets, and entire, elongated, willow-like leaves which are cottony beneath, and this separation has been maintained ever since.

When further broad-leaved plants were discovered in southern New South Wales and Victoria, they were assigned uncritically to the Tasmanian species *B. salicina* (e.g. Bentham, 1867; Maiden & Betche, 1916; Ewart, 1931). Hooker (1856) had pointed out the close similarity of *Bedfordia* to *Senecio* “to which it is united by means of the species belonging to Forster’s genus *Brachyglottis*; but as the intermediate forms are wanting in Australia, I have thought it more convenient to retain the genus for the present, its habit being very distinct from any of the *Senecios* of that country.” Mueller (1858, 1882, 1888, 1889), perhaps influenced by this view but disagreeing with the conclusion, transferred *B. salicina* and *B. linearis* to *Senecio* as *Senecio bedfordii* F.Muell. and *S. billardierii* F.Muell. Bentham disagreed with Mueller, and pointed out that *Bedfordia* has axillary inflorescences, unknown in *Senecio*; he also thought (mistakenly) that *Bedfordia* had stellate hairs, also unknown in *Senecio*. Bentham thus retained *Bedfordia* as a distinct genus. Several later authors uncritically followed Bentham in ascribing stellate hairs to *Bedfordia*, and this myth was not finally dispelled until a paper by Willis (1967). Finally, Hochreutiner (1934) recognised that the mainland specimens represented a distinct species, *B. arborescens*. Hochreutiner’s paper was largely overlooked in Australia until rediscovered by Gray (1974), but recent authors (e.g. Jeanes, 1999; Buchanan, 1999) agree on *Bedfordia* comprising three species *B. salicina*, *B. arborescens* and *B. linearis*.

In view of Hooker’s recognition of the close relationship between *Bedfordia* and *Brachyglottis*, it is of interest to note that recent molecular studies are suggesting a close relationship between *Brachyglottis brunonis* (Hook.f.) B.Nord. (syn. *Senecio brunonis* (Hook.f.) J.H.Willis, *Centropappus brunonis* Hook.f., *Senecio centropappus* F.Muell. *nom. illeg.*), a narrowly endemic shrubby species of Mt Wellington and Mt Dromedary,

Tasmania, and the partially sympatric Tasmanian *Bedfordia* species (reported by S.J.Wagstaff & I.Breitwieser, *150 Years Conference*, Melbourne, 2003).

Brachyglottis brunonis differs from *Bedfordia* in a number of morphological characters, perhaps most notably in being essentially glabrous. It has hairs confined to a ciliate fringe on the capitular bracts, and thus lacks both the cottony/woolly hairs so characteristic of *Bedfordia* species (and which gives *B. arborescens* its common name of Blanket Bush), and the subsessile glandular hairs of the young stems and leaves which provide the resinous aroma of both fresh and dried material so characteristic of *Bedfordia*. Instead, *Brachyglottis brunonis* has copious dark embedded glands in the upper surface of its leaves, and these exude a resinous glossy coating to the upper leaf surface. These glands are absent on the lower surface and do not occur in *Bedfordia* species. The midrib of *Brachyglottis brunonis* leaves is embedded in the rather fleshy lamina, not deeply channelled above and prominent below, as in *Bedfordia*. The fleshy texture of the *Brachyglottis brunonis* leaves also means that they are smooth, lacking the deeply rugose texture of *Bedfordia* species. The capitula of *Brachyglottis brunonis* bear an outer whorl of ligulate female florets, whereas *Bedfordia* completely lacks ligulate florets, all of its florets being bisexual and tubular. In *Bedfordia* the barbs on the pappus bristles are uniform in length, whereas in *Brachyglottis brunonis* the barbs at the tip of the pappus bristles are distinctly longer, forming a very short 'brush'. In view of these morphological differences it seems premature at this stage to include *Brachyglottis brunonis* in the same genus as *Bedfordia*, although they are probably closely related. If it is found that *Brachyglottis brunonis* does not belong with other *Brachyglottis* species on molecular evidence, then a more satisfactory solution might be to return to Hooker's view, and treat it as a monotypic genus *Centropappus*, alongside *Bedfordia*.

Taxonomy

Bedfordia DC., in A.-J. Guillemain, *Arch. Bot.* 2: 332 (1833)

Type: Not designated. Based on *Cacalia salicina* Labill. and *C. linearis* Labill. Lectotype (here chosen): *Bedfordia salicina* (Labill.) DC. Named in honour of John Russel, Duke of Bedford, patron of horticulture and botany, *vide* A.P. de Candolle, *Prodromus* 6: 440 (1838); J.D.Hooker, *Flora Tasmaniae* 1: 224 (1856).

Trees or *small shrubs* 1–8 (rarely to 12) m tall, aromatic due to glandular hairs on young stems and leaves. *Leaves* alternate, exstipulate, tapering to base with a short or poorly-defined petiole; lamina lanceolate to oblanceolate, planar with well defined midrib and pinnate venation, or oblong to linear with margins revolute to midrib; midrib and secondary venation if present usually impressed above, prominent below, more or less glabrous above, with woolly or velvety indumentum at least on midrib below, and sometimes across entire abaxial surface. *Inflorescences* borne in axils of upper leaves, comprising irregular panicles of 10–40 capitula, or reduced to just a single capitulum. *Peduncles* and inflorescence branches white-woolly. *Capitular bracts* in 2 whorls, each whorl of 4 or 5, woolly on outer surface, all similar, but the inner ones with glabrous margins. *Florets* 9–17 per capitulum, all bisexual and tubular. *Pappus* of 40–60 free setae; setae denticulate for entire length with teeth of equal length, unthickened at tip, arranged in a single whorl which may be slightly fused at extreme base. *Corolla tube* cream to yellow or orange, swollen at base, slender in centre and campanulate towards tip; corolla lobes ligulate or strap-like. *Anther* tails short, narrower than thecae. *Styles* exerted, carrying anther tube with them. *Cypselas* cylindrical, with 10–14 longitudinal ribs.

A genus of 3 species, confined to south eastern Australia, from sealevel to about 1200 m. Two species are confined to Tasmania; the third is found mainly in south eastern New South Wales and eastern Victoria, but extends to Cape Barren Island in Bass Strait. All are understorey species, in communities ranging from wet tall open forest to dry sclerophyll shrubland. Most seem to be pioneer species after fire or other disturbance.

Both *B. salicina* and *B. linearis* contain alkaloids (Bick *et al.*, (1991), perhaps pyrrolizidine alkaloids.

Key to the taxa of *Bedfordia*

1. Leaves lanceolate to narrowly ovate, more than 1 cm wide; inflorescences multiheaded in each leaf axil
 2. Undersurface of leaves with woolly hairs in 2 distinct layers, with hairs in outer layer arising from thickened bases and floccose*B. arborescens*
 - 2: Undersurface of leaves with woolly hairs in a single layer; hairs without thickened bases, and closely appressed/matted*B. salicina*
- 1: Leaves linear, usually less than 3 mm wide; inflorescences 1-headed in each leaf axil (rarely 3–5-headed in a few lower axils).....[*B. linearis*]
 3. Leaves (10–) 15–20x as long as wide; leaf tip bluntly acute*B. linearis* subsp. *linearis*
 - 3: Leaves 3–10x as long as wide; leaf tip rounded...[*B. linearis* subsp. *oblongifolia*]
 4. Leaves 5–10x as long as wide, more or less straight; peduncles 5–7 mm long*B. linearis* var. *oblongifolia*
 - 4: Leaves 3–5x as long as wide, with tip upwardly curved; peduncles 2–4 mm long.....*B. linearis* var. *curvifolia*

Bedfordia arborescens Hochr., *Candollea* 5: 332 (1934); G.R.Cochrane, B.A.Fuhrer, E.R.Rotherham & J.H.Willis, *Fl. Pl. Vict.* 144 (1968); A.M.Gray, *Muelleria* 3: 64–66 (1974); G.J.Harden, *Fl. NSW* 3: 298 (1992); N.G.Walsh & T.J.Entwisle, *Fl. Vict.* 4: 966 (1999).

