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A TAXONOMIC REVISION OF *APHELIA* (CENTROLEPIDACEAE)

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Abstract

The endemic Australian genus *Aphelia* is revised. Six species – *A. brizula*, *A. cyperoides*, *A. drummondii*, *A. gracilis*, *A. nutans* and *A. pumilio* – are distinguished on morphological features. The removal of any of these species to the segregate genus *Brizula* is not supported.

Introduction

Aphelia R. Br. is an endemic Australian genus of Centrolepidaceae characterised by its inflorescence: a spike, superficially resembling the spikelet of Cyperaceae, with distichous bracts enclosing unisexual florets. The florets are never fused to form pseudanthia, in contrast to the two other genera of the family, *Centrolepis* and *Gaimardia*. Robert Brown (1810) originally described this genus with a single species, *A. cyperoides*, and included it with other centrolepids and restiads in his concept of the family 'Restiaceae'.

Sonder (1856) added the two eastern Australian species, *A. gracilis* and *A. pumilio*, and Mueller (1866) described *A. brizula* from Western Australia. Hieronymus (1872) established the segregate genus *Brizula*: this was differentiated as having all the male florets grouped in the lowest one or two bracts of the inflorescence, with only female florets in the distal bracts. In his revision of the Centrolepidaceae, Hieronymus (1873) retained only *A. cyperoides* in *Aphelia* but added *Aphelia monogyna*, based on *Alepyrum monogynum* J.D. Hook., on the grounds that both of these otherwise disparate plants have a solitary male and female floret in each bract. Bentham (1878) restored all species of *Brizula* to *Aphelia* and added one more species, the rarely collected *A. nutans*. His concept of the genus is maintained in the present paper.

Ecology

All *Aphelia* species are winter-growing annuals, confined to the zone of southern Australia with reliable winter rainfall and a summer water deficit. Like the annual *Centrolepis* species (Cooke, 1992), *Aphelia* species have a reduced structure adapted to habitats where seasonal rainfall defines the growing season and growth within this period is further limited by the availability of nutrients. They may be categorised as stress-tolerant ruderals (in the system of Grime, 1979); their reduced and condensed structure is associated with the short growing season and limited resources. They occupy a range of microhabitats from the margins of seasonal freshwater pools to the sparse herb stratum in heath, scrub or woodland communities, but are absent from forests and other vegetation with a dense shading canopy.

In populations of an annual plant (Cooke 1992), seed production per individual provides a rough measure of the parameter r (the intrinsic rate of increase). This quantity may be estimated from the range of available herbarium material as l_n (median number of seeds/inflorescence X median number of inflorescences/plant); it is only an approximation of r , since the generations may overlap due to delayed germination of seeds forming a seed bank in the soil, and also because viability may not be uniform. Among annual *Centrolepis* species this value ranges from 2.4 to 8.1, corresponding to a wide gradation from species specialised for stress-tolerator niches to ruderal (sensu Grime) species with seed production several orders of magnitude higher (Cooke, 1992). In contrast, the six species of *Aphelia*

yielded values between 4.0 and 4.6 (Table 1), implying a more uniform stress-tolerant ruderal strategy throughout this genus.

<i>A. gracilis</i>	4.0
<i>A. nutans</i>	4.0
<i>A. pumilio</i>	4.0
<i>A. drummondii</i>	4.4
<i>A. brizula</i>	4.4
<i>A. cyperoides</i>	4.6

Table 1. *Aphelia* species listed by 1_n seed number/plant.

Morphology

Leaves

On the anatomical evidence summarised by Cutler (1969), I have previously considered the types of leaf and bract developed in Centrolepidaceae as a reduction series from a linear phyllome with an open sheathing base and a photosynthetic lamina, and originally containing three parallel vascular bundles (Cooke, 1992).

In all *Aphelia* species, each basal leaf consists of an open membranous sheath and a linear herbaceous lamina. They may have been derived from the distichous and subequitant type of leaf that appears to be plesiomorphic in *Centrolepis* and the Restionaceae, and they remain manifestly distichous in *A. cyperoides*. As in the related genera *Centrolepis* and *Gaimardia*, the last leaf produced before the scape and inflorescence is usually reduced: its lamina is shortened or completely suppressed, leaving the sheath as a small membranous cataphyll.

Inflorescence

The inflorescence of *Aphelia* has the form of a spike with the primary axis, here called the rachis, bearing several distichous herbaceous bracts. Each of these bracts encloses a sessile part-inflorescence that may be reduced to a single female or male floret. Although highly condensed by the suppression of internodes, those part-inflorescences that contain more than one floret are recognisable as cincinni (Hamann, 1962).

The whole inflorescence could be interpreted either as a thyrses, with a monopodial rachis bearing axillary cymes (Hamann, 1962), or as a compound cymose inflorescence in which the first order of branching has become a pseudomonopodium as a consequence of forming a compact imbricate structure. In other words, it may be regarded as one florescence (within a polytelic system comprising the whole plant) made up of axillary partial florescences, or as a monotelic inflorescence made up of axillary paracladia (sensu Troll, 1964).

The question of whether the rachis of *Aphelia* is a true monopodium may be one of terminology rather than substance, because all determinate monopodial inflorescences may derive ultimately from sympodial branching systems. However, the first interpretation assumes an extra degree of complexity in development because the higher orders of branching in centrolepid inflorescences are all clearly cymose (Hieronymus, 1886; Hamann, 1962; Cooke, 1980). The second interpretation is a more parsimonious alternative and is also consistent with the zig-zag, flexuose form of the rachis seen in all *Aphelia* species.

The first one or two bracts in the spike of *Aphelia* are differentiated, and are here termed the primary bracts. They are phyllomes with the bases modified to enclose part-inflorescences consisting wholly or mainly of male florets, and often bear short laminae

similar to those of the leaves, as do the two primary bracts of many *Centrolepis* species. The succeeding distichous bracts are also herbaceous but are reduced to the sheath, and in most species each encloses a solitary female floret only; at the fruiting stage each bract clasps the enclosed fruit and is shed with it. Because they subtend higher orders of branching within the inflorescence than do the primary bracts, these succeeding bracts are more closely homologous to the secondary bracts that occur between the pseudanthia of some *Centrolepis* species (Cooke, 1980) than to the two primary bracts of that genus. They are therefore termed "distal bracts" in this paper. The alternative view (Hamann, 1962) treats both the distal and primary bracts as equivalent and serially homologous organs along one monopodial axis.

The secondary bracts that subtend branches within the part-inflorescences of *Aphelia* are further reduced to hyaline scales one cell thick and without vascular tissue; they are homologous to the secondary bracts directly associated with the unisexual florets of *Centrolepis*.

The individual male and female florets of *Aphelia* are reduced respectively to solitary stamens and unicarpellate pistils showing little morphological variation between species. They are similar to the unisexual florets of *Centrolepis* and *Gaimardia*, but are never fused into pseudanthia: this may be either a plesiomorphy retained by the genus or the result of a reduction series parallel to that seen in *Centrolepis* species such as *C. monogyna*.

