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# *Semidelitschia nanostellata* (Fungi: Dothideales: Sporormiaceae): A New Species From Australia

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*Abstract*

A new species *Semidelitschia nanostellata* is described from Red-necked Wallaby (*Macropus rufogriseus*) dung collected in southwest Tasmania. The most distinctive character of this species is the presence of small star-like appendages at the base of the asci which firmly secure the asci to cells at the base of the centrum.

## Introduction

The new species of coprophilous Ascomycete belongs to the genus *Semidelitschia*. It was obtained from Red-necked Wallaby *(Macropus rufogriseus)* dung collected from the eastern shore of Bathurst Harbour, southwest Tasmania.

## Materials and Methods

The dried dung was first thoroughly soaked in sterile distilled water and then incubated on moist filter paper in a glass (lidded) container (Bell 1999). Most observations of the fungus were made in water mounts in order to study its features in their natural state. In addition, samples were mounted in congo red (a 1% aqueous solution) or lactophenol cotton blue (20 g phenol, 20 g lactic acid, 40 g glycerol, 0.05 g cotton blue, 20 g water). A number of semi-permanent slides were made using Shear's mounting medium (see Bell 1999 for recipe). The ascospore size range was determined by measuring 50 ascospores from the fresh material. A small portion of dung containing perithecia of the fungus was air dried for incorporation at The National Herbarium of Victoria (MEL).

Germination of ascospores was attempted. Mature ascospores were spread across the surface of corn meal agar (CMA) either immediately or following surface sterilization of mature perithecia in a 3% solution of hydrogen peroxide for 25–30 min. In another attempt the same 3% hydrogen peroxide treatment was followed by perithecial transfer to a drop of 10% buffered (pH 6.8) pancreatin and incubation at 37° C for 3 h (see Lundqvist et al. 1999). This technique attempts to simulate conditions in an animal's gut which are thought to trigger spore germination. Hydrogen peroxide treated ascospores were also spread on to CMA containing 7g/L sodium acetate or were transferred to sterile water and heated at 60° C for 30 min before spreading them over CMA lacking sodium acetate. All attempts to germinate ascospores have failed.

## Taxonomy

***Semidelitschia nanostellata*** Bell & Mahoney, sp. nov.

Perithecia aggregare, venters subterranea, globosa vel ovata, glabra, semicoreacea, nigra, 1 mm in diametro. Collumni emersum, 1 mm, inferior nigro, hirsutum, superior hyalinus. Paraphyses filiformi-ventricosae, crassae. Asci cylindraceus, bitunicatis, 8-spori, inferior stellifera. Sporae biseratae vel uniseratae, eseptata, ellipsoidea vel subdepressa, atro-brunneae, 34–42(–46) × 19–22 µm. Tota spora tunica gelatinoso crassus in aqua inflatum.

*Type*: Australia, 10 m S of Bathurst Creek, E shore of Bathurst Harbour, Port Davey,

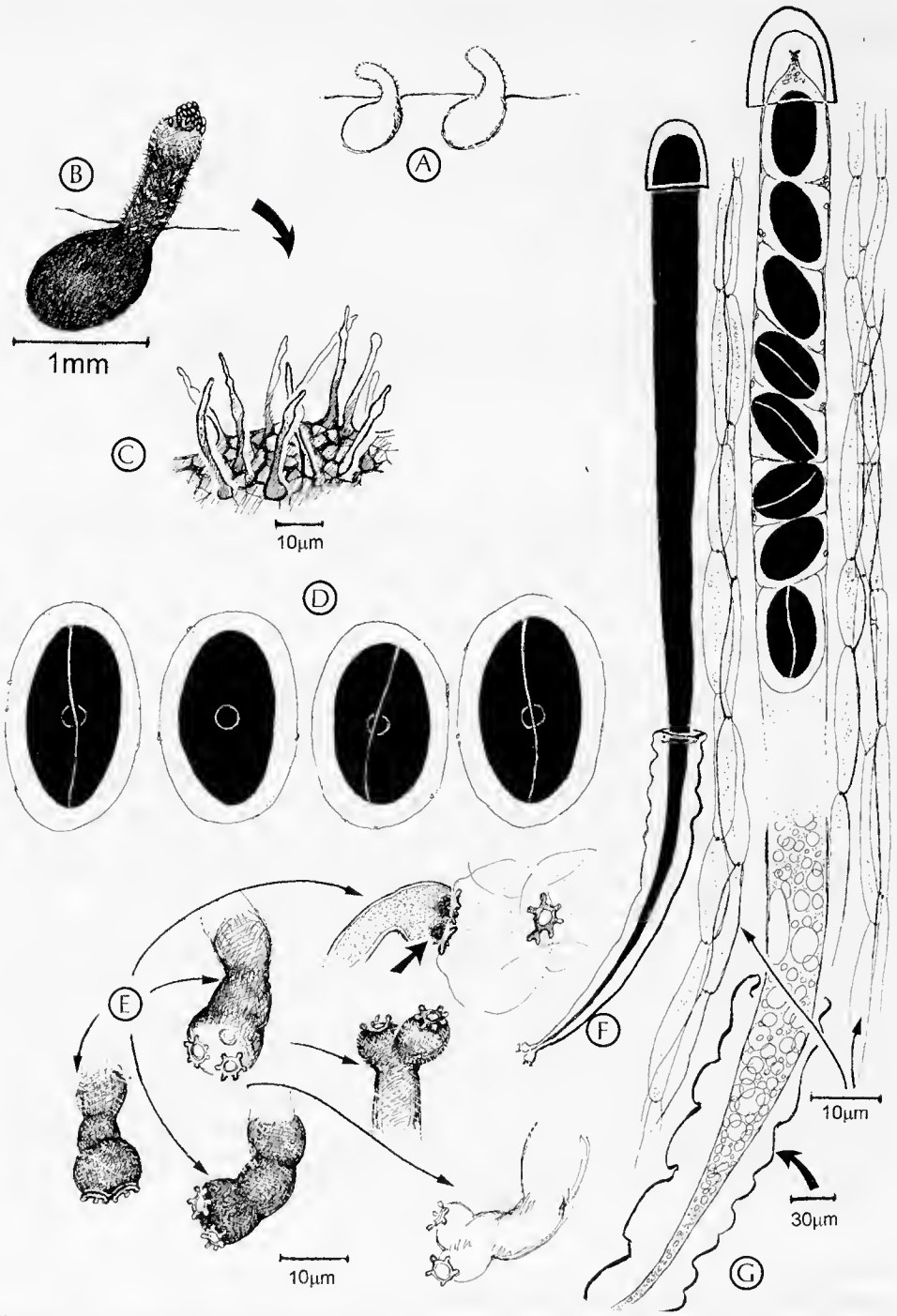


**Figure 1.** *Semidelitschia nanostellata.* **A**. Diagrammatic representation of perithecia on the dung. **B**. Habit of perithecium with cluster of released ascospores at the ostiole. **C**. Detail of perithecial neck hairs. **D**. Mature ascospores showing gelatinous sheaths, germination slits and nuclei. **E**. Star-shaped structures at the base of the asci (large arrow denotes stained material). **F**. Diagrammatic representation of dehisced ascus. **G**. Mature ascus and paraphyses (note these are drawn to different scales).

SW Tasmania, lat. 43°21′46″, long. 146°13′30″; substrate: dung of Red-necked Wallaby (*Macropus rufogriseus*), collected 12 April 1998, *Janet Fenton* (holotype MEL *2070230*).

*Characteristics on dung: Perithecia* aggregated but not confluent, venters submerged beneath the dung surface (Fig. 1A & B). Venters spheroidal or somewhat ovoid, black, approximately 1 mm in diameter, smooth, somewhat coriaceous in texture, composed of angular pseudoparenchyma (=textura angularis). Necks often attached at an angle to the venters, approximately 1 mm long, emergent from the dung surface, lower portions black and minutely hairy with a distinctly hyaline pubescent tip. Neck hairs are approximately 20 µm in length, one or more cells long and brown for the most part with pale tips (Fig. 1C). Ripe discharged ascospores often congregated at ostiole (Fig. 1B). *Paraphyses* densely packed around asci, consisting of variously sized elongate cells which are indented at their septa. Some lateral connections observed between contiguous chains of cells (Fig. 1G). *Asci* bitunicate, cylindric, abruptly contracted below into a short stipe, approximately 300 × 45 µm in their non-dehiscent state, rapidly elongating in water mounts (Fig. 1F & G). Dehiscence of the outer ascus wall is by subapical rupture (Ainsworth & Bisby's *Dictionary of the Fungi* 1995, Fig. 1L). Inner ascus wall endowed with a thickened but otherwise apparently undifferentiated tip (Fig. 1G). The most distinctive feature of the ascus is the star-shaped structure (usually two) at the base of each ascus. These attach the asci firmly to the cells lining the centrum (Fig. 1E & F). As a consequence of these tiny structures, the asci are extremely resistant to separation from the basal cells. Each star-shaped structure is approximately 5 µm in diameter and composed of several blunt little arms radiating from a central disc. Staining with cotton blue reveals two densely staining areas of cytoplasm associated with each stellate structure, indicating a firm living connection with the cell beneath each ascus (Fig. 1E, large arrow). *Ascospores* 8 per ascus, initially biseriate but becoming uniseriate in water mounts due to elongation of the asci, dark brown to black at maturity, smooth, ellipsoidal, equilateral or slightly inequilateral, 34–42(–46) × 19–22 µm with a straight or slightly sinuate germination slit extending along one side of the long axis of each ascospore. Each ascospore surrounded by a gelatinous sheath (Fig. 1D & G). Within the asci the compressed ascospore sheaths give a cellular appearance to the asci (Fig. 1G).

*Etymology*: *nano* = 'dwarf', *stellata* = 'star', referring to the structures at the base of the asci in this species.

## Discussion

The genus *Semidelitschia* was erected by Cain and Luck-Allen (1969) on the basis of single-celled dark ascospores bearing germination slits. It differs from the genus *Delitschia* Auersw. which has dark two-celled ascospores. In their description of *S. agasmatica*, Cain and Luck-Allen make no mention of any unusual structures at the bases of the asci and, unfortunately, the accompanying drawing illustrates what appears to be an ascus broken off above its base. Ascospores of *S. agasmatica* are (52–)54–76 × (28–)34–40 µm and are significantly larger than those of the species described here. Cain and Luck-Allen list nine herbarium samples of *S. agasmatica* from cow, sheep and horse dung collected from temperate locations in North America.

The only other species described for this genus is *S. tetraspora* (Mirza & Khan 1979). Its description is brief. The authors were uncertain as to the bitunicate nature of the asci and make no reference to the bases of the asci. They give the ascospore measurements for *S. tetraspora* as 18–22 × 9–12 µm, and list one sample from goat dung collected in Pakistan. Neither *S. agasmatica* nor *S. tetraspora* have been grown in culture.

*Semidelitschia* is a genus rarely recorded by mycologists. Indeed this is the first time we have observed the genus after some 30+ years of studying dung fungi. We do not know if the stellate ascus bases are peculiar to our new species or whether they were

simply overlooked in the other two described species. We do know, however, that these ascus bases are also shared by a number of species in the genus *Sporormiella* (research in progress). Another characteristic in common with various species of *Sporormiella* is the hyaline upper portion of the perithecial neck (Fig. 1B). However, species of *Sporormiella* have multicelled ascospores .

Observations made here support Cain and Luck-Allen's placement of *Semidelitschia* in the Sporormiaceae.

**Acknowledgements**

This fungus was found during the course of research into the coprophilous Ascomycetes of Australia funded by the Australian Biological Resources Study (ABRS). The authors gratefully acknowledge ABRS support and the efforts of Jane Fenton who collected the dung of the Red-necked Wallaby. Special thanks are also extended to Tom May at the Royal Botanic Gardens Melbourne who coordinated dung collection, and to Pat Grey who collated the samples and forwarded them to New Zealand.

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# Two New Endemic Australian Genera in the Tribe *Brongniartieae* (Fabaceae) to Accommodate Two Species Formerly Included in *Templetonia* R. Br.

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*Abstract*

Chemical and molecular data confirm the anomalous position within *Templetonia* R. Br. of *T. biloba* (Benth.) Polhill and *T. incana* J.H. Ross. Two new genera, *Cristonia* and *Thiuicola*, are described to accommodate *Templetonia biloba* and *Templetonia incana* respectively, and the relevant new combinations are made.

## Introduction

Although the circumscription of a number of genera await clarification, our understanding of the phylogenetic relationships at various taxonomic levels within the tribes *Mirbelieae*, *Bossiaeeae* and the Australian genera of the *Brongniartieae* has advanced considerably in recent decades (Lee, 1973; Polhill 1976, 1981; Arroyo, 1981; Crisp & Weston 1987, 1995; Polhill, 1994; Chappill, 1995; Doyle, 1995; Crisp *et al.*, in press).

Polhill (1976, 1981), on the basis of differences in anther and seed characters, divided the genera in the *Bossiaeeae* into two groups which he termed the *Templetonia* group (*Hovea* R. Br., *Lamprolobium* Benth., *Plagiocarpus* Benth. and *Templetonia* R. Br.) and the *Bossiaea* group (*Aenictophyton* A.T. Lee, *Bossiaea* Vent., *Goodia* Salisb., *Muelleranthus* Hutch., *Platylobium* Sm. and *Ptychosema* Benth.). The *Templetonia* group was characterised by having alternately basifixed and dorsifixed anthers with narrow inconspicuous connectives, seeds with an aril in the form of a collar or cap, often with a lip, straight radicles, and a tendency to accumulate quinolizidine alkaloids. In contrast, in the *Bossiaea* group the anthers are uniform in size, all dorsifixed, with perceptible brown connectives, seeds generally with hooded cap-like arils, inflexed radicles, and a tendency to accumulate canavanine. Arroyo (1981) and Polhill (1981) commented upon the close resemblance of some elements of the *Bossiaeeae* to the *Mirbelieae* on the one hand, and to the *Brongniartieae* on the other, and each suggested that the similarities may reflect a phylogenetic relationship.

The study of Crisp and Weston (1987) revealed clearly that the *Bossiaeeae* as previously circumscribed is polyphyletic. In order to remedy this situation, the *Templetonia* group of genera was transferred from the *Bossiaeeae* to the *Brongniartieae* with which it was found to share six strong synapomorphies. The more narrowly defined *Bossiaeeae* formed a monophyletic sister group to the *Mirbelieae*. However, although not strongly supported, there is some evidence from molecular data (Crisp *et al.*, in press) that the *Bossiaeeae* and *Mirbelieae* are not monophyletic sister taxa, and that the *Bossiaeeae* is nested within the *Mirbelieae*. The *Bossiaeeae* lineage has the same embryo-sac type (*Polygonum*-type with giant antipodals) as the *Daviesia* group of the *Mirbelieae*. Contrary to previous assumptions, the *Brongniartieae* is not closely allied to the *Bossiaeeae* or to the *Mirbelieae*.

In addition to modifying the circumscription of the *Bossiaeeae* and *Brongniartieae*, Crisp and Weston (1987) highlighted (i) the anomalous position within *Templetonia* of *T. biloba* (Benth.) Polhill and *T. incana* J.H. Ross, (ii) the fact that the two species are not closely related to each other, (iii) are more closely related to *Lamprolobium*, *Plagiocarpus* and *Hovea* than they are to *Templetonia*, (iv) and the need for further work to establish the phylogenetic status of these two species (see Fig. 1). As a consequence,

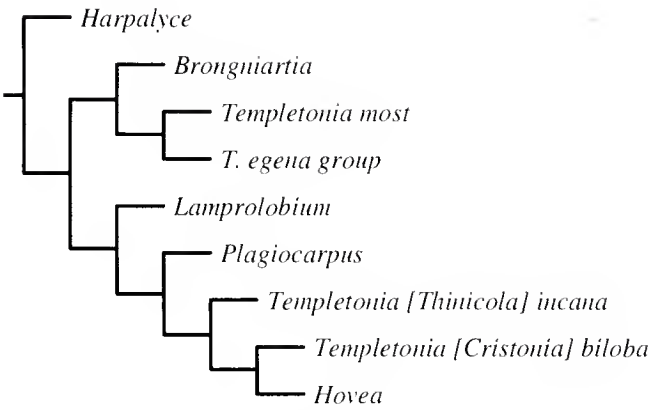


**Figure 1.** A portion of a cladogram taken from Crisp and Weston (1987) showing relationships between *Thinicola incana*, *Cristonia biloba*, and other exemplars of the *Brongniartieae*.

an endeavour was made to assemble additional collections and data relating to these two anomalous species of *Templetonia*, specifically chemical and molecular data, to try and establish their phylogenetic position. This paper summarises this work.

## Results

### ALKALOID DATA

Surveys of the alkaloids in *T. biloba* (Greinwald *et al.*, 1995b) and *T. incana* (Greinwald *et al.*, 1996a) revealed that both *T. biloba* and *T. incana* lack the ormosanine-type alkaloids that are typical constituents of the other species of *Templetonia* analysed, a finding that supports the removal of these species from *Templetonia*. *Templetonia biloba* was found to accumulate mainly α-pyridone alkaloids and tetrahydrocytisine derivatives with a fully saturated ring A. The co-occurrence of these compounds characterised *T. biloba* and it was concluded that tetrahydrocytisine and *N*-methyltetrahydrocytisine could be regarded as marker alkaloids for *T. biloba* because they represent quite rare constituents (Greinwald *et al.*, 1995b). In contrast to *T. biloba*, quinolizidine alkaloids were absent from all *Bossiaea* species studied where tyramine was found as major component of several species (Greinwald *et al.*, 1995b). This is significant because *T. biloba* was described initially as a species of *Bossiaea* before being transferred to *Templetonia* by Polhill (1976).

*Templetonia incana* was found to accumulate mainly α-pyridone alkaloids, together with smaller amounts of bicyclic quinolizidine alkaloids and the bipiperidyl alkaloid ammodendrine. *Templetonia incana* lacks the tetrahydrocytisine derivatives with a fully saturated ring A, that are typical constituents of *T. biloba*. The differences in the chemical profiles of *T. biloba* and *T. incana* reinforce the conclusion reached by Crisp & Weston (1987) that the two species are not sister species.

In terms of suggesting the possible affinities of *T. incana* and *T. biloba*, the alkaloid data are incomplete and, in part, inconclusive, but nevertheless provide some pointers. The data suggest that *T. incana* and *T. biloba* are more closely related to *Plagiocarpus* and *Lamprolobium* than they are to the other species of *Templetonia* or to *Hovea* (Greinwald *et al.*, 1995a). Among the Australian members of the *Brongniartieae*, ormosanine-type alkaloids have been reported only in *Hovea* and *Templetonia* (excluding *T. incana* and *T. biloba*).

Available data indicate that *T. incana*, *T. biloba* and *Plagiocarpus* have a similar

combination of quinolizidine alkaloids. Both *T. incana* and *Plagiocarpus* accumulate bicyclic quinolizidine alkaloids and mainly α-pyridone bases, and the presence of hydroxysparteines in *T. incana* and *Plagiocarpus* suggests a relationship between the taxa (Greinwald *et al.*, 1995a). The discovery of several hydroxysparteines in *T. incana* was significant because these compounds are absent from *T. biloba* and *Lamprolobiuin* (Greinwald *et al.*, 1996a). Although *Plagiocarpus* and *Lamprolobium* both accumulate bicyclic quinolizidine alkaloids and α-pyridones, *Lamprolobium* has the ability to produce the rather rare alkaloid lamprolobine and accumulates lower amounts of sparteine derivatives than *Plagiocarpus.*

The alkaloid pattern of *T. biloba* also exhibits a combination of bicyclic quinolizidine alkaloids and α-pyridones, but differs from that of *Plagiocarpus* by the absence of hydroxysparteine and by the presence of terahydrocytisine derivatives, therefore suggesting a more distant relationship to *Plagiocarpus* than is evident for *T. incana.* The presence of tetrahydrocytisine and its derivatives in *T. biloba* contrasts with the alkaloid profile of *Lamprolobium* (Greinwald *et al.*, 1995b).

To sum up, the akaloid data suggest that *T. incana* and *T. biloba* are not closely allied, and that their affinities are with *Plagiocarpus* and *Lamprolobium* rather than with *Templetonia* or *Hovea.* It was postulated (Greinwald *et al.*, 1996b), that the detection of lamprolobine in the leaves of *Brongniartia sousae* Dorado might reflect a relationship between *Brongniartia* and *Lamprolobium* as this alakaloid is known from very few sources. Arroyo (1976) drew attention to certain similarities between *Lamprolobium* and section *Brasilianae* of *Harpalyce*, but the alkaloid data provide no insight. The alkaloid profiles of *Brongniartia* and *Harpalyce* showed significant qualitative differences (Greinwald *et al.*, 1996b). A more comprehensive analysis of the alkaloid data in the Brongniartieae is given in Grimes *et al.* (in preparation).

## MOLECULAR DATA

Nuclear DNA from the 5S ribosomal DNA gene and spacer region and the first internal transcribed spacer region (ITS-1) of the 45S ribosomal DNA cistron of 23 taxa were sequenced (Thompson, 1999; Thompson *et al.*, in press). On the basis of the ITS-1 rDNA sequence data, and using *Bossiaea cinerea* and *Platylobium formosum* as outgroups, the members of the *Brongniartieae* form a strongly supported clade (Fig. 2). Within the *Brongniartieae*, *Harpalyce* is basal and sister to a strongly supported clade containing the remainder of the ingroup taxa. Within this clade of ingroup taxa, *Brongniartia* and *Plagiocarpus* form a clade, and *B. flava* and *P. axillaris* are sister taxa. *Lamprolobium grandiflorum*, *Templetonia incana* and *T. biloba* form a clade and there was moderate jackknife support for the pairing of *L. grandiflorum* and *T. incana.*

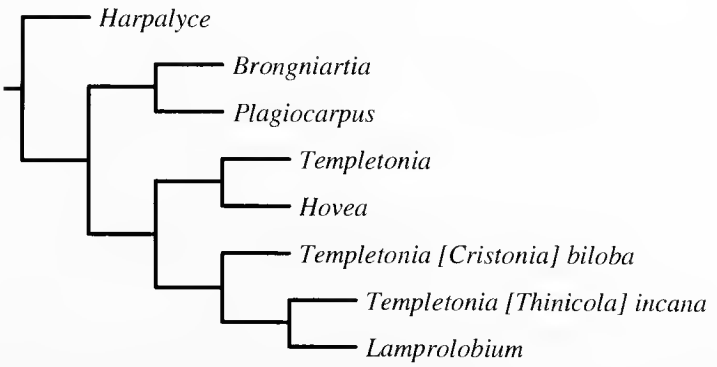


**Figure 2.** A portion of a cladogram taken from Thompson (1999) showing relationships between *Thinicola incana*, *Cristonia biloba*, and other exemplars of the *Brongniartieae.*

Deleting *Bossiaea* and *Platylobium* from the data set and changing the outgroup to *Harpalyce brasiliana* resulted in a tree that differed in only a few ways from the previous one. The clade comprising *Brongniartia flava*, *B. pringlei* and *Plagiocarpus axillaris*, although unresolved, was more strongly supported, but the clade of the previous tree comprising *Lamprolobium grandiflorum*, *Templetonia incana* and *T. biloba* is collapsed and forms part of a polychotomy with the remaining ingroup taxa. *Brongniartia* appears to be more closely related to some of the Australian members of the *Brongniartieae* than it is to *Harpalyce*, the other American member of the tribe.

To sum up, the molecular data suggest that *Harpalyce* occupies an isolated position in the tribe, that *Brongniartia* and *Plagiocarpus* form a clade, and that *Lamprolobium*, *Templetonia incana* and *T. biloba* form a clade.

## Discussion

The molecular and alkaloid data relating to *T. incana* and *T. biloba* are apparently contradictory. The alkaloid data suggest that the affinities of *T. incana* are with *Plagiocarpus* and that *T. biloba*, although not as closely allied as *T. incana*, also has affinities with *Plagiocarpus* rather than with *Lamprolobium* or the remaining species of *Templetonia*. On the other hand, the molecular data indicate that the affinity of *T. incana* and *T. biloba* is with *Lamprolobium* rather than with *Plagiocarpus* or the remaining *Templetonia* species, and that the affinities of *Plagiocarpus* are with *Brongniartia*.

The American genus *Harpalyce* is morphologically well circumscribed, has several unique character states, no evident close extant relative in the tribe, and its affinities are not clear. Molecular data suggest that *Brongniartia*, the only other American genus until now included in the tribe *Brongniartieae*, is more closely related to the Australian members of the tribe than it is to *Harpalyce*. However, it is evident (Hu *et al.*, 2000) that the neotropical genera *Poecilanthe* and *Cyclolobium*, previously considered part of the *Millettieae*, should be included in the *Brongniartieae*. Although the molecular data associated *Brongniartia* with *Plagiocarpus*, morphologically the genera are very dissimilar. In *Brongniartia* the calyx is more or less bilabiate, the vexillar stamen-filament is free, the flowers are large, and mostly in the orange-red-purple-violet range of the colour spectrum, the pods are oblong to obovate-oblong and compressed, and the leaves are imparipinnately compound. In *Plagiocarpus*, on the other hand, the calyx is not bilabiate, the vexillar stamen-filament is not free, the flowers are small and yellow, the pods are obliquely ellipsoid and turgid, and the leaves are mostly digitately trifoliolate.

Molecular data supported the sister relationship of *Lamprolobium* with *T. incana*, and associated *T. biloba* more closely with *Lamprolobium* than with *Plagiocarpus*. *Lamprolobium*, a ditypic genus, is confined in distribution to north-eastern Queensland, and *T. incana* to the sandy desert regions of Western Australia. Morphologically *Lamprolobium* and *T. incana* are dissimilar. *Lamprolobium* is distinguished readily by the calyx which is circumscissile basally, a unique character state in the tribe *Bongniartieae*, the flowers are small and yellowish, and the leaves are imparipinnately compound. In contrast, *T. incana* has large essentially red flowers that are adapted to bird pollination, and simple leaves.

All of the available evidence supports the exclusion from *Templetonia* of *T. incana* and *T. biloba*. The decision to do so is adopted here. The result of this decision to exclude *T. biloba* and *T. incana* from *Templetonia* is that the two species have to be accommodated elsewhere, either within an existing genus or genera or in a new genus or in new genera. Although the affinities of *T. biloba* and *T. incana* remain unclear, it appears most likely that they form part of a clade with the genus *Lamprolobium*. It could be argued perhaps that the two species should be accommodated within the ditypic *Lamprolobium*. However, this is not considered an appropriate option as neither species possesses a basally circumscissile calyx, the character state that is unique to *Lamprolobium*. Little is to be

gained by transferring two species that were anomalous within *Templetonia* to *Lamprolobium* where likewise they will be anomalous. *Templetonia biloba* and *T. incana* are not closely related to each other and consequently each is transferred to a new monotypic genus. The necessary changes are effected below.

**Taxonomy**

***Cristonia*** J.H. Ross, *genus nov.*, a speciebus omnibus *Templetoniae* foliis simplicibus apice bilobo manifeste plerumque, lobis calycis superis connatis in limbum truncatum productis, bracteolis linearibus herbaceis; a *Plagiocarpo* foliis simplicibus corollis flavis et purpureo-fuscis, leguminibus oblongis; a *Lamprolobio* foliis simplicibus, corollis flavis et purpureo-fuscis, calycibus non basaliter circumscissis; a *Thinicola* foliis apice bilobo manifeste, corollis flavis et purpureo-fuscis, lobis calycibus superis connatis in limbum truncatum productis, stipulis magnis oblique ovatis orbiculatis vel obovato-oblongis persistentibus foliaceis destitis differt.

*Typical species: C. biloba*

*Cristonia* differs from all species of *Templetonia* in having simple leaves that are usually distinctly bilobed apically, the 2 upper calyx-lobes united into a truncate limb, and linear herbaceous bracteoles; from *Plagiocarpus* in having simple leaves, large yellow and purplish-brown corollas, and oblong pods; from *Lamprolobium* in having simple leaves, yellow and purplish-brown corollas, and calyces that are not basally circumscissile; and from *Thinicola* in having leaves that are usually distinctly bilobed apically, the standard petal pale yellow internally with a broad purplish-brown zone around the throat, and the 2 upper calyx-lobes united into a truncate limb. Furthermore, the vegetative parts, pedicels and external surface of the calyces in *C. biloba* lack the dense spreading silvery hairs that are so conspicuous in *Thinicola*, and *C. biloba* lacks the large obliquely ovate, orbicular or obovate-oblong persistent foliaceous stipules of *Thinicola incana*.

***Cristonia biloba*** (Benth.) J. H. Ross, *comb. nov. Bossiaea biloba* Benth. in Endl. *et al.*, Enum. Pl. Nov. Holl. 36 (1837). *Templetonia biloba* (Benth.) Polhill, Bot. Syst. 1: 309 (1976); Ross, Muelleria 5: 6-8, figs. 3 & 4 (1982). *Type*: Western Australia, King Georges Sound, *Hügel* (holotype W).

*Bossiaea biloba* var. *stenophylla* Meisn. in Lehm., Pl. Preiss. 1: 85 (1844). *Type*: Western Australia, Swan River, *J. Drummond 264* (isotypes MEL, W).

*Cristonia biloba* occurs in Western Australia along the coastal plain and in the Darling Range from the vicinity of Perth northwards to Shark Bay. Although relatively widespread, plants are seldom common and, when not in flower, are easily overlooked.

The hairs on the exterior of the calyx in *C. biloba* are often dark brown, a feature shared with many species of *Hovea*. The two upper united calyx-lobes in *Lamprolobium* are reminiscent of those in *C. biloba*.

The name *Cristonia* is a contraction and acknowledges the contribution of Michael D. Crisp and Peter H. Weston whose joint studies have advanced significantly our understanding of the tribes *Mirbelieae*, *Bossiaeeae* and *Brongniartieae*. The bilobed leaf apices of *C. biloba* symbolise this joint contribution.

***Thinicola*** J.H. Ross, *genus nov.*, a speciebus omnibus *Templetoniae* partibus vegetativis pedicellis pagina externa calycis pilis densis effusis argenteis vestitis, stipulis magnis oblique ovatis orbiculatis vel obovato-oblongis persistentibus foliaceis, floribus magnis pendulis rubris admonum (*T. retusa* similtudine sed forma differt), bracteolis linearibus herbaceis; a *Plagiocarpo* et *Lamprolobio* foliis simplicibus, stipulis magnis persistentibus,

floribus magnis rubris admonum; a *Cristonia* partibus vegetativis pedicellis pagina externa calycis pilis densis effusis argenteis vestitis, foliis non apice bilobis, stipulis magnis persistentibus, floribus magnis rubris admonum differt.

*Typical species: T. incana*

*Thinicola* differs from all species of *Templetonia* in having the vegetative parts, pedicels and the external surface of the calyces clothed with dense spreading silvery hairs, large obliquely ovate, orbicular or obovate-oblong persistent foliaceous stipules, large, pendulous and essentially red flowers (also in *T. retusa* but the shape of the corolla differs), distinctive auricles at the apex of the standard claw, and linear herbaceous bracteoles; from *Plagiocarpus* and *Lamprolobium* in having simple leaves, large persistent stipules, and large essentially red flowers; and from *Cristonia* in having the vegetative parts, pedicels and external surface of the calyces clothed with dense spreading silvery hairs, leaves not bilobed apically, large persistent stipules, and large essentially red flowers. Unlike *Lamprolobium, Thinicola* does not have basally circumscissile calyces.

***Thinicola incana*** (J.H. Ross) J.H. Ross, *comb. nov. Templetonia incana* J.H. Ross, Muelleria 4: 247–249, fig. 1 (1980). *Type*: Western Australia, red sand dune 19 miles ENE of Jupiter Well, 28.vii.1967, *A.S. George 9065,* (holotype PERTH; isotypes AD, CANB, K, MEL, PERTH).

*Thinicola incana* occurs on the crest of dunes in the Gibson, Great and Little Sandy Deserts in Western Australia. Sometimes grows in association with *Crotalaria cunninghamii* with which it is easily mistaken from a distance on account of the superficially similar foliage.

When first described, mature pods and seeds were unknown. This deficiency has been remedied. Pods oblong, 2.4–3.2 cm long, 1.2–1.5 cm wide, valves yellowish-brown when mature, inconspicuously transversely venose, shiny, glabrous, flattened, apically apiculate, dehiscent. Seeds elliptic to ovate or occasionally almost rounded, 5.3–6.6 mm long, 3–4.4(–5.7) mm wide, 3–4.2 mm thick, straw- to chestnut-brown, the small hilum surrounded by a cap-like aril.

The name *Thinicola* is derived from the Latin '*thinium*' meaning 'dune', and '*cola*' meaning 'dweller', and refers to the preferred habitat of *T. incana* on the crests of sand dunes.

**Key to the Australian genera of the *Brongniartieae***

1. Leaves all or mostly 3–5(–7)-foliolate; leaflets elliptic- to obovate-oblong, oblong, obovate, narrowly elliptic to narrowly ovate, never linear-terete or filiform ..... 2
1. Leaves simple, unifoliolate, reduced to scales or imparipinnate but then leaflets linear-terete to filiform ..... 3

2. Leaves imparipinnately compound, usually 3–5(–7)-foliolate, but distal leaves often unifoliolate; calyx circumscissile basally; pods oblong ..... ***Lamprolobium***
2. Leaves digitately 3-foliolate; calyx not circumscissile basally; pods obliquely ellipsoid ..... ***Plagiocarpus***

3. Leaves simple, unifoliolate, reduced to scales or imparipinnately compound and the leaflets linear-terete to filiform; bracteoles ovate, papery ..... ***Templetonia***
3. Leaves simple; bracteoles linear to ovate but not papery ..... 4

4. Corolla (except for markings in throat of standard) blue, purple or mauve, rarely white; pods not or scarcely longer than broad; aril 3 or more times as long as broad ..... ***Hovea***
4. Corolla yellow with purplish-brown markings or essentially red; pods oblong, much longer than broad; aril nearly circular to elliptic ..... 5

5. Subshrub to 0.5 m high; branchlets sparingly to densely clothed with villous hairs; leaves linear to linear-cuneate or cuneate-oblong, typically bilobed apically; stipules absent; corolla yellow with purplish-brown markings; 2 upper calyx-lobes fused into a truncate limb ..... ***Cristonia***
5. Shrub to 3 m high; branchlets and leaves densely clothed with spreading silvery hairs; leaves elliptic, ovate or elliptic-oblong, rounded, obtuse to slightly emarginate and apiculate apically; stipules large, conspicuous; corolla essentially red but often partially pale cream or yellow; 2 upper calyx-lobes larger than the lower 3 but not fused into a truncate limb ..... ***Thinicola***

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# Notes on the *Philotheca myoporoides* Complex (Rutaceae) in Victoria

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*Abstract*

*Philotheca myoporoides* subsp *petraeus* nov. is described from the Gippsland area of Victoria, and *P. myoporoides* subsp *brevipedunculata* is recorded from the state for the first time.

## Introduction

The taxonomy of *Philotheca myoporoides* (DC) M.J.Bayly was most recently revised by Bayly (1998), who transferred the species from *Eriostemon*, in line with the classification of Wilson (1998), and recognised nine subspecies. Bayly (1998, p. 118) maintained a broad circumscription of *P. myoporoides*, even though he noted that most of the "taxa in the *Philotheca myoporoides* complex are both morphologically and geographically distinct".