Senecio bedfordii F.Muell., *Cat. Pl. Cult. Melbourne Bot. Gardens* 26 (1857); F.Mueller, *Syst. Census Austral. Pl.* 84 (1882); F.Mueller, *Key Syst. Vict. Pl.* 1: 340 (1888); F.Mueller, *Second Syst. Census Austral. Pl.* 142 (1889); C.Moore & E.Betche, *Hdbk Fl. NSW* 298 (1893), *nom. illeg.* (based on *Bedfordia salicina* (Labill.) DC., which itself is misapplied to the Victorian and New South Wales plants).

Bedfordia salicina auctt. mult., non (Labill.) DC.: G.Bentham, *Fl. Aust.* 3: 673 (1867), *p.p.*; J.H.Maiden & E.Betche, *Census NSW Pl.* 205 (1916); A.J.Ewart, *Fl. Vict.* 1178 (1931); J.H.Willis, *Muelleria* 1: 163 (1967); J.H.Willis, *Hdbk Pl. Vict.* 2: 756 (1972); N.T.Burbidge & M.Gray, *Fl. ACT* 375 (1976).

Type: *B.P.G.Hochreutiner 3046*, 26.ii.1905, Australia, Victoria, mts Blackspurs, forêt d'*Eucalyptus* à sous-bois dense, alt. 600m., arbre de 8.m à fleurs jaunes. Holo: G, *n.v.*, photo. CANB!

Illustrations: G.R.Cochrane, B.A.Fuhrer, E.R.Rotherham & J.H.Willis, *Fl. Pl. Vict.* 144 (1968); N.T.Burbidge & M.Gray, *Fl. ACT* 377 (1976); N.G.Walsh & T.J.Entwisle, *Fl. Vict.* 4: 967, fig. 198a (1999).

Shrubs or *small trees* 5–8 (–12) m tall. Young *branches* with dense white-woolly indumentum. Older branches glabrescent; leaf scars slightly raised but not peg-like. *Leaf* lamina oblong to narrow-elliptic or lanceolate, 10–22 cm long, 2–5 cm wide, tapering abruptly to a slender petiole (1–) 2–3 cm long; tip blunt to rounded; margins flat, entire to crenate; upper surface dark glossy green, glabrous, with impressed veins; lower surface densely and thickly woolly tomentose throughout, with hairs in 2 distinct layers (outermost floccose), with veins largely obscured. *Inflorescence* an irregular panicle of (10–) 20–30 (–40) capitula in the axils of several of the upper leaves. *Peduncle* white-woolly, bearing reduced narrow bracts; pedicels similar, with or without bracts. *Capitular bracts* in 2 whorls usually of 4–5 each. Outer bracts broadly lanceolate, 4–6 mm long, 1–2 mm wide, slightly navicular, acute to blunt, entirely white-woolly but with no

terminal tuft of hairs. Inner bracts similar, but with more or less glabrous margins. *Florets* 10–14 per capitulum, all bisexual, tubular. *Pappus* of 40–60 free setae, denticulate for entire length, arranged in a single basally fused ring. *Corolla tube* yellow to orange, in 3 sections: basal swollen section 0.5–0.7 mm long, 0.8 mm diam.; central slender section 2.5–3.0 mm long, 0.5 mm diam.; terminal campanulate section 0.5 mm long, 0.8 mm diam., with 5 ligulate reflexed/curling corolla lobes 1.5 mm long. *Anther* tube yellow–orange, 1.0–1.7 mm long; anther tails short; anther appendages 0.4–0.5 mm long, narrower than or equalling the thecae. *Style* arms c. 1.0–1.2 mm long, thick, blunt, with very short antrorse hairs on abaxial surface. *Cypselas* cylindrical, 2.9–3.0 mm long, 0.6 mm diam., red-brown with 10 weakly paired vertical ribs.

Ecology: Most collections are described as coming from the shrub understorey of relatively wet tall open forest (e.g. *Eucalyptus fastigiata* - *E. cypellocarpa* - *E. elata* forest with understorey shrubs such as *Pomaderris aspera*, *Cyathea australis*, *Polystichum*, *Dicksonia*, *Atherosperma*, *Elaeocarpus* and *Olearia argophylla*) at altitudes of up to 1160 m. Flowering and fruiting from October to about February, with old capitula remaining on the plant for most of the year.

Distribution: Endemic to south eastern Australia; in the South Coast and Southern Tablelands regions of New South Wales; in Victoria in the Midlands, Otway Plain, Otway Range, Eastern Highlands, Gippsland, Gippsland Highlands, Wilson's Promontory, Snowfields, and East Gippsland region; and an outlier in Tasmania on Mt Munro, Cape Barren Island. *Figure 1A*.

Specimens examined (selection): NEW SOUTH WALES: *I.Crawford* 1305, 28.i.1991, Tantawangalo State Forest (CANB, MEL, NSW); *R.Pullen* 3944, 20.xi.1963, Brown Mountain, E of Nimmitabel (A, B, C, CANB, H, L, K, NSW, WELT); *A.J.Whalen* 348, *G.T.Chandler* & *S.Fethers*, 16.xii.1998, 4 km along Bemboka River Road (CBG, MEL, NSW). AUSTRALIAN CAPITAL TERRITORY: *R.Pullen* 2534, 10.i.1961, saddle to S of Mt Coree (A, AD, B, BH, BISH, BM, BRI, CANB, G, K, L, MEL, NSW, P, SING, Z); *M.M.Richardson* 82, *P.Ollerenshaw* & *S.Walton*, 22.iv.1987, 7.5 km from Uriarra Road on Blue Range Road (CANB). VICTORIA: *E.M.Canning* 1460, 4.i.1969, 70.8 km from Corryong toward Omeo (CBG, L); *A.E.Orchard* 6125, 18.i.1991, 9 km from Apollo Bay along Great Ocean Road (HO); *R.Schodde* 3185, headwaters of Don River, Donna Buang Range (K); *R.V.Smith* 73/37, 21.xi.1975, Cudgewa Bluff (AD, BRI, HO, CANB, NSW). TASMANIA: *P.Collier* 3598, 7.x.1988, Mt Munro, Cape Barren Island (HO); *P.Cullen s.n.*, 15.iii.1990, Mt Munro, Cape Barren Island (HO).

Bedfordia salicina (Labill.) DC., *Prodr.* 6: 441 (1838); J.D.Hooker, *Fl. Tasman.* 1: 224 (1856); L.Rodway, *Tasman. Fl.* 92 (1903) *p.p.*; W.M.Curtis, *Student's Fl. Tasman.* 2: 371 *p.p.*; J.H.Willis, *Muelleria* 1: 163 (1967), *p.p.*; A.M.Gray, *Muelleria* 3: 64–66 (1974).

Cacalia salicina Labill., *Nov. Holl. Pl.* 2: 37, Tab. 179 (1806).

Culcitium salicina (Labill.) Spreng., *Syst. Veg.* 3: 431 (1826).

Type: J.J.H. de Labillardière, [SE Tasmania] Habitat in capite Van-Diemen, *n.v.* Possible isotype: “*Cacalia salicina*, ex herb. P.B.Webb” (no collector or locality), K.