In all *Aphelia* species each male floret is subtended by a secondary bract on its dorsal side, i.e. the secondary bract is opposed to the primary or distal bract that encloses the part-inflorescence. In *A. brizula*, *A. cyperoides*, *A. drummondii* and *A. pumilio* there is also a secondary bract on the dorsal side of each of the solitary female florets. In *A. gracilis* and *A. nutans* this bract is either absent or vestigial.

Fruit and seed

The fruit, a tardily dehiscent follicle with a thin pericarp enclosing one seed, is similar in all species. Each distal bract abscises from the rachis carrying the fruit that it clasps; this adaptation of the inflorescence for passive dispersal occurs in all species. The hairs on these bracts may give them some potential to adhere to the fur of animals for longer range dispersal. The testa is thin and without sculpture.

Vestiture

All trichomes produced by *Aphelia* species are uniseriate eglandular hairs, each developed from a basal epidermal cell as an unbranched chain of 2–5 empty, thin-walled cylindrical cells; in most species they are restricted to the distal bracts. In *A. gracilis* the distal bracts bear straight hairs 0.03–0.06 mm wide similar to those of *Centrolepis* species, but two distinctive hair types occur in other *Aphelia* species. In *A. cyperoides* the terminal cell of each hair is minutely hooked at the apex or appears circinnate due to more extensive spiral curvature. *A. brizula*, *A. drummondii* and *A. pumilio* have a crest of modified hairs along the keel of the distal bracts. The lowest cell of each hair is enlarged and the succeeding cells are reduced in number and size; in *A. drummondii* each hair is further reduced to a single inflated tooth-like basal cell.

Relationships

If an assumption of a general trend to reduction in structure is correct, *A. cyperoides* would be the most primitive member of the genus because of its three-veined distichous leaves, spike not divisible into male and female sections and unspecialised leaf-like primary bracts. It is also unique in bearing circinnate or hooked hairs. However, considering the homogeneity of *Aphelia* sens. lat. and its distinctness in inflorescence structure – with

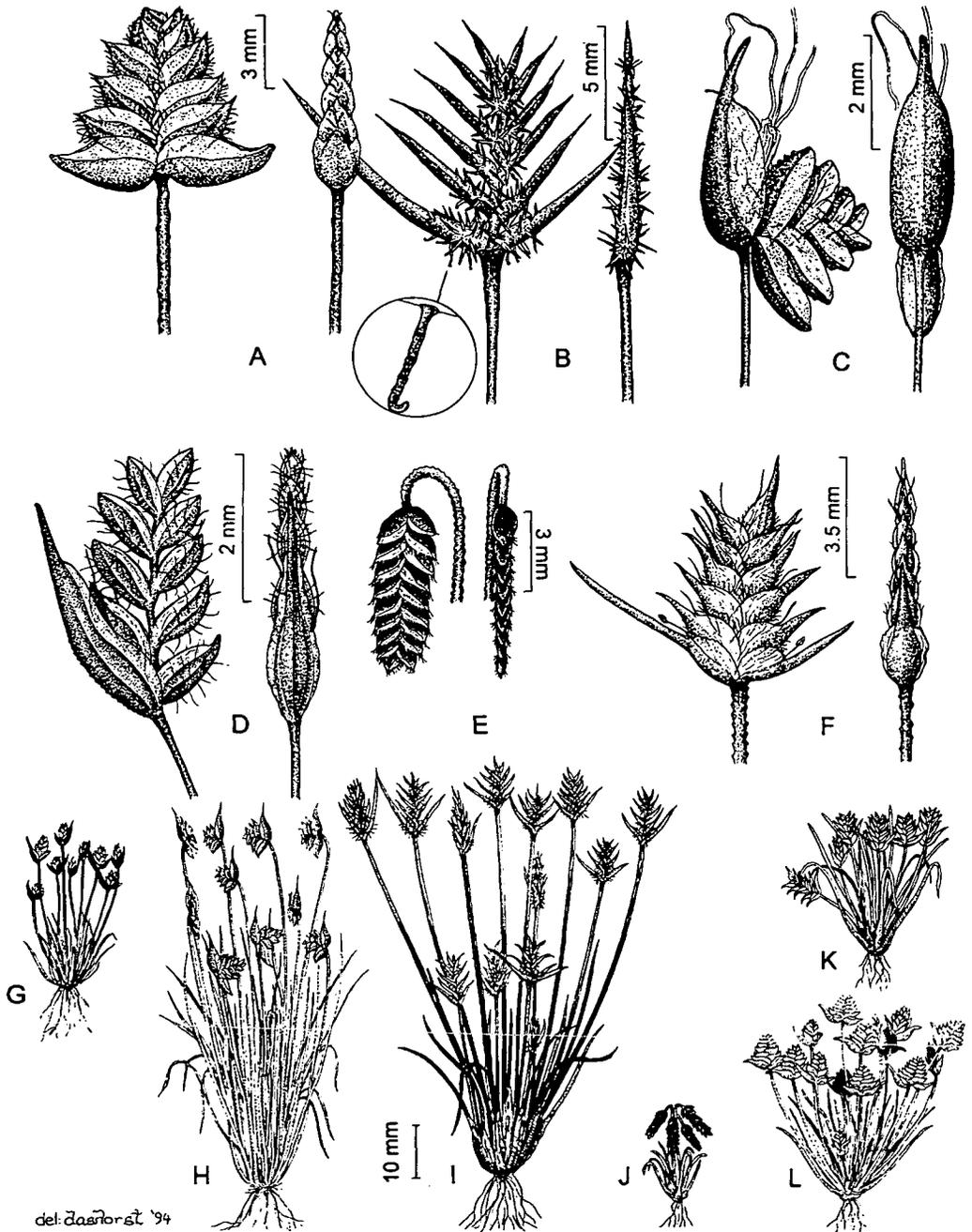


Fig. 1. *A. brizula* (Donner 2892). A, inflorescence; L, habit $\times 1$. *A. cyperoides* (Carrick 8859). B, inflorescence; I, habit $\times 1$. *A. drummondii* (Butler s.n. PERTH). C, inflorescence; H, habit $\times 1$. *A. gracilis* (Eichler 17077). D, inflorescence; G, habit $\times 1$. *A. nutans* (Eichler 20348). E, inflorescence; J, habit $\times 1$. *A. pumilio* (Spooner 296). F, inflorescence; K, habit $\times 1$.

distichous secondary bracts, each enclosing a single seed and shed with it - from the other genera of Centrolepidaceae, it appears preferable to retain all six species in one genus.

Although four species are restricted to Western Australia and the others to the south-eastern States, the genus is not divisible into eastern and western groups. It appears likely that *Aphelia* underwent most of its evolution before the winter-rainfall region of south-western Australia became isolated from the corresponding zone of eastern Australia by increasing aridity.

APHELIA R. Br.