In this paper a new taxon from Mount Stewart in the Gippsland Region of Victoria is formally described. It was first collected in 1963. Material of this taxon was identified by Paul Wilson when preparing his (1970) revision of *Eriostemon*, as *E. myoporoides* [=*P. myoporoides*] with the annotation "I have seen no other material of this form". Subsequently, the Flora of Victoria treatment of *Eriostemon* (Bayly 1999), which was prepared (but not published) prior to Bayly's (1998) work, placed the Mount Stewart collections under *E. myoporoides* subsp. *myoporoides*, which was at the time of preparation, the only described subspecies of *E. myoporoides* recognised from the State. More information on this taxon was provided by Bayly (1998), who included a brief description and noted that the Mount Stewart collections "most closely resemble members of subsp. *brevipedunculata*" but did not "sit comfortably within the present circumscriptions of subspecies". A new subspecies of *P. myoporoides* is here proposed for the Mt Stewart collections, as this is consistent with the current circumscription of taxa within this complex. This paper also provides the first record of *Philotheca myoporoides* subsp *brevipedunculata* from Victoria. The specimens studied are all from the National Herbarium of Victoria (MEL).

***Philotheca myoporoides*** subsp. ***petraeus*** Rozefelds subsp nov. a Philotheca myoporoides subsp. myoporoides foliis 8–16 mm longis, pedicellis 1–3(–4), atque a Philotheca myoporoides subsp. brevipedunculata pedunculis 2.2–3.0 mm longis, pedicellis usque 3mm longis differt.

*Type*: North west facing slope at the summit of Mt Stewart, East Gippsland, Victoria, *J.Turner 1055*, 18 Nov. 1995 (holotype MEL *2030756* (Fig. 1))

*Philotheca myoporoides p. p. sensu* M.J.Bayly, *Muelleria* 11: 118–119 (1998).

*Eriostemon myoporoides* subsp. *myoporoides p. p.* sensu M.J.Bayly, *Flora of Victoria* 4: 183 (1999).

An erect *shrub*, glabrous except for the staminal filaments. *Branches* green, terete, prominently glandular, verrucose. *Leaves* sessile, 8–16 mm long, 4–7 mm wide, coriaceous, concolorous in dried specimens, with midrib not extended into aristate tip, smooth on adaxial surface, conspicuous small glands on abaxial surface, margin tinged with red. *Inflorescence*, 1–3(–4)-flowered in axillary cymes, peduncle 2.2–3 mm long, bracts conspicuous, pedicel 2.5–3.1 mm expanding distally. *Flowers* 5-merous; *sepals* semiorbicular,

**Figure 1.** Holotype of *Philotheca myoporoides* subsp. *petraeus*.

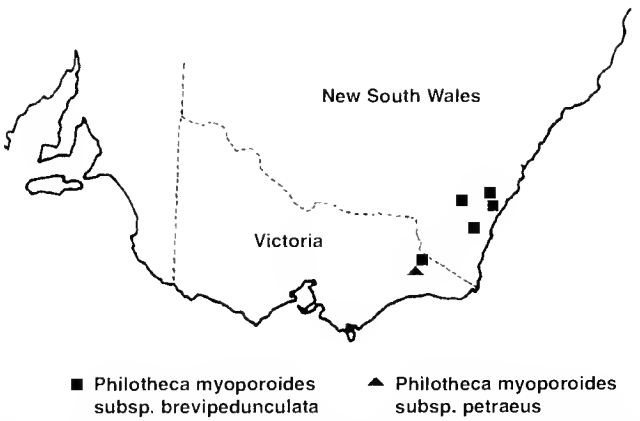


**Figure 2.** Map of south-eastern Australia showing the distribution of *Philotheca myoporoides* subsp. *brevipedunculata* ■ based upon MEL records, and the type locality of *P. myoporoides* subsp. *petraeus* ▲.

c. 1.0 mm long, c. 1.5 mm wide apex obtuse; *petals* elliptical, c. 6 mm long, 2.3–3.0 mm wide, white; *stamens* 10; *staminal filaments* slightly expanded at base, apex narrow and gradually tapering, margin near base ciliate, more pilose near apex; *anthers* bi-glandular with a short, white apiculum. *Ovary* c. 2.0 mm long, *carpels* 5, narrow, *style* c. 1.0 mm, *stigma* rounded. *Fruit* and seed not seen.

*Additional material examined*: VICTORIA: Mt Stewart [spelled 'Stuart' on specimen], near Millickmunjie Creek, East Gippsland, *K.Rogers s.n.* 13 Mar. 1963 (MEL *4133*).

*Distribution and Habitat*: *Philotheca myoporoides* subsp. *petraeus* is presently known from the type locality at Mt Stewart, where it occurs in rocky areas. The subspecies is poorly known and current herbarium collections would suggest that it is rare, although a survey of surrounding areas would be useful to determine its distribution and abundance.

*Phenology*: Recorded flowering in November.

*Etymology*: The subspecies name is derived from the Latin *petraeus*, which alludes to its growing among rocks.

*Notes*: Bayly (1999) recognised the Mt Stewart population (=*P. myoporoides* subsp. *petraeus*) as a variant within *P. myoporoides* subsp *myoporoides*. It differs from the type subspecies in that its leaves are 10–16 mm long, versus 30–155 mm long, and it has 1–3 (–4) flowers/per inflorescence versus 3–8 in the type subspecies (Bayly 1998).

Bayly (1998, p. 118) noted that subsp. *petraeus* superficially resembles subsp. *brevipedunculata* M.J.Bayly, but he did not discuss the similarities between these taxa. *Philotheca myoporoides* subsp. *brevipedunculata*, differs from subsp *petraeus* in having very short peduncles, which are less than 2 mm long, and slender pedicels that are more than 4 mm long and usually uniflowered inflorescences. Both subspecies have leaves that are similar in size and shape; and they also have staminal filaments that are distally pilose.

***Philotheca myoporoides*** subsp. ***brevipedunculata*** M.J.Bayly, *Muelleria* 11:121–122 (1998)

An erect shrub, glabrous except for the staminal filaments. *Branches* green, terete, prominently glandular, verrucose. *Leaves* sessile, 11–30 mm long, 4–7 mm wide, coriaceous, concolorous in dried specimens, apex acute, truncate, with midrib extended into mucronate tip, smooth on adaxial surface, conspicuous small glands on abaxial surface, margin sometimes tinged with red. *Inflorescence*, 1(–3)-flowered in axillary cymes, peduncle very short, 0–2 mm long, bracts conspicuous, pedicel slender, 4–8 mm long, tapering distally. *Flowers* 5-merous; *sepals* semiorbicular-broadly ovate, c. 1 mm long, c. 1.5 mm wide apex obtuse; *petals* elliptical, c. 6–7 mm long, 2.5–3.5 mm wide, white tinged with pink in bud; *stamens* 10; *staminal filaments* ciliate near base, sparsely pilose in upper half; *anthers* bi-glandular with a short, white apiculum. *Ovary* c. 0.75–1.0 mm long, *carpels* 5, narrow, *style* c. 1.5 mm, *stigma* rounded. *Cocci* erect, rostrate, *Seed* 5 mm long, shiny black, hilum long and thin.

*Habitat and Distribution*: Bayly (1998) recorded this subspecies from the Mount Donald area of Deua National Park (Type Locality), Round Hill south of Sassafras, Enchanted Hill north of Williamsdale and Little Forest north-west of Milton (based upon a pers. comm. from Paul Wilson). All of these records are from New South Wales, so the new record from Suggan Buggan in Victoria represents a significant range extension (Fig. 2). This subspecies has been collected from skeletal soils on rhyolite (Bayly, 1998). The Archer *s.n.* specimen was collected from a rocky ridge.

*Conservation Status*: Bayly (1998) suggested a conservation code (Briggs and Leigh 1988) of 3RC for *P. myoporoides* subsp. *brevipedunculata*, but with this significant range extension for the subspecies, further surveys may show that the subspecies is more common than currently recognised.

*Phenology*: *Philotheca myoporoides* subsp. *brevipedunculata* has been collected in flower in August–October and December–January.

*Notes*: The specimen (W.R.Archer *s.n.*) collected from near Suggan Buggan in north eastern Victoria is consistent with the type material in having short, reduced peduncles that are less than 2 mm long, and the mature flowers have long tapering pedicels that are more than 4 mm long. The anthers are distally pilose and the inflorescences are uniflowered. The specimen differs from the type description in having slightly smaller leaves, 11–19 mm long versus 13–30 mm and 4–7mm versus 5–10 mm wide leaves.

*Material examined*: **New South Wales**: Holotype, Deua National Park, c. 13 km (direct) WSW of Moruya, prominent rocky knoll, c. 1.1 km NW of Coondella Trig. Point, SW slope of knoll, 35°57'S 149°54'E, Altitude 450 m, *R.O.Makinson* 1239 & *G.Butler*, 23 Nov. 1992 (MEL *717249*); Prominent rocky peak 2 km due N of Coondella Trig. Point, Deua National Park, 35°55'40"S 149°54'20"E, altitude 500 m, *D.E.Albrecht 4586*, 21 Oct. 1990 (MEL *2012427*); Prominence 1.9 km N. from Coondella Trig. Point, c. 16km WSW from Moruya, 35°55'50"S 149°54'20"E, altitude 480 m, *N.G.Walsh 1883*, 7 Dec. 1987 (MEL *691809*); Peak 3 km due W of Bundogeran Hill, Deua National Park, 35°53'15"S 149°54'10"E, *D.E.Albrecht 5314*, 1 Jan. 1993 (MEL *2016787*); Rocky Gully, northern slopes of Enchanted Hill, 13 km N of Williamsdale, 35°28'S 149°08'E, altitude 800 m, *B.J.Lepschi 842*, 2 Aug. 1992 (MEL *713459*). **Victoria**: Rocky Range Faunal Reserve, on ridge running eastwest, 5 km SW from Suggan Buggan, north east Gippsland. *W.R.Archer s.n.*., 28 Aug. 1984 (MEL *666433*).

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# The Tasmanian species of *Philotheca* (Rutaceae)

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*Abstract*

*Philotheca freyciana sp. nov.* is described from the Freycinet Peninsula in Eastern Tasmania. The five-merous flowers and obcordate glandular leaves suggest affinities with *P. verrucosa* (A.Rich.) Paul G. Wilson, but it differs from this taxon in having anthers with an acute apex, larger leaves and flowers, and also in habit. The morphology of both these species and *P. virgata* (Hook.f.) Paul G. Wilson is described, and the variation in leaf size and anther morphology is illustrated. A key to the species of *Philotheca* in Tasmania is provided, along with data on the distribution and phenology of each species.

## Introduction

Wilson (1998) recently completed a taxonomic revision of the genera, *Eriostemon* Sm. and *Philotheca* Rudge (Rutaceae), and transferred the two Tasmanian species *E. verrucosus* A.Rich. and *E. virgatus* Hook.f. to *Philotheca*. In preparing the revised State Flora, the Tasmanian species in *Philotheca* were re-examined using the collections in the Tasmanian Herbarium. A study of these collections indicated that a previously undescribed taxon occurred on the Freycinet Peninsula in eastern Tasmania. Wilson (1970, p. 48) had also noted much earlier that "on Freycinet Peninsula a plant with broad, imbricate leaves (to 12 × 9 mm) is found, considerably larger than the mainland form". Limited fieldwork by the author resulted in the finding of three plants of this taxon, in two separate localities.

*Philotheca virgata* is sympatric with the new taxon, but it differs in leaf shape, floral merotomy and inflorescence structure. *Philotheca verrucosa* has not been collected on the Freycinet Peninsula. The new taxon differs from *P. verrucosa* in having larger leaves and flowers, the apex of the anthers is acute, and the leaves are almost imbricate. The morphological differences identified indicate that formal recognition of the Freycinet populations as a discrete taxon is required and specific rank seems appropriate. Information on the morphology and distribution of *P. verrucosa* and *P. virgata* in Tasmania is also included.

## Materials and Methods

Herbarium material of all Tasmanian taxa of *Philotheca* were examined in the Tasmanian Herbarium. For scanning electron microscopy alcohol-preserved material was taken through an alcohol dehydration series, critical point dried, placed onto aluminium stubs with carbon or double-sided tape and sputter coated with gold to a thickness of ~20 µm and examined with an Environmental Scanning Electron Microscope 2020 operated at 15–20 kV under high vacuum. The geographical regions of Tasmania used are those of Orchard (1988).

## Taxonomy

Basionyms, nomenclature and complete synonymies for *P. virgata* and *P. verrucosa* are cited in Wilson (1970, 1998).

**1. *Philotheca virgata*** (Hook.f.) Paul G. Wilson

An erect *shrub*, occasionally up to 1–2(–2.5) m tall, glabrous except for the pilose staminal filaments. *Branches* terete, scarcely to strongly glandular-verrucose. *Leaves* sessile, flat to slightly convex, oval to narrowly obovate, 9–18(–40) mm long, 3–5 mm wide, coriaceous, relatively thin, with mid-rib extended into a mucronate tip, smooth on abaxial surface, with tubercular glands on adaxial surface (Figs 1A–C). *Inflorescence* single flowered, axillary, *peduncle* absent; *flowers* 4(–5)-merous; *bracteoles*, c. 1 mm long, four, deltoid, caducous, inserted at the base of the pedicel; *pedicel* 3–5 mm long; *sepals* ± semiorbicular, 0.5–1 mm long; *petals* 4(–5), broadly elliptical, 5.0–6.5 mm long, 3.0–3.5 mm wide, white; *stamens* 8(–10), filament broadly flattened proximally and prominently pilose near apex, tapering abruptly or gradually towards the anther, *antesepalous filaments* 1.8–2.8 mm long, *antepetalous filaments* 1.8–2.4 mm long; *anther* cordate, versatile, introrse, c. 1 mm long, apex biglandular, apiculum bluntly pointed, pollen orange (Fig. 2A–B); *ovary* inserted into the disc; *carpels* 4(–5), narrow, *style* <0.5 mm free; *stigma* 4(–5)-partite. *Cocci* spreading, 4.5–6.0 mm long, 2.5 mm wide, adaxial margin rounded, the apex acute to rostrate, surface irregularly rugose. *Seed* black, shiny, c. 3 mm long.

*Habitat and Distribution: Philotheca virgata* occurs commonly in western Tasmania, with disjunct populations on the East Coast in the Coles Bay area, and further north in the Scamander area (Fig. 3A), and there are also disjunct populations at Mt Imlay in southern New South Wales, and Mt Kaye in Victoria. In Tasmania, it is typically a lowland taxon, usually occurring at altitudes of less than 300 m, but occasionally up to 800 m as in the Mt Imlay population in New South Wales; and it occurs in a range of community types including both heath and sedge communities.

*Conservation Status*: The species is common in western Tasmania.

*Phenology*: *Philotheca virgata* flowers in October–February, but plants may be found in flower throughout the year.

*Notes*: *Philotheca virgata* varies in leaf-size between populations (Fig. 1A–C), and plants with very long slender leaves, usually 30–40 mm long, occur in the Cygnet area in southern Tasmania. There are also differences between populations in the width and the shape of the

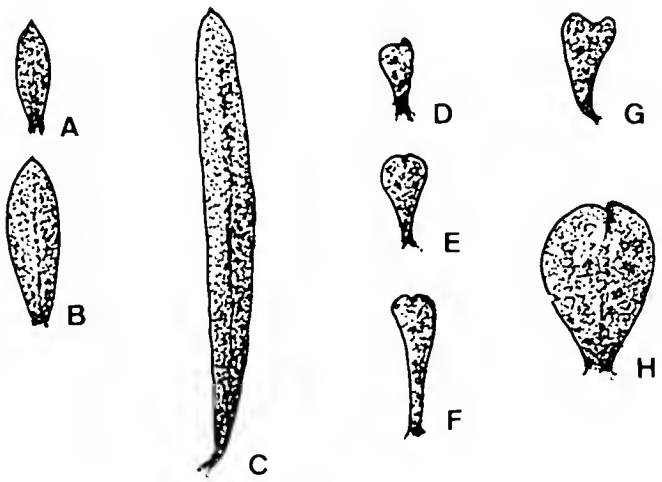


**Figure 1.** Variation in leaf size and shape in *Philotheca* species. **A–C** *P. virgata*, **A** *D.Ziegler 5* , HO *99916*; **B** *W.D.Jackson s.n.*, HO *4882*; **C** *Rozefelds 952*, HO *329845*; **D–G** *P. verrucosa*, **D** *F.H.Long 875*, HO *92397*; **E** *A.V.Giblin s.n.*, *HO4864*; **F** *P.Collier 654*, HO *97961*; **G** *J.F.Thompson s.n.*, HO *97800*; **H** *P. freyciana*, *B.Gee s.n.*, HO *320402*. All 1.4 × natural size.

filaments of the stamens. Material from Freycinet (*Rozefelds 1668* HO) and Mt Imlay (*Duretto 720* MEL) have a relatively broad filament-base which tapers abruptly, while the West Coast specimens (e.g. *W.J.Jackson s.n.* (HO *4882*)) have narrower filaments which taper gradually. The filaments of the West Coast material are also often strongly sigmoid.

*Representative Specimens*: **New South Wales**: Mt Imlay, 20 km SW of Eden, 37°11'S 149°44'E altitude 850m, *I.R.Telford 6761*, 25 Oct. 1977 (HO *59327*), Mt Imlay summit, 37°11'S 149°45'E, altitude 880 m, *M.F.Duretto 720*, 2 Oct. 1995 (HO *326895*). **Tasmania**: EAST COAST: Middleton Creek, 3 kms NE of Coles Bay, 42°06'S 148°18'E, *D.Ziegeler 5*, 4 Oct. 1986 (HO *99916*); Coles Bay, 42°08'S 148°17'E *W.M.Curtis s.n.*, Oct. 1946 (HO *4884*); Nicholls Rivulet near Cygnet, 43°09' 52"S 147°09'40"E, altitude 120m, *A.C.Rozefelds 952*, 6 Nov. 1998 (HO *329845*). WEST COAST: 7 miles from Zeehan, on Granville Harbour Road, 41°50'S 145°15'E, altitude 190m, *A.E.Orchard 5615*, 3 Dec. 1981 (HO *120567*); Long Plains, Corinna, 41°31'S 145°13'E, *W.D. Jackson s.n.*, Jan. 1954 (HO *4882*); SOUTH WEST: Plateau area between Hills Creek and Fern Creek on track 42°28'S 145°21'E, altitude 180 m *A.M.Buchanan 1911*, 7 Dec. 1983, (HO *89967*).

**2. *Philotheca verrucosa*** (A. Rich.) Paul G. Wilson

*Shrub* to 1.0 m tall, erect, spreading to scandent in habit, glabrous except for staminal filaments. *Branches* terete, green, prominently glandular-verrucose. *Leaves* sessile, thick, slightly concave to conduplicate, narrowly obcordate or obovate, (4–)5–10(–14) mm long and 3.5–5 mm wide, coriaceous with prominent tubercular glands on the abaxial surface, the adaxial surface smooth (Figs 1D–G). *Inflorescence* 1(–3) flowered, axillary; *peduncle* 2.0–3.0 mm long; *flowers* 5-merous; *bracteoles* four, brown, caducous at base of pedicel; *pedicel* 1.0–2.0 mm long; *sepals* semiorbicular, c. 1 mm long, c. 1 mm wide, margin finely ciliate; *petals* 5, elliptical, 4–6 mm long, 2.8–3.0 mm wide, white, pink in bud; *stamens* 10, staminal filaments slightly flattened, narrow and tapering, margin sparsely pilose, *antesepalous filaments* 2.4–2.8 mm long, *antepetalous filaments* 2.3–2.5 mm long; *anthers* versatile, introrse, c. 1 mm long, apex biglandular, rounded with "pinched" apex in bud (Figs 2C–D), less evident in mature stamens, apex obtuse with a small indentation near the apex (Fig. 2E), pollen orange; *ovary* inserted into the disc, *carpels* 5, narrow, style <0.5 mm free; *stigma* 5 partite. *Cocci* spreading, 4.0–4.5 mm long, c. 2.8–3.0 mm wide, adaxial margin rounded, apex acute, sometimes shortly rostrate, surface weakly rugose. *Seed* black and shiny, 4–4.5 mm long.

*Habitat and Distribution*: *Philotheca verrucosa* occurs in Victoria, South Australia and Tasmania (Wilson 1970). In Tasmania, it occurs in forests of *Eucalyptus amygdalina* Labill. and *E. viminalis* Labill. on dry hillsides and is restricted to the eastern half of the State (Fig. 1B). It typically occurs at low altitudes (< 200 m), but occasionally up to 500 m, as in the Mount Sugarloaf locality.

*Conservation Status*: This species is common in eastern Tasmania and is not considered under threat.

*Phenology: Philotheca verrucosa* flowers commonly in October–January, but plants have been collected in flower in most months of the year.

Representative Specimens: **Victoria**: Mt Difficult Road, The Grampians, *T.B.Muir 2613*, 10 Oct. 1962; (HO *37594*, MEL *4503*); 1 km SW of Chewton and 4 km ESE of Castlemaine, 37°05'S 144°05'E, *T.B.Muir 6744*, 6 Oct. 1981 (HO *83168*). **Tasmania**: EAST COAST: Near South East Boundary of east Risdon Nature Reserve, 42°49'S 147°19'E, altitude 110 m, *A.M.Buchanan 3775*, 21 Oct. 1984, (HO *86743*); North of the Basin, Ouse River, 42°24'S 146°48'E, altitude 180 m, *P.Collier 654*, 15 Sept. 1985 (HO *97961*); Mt Peter, Eastern Ridge, dry dolerite ridge, 42°01'S 148°15'E, altitude 200 m, *A.M.Buchanan 7671*, 29 Dec. 1985 (HO *406919*); Lynes Sugarloaf, 42°55'S 148°7'E, altitude 552 m, *A.Moscal 357*, 15 Jun. 1980 (HO *35287*); Upper Proctors Road, Hobart, 42°54'S 147°20'E, *J.F.Thompson s.n.*, Oct. 1959 (HO *97800*); Campania, 42°40'S 147°25'E, *A.V.Giblin s.n.*, Nov. 1929 (HO *4864*); Glenorchy, on water reserve, 42°49'S 147°18'E, altitude 300 m, *F.H.Long 875,* 25 Oct. 1931 (HO 92397).

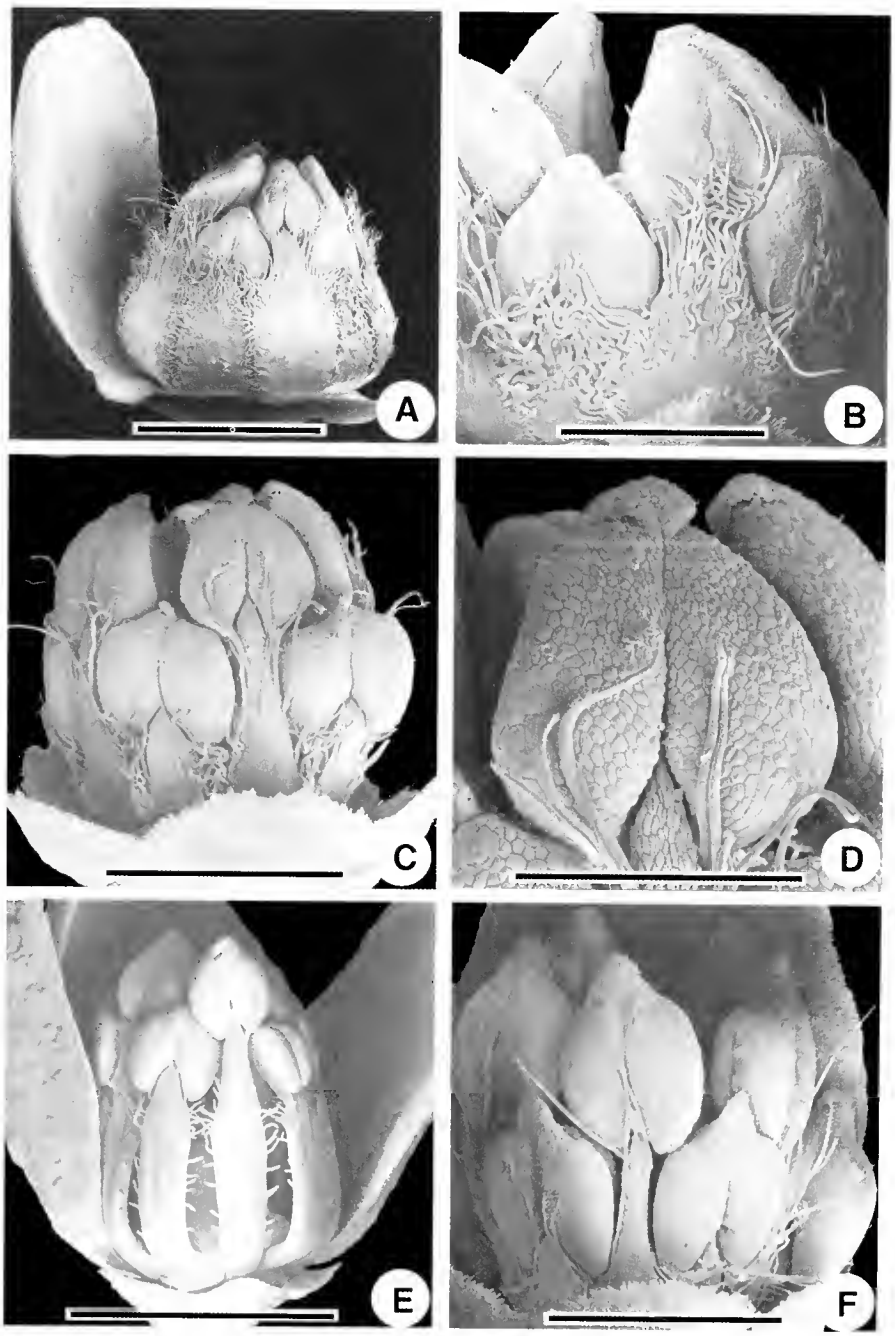


**Figure 2.** Abaxial views of anthers of the three Tasmanian *Philotheca* species: *P. virgata*, **A** – Dissected bud showing arrangement of stamens, note the broad flattened hairy anther filaments, **B** – Detail of anther from 2A; *P. verrucosa*, **C** – Dissected bud showing arrangement of stamens and note the relatively thin filaments, **D** – Detail of anther from Fig. 2C showing the pinched apex and note that the shape of the apex of the anther varies slightly between episepalous and epipetalous anthers, **E** – open flower with stamens fully elongated; *P. freyciana*, **F** – Dissected bud showing the conspicuous glands towards the apex of the anther (A–B, *Rozefelds 1668*, Coles Bay, Tasmania, Oct. 1999 (HO); C–E, *Rozefelds 1667*, Orford, Tasmania Sept. 1999 (HO); F, *Rozefelds 1666* (HO)). Scale Bars: A,C,F = 1 mm; B, D, E = 500 µm.

Comments: Wilson (1970) considered *P. verrucosa* a uniform taxon, although it is variable in leaf-shape, the degree of leaf-concavity, and also in the appearance of glands on the abaxial surface of the leaves. Leaf shape in *P. verrucosa* varies from narrowly obovate to obcordate (Fig. 1D–F).

**3. *Philotheca freyciana*** Rozefelds sp. nov.

*a Philotheca verrucosa* (A.Rich.) Paul G. Wilson foliis 9–13 mm longis, 8–13 mm latis, et antheris valde apiculatis, a *P. virgata* (Hook. f.) Paul G. Wilson foliis obcordatis, a *P. myoporoides* (DC) M.J.Bayly foliis obcordatis, valde conduplicatis, pagina abaxiali manifeste glandulosa differt.

*Type*: Mt Amos, Freycinet National Park, *anon.*, Oct. 1970. (holotype HO *33348*).
*E. verrucosus* p. p. Paul G. Wilson, *Nutysia* 1: 48 (1970)

An erect *shrub* less than 40 cm tall, compact, glabrous except for sparsely pilose stamen filaments. *Branches* green, terete, prominently glandular, verrucose. *Leaves* sessile, almost imbricate in appearance, coriaceous, broadly obcordate-obovate, folded through to 90° in life, 9–13 mm long, 8–13 mm wide, with prominent tubercular glands on the abaxial surface, smooth on the adaxial surface, margins tinged red (Fig. 1I). *Inflorescence* uniflowered, axillary; *peduncle* 1.0–2.0 mm long; *flowers* 5-merous; *bracteoles* four, brown, caducous, at base of pedicel; *pedicel* 3–4 mm long; *sepals* semiorbicular, c. 1 mm long, c. 1.5 mm wide; *petals* 5(–6), broadly elliptical, white, pink in bud, 8–10 mm long, 4–5 mm wide; *stamens* 10, staminal filaments flattened, margins sparsely pilose, *antesepalous filaments* 3.5–4.0 mm long, *antepetalous filaments* 2.7–3.2 mm long; *anthers* versatile, introrse, c. 1 mm long, apex biglandular and pointed, pollen orange (Fig. 2F); *ovary* inserted into the disc; *carpels* 5, narrow; *style* c. 1 mm long, *stigma* rounded, 4–5-partite. *Cocci* c. 4 mm long, c. 3.5 mm wide, adaxial margin rounded with apex acute, surface smooth, weakly rugose, with a few scattered glands. *Seed* black, shiny, c. 4 mm long.

*Etymology*: This species is named after Freycinet Peninsula, the type locality.

*Habitat and Distribution: Philotheca freyciana* occurs in skeletal sandy soils, derived from granitic rocks, and is found with *Eucalyptus amygdalina* Labill., *E. tenuiramis* Miq., *Leptospermum grandiflorum* Lodd., and *Hakea megadenia* R.M.Barker. *Philotheca freyciana* is known from four herbarium specimens, and three living plants.


**Figure 3.** Map of Tasmania showing the distribution of *Philotheca* species based upon Tasmanian Herbarium (HO) records. **A** – *P. virgata*, **B** – *P. verrucosa* and *P. freyciana* (triangle) arrowed.

*Conservation Status*: While the species is conserved in the Freycinet National Park, it is considered endangered as only three plants, from two separate localities, were located during fieldwork.

*Phenology*: Buds in *P. freyciana* are formed prior to winter, and flowers have been seen in autumn (April–May), and also in spring (September–October).

*Other Specimens Seen* (3 examined): **Tasmania**: East Coast: Mt Amos, Freycinet Peninsula, *B. Gee s.n.*, 5 Oct. 1961 (HO *320402* [two sheets], MEL *4316*); ibid. *M. E. Phillips s.n.*, 13 Jan. 1962 (AD *99951060 n.v.*); ibid. *Rozefelds 1666* Oct. 1999 (HO). Cape Tourville, Freycinet Peninsula, *Rozefelds 1788*, 14 June 2000 (HO).

*Notes*: The locality information on three herbarium sheets from Mt Amos is limited. Phillips indicates that her material was collected from 900 feet (~ 300 m) which would suggest that it was collected from a different plant to that known by the author (*Rozefelds 1666*), which is growing at about 150 m altitude. The B.Gee Collections in HO and MEL are interpreted as being duplicates. A recent collection from Cape Tourville (*Rozefelds 1788*) would suggest that the species is more common than currently thought.

## Comparisons with other species in Section *Erionema*

*Philotheca freyciana* is placed in *Philotheca* sect. *Erioneua* (F. Muell.) Paul G Wilson as it shares with the other species in this section embedded glands in the anthers and characteristic seeds (Wilson 1998). Nine species are currently recognised in Section *Erioneua*. *Philotheca freyciana* differs from *Philotheca hispidula* (Spreng.) Paul G Wilson, *P. obovalis* (A. Cunn.) Paul G Wilson and *P. buxifolia* (Sm.) Paul G Wilson and most forms of *P. scabra* (Paxton) Paul G Wilson (= *P. scaber* in Bayly, 1999 and Weston and Porteners 1991) in having glabrous stems and/or foliage (Bayly 1999; Weston and Porteners 1991). It differs from *Philotheca trachyphylla* (F. Muell.) Paul G Wilson, *P. virgata* and *P. brucei* (F. Muell.) Paul G. Wilson in having pedunculate inflorescences (Bayly 1999; Wilson 1970).

Comparisons with *P. myoporoides* are difficult because of the morphological variation in this taxon (Bayly 1998). The following combination of characters; uniflowered inflorescence, obcordate concave leaves that are smooth above with large glands on the underside, and sparsely pilose staminal filaments separates *Philotheca freyciana* from all recognised subspecies of *Philotheca myoporoides* complex and an undescribed form from Mt Stewart, in Victoria (Bayly 1998).

Wilson (1970) included the Freycinet populations, here described as *P. freyciana*, in *P. verrucosa*. *Philotheca freyciana* is larger in all its parts than *P. verrucosa* although it shares with it the concave and conspicuously glandular thick obcordate leaves, and in having similar staminal filaments. It seems likely that the two species are closely related.

## Key to *Philotheca* species in Tasmania

1. Flowers 4-merous, rarely 5-merous, inflorescences not pedunculate leaves thin flat, apex acute with mcronate tip ..... ***P. virgata***
1. Flowers 5-merous, inflorescences shortly pedunculate, leaves thick, conduplicate, apex usually obcordate, not conspicuously acute ..... 2
2. Apex of anthers "pinched" in bud, obtuse at maturity, habit erect to scrambling, leaves narrowly obovate to obcordate, < 5 mm wide ..... ***P. verrucosa***
2. Apex of anthers not pinched in bud, pointed at maturity, habit compact, leaves broadly obovate to obcordate, > 8 mm wide ..... ***P. freyciana***


**Figure 4.** *Philotheca freyciana* sp nov. **A** – view of upper branches showing 'imbricate' foliage, **B** – detail of flowers and leaf morphology, and verrucose stems.

## Endemicity on the Freycinet Peninsula

Kirkpatrick and Brown (1984a, b) recognised centres of higher plant endemicity in Tasmania, including Great Oyster Bay, which is a physiographically and geologically diverse region. The endemic flora of the Great Oyster Bay includes species restricted to dolerites, e.g., *Eucalyptus barberi* L.Johnson & Blaxell, *Ozothamnus lycopodioides* Hook.f., *Lasiopetalum micrantheum* Hook.f. and *Melaleuca pustulata* Hook.f., and those that only occur on the granitic rocks of the Freycinet Peninsula and associated areas.

Freycinet Peninsula has a number of local endemics including *Epacris barbata* Melville, *Philotheca freyciana* and a new taxon of *Boronia* (Duretto pers comm.). A species of *Zieria* (Duretto 1999), that was previously recorded as *Zieria cytisoides* Sm. in Curtis and Morris (1975), is also restricted to the granitic soils of eastern Tasmania. *Viminaria juncea* (Scrad. & J.Wendl.) Hoffsgg. occurs in mainland Australia and also in Freycinet Peninsula. The only mainland Tasmanian occurrences of *Pseudanthus divaricatissimus* (Müll. Arg.) Benth. are also in the Freycinet Peninsula.

An undescribed subspecies of *Leptospermum grandiflorum* Lodd. (Rozefelds pers. obs.) occurs in the Freycinet Peninsula. The systematic status of the Freycinet populations of *Almaleea subumbellata* (Hook.) Crisp & P.Weston and the *Tetratheca pilosa* spp. complex also require study, and may include local endemics. The Freycinet Peninsula is an important centre of endemicity in eastern Tasmania.

## Acknowledgments

Funding to undertake this research was provided by ABRS towards the Flora of Tasmania project. Ms Belinda Pellow prepared the samples and undertook the scanning electron microscopy, and Simon Cuthbert provided the photographs for Fig. 4 for this study. Philip Brown provided access to a Critical Point Drier, in the Department of Agricultural Sciences, and David Steele of the Central Science Laboratories, University of Tasmania

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# A New Species of *Oreobolus*, *O. tholicarpus* (Cyperaceae), Endemic to Tasmania

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*Abstract*

*Oreobolus tholicarpus*, a new species from western Tasmania is described and illustrated. A key to all species of *Oreobolus* recorded in Tasmania is provided.