Illustrations: J.J.H. de Labillardière, *Nov. Holl. Pl.* 2: Tab. 179 (1806); A.M.Gray, *Muelleria* 3: 66, fig. 30a (1974).

Shrubs or *small trees* to 2–5 (–7) m tall. Young *branches* with dense white-woolly indumentum. Older branches glabrescent, leaf scars flattened, peg-like. *Leaf* lamina oblanceolate, 6–13 cm long, 1.0–1.8 cm wide; tip acute to rounded; margins flat to slightly revolute, sometimes slightly undulate; upper surface dark glossy or dull green, glabrous, with midrib and secondary veins obvious and impressed; lower surface completely covered with a fine white-woolly indumentum in a single matted layer which does not obscure the prominent midrib and lateral veins; lamina tapering to a slender petiole 1.0–1.5 cm long; petiole widening abruptly at base. *Inflorescence* an irregular

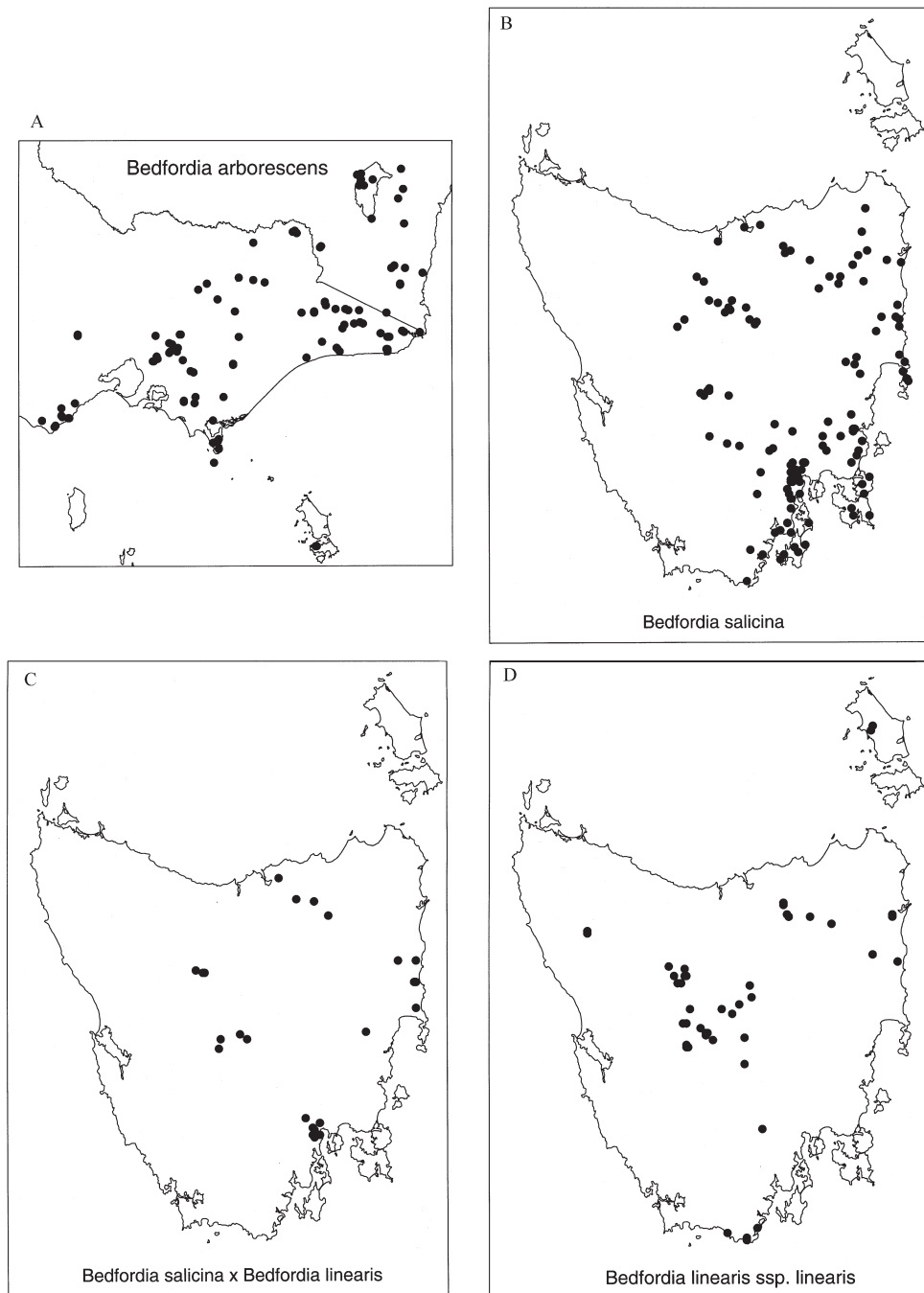


Figure 1. Distribution maps. **A.** *Bedfordia arborescens*. **B.** *Bedfordia salicina*. **C.** *Bedfordia salicina* x *Bedfordia linearis*. **D.** *Bedfordia linearis* ssp. *linearis*.

panicle of (3–) 8–25 (–40) capitula in the axils of several upper leaves; sometimes with 2 or 3 panicles per axil. *Peduncle* white-woolly, bearing reduced leaf-like bracts; pedicels similar, slender, 2–5 mm long, also with 2–3 narrow white-woolly bracts. *Capitular bracts* in 2 whorls of usually 4 each. Outer bracts lanceolate, 4.3–5.0 (–5.8) mm long, 1.3 mm wide, slightly navicular, acute, slightly thickened at base, entirely white-woolly, with midrib darker, and with a terminal tuft of hairs. Inner bracts similar but slightly wider, 1.7–1.8 mm wide, with 1 or 2 subglabrous wing-like margins; tip blunt with a terminal hair tuft; wing margins ciliate near apex. *Florets* 10–15 per capitulum, all bisexual, tubular. *Pappus* of 40–60 free setae, denticulate for entire length; arranged in a single slightly lobed ring. *Corolla tube* yellow, in 3 sections: basal swollen section 0.5 mm long, 0.8 mm in diam.; central slender section 2.2 mm long, 0.5 mm diam.; terminal campanulate section 0.8 mm long, 0.8 mm diam., with 5 ligulate reflexed/curled corolla lobes 1.7 mm long. *Anther* tube pale brown, 1.0–1.7 mm long; anther tails short; anther appendages c. 0.4 mm long, linear, narrower than thecae. *Style* arms c. 1.0–1.2 mm long, thick, blunt, with very short antrorse hairs on abaxial surface. *Cypselas* cylindrical, 2.9 mm long, 0.7 mm diam., red-brown with 10 lighter coloured weakly paired vertical ribs.

Ecology: Most collections are described as coming from the shrubby understorey of dry sclerophyll forest, on dolerite soils, although there is considerable variation. Commonly associated species include *Eucalyptus obliqua*, *E. delegatensis*, *E. globulus*, *E. pulchella*, *Pomaderris apetala*, *Acacia dealbata*, *A. mucronata*, *Leptospermum lanigerum*, *Bursaria spinosa*, *Dodonaea viscosa*, *Olearia viscosa*, *Monotoca glauca*, *Blechnum watsii* and *B. nudum*. Altitudinal range: sealevel to 1000 m. Flowering occurs from (September–) October–December with fruit remaining until about March. Old empty capitula remain on the plant year round.

Distribution: Endemic to mainland Tasmania: most frequent in the East Coast region, moderately common in the Central Highlands, and with occasional records from the North West, North East, Midlands, Ben Lomond, Mt Wellington and eastern part of the South West regions. *Figure 1B*.