Aphelia R. Br., Prodr. 251 (1810); Roemer & Schultes, Syst. Nat. 1: 43 (1817); Endl., Gen. Pl. 120 (1836); Kunth, Enum. Pl. 3:489 (1841); Nees in Lehm., Pl. Preiss. 2: 71 (1846); Steud., Syn. Pl. Glum. 2: 266 (1855); J.D. Hook., Fl. Tasman. 2: 75 (1858); F. Muell., Fragm. Phyt. Aust. 5: 203 (1866); Hieron., Abh. Naturf. Ges. Halle 12: 208 (1873) *pro parte*; Benth., Fl. Austral. 7: 200 (1878); Benth. & J.D. Hook., Gen. Pl. 3: 1026 (1883); Hieron., Pflanzenfam. 2(4): 15 (1888); Baillon, Hist. Pl. 12: 133 (1892); Rodway, Tasm. Fl. 231 (1903); Ewart, Fl. Vict. 260 (1931); J. Black, Fl. S. Aust. 2nd edn 1: 177 (1943); Hutchinson, Fam. Fl. Pl. 2nd edn 2: 700 (1959); D. Cooke in Jessop & Toelken, Fl. S. Aust. 4: 1823 (1986); Rye in Marchant *et al.*, Fl. Perth Reg. 2: 294 (1987).

Type species: A. cyperoides R. Br.

Brizula Hieron., Bot. Zeit. 30: 206 (1872); Abh. Naturf. Ges. Halle 12: 206 (1873); F. Muell., Fragm. Phyt. Aust. 8: 237 (1874); Hieron., Pflanzenfam. 2(4): 15 (1888); J. Black, Fl. S. Aust. 1: 101 (1922); Hutchinson, Fam. Fl. Pl. 2nd edn 2: 700 (1959); Hamann in Melchior, Syll. Pflanzenfam. 2: 559 (1964); Hamann, Bot. Jahrb. Syst. 96: 158 (1975).

Type species: B. muelleri Hieron. Hieronymus (1872) wrote in the plural that "diese Arten unterscheiden sich von ... *Aphelia cyperoides* R. Br." but did not name any species in the new genus. It is possible that he based his generic concept on *A. brizula*, *A. drummondii*, *A. gracilis* and *A. pumilio* because *Brizula* comprised these four species in his revision, published in the following year. *Brizula muelleri* is here chosen as the lectotype because it was an avowed synonym for *Aphelia brizula*; since Hieronymus derived the generic name from this epithet, it is certain that at the time of the protologue his concept of the genus included at least this species.

Aphelia Hieron., Abh. Naturf. Ges. Halle 12: 208 (1873), *pro parte*.

Alephia Dumort., Anal. Fam. Pl. 63 (1829), *sphalm. orthog.*

Small terrestrial annual herbs. *Root system* fibrous with few to many adventitious roots from the leaf axils, few-branched or unbranched. *Rhizome* absent; *stem* extremely short, compactly branching with internodes of negligible length. *Leaves* all basal, 1–3-veined, linear to subulate with somewhat dilated open membranous sheathing bases; ligule absent. Uppermost leaf usually reduced to a membranous cataphyll. *Scapes* terminal, erect, terete, consisting of a single internode. *Inflorescence* a terminal laterally compressed spike with distichous, 3-veined, herbaceous bracts each enclosing a sessile condensed cincinnus of 1–8 unisexual florets; rachis flexuose, often concealed by the bracts. *Primary bracts* 1–2, differentiated from distal bracts, usually with apices similar to laminae of leaves. *Distal bracts* 4–16, all similar, successively reduced in size, imbricate at anthesis, each ultimately clasping a solitary enclosed fruit and shed with it. *Secondary bracts* concealed, short, veinless, hyaline, entire or minutely erose, solitary on the dorsal side of each male, and sometimes female, floret. *Male floret* a solitary stamen; filament capillary, glabrous; anther shortly exserted, dorsifixed, versatile, unilocular, ellipsoid to ovoid, dehiscing by a longitudinal slit. *Female floret* a solitary carpel, shortly stipitate; ovary fusiform, unilocular with 1 pendulous orthotropous ovule, hyaline, glabrous; style terminal, filiform, exserted, persistent, with unbranched stigmatic papillae all along the adaxial side. *Fruit* a dry