## Introduction

In 1978 S.J. Jarman and R.K. Crowden, while conducting a vegetation survey of the Lower Gordon River area, recorded a number of specimens of an apparently unnamed *Oreobolus* as '*O.* cf. *acutifolius*' (Jarman and Crowden 1978). Later, M.J. Brown, Crowden and Jarman collected more material of the same taxon as '*O.* aff. *acutifolius*' from the Hardwood River valley (Brown *et al* 1982). In all of these collections only the remains of fruiting culms were present, without mature nuts. None of the specimens were at that time lodged at HO and consequently were not available to Seberg (1988) when he prepared his extensive study of the genus, or to Curtis (1994) when describing the genus in Tasmania. More recent collections from western Tasmania have revealed that in the characters of the leaf lamina and of the nut the species differs from any of the previously known species as described by Seberg (1988).


**Figure 1.** *Oreobolus tholicarpus* D.I. Morris **A** – fruiting culm × 2. **B** – terminal spikelet with subtending bract × 5. **C** – lateral spikelet × 5. **D** – nut × 10. **E** – nut, longitudinal section, × 10.

## Taxonomy

***Oreobolus tholicarpus*** D.I. Morris *sp. nov.*

affinis *O. oxycarpo* S.T. Blake a qua nuce doliiformi apice attenuata tholiformi et superficie adaxiali laminae folii stomatibus ad margines differt.

*Type:* Coffin Bay, Port Davey, Tasmania 43°17' S, 145°58' E, 11. Jan. 1987, *A. Moscal* 13881 (holotype HO; isotype MEL).

Mat-forming perennial herb up to 8 cm high. *Leaves* erect to acutely spreading, spirodistichous; *sheaths* 4–8 mm long, apex rounded or with short erect auricles, margins ciliolate, 5–7-ribbed, golden to reddish-brown, ± shining; *pseudo-petiole* 10–20 mm long, channelled; *lamina* slightly widened at the proximal end, 10–25 mm long, 0.6–1.3 mm wide, tapering gradually to a subacute or rounded apex; margins scaberulous, adaxial surface with 3 faint ribs; stomata confined to the area between the lateral ribs and the margins; ribs prominent on the abaxial surface. *Culms* a little shorter than to ± equal to the leaves, with 1–3 nodes, the lower nodes each producing a branch subtended by a leaf-like

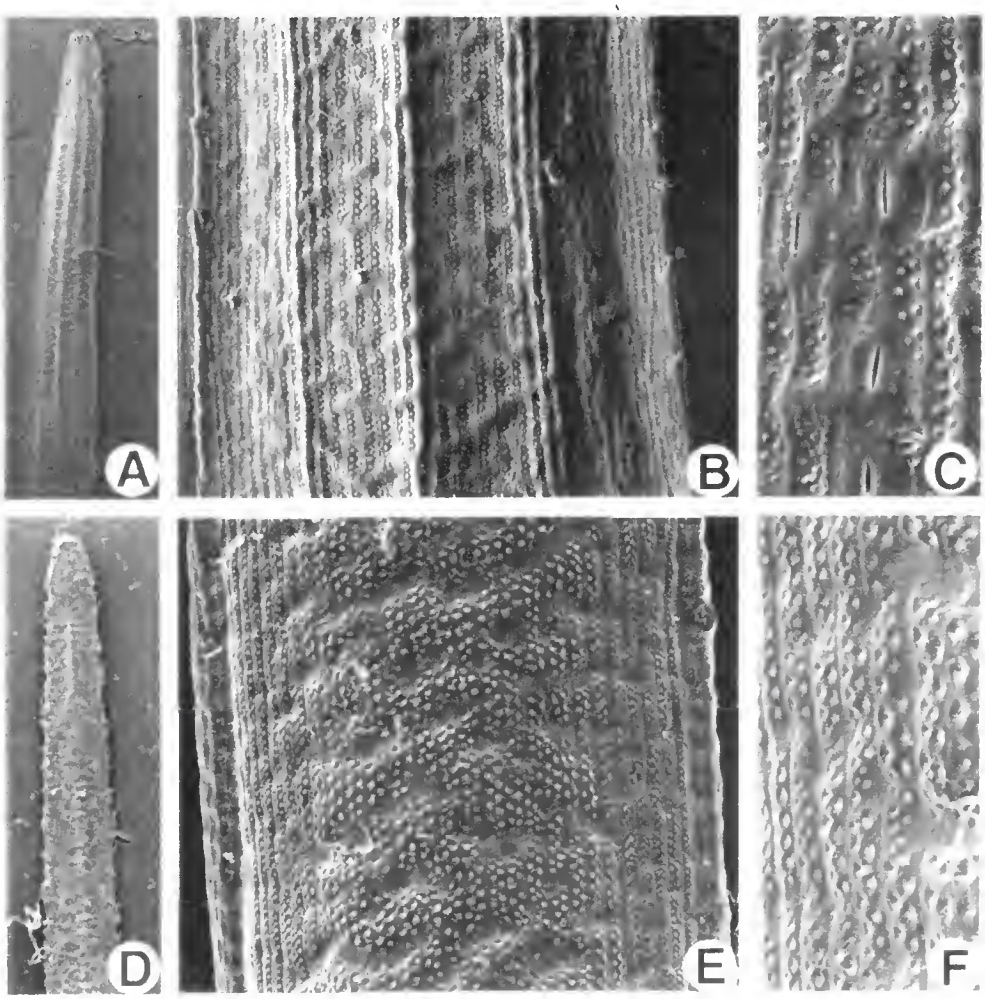


**Figure 2.** Leaves of *O. tholicarpus* and *O. oxycarpus*. **A–C** *O. tholicarpus* (*Moscal* 13881 HO *408585*) **D–F**, *O. oxycarpus* (D.A. & A.V. *Ratkowsky* s.n. HO *60146*). **A,D** adaxial leaf lamina, × 10; **B,E** adaxial leaf lamina, × 70; **C** adaxial leaf lamina, area between lateral vein and margin, × 300; **F** adaxial leaf lamina, comparable area to that in C, × 300

bract and a prophyll, each branch bearing a solitary spikelet; terminal node producing a sessile or subsessile spikelet subtended by a reduced leaf-like bract equalling or exceeding the spikelet by up to 4 mm. *Spikelet* 3.8–6.5 mm long with 3 narrow-triangular glumes, lowest glume 3.3–6.5 mm long, keel green, often laterally compressed above, margins green, reddish or brown, minutely ciliolate; second glume similar, upper glume often purple, 3.3–5 mm long. *Hypogynous scales* 1.7–2 mm long, narrow-triangular, whitish, margins minutely ciliolate. *Staminal filaments* 3–4 mm long; anthers 1.3–1.7 mm long. *Styles* c. 1.5 mm long, stigmas 2 mm. *Nut* 2–2.3 mm long ± dolioform, slightly constricted at about the mid-point, the upper half a hollow, domed, trilobed elongation, fuscous, shining, crustaceous; lower half yellow or whitish, shallowly trilobed, narrowing abruptly at the base to a short stipe. (Figs. 1, 2)

*Distribution:* Endemic to Western Tasmania. Most collections are from the Port Davey area and catchments of the Giblin, Hardwood, Olga and Davey Rivers with an isolated specimen from Burgess Hill, near Savage River, from near sea level to c. 500 m altitude. (Fig. 3)

*Etymology*: From the Latin *tholus*, a dome or cupola and-*carpus*, fruited, in reference to the shape of the apex of the nut.

*Habitiat:* Open heath and sedgelands, marshy depressions and seepage areas on rocky sites. Soils are mostly peaty on quartzite sands and gravels with some occurrences on alkaline pans and one specimen from a serpentine-derived soil.

*Conservation status:* Burgess Hill is in a Multiple Use Forest area. All other collections are from the World Heritage Area.

*Selected specimens examined* (12 examined): **Tasmania**: Olga River at edge of a swamp, 19 February 1976, *Jarman & Crowden* s.n. (HO); Hardwood Valley, 21 January 1978, *Jarman & Crowden* s.n. (HO); Giblin River, 11 January 1986, *Moscal* 11585 (HO, NSW); small lagoon at Mulcahy Bay, 20 January 1986, *Buchanan* 8058 (HO); north west slope of Burgess Hill, 26 January 1990, *Buchanan* 11644 (HO); just south of Melaleuca airstrip on track to Cox Bight, 4 April 1992, Wilson 8468 (NSW, HO).

**Figure 3.** Distribution of *Oreobolus tholicarpus* in Tasmania

## A key to Oreobolus in Tasmania

1. Inflorescence a terminal cluster of spikelets on very short pedicels ..... ***O. oligocephalus*** (*Schoenoides oligocephalus* O. Seberg)
1. Inflorescence of 1–3 spikelets solitary at nodes on the culm.....2

2. Leaf-lamina channelled, depressed-triangular in section, 2-veined; achene fusiform with an acute apex.....***O. distichus***
2. Leaf-lamina flat or plano-convex; achene either obovoid to pyriform, apex ± truncate or with an elongated conical or domed apex .....3

3. Achene obovoid to pyriform, apex ± truncate .....4
3. Achene with an elongated conical or domed apex .....5

4. Leaf-lamina long-tapered to an acute apex, upper surface veins obscure, stomates absent .....***O. acutifolius***
4. Leaf-lamina linear, tapering above to an obtuse or subacute apex, upper surface 5–6 veined, densely covered with stomates. .....***O. pumilio***

5. Abaxial surface of leaf lamina with one vein; nut with an elongated conical blackish-purple apex which collapses at maturity. .....***O. oxycarpus***
5. Abaxial surface of leaf lamina 3 veined; nut ± dolioform with a domed fuscous apex which does not collapse at maturity .....***O. tholicarpus***

## Acknowledgements

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*Muelleria* 15:31 (2001)

# The identity of *Bossiaea strigillosa* Benth. (Fabaceae: Tribe *Bossiaeeae*)

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*Abstract*

*Bossiaea strigillosa* Benth. is a synonym of *Pultenaea rotundifolia* (Turcz.) Benth. A lectotype is selected for *B. strigillosa*.

Bentham (1864) based his description of *Bossiaea strigillosa* on a specimen collected in Western Australia by James Drummond, which he cited in the protologue as 'Drummond 5$^{th}$ coll.?, no. 81'. Bentham's description is as follows:

> 'Branches divaricate, rigid, rather slender, clothed when young, as well as the under side of the leaves, with short rigid almost appressed hairs. Leaves opposite, broadly obovate-orbicular, with a recurved point, mostly about 2 lines long and broad, very rigid, with recurved margins, obtuse at the base, glabrous and veined above. Stipules subulate, recurved. Pedicels short. Bracteoles lanceolate-subulate. Calyx pubescent: the upper lobes large and rounded, the lower ones small and narrow.'

The application of the name *B. strigillosa* has long been uncertain and, to my knowledge, apart from the type, only one specimen (*C.A. Gardner 13751* from near the Jerdacuttup River) was ever referred to the species, and incorrectly as it transpires. In view of the perception that the taxon was rare, several attempts were made in recent decades to locate material in the field of a species of *Bossiaea* with opposite leaves that matched Bentham's description. This task was not made easier by the absence of a precise locality for the Drummond collection, and the uncertainty surrounding the set of collections of which Drummond's type formed a part. In the protologue, Bentham queried whether or not the type of *B. strigillosa* belonged to Drummond's 5th collection. This uncertainty is justified, and remains, because one of the syntypes of *Bossiaea concinna* Benth. is cited as Drummond 5th coll. n 81. Clearly one of these specimens either has been incorrectly attributed to Drummond's 5th collection, or the number 81 is incorrect.

In deciding the generic placement of this taxon, Bentham stated 'I have seen neither full-blown flowers nor fruit, but the petals and stamens in the young bud, and the remains of fruiting pedicels, are sufficient to indicate the genus'. Unfortunately, neither the remains of Bentham's floral dissection, nor the remains of the fruiting pedicel are associated any longer with the type material in K and the specimen is now completely sterile. I have not succeeded in locating another sheet of this Drummond collection in any other herbarium. The absence of any flowers on the type makes confirmation of the generic placement of the species difficult, but I am of the opinion that for some reason Bentham erred in referring Drummond's specimen to *Bossiaea*.

Vegetatively the type of *B. strigillosa* resembles *Pultenaea rotundifolia* (Turcz.) Benth. closely in leaf shape, size and texture, the nature of the stipules, and in indumentum, although the indumentum in the type of *B. strigillosa* is slightly denser and the hairs are more spreading. I believe that *Bossiaea strigillosa* is in fact referrable to *Pultenaea* and it is treated here as a synonym of *Pultenaea rotundifolia* (Turcz.) Benth. *Pultenaea roundifolia* is relatively common in some parts of the southern Eyre Botanical District.

***Pultenaea rotundifolia*** (Turcz.) Benth., *Fl. Austral.* 2: 121 (1864). *Euchilus rotundifolius* Turcz., Bull. Soc. Imp. Nat. Moscou 26: 277 (1853). *Type*: Western Australia, J. Drummond, 5th coll. No. 78. (isotype: K)

*Bossiaea strigillosa* Benth., *Fl. Austral.* 2: 157 (1864), synon. nov. *Type*: Western Australia, J. Drummond, '5th Coll.?, n.81'. (lectotype: K, *hic designatus*)

**Acknowledgement**

I am most grateful to the Keeper of the Herbarium, Royal Botanic Gardens, Kew, for the loan of the type material of *Bossiaea strigillosa* and *Pultenaea rotundifolia*.

**Reference**

Bentham, G. (1864) Flora Australiensis, Vol. 2, Lovell Reeve & Co., London

*Muelleria* 15:33 (2001)

# A Revision of *Centipeda* (Asteraceae)

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*Abstract*

The taxonomy of the genus is revised to comprise 12 taxa in 10 species, 7 of these taxa described here as new. The currently accepted taxa are *C. cunninghamii* (DC) A. Braun & Asch., *C. elatinoides* (Less.) Benth. & Hook. *ex* O. Hoffm, *C. minima* (L.) A. Braun & Asch., *C. racemosa* (Hook.) F. Muell., and *C. thespidioides* F. Muell. The new taxa are *C. aotearoana* N.G. Walsh, *C. borealis* N.G. Walsh, *C. crateriformis* N.G. Walsh subsp. *crateriformis*, *C. crateriformis* subsp. *compacta* N.G. Walsh, *C. minima* subsp. *macrocephala* N.G. Walsh, *C. nidiformis* N.G. Walsh and *C. pleiocephala* N.G. Walsh. All species except the New Zealand endemic *C. aotearoana* occur in Australia. *Centipeda elatinoides* occurs also in New Zealand and South America. *Centipeda minima* subsp. *minima* is found through the South Pacific area to Southeast Asia and India, and *C. borealis* extends to Papua New Guinea. A key, descriptions, illustrations and distribution maps are included.

## Introduction

*Centipeda* Lour., to date, has been accepted as consisting of five species with the centre of diversity in Australia where 4 species are represented (*C. minima, C. cunninghamii, C. racemosa* and *C. thespidioides*). The most widespread species, *C. minima*, extends beyond Australia through the western Pacific and south-east Asia to Taiwan and as far west as India. *Centipeda cunninghamii* has been known to occur in New Zealand at least since 1930, but is possibly adventive there as treated by Webb *et al.* (1988). A fifth species, *C. elatinoides*, in recent times was believed to be confined to Chile and neighbouring areas in Argentina. Examination of specimens of *Centipeda* at MEL has indicated not only that *C. elatinoides* is common in Australia and New Zealand, but also that many other specimens are inadequately accounted for by the prevailing taxonomy.

Consequently, specimens have been examined from herbaria within and beyond Australia to cover the geographic extent of the genus. A total of 12 taxa has been distinguished amongst these specimens, with the new taxa largely confined to Australia, but one apparently endemic to New Zealand and one extending from northern Australia to Papua New Guinea.

### TRIBAL PLACEMENT OF THE GENUS

*Centipeda* has traditionally been placed in the tribe Anthemideae (e.g. Bentham 1867, Willis 1973, Heywood & Humphries 1977), but more recent evidence, from floral and cypsela morphology, chemistry, pollen anatomy and chromosome number (e.g. Sorenson 1977, Skvarla *et al.* 1977, Gadek *et al.* 1989, Bruhl & Quinn 1990, 1991, Nesom 1994) has variously suggested its placement in the Inuleae (Skvarla *et al.* 1977), Gnaphalieae (Gadek *et al.* 1989) or Astereae (Bremer, 1987, Nesom 1994 — subtribe Grangeinae). Nesom cited the hairs on the cypsela ribs of *C. cunninghamii* as being one of the characters confirming the genus' placement in the Grangeinae, and pointed out that the similarity of these hairs to those on cypselas of many members of the Brachycominae may indicate a close affinity between the subtribes. Nesom described these hairs as 'glochidiate'. I find the hairs of *C. cunninghamii* and several other species to be apically inrolled (eg. *C. pleiocephala*, Fig. 1), not barbed as 'glochidiate' might imply, but this characteristic is not invariable within species. Bremer (1994) included *Centipeda* in subfamily Asteroideae, but excluded it (along with 7 other genera) from any currently recognised tribe.

The following account does not attempt to address the question of the position of *Centipeda*, but the increased number of species suggests even more strongly than before a

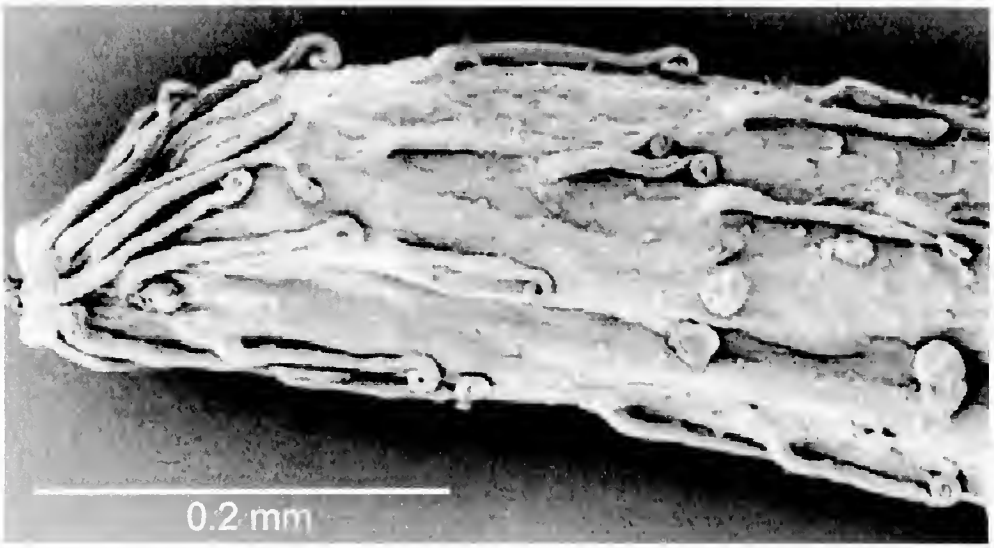


**Figure 1.** Apically inrolled hairs on cypsela of *Centipeda pleiocephala* (*Walsh 4949*, MEL)

Gondwanan origin for the group. This distribution adds support for its exclusion from the Anthemideae — a principally Northern Hemisphere tribe — and perhaps, for the same reason, adds further weight for closer association to the Astereae or the Gnaphalieae.

## MEDICINAL USES AND TOXICITY

*Centipeda* has been used in traditional medicines in India, China and Australia. In India, powdered parts of *C. minima* (vern. *Nakk-chikni* (Hindi) or *Shikani*) are used as a treatment for ozaena (nostril ulcers), headaches, and head-cold, a paste made from boiled leaves used for toothache, and both powdered herbage and the seeds used as a sternutatory (sneeze inducer – hence *Artemisia sternutatoria* Roxb. – see synonymy for *C. minima*) and vermifuge. It is also used to treate epidiymitis, epilepsy and hydrocoele (Dymock 1885, Duke & Ayensu 1985). In Chinese medicine the same species (vern. *Shih-Hu-Sui*, *O-pu-shih-tsao*) is used to reduce swelling and to treat various symptoms associated with colds as well as haemorrhoids, malaria, conjunctivitis, opthalmia and skin rashes (Hooper 1929, Duke & Ayensu 1985, Hsu *et al.* 1986). Latz (1995) reported the use of *C. minima*, *C. cunninghamii* and *C. thespidioides* by Central Australian aborigines (vern. *Inteng-inteng*, *Karengkal*, *Kata-palkalpa*, *Mmyu-parnti-parnti*) for the treatment of colds, and as a pituri substitute when wild tobacco is unavailable. *Centipeda crateriformis* and perhaps *C. pleiocephala* (both described below, previously included within the three species noted above) are probably used in similar ways. In south-eastern Australia, an infusion of *C. cunninghamii* (vern. *Gukwonderuk*, *Old man weed*) is still used in aboriginal medicine as a general tonic and for the treatment of colds and other chest complaints, including tuberculosis, and for skin complaints (Zola & Gott 1992). Commercial preparations using *C. cunninghamii* are claimed to be effective in the treatment of various skin disorders including the relief of itching and dry skin from psoriasis.

Chemical constituents have been noted to include myriogenic acid, taraxasterol, taraxerol, arnidiol, stigmasterol, ?-sitosterol, triterpenoid saponins and terpenes (Hooper 1929, Duke & Ayensu 1985, Hsu *et al.* 1986, Gupta & Singh 1989, P. Neville-Smith pers. comm.).

There are several references on herbarium specimens to plants of various species either being avoided by stock, or if eaten, causing sickness or death. Bailey (1906) and Hurst (1942) provided anecdotal information of stock being poisoned by species of *Centipeda*, but Everist (1974) did not include it amongst known poisonous Australian plants.

## MORPHOLOGY

### *Perenniality*

Despite conventional descriptions of an annual life cycle in floras etc., many species of *Centipeda* are facultative perennials given conditions of fairly even moisture (e.g. glasshouse conditions, seepage areas), but the favoured habitats of most of the species, around lakes, dams, beside watercourses, on floodplains etc., militates against their persistence beyond a single growing season. *Centipeda pleiocephala, C. nidiformis* and *C. thespidioides* however appear to be genuine annuals (i.e. plants do not persist beyond fruiting even under benign nursery conditions). In permanently damp shaded sites, *C. minima* may persist for several seasons but is otherwise an annual. In temperate areas *C. elatinoides*, *C. cunninghamii* and *C. crateriformis,* and in the tropics *C. boreali*, are commonly perennial. *Centipeda racemosa* appears to be perennial throughout its range. Both it and *C. borealis* persist through the dry season or through prolonged dry spells by a perennating rootstock, with above-ground parts usually fully drying off.

### *Inflorescence*

Capitula are initiated terminally and new vegetative growth is produced immediately below. The rate of development of the inflorescence and/or the subtending vegetative shoot(s) differs between species. In some species such as *C. borealis*, *C. nidiformis*, and to a lesser extent, *C. minima*, the capitula often mature before extension of the subtending vegetative shoot. Capitula then appear terminal. In other species (e.g. *C. aotearoana*, *C. crateriformis*, *C. cunninghamii*, *C. thespidioides*) the capitula mature more slowly relative to the subtending shoot and then, at maturity, the capitula appear axillary or, if there is no immediately subtending leaf, borne directly on the branch.

In most cases the capitula are sessile. In *C. racemosa*, *C. pleiocephala* and, to a lesser extent, *C. elatinoides* the capitula are shortly pedunculate.

### *Fruiting and seed dispersal*

There appears to be a marked difference in dissemination strategy among species of *Centipeda*. One group of species (*C. minima*, *C. pleiocephala*, *C. nidiformis*, *C. borealis*, *C. racemosa*, *C. elatinoides*) have capitula that disintegrate virtually as soon as cypselas are mature. Another group have capitula that persist intact until long after the flowering stems or entire plants have withered (e.g. *C. thespidioides*, *C. crateriformis* subsp. *crateriformis*). *Centipeda cunninghamii*, *C. crateriformis* subsp. *compacta* and *C. aotearoana* are somewhat intermediate in having capitula that, although persisting for a significant period after cypsela maturity, usually dissociate within the same growing season. The seeds of all species are buoyant (due at least partly to the spongy apical process of most of the species) and I have observed 'rafts' of seed of *C. minima* and *C. pleiocephala* floating in backwaters and eddies of waterbodies where the level has recently risen to cover mature plants. The cyspelas are subsequently deposited on sand or silt at or near the floodmark, giving rise to the characteristic zonality of populations of *Centipeda* around water-bodies. The presence of short, often apically inrolled hairs, and droplets of viscid resin from the vesicular trichomes, provide a means for long-distance dispersal via attachment to fur or feathers. This might explain the shared occurrence of some species between land masses separated by substantial tracts of ocean, e.g. *C. cunninghamii* (Australia, New Zealand) and *C. minima* (Australia, New Zealand, South Pacific islands, southern Asia), *C. elatinoides* (Australia, New Zealand, Chile). The bracts of the fruiting capitula of *C. thespidioides* and *C. crateriformis* subsp. *crateriformis* have strongly thickened, spongy bases, and this feature, along with the persistent nature of the capitula possibly represents a means by which the entire capitulum might act as the disseminule.

## Taxonomy

***Centipeda*** Lour., *Fl. Cochinch.* 492 (1790). *Typical species*: *C. minima* (L.) A. Braun & Asch.

Annual or facultatively perennial *herbs*, glandular and aromatic. *Leaves* alternate, cauline, sessile, toothed to entire, glandular-punctate, glabrous to densely cottony. *Inflorescences* mostly terminal and solitary, but appearing axillary by sympodial growth of subtending shoots, rarely racemose or truly axillary. *Capitula* heterogamous, sessile to shortly pedunculate, globular, biconvex, hemispherical, cup-shaped or campanulate; involucral bracts in c. 2 rows, herbaceous, scarious-margined; receptacle slightly concave to distinctly convex, glabrous, epaleate, with pithy tissue present to some degree below surface; outer florets female, corolla tubular, narrowed above and minutely 3-lobed, lobes very short relative to tube, acute to rounded, style branches linear, glabrous; inner florets bisexual, corolla funnelform, 4-lobed, lobes triangular, from half to almost as long as tube; both corolla types with scattered short vesicular trichomes (appearing as glistening sessile resin droplets); anthers shortly tailed, lacking apical appendages, or with short ovate apical appendages, anther collar not strongly differentiated, tapering evenly from filament to anther base, c. 0.05 mm long, style branches oblong, broadly rounded and papillose apically. *Cypselas* of female and bisexual florets similar, clavate to cylindric, 4–6(–16)-ribbed, mostly with a swollen, pithy or spongy apical portion; glandular trichomes generally present between ribs, eglandular hairs usually present along ribs, acute and straight or tightly inrolled at the apex; pappus absent. *Carpopodium* absent.
x = 10 (Hair 1963; Bruhl 1990; Nishikawa 1985; Gupta & Gill 1989; de Lange pers. comm.).

### RELATIONSHIPS WITHIN THE GENUS

Species have been ordered in the following account in an attempt to reflect their relationship, using evidence of gross morphology, and more particularly, capitulum and cypsela morphology. All species are similarly aromatic (but the odours are subtly different) and are bitter to taste. *Centipeda elatinoides* appears to have no close relatives within the genus. It is set apart by its relatively loose, few-flowered capitula and obovoid, flattened cypselas that lack conspicuous pithy thickening toward the apex. The group of *C. minima*, *C. nidiformis*, *C. borealis* and *C. racemosa* are united by their more or less spherical flowering and fruiting capitula that readily disintegrate, their strongly convex receptacles, small, more or less obcuneoid cypselas that are apically thickened by pithy tissue and lack apically inrolled hairs. *Centipeda pleiocephala* differs from this group in having more cylindrical cypselas with apically inrolled hairs. *Centipeda crateriformis*, *C. thespidioides* and *C. cunninghamii* share characters of (to a greater or lesser extent) persistent fruiting capitula and more or less linear cypselas with conspicuous pithy apical processes, and the hairs of the cypselas often minutely inrolled at the apices. *Centipeda aotearoana* appears to be somewhat intermediate between the *C. crateriformis* and *C. minima* groups, sharing with the former (and particularly with *C. cunninghamii*) moderately firm fruiting capitula and cypsela morphology, but like the *C. minima* group, lacking apically inrolled hairs on the cypselas.

## Key to taxa

1. Cypselas ± narrowly obovate in outline, usually somewhat flattened, rounded to obtuse at apex, the ribs not terminating in a thickened, spongy or corky apical process; plants creeping, often rooting at lower nodes, wholly glabrous or with short arachnoid hairs near the growing tip; capitula distinctly (but shortly) pedunculate; southern Australia, New Zealand, Chile ..... **1. *C. elatinoides***

1. Cypselas linear or narrowly obcuneate in outline, more or less isodiametric, truncate or nearly so at apex, the ribs terminating in a somewhat thickened, spongy or corky apical process; plants erect to prostrate, but not or rarely rooting at lower nodes, subglabrous to distinctly hairy; capitula often sessile; Asia, Russia, Australasia .....2

2. Cypselas ≤ 1.1 mm long (rarely to 1.3 mm in *C. pleiocephala* which has a shortly racemose axillary inflorescence); capitula solitary or in short racemes.....3
2 Cypselas > 1.1 mm long; capitula always solitary .....8

3. Cypselas broadly cuneiform, ± half as wide as long, prominently 4- or 5-angled, often narrowly winged at the angles, the intervening faces concave; corolla of female florets 0.35–0.5 mm long; plants usually distinctly cottony; mainland Australia only .....**4. *C. uidiformis***
3. Cypselas at least 3 times as long as wide, ribbed but not winged, with intervening faces flat or convex; corolla of female florets 0.1–0.3 mm long (except in C. *crateriformis* subsp. *compacta* which has firm, somewhat persistent fruiting capitula); plants glabrescent to cottony .....4

4. Inflorescence a single terminal, axillary or leaf-opposed capitulum .....5
4. Inflorescence (sometimes very shortly) racemose, of 2–7 capitula (rarely the lowermost inflorescences a single capitulum).....7

5. Fruiting capitula firm, not readily breaking up, fruiting involucre bowl- or cup-shaped; receptacle ± flat to slightly domed; cypselas with pericarp thickish, often obscuring the brown testa of the underlying seed; southern mainland Australia .....
.....**9b. *C. crateriformis*** subsp. ***compacta***
5. Fruiting capitula soft, readily disintegrating, involucre bracts at fruiting widely spreading or reflexed; receptacle distinctly convex; cypselas with pericarp thin between ribs, the brown testa of the underlying seed clearly apparent.....6

6. Plants annual (rarely perennial in permanently moist sites), tufted (rarely producing adventitious roots near base), glabrescent to cottony; leaves generally under 10 mm long, mostly less than 3 times as long as wide; capitula hemispherical to subglobular; receptacle ± hemispherical; widespread in Australia (where rare north of latitude 20°S), also Asia, southern Russia, New Zealand, Pacific Islands .....
.....**2a. *C. minima*** subsp. ***minima***
6. Plants mostly perennial, rhizomatous, densely white-cottony on at least young growth; leaves generally longer than 10 mm long, mostly more than 3 (usually 4) times as long as wide; capitula ± globular; receptacle ± matchhead-shaped, mostly higher than wide; northern Australia, Papua New Guinea .....**3. *C. borealis***

7. Perennial (but dying down annually to perennating rootstock; inflorescences terminal (sometimes also in upper axils then sometimes appearing sub-paniculate), 0.5–1.2(–2) cm long, of 2–7 capitula; capitula subglobular to globular; leaf margins recurved; mainland Australia.....**5. *C. racemosa***
7. Short-lived annual; inflorescences axillary, to c. 0.5 cm long, of 2–4 capitula, the lowest capitulum usually sessile or subsessile; capitula hemispherical to biconvex; leaf margins (except sometimes of immature leaves) plane; inland Australia.....
.....**6. *C. pleiocephala***

8. Fruiting involucre cup-shaped to campanulate; cypselas with hairs confined to a basal ring and a subapical band; plants strictly annual, usually erect; inland areas of mainland Australia.....**10. *C. thespidioides***
8. Fruiting involucre bowl-shaped, or involucral bracts widely spreading or deflexed; cypselas with hairs scattered along ribs (and sometimes on faces); plants annual or perennial; Australia and New Zealand.....9

9. Reeeptaele prominently raised (± hemispherical); involeral braets at fruiting widely spreading or deflexed ..... 10
9. Reeeptacle slightly concave to slightly eonvex; fruiting involuere ± bowl-shaped .. 12

10. Cypselas truneate, less than 3 times as long as wide; corollas of female florets under 0.3 mm long; plants overall eottony-pubeseent; fruiting eapitula readily breaking up before stems scnesee; northern Australia ..... **9b. *C. minima*** subsp. ***macrocephala***
10. Cypselas rounded or truncate at apex, at least 3 times as long as wide; eorollas of female florets 0.3 mm long or more; plants usually glabreseent (rarely eottony); fruiting eapitula usually remaining intaet until after stems senesee; southern Australia, New Zealand ..... 11

11. Plants prostrate or weakly aseending; leaves 4–8(–12) mm long; bisexual florets fewer than 17; New Zealand only ..... **7. *C. aotearoana***
11. Plants more or less ereet; leaves mostly longer than 1 cm; bisexual florets c. 20 or more; Australia and New Zealand ..... **8. *C. cunninghamii***

12. Deeumbent to ereet annuals, never producing adventitious roots; ripe fruiting capitula 3.5–7 mm diam., very hard, not readily disintegrating; eypselas ± linear (at least 5 times longer than wide), (1.5–)1.8–2.5 mm long, the pericarp thin and translueent between the ribs in the lower half; inland areas of Australia ..... ..... **9a. *C. crateriformis*** subsp. ***crateriformis***
12. Prostrate to deeumbent annuals or pcrennials, often producing adventitious roots, or sometimes rhizomatous; ripe fruiting capitula 2.5–5 mm diam., usually readily disintegrating; cypselas narrowly obcuneoid (less than 5 times longer than wide) 1–1.7 mm long, the periearp often thiekish and opaque between the ribs (or the ribs rather widc and obscuring the intervening periearp), obseuring the testa of the enelosed seed; southern Australia (but not Tasmania) ..... ..... **9b. *C. erateriformis*** subsp. ***compacta***

**1. *Centipeda elatinoides*** (Less.) Benth. & Hook. *ex* O. Hoffm. in Engl. & Prantl, *Nat. Pflanzenfam.* 4(5): 280 (1892). *Myriogyne elatinoides* Less., *Linnaea* 6: 219 (1831). *Type*: 'Chili, ad Talcaguanho eel., dc Chamisso. ad Conception', *Dombey* (*herb. kunth.*); '(Australia, New South Wales) in montibus eoerulcis Novae Hollandieae', *Lesson* (*herb kunth.*)'; Lectotype (*hic designatus*) Chile, ad Concepcion, 1782, *Dombey*: P!; isolectotype P!, G-DC. (photo seen). An unnumbered Dombey eollection at L (*L 0069571*) is an exciceata speeimen from P. It is probably a duplicatc of the leetotype, but without Dombey's collecting number or detailed provcnance information, the speeimen ean only tentatively bc regarded as an isoleetotype.

*Cotnla foetida* Poepp. *ex* DC., *Prodr.* 6: 139 (1838), *nom. nud.* (cited in synonymy only) *Type*: 'in paludos. exsieeat. ad Talcahuana', *Poeppig pl. exs. n. 453*, G-DC. (photo secn).

*Centipeda minima sens. auctt., p.p., non* (L.) A. Braun & Asch. (1867).

*?Centipeda orbicularis* var. *sternutatoria* (Roxb.) Bailey, *Qld Fl.* 860 (1900). *Centipeda* sp. 1, *sensu* Walsh in Walsh & Entwisle (eds), *Fl. Victoria* 4: 721 (1999).