Specimens examined (selection): NORTH WEST: *A.M.Buchanan* 7527, 28.xi.1985, Mersey River 0.2 km downstream from Alum Cliffs (HO). MIDLANDS: *A.M.Buchanan* 13450, 28.ix.1993, Clarence Point, West Tamar (HO); *A.Moscal* 12737, 14.iii.1986, Dale Brook, c. 13 km SSE of Mole Creek (HO). NORTH EAST: *A.M.Buchanan* 4897, 13.xii.1984, above Pipers River near Karoola (HO); *A.M.Buchanan* 12371, 25.v.1992, corner of Basin Creek Road and Old Coach Road (HO); *A.M.Buchanan* 11278, 30.xii.1988, head of Constable Creek (HO). BEN LOMOND: *M.J.Brown* 801, 13.iii.1985, Mt Albert (HO); *A.M.Buchanan* 4516, 15.xi.1984, Eton Road, Billy Taylor Bridge (HO); *A.M.Buchanan* 7361, 25.xi.1985, end of Cox 9, Tower Hill Plantation (HO). CENTRAL HIGHLANDS: *N.T.Burbidge* 3316, 24.i.1949, 8 km N of Tarraleah (HO); *A.M.Gray* s.n., 25.v.1975, Tungatinah (HO); *A.Moscal* 18328, 5.i.1990, head of Garcias Creek, Cathcart Bluff (HO). MT WELLINGTON: *D.Paton, J.Willis & R.Melville* s.n., 15.xii.1952, Mt Wellington (HO). EAST COAST: *A.M.Buchanan* 4823, 11.xii.1984, Reynolds Hill (HO); *A.M.Buchanan* 8337, 29.iii.1986, Variety Bay, North Bruny Island (HO); *A.E.Orchard* 5012, 16.iv.1978, Forest Rd extension, Knocklofty (AK, BAA, HO, NSW). SOUTH WEST: *A.M.Buchanan* 8357, 30.iii.1986, Fluted Cape, South Bruny Island (HO).

Bedfordia salicina x Bedfordia linearis

Hybrids between *B. salicina* and *B. linearis* are common, especially on the slopes of Mt Wellington and vicinity, but several records are also known from the Central Highlands, and occasional specimens from the North East and Ben Lomond regions. *Figure 1C*. Well-developed hybrid swarms can be found with plants displaying all leaf shapes between *B. salicina* and *B. linearis*. Many of these plants have leaves with the shape of *B. linearis* (both subspecies), but the hairs of *B. salicina*. Inflorescence structure in these hybrid plants is intermediate between the two species, and usually consists of panicles of

2 or 3 capitula per axil. Occasional specimens set apparently normal seed, and the populations have the appearance of containing both F1 and backcross progeny.

Specimens examined (selection): NORTH EAST: *A.M.Buchanan 12420*, 7.vii.1992, Dismal Range (HO); *A.M.Buchanan 15437*, 3.ii.1999, NE ridge Mt Arthur (HO, CANB); *P.Collier 2623*, 28.viii.1987, Tippogoree Hills (HO). BEN LOMOND: *W.D.Jackson s.n.*, 23.ii.1983, Mt Barrow (HO); *A.V.Ratkovsky s.n.*, 12.i.1992, Mt Barrow (HO). CENTRAL HIGHLANDS: *A.M.Buchanan 2024*, 9.xii.1983, 14 Mile Road near Tarraleah (HO); 1 km NE of Howell's Bluff, Lake Rowallen (HO); *J.Wells s.n.*, 30.v.1984, Mags Road Bogs (HO). EAST COAST: *A.M.Buchanan 7688*, 29.xii.1985, Mt Peter (HO); *W.M.Curtis s.n.*, 15.ix.1942, Hobart, Proctor's Road (HO); *J.Milligan 1039*, 9.vii.1848, ravines between Mt Wellington and Knocklofty, Hobart (HO); *A.E.Orchard 6246, 6247, 6248, 6249*, 1991, old quarry site, slopes of Mt Wellington (HO).

Bedfordia linearis (Labill.) DC. *Prodr.* 6: 441 (1838); J.D.Hooker, *Fl. Tasman.* 1: 225 (1856); L.Rodway, *Tasman. Fl.* 92 (1903); W.M.Curtis, *Student's Fl. Tasman.* 2: 371 (1963); M.Cameron, *Guide Fl. Pl. Tasman.* 44 (1981).

Cacalia linearis Labill., *Nov. Holl. Pl.* 2: 36, tab. 178 (1806).

Culcitium lineare (Labill.) Spreng., *Syst. Veg.* 3: 431 (1826).

Senecio billardierii F.Muell., *Cat. Pl. Cult. Melbourne Bot. Gardens* 26 (1858); F.Mueller, *Syst. Census Austral. Pl.* 84 (1882); F.Mueller, *Second Syst. Census Austral. Pl.* 142 (1889), *nom. illeg.* (based on *Bedfordia linearis* (Labill.) DC.)

Type: J.J.H. de Labillardière, [SE Tasmania] Habitat in capite Van-Diemen, *n.v.* Possible isotype: "Cacalia linearis, N. Holl." (no collector), K.

Illustrations: J.J.H. de Labillardière, *Nov. Holl. Pl.* 2: tab. 178 (1806); Cameron, *Guide Fl. Pl. Tasman.* fig. 83 (1981).

Shrubs 1–2 (–3) m tall. Young *branches* with dense white-woolly indumentum, becoming discoloured with age, at first with a yellowish resin, later with adherent dust; older branches glabrescent, with peg-like leaf scars. *Leaf* lamina linear to oblong or narrowly oblong, (6–) 10–90 mm long, to 3 mm wide, very shortly petiolate; upper leaf surface glabrous, glossy, with midrib impressed and other veins obscure. *Inflorescence* of a single capitulum in each of several upper leaf axils (very rarely with 3–5 in lower axils; upper axils always bearing only a single capitulum); *peduncle* 2–7 mm long, white-woolly, with 3 linear bracts. *Capitular bracts* in 2 whorls, with c. 4 bracts in each, all lanceolate but inner whorl generally broader; central region white-woolly; margins wing-like and subglabrous, usually with ciliate margins. Florets 9–17 per capitulum, all bisexual and tubular. *Pappus* of 40–60 free seta, denticulate for entire length. *Corolla tube* cream to yellow, swollen at base, slender in centre and campanulate at apex, with 5 strap-like lobes. *Anther* tube brown; anther tails short; anther appendages linear, 0.5 mm long, narrower than thecae. *Style* arms 1.3–1.6 mm long, thick, blunt, with short antrorse hairs on abaxial surface. *Cypsela* deep purplish-black, cylindrical, 2.5–3.3 mm long, 0.7–1 mm diam., with 10–14 vertical ribs; pappus persistent with basal pappus ring weakly 5-lobed.