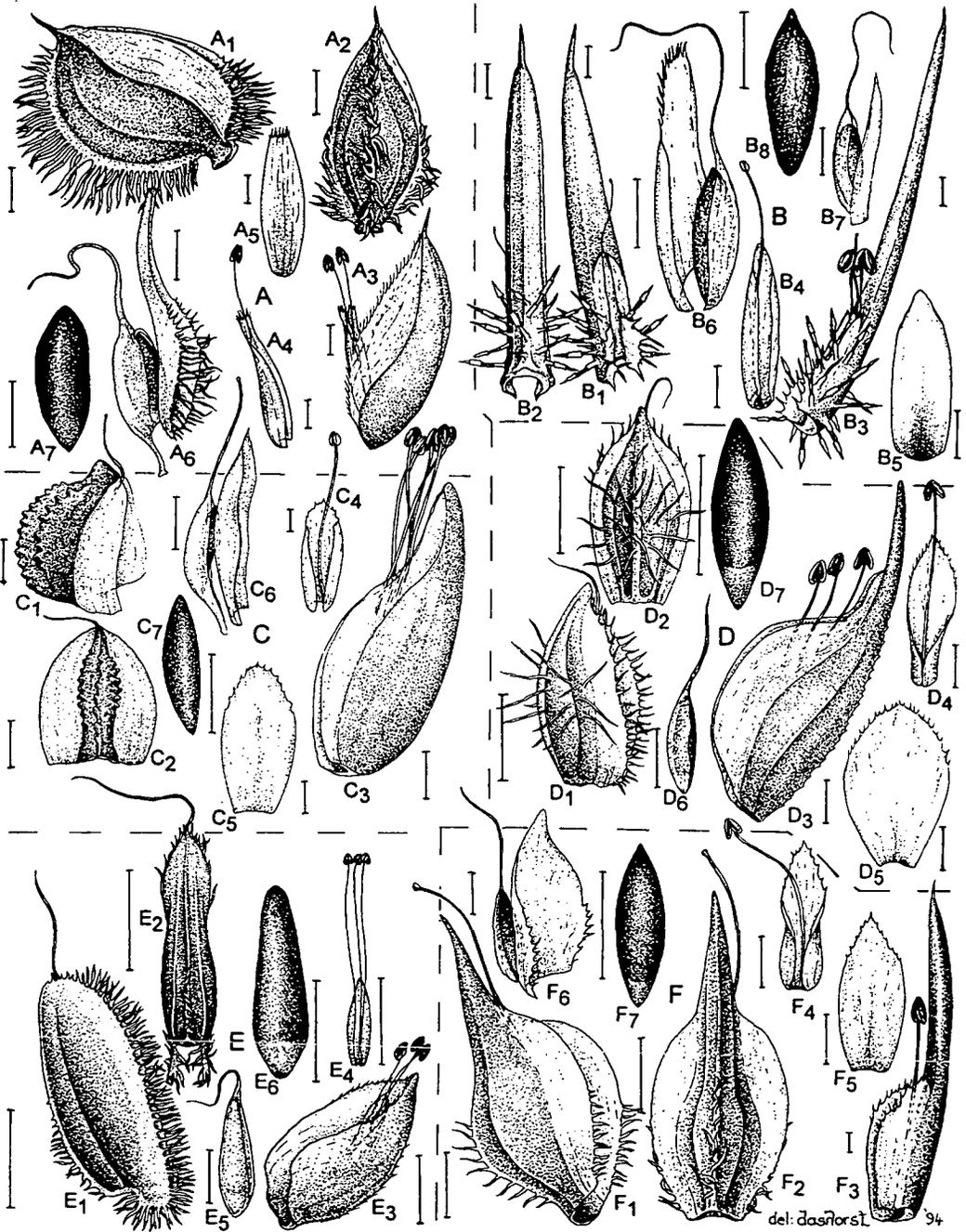


Fig. 2. A *A. brizula* (Donner 2892). A₁, distal bract, side view; A₂, distal bract, dorsal view; A₃, primary bract with male flowers; A₄, male floret with secondary bract; A₅, secondary bract; A₆, female floret with secondary bract; A₇, seed. B *A. cyperoides* (Carrick 8859). B₁, distal bract, ventral view; B₂, distal bract, dorsal view; B₃, primary bract with male florets; B₄, male floret with secondary bract; B₅, secondary bract; B₆, female floret from axil of primary bract, with secondary bract; B₇, female floret from axil of distal bract, with secondary bract; B₈, seed. C *A. drummondii* (Butler s.n. PERTH). C₁, distal bract, side view; C₂, distal bract, dorsal view; C₃,

membranous 1-seeded follicle dehiscent by an adaxial slit. *Seed* usually retained within fruit and bract, fusiform, endospermic with a small apical embryo; testa smooth, membranous.

A genus of 6 species endemic to southern Australia.

Key to species

1. Scape decurved at apex; spike pendulous 2. *A. nutans*
 1: Scape straight; spike erect or oblique 2
2. Spike oblique, asymmetric; primary bract 1 3
 2: Spike erect, symmetric; primary bracts 2 4
3. Distal bracts without keel; margins ciliolate 3. *A. gracilis*
 3: Distal bracts with a cristate keel; margins entire 6. *A. drummondii*
4. Spike becoming lax by growth of rachis; distal bracts pilose, the hairs not confined to keel 1. *A. cyperoides*
 4: Spike remaining compact; distal bracts with hairs on the keel only 5
5. Distal bracts ovate, prominently mucronate, with hyaline margins extending about halfway to the apex 4. *A. pumilio*
 5: Distal bracts broad-ovate, shortly apiculate, with hyaline margins extending to the apex 5. *A. brizula*

1. *Aphelia cyperoides* R. Br., Prodr. 252 (1810); Roemer & Schultes, Syst. Nat. 1: 43 (1817); Desv., Ann. Sci. Nat. (Paris) 13: 42 (1828); Kunth, Enum. Pl. 3: 488 (1841); Nees in Lehm., Pl. Preiss. 2: 71 (1846); Steud., Syn. Pl. Glum. 2: 266 (1855); Hieron., Abh. Naturf. Ges. Halle 12: 208 (1873); F. Muell., Fragm. Phyt. Aust. 8: 236 (1874); Benth., Fl. Austral. 7: 200 (1878); Baillon, Hist. Pl. 12: 128 (1892); Blackall & Grieve, West. Aust. Wildfls 1: 59 (1954); Rye in Marchant et al., Fl. Perth Reg. 2: 294 (1987).

Type: Oyster Harbour, King Georges Sound [W.A.], xii.1801, R. Brown sub Bennett No.5826 (lecto. here chosen because it includes most of Brown's material with his annotations: BM!; isolecto.: MEL 535279! CANB 67858!)

—var. *minor* Hieron., Abh. Naturf. Ges. Halle 12: 208 (1873).

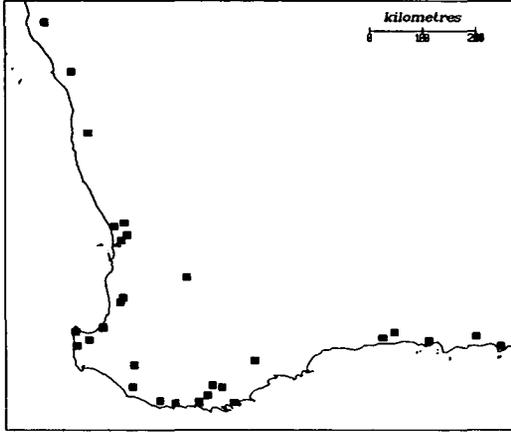
Type: no locality [W.A.], J. Drummond s.n. (holo.: B n.v.; iso.: MEL 577849!)

Tufted annual herb 1–15 cm high, remaining light green at flowering. *Leaves* manifestly distichous, 2–3-veined; *sheath* membranous to hyaline, 2.5–10 mm long, glabrous or rarely strigose, passing abruptly into a slightly recurved keeled linear-subulate glabrous lamina 0.5–5 cm long, c. 0.6 mm wide; apex acute, mucronate. *Cataphyll* 2–10 mm long, acute to obtuse, rarely absent. *Scape* straight, erecto-patent, 1–16 cm long, glabrous. *Spike* erect, slightly asymmetric, triangular to rhomboid, 5–13 mm long, 5–12 mm wide; rachis accrescent and becoming exposed in fruit. *Primary bracts* two, with entire margins and spreading leaf-like apices, glabrous or sparsely pilose on sheath, each enclosing 1–2 male florets sometimes with 1 female floret, the lower bract 6–11 mm long, the second shorter. *Distal bracts* 5–14, lanceolate-cymbiform, acute, 3–6 mm long, with rounded backs densely pilose except near the midline and narrow, ciliolate margins becoming incurved in fruit,

primary bract with male florets; C₄, male floret with secondary bract; C₅, secondary bract; C₆, female floret with secondary bract; C₇, seed. D *A. gracilis* (Eichler 17077). D₁, distal bract, side view; D₂, distal bract, dorsal view; D₃, primary bract with male florets; D₄, male floret with secondary bract; D₅, secondary bract; D₆, female floret; D₇, seed. E *A. nutans* (Eichler 20348). E₁, distal bract, side view; E₂, distal bract, dorsal view; E₃, primary bract with male florets; E₄, three male florets with one secondary bract; E₅, female floret; E₆, seed. F *A. pumilio* (Spooner 296). F₁, distal bract, side view; F₂, distal bract, dorsal view; F₃, primary bract with male florets; F₄, male floret with secondary bract; F₅, secondary bract; F₆, female floret with secondary bract; F₇, seed. (Scale 0.5 mm.)

each enclosing 0–1 male floret and 1 female floret. *Stamens* each subtended by a lanceolate, acute, secondary bract c. 2 mm long; filament 2–3 mm long; anther oblong-ellipsoid, 0.7–1.5 mm long. *Ovary* c. 1 mm long; style 2.5–3.5 mm long; secondary bract lanceolate, 1–2 mm long. *Seed* 1.0–1.3 mm long; testa pale brown. (Fig. 1B, I; 2B)

Distribution (Map 1)



Map 1. Distribution of *Aphelia cyperoides* in south-western WA.