Prostrate *annual* or *perennial*; branches to c. 30 cm long, sometimes rooting from lower nodes, essentially glabrous, hut sometimes with short arachnoid hairs near the growing tip. *Leaves* mostly alternatc, obovate or narrowly obovate, (6–)10–20 mm long, 2.5–8 mm wide, entire or shallowly serrate, glabrous, resin-dotted on both surfaces, coneolorous or slightly paler heneath. *Inflorescence* a single shortly pedunculate capitulum, usually leaf-opposed; peduncle 0.5–3 mm long. Capitula at anthesis hieonvex to hemispherical, 3–5 mm diam.; involucral bracts 1–2-seriate, obovate with ruminate membranous margins, 1–1.5 mm long; receptacle convex; female (outer) florets 40–80, in 2–4 rows, corollas narrowly cylindrical, 0.2–0.4 mm long (including lobes less than 0.1 mm long), green or yellow-

green; bisexual (inner) florets 4–14, corollas broadly obconical, 0.5–0.7 mm long (including lobes 0.2–0.3 mm long and wide) often purplish. *Fruiting heads* breaking up before stems senesce, involucral bracts at fruiting widely spreading to slightly deflexed; fruiting receptacle 1.5–2 mm diam., with a pith layer entirely contained within the dome of the receptacle; *cypselas* of female and bisexual florets similar, narrowly obovate, 1.2–2.0 mm long, 0.5–0.8 mm wide, obtuse at apex, usually somewhat flattened, 3- or 4-angled in section, each angle with a thickened longitudinal rib, each intervening face membranous with a less prominent rib (sometimes 1 or 2 faces lacking a rib), at least the larger ribs with short ascending to appressed hairs, intervening faces with scattered glandular trichomes; pericarp slightly thickened at and shortly below the apex. (Figs 2, 4a, 6a)

*Representative specimens*: **AUSTRALIA**: **South Australia**: Glenshera, 25.i.1988, *D.E. Murfet 644* (AD); Square Waterhole, 20.xi.1882, *R. Tate* (AD 97623443 *p.p.*). **Queensland**: Stanthorpe, xii.1875, *F.M. Bailey s.n.* (BRI). **New South Wales**: North-West Slopes, Tingha, iii.1917, *J.L. Boorman s.n.* (NSW); Central Tablelands, Mt Wiggdon, 25 km N of Bathurst, 31.iii.1960, *E.F. Constable s.n.* (NSW); South West Slopes, Basin Ck, Dora Dora State Forest, 17.iv.1988, *J.M. Dalby 88/44 & R.G. Coveny* (MEL, NSW, PRE); Southern Tablelands, Kosciuszko National Park, Cave Creek, 20.ii.1991, *R.E. Davies 1584* (AD, CBG, HO, MEL, PERTH); Northern Tablelands, Dumaresq Dam, W of Armidale, 12.ii.1989, *G.J. White & D.A. Saladine s.n.* (NE, MEL). **Victoria**: East Gippsland, Lind National Park, 14.xii.1969, *A.C. Beauglehole 32394* (MEL); Riverina, Murray River near Tocumwal, 4.vi.1979, *A.C. Beauglehole 63980* MEL); Victorian Volcanic Plain, Mt Mercer, *1894 J. Farrell s.n.*(MEL); Gippsland Plain, Dromana, 17.iv.1914, *J.H. Findlay s.n.* (MEL); Snowfields, 3.7 km E of Mt Cobberas no 1, 19.iv.1980, *S.J. Forbes 339* (MEL); Midlands, Avoca, ?1853, *F. Mueller s.n.* (MEL); Eastern Highlands, South of Eildon Reservoir, 9.iii.1964, *T.B. Muir 3344* (MEL); Wannon, Coboboonee Forest, 28.ii.1985, *C.E. Woolcock 2021* (MEL). **Tasmania**: Greens Beach Rd, 19.iii.1998, *A.M. Buchanan 15164* (HO); Tasman Peninsula, 1894, *Rev. J. Bufton s.n.* (MEL); Elderslie Rd, Broadmarsh, 2.iv.1979, *D.I. Morris 79119* (HO); South Esk River, 28.xii.1937, *A.M. Olsen s.n.* (HO); Waterworks, 23.ii.1913,

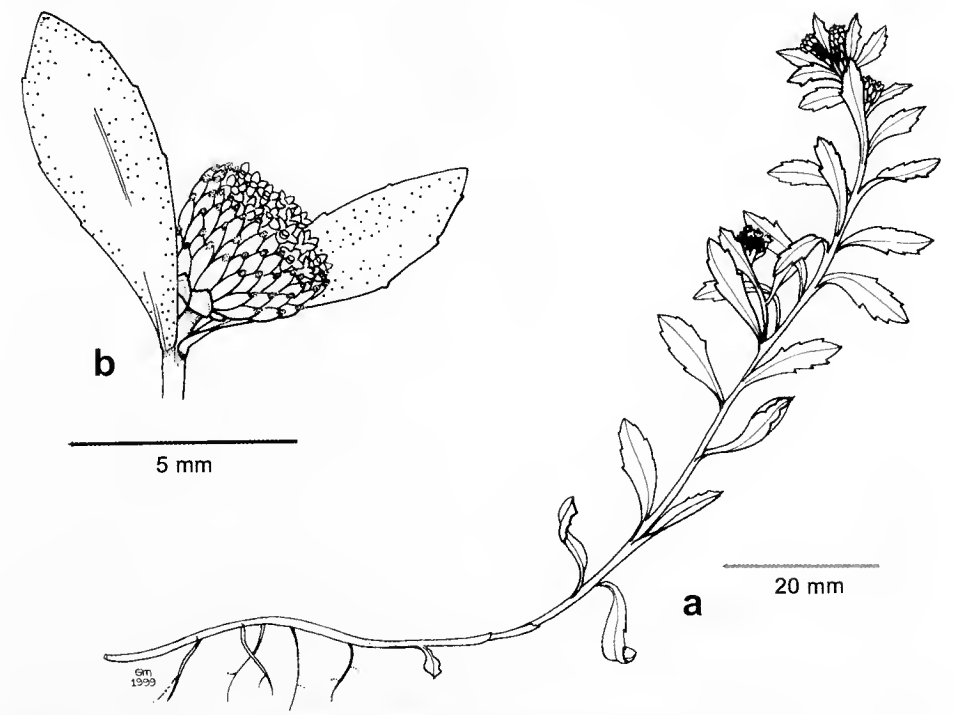


**Figure 2.** *Centipeda elatinoides*. **a** habit (*Piesse 832*, MEL); **b** capitulum and subtending leaves (*Albrecht 1602*, MEL).

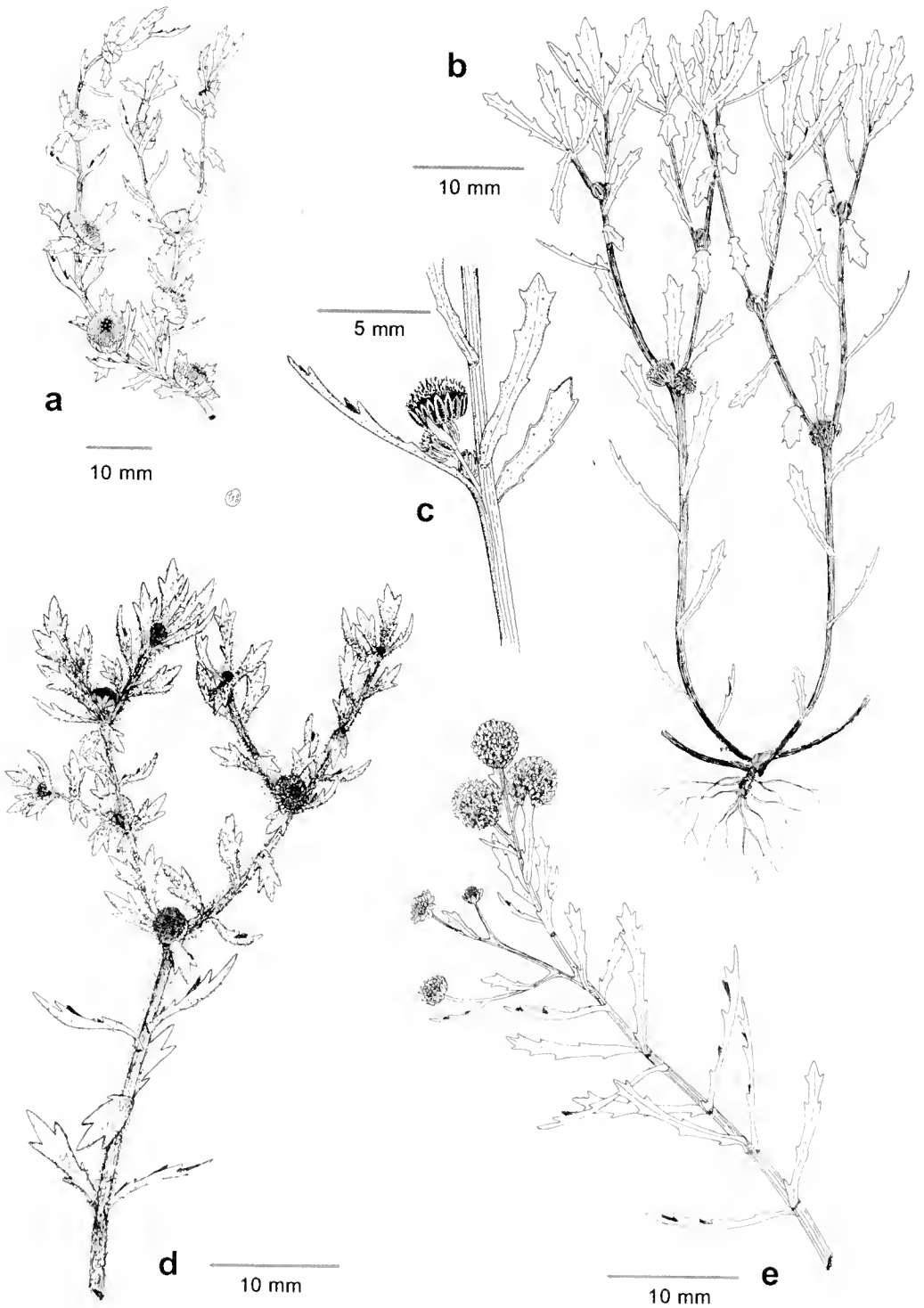


**Figure 3.** *Centipeda* habits. **a** *C. crateriformis* subsp. *crateriformis* (*Symon 4076*, AD); **b**, **c** *C. pleiocephala* (*Walsh 4967*, MEL); **d** *C. borealis* (*Clarkson 4873*, MEL); **e** *C. racemosa* (*Willis s.n.* MEL 2057177).

*L. Rodway s.n.* (HO). **NEW ZEALAND**: **North Island**: Auckland, Te Atatu North coast, 25.ii.1996, *R.O. Gardner 7315* (AK, MEL); Waikato River, near Hamilton, 14 Dec. 1961, *A.J. Healy 61/358* (CHR); Whangamarino, 21 Mar. 1962, *J.R. Murray s.n.* (CHR); Wainui Station, Paekakariki, Wellington, 15 Mar. 1980, *C.C. Ogle 552* (CHR). **South Island**: Between Arahura & Stafford, Westland, 15.ii.1958, *R. Mason & N.T. Moar 5244* (CHR). **CHILE**: Lago Panguipulli, 15.i.1976, *C. Marticorena, M. Quedeza & R. RodrPguez 391* (CONC); Callaqui, 23.i.1985, *C. Marticorena & M. Quedeza 9646* (CONC).

*Distribution and Conservation Status:* Occurs through cool-temperate areas of south-eastern Australia from south-eastern Queensland (Stanthorpe area) to Tasmania (Hobart area) and as far west as Adelaide area (latitude c. 28° to 43° S). Also in New Zealand (North Island, Aukland to Wellington areas, latitude c. 37° to 40° S), and Chile (Concepcion to Valdivia areas, latitude c. 37° to 40° S). Not considered rare or threatened in Australia, and well represented in conservation reserves. The possibility exists that *C. elatinoides* is naturalized across part of its range (see notes below). (Fig. 8)

*Habitat*: Typically growing on seasonally inundated sites, such as creek-beds, margins of rivers, lakes and billabongs, usually on silty to clayey soils, sometimes on wet gravels. Occurs from near sea-level to c. 1200 m altitude.

*Notes*: Most Australian and New Zealand herbarium specimens of this species have in the past been identified as *C. minima* from which it is readily distinguished by the larger cypselas of quite different morphology. Cypselas of *C. minima* are up to 1 mm long, truncate or depressed at the apex, and lack the facial ribs of *C. elatinoides*. The female corollas of *C. minima* are 0.1–0.25 mm long, and the bisexual florets 0.3–0.4 mm long. Plants of *C. elatinoides* are generally more robust than those of *C. minima*, and are typically quite prostrate and freely rooting from the lower nodes. The leaves are generally longer (rarely exceeding 10 mm in *C. minima*). *Centipeda elatinoides* is commonly perennial wheras *C. minima* appears to be a strictly annual species, at least through the southern part of its range where the two species are sometmies sympatric. In the field, *C. elatinoides* commonly occurs with *C. cunninghamii*, but apparently only rarely with *C. minima*. This is probably the taxon referred to as the larger-fruited form of *C. minima* by Brown (1992).

Most Australian and New Zealand plants of *C. elatinoides* tend to have larger fruits and leaves than those from Chile, but specimens from higher altitudes, at least in Australia (e.g. *R.E. Davies 1584*) are virtually indistinguishable from Chilean plants. Similarly, larger-leaved specimens from Chile could not be separated from the form more common in Australia and New Zealand.

Lessing's original description refers to three collections, two from Chile ('ad Talcaguanho', *Chamisso*; 'ad Concepcion', *Dombey*), and one from the Sydney region in Australia ('in montibus coeruleis', *Lesson*). The Lesson collection would have been made between 1827 and 1829 (Maiden 1910). The next earliest Australian specimens appear to be 1839 (*Gunn*, Tasmania, NSW *426060*), probably 1853 (*Mueller*, Avoca and Murray Lagoons – MEL *608026* and *1517624* respectively, specimens undated, but Mueller is known to have collected in these areas during 1853); 1882 (*Tate*, Square Lake, SA, AD *97623443 p.p.*) and 1889 (*Betche*, Blue Mountains, NSW *469263*). There is a possibility that *C. elatinoides* is a long-naturalised species in Australia (originally from seed inadvertently shipped from Chile), but there is nothing about the species' ecology or present-day distribution to support such a claim. It is here regarded as being native to Chile, New Zealand and Australia.

Of the collections cited by Lessing, only the Dombey collection (P) could be located. This is here chosen as the lectotype.

A specimen at BRI (*358892*) from Stanthorpe, south-east Queensland, is labelled in Bailey's hand as *Centipeda orbicularis* var. *sternutatoria*, but it is unknown if Bailey's concept of the variety is restricted to plants represented by this specimen. No other specimens labelled as this taxon by Bailey have been seen.

This is not the same taxon as *Artemisia sternutatoria* Roxb., which is a synonym of *C. minima*.

**2. *Centipeda minima*** (L.) A. Braun & Asch., *Ind. Sem. Hort. Berol.* app. 6 (1867). *Artemisia minima* L., *Sp. Pl.* 849 (1753). *Type*: provenance and collector unknown, LINN (photo seen).

*Myriogyne minuta* (G. Forst.) Less., *Linnaea* 6: 219 (1831). *Cotula minuta* G. Forst., *Fl. Ins. Austral. Prodr.* 57 (1786). *Type*: Noua Caledonia, not found.

*Centipeda orbicularis* Lour., *Fl. Coch.* 2: 602 (1790). *Type*: 'inculta in agris Cochinchiniae', BM!

*Myriogyne minuta* var. *lanuginosa* DC., *Prodr.* 6: 139 (1838). *Syntypes*: 'in India ori-

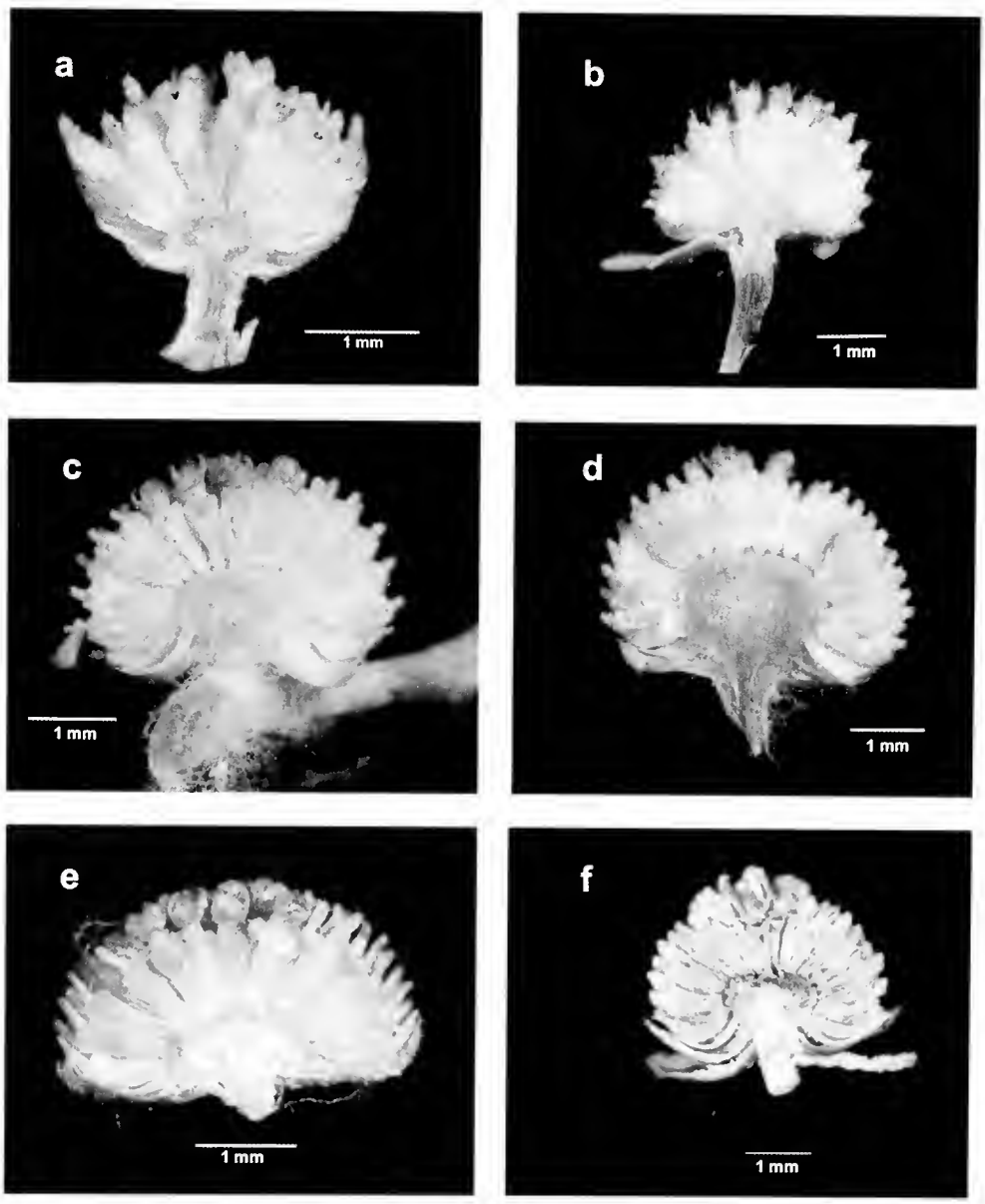


**Figure 4.** *Centipeda* capitula, longitudinal sections. **a** *C. elatinoides* (*Walsh 5145*, MEL); **b** *C. minima* subsp. *minima* (*Walsh 4950*, MEL); **c** *C. minima* subsp. *macrocephala* (*Walsh 4984*, MEL); **d** *C. borealis* (*Walsh 4992*, MEL); **e** *C. nidiformis* (*Walsh 4982*, MEL); **f** *C. racemosa* (*Doherty s.n.*, BRI).

entali, *Wallich'*; 'in Java, *Blume*', G-DC. (photos seen); *Centipeda minima* var. *lanuginosa* (DC.) Domin, *Bibl. Bot.* Heft 89: 683 (1930); *Centipeda orbicularis* var. *lanuginosa* (DC.) Bailey, *Qld. Fl.* 3: 869 (1900).

*Artemisia sternutatoria* Roxb., *Hort. Berg.* 61 (1814) *nom. nud.*; *Fl. Ind.* 3: 423 (1832). Lectotype (*hic designatus*): provenance and date not given, Roxburgh, Wallich herbarium, K *p.p.*; *Cotula sternutatoria* (Roxb.) Wall. *ex* DC. *Prodr.* 6: 139 (1838). The type sheet consists of at least two collections, marked by Wallich 'a' and 'b' corresponding to the first of five entities marked on the label on the upper left of the sheet. The two

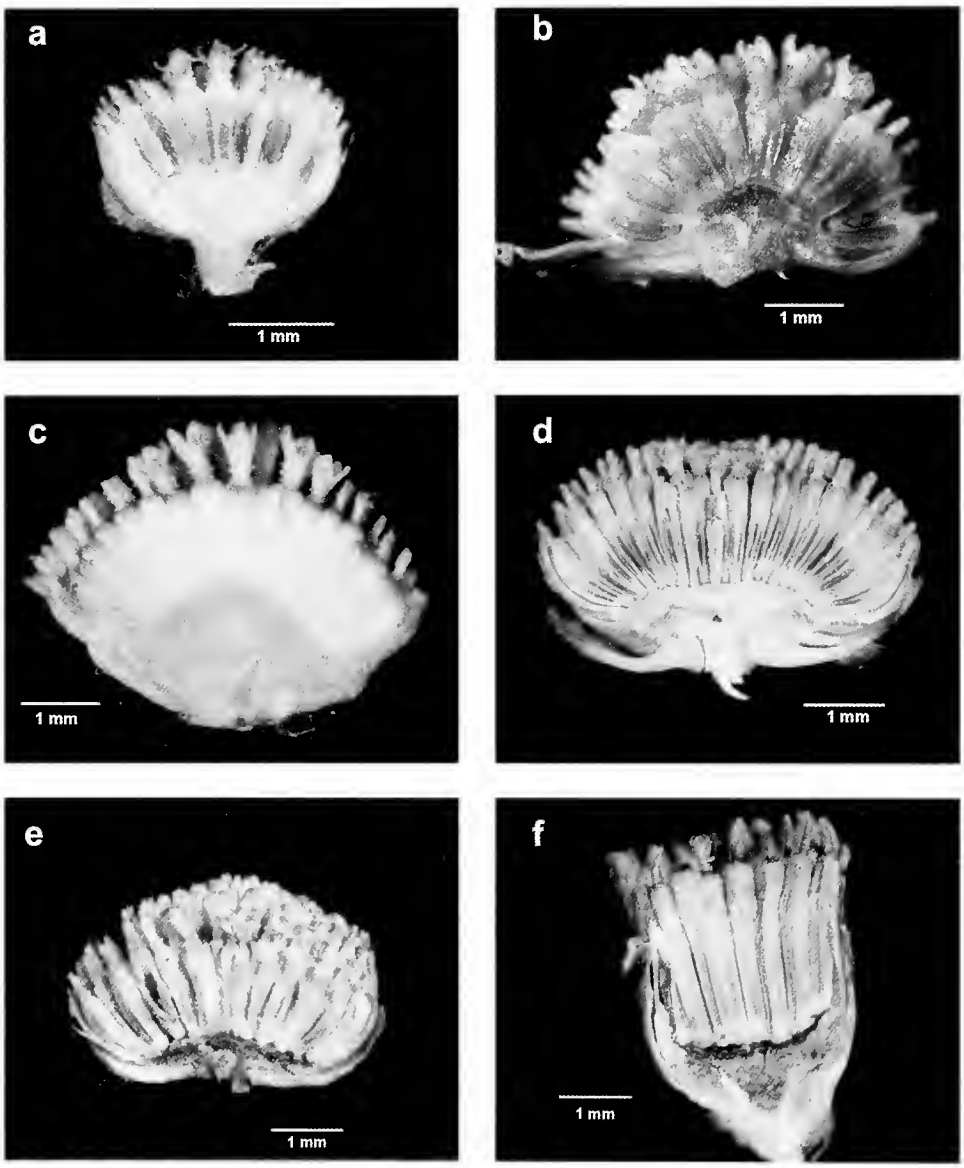


**Figure 5.** *Centipeda* capitula, longitudinal sections. **a** *C. pleiocephala* (*Walsh 4949*, MEL); **b** *C. aotearoana* (*Healy 96/8*, CHR); **c** *C. cunninghamii* (cult. RBGM); **d** *C. crateriformis* subsp. *crateriformis* (*Moore 5565*, CANB); **e** *C. crateriformis* subsp. *compacta* (*Alcock 3514*, AD); **f** *C. thespidioides* (*Keighery 551 & Gibson*,

fragments marked 'a' on the upper part of the sheet are those attributed to Roxburgh. One is a nearly complete plant, with roots and several branches (but one branch clearly broken off), the other is a flowering branch (which may be the missing piece of the larger specimen). The larger, rooted plant is here chosen as the lectotype. A coloured plate of *A. sternutatoria*, agreeing with the Roxburgh collection, exists in the *Icones Roxburghianae* at K, a transpareney of which is now at MEL.

*Sphaeromorphaea russelliana* DC. var. *glabrata* DC., *Prodr.* 6: 140 (1838); *Type*: India, 'in Ind. orient. prov. bor. occid. *Royle*'; K!.

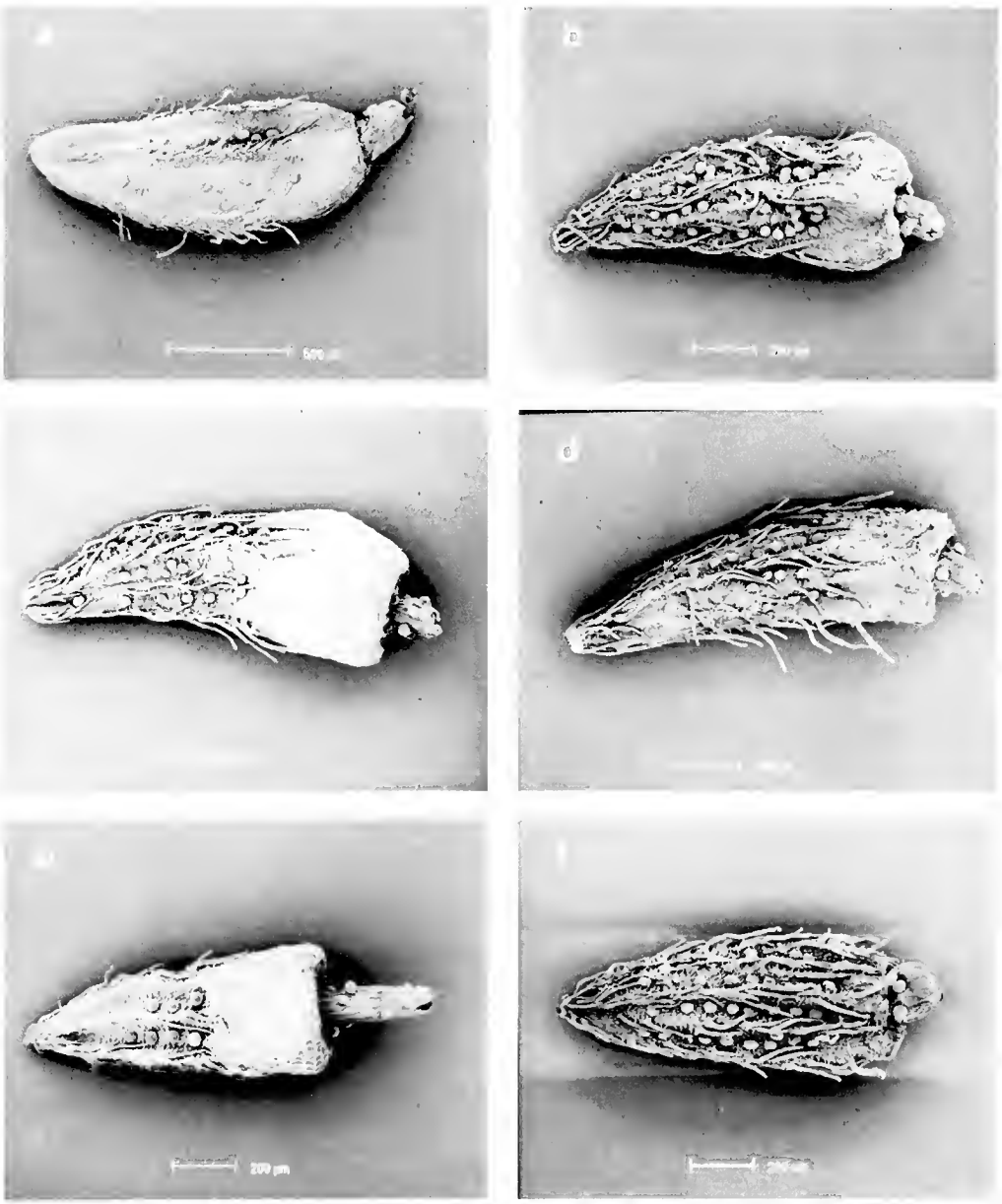

**Figure 6.** *Centipeda* cypselas. **a** *C. elatinoides* (*Walsh 5145*, MEL); **b** *C. minima* subsp. *minima* (*Walsh 4975*, MEL); **c** *C. minima* subsp. *macrocephala* (*Walsh 4984*, MEL); **d** *C. borealis* (*Russel-Smith 4074*, DNA); **e** *C. nidiformis* (*Leach* 793 MEL); **f** *C. racemosa* (*McKey 328*, BRI).

Prostrate to (rarely) erect *annual* or facultative *perennial*, spreading to c. 25 cm diam. and/or 20 cm high; adventitious roots sometimes produced from lower nodes; branches glabrescent to moderately (rarely densely) cottony, if glabrescent then axils and young growing tips usually with some cottony hairs. *Leaves* obtrullate to spathulate, 3–12(–27) mm long, 1.5–6(–11) mm wide, variably serrate to shallowly incised; surfaces glabrescent to densely cottony, with scattered resin droplets. *Inflorescence* a solitary sessile or subsessile capitulum, (peduncles to c. 1 mm long), appearing axillary or leaf opposed. *Capitula* at anthesis hemispherical to subglobular, 1.5–5 mm diam.; involucral bracts

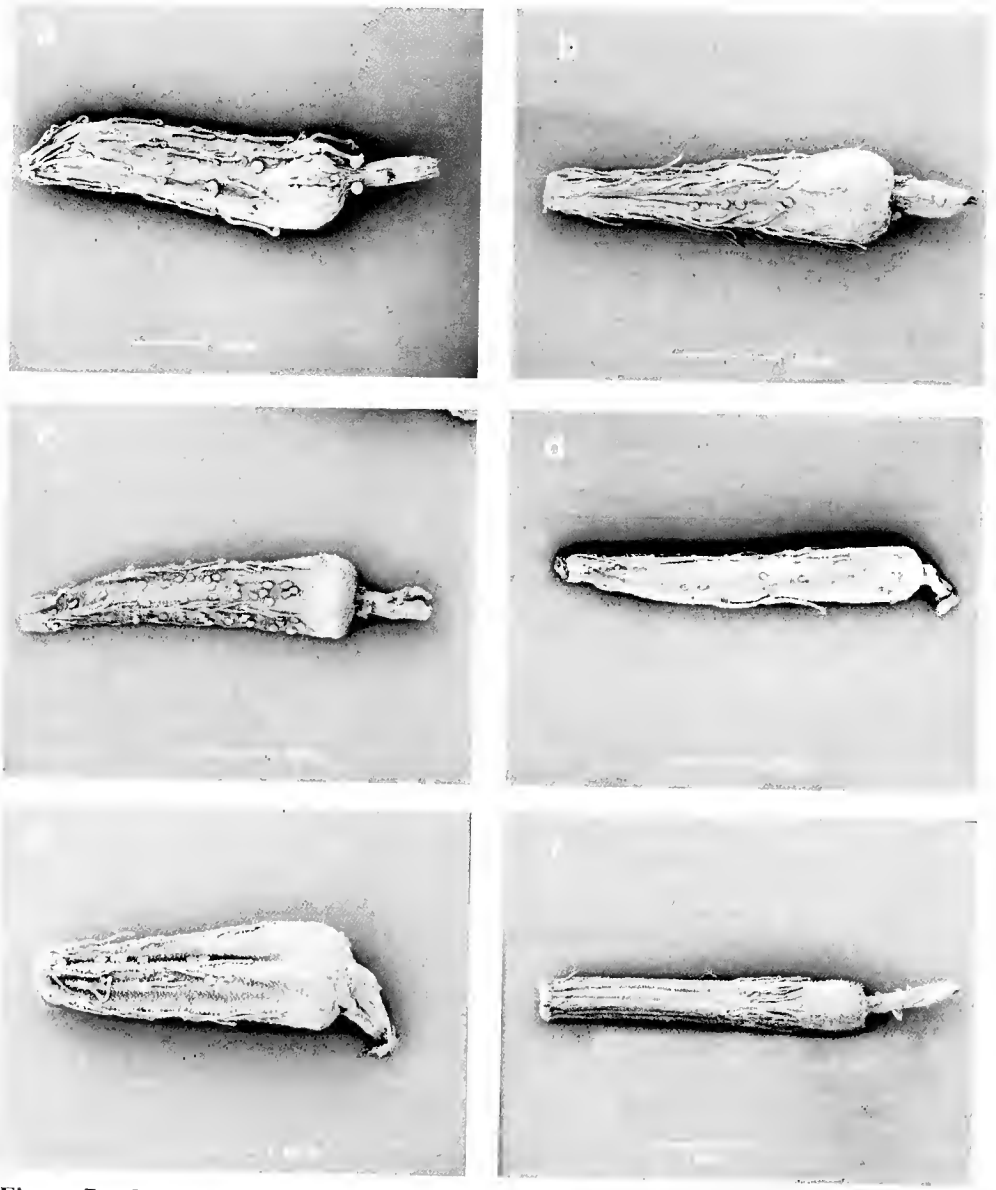

**Figure 7.** *Centipeda* cypselas. **a** *C. pleiocephala* (*Walsh 4949*, MEL); **b** *C. aotearoana* (*Poole s.n.*, CHR); **c** *C. cunninghamii* (*Cornwall s.n.*, MEL); **d** *C. crateriformis* subsp. *crateriformis* (*Clinnock 7767*, AD); **e** *C. crateriformis* subsp. *compacta* (*Jackson 1438*, PERTH); **f** *C. thespidioides* (*Everist 3961*, BRI).

obovate with erose membranous margins, 1–1.6 mm long; receptacle convex; corollas of female florets 0.1–0.25 mm long; corollas of bisexual florets 0.3–0.4 mm long. *Fruiting heads* breaking up before stems senesce. *Cypselas* narrowly obcuneate (length-width ratio c. 3–4), 0.6–1.5 mm long, truncate or obtusely rimmed and very slightly impressed at the apex, the 4–6(–8) ribs with short ascending bristles, uniting in the distal quarter to half into a pale, pithy apical portion, faces between ribs with vesicular trichomes in a vertical row or scattered (rarely with scattered hairs), hairs antrorsely appressed to spreading, 0.15–0.2 mm long, acute or obtuse (not inrolled or thickened) at apex.

**2a. *Centipeda minima* subsp. *minima***

*Stems* and base of capitula glabrescent to moderately cottony; *leaves* ± kite shaped, 3–12(–27) mm long, 1.5–6(–11) mm wide, cottony to glabrescent. *Capitula* at anthesis 1.5–3(–3.5) mm diam.; involucral bracts c. 1 mm long; receptacle depressed-hemispherical, 1–1.2(–1.5) mm diam. at anthesis; female florets 75–200, corollas 0.1–0.25 mm long; bisexual florets 10–20, corollas 0.3–0.4 mm long. *Cypselas* narrowly obcuneate, 0.7–1.1 mm long, c. 0.3 mm wide, with scattered vesicular trichomes on faces; angles 4(–6), obtuse to acute. (Figs. 4b, 6b)

The extreme (bracketed) measurements derive from plants growing in premanently moist, shaded sites, or rarely, from wholly submerged plants.