Bedfordia linearis subsp. *linearis*

Shrubs to 1.5–2.0 (–3.0) m tall. Young *branches* densely white-woolly; bark red-brown to grey-brown, vertically striate to stringy. *Leaf* lamina narrowly linear, (25–) 35–70 mm long, 1.5–2.0 (–2.5) mm wide, length:width ratio 15–20 (rarely only 10); tip bluntly acute, slightly reflexed; margin revolute. Lower leaf surface densely white-woolly with crisped hairs arising mainly from midrib, interlocking with similar hairs on the upper and lower surface of the thin reflexed margin; lamina either side of midrib more or less glabrous apart from scattered sessile yellow glandular hairs; midrib with or without a longitudinal subcuticular void on each side; petiole 1–2 mm long, persistent as a peg after leaf fall. *Peduncle* 4–6 mm long, white-woolly, with c. 3 linear bracts 2 mm long. *Capitular bracts* in 2 whorls of usually 4 each. Outer bracts narrowly lanceolate, 5.0–6.0

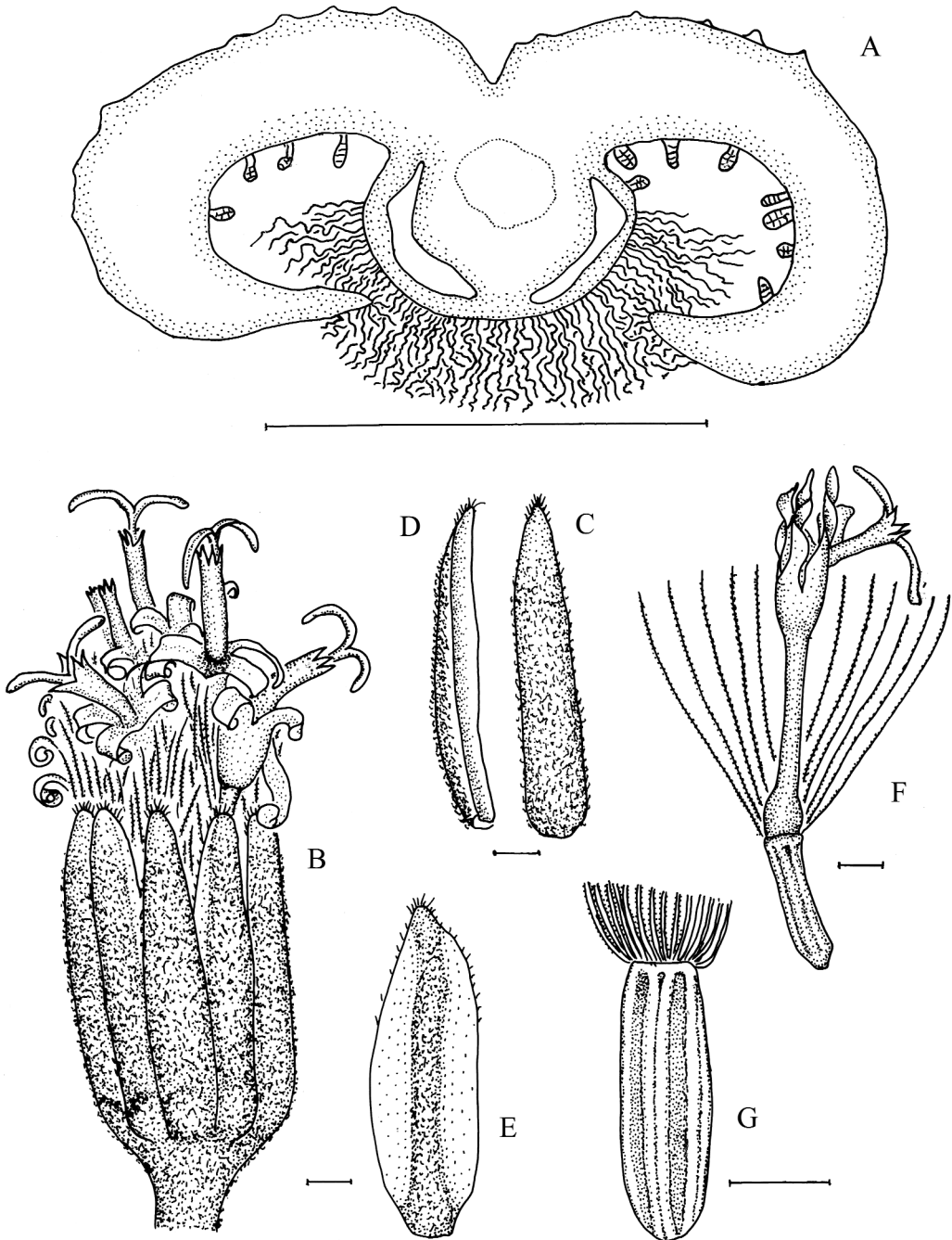


Figure 2. *Bedfordia linearis* subsp. *linearis*. **A.** Leaf cross section (semidiagrammatic) – note voids alongside midrib. **B.** Capitulum. **C.** Outer capitular bract (dorsal view). **D.** Outer capitular bract (lateral view). **E.** Inner capitular bract (dorsal view). **F.** Floret (some pappus bristles removed). **G.** Mature cypsela. (A–G, *P. Collier 3109*). All scale bars represent 1 mm.

(–7.0) mm long, 1.5 mm wide, slightly navicular, with darker midrib, dorsally white-woolly, sometimes slightly thickened at base. Inner bracts similar but broader, c. 1.8–2.0 mm wide, with subglabrous wing-like margins; central region white-woolly; wing margins ciliate, especially distally; tip rounded to acute, with a short terminal tuft of hairs. *Florets* c. 12–17 per capitulum, all bisexual, tubular. *Corolla tube* yellow, in 3 sections: basal section 0.5–0.6 mm long, swollen, 0.8 mm diam.; central section 3.3 mm long, slender, 0.4 mm diam.; terminal section 0.8–0.9 mm long, swollen, campanulate, 0.75 mm diam., with 5 strap-shaped corolla lobes c. 2 mm long and variously twisted or curled after anthesis. *Anther* tube 1.6–2.1 mm long; anther appendages linear, c. 0.5 mm long, narrower than thecae. *Style* arms c. 1.7 mm long, thick, blunt, with short antrorse hairs on abaxial surface. *Cypsela* dark purplish black, approximately cylindrical, 2.5–2.9 mm long, 0.8 mm diam. in centre, tapering very slightly to each end, faintly reticulate, with c. 12–14 longitudinal ribs; pappus persistent; pappus ring unlobed. *Figure 2.*

Ecology: Found in a range of habitats, usually somewhat wetter than those described for subsp. *oblongifolius*. Frequently a shrub in the understorey of *Eucalyptus delegatensis* (sometimes *E. amygdalina*) forest, often on stony soils. While many collections are from river valleys, other specimens are described as growing only on ridges, or on scree slopes. Flowering occurs December–January, fruits are present until March, and old empty capitula remain on the plant year-round.

Distribution: Endemic to Tasmania. Most common in the Central Highlands region, but extending also to the Furneaux, North East, East Coast, Ben Lomond, West Coast and South West regions. Generally found at slightly higher altitudes (to 1130 m) than subsp. *oblongifolia*, especially where the two abut in distribution on the East Coast, but descending to sealevel on the south coast. *Figure 1D.*

Specimens examined (selection only): FURNEAUX: *P.J.Cullen s.n.*, 31.i.1990, Flinders Island, Brougham Sugarloaf (HO128675); *L.Rodway 423*, -i.1895, Flinders Island (HO); *J.S.Whinray 8987 & 9386*, 7.i.1991, State Forest in the upper NW corner of Badger Gully (AD, CANB, HO, NSW); *J.S.Whinray 9351*, no date, State Forest 1 km E of Sugarloaf (AD, CANB, HO, MEL). NORTH EAST: *T.E.Burns 183*, 5.xii.1959, Prossers Forest (HO); *A.M.Buchanan 10549*, 2.x.1987, above Pipers River near Karoola (HO). BEN LOMOND: *A.M.Buchanan 219*, 21.iv.1980, Mt Barrow, north-east slopes (CHR, HO); *P.Collier 1291*, 18.iii.1986, Ben Nevis (HO). CENTRAL HIGHLANDS: *A.M.Buchanan 128*, 1.i.1980, head of Arm River/Pelion Track (AD, AK, HO); *N.T.Burbidge 3419*, 6 miles [9.5 km] SW of Great Lake (K); *A.M.Gray s.n.*, 10.i.1977, Derwent Bridge, Lyell Highway (AK, CANB, HO); *A.Moscal 1474*, 22.i.1983, Howell's Bluff, Fish River, Walls of Jerusalem (AD, HO, MEL). WEST COAST: *A.M.Buchanan 11631*, 25.i.1990, Brassey Hill (HO); *A.M.Buchanan 13390*, 10.vi.1993, Duffs Hill, Heazlewood River (HO). EAST COAST: *A.M.Buchanan 7406*, 26.xi.1985, E Road, above Picaninny Creek (HO); *P.Collier 651*, 15.ix.1985, N of The Basin, Ouse River (HO). SOUTH WEST: *P.Collier 2848*, 26.ix.1987, Sullivan Point, Recherche Bay (HO); *K.D.Nicolls s.n.*, 17.xii.1978, South Cape Bay, c. 1.5 km SE of Lion Rock (AK, HO).