Western Australia: Widespread from Greenough River south to Albany and east to Cape Arid, in the Irwin, Darling, Avon, Eyre and Rowe botanical districts of Beard (1980).

Ecology

Winter annual of moist open sites in heath and woodland, on swamp margins and lithoseral moss beds. Flowers September to November.

Notes

The variety *minor* was based on a depauperate specimen among the few collections examined by Hieronymus, and differs from typical *A. cyperoides* only in the size of most organs and the number of

distal bracts. These characters vary widely and continuously within the species according to habitat conditions, and therefore I have not recognised the variety.

Selected specimens examined (total 62)

WESTERN AUSTRALIA: near Moates lake W of Two Peoples Bay, 21.x.1983, *Corrick 8859* (AD; MEL); Young River crossing 5 km N Neds Corner, 27.ix.1968, *Donner 2813* (AD; PERTH); 8 km S Eneabba, 28.ix.1979, *Hnatiuk 790062* (PERTH); Lort River crossing, Ravensthorpe–Esperance road, 11.ix.1968, *Jackson 1396* (AD; PERTH); Howatharra Hills, 27.viii.1980, *Keighery 3237* (PERTH); 3 km N Yallingup, 7.x.1981, *Keighery 4046* (PERTH); Manjimup, xi.1920, *Koch 2497* (PERTH); Serpentine River, i.xii.1877, *Mueller* (MEL); c. 20 km S of Ongerup, *Newbey 4509* (PERTH); c. 10 km W of Cookernup, 5.xii.1974, *Pullen 9831* (CANB); c. 7 km S of Capel, 5.xii.1974, *Pullen 9846* (CANB); Mt Chudalup, 9.x.1966, *Scrymgeour 1602* (PERTH); Porongorup Ranges N.P., 6.x.1978, *Spencer 2* (MEL); between Cowaramup and Margaret River, 6.xi.1974, *Whibley 5049* (AD; PERTH).

2. *Aphelia nutans* J.D.Hook. ex Benth., Fl. Austral. 7: 200 (1878); Rye in Marchant et al., Fl. Perth Reg. 2: 924 (1987).

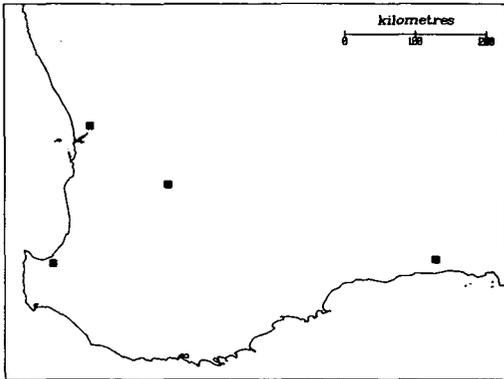
Type: W. Australia, *J. Drummond suppl.* 84 (holo.: K n.v.).

Brizula nutans (J.D. Hook. ex Benth.) C. Gardner, Enum Pl. Aust. Occ. 1: 17 (1930); Blackall & Grieve, West. Aust. Wildfls 1: 58 (1954); Beard, Descript. Cat. W. Aust. Pl. 8 (1965).

Annual herb 1.2–3.5 cm high, becoming purple-pigmented at flowering. *Leaves* obscurely distichous, 1-veined, glabrous; sheath 1–2 mm long, hyaline, passing into a recurved linear-subulate terete lamina 2–9 mm long, c. 0.15 mm wide; apex subacute, apiculate. *Cataphyll* obtuse, c. 1 mm long. Scape abruptly recurved at apex, 0.9–3 cm long, glabrous. *Spike* pendulous, symmetric, oblong-lanceolate, 3–8 mm long, 2–2.5 mm wide, becoming looser in fruit; rachis slightly accrescent. *Primary bracts* two, equal, broad-ovate, acute, 1.2–1.6 mm long, glabrous, each enclosing 2–4 male florets; backs rounded, smooth; margins broad, membranous, entire. *Distal bracts* 6–16, oblong, obtuse, 1–1.8 mm long,

each enclosing one female floret; backs rounded, smooth, or rarely scaberulous on midline near base; margins broad, hyaline to the apex, ciliolate, imbricate at base, becoming incurved in fruit. *Stamens* each subtended by a narrow-lanceolate, acute secondary bract 0.3–0.5 mm long; filament 1.5–2 mm long; anther elliptic, 0.5–0.7 mm long. *Ovary* c. 1 mm long; style c. 0.8 mm long; secondary bract absent or vestigial. *Seed* c. 0.9 mm long; testa pale brown. (Fig. 1E, J; 2E)

Distribution (Map 2)



Map 2. Distribution of *Aphelia nutans* in southwestern WA.

Western Australia: Scattered and apparently disjunct in the southwest, where collected from four localities only, in the Darling, Avon and Eyre botanical districts.

Ecology

Winter annual of moist microhabitats such as moss swales and swampy sands. Flowers September, October.

Specimens examined (total 4)

WESTERN AUSTRALIA: near Young River, 21 km NNW Stokes Inlet, 20.x.1968, *Eichler 20348* (AD, PERTH); Yoongarillup, 16.x.1950, *Royce 3374* (PERTH); Tutanning Reserve, 20.ix.1962, *Royce 7653* (PERTH).

3. *Aphelia gracilis* Sonder, *Linnaea* 28: 227 (1856); F. Muell., *Fragm. Phyt. Aust.* 5: 204 (1866); Benth., *Fl. Austral.* 7: 201 (1878); C. Moore, *Handb. Fl. N.S.W.* 441 (1893); Rodway, *Tasm. Fl.* 231 (1903); Ewart, *Fl. Vict.* 259 (1931); J. Black, *Fl. S. Aust.* 1: 177 (1943); J.H. Willis, *Handb. Pl. Vict.* 1: 277 (1962); Cooke, *Fl. S. Aust.* 4: 1824 (1986); E. Brown, *Fl. N.S.W.* 4: 408 (1993).

Type: Australia felix [western Victoria], *F. Mueller* (lecto. here chosen because it is the most typical and best preserved specimen: MEL 558047! ex herb. Sonder); Echinsuga [Echunga, S.A.], xi.1848, *F. Mueller* (syn.: MEL 577702 pro parte!, a mixed sheet with another Mueller collection from Onkaparinga); Van Diemensland [Tasmania], 1848, *C. Stuart* (syn.: MEL!).

Brizula gracilis (Sonder) Hieron., *Abh. Naturf. Ges. Halle* 12: 206 (1873); F. Muell., *Fragm. Phyt. Aust.* 8: 237 (1874); J. Black, *Fl. S. Aust.* 1: 101 (1922).