*Representative specimens*: **AUSTRALIA**: **Western Australia**: Rawlinson Range, Pass of the Abencerrages, 24.vii.1974, *A.S. George 12134* (PERTH); Carnarvon Basin, Wardawara Pool, 31.viii.1995, *G.J. Keighery & N. Gibson 690* (PERTH); Ruddall River National Park, Little Sandy Desert, 30.iv.1979, *A.S. Mitchell 836* (NT, PERTH); c. 150 km SE of Shay Gap, 11.vii.1984, *K. Newbey 10425* (PERTH);. **Northern Territory**: Gardiner River floodout, 10.vi.1996, *D.E. Albrecht 7884* (DNA); Standley Chasm, 55 km W of Alice Springs, 2.vi.1961, *G. Chippendale s.n.* (DNA, MEL); Central Mt Stuart, 2.vii.1974, *T.S. Henshall 484* (DNA, MEL); Cleary Dam, Loves Creek Station, 16.vii.1991, *P.K. Latz 12044* (MEL, MO, NT). **South Australia**: Wrattonbully, xii.1973, *K. Alcock 8* (AD); River Murray opposite Newena Island, 11.ix.1979, *W.R. Barker 3778 & R.M. Barker* (AD, MEL); Cullyamurra Waterhole, 1.xi.1987, *P.E. Conrick 2212a* (AD); c. 170 km N of Oodnadatta, 27.viii.1931, *E.H. Ising s.n.* (AD). **Queensland**: Port Curtis District, Leeks Dam, 9.xi.1987, *G.N. Batianoff 9348* (BRI, K, NSW, US); Warrego District, Charleville, 26.iv.1934, *S.T. Blake 5530* (BRI); Maranoa District, Leichhardt River, Kajabbi, 6.vi.1935, *S.T. Blake 9305* (BRI); North Gregory District, Bladensburg National Park, 18.iii.1998, *P.I. Forster 22168 & R. Booth* (AD, BRI, MEL); Darling Downs District, c. 11 km SE of Mandarra, 22.xi.1959, *R.W. Johnson 1183* (BRI); Mitchell District, Cameron Downs, Hughenden, *S.E. Pearson 165* (BRI). **New South Wales**: Central Coast, Picton Lakes, Thirlmere, 21.xi.1965, *E. McBarron & M.D. Tindale s.n.* (NSW); South West Slopes, Ten Mile Creek, Holbrook, 23.iii.1947, *E.J. McBarron 742* (NSW); Southern Tablelands, Goodradigbee River, Wee Jasper, 26.iii.1963, *E.J. McBarron 7901* (NSW); North Far West Plain, Mootwingee, 22.ix.1972, *W.E. Mulham 580* (NSW); North West Plain, Iolanthe, c. 25 km W of Garah, 3.iv.1972, *K.L. Solling 244* (NSW). **Victoria**: Riverina, c. 0.5 km S of Murray River, SW of Tocumwal, 29.x.1982, *H.I. Aston 2355* (MEL); Grampians, Lynch Track, 23.ii.1969, *A.C. Beauglehole 30589* (MEL); Midlands, 14.5 km WSW of Walwa, 16.v.1980, *A.C. Beauglehole 68327* (MEL); Gippsland Plain, Lake Glenmaggie, NE of 'The Retreat', 28.iv.1985, *A.C. Beauglehole 79435* (MEL); Wimmera, Lake Marmal Reserve, 27.xii.1985, *A.C. Beauglehole 82960A* (MEL). **NEW ZEALAND**: **North Island**: Waikouia Kaitaia, Jan. 1898, *H. Carse s.n.* (CHR); Great Barrier Is, Whangapoua catchment, 23 Mar. 1986, *E.K. Cameron 3934*, (AKU, CHR); N. Auckland, Lake Taharoa near Dargaville, Jan. 1981, *P.N. Johnson s.n.* (CHR); Kerikeri Swamp, Bay of Islands, 3 Dec. 1949, *R. Mason & N.T. Moar 366* (CHR); Mansiona House Bay, Kawau Is., 16 Feb. 1972, *W.R. Sykes 290/72* (CHR). **INDIA**: Uttar Pradesh, Mirzapur, 7.ii.1961, *U.C. Bhattacharya s.n.* (L); Calcutta, 7.xi.1916, *Hallier s.n.* (L); Assam & Khasia, *s.d.*, *Masters s.n.* (L) Dharmapuri, 1.v.1979, *K.M. Matthew & N. Venngopal s.n.*(L). **THAILAND**: Chiang Mai, 13.vi.1968, *C.F. Bensekom & C. Phengkhlai 1215*, (AAH, BKF, C, E, K, L, P); Mae La Poean, 29.1.1964, *B. Hansen et al. 10971* (L). **RUSSIA**: Blagoveshchensk, in Amurgebiete, vii.1898, *F. Karo 201* (L). **CHINA**: Songtao Xian, vicinity of Lengjiaba, 5.i.1986, *Sino-American Guizhou Botanical Expedition no 2070* (L). **TAIWAN**: Tomita-cho, Tihoku-shi, 20.v.1932, *T. Tanaka & Y.*

*Shimada s.n.* (L, NYBG). **JAPAN**: Hondo, Koshigaya, 28.vi.1951, *J. Ohwi s.n.* (L, TNS); Nagasaki, 1862, *R. Oldham s.n.* (K,L). **SINGAPORE**: 21.iv.1951, *J. Sinclair s.n.* (L). **INDONESIA**: Lombok, 6.v.1909, *J. Elbart s.n.* (L); Celebes, 25.vii.1937, *Eyma 1268* (BO, L); Java, Banjoemas, 1923–1925, *D. Kievits 167* (L); Sarawak, Lundu, 20.ix.1955, *J.W. Purseglove 4603I* (L). Sumatra, 10.v.1919, *J. A. Zorszing 6435* (L). **PHILIPPINES**: Mt Province, Luzon, 15.v.1963, *H.C. Conklin & Buwaya s.n.* (L, PNH). **PAPUA NEW GUINEA**: Veiya, 9.ii.1935, *C.E. Carr 11603* (L); Cloudy Mountains, 1878, *Chalmers s.n.* (MEL); Lorne Range, 1878, *Chalmers s.n.* (MEL). **NEW CALEDONIA**: 1886, *F.J. Roberts s.n.* (MEL). **FIJI**: 1860, *B. Seeman 265* (L): xi.1947, *A.C. Smith 6885* (K, L). **SAMOA**: Talelima, Savaii, iv. 1881, *Betche s.n.* (MEL).

*Distribution and Conservation Status*: Occurs in all mainland States of Australia, overall common, but uncommon below c. 35°S and above c. 20°N, and apparently rare in Western Australia. It is widespread through Pacific Islands and southern Asia, also in Pakistan, Afghanistan and south-eastern Russia. Its apparent absence from extreme northern Australia is surprising, particularly when its distribution through south-east Asia is considered. It is not rare or threatened. (Fig. 8)

*Habitat*: Occurs on muds, clays, sands etc. surrounding lakes, dams, billabongs and watercourses, or their drying beds. It is occasionally a weed of agricultural land.

*Notes*: I have seen only photographs of the type at LINN, the specimen being a weak, apparently procumbent plant, but this habit is consistent with many plants seen in Australian herbarium collections, particularly those from shaded or permanently moist

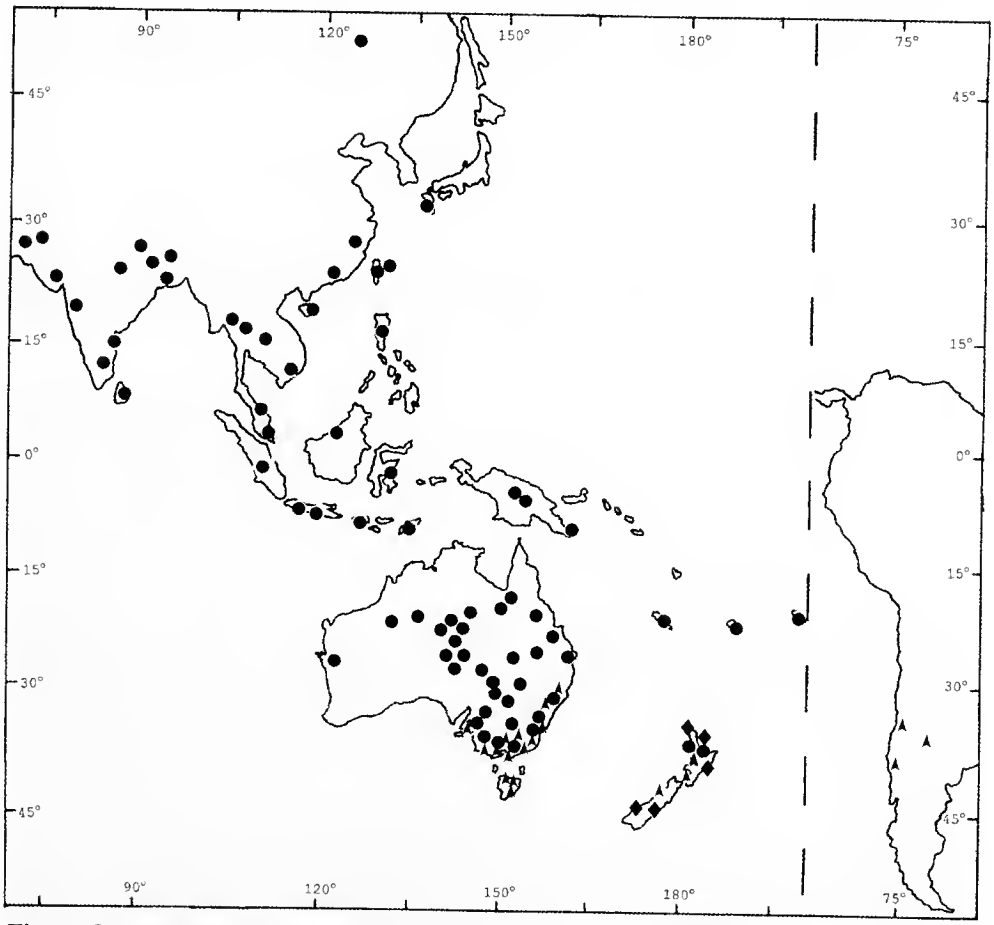


**Figure 8**. Distribution of *C. elatinoides* (arrowheads); *C. minima* subsp. *minima* (closed circles); *C. aotearana* (diamonds).

sites. The characters of the corollas and cypselas conform to those of Australian specimens of subsp. *minima* as here defined (R. Chinnock, pers. comm.).

Forms from semi-arid areas are often cottony-pubescent. The name *C. minima* var. *lanuginosa* has been applied to such cottony plants, as well as to specimens of *C. minima* subsp. *macrocephala*, *C. borealis* and *C. nidiformis*. However the indumentum observed in specimens of *C. minima* subsp. *minima* ranges from virtually non-existent (as represented by the Linnaean type) to fairly densely cottony, with no sensible disjunction to justify the retention of var. *lanuginosa*.

The Wallich collection (no *349*, specimens seen from K and L) cited by DeCandolle in his description of *Cotula sternutatoria* clearly belongs to the typical subspecies as recognised here.

*Sphaeromorphaea russelliana* DC. var. *glabrata* DC. (type seen, at K) is also referable to this taxon, but specimens of *Sphaeromorphaea russelliana* DC. *sens. str.* (including Wallich's type collection) in DeCandolle's herbarium are of *S. australis* (Less.) Kitam. (syn. *Epaltes australis* Less).

The type of *C. orbicularis* (*Loureiro*, Cochin, BM) has female corollas 0.1–0.15 mm long and cypselas 0.9 mm long. The leaves are 3–5(–7) mm long, but less toothed than typical (often obovate or spathulate). There are numerous adventitious roots and the impression is that it might have been aquatic or semi-aquatic. The habitat given in type description 'inculta in agris Cochinchiniae' suggests this may have been the case (an agricultural ditch perhaps). It is closely comparable to the type of *C. minima*.

Young and/or incomplete specimens of hairier forms of the taxon may be difficult to distinguish from *C. borealis*, but except in Papua New Guinea (and perhaps Irian Jaya), the two do not appear to be sympatric.

**2b. *Centipeda minima*** subsp. ***macrocephala*** N.G. Walsh *subsp. nov.*

a subspecie typica capitulis et cypselis majoribus, foliis et caulibus gossypinis constanter, et in distributione boreali differt.

*Type*: Australia, Western Australia, Fortescue Botanical District, Creek crossing, 45 km from Tom Price along Marandoo Development Road, 30.viii.1995, *P.S. Short 4280* (holotype: MEL *2027702*; isotypes: PERTH, TI).

*Stems* and base of capitula white-cottony; *leaves* ± kite shaped, 5–13 mm long, 2–5 mm wide, shallowly toothed to pinnatifid, cottony to glabrescent with age; *capitula* at anthesis 3–5 mm diam.; involucral bracts 1.2–2 mm long; receptacle depressed-hemispherical, 1.5 mm diam. at anthesis; female florets (60–)120–250; bisexual florets (7–)16–21; *cypselas* narrowly obcuneate, 1.15–1.7 mm-long, 0.4–0.45 mm wide, with scattered vesicular trichomes (and sometimes scattered hairs) on faces; angles 4(–8), acute. (Figs 4c, 6c)

*Representative specimens*: **AUSTRALIA**: **Western Australia**: Kimberleys, c. 60 km S of Halls Creek, 13.vii.1974, *A.C. Beauglehole 47338* (PERTH); Barrow Island, xii.1966, *W.H. Butler s.n.* (PERTH); Pilbara, c. 8 km N of Ethel Creek Homestead, 28.viii.1995, *A.A. Mitchell PRP448* (MEL, PERTH); Hammersley Range, 5.x.1989, *B. Nordenstam & A.A. Anderberg 327* (PERTH); Marble Bar Pool, 29.viii.1995, *P.S. Short 4265* (MEL, PERTH). **Northern Territory**: Pargee Rockhole, Western Tanami, 10.vi.1996, *D.E. Albrecht 7866* (DNA); Walhollow Station, 9.x.1994, *C. Edgoose 1 & A. Kennedy* (DNA); Mary Ann Dam, Tennant Ck, 3.v.1993, *J. Egan 2269* (DNA); Junction Reserve, 16.vii.1982, *P.K. Latz 9316* (DNA); Camping Ground Island, Macarthur River, 7.vii.1984, *G. Wightman 1598* (DNA). **Queensland**: Near Karumba, c. 32 km NW of Normanton Township, 15.viii.1953, *M. Lazarides 3950* (CANB, DNA).

*Distribution and Conservation Status*: Apparently endemic in Australia, occurring between latitudes c. 16°N and c. 25°N, but apparently confined to areas north of c. 22°N (around Barrow Ck) in Central Australia. It is apparently commonest in north-west

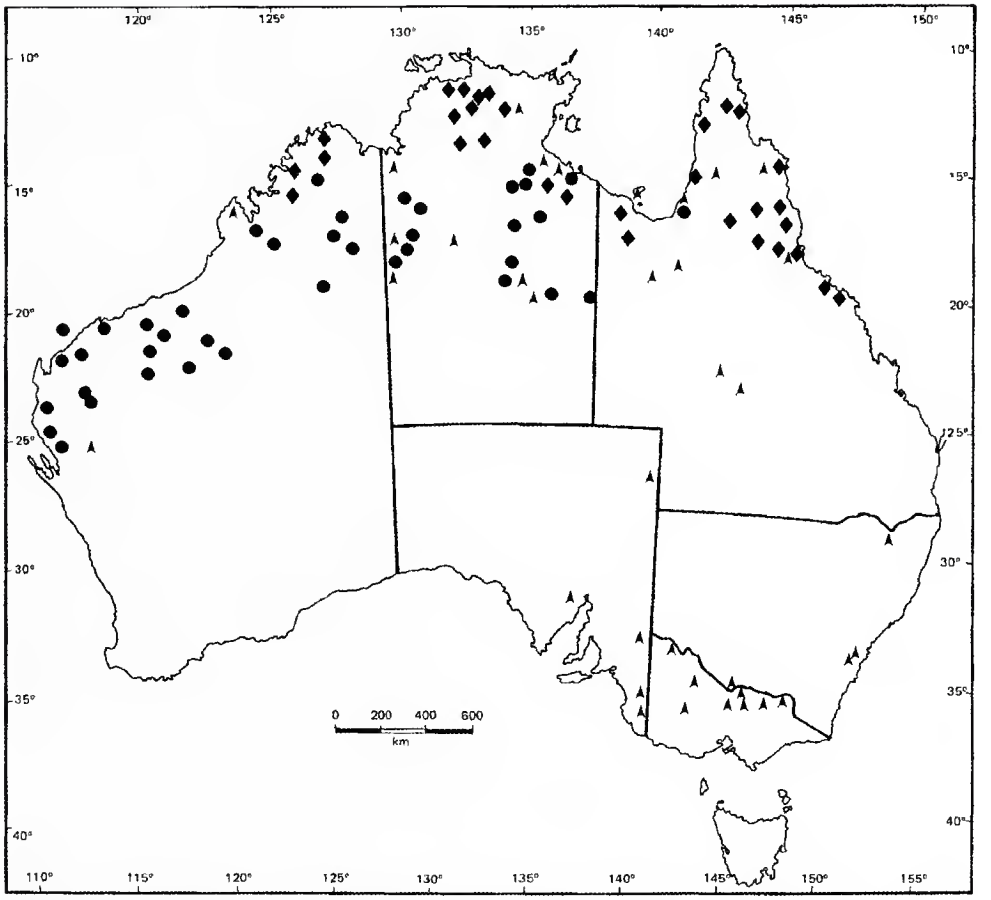


**Figure 9.** Distribution of *C. minima* subsp. *macrocephala* (closed circles); *C. borealis* (diamonds); *C. nidiformis* (arrowheads).

Western Australia (Carnarvon area), extending to the Gulf district of Queensland (1 record). Not rare or threatened. (Fig. 9)

*Habitat*: Occurs in sandy or clayey soils at margins of and in dry beds of watercourses, around pools, dams, springs etc.

*Notes*: Apart from the larger capitula and cypselas, subsp. *macrocephala* is typically a more robust, twiggier plant and is more densely and consistently white-cottony than is subsp. *minima*. It has a generally more northerly distribution than the typical subspecies. Young plants may superficially resemble *C. borealis* but at maturity the larger capitula and cypselas readily distinguish it. Many mature, fruiting specimens are conspicuous in having fallen cypselas retained within the cottony indumentum of lower stems and leaves.

The subspecific name is from Latin, meaning 'large-headed', drawing a comparison of the capitula to those of the typical subspecies.

**3. *Centipeda borealis*** N.G. Walsh *sp. nov*

a *C. minima* habitu rhizomatoso, indumento albo-gossypino dense et foliis longioribus angustioribus relative distincta.

*Type*: Australia, Queensland, 12.1 km from Peninsula Development Road on track following telegraph line to Weipa, 2.viii.1983, *J.R. Clarkson 4873* (holotype: MEL *676346*; isotypes: BRI, DNA, K, L, MO, NSW, QRS).

*Centipeda minima* auct. non. (L.) A. Braun & Asch.; Dunlop in Cowie *et al.*, *Floodplain Flora* 182 (2000).

Procumbent to ascending, often rhizomatous *herb*, perennial or annual, to c. 30 cm high, usually many-branched from near base, densely white- or grey-cottony on leaves and all but oldest stems. *Leaves* narrowly obtrullate to ± oblong in outline, 6–20 mm long, 1.5–2.5(–4) mm wide, distally with 3–5(–7) obtuse to acute teeth or narrow lobes, white- to grey-cottony, sometimes the older leaves glabrescent, both surfaces resin-dotted but obscured by indumentum, ± concolorous. *Inflorescence* a single sessile capitulum, terminal at anthesis, but subtending vegetative buds often growing out and overtopping capitulum in fruit and the capitula then appearing axillary and subterminal. *Capitula* at anthesis ± globular, 1.5–3(–4) mm diam.; involucral bracts obovate, 0.7–1 mm long, margins membranous, ruminate; receptacle strongly domed (usually as high or higher than wide); female (outer) florets c. 160–250 in 6–10 rows, corollas cylindrical, c. 0.2 mm long; bisexual florets 11–20, corollas funnel-shaped, c. 0.4 mm long (including lobes c. 0.2 mm long and wide). *Fruiting heads* soft, readily disintegrating when mature on still-growing plants; bracts of fruiting heads strongly to moderately reflexed, straight or slightly upcurved distally, not thickened or pithy; fruiting receptacle 0.9–1.3 mm diam., with a pith layer contained entirely the dome, not extending below base of involucre; *cypselas* narrowly clavate to narrowly obcuneoid, 0.8–1.1 mm long, 0.2–0.3 mm wide, truncate at apex, smooth or scabridulous, weakly to strongly 4(–6)-angled, the angles ciliate, united at or above ± four-fifths of the cypsela length into a slightly thickened, pale, apical portion, the pericarp between the ribs in the lower part very thin, with the brown testa of the seed apparent, the faces with or without a row of hairs down the centre, vesicular trichomes sparsely scattered over faces, hairs antrorsely appressed or subappressed, 0.1–0.2 mm long, acute, not inrolled at apex. (Figs 3d, 4d, 6d)

*Representative specimens*: **AUSTRALIA**: **Western Australia**: Kimberley, Gibb River, Kalumburu Mission Road, *A.C. Beauglehole 51658* (PERTH); Charnley River, viii.1905, *W. Fitzgerald s.n.* (PERTH); Mt Trafalgar, Kimberley coast, 14.vi.1988, *K.F. Kenneally 10777* (DNA, PERTH); King Edward River floodplain, 22.viii.1993, *A.A. Mitchell 3247* (BROOME, MEL, PERTH). **Northern Territory**: Litchfield National Park, Butterfly Gorge, 29.ix.1991, *M.J. Barritt 912* (DNA); Kakadu National Park, 3 km N of Old Goodparla, 3.viii.1994, *M.J. Barritt 1109* (DNA); Litchfield Station, 8.x.1989, *K.M. Manning 485* (DNA); Mataranka, 22.vi.1999, *N.G. Walsh 4989* (MEL); Magela Creek, East of Ja Ja, 21.viii.1980, *J.T. Waterhouse s.n.* (CANB, DNA). **Queensland**: Cook District, Cooktown, viii.1881, *E. Betche s.n.* (BRI); North Kennedy District, Proserpine, 10.xii.1919, *Rev. N. Michael* (BRI); Cape York, Archer Bend National Park, 2.viii.1981, *A.Morton 1309* (BRI, MEL); North Kennedy District, Baratta Creek, 21.vi.1949, *L.S. Smith 4321* (BRI). **PAPUA NEW GUINEA**: Western District, Bula Plains, Morehead subdistrict, 10 Nov. 1972, *E.E. Henty & D.B. Foreman, NGF 49356* (LAE, L, BRI); Western Province, Tambari Plain, Balamuuk, 18 Sept. 1979, *N.A. Jinas & E.K. Naoni 35* (LAE); Marauke, Taram River, 4 Aug. 1954, *P. van Royen 4606* (LAE, L).

*Distribution and Conservation Status*: Occurs in far northern Australia (latitudes near and above c. 20°N), from near-coastal areas of the Kimberley Region, Western Australia eastward to Townsville area in Queensland. It also occurs in western Papua New Guinea and perhaps to be anticipated in suitable areas of Irian Jaya. It is not well represented in herbaria and in the few places that I have seen the species, it is not locally abundant. A Conservation Code of 3RC- is suggested (Briggs & Leigh 1996). (Fig. 9)

*Habitat*: Occurs in seasonally inundated depressions and on floodplains, commonly around lagoons, billabongs and beside watercourses, mostly on alluvial silts.

*Notes*: Closely related to *C. minima* but distinguished by the perennial, rhizomatous, more robust habit, conspicuous white-cottony indumentum and longer and relatively narrow leaves. See also notes under *C. minima* (both subspp.).

The epithet is Latin, meaning northern, a reference to its restricted occurrence within Australia.

**4. *Centipeda nidiformis*** N.G. Walsh *sp. nov.*

a *C. minima* corolla longiore et cypselis angulatis valde differt.

*Type*: Australia, Northern Territory, Barkly Tableland, Waterhole on Morphet Ck, c. 200 m west of Stuart Hwy crossing, 21.vi.1999, *N.G. Walsh 4982* (holotype: MEL *2060050*; isotypes: CANB, NT).

Decumbent to ascending cottony *annual*, spreading to c. 15 cm diam. and/or 15 cm high; adventitious roots not or rarely produced; branches densely white-cottony at least on young growth. *Leaves* ± spathulate, 3–10 mm long, 1–5 mm wide, usually with very slender petiole-like bases that are often almost as long as (occasionally longer than) the broader part of the lamina, shallowly (often obtusely) toothed or subentire; surfaces usually densely (rarely lightly) cottony, with (often indistinct) scattered resin droplets. *Inflorescence* a single sessile capitulum, terminal and/or cauline, subtended by 1–4 leaf-like bracts. *Capitula* at anthesis ± globular, 2.5–5 mm diam; involucral bracts 1–1.6 mm long, densely cottony (except in specimens from southernmost localities); receptacle depressed hemispherical, 1.5–2.5 mm diam. at anthesis; female florets c. (50–)110–230, corollas 0.35–0.5 mm long; bisexual florets (6–)9–11, 0.6–0.7 mm long. *Fruiting heads* soft, readily disintegrating when mature on still-growing plants; bracts of fruiting heads widely spreading to slightly deflexed, straight or slightly upcurved distally, not thickened or pithy; fruiting receptacle 1–1.5 mm diam., with a thin pith layer contained entirely within the dome, not extending below base of involucre; *cypselas* obcuneate, 0.8–1.1 mm long, c. 0.4–0.5 mm wide, depressed-truncate at apex, usually strongly 4 (rarely 5 or 6)-angled with 1 or 2 lines of vesicular trichomes down centre of usually concave faces, apical rim and ribs at angles very acute or narrowly finned. Hairs on angles subappressed, c. 0.25 mm long, occasionally shorter hairs present on mid-line of faces. (Figs 4e, 6e)

*Representative specimens*: **AUSTRALIA**: **Western Australia**: Kimberley, Fitzroy River on Great Northern Highway, 29.vii.1974, *A.C. Beauglehole 48097* (PERTH); Carnarvon Basin, Cardilya Pool, 31.viii.1995, *G.J. Keighery & N. Gibson 589* (PERTH); Bunguaduk waterhole, Dampierland Peninsula, 20.viii.1985, *K.F. Kenneally 9454* (PERTH). **Northern Territory**: Near Nourlangie Rock, 12.x.1973, *J. Burrell 1257* (CANB, DNA); Sanctuary Swamp, 4.vii.1980, *J. Maconochie 2465* (CANB, DNA); Tanumbrini Station, 12.vii.1987, *B.G. Thomson 1988* (DNA). **South Australia**: Innamincka Station, 4.xi.1987, *P.E. Conrick 2245* (AD); Murray River floodplain, 6.5 km W of Berri, 20.iv.1957, *H. Eichler 13799* (AD); Chowilla Station, vii.1966, *R.H. Kuchel 399* (AD); Mulligans Swamp Conservation Park, 6.iv.1996, *R. Taplin 717 & D. Murfet* (AD). **Queensland**: Cook District, west coast of Cape Yorke Peninsula, vii.1977, *P. Black 12* (CANB); Maranoa District, Leichhardt River, Kajabbi, *S.T. Blake 9307* (BRI); Burke District, Normanton, 7.viii.1936, *S.T. Blake 12488* (BRI); North Kennedy District, Wairuna Lake, 10.viii.1976, *M. Lazarides 8164* (BRI, CANB); Mitchell District, Thompson River Crossing, 100 km SW of Longreach, 30.v.1993, *J. Milson 389* (BRI). **New South Wales**: Central Coast, Elderslie near Camden, 1.vi.1968, *E.J. McBarron 15348* (NSW); South-West Plains, 2 km S of Deniliquin, xi.1977, *W.E. Mulham 1201* (NSW). **Victoria**: Midlands, Mt Black Flora Reserve, 3.v.1981, *A.C. Beauglehole 68917* (MEL); Murray Mallee, Hattah National Park, Chalka Creek, south of Lake Lockie, 3.x.1982, *D.C. Cheal s.n.* (MEL); Wimmera, Yarriambiack Creek, 31.viii.1902, *F.M. Reader s.n.* (MEL); Riverina, Ulupna Island, 25.i.1993, *P.S. Short 3929 et al.* (MEL).

*Distribution and Conservation Status*: Apparently commonest in northern Australia (north of the Tropic of Capricorn) where scattered but locally abundant, apparently not rare. Rather rare in southern Australia (northern Victoria, southern and eastern NSW, eastern SA, with disjunct occurrences in the south-western part of the Gascoyne province in WA. (Fig. 9)

*Habitat*: Margins of streams, waterholes etc. on usually clay or clay-loam soils. In areas of reliable rainfall, but relatively warm climates.

*Notes*: Close to *C. minima* subsp. *minima* but distinguished by the longer corollas and relatively broader, strongly angular cypselas that typically have concave faces between the ribs. The leaves are generally diagnostic, usually having relatively long, 'pseudopeti-

olate' bases, a feature rarely observed in *C. minima*. Through most of the range of the species, plants are densely cottony-pubescent, but specimens from the southern part of the range may be only lightly pubescent.

See also notes under *C. minima* and *C. borealis*.

The epithet is latin meaning 'nest-shaped', an allusion to the capitula which are typically embedded in cottony indumentum, appearing like a small bird's nest.

**5. *Centipeda racemosa*** (Hook.) F. Muell., *Syst. Cens. Austral. Pl.* 84 (1883). *Myriogyne racemosa* Hook. in T.L. Mitch., *J. Trop. Austral.* 353 (1848). *Type*: Australia, Maranoa River, 17 Oct. 1846, *T.L. Mitchell* (lectotype, *hic designatus,* K (*ex herb. hookerianum* 1867, photo seen); isolectotype K *(ex herb. benthamianum*, photo seen)).

*Centipeda racemosa* var. *lanata* F.M. Bailey, *Qld Agric. Journ.* 28: 276 (1912). *Type*: Australia, 'Herberton, *Dr. F. Hamilton Kenny*' (BRI).

Erect perennial *herb* with branches annual or perennial from a perennating rootstock, perhaps annual in some situations, to c. 45 cm high, usually many-branched from base, glabrous to quite cottony on stems of current-seasons growth. *Leaves* ± oblong, slightly tapered to base, 3–14 mm long, 1–2 mm wide, evenly serrate with acute teeth often incised ± halfway to the midrib, less commonly shallowly toothed in the upper half only, or subentire, margin usually recurved; glabrous or, when young, lightly white-cottony (rarely persistently lanate), resin-dotted on both surfaces, ± concolorous. *Inflorescences* racemose, 0.5–1.2(–2) cm long, terminal and sometimes also in upper axils (then sometimes appearing sub-paniculate), of 2–7 capitula; peduncles 0.5–5(–8) mm long. Peduncles each subtended by a bract, more or less intermediate in form and size between the uppermost leaves and involucral bracts. *Capitula* at anthesis highly domed-hemispherical to globular, 1.8–4 mm diam.; involucral bracts obovate, 1–1.5 mm long, margins membranous, ruminate; receptacle distinctly convex; female (outer) florets c. 80–150 in 5–8 rows, corollas narrowly cylindrical, c. 0.3 mm long; bisexual florets 9–18, corollas funnel-shaped c. 0.7–0.8 mm long (including lobes c. 0.3 mm long and wide). *Fruiting heads* soft, readily disintegrating when mature on still-growing plants; bracts of fruiting heads straight or slightly incurved, widely spreading or reflexed, not thickened or pithy; fruiting receptacle 0.8–1.2 mm diam., with a pith layer contained entirely the dome, not extending below base of involucre; *cypselas* narrowly obcuncoid, 0.8–1.1 mm long, truncate at apex, smooth or scabridulous, strongly 4-angled to the apex, the angles ciliate, the intervening faces with a row of similar hairs down the centre, this area sometimes slightly ribbed, vesicular trichomes apparent between lines of hairs on faces, hairs antrorsely appressed or subappressed, c. 0.1–0.2 mm long, not conspicuously inrolled or thickened at apex. (Figs 3e, 4f, 6f)

*Representative specimens*: **AUSTRALIA**: **Western Australia**: Towrana Station, 25.v.1982, *R.J. Cranfield 2105* (PERTH). **Northern Territory**: Lake Surprise, 32 km SW Tennant Creek, 6.v.1994, *D.E. Albrecht 5883* (DNA, NSW, NT); S of Mongrel Downs Station, 5.viii.1976, *P.K. Latz 6555* (NT); Annitowa Station, 10.v.7023, *P.K. Latz 7023* (DNA, NT); 107 km NE of Tanami Bore, 17.v.1971, *J.R. Maconochie 1109 p.p.* (CANB, K, MEL, NT PERTH). **Queensland**: Leichhardt District, 'Minerva' N of Springsure, 5.vii.1934, *S.T. Blake 7023* (BRI); North Kennedy District, Charters Towers, 2.v.1981, *W.R. Carter s.n.* (BRI); Burke District, 48 km S of Lyndhurst Station on Hughenden Rd, 15.v.1975, *J.R. Clarkson 198* (BRI, K); Mitchell District, c. 64 km NE of Blackall, 18.x.1963, *J.K. Cull s.n.* (BRI); Cook District, Lyndhurst Station Homestead, 12.viii.1969, *N.W. Doherty s.n.* (BRI). **New South Wales**: Central West Slopes, Rocky Creek, 21.iii.1843, *F.W.L. Leichhardt s.n.* (NSW); North West Slopes, Binnaway, 21.xii.1960, *E.J. McBarron s.n.* (NSW); North West Plains, Gwabegar, x.1932, *H.M.M. Rupp s.n.* (NSW).

*Distribution and Conservation Status*: Occurs mainly in the Northern Territory and Queensland northwards from around 25° latitude, with disjunct occurrences in the gener-

al vicinity of the Warrumbungle Ranges of New South Wales, inland southern Queensland, and a remarkable occurrence in Western Australia, inland from Carnarvon. There are fewer than 50 collections represented in Australian herbaria. It is probably reasonable to regard the species as rare, but as there appear to be no post-1980 collections from New South Wales, and only a few from Queensland, further investigation may indicate it to be threatened. Suggested Conservation Code is 3K (Briggs & Leigh 1996). (Fig. 10)

*Habitat*: Floodplains and margins of watercourses, gilgais, or other water-retentive sites, with clayey, sandy or rocky substrates. Species or plant associations noted as occurring with *C. racemosa* on herbarium labels include 'Wiregrass' (presumably *Aristida* sp.), 'Box-Sandalwood forest', 'mixed eucalypt forest', 'short grazed turf', 'sedgeland surrounded by *Eucalyptus largiflorens*'. The species may to be favoured by soil disturbance, one specimen noting its occurrence in a ploughed paddock, another, from a cattle station noting it to be 'spreading on property in recent years'.

*Notes*: *Centipeda racemosa* is distinctive in its relatively tall, erect habit, often several-branched from the woody perennating rootstock, and the racemose inflorescence with subglobular to globular capitula. Its cypselas differ from others in the *C. minima* group by the absence of a thickened spongy apical portion.