Discussion: The majority of plants have leaves with a length:width ratio of 15–20. Occasional plants have shorter leaves in which the ratio approaches 10X, especially in the Prossers Forest/Ben Nevis/Mt Barrow region, but also elsewhere. These can be distinguished from narrow-leaved forms of *B. linearis* var. *oblongifolia* by their slightly tapering leaf tips and shorter involucral bracts. It should be noted that hybrids, *B. linearis* × *B. salicina*, also occur on Mt Barrow (e.g. *Jackson s.n.*, HO62110), and that some of these (particularly backcrosses) can also resemble *B. linearis* subsp. *linearis*.

A collection from Lake Sorell (*Moscal 19281*, HO144419) is somewhat intermediate between subsp. *linearis* and subsp. *oblongifolius* in leaf shape and size (20–23 × 2–2.5 mm) and underlines the close relationship between these two taxa. It has been included here under subsp. *linearis* because its capitular bracts measure only 5–6 mm, more in keeping with that subspecies. Other small leaved forms of subsp. *linearis* can be found in the Launceston/Mt Barrow area (for example HO98134, HO62111, HO36230). However, other collections from the same area (for example HO36138) are clearly subsp. *linearis*.

In inland collections, as the leaf matures the epidermis on the lower surface and one or two layers of the underlying parenchyma separate from the remaining parenchyma and form elongated inflated voids alongside the midrib. These voids are clearly visible in transverse section at 10X magnification. In lowland/coastal collections (e.g. from the south coast, Brassey Hill, Karoola and Flinders Island) the parenchyma around the lower side of the midrib increases in size and therefore there is no separation and no development of voids.

***Bedfordia linearis* subsp. *oblongifolia* Orchard, subsp. nov.**

Diagnosis: Frutices subsp. *linearem* simulans, sed foliis oblongis vel anguste oblongis (longitudine:latitudo minus quam 10:1), apicibus foliorum rotundatis, differt.

Type (here designated): *A.M. Gray 596*, 9.xii.1981, Tasmania: Summerleas Road, c. 1.5 km from Ferntree. Holotype: HO46635. Isotypes: AD, AK, MEL.

Shrubs 1–2 (–3) m tall. Young *branches* densely white-woolly, becoming discoloured with age, at first with yellowish resin, later with dust adhering to resin; bark dark grey/black. *Leaf* lamina oblong to narrowly oblong, spreading, straight or sigmoidly curved with tips upwardly curved, (6–) 10–20 (–45) mm long, (1.5–) 2–3 mm wide, length:width ratio 3–10; tip rounded, blunt; margin revolute. Lower leaf surface glabrous apart from scattered glandular hairs, obscured by dense white woolly hairs arising from the midrib and interlocking with usually sparse similar hairs on the upper and lower surface of the revolute margins; midrib with or without a longitudinal subcuticular void on each side; petiole c. 1 mm long, persistent as a peg after leaf fall. *Peduncle* 2–7 (–13) mm long, white-woolly, with 3 linear bracts 1.5–2 mm long. *Capitular bracts* in 2 whorls of usually 4 each. Outer bracts narrowly lanceolate, often slightly thickened at base, (4.5–) 5–7.5 (–8.0) mm long, 1.4 mm wide, slightly navicular with darker midrib, dorsally white-woolly; tip rounded or blunt, sometimes almost acute, with a terminal hair tuft. Inner bracts similar but broader, 1.7–2.0 (–2.5) mm wide; tip rounded to acute. *Florets* 9–17 per capitulum, all bisexual, tubular. *Corolla tube* cream to yellow, in 3 sections: basal section swollen; central section slender; terminal section campanulate, with 5 ligulate lobes. *Anther* tube brown; anther appendages linear, narrower than thecae; anther tails short. *Style* arms thick, blunt, with short antrorse hairs on abaxial surface. *Cypsel*a dark purplish black (sometimes deep red-brown with lighter brown ribs), approximately cylindrical, 2.9–3.3 mm long, 0.7–1.0 mm diam., tapering slightly to base, with 10–12 paired longitudinal ribs, throughout faintly reticulate; pappus persistent; pappus ring weakly 5-lobed.

This subspecies comprises 2 varieties (see key under generic description, above):

Bedfordia linearis* (Labill.) DC. subsp. *oblongifolia* var *oblongifolia

Shrubs 1–2 m tall. *Leaf* lamina straight, spreading at 90° to stem, oblong to narrowly oblong, 10–20 (–45) mm long, (1.5–) 2.5–3 mm wide, length:width ratio c. 5–10; tip rounded, blunt; lower midrib with or without voids. *Inflorescences* of single pedunculate capitula in upper leaf axils (rarely a few lower axils with 3–5-capitular inflorescences). Peduncles 5–7 (–13) mm long. Outer *capitular bracts* (6.0–) 6.5–7.5 (–8.0) mm long; inner capitular bracts 1.8–2.0 mm wide. *Florets* c. 12–17 per capitulum. *Corolla tube* cream; swollen basal section 0.4 mm long, 0.8 mm diam.; slender central section 2.1 mm long, 0.4 mm diam.; terminal campanulate section 1.2–1.6 mm long, 1.0 mm diam.; corolla lobes 1.5–2.0 mm long, strongly reflexed/curled. *Anther* tube 1.7–1.8 mm long; appendages c. 0.5 mm long. *Style* arms c. 1.6 mm long. *Cypsel*a 3.3 mm long, 1.0 mm diam., with 10 paired reddish brown vertical ribs. *Figure* 3A–E.

Ecology: Most collections are described as coming from dry stony dolerite soils in open *Eucalyptus* forest. On the Central Highlands the forest is usually *E. delegatensis*,