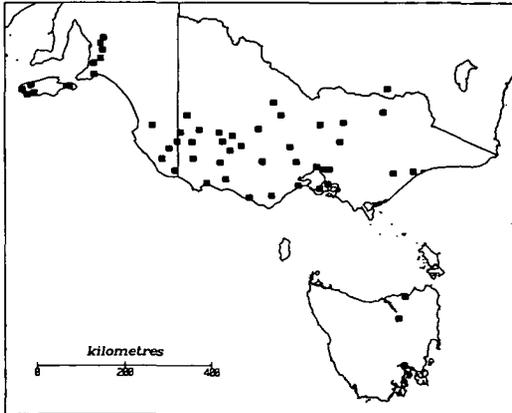
Aphelia gunnii J.D. Hook., *Fl. Tasman* 2: 75, t.138C (1858). Nom. illeg., as stated by Hooker to be a substitute name for *A. gracilis*.

Type: "(Gunn, 1499.) Wet places:Formosa, Gunn.-(Fl. Nov.)" [Tasmania], ex herb *R.C. Gunn* (holo.: K n.v.).

Tufted annual herb 2–4 cm high, remaining light green at flowering. *Leaves* obscurely distichous, 1-veined, glabrous; sheath subhyaline, 2–3 mm long, passing into a linear, lax flattened filiform lamina 1–2.3 cm long, c. 0.2 mm wide; apex acute, emucronate. *Cataphyll* usually absent, rarely 1–3 mm long, acute. *Scape* straight, 1.5–3.5 cm long, glabrous. *Spike* oblique, asymmetric, lanceolate-oblong, 2.5–5 mm long, 1.5–2.5 mm wide; rachis accrescent. *Primary bract* solitary, erect, ovate, acuminate, 3–4 mm long, glabrous, enclosing 1–2 male florets and often 1 female floret; back rounded, smooth; margins hyaline, entire, not reaching apex. *Distal bracts* 4–8, ovate-cymbiform, obtuse, 0.8–1.6 mm

long, each enclosing 1 female floret; backs rounded, smooth, pilose; margins broad, hyaline to the apex, ciliolate, becoming incurved in fruit. *Stamens* each subtended by an ovate, acute secondary bract 1.5–2 mm long; filament 1.5–2 mm long; anther elliptic, 0.6–0.7 mm long. *Ovary* c. 0.8 mm long; style 0.7–1 mm long; secondary bract absent. *Seed* 0.7–0.9 mm long; testa pale brown. (Fig. 1D, G; 2D)

Distribution (Map 3)



Map 3. Distribution of *Aphelia gracilis*

glabra. Flowers October, November.

Selected specimens examined (total 82)

SOUTH AUSTRALIA: Mary Seymour Conservation Park, 13.x.1982, *Donner 9310* (AD); above Waterfall, Belair, 27.xi.1960, *Eichler 17077* (AD); Stewarts Range, 17.xi.1962, *Hunt 1403* (AD); Lenswood Research Centre, 8.xi.1979, *Spooner 6768* (AD); Rocky River, 18.x.1968, *Wheeler 1221* (AD); Kelly Hill Reserve, 15.xi.1958, *Wilson 968* (AD).

VICTORIA: McDonald Park, Ararat, 16.xi.1966, *Beaglehole 21753* (MEL); Baddaginnie, 13.x.1942, *Black* (MEL); Mt Sturgeon, Grampians, 3.xi.1968, *Corrick 1237* (MEL); French Id, 30.xi.1980, *Gullan s.n.* (MEL); Oakleigh, 11.xi.1893, *Morrison* (AD, CANB); Jamieson road 3 miles from Eildon, 30.x.1960, *Muir 1615* (MEL).

TASMANIA: South Esk R., near Perth, 1848, *Stuart s.n.* (MEL).

4. *Aphelia pumilio* F. Muell. ex Sonder, *Linnaea* 28: 226 (1856); J.D. Hook., *Fl. Tasman.* 2: 76 (1858); F. Muell., *Fragm. Phyt. Aust.* 5: 204 (1866); Benth., *Fl. Austral.* 7: 201 (1878); C. Moore, *Handb. Fl. N.S.W.* 441 (1893); Rodway, *Tasm. Fl.* 231 (1903); Ewart, *Fl. Vict.* 259 (1931); J. Black, *Fl. S.Aust.*, 1: 177 (1943); J.H. Willis, *Handb. Pl. Vict.* 1: 277 (1962); Cooke, *Fl. S. Aust.* 4: 1824 (1986).

Type: Inter montem Gambir et sinum Rivolibay [between Mount Gambier and Rivoli Bay, S.A.], *F. Mueller* (Lecto. here chosen because it is the most typical and best preserved specimen: MEL 558048! pro parte, ex herb. Sonder); versus Rivoli Bay [S.A.], x.1848, *F. Mueller* (Syn.: MEL 558048! pro parte); In collibus arenosis virgultis Brighton versus [S.A.], x.1852, *F. Mueller* (Syn.: MEL 1501518!).

Brizula pumilio (F. Muell. ex Sonder) Hieron., *Abh. Naturf. Ges. Halle* 12: 206 (1873); F. Muell., *Fragm. Phyt. Aust.* 8: 237 (1874); J. Black, *Fl. S.Aust.* 1: 101 (1922).

South Australia: southern Eyre Peninsula, Kangaroo Island, southern Mt Lofty and the South-eastern region. New South Wales: very localised in the Southern Western Slopes region. Victoria: widespread in the western district to about 36°S, extending to the central coast and the Murray Valley. Tasmania: localised near the northern and eastern coasts.

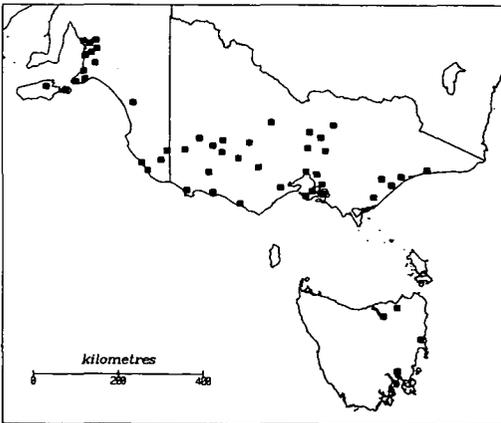
A record for Western Australia (Blackall & Grieve, 1954) is not confirmed by herb-arium material and is apparently erroneous.