Two presumed type sheets of *Myriogyne racemosa* are at K, both dated 1846, collected by Mitchell and labelled 'Sub-tropical New Holland', with a determination in

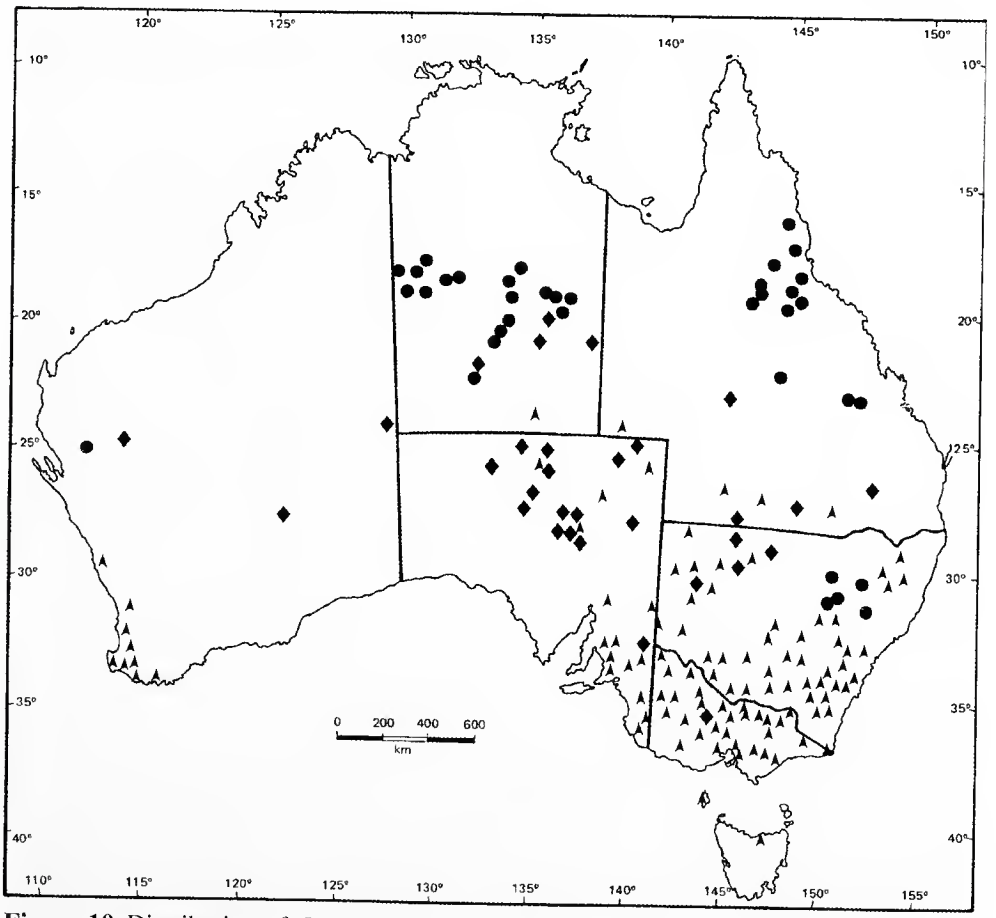


**Figure 10.** Distribution of *C. racemosa* (closed circles); *C. pleiocephala* (diamonds); *C. cunninghamii* (arrowheads).

Hooker's hand. One is stamped 'Herbarium Benthamianum 1854', the other 'Herbarium Hookerianum 1867'. They are presumably from the same original collection. The specimen from Hooker's herbarium is larger and more floriferous and is here chosen as the lectotype specimen.

*Centipeda racemosa* var. *lanata* is known only from the type specimen. It differs from other specimens here attributed to *C. racemosa* in being particularly lanate and in having slightly broader, less dentate leaves than typical, that are virtually devoid of resin-droplets on the adaxial surface. It is here included in synonymy, but it is possibly a hybrid with *C. borealis* or a particularly densely cottony form of *C. minima*, or may represent a rare or undercollected form of the species perhaps deserving of infraspecific rank. Further searches in the Herberton area are encouraged to confirm the correct status of this entity.

**6. *Centipeda pleiocephala*** N.G. Walsh *sp. nov.*

a *C. minima* habitu erecto, inflorescentibus axillaribus racemosis ex 2–4 capitulis compositis differt; a *C. racemosa* habitu annua, capitulis biconvexis, cypselis inflatis apice leniter differt.

*Type*: Australia, Queensland, Currawinya National Park, NE of Karatta Bore, 21.iii.1997, *P.I. Forster 20546 & M. Watson* (holotype: MEL *2055149*; isotypes: BRI, DNA, NSW).

Erect slender *annual*, to 30(–40) cm high, often several-branched from base, glabrous except for a few cottony hairs on young branchlets, sometimes persisting in axils. *Leaves* ± oblong to narrowly obovate, 8–25 mm long, 2–7 mm wide, serrate, margin flat (sometimes recurved on young leaves), glabrous, resin-dotted on both surfaces, concolorous. *Inflorescences* axillary, of 2–4 capitula, racemosely arranged (less commonly a single capitulum), the lowest capitulum usually sessile or subsessile, and the upper 1–3 with peduncles to c. 5 mm long. *Capitula* at anthesis hemispherical to biconvex, 2–4.5 mm diam.; involucral bracts spathulate to obovate, 1–1.5 mm long, margins membranous, ruminate; receptacle distinctly convex; female (outer) florets c. 100–170 in 3–5 rows, corollas narrowly cylindrical, 0.2–0.3 mm long; bisexual florets (4–)10–18, corollas narrowly funnel-shaped c. 0.6–0.8 mm long (including lobes 0.2–0.3 mm long and wide). *Fruiting heads* soft, readily disintegrating when mature on still-growing plants; bracts of fruiting heads straight or slightly incurved, widely spreading, not thickened or pithy; fruiting receptacle 1–1.5 mm diam., with a pith layer contained entirely or nearly within the dome, not extending below base of involucre; *cypselas* obloid, narrowly obovoid, or narrowly obcuneoid, 0.8–1.1(1.3) mm long, obtuse or rounded (female florets) or truncate (bisexual florets) at apex, smooth, finely 2–4-ribbed, the ribs confluent with a pale, spongy apical process not or hardly wider than the body of the cypsela and up to one-quarter the entire cypsela length, vesicular trichomes lacking or very sparse, hairs antrorsely appressed, c. 0.1–0.2 mm long, confined to ribs, crowded near base, rather sparse toward apex, straight or minutely inrolled at apex. (Figs 1, 3b, 3c, 5a, 7a)

*Representative specimens*: **AUSTRALIA**: **Western Australia**: East of Giles Creek, south of Rawlinson Range, 22.vi.1960, *J.B. Cleland s.n.* (AD). **Northern Territory**: Ross's Waterhole, Macumba River, 5.i.1927, *J.B. Cleland s.n.* (AD); West MacDonnel National Park, Ellery Ck, 18.vi.1999, *N.G. Walsh 4967* (MEL, NT). **South Australia**: Gairdner-Torrens, Canegrass Dam, Stuart Creek Station, 7.viii.1989, *F.J. Badman 3379* (AD); North-Western, Mintabie, 6.vii.1989, *R. Bates 19961* (AD); Lake Eyre, Wood Duck Waterhole, 2.iii.1984, *J.Z. Weber 8756* (AD); c. 30 km W of Coward Springs, 4.iii.1983, *J.Z. Weber 8763* (AD, BRI, NSW). **Queensland**: Mitchell District, Vergemont Creek, 22.ix.1990, *A.J. Emmott 466* (BRI); Maranoa District, 10 km E of 'Wongamee', 19.vi.1976, *R.W. Purdie 425* (BRI); Darling Downs District, c. 6 km E of Meandarra, 1.viii.1969, *M.J. Russell s.n.* (BRI). **New South Wales**: North Far West Plains, Wanaaring, 1.vi.1947, *L.A.S. Johnson 547/126* (NSW); North West Plains, Coolabah-Gongolgon Rd, 26.viii.1973, *J. Thompson 1822* (BRI, NSW). **?Victoria**: Avoca, F. Mueller s.d. (MEL); On the Murray Lagoons, F. Mueller s.d. (MEL).

*Distribution and Conservation Status*: Scattered through inland Australia, mostly between latitudes 20° and 32° south, occurring in all mainland States, except possibly Victoria, with most collections from north-western South Australia (Lake Eyre biological subdivision). Two specimens collected by Mueller and labelled 'Avoca' and 'on the Murray Lagoons' (probably collected during 1853) represent the only known collection of the species from Victoria, c. 300 km from of its nearest confirmed occurrence. The possibility exists that either the specimens were mislabelled or that the species is now extinct or extremely rare in Victoria. It is here assessed as Rare, with Conservation Code 3RCa (Briggs & Leigh 1996). (Fig. 10)

*Habitat*: Semi arid to arid areas in moist sandy, silty or clay soils (rarely amongst rock) at margins of waterholes, dams, creeklines, and on floodplains and gilgai landforms. Usually associated with ephemeral herbaceous herbage amongst shrubland (e.g. *Atriplex*, *Maireana*, *Muehlenbeckia*) or woodland (e.g. *Eucalyptus microtheca* F. Muell., *E. largiflorens* F. Muell., *E. camaldulensis* Dehnh., *Acacia stenophylla* A. Cunn. ex Benth.).

*Notes*: *Centipeda pleiocephala* differs from *C. minima* in its erect habit and axillary, shortly racemose inflorescences typically of 2–4 capitula. It differs from *C. racemosa* in the strictly annual habit, the axillary inflorescences usually of fewer capitula, biconvex (rather than subglobular) capitula, and in the cypselas having a slightly inflated apical process.

The epithet is from Greek, meaning 'many-headed', a reference to the individual inflorescences.

Some distributed specimens of this taxon may have been labelled with the epithet '*pluricephala*'.

**7. *Centipeda aotearoana*** N.G. Walsh *sp. nov.*

a *C. cunninghamii* foliis minoribus, habitu prostrato, capitulis minoribus plerumque, flosculis bisexualibus paucioribus differt.

*Type*: New Zealand, South Island, Between Leeston and Southbridge, Canterbury, 27.ii.1967, *R. Mason 10626* (CHR).

Prostrate *annual*, 10–30 cm diam., sometimes producing adventitious roots from lower nodes, usually several-branched from base, varying from being glabrescent with a few cottony hairs on young growth, to, rarely, moderately cottony all over. *Leaves* ± obovate to spathulate in outline, 4–8(–12) mm long, 1.5–4 mm wide, mostly with 1–3 acute to blunt teeth along each side, rarely entire, margin slightly thickened and/or sometimes slightly recurved, resin-dotted on both surfaces, concolorous or slightly paler beneath. *Inflorescence* a single sessile capitulum, often leaf-opposed, immediately subtended by a leaf and appearing axillary to it, sometimes in branch-axils. *Capitula* at anthesis ± hemispherical, distinctly domed, 3–4(–7) mm diam., (immature capitula, prior to anthesis, cup-shaped to biconvex); involucral bracts obovate, 1–2 mm long, minutely ruminate and membranous distally; receptacle distinctly domed, hemispherical or slightly lower than this; female (outer) florets c. 60–120 in 3–5 rows, corollas narrowly cylindrical, 0.3–0.4 mm long; bisexual florets 8–16, corollas narrowly funnel-shaped, c. 0.5–0.8 mm long (including lobes 0.2–0.3 mm long and wide). *Fruiting heads* firm, somewhat persistent, but disintegrating before stems senesce; bracts of fruiting heads widely spreading to slightly deflexed near base, slightly upcurved in distal half, not significantly thickened and not pithy toward base; fruiting receptacle 0.9–1.3 mm diam., the underlying pith layer not extending below base of involucre; *cypselas* clavate or narrowly obcuneoid (less than 5 times longer than wide), 1.2–1.7 mm long, obtuse (female florets) or truncate (bisexual florets) at apex, smooth or minutely scabridulous in the lower half only, prominently and usually regularly 4-angled with prominent ribs at each of the angles, usually

with a finer rib alternating with each of the major angles, the ribs terminating 2/3 or 4/5 of the cypsela length in a thickened spongy apical portion, pericarp between ribs usually thin, revealing the brown shining seed beneath, vesicular trichomes absent from cypsela body or sparsely scattered over faces, hairs antrorsely spreading or subappressed, 0.2–0.4 mm long, confined to ribs, extending from base to the distal quarter of cypsela, neither inrolled nor conspicuously thickened at apex, acute or obtuse. (Figs 5b, 7b)

*Representative specimens*: **NEW ZEALAND**: **North Island**: Great Is, Three Kings, 30.xi.1945, *G.T.S. Bayliss* (AK); Elands Lake, Hawkes Bay, 24.v.1990, *P.D. Champion s.n.*(WAIK); Muriwai, Waitakerei, iii.1914, *T.F. Cheeseman* (AK); near Cape Palliser, Wairarapa, ii.1947, *A.P. Druce* (CHR); Taranaki Land District, south of Opunake, 15.iii.1994, *P.N. Johnson 1254* (CHR); Turakirae Head, iv.1973, *C. Ogle* (CHR); Great Barrier Island, 3.iv.1980, *C.C. Ogle 461* (CHR); Whangamarino Swamp, Waikato, 15.i.1981, *C.C. Ogle 616* (CHR); Kapiti Island, Te Wairoua Valley, 27.iv.1982, *C.C. Ogle* (CHR). **South Island**: Wairarapa Coast, NE of Otorie River, xii.1978, *A.P. Druce* (CHR); Darfield, ?1950s, *A.E. Esler* (AK); Hagley Park, Christchurch, 12.iv.1954, *A.J. Healy 55/43* (CHR); North Canterbury, Medbury, 26.i.1996, *A.J. Healy 96/8* (CHR); Awatere Valley, Marlborough, 23.i.1955, *R. Mason 3144* (CHR); Lake Wanaka, *N. Petrie s.d.* (AK); Saltwater Lagoon, Westland, 7.iii.1980, *P. Wardle* (CHR).

*Distribution and Conservation Status*: Apparently endemic to New Zealand. From Three Kings Islands in the extreme north south to at least Lake Wanaka on the south island. It does not appear to be rare. (Fig. 8)

*Habitat*: Occurs chiefly on sandy or muddy shores and drying beds of lakes, swamps, rivers etc.; noted from the beach near Cape Palliser (*Druce, s.n.* CHR 82235). Also relatively common on disturbed sites, e.g. gravel and shale pits, levee banks etc.

*Notes*: *Centipeda aotearoana* is distinguished from other species in New Zealand (*C. cunninghamii*, *C. elatinoides* and *C. minima*) in the combined features of prostrate habit, and firm, hemispherical fruiting capitula. From *C. cunninghamii* it differs in smaller leaves, prostrate habit, generally smaller capitula, and fewer bisexual florets. From *C. elatinoides* it differs in the firm fruiting heads and the non-flattened cypselas with a pithy apical process. From *C. minima* it differs in the firm, hemispherical fruiting heads, non-flattened and larger cypselas. Amongst other species not occurring in New Zealand, it is closest to *C. crateriformis* subsp. *compacta* from which it differs chiefly in the shape of the capitula (hemispherical vs biconvex), the conspicuously domed receptacle, the generally relatively narrower cypselas, and the cypsela hairs which are acute or obtuse, neither thickened or inrolled at their apices. Both the cypselas and corollas of *C. aotearoana* are less glandular than those of either subspecies of *C. crateriformis*.

The epithet is based on the Maori word for their country, meaning 'land of the long white cloud'.

**8. *Centipeda cunninghamii*** (DC.) A. Braun & Asch., *Ind. Sem. Hort. Berol. App.* 6 (1867). *Myriogyne cunninghamii* DC., *Prodr.* 6: 139 (1838). *Type*: Australia, New South Wales, 'inundated banks of the Lachlan River', 29 Apr. 1817, *A. Cunningham* (lectotype, *hic designatus*, G-DC (photo seen); isolectotype: K (photo seen)).

Erect or ascending *perennial* (sometimes *annual* in adverse conditions) to c. 30 cm high, new growth commonly resprouting from base, glabrous, or cottony near the growing tips, or rarely cottony overall. *Leaves* oblong or narrowly obovate, 7–30 mm long, 2.5–7 mm wide, serrate, glabrous, resin-dotted on both surfaces, concolorous or slightly paler below. *Inflorescence* a single sessile cauline capitulum, not leaf-opposed, often in branch axils. *Capitula* at anthesis biconvex, hemispherical or subglobular, 4–6(–8) mm diam.; involucral bracts 3–5-seriate, obovate, 1.5–3 mm long, entire or with minutely ruminate membranous margins, glabrous to lightly (rarely densely) cottony; receptacle strongly convex; female (outer) florets c. 200–350, in 7–12 rows, corollas narrowly cylindrical,

0.3–0.5(–0.7) mm long (including lobes c. 0.1 mm long); bisexual florets c. 20–50(–70), corollas funnel-shaped, 0.7–0.8 mm long (including lobes c. 0.3 mm long and wide), pale green, rarely tipped reddish. *Fruiting heads* usually remaining intact until stems senesce; bracts of fruiting heads widely spreading; fruiting receptacle 1.8–2.5(–3.5) mm diam., with a pith layer entirely contained within the dome of the receptacle; *cypselas* oblong, 1.2–1.6 (–2) mm long, truncate or rounded at apex, with 4 prominent ribs, occasionally with 1 or 2 minor ribs, the ribs smooth or scabridulous, united at or above three-quarters of the cypsela length into a thickened, spongy or corky apical portion, the pericarp between the ribs in the lower part normally very thin with the brown testa of the seed apparent; vesicular trichomes scattered over the faces of the cypsela between the ribs. Hairs on ribs antrorse (sometimes appressed), c. 0.1–0.2 mm long, usually tightly inrolled at their apices. (Figs 5c, 7c)

*Representative specimens*: **AUSTRALIA**: **Western Australia**: 3 km E of Quinninup, 6.ii.1997, *R.J. Cranfield 10956* (PERTH); Narrogin Brook, ii. 1904, *W.V. Fitzgerald s.n.* (PERTH); Lowden, xi.1910, *M. Koch 1936* (PERTH); Pemberton, xii.1921, *M. Koch 2571* (PERTH); Blackwood River, 30 km W of Nannup, 30.i.1965, *R.D. Royce 8299* (PERTH). **Northern Territory**: Andado Station, 28.ix.2000, *D.E. Albrecht 9429 & R.A. Kerrigan* (MEL, NT). **South Australia**: Lake Eyre Basin, Coward Springs, 8.viii.1984, *Badman 1416:* AD, MEL, Coongie Lakes, 9.xi.1986, *J. Gillen 38* (AD); South-eastern, Nalan Creek, Mundulla, 11.i.1993, *D.N. Kraehenbuehl 5560* (AD, CANB); Murray Mallee, Chowilla, 13.vii.1966, *R.H. Kuchel 2300* (AD). **Queensland**: Diamantina River, 1.x.1960, *R.B. Filson 3351*: MEL). **New South Wales**: North-West Slopes, Tingha, iii.1917, *J.L. Boorman*, (NSW); Southern Tablelands, 19.1.1988, *E.M. Canning 6460* (CANB, MEL, MO, NSW, P); North Far-West Plains, Warrego River, 19.x.1963, *Constable 4570* (K, NSW); Northern Tablelands, Dangars Lagoon, 10.viii.1987, *P. Hind 5286 & G. D'Aubert* (NSW); South-West Slopes, Munderoo State Forest, 26.xii.1948, *E.J. McBarron 2825* (NSW); Central Tablelands, Rydal, iv.1897, *J. McNab s.n.* (NSW); Central West Slopes, 24 km NW of Temora, 22.iii.1979, *J. Whiteley s.n.* (NSW). **Victoria**: Eastern Highlands, Avon River, Valencia Creek township, 10.v.1979, *H.I. Aston 2031* (MEL); Riverina, Murray River, SW of Tocumwal, 29.x.1982, *H.I. Aston 2356* (MEL); Otway Plain, 13 km N of Anglesea, 17.i.1979, *A.C. Beauglehole 63358* (MEL); Lowan Mallee, Broughtons Waterhole, 8.xi.1979, *A.C. Beauglehole 66307* (MEL); Grampians, Mt Arapiles, 16.xii.1981, *R. Brouwers s.n.* (MEL ); Murray Mallee, Lake Hattah, 12.xii.1998, *A.C. Cochrane 310* (MEL); Gippsland Plain, Yarra, 1852, *F. Mueller s.n.* (MEL); Wimmera, 45 km SW of Horsham, 6.ii.1963, *F.G. Swindley 1479*; Midlands, Wedderburn, 14.ii.1982, *K.R. Thiele 320* (MEL); East Gippsland, Cann River, 1946, *N.A. Wakefield 3999* (MEL). **Tasmania**: Sea Elephant River, King Island, 9.i.1979, *D.I. Morris 7962* (HO); Trevallyn State Recreation Area, 18.xii.1991, *A.V. Ratkowsky* (HO). **NEW ZEALAND**: **North Island**: Waikawau Estuary, 8.i.1998, *E.K. Cameron 9080* (AK); St Johns Lake, 14.vi.1930, *L.M. Cranwell s.n.* (AK); Lake Waikearemoana, 10.ii.1970, *P. Hynes s.n.* (AK); Aotea Harbour, Taranaki Bluffs, 12.vi.1985, *P.J. de Lange s.n.* (AK); Lake Whangape, 5.i.1990, *P.J. de Lange s.n.* (AK, WAIK);. **South Island**: Nelson, near Mt Campbell, 2.v.1991, *W.R. Sykes 262/91* (AK, CHR); Golden Bay, Farewell Spit, 25.v.1977, *A.E. Wright 2383* (AK). **NEW CALEDONIA**: *Jodifroy 3516*, x.1910 (L). **SPAIN**: Cáceres, Guijo de Granadilla, 25.iv.1997, *J.A. Sánchez Rodríguez s.n.* (SALA) (*n.v. in litt.*).

*Distribution and Conservation Status*: *Centipeda cunninghamii* is probably endemic to Australia. It is regarded by Webb *et al.* (1988) as naturalised in New Zealand, but possibly native there (de Lange pers. comm.). It is common and widespread through south-eastern mainland Australia, mostly south of 30° S; rare in Tasmania (northern parts only) and Northern Territory (1 collection) and confined in Western Australia to the far south-west. A single 1910 collection purportedly from New Caledonia exists at L, but only *C. minima* subsp. *minima* is represented at NOU (M. Duretto pers. comm.). Assuming no mixing of labels, it seems that *C. cunninghamii* occurs (or occurred) there, probably by introduction. It has recently been reported as naturalised beside a reservoir (*'embalse de Gabriel y Galán'*) at one site in eastern Spain (Sánchez Rodríguez & Elías Rivas 1998). (Fig. 10)

*Habitat*: Locally common on banks of perennial rivers, lakes and dams, on sandy, silty or clayey soils. Occurs from near sea-level to c. 500 m altitude.

*Notes*: Most specimens from Western Australia differ slightly from eastern specimens

in the cypselas having thicker ribs, so that the testa of the enclosed seed is largely obscured. The receptacle of these specimens, although distinctly convex, is less prominent than in most eastern specimens. There may be some introgression in this area with *C. crateriformis* subsp. *compacta*.

Bracketed measurements in the description above correspond to specimens from Andado Station, Northern Territory (*Albrecht 9429*: MEL, NT), Diamantina River, Queensland (*Filson 3351:* MEL) Coward Springs, South Australia (*Baduan 1416:* AD, MEL) and Warrego River, New South Wales (*Constable 4570:* K, NSW). Not only do these specimens have the largest reproductive parts of all specimens of *C. cunninghamii* examined, but they are also the most densely cottony and generally are of a more spreading habit than typical. They are amongst the most inland occurrences of the species. Further study may indicate these specimens represent a distinct (probably infraspecific) taxon, although specimens that have floral and fruiting parts of nearly comparable size to these cottony plants but are otherwise typical do exist. The large-flowered specimens are therefore here treated as extreme conditions within a single variable species. It is possible too that they represent hybrids with *C. crateriformis* subsp. *Crateriformis*, which is sympatric at some of these sites.

**9. *Centipeda crateriformis*** N.G. Walsh *sp. nov.* a speciebus generis capitulis fructioribus duris persistentibus biconvexis crateriformis vel cyathiformibus, receptaculis planis ad concava vel convexa leviter differt.

*Type*: Australia, Northern Territory, Surprise Dam, Andado Station, 23.x.1980, *P.K. Latz 8508* (holotype: DNA; isotypes: AD, BRI, NT).

*Annual* or *perennial*, commonly several-branched from base, glabrescent to cotton-pubescent. *Leaves* narrowly obovate to spathulate, serrate, or rarely, entire, resin-dotted on both surfaces, concolorous. *Inflorescence* a single sessile or minutely pedunculate capitulum, sometimes terminal on ultimate branchlets, not leaf-opposed. *Capitula* at anthesis bowl-shaped to cup-shaped or sub-globular, domed or flat-topped; involucral bracts ovate to obovate; receptacle slightly convex, flat, or slightly concave. *Fruiting heads* firm to hard, persistent to some degree; bracts of fruiting heads spreading, slightly upcurved in distal half, the outer ones slightly thickened and pithy toward base; fruiting receptacle with an underlying pith layer extending slightly below base of involucre; cypselas linear or narrowly obcuneoid, obtuse at apex, smooth or scabridulous, 4- or 5-angled with prominent ribs at each of the angles, the ribs terminating in a spongy apical portion usually slightly wider than the body of the cypsela, vesicular trichomes sparsely scattered over faces of cypsela, hairs antrorse, subappressed, confined to ribs, often with minutely inrolled or thickened apices.

There are two subspecies, both apparently endemic to Australia.

**9a. *Centipeda crateriformis*** subsp. ***crateriformis***

*Annual* to c. 20 cm high, 30 cm diam., typically several-branched from base with branches prostrate to ascending, but sometimes erect and few-branched, glabrescent to conspicuously cottony in axils and toward stem apices. *Leaves* ± narrowly obovate to spathulate, 3–8(–12) mm long, 2–4(–6) mm wide. *Capitula* at anthesis ± hemispherical to bowl-shaped, slightly domed or flat-topped, 3.5–7 mm diam.; involucral bracts ovate to obovate, 1.5–4 mm long, entire or with minutely ruminate membranous margins; receptacle flat to very slightly concave or convex; female (outer) florets c. 100–200 in 3–5 rows, corollas narrowly cylindrical, 0.4–0.7 mm long; bisexual florets (7–)12–22, corollas narrowly

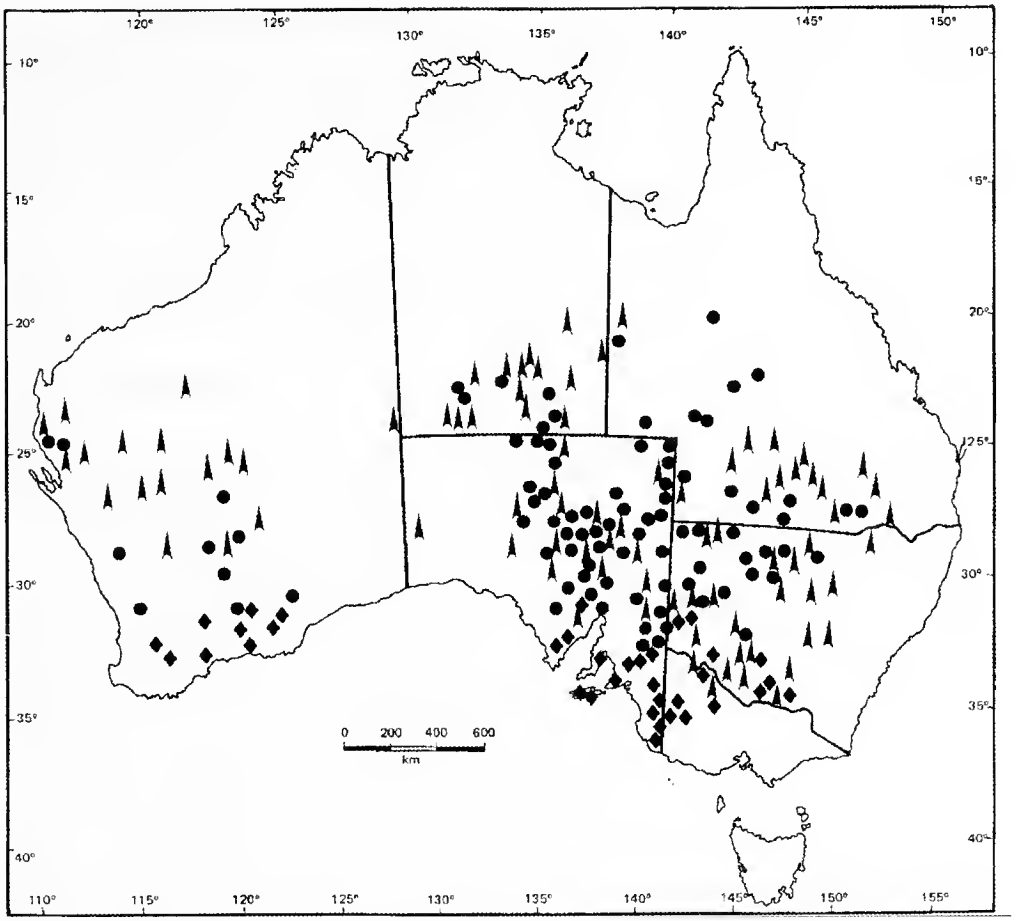


**Figure 11.** Distribution of *C. crateriformis* subsp. *crateriformis* (closed circles); *C. crateriformis* subsp. *compacta* (diamonds); *C. thespidioides* (arrowheads).

funnel-shaped, ± 0.8 mm long (including lobes ± 0.3 mm long and wide). *Fruiting heads* hard, remaining intact until long after stems senesce (sometimes at least until following season); fruiting receptacle 2–3.5(–4) mm diam.; cypselas linear (at least 5 times longer than wide), (1.4–)1.8–2.5 mm long, smooth or (rarely) scabridulous along ribs, 4- or 5-angled with prominent ribs at each of the angles (uncommonly with a finer rib alternating with some or all of the prominent ribs), the ribs extending from the base of the cypsela and terminating in the distal third in the thickened apical portion, hairs antrorse, sparse, appressed, ± 0.4 mm long, extending from base of cypsela to the lower part of the apical process, mostly not inrolled at apex, but sometimes thickened slightly. (Figs 3a, 5d, 7d)

*Representative specimens*: **AUSTRALIA**: **Western Australia**: Muddy Lake, 3.iv.1994, *A. Chapman s.n.* (PERTH); Quaderwardup Lake, 19.x.1982, *G.J. Keighery 5718* (PERTH); Mokine Nature Reserve, 11.12.1987, *G.H. Keighery & J.J. Alford 1212* (PERTH); Rocky Pool, Gascoyne River, x.1975, *K.F. Kenneally 4682* (PERTH); 5 km NW of Ongerup, 18.xi.1974, *K. Newbey 4592* (PERTH). **Northern Territory**: George Gill Range, Lake Cotteril, 8.vii.1968, *A.C. Beauglehole 25980* (DNA, MEL); Simpson Desert, Old Andado Homestead, 29.vii.1968, *A.C. Beauglehole 27953* (DNA, MEL); Ilparpa Claypans, c. 8 km SSW of Alice Springs, 19.vi.1999, *N.G. Walsh 4971 & D.E. Albrecht* (MEL). **South Australia**: Gairdner-Torrens Region, SW end of Lake Alcoona, 2.x.1987, *R.J. Chinnock 7767* (AD, MEL); Andamooka Rd, c. 8 km N of Roxby Downs-Woomera Rd, 29.ix.2990, *C. Daniels s.n.* (MEL); Murray Mallee, Canegrass, c. 60 km NNE of

Morgan, 21.ix.1937, *E.H. Ising s.n.* (AD); Flinders Ranges, Lydhurst, c. 30 km N of Copley, 14.xii.1938, *E.H. Ising & H. Mincham s.n.* (AD); Lake Eyre Region, Lake Walkooanie, 15.viii.1987, *J. Reid 1028* (AD). **Queensland**: Warrego District, Bulloo River, xi.1896, *F.M. Bailey s.n.* (BRI); Gregory North District, Glenormiston, Lake Idamea, 28.i.1935, *A.C. Boyle s.n.* (BRI); Mitchell District, 30 km N of Longreach, ix.1952, *D. Davidson 291* (BRI). **New South Wales**: North Far Western Plains, Sturt National Park, Fort Grey, 3.ix.1989, *R.G. Coveny 13480* (AD, BRI, MEL, NSW); North West Plains, Bourke, ix.1889, *L. Henry s.n.* (NSW); South West Plains, Wanganella via Hay, xii.1903, *E. Officer s.n.* (NSW).

*Distribution and Conservation Status*: Endemic to Australia. Occurs in all mainland States apparently except Victoria (but possibly to be anticipated there in the extreme north-west). Locally common in semi-arid areas between c. 23° and 35° south. Not considered rare or threatened. (Fig. 11)

*Habitat*: Occurs mostly on clayey soils of shallow, seasonally inundated lakes and depressions in claypans.

*Notes*: This subspecies resembles *C. thespidioides* in most respects, but differs in the bowl-shaped involucre, the often slightly domed capitula and receptacle, the ribs of the cypselas bearing hairs from the base almost to the apex, and the smooth (rather than scabridulous) apical process. As in *C. thespidioides*, intact fruits are usually retained on plants until long after aerial stems are dead and leaves have fallen. It differs from *C. cunninghamii* in the virtually flat receptacle and flat-topped or slightly domed, bowl-shaped capitula, the strictly annual lifecycle, the harder, more persistent fruiting heads, and the generally larger cypselas with more pronouncedly scabridulous ribs and longer hairs. Very few specimens appear somewhat intermediate between the two species, sometimes due to the juvenility of the specimens, and generally their habitats are distinct, with *C. crateriformis* susbp. *crateriformis* generally associated with more ephemeral wetlands.

A few specimens from the southern parts of the range (e.g. northern Eyre Peninsula, upper Murray River area of South Australia, Narrogin, Qualup areas in Western Australia) appear intermediate with subsp. *compacta* and there may be some intergradation between the two, but there does not appear to be a gradual or clinal difference in features and most plants can be readily placed in one or the other subspecies

The epithet is from Latin and refers to the bowl-shaped involucre.

**9b. *Centipeda crateriformis*** subsp. ***compacta*** N.G. Walsh *subp. nov.*

a subspecie typica capitulis fructioribus minoribus mollioribus, cypselis brevioribus, radicibus adventitiis factis libere differt.

*Type*: Australia, Western Australia, Eucla Division, Esperance district, c. 18 km north-north-west of Young River crossing on Ravensthorpe-Esperance main road, 16.x.1968, *E.N.S. Jackson 1438* (holotype: AD; isotypes: ?CANB (not found), PERTH).