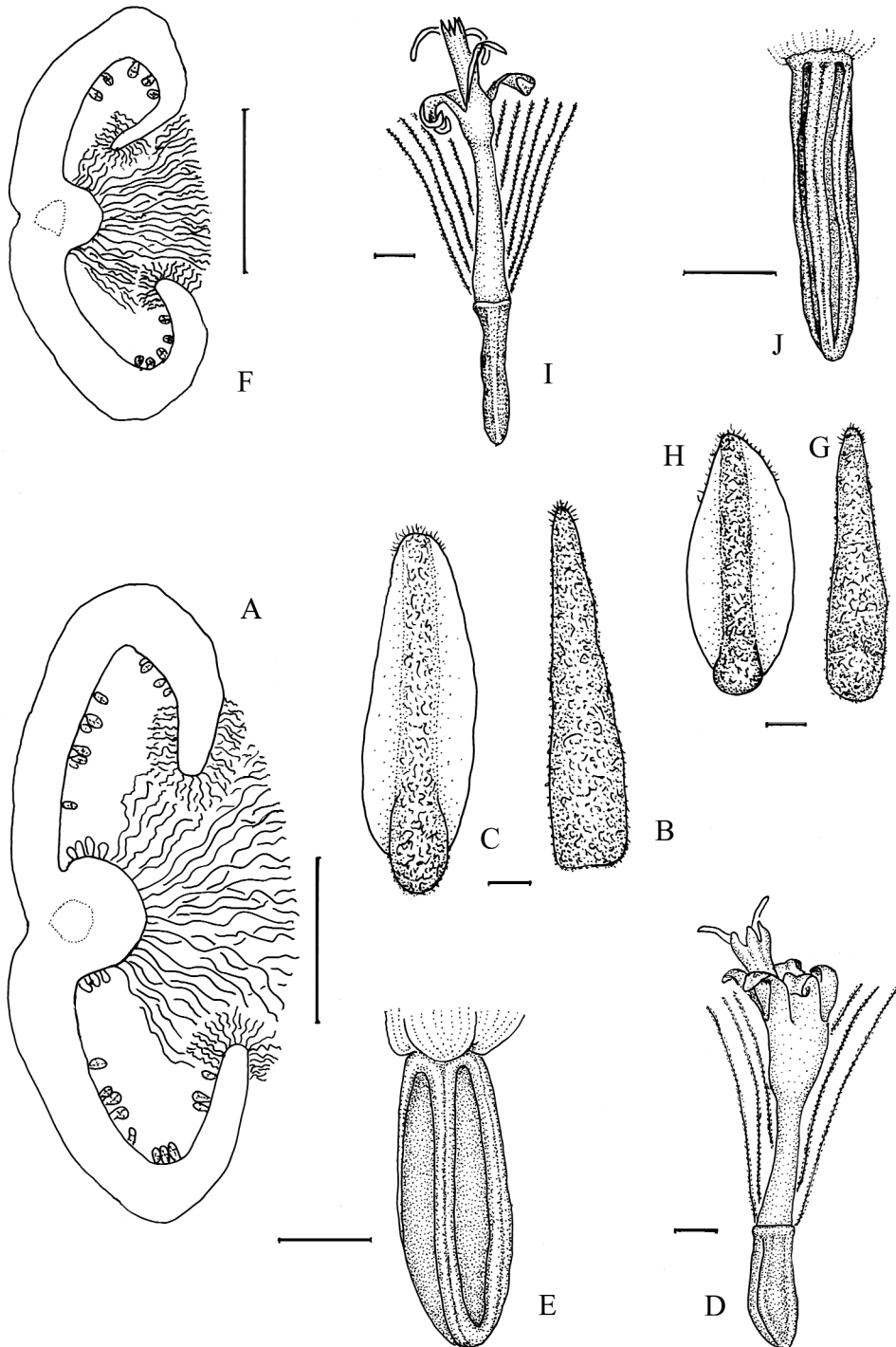


Figure 3. *Bedfordia linearis* subsp. *oblongifolia*. **A–E.** var. *oblongifolia*. **A.** Leaf cross section (semidiagrammatic). **B.** Outer capitular bract (dorsal view). **C.** Inner capitular bract (dorsal view). **D.** Floret (some pappus bristles removed). **E.** Mature cypselas. **F–J.** var. *curvifolia*. **F.** Leaf cross section (semidiagrammatic). **G.** Outer capitular bract (dorsal view). **H.** Inner capitular bract (dorsal view). **I.** Floret (some pappus bristles removed). **J.** Cypselas (slightly immature). (**A–D.** *A.M.Gray 596*; **E.** *L.Rodway s.n.*, HO9739; **F–J.** *A.E.Orchard 5160*). All scale bars represent 1 mm.

with a shrubby understorey of *Bedfordia linearis*, *Leptospermum lanigerum*, *Callistemon viridiflorus*, *Helichrysum thyrsoideum*, *Hakea lissosperma*, *Notolaea ligustrina*, *Acacia mucronata* and *Poa labillardieri*. On the East Coast the dominant trees are *E. pauciflora*, *E. amygdalina*, *E. pulchella*, *E. tenuiramis*, *E. delegatensis* or *E. globulus*, and the associated shrubs include *Hakea epiglottis*, *Parahebe formosa* and *Westringia rubiaefolia*. Soils are usually described as dry, but a few collections are from the margins of marshes, and these plants tend to be unusually robust. Altitudinal range is 280–550 m in the East Coast region, extending to 1000–1090 m in the Central Highlands and Ben Lomond regions. Flowering occurs (October–) December–February, fruiting in February. Remains of old heads are retained on the plant for about 12 months.

Distribution: Endemic to Tasmania. Most common in the East Coast region between the Douglas/Apsley Rivers and Hobart/Mt Wellington, with outliers in the Central Highlands and Ben Lomond regions. *Figure 4A*.

Specimens examined: CENTRAL HIGHLANDS: *A.M.Buchanan 15404*, 23.xii.1998, Tods Corner, Great Lake (HO); *A.Moscal 17046*, 24.ii.1989, Mountain Creek (HO); *A.Moscal 18368*, 11.i.1990, Cathcart Bluff (CANB, HO); *A.Moscal 18815*, 11.ii.1990, Snowy Knob (HO); *A.Moscal 19281*, 19.iii.1990, Tods Hill, Lake Sorell (HO); *A.Moscal 19371*, 25.iii.1990, 1.5 km W of Sandbanks Tier (HO). BEN LOMOND: *G.Williams s.n.*, 19.iii.1993, Rigney Hills area (HO). EAST COAST: *M.Allan s.n.*, 12.ii.1989, near upper Douglas River on track to Heritage Falls (HO); *M.J.Brown 192*, 3.v.1983, slope W of Apsley River (HO); *P.Collier 965*, 3.xi.1985, north side of Mt Andrew (HO); *F.Duncan s.n.*, 8.xii.1987, 'O' Road, S of Swilly Marsh (HO); *F.Duncan s.n.*, 25.xi.1993, Rigney Hills (HO); *A.V.Giblin s.n.*, 15.x.1929, New Town Creek (HO); *A.M.Gray s.n.*, Summerleas Road, 2 km from Huon Highway (HO); *A.M.Gray 778*, 14.i.1995, North M Road, Black Marsh (HO); *A.M.Gray 813c*, 5.ix.1996, corner of Valley Road and Meadstone Falls Road (HO); *A.Moscal 173*, Mt Allen marsh, summit of Mt Allen, near Bicheno (HO); *A.Moscal 245*, 20.iii.1980, Bedggood Hill, ridge near Stonyford Creek watershed (HO); *A.Moscal 285*, 9.iv.1980, Horseshoe Marsh, St Pauls River (HO); *A.Moscal 936*, 6.iii.1982, Storeys Creek, 4 km upstream

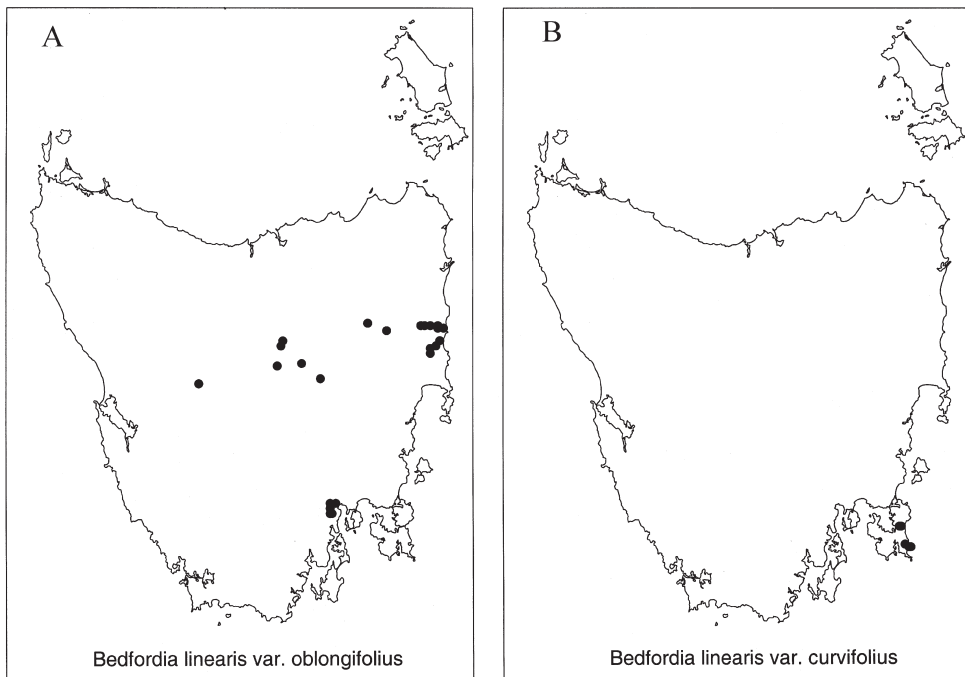


Figure 4. Distribution maps. A. *Bedfordia linearis* var. *oblongifolia*. B. *Bedfordia linearis* var. *curvifolia*.