Ecology

Winter annual of seasonally flooded heavy soils in the 500–1000 mm annual rainfall zone, e.g. on clay pans and pool margins, where often associated with *Centrolepis*

Tufted annual herb 1–3 cm high, remaining light green at flowering. *Leaves* obscurely distichous, 1-veined, glabrous; sheath hyaline, 2–3 mm long, passing into a slightly recurved linear-subulate slightly keeled lamina 0.8–2 cm long, c. 0.5 mm wide; apex acute, mucronate. *Cataphyll* 1.5–3 mm long, acute, sometimes absent. *Scape* straight, 0.7–2.5 cm long, glabrous. *Spike* erect, symmetric, broad-ovate, 3–6 mm long, 3–4 mm wide, remaining dense; rachis not accrescent. *Primary bracts* two, unequal, glabrous, with entire margins and leaf-like apices, the first bract 4–10 mm long, the second 3–6 mm long, each enclosing 1–3 male florets. *Distal bracts* 4–9, ovate, acuminate, 1.5–2.8 mm long, each enclosing 1 female floret; backs keeled with a single median row of 1–3-celled hairs; margins broad, subhyaline, not extending to bract apex, ciliolate near the base, imbricate in flower, spreading in fruit. *Stamens* each subtended by a lanceolate-elliptic, acute secondary bract 1–1.7 mm long; filament c. 2 mm long; anther ovoid, 0.6–0.7 mm long. *Ovary* c. 0.9 mm long; style 1–1.4 mm long; secondary bract ovate, 2 mm long. *Seed* 0.7–0.9 mm long; testa dark brown. (Fig. 1F, K; 2F)

Distribution (Map 4)



Map 4. Distribution of *Aphelia pumilio*

South Australia: Southern Mt Lofty, eastern Kangaroo Island and South-eastern regions. Victoria: widespread in the western district to about 37°S, extending to the Gippsland coast and the Murray Valley. Tasmania: close to the northern and eastern coasts.

This species was listed by Moore (1893) and Maiden & Betche (1916) for New South Wales but this record is not confirmed by herbarium material.

Ecology

Winter annual of moist ground in heath, scrub and woodland in the 450–900 mm annual rainfall zone, often growing with *Centrolepis* spp. Flowers September to November.

Notes

Close to the Western Australian *A. brizula*, the two species forming a vicarious pair in south-western and south-eastern Australia respectively.

Selected specimens examined (total 85)

SOUTH AUSTRALIA: Mt Barker near summit, 1.x.1958, *Eichler 15010* (AD); Comaum, 28.x.1962, *Hunt 1310* (AD); Penola Forest near Nangwarry, 31.x.1964, *Hunt 2210* (AD); Parndana Reserve, *Jackson 650* (AD); National Park, Belair, 2.xi.1958, *Schodde 1020* (AD); Fairview Park, 10.x.1968, *Smith 2184* (AD); Torrens Gorge, 6.xi.1968, *Spooner 296* (AD).

VICTORIA: Mount Arapiles, 22.ix.1968, *Beaglehole 28644A* (MEL); Grampians, 37°9'30"S 146°16'E, 22.x.1978, *Corrick 6135* (MEL); 1.5 km north of Tallarook, 12.x.1978, *Muir 6182* (MEL); South Belgrave, 25.xi.1980, *Muir 6530* (MEL); Whittlesea, 17.x.1901, *St. John* (MEL); Hawkesdale, xi.1903, *Williamson* (MEL); Quail Island, Westport Bay, 23.xi.1952, *Willis* (MEL).

TASMANIA: Tasmania, s.dat., *Archer 44* (NSW); near Launceston, 12.x.1887, *n.coll.* (MEL).

5. *Aphelia brizula* F. Muell., *Fragm. Phyt. Aust.* 5: 203 (1866); Benth., *Fl. Austral.* 7: 202 (1878); Rye in Marchant et al., *Fl. Perth Reg.* 2: 294 (1987).

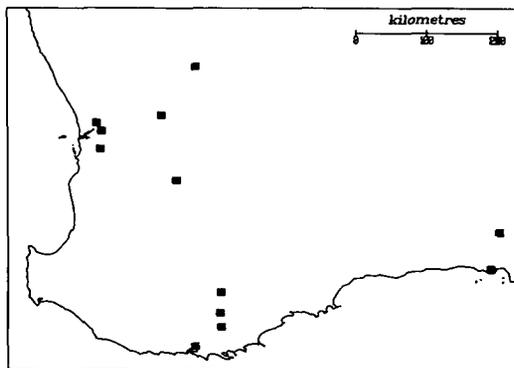
Type: ad flumen Cygnorum [W.A.], J. Drummond 119 (holo.: MEL 1501519!).

Brizula muelleri Hieron., Abh. Naturf. Ges. Halle 12: 207 (1873), *pro syn. ut muelleri*; F. Muell., Fragm. Phyt. Aust. 8: 237 (1874); Diels & Pritzel, Bot. Jahrb. Syst. 35: 95 (1904); Blackall & Grieve, West. Aust. Wildfl. 1: 59 (1954); nom. illeg., based on *A. brizula* F. Muell.

Aphelia drummondii auct. non (Hieron.) Benth.: Baillon, Hist. Pl. 12: 129, figs. 213–217 (1892); Hamann, Ber. Deutsch. Bot. Ges. 75: 167 (1962).

Densely tufted annual herb 1–6 cm high, remaining light green at flowering. *Leaves* obscurely distichous, 1-veined, glabrous; sheath subhyaline, 3–6 mm long, passing into a slightly recurved linear-subulate slightly keeled lamina 5–20 mm long, c. 0.5 mm wide; apex subacute, mucronate. *Cataphyll* 2–4 mm long, acute, rarely absent. *Scape* straight, 0.3–5.5 cm long, glabrous. *Spike* erect, symmetric, broad-ovate, 3–7 mm long, 4–6 mm wide, remaining dense; rachis not accrescent. *Primary bracts* two, unequal, glabrous, the first bract with an ovate base 3–5 mm long, entire, usually produced into a leaf-like apex to 4 mm long, the second broad-ovate, apiculate, 3–4 mm long with a ciliolate margin, each enclosing 2–3 male florets. *Distal bracts* 4–14, broad-ovate, apiculate, 2–3.5 mm long, each enclosing 1 female floret; backs keeled, with a single median row of 1–2-celled hairs; margins broad, membranous, ciliolate near the base, imbricate in flower, spreading in fruit. *Stamen* subtended by a narrow-elliptic, acute, secondary bract 2–3 mm long; filament 2.5–3.5 mm long; anther elliptic, 0.7–1 mm long. *Ovary* c. 0.9 mm long; style 1.5–2 mm long; secondary bract broad-ovate, 2–3 mm long. *Seed* 1–1.1 mm long; testa dark brown. (Fig. 1A, L; 2A)

Distribution (Map 5)



Map 5. Distribution of *Aphelia brizula*.

Hills, 4.x.1968, *Donner 2892* (AD); Yorkrakine Rock, N of Tammin, 12.ix.1967, *George 9196* (PERTH); Bakers Hill Research Station, 26.ix.1962, *Goodall 812* (PERTH); summit of Mt Burdett, 4.x.1968, *Jackson 1331* (AD); 18 km SE Ongerup, 12.ix.1974, *Newbey 4365* (PERTH); Tutanning Reserve, 8.x.1964, *Royce 8191* (PERTH); Porongorup Ranges National Park, 6.x.1978, *Spencer 1* (MEL); c. 30 km N of Katanning, 20.ix.1964, *Wilson 3383* (AD); Albany Hwy 27 km SE Williams, 7.ix.1967, *Wilson 6203* (PERTH); Mt William near Wagerup, 5.ix.1979, *Van der Moezel 13* (PERTH).