Tufted or loosely mat-forming *perennial* (probably *annual* in adverse conditions), sometimes shortly rhizomatous or producing adventitious roots from lower nodes, to c. 10 cm high, 20 cm diam., commonly several-branched from base, with branches prostrate to suberect, virtually glabrous except for cottony hairs on young apical growth. *Leaves* ± oblong to spathulate, 4–10(–14) mm long, 1–2(–3.5) mm wide, mostly 3–5(–7)-toothed toward apex, or entire. *Capitula* at anthesis bowl-shaped to cup-shaped or sub-globular, domed, rarely flat-topped, 2.5–5 mm diam.; involucral bracts ovate to obovate, 1.5–1.8(–2) mm long, with minutely ruminate membranous margins; receptacle slightly convex or flat; female (outer) florets c. 90–150 in (2–)3–6 rows, corollas narrowly cylindrical, 0.4–0.5 mm long; bisexual florets c. 10–21, corollas narrowly funnel-shaped, c. 0.7–0.8 mm long (including lobes c. 0.3 mm long and wide). Fruiting heads, firm, somewhat persistent, but usually disintegrating within the growing season; fruiting receptacle 1.3–1.6(–2.5) mm diam.; cypselas narrowly obcuneoid (less than 5 times longer than

wide) 1–1.7 mm long, scabridulous, rather thick-walled, 4- or 5-angled with prominent ribs at each of the angles, sometimes with 1–3 finer ribs alternating with the prominent ribs, the ribs terminating from the distal quarter to just below the apex of the cypsela into the thickened spongy portion, hairs antrorse, subappressed, 0.2–0.3 mm long, confined to ribs, extending from base of cypsela to ± two-thirds of cypsela, minutely inrolled or thickened at apex. (Figs 5e, 7e)

*Representative specimens*: **AUSTRALIA**: **Western Australia**: Lake Cronin, 3.x.1979, *K. Newbey 6177* (PERTH); Ponier Rock, 14.ix.1980, *K. Newbey 7309A* (PERTH); c. 26 km N of Esperance – Ravensthorpe Rd, 26.ix.1968, *P.G. Wilson 7950* (PERTH); Scaddan, 28.xi.1974, *E. Wittwer 1502* (PERTH); Newmans Rock, 12.xi.1976, *E. Wittwer 1913* (PERTH). **South Australia**: Kangaroo Island, Rocky River near Shackle Road, 6.i.1966, *H. Eichler 18599* (AD); Eyre Peninsula, E of Lake Gillies Conservation Park boundary, 7.x.1988, *A.G. Spooner 11194* (AD); Murray Mallee, c. 34 km NE of Overland Corner, 11.x.1965, *D.E. Symon 3848* (AD); South East, Big Heath National Park, 6.xi.1969, *J.Z. Weber 1822* (AD); Southern Lofty, 6.5 km SW of Williamstown, 16.v.1979, *L.D. Williams 10386* (AD). **New South Wales**: South West Slopes, Henty, iv.1942, *E.J. Bennett 247* (NSW); South West Plains, 'Miewurlie' Station, NE of Hay, 22.iii.1990, *M.F. Porteners 9005077* (NSW); South Far West Plains, Prungle Station, c. 52 km NNE Robinvale, 28.x.1999, *N.G. Walsh s.n.* (MEL). **Victoria**: Lowan Mallee, Wyperfeld National Park, Lunar Clearing, 6.x.1968, *A.C. Beauglehole 28949 & Corricks* (MEL); Murray Mallee, Lake Carpul, 2.xi.1999, *I.R.K. Sluiter s.n.* (MEL).

*Distribution and Conservation Status*: This subspecies is endemic to Australia. It occurs in south-western Western Australia, between Balladonia area and Ravensthorpe where apparently rather rare, south-eastern South Australia (Kangaroo Island, Eyre and Fleurieu (and probably Yorke) Peninsulas, Naracoorte-Penola areas) and adjacent areas in far western and north-western Victoria and south-western New South Wales. It is not regarded as rare or threatened. (Fig. 11)

*Habitat*: Occurs chiefly on shores and drying beds of lakes, claypans, stream-beds, dams, and seasonally inundated swamps and depressions. In south-west WA it is recorded as occurring on wetter soils of granitic outcrops and their peripheries.

*Notes*: This taxon is distinctive in its leafy, low, compact, rhizomatous and/or stoloniferous habit, and apparent perenniality. Some specimens resemble, in general habit and capitulum shape, southern forms of subsp. *crateriformis* but are distinguished by the smaller, obcuneoid cypselas with heavily thickened ribs, and, usually, by the freely produced adventitious roots. Some Western Australian plants, particularly those associated with depressions on granite outcrops are distinctive in their dense, domed habit, but this appears to be at least partly a response to environmental conditions. Further collections from this area may prove this form to be worthy of formal recognition. See also notes under subsp. *crateriformis* and *C. aotearoana*.

The subspecific name is Latin and refers to the compact growth habit, particularly in comparison to the typical subspecies.

**10. *Centipeda thespidioides*** F. Muell., *Fragm.* 8: 143 (1874). *Type*: Australia, 'Ad flumina Murray's et Darling's River et Murrumbidgee', *F. Mueller* (MEL); 'ad flumina Finke's River et Stuart's Creek', *J. Macd. Stuart* (MEL) (lectotype, *hic deisgnatus*, 'On the River Finke' *J. Macd. Stuart*: MEL *295548*).

*Annual* to c. 20 cm high, typically several-branched from base, with branches ascending to erect, occasionally simple or branched above base only, glabrescent, but usually somewhat cottony in upper axils and just below capitula. *Leaves* ± oblong, 4–22 mm long, 2–6(–8) mm wide, serrate, glabrous, resin-dotted on both surfaces, concolorous. *Inflorescence* of one, rarely 2, sessile cauline capitulum(a), sometimes terminal on ultimate branchlets, not leaf-opposed, commonly in branch axils. *Capitula* at anthesis cup-shaped to broadly campanulate or broadly obconical, rarely somewhat urceolate, flat-

topped or slightly depressed (rarely very slightly domed), 3–5(–6.5) mm diam.; involucral bracts ovate to obovate, 2–5 mm long, entire or with minutely ruminate membranous margins; receptacle slightly concave or flat; female (outer) florets c. 40–80(–120) in 3–5 rows, corollas narrowly cylindrical, 0.6–0.8 mm long; bisexual florets (3–)10–18(–25), corollas narrowly funnel-shaped, c. 0.8 mm long (including lobes 0..2–0.3 mm long and wide). *Fruiting heads* very hard, remaining intact until after stems senesce (sometimes at least until following season); bracts of fruiting heads straight or slightly incurved, spreading to erect, the outer ones thickened and pithy toward base; fruiting receptacle 2.5–3.5 mm diam., with an underlying pith layer extending below base of involucre; *cypselas* linear, 2.2–3.3 mm long, obtuse or truncate at apex, scabridulous along ribs and on apical process, finely 8–16-ribbed (about half of these more prominent than others), the ribs terminating about two-thirds from base of cypsela in a spongy apical process the same width as the body of the cypsela, vesicular trichomes lacking or very sparse, hairs antrorse, c. 0.3 mm long, in 2 rings, one at the base of the cypsela and one at the point of fusion of the ribs into the apical process, some or all of the hairs finely inrolled at the apex. (Figs 5f, 7f)

*Representative specimens*: **AUSTRALIA**: **Western Australia**: 10 km ENE of Mt Aubrey, 3.v.1995, *R.J. Cranfield 9619* (PERTH); Belele Station, NW of Meekatharra, 22.x.1965, *D.W. Goodall 3197* (PERTH); 7.5 km E of Malcolm, 14.iv.1986, *J. Neden 25* (PERTH); c. 30 km NE of Carnarvon, 30.ix.198, *P.G. Wilson 12728* (PERTH). **Northern Territory**: Hamilton Dam near Mt Hay, 21.viii.1932, *J.B. Cleland s.n.* (AD); NW Simpson Desert, 30.ix.1973, *N.M. Henry 979* (AD, DNA); 50 km N of Alice Springs, 30.x.1962, *R. Swinbourne 523* (DNA, NSW). **South Australia**: Flinders Range, Between Myrtle Springs & Witchelina, 29.ix.1962, *T.R.N. Lothian 1088* (AD); Lake Eyre Basin, Clayton River, Birdsville Track, 8.iv.1997, *H.T. Smyth 178* (AD); Near Nappamerie Station, 20.viii.1968, *D.E. Symon 5742* (AD); Gairdner Torrens Region, Durkin Outstation, c. 15 km W of Mulgathing, 27.ix.1971, *J.Z. Weber 2829* (AD); Eastern, 5 km SE of Strathearn Homestead, 29.viii.1978, *L.D. Williams 10028* (AD). **Queensland**: Maranoa District, 16 km W of St George, 31.viii.1983, *H.I. Aston 2454* (BRI, CBG, MEL); Darling Downs, 94 km from Moonie toward Goondiwindi, 11.x.1983, *E.M. Canning 5846 & B. Rimes* (BRI, CANB, NSW); North Gregory District, Currawilla c. 160 km W of Windorah, 11.vi.1949, *S.L. Everist 3961* (BRI, K); Currawinya National Park, NE of Karatta Bore, 21.iii.1997, *P.I. Forster 20545 & M. Watson* (BRI, DNA, MEL); Warrego District, c. 14 km SW of Eulo, 13.ix.1973, *R.J. Henderson H2044 & D.E. Boyland* (AD, BRI, K). **New South Wales**: North Far West Plains, Sturt National Park, 4.ix.1989, *R.G. Coveny 13515 & B. Wiecek & M. Savio* (AD, BRI, NSW); North West Plains, 10.5 km NE of Janbeth Homestead, 26.x.1981, *L. Haegi 2108* (AD, NSW); South Far West Plains, Newell Hwy, Balranald, 24.ix.1973, *E.J. McBarron s.n.* (NSW); South West Plains, 32 km N of Hay, 1.xi.1983, *B. Semple 7829* (NSW). **Victoria**: Murray Mallee, Annuello, 29.iv.1977, *A.C. Beaglehole 55925* (MEL).

*Distribution and Conservation Status*: This species is endemic to Australia. It occurs in all mainland States, but is rare in Victoria where confined to the north-west. Locally common in inland areas between c. 22° and 35° south. It is not rare or threatened. (Fig. 11)

*Habitat*: This is principally a species of semi-arid areas, occurring mainly on heavy clayey soils prone to inundation (gilgais, creeklines etc.) in depressions surrounded by halophytic shrublands, and in eucalypt (e.g. *E. coolabah* Blakely & Jacobs) woodlands.

*Notes*: This species differs from all other species of *Centipeda* in the campanulate to urceolate, flat-topped or slightly depressed capitula, and in the relatively large, scabridulous cypselas that have hairs arranged in 2 rings. A few specimens from north-western New South Wales have scattered hairs between the basal and subapical bands of hairs but the plants are otherwise indistinguishable from typical *C. thespidioides*. They may be the result of hybridisation with *C. crateriformis* subsp. *crateriformis* which occurs in the same area. As with *C. crateriformis* subsp. *crateriformis*, apparently its closest congener, intact fruits are retained on plants until long after aerial stems are dead and leaves have fallen.

Of specimens cited by Mueller in the protologue, only the Stuart collection from the Finke River could be found despite searches at MEL and K. Two other collections mounted as types at MEL are rejected, one (*F. Mueller*, Murrumbidgee R, 1878) was collected

after the description of *C. thespidioides*, the other (*F. Mueller*, Murray River and tributaries, Mildura Station, s.d.) does not exactly match the locality given in the protologue.

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I am grateful to Phil & Emma Short (DNA), Michael Barrit (Parks and Wildlife Commission, Northern Territory) and Sandy Cochrane (MEL) for assistance with fieldwork; to Dave Albrecht (NT) for both assistance with fieldwork and sharing his perceptive observations of Central Australian taxa; to Peter de Lange (Department of Conservation, Auckland New Zealand) for information on New Zealand taxa; to my colleague Marco Duretto who examined specimens at NOU; to Jeremy Bruhl (NE), to Nicholas Hind (K) and Michael Dillon (F) for sharing their expertise in the group; to ABLOs Don Foreman, Alex Chapman, Bob Chinnock and Rod Seppelt for searching collections and procuring photographs of critical specimens at K and BM; to Peter Neville-Smith and Barbara Meurer-Grimes for information on chemical constituents; to Jocelyn Carpenter (Universtiy of Melbourne) for SEM assistance; to illustrators Enid Mayfield (Fig. 2) and Thomas Brosch (Fig. 3); to colleagues Geraldine Jones and Simon Lewis for assistance with imaging; to horticultural staff at Royal Botanic Gardens Melbourne for curation of living collections, and to staff at AD, BRI, CANB, CHR, CONC, DNA, HO, K, L, LAE, NSW, P, PERTH, WELT, UPNG for prompt attendance to loan requests. Two anonymous reviewers made helpful suggestions on drafts of this paper.

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# Cypsela morphology and a reassessment of the record of *Omalotheca supina* (Asteraceae) from Tasmania

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*Abstract*

The cypselas of Tasmanian material referred to *Omalotheca supina* (L.) DC, as *Gnaphalium supinum* L. in Curtis (1963), consists of two species, which differ from each other, and also from those of *Omalotheca supina* from the Northern Hemisphere. The Tasmanian material is referred to *Euchiton poliochloris* N.G. Walsh and *E. traversii* (Hook. f) Holub. The cypselas of *Euchiton poliochlorus* lack hairs and conspicuous paired papillae on the cypselas. *Euchiton traversii* has hairs on the cypselas with rounded apices, and conspicuous paired papillae. As the record of *Omalotheca supina* in Tasmania is based upon a misidentification, the species should be deleted from the list of rare species for the State.

## Introduction

The genus *Gnaphalium* as treated in the Student's Flora of Tasmania by Curtis (1963) is now recognised as a polyphyletic assemblage of taxa (Nesom 1990; Anderberg 1991), which in Tasmania includes *Euchiton, Gnaphalium Vellereophyton, Pseudognaphalium* and *Gamochaeta*. Cypsela morphology, and in particular epidermal characters, provide important characters for identifying genera within the *Gnaphalium* complex (Drury 1970; Hilliard & Burtt 1981; Anderberg, 1991). A study of the cypsela morphology of the Tasmanian species has recently been undertaken by this author, and these species and genera are also currently being revised by Paul Wilson (PERTH) for the Flora of Australia Series.

This paper describes and illustrates the cypselas of *Omalotheca supina* (L) DC from Europe and compares it to material that has been considered conspecific from Tasmania. *Omalotheca supina* (cited as *Gnaphalium supinum* L. in Curtis 1963, p. 320) was described as having a localised distribution in Tasmania being restricted "to acid water-logged soil between tussocks of button-grass *Gymnoschoenus sphaerocephalus* Hook. f. in montane heaths". As Curtis (1963) pointed out, its presence in Tasmania is surprising because it was considered a plant of the mountains of central Europe and western Asia and of the arctic regions in Europe, Greenland and Canada. She also commented that the distribution was difficult to understand and suggested that the southern [Tasmanian] plant may prove to be distinct. It's limited distribution and few records, and confusion between species in this genus in Tasmania, has led to its being listed as "Rare" under Schedule 5 of the Tasmanian Threatened Species Act (1995). The Tasmanian material, referred to *O. supina,* has not been re-examined since Curtis (1963). In this paper its status is assessed by comparing cypsela morphology of the material assigned to this taxon from Tasmania with *Omalotheca supina* from the Northern Hemisphere.

## Methods and Material

The study was based primarily upon collections in the Tasmanian Herbarium (HO) and material of European *Omalotheca supina* from the National Herbarium of Victoria (MEL). Specimens were selected that had old withered capitula with maturing or mature seeds. Cypselas were taken from the Tasmanian specimens identified as *O. supina* by P. Lewis (KEW), who originally identified this taxon in Tasmania. Cypselas were dissected from the capitulum and three to seven cypselas were placed on aluminium stubs with

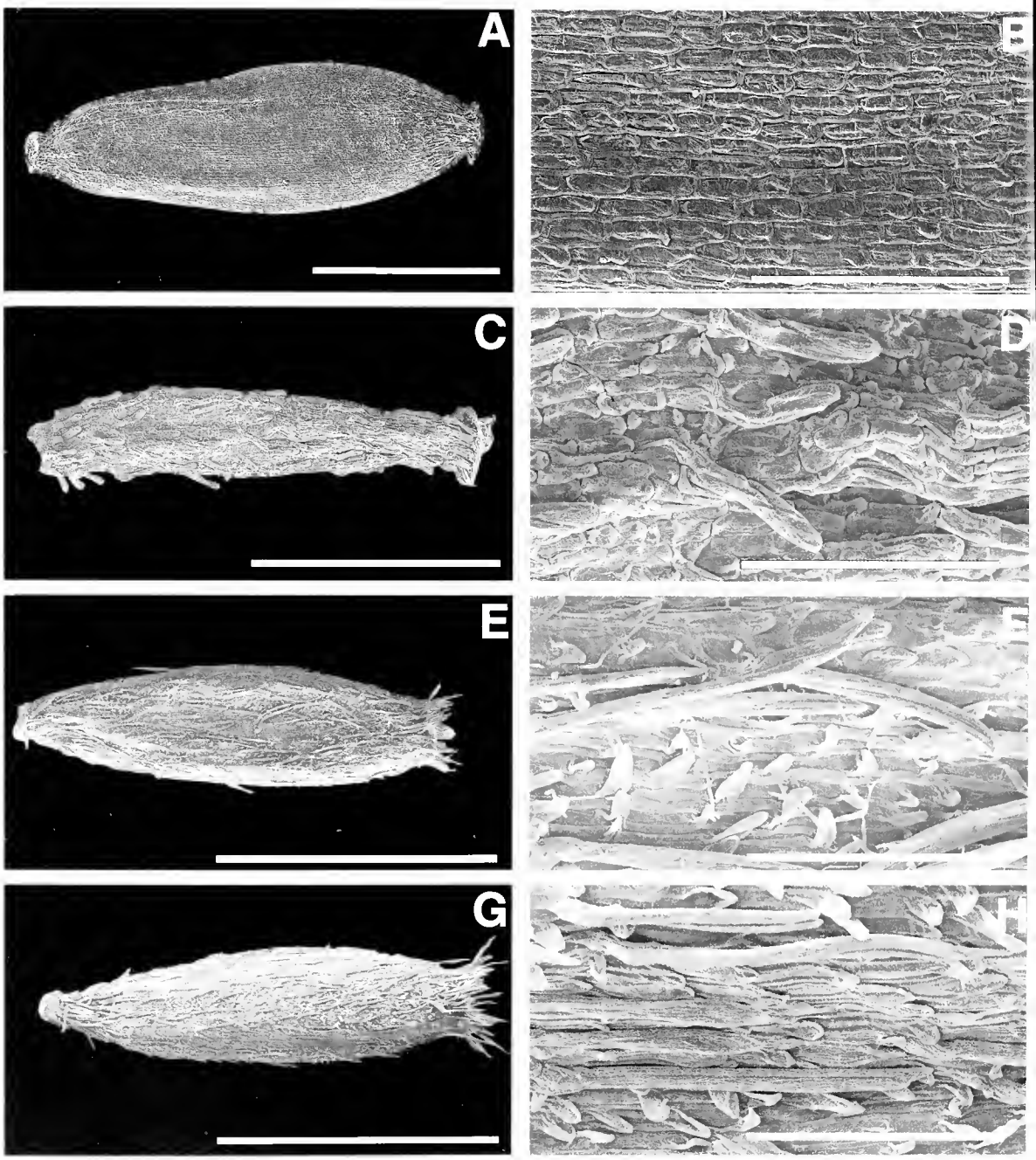


**Figure 1.** Scanning electron micrographs of cypselas. **A–B** *Euchiton poliochlorus*: **A** Cypsela; **B** Detail of ornamentation of cypsela (*W.M.Curtis s.n.*, HO *52377*). **C–D** *Euchiton traversii*: **C** Cypsela; **D** Detail of ornamentation of cypsela (*W.M.Curtis s.n.*, HO *70831*). **E–H** *Omalotheca supina*: **E** Cypsela; **F** Detail of ornamentation of cypsela; **G** Cypsela; **H** Detail of ornamentation of cypsela (Dovre, Norvegiae (Norway), *ex hb. w. sonder, C.J.Lindberg*). Scale bars: **A** 500µm; **B, D, F, H** 100µm; **C** 450µm; **E, G** 1mm.

double-sided tape. The cypselas were oriented in either dorsal, ventral or lateral views. The stubs were sputter coated and examined with a SEM in high vacuum mode at 10–15 kv. The descriptive terminology used by Anderberg (1991) to describe the micro morphological characters will be used.

CYPSELA MORPHOLOGY

European specimens

***Omalotheca supina*** (L.) DC. (Figs 1 E–H).

Cypselas elliptical/ovate in shape, c. 1.4 mm long, c. 0.4 mm wide, with a distal fringe of hairs. Epidermal cells, longitudinally arranged, rectangular in shape, have straight to slightly sinuous cell walls. Hairs large conspicuously paired, antrorse, apex acute, prominent furrow, surface finely striated. Single papillae with pointed apex overlaps the distal cell margin of the adjoining epidermal cell.

*Material examined*: Dovre, Norvegiae (Norway), Ex hb. W Sonder, *C.J.Lindberg* c. 1874 (MEL); Poturages alpins du Lautaret, Daphine, France; identified E. Casson, 10. viii. 1860 (MEL); Near (?Tyndrum), Perthshire, 3000', England, 31. xi. 1883, ex herb. J.T.H. Groves (MEL).

*Notes*: The cypselas of the European material examined are consistent in morphology. Drury (1970) recorded that the cypselas of *O. supina* (Northern Hemisphere) had hairs and imbricate papillae. This study has shown that the cypselas have antrorse hairs have an acute apex and are conspicuously furrowed. A single pointed papilla occurs on each epidermal cell, and this arrangement of papillae gives the imbricate appearance alluded to by Drury (1970). Drury (1970) identified group of species with "imbricate papillae," that have since been referred to *Omalotheca*; eg. *O. supina, O. sylvatica* (L.) Schulz-Bip. & F.W. Schulz and *O. norvegica* (Gunn.) Schulz-Bip. & F.W. Schulz.

Tasmanian specimens

The Tasmanian material differs from the Northern Hemisphere specimens in lacking the distal fringe of hairs on the cypselas, and also the pointed conspicuously paired hairs with a prominent longitudinal furrow. Two species, *Euchiton poliochlorus* and *E. traversii*, are represented in the material identified as *G. supinum* in the Tasmanian Herbarium.

***Euchiton poliochlorus*** N.G.Walsh (Figs 1A–B)

Cypselas elliptical/ovate in shape, c. 1.2 mm long, c. 0.4 mm wide, lacking a distal fringe of hairs. Epidermal cells longitudinally arranged with straight walls. Hairs absent. Papillae a slight rounded single bulge towards the distal end of the epidermal cell.

*Material examined*: Tasmania: Cradle Mountain Reserve, 41°41'S 145°57'E, between tussocks of button grass, altitude c. 1050m, *W.M. Curtis s.n.*, 8. iii. 1949 (HO *52377*); Waldheim, Cradle Mountain 41°38'S 145°56'E, in button grass, *W.M. Curtis s.n.*, 8. iii. 1949 (HO *11324*).

*Notes*: The cypselas of this Tasmanian species lack hairs on the epidermal cells or conspicuous papillae and this taxon is clearly distinct from *O. supina*. These specimens have been recently described as *Euchiton poliochlorus* (Walsh 1999).

***Euchitou traversii*** (Hook. f.) Holub (Figs 1C–D)

Cypselas probably elliptical in shape, c. 1.0 mm long, c. 0.1 mm wide, lacking a distal fringe of hairs. Epidermal cells longitudinally arranged, straight cell walls. Hairs antrorse, with rounded apices, surface smooth. Papillae rounded, occurring in pairs, near the distal and proximal cell walls of the epidermal cells.

*Material examined*: Tasmania: Wombat Moor, Mt Field National Park, 42°41'S 146°37'E, *W.M. Curtis s.n.*, 4. i. 1948 (HO *70831*); Wombat Moor, Mt Field National Park, 42°41'S 146°37'E,

*W.M. Curtis s.n.*, 4. i. 1947 (HO *70786*).

*Notes*: The correct name for these specimens has been unclear, although they are currently being referred to *E. traversii* (Paul Wilson, pers. comm.). The cypselas are not mature in the collection studied (HO *70831*), and they have partially collapsed and are distorted and interpreting their original shape is difficult. They differ from those of *Omalotheca supina* (Northern Hemisphere) in having paired papillae on each epidermal cell, which was considered a synapomorphy for *Euchiton* (Anderberg, 1991). The hairs on the cypselas of *E. traversii* also have a rounded apex, lack a prominent longitudinal furrow and also fine striations, and they are shorter than those of *Omalotheca supina*. The cypselas of *E. traversii* also lack a distal fringe of hairs.

## Discussion

This study demonstrates morphological differences between cypselas of *Omalotheca supina* from the Northern Hemisphere and the Tasmanian material referred to this taxon. *Omalotheca supina* (as *Gnaphalium supinum)* was listed as rare in Schedule 5 of the Tasmanian Threatened Species Protection Act (1995). This study demonstrates that the specimens previously referred to *O. supina* from Tasmania were misidentified, and the species should be delisted from the Act.

The study of cypselas also shows that the Tasmanian material previously assigned to *Omalotheca supina* consists of two taxa, *Euchiton poliochlorus* and *E. traversii*. The cypsela morphology of these two species is illustrated and demonstrates that the cypselas can be used to identify species. Assuming that the cypselas are mature, the study would suggest that not all species of *Euchiton* have paired imbricate papillae which was considered by Anderberg (1991) to be a synapomorphy for the genus.

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# *Lepidium ginninderrense* (Brassicaceae), a new species from the Australian Capital Territory

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*Abstract*

A new species, *Lepidium ginninderrense*, is described. It is compared with *L. pseudopapillosum* Thell. and *L. monoplocoides* F. Muell., species to which it had previously been referred. It is assigned a risk code of 2E A 55, reflecting its small population which occurs at only one unreserved site. Some morphological characters of special interest are discussed and a key to the species in *Lepidium* sect. *Papillosa* is provided.

## Introduction

In 1970 Burbidge and Gray published an English description of an apparently new species of *Lepidium* under the name '*L.* aff. *monoploccoides* F. Muell.' This was known from a single collection from the lower slopes of Mt Ainslie in the Reid area of Canberra in the Australian Capital Territory (A.C.T.) (*R.D. Hoogland 3085*, 20. xii. 1952, CANB *64913*). In her revision of the genus *Lepidium* in Australia, Hewson (1982a) provisionally included the Hoogland collection within the circumscription of *L. pseudopapillosum* Thell., an extremely rare species from the Flinders Ranges of South Australia, the northern plains of Victoria and the unidentified type locality which is possibly in New South Wales.

In 1993 a population identical in diagnostic characters to the Hoogland collection was discovered on the floodplain of Ginninderra Creek in the Belconnen Naval Transmission Station, also in the A.C.T. (S. Sharp *in litt.* 1999). Plants grown from the seed of this population showed no evidence of hybrid origin. In view of this and the unique combination of characters shared by the two known populations, the taxon is here described as a new species in *Lepidium* sect. *Papillosa* Thell. *ex* Hewson.

## Taxonomy

***Lepidium ginninderrense*** N.H. Scarlett *sp. nov.*

affine *L. pseudopapilloso* Thell. sed ab combinatione characterum sequentium distinguitur: Planta graciliore. Caules leviter papillosae. Siliculae obtusi-obovatae, vesiculato-papillosae, non profunde emarginatae (incisura longitudinae ca. 1/10 siliculae), superne leviter concavae. Pedicelli fere glabri sed marginibus distincte papillosi. Nectaria lageniformia, nectaria mediana lateralibus longiora. Stylus ad alas adnatus, in fructu maturo ad apicem bifurcatus, lobi stylares stigma aequantibus vel brevioribus.

*Typus:* Australia. Australian Capital Territory: Belconnen Naval Station, NW corner. Grid ref.: 689661006, 35°13′S 149° 05′E, 579 m altitude, *I. Crawford 3347, J. Hewson* and *A. Rowell*, 17 .xi. 1995 (holotypus CBG *9517925*, isotypus NSW).

*Lepidium* sp. aff. *monoploccoides* (*sphalm.*) F. Muell. (1855): Burbidge and Gray, Fl. Austral. Cap. Terr.: 186 (1970); *Lepidium pseudopapillosum sensu* Hewson, *Brunonia* 4: 272–273 (1982), Fl. Australia 8: 273 (1982); L. Retter and G.J. Harden in Harden, Fl. New South Wales 1: 469 (1990); T.J. Entwisle, in Walsh & Entwisle Fl. Victoria 3: 420 (1996) *pro minore parte, non* Thellung, Vierteljahrschr. Naturf. Ges. Zürich 61: 462–463 (1916) *sensu stricto.*

Small perennial *herb*, 10 cm to a maximum of c.20 cm high with one to c. six branched stems from the rootstock, stems striate and moderately papillose. *Leaves* rather thick and

**Figure 1.** Holotype collection of *L. ginninderrense.*

fleshy, glabrous and shiny on the upper (adaxial) surface. Rosette leaves widely spaced, linear to very narrow oblanceolate 15–55 mm long, 1.5–2.0 mm wide, entire or with 1–2 short lobes, ± glabrous on both surfaces but with 1–3 papillae on the apex, tapering gradually to a petiole c. 1 mm wide, which is markedly stippled with purple and expanded into a partly stem-sheathing base. Lower cauline leaves broad-lanceolate in outline, 15–35 mm long, 15–20 mm wide, pinnatifid with 1–3 pairs of linear pinnae which are entire or with one tooth on the distal margin, the margins and lower (abaxial) surface sparsely papillose, particularly on the midrib. Upper cauline leaves linear-lanceolate, 7–25 mm long, 1–1.5 mm wide, entire or with 1 or 2 short, narrow lobes, the margins and lower surface sparsely papillose, particularly on the midrib. Petiole of all cauline leaves short to ± absent, stippled with purple, the base scarcely expanded. *Inflorescence* an elongating raceme, finally from 5 cm to a maximum of c. 15 cm long. *Pedicels* erecto-patent, 2–3 mm long, c. 0.5 mm wide, flattened and glabrate except for the papillose margins which frequently also have one or a pair of cylindrical hairs to 1 mm long toward the base. *Flowers* small c. 1.5 mm long, 2 mm wide. *Sepals* c. 0.75 mm long, 0.5 mm wide, green with scarious margins, the adaxial exterior sepal with a conspicuous median patch of elongate papillae, the abaxial exterior sepal with only 1–3 papillae near the tip, the two interior sepals glabrous. *Petals* absent. *Stamens* 4, median, the filaments expanded into a cushion-like base. *Nectaries* 6, bottle-shaped, the two median nectaries c. 1/5 of the sepal length, the two lateral nectaries about half that length and much narrower. *Style* fused with the silicula-wings in the mature fruit, the short, free portion bifurcate at maturity, the lobes equal to or shorter than the included stigma. *Siliculae* bluntly obovate, 4–5 mm long, 3–3.5 mm broad, valves carinate in the proximal quarter and broadly winged distally, emarginate, vesiculate-papillose, reticulate and concave adaxially due to the incurved, obtuse wings which form a notch about 1/10 of the length of the silicula. Wing-margins sparsely papillose. *Seeds* orange, c. 1.5 mm long, 1 mm wide, obovoid and narrowly-margined; radicle incumbent (Figs 1, 2 & 3).

*Distribution and conservation status: Lepidium ginninderrense* is known only from the two cited localities in the A.C.T. It is remarkably disjunct from all other members of sect. *Papillosa* in south-eastern Australia, which are mainly confined to the inland plains west and north of the Eastern Highlands.

*Lepidium ginninderrense* is now known only from the type locality. It has not been rediscovered in the Reid area despite deliberate searches (M.Gray pers. comm.). The pop-

ulation at the type locality is currently c. 2000 plants, occupying an area of 90 × 30 metres (Avis 2000). Within this area, 100m$^2$ was fenced in 1995 to protect plants of *Lepidium ginninderrense* from grazing, mowing and vehicle traffic (S. Sharp *in litt.* 1997; pers. comm. 2000). In view of the small population which is confined to a single unreserved site, the appropriate risk-code is 2E A 55, using the system of Briggs and Leigh (1996). In Briggs and Leigh's publication, *L. pseudopapillosum*, which is listed as Vulnerable (3VCa SNAV) clearly includes *L. ginninderrense*, as the A.C.T. is included in its distribution. This is also true of the listing for that species in the ANZECC Threatened Australian Flora List (1999). The description of *L. ginninderrense* as a new species makes it necessary to revise the data on *L. pseudopapillosum* in these publications.

**Figure 2.** Siliculae of *L. ginninderrense* (× 10) showing the vesiculate-papillose, reticulate surfaces, fused style and shallow notch (from Holotype, left hand plant).

*Lepidium ginninderrense* occupies sites subject to winter inundation. Many native plant species of such sites are threatened by trampling, continuous grazing by introduced herbivores and associated pasture development, e.g. *Lepidium aschersonii*, *L. monoplocoides*, *Cullen parvum*, *C. tenax* and *Euphrasia scabra* (I. Crawford *in litt.* 1999). If *L. ginninderrense* still occurs undetected at other localities, it is likely to be at risk at these also.

*Notes on habitat and ecology*: The climate of the Canberra area is continental, with hot summers and cold winters with frequent frosts. The mean annual rainfall is 632 mm, spread fairly evenly throughout the year (Gentilli 1971).

At the type locality, the species grows on the floodplain of Ginninderra Creek in native grassland dominated by *Anstrodanthonia* spp. and *Bothriochloa macra*. Associated herbaceous species include *Plantago gandichandii*, *Juncus filicaulis*, *Triptilodiscus pygmaeus*, **Parentucellia latifolia* and *Calocephalus citreus*. The soil is a brown clay loam developed on Quaternary alluvium (I. Crawford *in sched.* 1995). Avis has shown that *L. ginninderrense* grows in areas with relatively low perennial grass cover often with indications of past soil disturbance (Avis 2000). The habitat at the Reid locality was rather similar: 'locally rather common, in depression with little vegetation in grassland' (R.H. Hoogland *in sched.* 1952), but no further details are known.

*Etymology*: The specific epithet refers to the type locality.

*Other specimens examined*: Australia, A.C.T., Canberra City Distr., Reid, ca. 600 m, *R.D. Hoogland*, 20.xii.1952 (CANB *64913*). This specimen was collected from an area between the Canberra Institute of Technology and St. John's Church (M. Gray pers. comm. 13 May 1999 *teste* I. Crawford, *in litt.* 23 Oct. 1999).

*Notes*: *L. ginninderrense* is distinguished from *L. pseudopapillosum* by the vesiculate papillae on the face of the silicula, by the shallower silicula notch, by the silicula-wings being adnate to the style in the mature fruit, by the smaller and differently shaped nectaries, and by the bifurcate mature style. *L. monoplocoides* F. Muell. differs markedly from *L. ginninderrense* in the narrowly acute apex of the wings which form the silicula notch; however both species have an almost circumferential wing and a bifurcate style adnate to the wings in the mature fruit.

The silicula of *L. pseudopapillosum* is glabrous apart from very sparse papillae and/or acute hairs on the outer wing margins. Hewson's description of its silicula as 'glabrous to papillose' (Hewson 1982a and b) follows from her provisional inclusion of the Hoogland

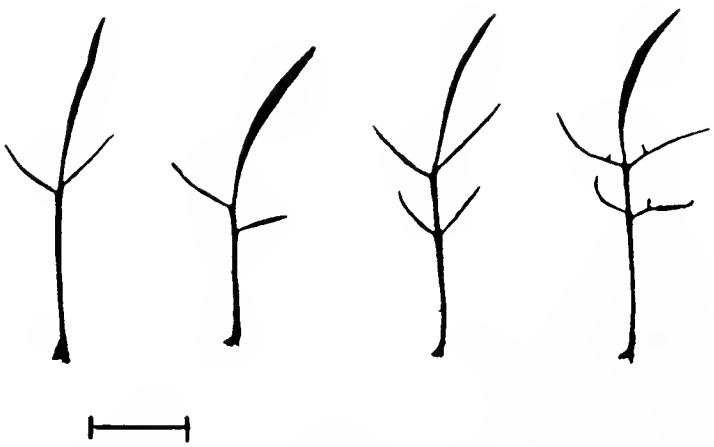

**Figure 3.** Lower cauline leaves of *L. ginninderrense*, from cultivated material grown from seed from the type locality (*ex* ANBG seedstore). Scale bar 10 mm.

collection within the circumscription of *L. pseudopapillosum*. The illustration in Hewson (1982a) is of *L. pseudopapillosum sensu stricto* as evidenced *inter alia* by the clearly glabrous silicula. Retter and Harden (1990) compound the potential confusion by describing the silicula of *L. pseudopapillosum* as 'papillose, usually glabrous', while the illustration of the silicula is that of *L. ginninderrense* with vesicular papillae on the face of the valves, a short silicula-notch and the style fused to the wings. Entwisle (1996) describes the siliculae of *L. pseudopapillosum* as 'without hairs', but in an appended note he states that they are 'glabrous or papillose'. However, the illustration of the silicula in this case is that of *L. pseudopapillosum sensu stricto*.