from Aberfoyle Homestead (HO); *A.Moscal* 26424, 24.xii.1994, Thompson's Marshes (HO); *A.F.Oldfield* 217, swamp near the NW Bay Rivulet, Huon Track (K); *A.V. & D.A.Ratkowsky* 945, 29.xi.1973, Dunns Creek, between Chimney Pot and Ridgeway (HO); *L.Rodway s.n.*, 15.i.1893, near Fern Tree (HO); *D.Ziegeler* 56, 13.vi.1988, Horseshoe Marsh, Eastern Tiers (HO).

Discussion: Plants of this variety on Mt Wellington lack the voids alongside the lower surface of the midrib. Plants from the east coast vary, some having voids, others lacking them.

The collection *Collier* 965 from Mt Andrew has very narrow leaves for this variety (1.5 mm), but its leaf proportions suggest it belongs here.

Some plants from dry places on the slopes of Mt Wellington (e.g. *Ratkowsky & Ratkowsky* 945; *Rodway s.n.*, HO9739) have shorter than normal leaves (10–12 mm long; ratio l:w = 3–4), and superficially resemble var. *curvifolia*. However, the leaves are more or less straight, not sigmoid with upwardly curved tips, and the capitular peduncles are 4–5 mm long, suggesting that these are just depauperate var. *oblongifolia*, not var. *curvifolia*. The collection *Moscal* 936 from Storeys Creek also superficially resembles var. *curvifolia*, but its long peduncles suggest it belongs in var. *oblongifolia*.

Most plants have inflorescences consisting of single capitula in the axils of the upper leaves. However very robust plants from Mt Wellington (e.g. *Gray s.n.*, HO27375) have occasional irregular panicles of 3–5 capitula in some of the lower fertile leaf axils. Even in these plants, most axils bear only a single capitulum.

Another collection (*Gray* 778) from Black Marsh is also very robust and has leaves to 45 mm long. However, in leaf width (3–4 mm) and peduncle length (2–3 mm) this plant belongs here.

***Bedfordia linearis* subsp. *oblongifolia* var. *curvifolia* Orchard, var. nov.**

Diagnosis: Frutices var. *oblongifoliam* simulans, sed foliis sigmoideo-curvatis, apicibus erectis, (6–) 10–12 mm longis, longitudine:latitudo 3–5:1; pedunculis c. 2–4 mm longis; bracteis capitularibus exterioribus (4.5–) 5–6 mm longis; bracteis capitularibus interioribus 1.7–2.0 (–2.5) mm latis; floribus c. 9 vel 10 per capitulum; tubis corollarum flavis; tubis antherarum 1.3–1.5 mm longis; brachiis stylorum 1.3 mm longis; acheniis 2.9–3.3 mm longis, 0.7 mm latis, costis verticalibus 12 infirme binatis rubello-purpureis, differt.

Type (here designated): *A.E. Orchard* 5160, 18 Dec. 1980, Tasmania: East Coast, Fortescue Bay – Cape Hauy track, top of first ridge. Dry stony ridge, in *Eucalyptus*, *Banksia marginata*, *Casuarina* open forest; *Hakea* and *Acacia mucronata* understorey; infrequent. Holotype: HO. Isotypes: AD, AK, CANB, CHR, MEL, NSW, WELT.

Shrubs 1–2 (–3) m tall. *Leaves* sigmoidally spreading with tips upwardly curved, oblong, (6–) 10–12 mm long, 2–3 mm wide, length:width ratio 3–5; tip rounded, blunt; voids alongside midrib apparently absent. Inflorescences of single pedunculate capitula in upper leaf axils. *Peduncles* c. 2–4 mm long. Outer capitular bracts (4.5–) 5–6 mm long; inner capitular bracts 1.7–2.0 (–2.5) mm wide. *Florets* c. 9 or 10 per capitulum. *Corolla* tube yellow; swollen basal section c. 0.5 mm long, 0.5 mm diam.; slender central section 2.0–2.5 mm long, 0.2 mm diam.; terminal campanulate section 0.7–0.8 mm long, 0.5 mm diam.; corolla lobes c. 1.5 mm long, reflexed. *Anther* tube 1.3–1.5 mm long; appendages c. 0.4 mm long. *Style* arms 1.3 mm long. *Cypsela* 2.9–3.3 mm long, 0.7 mm diam., deep purple-black with 12 weakly paired reddish-purple vertical ribs (rarely deep red brown with lighter brown ribs). *Figure* 3F–J.

Ecology: Most collections are described as coming from dry stony ridges in open *Eucalyptus* forest, at altitudes of up to 150 m. Associated shrubs are *Banksia marginata*, (*Allo*)*Casuarina* spp., *Hakea* sp. and *Acacia mucronata*. The collection from Fortescue Forest Reserve (*Moscal* 30133) is described as growing on dolerite rubble around the edge of a wetland slope in wet heathland. It was growing in sparse *Eucalyptus amygdalina*

forest with *Sprengelia incarnata*, *Gleichenia dicarpa*, *Lepidosperma elatius*, *Leucopogon collinus*, *Bauera rubioides*, *Allocasuarina verticillata* and *Xyris*. It is more robust than collections from drier areas, but shares their short sigmoidly curved leaves and short capitular peduncles. Flowering and fruiting seems to be confined to November–December, with only remnant old empty heads remaining on the plants by March.

Distribution: Endemic to Tasmania. This variety seems to be confined to a small number of localities on Tasman Peninsula, between Eaglehawk Neck and Cape Hauy. *Figure 4B*. It is locally reasonably common, but its limited distribution, albeit mostly in reserves of one sort or another, poses some threat to its continued survival. A collection from Storeys Creek (*A.Moscal 936*) superficially resembles this variety, with short, curved leaves. However it has very long capitular peduncles (to 10 mm or more) and is probably best considered as a slightly anomalous plant of var. *oblongifolia*.

Specimens examined: EAST COAST: *I.Boyer s.n.*, 7.xii.1980, track to Cape Hauy (HO40710); *A.M.Buchanan 10884 & 10885*, 27.iii.1988, Cashes Lookout, Eaglehawk Neck (HO); *A.M.Gray 593, 594 & 595*, 9.xii.1981, Cashes Lookout (HO); *W.D.Jackson s.n.*, Fortescue Bay, Cape Hauy Track (HO50714); *A.M.Moscal 30133*, 26.xi.1998, Fortescue Forest Reserve (HO).

Discussion: The cypselas of this variety are usually deep purple black with reddish-purple ribs, occasionally, however, they are lighter in colour, deep red-brown with lighter brown ribs.

Acknowledgments

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