Western Australia: Widespread from Perth to Cape Arid in the Darling, Eyre, Avon and Roe botanical districts between the 300 and 800 mm annual isohyets.

Ecology

Winter annual of moist open ground in woodland, also occurring in lithoserai moss beds on granite. Flowers August to October.

Selected specimens examined (total 43)

WESTERN AUSTRALIA: Darlington, ix.1902, *Andrews* (PERTH); N slopes Mt Angwin, 13.ix.1977, *Barker 2361* (AD); Munglignup Creek, 33°51'S 122°40'E, 29.ix.1986, *Chincock 7438* (AD); Middleton, 6.ix.1978, *Cranfield* (PERTH); Wittenoom Hills, 4.x.1968, *Donner 2892* (AD); Yorkrakine Rock, N of Tammin, 12.ix.1967, *George 9196* (PERTH); Bakers Hill Research Station, 26.ix.1962, *Goodall 812* (PERTH); summit of Mt Burdett, 4.x.1968, *Jackson 1331* (AD); 18 km SE Ongerup, 12.ix.1974, *Newbey 4365* (PERTH); Tutanning Reserve, 8.x.1964, *Royce 8191* (PERTH); Porongorup Ranges National Park, 6.x.1978, *Spencer 1* (MEL); c. 30 km N of Katanning, 20.ix.1964, *Wilson 3383* (AD); Albany Hwy 27 km SE Williams, 7.ix.1967, *Wilson 6203* (PERTH); Mt William near Wagerup, 5.ix.1979, *Van der Moezel 13* (PERTH).

6. *Aphelia drummondii* (Hieron.) Benth., Fl. Austral. 7: 201 (1878); Rye in Marchant et al., Fl. Perth Reg. 2: 294 (1987).

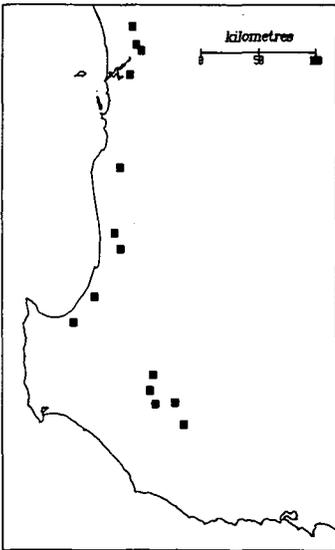
Type: Nova Hollandia inter occasum solis et meridiem spectante [W.A.], J. Drummond (holo.: B n.v.; iso.: MEL 1513971!). Both of these sheets bear Drummond's number 933 although this was not cited by Hieronymus. The holotype was originally cited as located at the Vienna Herbarium (W) but was later removed to Berlin-Dahlem; it bears the annotation

"Hb Hieronymus" (Leuenberger 1982, pers. comm.). Other probable isotypes are MEL 1513972 and MEL 1513973, both from Drummond's first collection but lacking numbers.

Brizula drummondii Hieron., Abh. Naturf. Ges. Halle 12: 206 (1873); Diels & Pritzel, Bot. Jahrb. Syst. 35: 95 (1904); Blackall & Grieve, West. Aust. Wildfl. 1: 59 (1954).

Tufted annual herb 2.5–8 cm high, remaining light green at flowering. *Leaves* obscurely distichous, 1-veined, glabrous; sheath subhyaline, 2.5–5 mm long, passing into a linear, lax flattened lamina 1–4 cm long, c. 0.25 mm wide; apex acute, emucronate. *Cataphyll* 2–4 mm long, acute, rarely absent. *Scape* straight, 2–7.5 cm long, glabrous. *Spike* oblique, asymmetric, broad-ovate, 3–7 mm long, 2–4.5 mm wide, remaining dense; rachis not accrescent. *Primary bract* solitary, erect, broad-ovate, acuminate, 2.5–3.6 mm long, glabrous, enclosing 3–8 male florets; back rounded, smooth; margins broad, membranous, entire. *Distal bracts* 6–15, broad-ovate, apiculate, 1.2–2.2 mm long, each enclosing 1 female floret; backs keeled, with 3 rows of inflated tooth-like hair bases in the central third of their length, the median row erect, the lateral rows deflexed; margins broad, membranous, finely erose, spreading in fruit. *Stamens* each subtended by an elliptic, acute, secondary bract 2–3 mm long; filament 3–5 mm long; anther elliptic, 1.2–1.5 mm long. *Ovary* c. 0.8 mm long; style c. 1 mm long; secondary bract broad-ovate, 0.8–2 mm long. *Seed* c. 0.8 mm long; testa pale brown. (Fig. 1C, H; 2C)

Distribution (Map 6)



Map 6. Distribution of *Aphelia drummondii*

Western Australia: Restricted to the Darling botanical district on the coastal plain between Ellen Brook and the Vasse River and on the Darling Plateau between Yornup and Lake Muir.

Ecology

Winter annual of seasonally flooded heavy soils, e.g. clay pans and pool margins, in the 500–1000 mm annual rainfall zone. It occupies wetter sites than *A. brizula* and is often associated with *Centrolepis glabra*. Flowers September to November.

Notes

A. drummondii is apparently closest to *A. brizula* but shows some convergence with *A. gracilis* in its foliage and single primary bract.

Selected specimens examined (total 22)

WESTERN AUSTRALIA: Midland Junction, 17.x.1902, Andrews (PERTH); Ellen Brook Sanctuary, 28.xii.1971, Burbidge 7932 (CANB); Perup River E of Manjimup, x.1948, Butler s.n. (PERTH); Pinjarra, 27.ix.1897, Helms (PERTH); Cannington, 2.i.1899, Helms (PERTH); Ellen Brook Tortoise Reserve, 19.x.1978, Keighery 1842 (PERTH); Brixton road, Kenwick, 21.x.1981, Keighery 4175 (PERTH); Manjimup road 20 km S of Bridgetown, 20.xi.1981, Keighery 4289 (PERTH); Cannington, 6.xi.1907, Morrison (PERTH); swamps near Tone River, Oldfield 577 (MEL); Vasse River, Oldfield s.n. (MEL 577564); Yornup, 29.ix.1948, Royce 2739 (PERTH); Elgin, 17.ix.1953, Royce 4353 (PERTH); Benger, N of Bunbury, 11.x.1954, Royce 4873 (PERTH).

Excluded species

Aphelia monogyna (J.D.Hook.) Hieron., *Abh. Naturf. Ges. Halle* 12: 208 (1873). This is a perennial with a capitular inflorescence containing reduced pseudanthia between two primary bracts, and is now placed in *Centrolepis* as *C. monogyna* (J.D.Hook.) Benth. (Cooke, 1992).

Acknowledgments

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