*Lepidium ginninderrense* is placed in sect. *Papillosa* Thell. ex Hewson as it has apetalous flowers with 4 stamens and ± sessile stigmas. However, like *L. pseudopapillosum*, its rather thick, fleshy leaves and incurved, almost circumferential silicula-wings suggest a relationship to sect. *Monoploca* (Bunge) Prantl. (Thellung 1916). *Lepidium monoplocoides*, included in sect. *Papillosa* by Hewson (1982a), also has these 'Monoploca-like' characters, and was included by Thellung in his 'grex Monoplocoidea'. Mueller clearly shared that opinion, as is indicated by the species' name. *Lepidium monoplocoides* and *L. ginninderrense* both have bifurcate styles in the mature fruits, a character particularly noticeable in the former species where the style lobes often markedly exceed the stigma in the mature flower (Hewson 1982a). This character appears to be unknown in any other *Lepidium* species (Thellung 1906; Hitchcock 1945; Hewson 1982a). Furthermore, as Thellung (1906) points out for *L. monoplocoides*, the combination of apetalous flowers, reduced stamen number and silicula wings adnate to the style is also unique in the genus. Mummenhoff *et al.* (1995), adopting Hewson's tentative evolutionary treatment, point out that the extra-Australian sections *Lepia* (Desv.) DC., *Lepiocardamon* Thell. and *Cardamon* DC. 'seem to represent one evolutionary lineage, separated from the other sections by the style fused to the wing of the fruits'. The isolated occurrence of this character in two Australian species with reduced flowers is apparently anomalous, although a slight degree of fusion of the style with the silicula wings also occurs in one other Australian species, *L. leptopetalum* F. Muell. in sect. *Monoploca* (Thellung 1906). It is likely that style/wing fusion has evolved independently in Australia, but a more direct phylogenetic connection with the extra-Australian *Lepia-Lepiocardamon-Cardamon* lineage cannot be entirely discounted (see Mummenhoff *et al.* 1992; 1995). In any event, *L. ginninderrense* is of particular significance for further research on *Lepidium* phylogeny. Its conservation is of great importance as a consequence.

**Key to *Lepidium ginninderrense* and allied species in sect. Papillosa** (after Hewson 1982a and b).

1. Cauline leaves auriculate at the leaf insertion ..... 2
1. Cauline leaves not auriculate at the leaf insertion but sometimes with a winged petiole ..... 3

2. Stem with vesicular and papillose hairs ..... ***L. papillosum***
2. Stem with acicular hairs ..... ***L. oxytrichum***

3. Silicula less than 3 mm long ..... ***L. merrallii***
3. Silicula more than 3 mm long ..... 4

4. Silicula-wings narrow and acute at the apex ..... ***L. monoplocoides***
4. Silicula-wings broad and obtuse at the apex ..... 5

5. Silicula glabrous except for a few fine papillae or acute hairs on the outer margins of the wings; style free of the silicula-wings ..... ***L. pseudopapillosum***
5. Silicula vestured with both papillate and vesicular hairs; style fused with the silicula-wings ..... ***L. ginninderrense***

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# Resolution of the *Thelymitra canaliculata* R.Br. (Orchidaceae) complex in southern Australia.

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*Abstract*

The five currently known taxa in the *Thelymitra canaliculata* R.Br. complex from southern Australia are discussed and descriptions are presented for each. *Thelymitra jonesii* Jeanes from Tasmania, *Thelymitra latiloba* Jeanes from southwestern Australia and *Thelymitra occidentalis* Jeanes from southern Australia are described as new and illustrated. The key diagnostic features relating to the size, shape and relative position of the auxiliary lobes of the column and the size and shape of the post-anther lobe of the column are elucidated. Information on distribution, habitat, pollination biology and conservation status is given for all five taxa. The relationships between *Thelymitra canaliculata*, *Thelymitra azurea* R.S.Rogers and the three new species are discussed. A key is provided to distinguish all five members of the *Thelymitra canaliculata* complex.

## Introduction

*Thelymitra* J. & G. Forst. is a complex genus consisting of about 75 described species, several described natural hybrids and an uncertain number of undescribed taxa. It is mainly concentrated in higher rainfall areas of temperate Australia, but a few species occur in tropical northeastern Australia, about 10 endemic species occur in New Zealand and four additional species occur in Indonesia, New Caledonia, New Guinea and the Philippines.

There are a number of features that, in combination, readily distinguish members of the *Thelymitra canaliculata* R.Br. complex from all other *Thelymitra* species. The column has a well developed, fleshy, post-anther lobe (sometimes called the mid-lobe) that forms a hood over the anther, as well as two adjacent well developed, fleshy, auxiliary lobes (sometimes called accessory lobes or side lobules). The flowers are pale blue to deep azure blue, usually with darker longitudinal stripes and often with pink to mauve flushes at the base and/or apex of the perianth segments. The column wings have variously developed distal flanges on which the lateral lobes (sometimes called column arms or lateral staminodes) are inserted.

*Thelymitra canaliculata* was described by Robert Brown in his *Prodromus* (Brown 1810), the distribution given as (T.) for Tropical Australia. This is obviously in error as the specimens in Brown's herbarium and Bauer's drawing give King Georges Sound (Albany, Western Australia) as the provenance (Bentham 1873, Clements 1989). Over 100 years later, Dr Richard Rogers of Adelaide described *Thelymitra azurea* R.S.Rogers from South Australia (Rogers 1917), a species with obvious affinities to *T. canaliculata*. *Thelymitra azurea* was later reduced to synonymy under *T. canaliculata* (George 1971) with the comment "Rogers' specimens are shorter and more robust than Brown's but the floral morphology is the same. Both forms occur in Western Australia." Clements (1989) reinstated *T. azurea* commenting on the different structure of the column lobes and the different habitats of the two species.

After examining preserved and living plants as part of a revision of *Thelymitra* for Australia (in preparation), I am confident that *T. canaliculata* and *T. azurea* are distinct species. These studies further revealed that another three distinct undescribed species occur within the *T. canaliculata* complex in southern Australia. This opportunity is taken to describe these three new species and discuss their distinguishing characteristics.

## Taxonomy

***Thelymitra canaliculata*** R.Br., *Prod.* 314 (1810). *Type*: 'In swamps towards King Georges Sound' (*In paludibus ad Portum Regis Georgii III*), xii. 1801, *F. Bauer s.n.* (lectotype α BM!, designated Clements 1989; isolectotypes BM!, E).

*Illustration*: Hoffman & Brown (1998) page 257

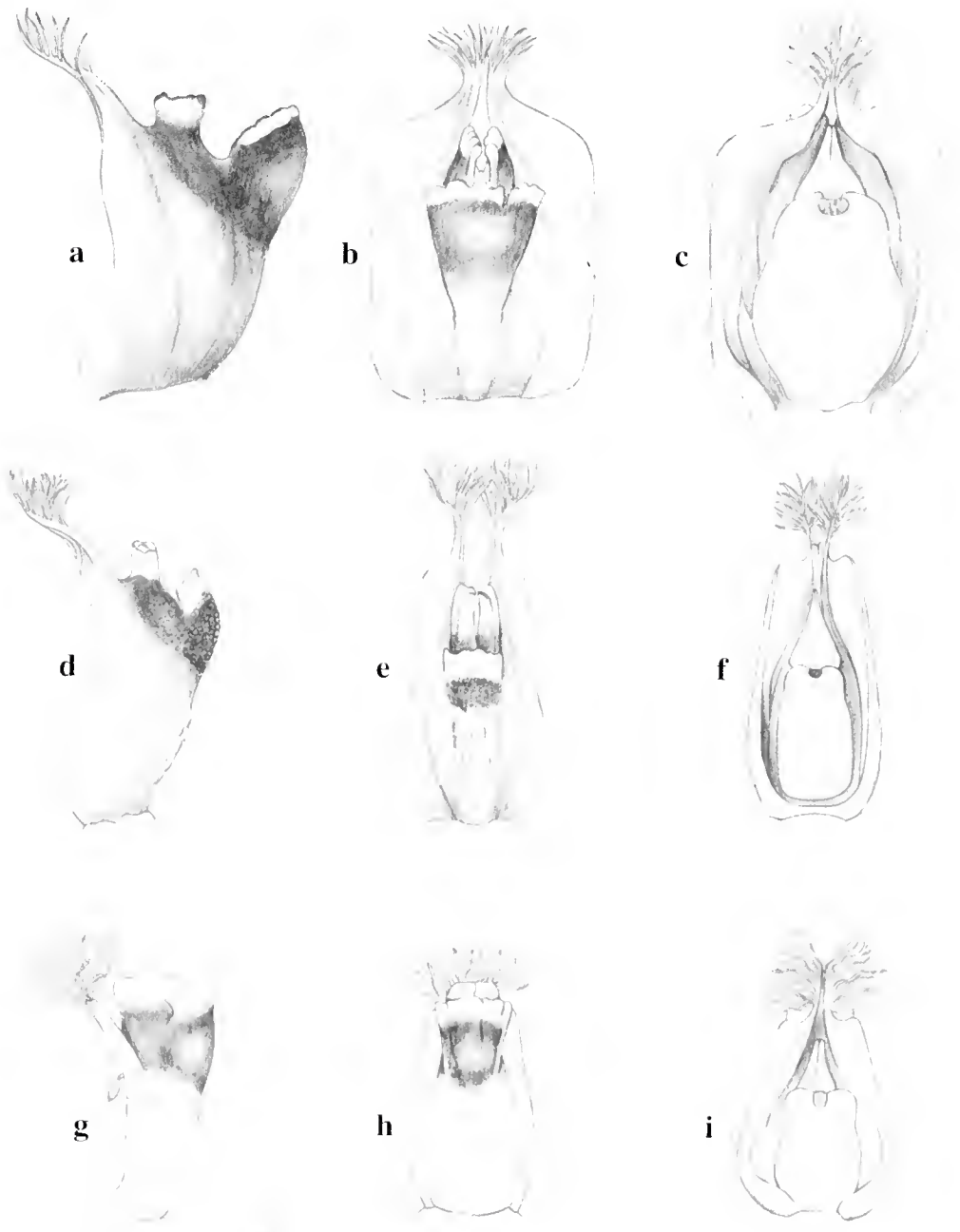


**Figure 1.** *Thelymitra canaliculata* **a** column from side ×8; **b** column from rear ×8; **c** column from front ×8; *Thelymitra azurea* **d** column from side ×8; **e** column from rear ×8; **f** column from front ×8; *Thelymitra jonesii* **g** column from side ×8; **h** column from rear ×8; **i** column from front ×8.

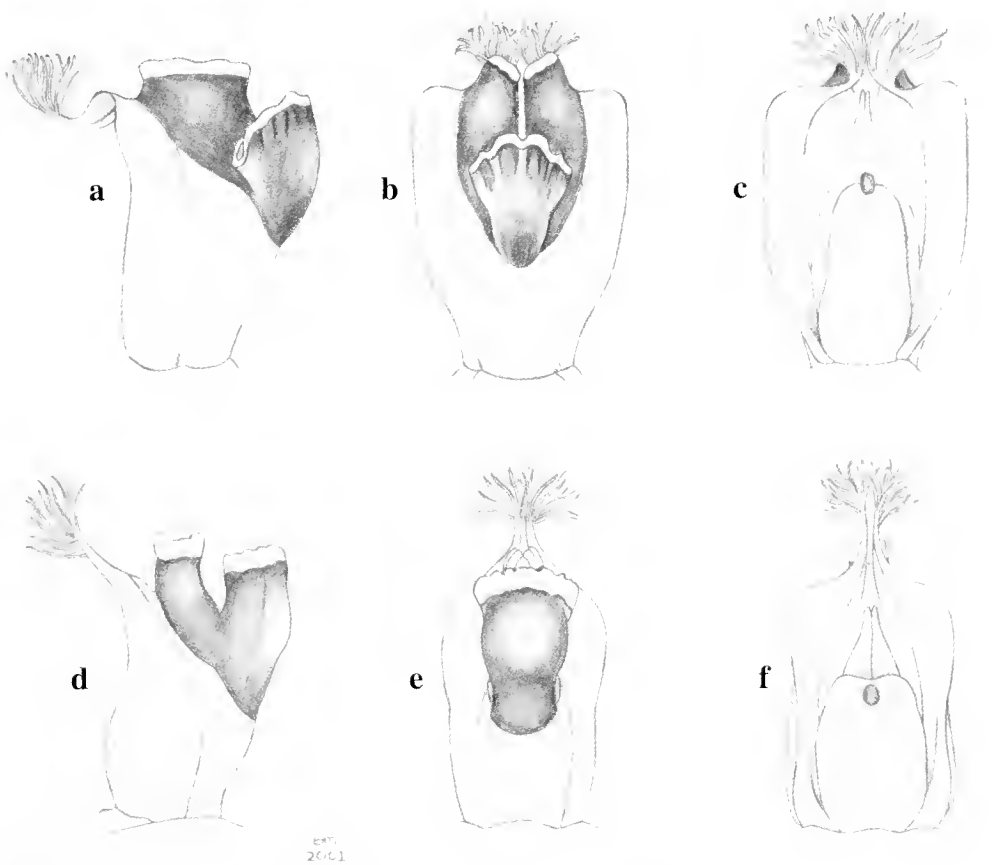


**Figure 2.** *Thelymitra latiloba* **a** column from side ×8; **b** column from rear ×8; **c** column from front ×8; *Thelymitra occidentalis* **d** column from side ×8; **e** column from rear ×8; **f** column from front ×8.

Glabrous, terrestrial *herb*. *Tubers* ovoid, fleshy. *Leaf* linear to linear-lanceolate, 20–35 cm long, 3–20 mm wide, erect, fleshy, canaliculate, dark green with a purplish base, ribbed abaxially, sheathing at base, apex acuminate. *Scape* 20–85 cm tall, 1–6 mm diam., straight, green to purplish. *Sterile bracts* 1–3, linear to linear-lanceolate, 1.2–8.5 cm long, 2–15 mm wide, closely sheathing, green or purplish, apex acuminate. *Fertile bracts* ovate-acuminate to obovate-acuminate, 4–25 mm long, 2–8 mm wide, sheathing the pedicels, green or purplish. *Pedicels* 2.5–7 mm long, slender. *Ovary* cylindric to narrow-obovoid, 3.5–13 mm long, 1.5–3 mm wide. *Flowers* 3–28, (15–)20–36 mm across, pale to dark blue with darker longitudinal veins, sometimes flushed pinkish, opening freely in warm weather. *Perianth segments* (7.5–)10–18 mm long, 3–9 mm wide, concave, often shortly apiculate; *dorsal sepal* ovate to obovate, acute; *lateral sepals* ovate to obovate, acute; *petals* ovate to obovate, obtuse to acute; *labellum* lanceolate to oblanceolate, often smaller than other segments, obtuse to acute. *Column* erect from the end of ovary, 4–6 mm long, 2.5–4 mm wide, winged, pale blue at base grading to dark purplish black towards apex, wings with distal flanges; *post-anther lobe* hooding the anther, 1–1.5 mm long, 2.5–3.5 mm wide when flattened, purplish black at base, apex almost semicircular, fleshy, toothed, irregularly undulate, dissected, crest yellow; *auxiliary lobes* converging, 0.8–1.1 mm long, 0.8–1.3 mm wide, fleshy, more or less flat, usually wider than long and widest at apex, purplish black at base, apex shallowly toothed, irregularly undulate, yellow; *lateral lobes* converging, 2–2.7 mm long, flat, porrect or obliquely erect, 0.7–1.3 mm wide at base, tapering abruptly, distal half

oblong, each with a dense mass of erect and spreading trichomes on distal margins, the individual trichomes 0.8–1.1 mm long, white, rarely yellow or purplish. *Anther* situated about mid-way along column, mostly obscured behind stigma, ovoid, 2.5–3.1 mm long, 1.5–2 mm wide, connective produced into an apical beak 0.5–1 mm long; *pollinarium* 1.5–2.5 mm long; *viscidium* elliptic to more or less circular, c. 0.5 mm long, c. 0.4 mm wide; *pollinia* white, mealy. *Stigma* situated at base of column, ovate-quadrate, 2–3 mm long, c. 2.5 mm wide, margins irregular. *Capsules* obovoid, 8–15 mm long, 3–7 mm wide, erect, ribbed. (Fig. 1 a–c; Fig. 3)

*Selected specimens examined*: **Western Australia**: 13 km WSW of Walpole, Walpole Nornalup National Park, 30 xi. 1988, *G. Wardell-Johnson W120* (PERTH *02661020* & PERTH *02661039*); Spencer Park, Albany, xi. 1978, *R. Heberle s.n.* (PERTH *00293946*); Flat at junction of Station Road and Conspicuous Beach Road, Nornalup, 23 xi. 1994, *W. Jackson BJ305* (PERTH *04261917*); 9 miles S of Northcliffe, 26 xi. 1961, *A.S. George 3197* (PERTH *00293881*); Nannarup, 9 xii. 1964, *A.S. George 6481* (PERTH *00293849*); Spencer Park, Albany, 28 x. 1959, *Peter Smith s.n.* (PERTH *00293377*); 2 miles S of Pemberton-Nannup Road, c. 15 miles W. of Pemberton, 8 xii. 1957, *A.S. George s.n.* (PERTH *00330329*); Gravel road running S from South Coast Hwy just W

**Figure 3.** *Thelymitra canaliculata* Walpole area, Western Australia (photograph by C.J. French).

of Kent River, 13 xii. 1984, *A.P. Brown & S. Van Leeuwen 169* (PERTH *00293865*); Peaceful Bay Road recreation site, 2.5 km NE of Ficifolia Road junction, Walpole-Nornalup National Park, 24 xi. 1990, *N. Gibson & M. Lyons 1206* (PERTH *03050505*); 3 km E of Walpole, Walpole-Nornalup National Park, near Pt. 1041, 19 xi. 1987, *A.R. Annels 138* (PERTH *02661012*).

*Distribution and habitat*: Endemic to near coastal, south-west Western Australia, mostly between Augusta and Albany (Fig. 8). Grows around the margins of winter-wet swamps or on raised hummocks within them (Hoffman & Brown 1998). Altitude: 10–200 m.

*Conservation Status*: This species is moderately widespread and represented in reserves.

*Flowering period*: Late October to December.

*Pollination biology*: The large, freely opening flowers, coherent pollen, functional viscidium and sporadic capsule development, indicate that this species is most likely entomophilous.

*Notes*: *Thelymitra canaliculata* has been confused with *Thelymitra azurea*, but the two species are quite distinct. The latter is a less robust, earlier flowering species with generally smaller flowers (21–27 mm across), a narrower post-anther lobe (0.9–2 mm wide) and smaller auxiliary lobes (0.5–1 mm long by 0.5–0.8 mm wide). It is found primarily in sandy heathland and mallee scrubland in dry situations, and is confined to eastern Australia. *Thelymitra canaliculata* is probably most closely related to *Thelymitra latiloba* Jeanes from the wheatbelt of Western Australia. The latter grows primarily in dry 'Wandoo' open forests and woodlands, has an earlier flowering season, a more convoluted apex to the post-anther lobe and generally broader (1.1–2.1 mm) and shorter (0.4–0.7 mm) auxiliary lobes. The apices of the three column lobes are distinctly bright yellow in *T. canaliculata*, but white or pale pink in *T. latiloba*. *Thelymitra canaliculata* is also related to *Thelymitra occidentalis* Jeanes, but the latter has a slightly narrower post-anther lobe (2–2.5 mm wide when flattened), slightly narrower auxiliary lobes (0.5–0.8 mm wide), flowers considerably earlier and grows in drier habitats.

***Thelymitra azurea*** R.S.Rogers, *Trans. & Proc. Roy. Soc. South Australia* 41: 342, t. 17 (1917). *Type*: Found blooming in great numbers between Mount Compass and Victor Harbour, South Australia, 19 xi. 1916, *R.S. Rogers s.n.* (holotype AD, isotypes AD, MEL *677563*!).

*Thelymitra canaliculata sensu* J.Z. Weber & T.J. Entwisle in N.G. Walsh & T.J. Entwisle (eds), *Fl. Victoria* 1: 845 (1994), *non* R.Br. (1810).

*Illustrations*: Backhouse & Jeanes (1995) page 331; Bates & Weber (1990) Plate 200

Glabrous, somewhat glaucous terrestrial *herb*. *Tubers* ovoid, fleshy. *Leaf* linear to filiform, 10–27 cm long, 3–8 mm wide, erect, fleshy, canaliculate to conduplicate, dark green with a purplish base, ribbed abaxially, sheathing at base, apex acuminate. *Scape* 13–45 cm tall, 0.8–2.2 mm diam., straight to slightly flexuose, green to purplish. *Sterile bract* 1, rarely 2, linear to linear-lanceolate, 1.5–4 cm long, 3–6 mm wide, closely sheathing, green or purplish, apex acuminate and papillate. *Fertile bracts* ovate-acuminate to obovate-acuminate, 3–14 mm long, 2–5 mm wide, sheathing the pedicels, green or purplish, apex papillate. *Pedicels* 2–7 mm long, slender. *Ovary* cylindric to narrow-obovoid, 4–10 mm long, 1.5–4 mm wide. *Flowers* 1–10, (13–)21–27 mm across, usually dark azure blue with darker longitudinal veins, often with mauve tonings, rarely pink, opening moderately freely in warm weather. *Perianth segments* (6–)10–13 mm long, 3–7 mm wide, concave, often shortly apiculate; *dorsal sepal* ovate, obtuse; *lateral sepals* lanceolate to ovate, acute or obtuse; *petals* lanceolate to ovate, acute or obtuse; *labellum* lanceolate to narrow-ovate, often narrow than other segments, apex acute. *Column* erect from the end of ovary, 2.5–4.5 mm long, 2–2.5 mm wide, winged, blue to purplish, wings with distal flanges; *post-anther lobe* slightly hooding the anther, 0.5–1 mm long, 0.9–2 mm wide when flattened, fleshy, blackish at base, apex an arc subtending an angle of c. 90 °, toothed or warty, yel-

low; *auxiliary lobes* converging, 0.5–1 mm long, 0.5–0.8 mm wide, fleshy, rod-like, blackish at base, apex toothed or warty, yellow; *lateral lobes* converging, 1.2–2 mm long, flat, porrect or obliquely erect, 0.5–1 mm wide at base, tapering abruptly, distal half oblong, each with a dense mass of erect and spreading trichomes on distal margins, the individual trichomes 0.7–1 mm long, white or purplish. *Anther* situated at base of column, mostly obscured behind stigma, ovoid, 1.8–2.4 mm long, 1–1.6 mm wide, connective produced into an apical beak 0.4–0.8 mm long; *pollinarium* 1.2–1.8 mm long; *viscidium* ovate, 0.3–0.5 mm long, c. 0.3 mm wide; *pollinia* white, mealy. *Stigma* situated at base of column, ovate-quadrate, 1.8–2.3 mm long, 1.2–1.6 mm wide, margins irregular. *Capsules* obovoid, 8–14 mm long, 4–6 mm wide, erect, ribbed. (Fig. 1 d–f; Fig. 4)

*Selected specimens examined*: **South Australia**: Mt Compass, 14 xi. 1932, *R.S. Rogers s.n.* (MEL *625468*); South east district: Lower Coorong, between the 156 and 157 mile post on the road from Adelaide to Kingston SE, 22 x. 1967, *R. Nash s.n.* (CANB *8104444*); South east district: 45 mile post on Naracoorte–Keith Road, 13 x. 1969, *M. Beek s.n.* (CANB *8104443*); Port Elliot, 19 xi. 1916, *Dr & Mrs Rogers s.n.* (NSW *181295*); Eyre Peninsula: Tooligie Hills, 13 x. 1958, *P.G. Wilson 442* (AD *95930067*); Eyre Peninsula: Cowell Hills, 29 ix. 1989, *R. Bates 20932* (AD *98930065*);

**Figure 4.** *Thelymitra azurea* Little Desert N.P., Victoria (photograph by J.A. Jeanes).

Gip Gip Rocks, Padthaway, 10 x. 1964, *D. Hunt 2182* (AD *DH2182*); Mt Compass, 30 x. 1976, *R. Bates s.n.* (AD *RJB/SE*). **Victoria**: Little Desert. By main N–S track 2.5 km S of Little Desert National Park and 27 km S of Kiata, 4 xi. 1978, *T.B. Muir 6324* (MEL *1591905* & MEL *565908*); Victoria Valley, xi. 1932, *Lorna Banfield s.n.* (MEL *236697*); Mallee. 8 km by track south-west of Red Bluff camping area on the SA/Vic. Border track, Big Desert, 6 xi. 1984, *David E. Albrecht 1235* (MEL *673998*); Glenisla heathland, beside Henty Highway & west of Grampians Victoria Range, 6 xii. 1968, *A.H. Corrick s.n.* (MEL *665159*); Wyperfeld National Park. 0.5 miles SE of Quandong Hill, 14 x. 1968, *A.C. Beauglehole 29355* (MEL *652722*); Glenelg Shire, 8 miles W of Casterton P.O., 17 xi. 1971, *A.C. Beauglehole 37909* (MEL *652720*); Lower Glenelg National Park, Kentbruck Heath, 22 xi. 1984, *A.C. Beauglehole 79113* (MEL *669210*); Little Desert (Eastern) near Wail, x. 1948, *A.C. Beauglehole 18787* (MEL *221696*); Tea Tree Creek area S of Glenisla Station, 13 xi. 1971, *A.C. Beauglehole 37894* (MEL *652721*); Yanac, x. 1942, *T.E. George s.n.* (MEL *1550418*).

*Distribution and habitat*: South Australia and Victoria (Fig. 8). In South Australia it occurs from the Eyre Peninsula to the Victorian border including Kangaroo Island. In Victoria it occurs in the Lowan Mallee, Wannon and Grampians Natural Regions (Conn 1993). Widespread but rather uncommon in mallee scrublands, heathy woodland and heathland on deep sand or sandy loam or peaty soils around swamp margins, often flowering most abundantly the season following fires. Altitude: 10–250 m.

*Conservation Status*: This species is moderately widespread and represented in reserves.

*Flowering period*: Late September to early December

*Pollination biology*: The freely opening flowers, coherent pollen, functional viscidium and sporadic capsule development, indicate that this species is most likely entomophilous.

*Notes*: *Thelymitra azurea* has been confused with *Thelymitra canaliculata*, but the two species are quite distinct (see notes under the latter species). *Thelymitra azurea* is most closely related to *Thelymitra occidentalis*, but the latter species has a broader post-anther lobe (2–2.5 mm wide) whose distal margin forms a more or less semi-circular rim, a more westerly distribution and generally earlier flowering period.

***Thelymitra jonesii*** Jeanes, *sp. nov.*

*T. azureae* R.S.Rogers affinis sed floribus pallidioribus, lobis lateralibus columnae brevioribus, et lobis auxiliaribus ab lobis post-antheris distinctus minus a plicis involutis duis vel incisuris vadis duis marginis distalis sejunctis differt.

*Type*: Tasmania. Tasman Peninsula; Arthur Highway, between Eaglehawk Neck and Taranna, 24 x. 1997, *J.E. Wapstra ORG962* (holotype CANB *609353.1*, isotype CANB *609353.2*).

*Thelymitra azurea sensu* D.L.Jones *et al.*, *The Orchids of Tasmania* 266 (1999) *non* R.S.Rogers (1917).

*Illustrations*: Jones *et al.* (1999) pp. 260 & 266

Glabrous terrestrial *herb*. *Tubers* not seen. *Leaf* linear to filiform, 6–21 cm long, 3–6 mm wide, erect, fleshy, canaliculate to conduplicate, ribbed abaxially, dark green with a purplish base, sheathing at base, apex acuminate. *Scape* 8–40 cm tall, 0.7–2.5 mm diam., straight to slightly flexuose, green or purplish. *Sterile bract* solitary, linear to linear-lanceolate, 1.5–3.6 cm long, 3–6 mm wide, closely sheathing, green or purplish, apex acuminate and papillate. *Fertile bracts* ovate-acuminate to obovate-acuminate, 4–12 mm long, 2–5 mm wide, closely sheathing the pedicels, green or purplish, apex papillate. *Pedicels* 2–6 mm long, relatively stout. *Ovary* narrow-obovoid, 4–8 mm long, 1.5–4 mm wide. *Flowers* 1–6, 13–21(–27) mm across, light blue to azure blue with darker veins, opening freely in warm weather. *Perianth segments* 6–10(–13) mm long, 2–8 mm wide, often shortly apiculate; *dorsal sepal* ovate, obtuse; *lateral sepals* lanceolate to ovate, acute or obtuse; *petals* lanceolate to ovate, acute or obtuse; *labellum* lanceolate to narrow-ovate,

often narrower than other segments, apex acute. *Column* erect from the end of ovary, 3–5 mm long, 1.5–2.5 mm wide, winged, blue to purplish, wings with distal flanges, sometimes terminating in entire, toothed or fimbriate lobes; *post-anther lobe* hooding the anther, 0.5–0.9 mm long, 1–2 mm wide when flattened, blackish at base, apex a fleshy, curved, toothed or warty crest, yellow; *auxiliary lobes* converging, 0.7–1.1 mm long, 0.5–1 mm wide, held in close proximity to post-anther lobe and differentiated from it by two inward folds or two shallow incisions of the distal margin, thick and fleshy, blackish at base, apex toothed or warty, yellow; *lateral lobes* converging, 0.5–1 mm long, 0.3–0.4 mm wide, fleshy, porrect or obliquely erect, terminal, continuous with column wing or inserted on inner apical margin of column-wing, each with a dense mass of erect and spreading trichomes on distal margins, the individual trichomes 0.9–1.1 mm long, white. *Anther* situated at base of column, mostly obscured,behind stigma, ovoid, 1.7–2.5 mm long, 1.2–1.8 mm wide, connective produced into an apical beak 0.3–0.8 mm long; *pollinarium* 1.4–2 mm long; *viscidium* more or less circular, c. 0.3 mm diam.; *pollinia* white, friable, mealy. *Stigma* situated at base of column, ovate-quadrate, 1.5–2.2 mm long, 1.1–1.9 mm wide, margins irregular. *Capsules* obovoid, 8–12 mm long, 4–6 mm wide, erect, ribbed. (Fig. 1 g–i; Fig. 5)

**Figure 5.** *Thelymitra jonesii* Tasman Peninsula, Tasmania (photograph by L. Rubenach).

*Specimens examined*: TASMANIA: Cape Barren Island, Furneaux Group, 26 x. 1973, *J.S. Whinray 631* (MEL *533323*); Cape Barren Island, Furneaux Group, 26 x. 1973, *J.S. Whinray 177* (AD *97512443*); Southport Bluff, 28 xi. 1976, *M. Allan s.n.* (HO *410816*); Eaglehawk Neck, 5 xi. 1984, *M. Cameron s.n.* (CANB *9702851.1* upper photograph); Mason Point between Eaglehawk Neck and Taranna, 31 x. 2000, *J. & A. Wapstra JAJ909* (MEL *2089283*); Taranna, Tasman Peninsula, 31 x. 1996, *R. Minchin ORG385* (CANB *611006.1* & CANB *611006.3*).

*Distribution and habitat*: Apparently endemic to Tasmania where known from only four widely separated areas (Fig. 8). Grows in moist coastal heath on sandy to peaty soil (Jones *et al.* 1999). Altitude: 10–250 m.

*Conservation Status*: Known from very few collections. Suggest 3EC by criteria of Briggs & Leigh (1996).

*Flowering period*: October to early December.

*Pollination biology*: The freely opening flowers, coherent pollen, functional viscidium and sporadic capsule development, indicate that this species is most likely entomophilous.

*Notes*: *Thelymitra jonesii* Jeanes is most closely related to *Thelymitra azurea* and *Thelymitra occidentalis*, but the former has generally paler blue flowers and the column has shorter lateral lobes (1.2–2 mm long in *T. azurea*, 1.5–2.5 mm long in *T. occidentalis*). Also, the auxiliary lobes in *T. jonesii* are less differentiated from the post-anther lobe, only being separated from it by two inward folds or two shallow incisions of the distal margin.

Specimens of *T. jonesii* from Cape Barren Island have a variable column post-anther lobe ranging from virtually absent to more typical of the species on the Tasmanian mainland.

*Etymology*: Named after David L. Jones (1944– ), botanist, horticulturist and botanical author, and probably the first person to recognise *Thelymitra jonesii* as a distinct species. David is pre-eminent among contemporary orchid taxonomists in Australia, and has been of immeasurable help in my orchid research over many years, particularly more recently on the genus *Thelymitra*.

***Thelymitra latiloba*** Jeanes, *sp. nov.*

*T. canaliculatae* R.Br. affinis sed lobis columnae ad apicem alba vel rosea, lobis auxiliaribus brevioribus latioribus, florescentia praecociore et habitationibus siccioribus differt.

*Type*: Western Australia. Weam Nature Reserve, c. 9 km E of Brookton, 15 x. 2000, *J.A. Jeanes* 845 (holotype PERTH, isotypes CANB, MEL *2089278*).

*Thelymitra azurea sensu* N. Hoffman & A. Brown, *Orchids of South-west Australia* edn 2, 258 (1998) *p.p.*, *non* R.S.Rogers (1917).

Glabrous, terrestrial *herb*. *Tubers* not seen. *Leaf* linear to linear-lanceolate, 15–30 cm long, 3–12 mm wide, erect, fleshy, canaliculate, dark green with a purplish base, ribbed abaxially, sheathing at base, apex acuminate. *Scape* 8–60 cm tall, 1.3–3.5 mm diam., straight, green to purplish. *Sterile bract* usually 1, rarely 2, linear to linear-lanceolate, 2–8 cm long, 3–10 mm wide, closely sheathing, green or purplish, apex acuminate to long-acuminate. *Fertile bracts* ovate-acuminate to obovate-acuminate, 3.5–25 mm long, 2–6 mm wide, green or purplish, sheathing the pedicels. *Pedicels* 3–8 mm long, slender. *Ovary* narrow-obovoid, 4–10 mm long, 1.5–3 mm wide. *Flowers* 2–12, (20–)30–38(–46) mm across, blue with darker blue longitudinal veins, sometimes flushed mauve towards centre and at extremities, opening freely in warm weather. *Perianth segments* (8–)14–18(–22) mm long, 3–9 mm wide, concave, often shortly apiculate; *dorsal sepal* ovate-lanceolate to ovate, acute; *lateral sepals* ovate-lanceolate to ovate, acute; *petals* ovate-lanceolate to ovate, sometimes asymmetric, obtuse to acute; *labellum* lanceolate to ovate-lanceolate, often smaller than other segments, subacute. *Column* erect from the end of

ovary, 3.5–5.5 mm long, 2–3 mm wide, winged, whitish or pale blue at base grading to dark blue dorsally and towards apex, wings with distal flanges; *post-anther lobe* hooding the anther, 1–1.7 mm long, 1.9–3.5 mm wide when flattened, a dorsally compressed inflated tube, dark purplish black, apex a curved, fleshy, toothed or lobed, irregularly undulate to crispate, white or pink crest; *auxiliary lobes* converging, 0.4–0.7 mm long, 1.1–2.1 mm wide, flat, dark purplish black at base, apex fleshy, shallowly toothed, irregularly undulate, white or pink; *lateral lobes* converging, 1.3–2 mm long, flat, porrect or obliquely erect, 0.5–1.1 mm wide at base, tapering abruptly, distal half oblong, each with a dense mass of erect and spreading trichomes on distal margins, the individual trichomes 0.8–1.1 mm long, usually purple, occasionally white. *Anther* situated about mid-way along column, mostly obscured behind stigma, ovoid, 2–3 mm long, 1.3–2 mm wide, connective produced into an apical beak 0.5–0.8 mm long; *pollinarium* 1.4–2.3 mm long; *viscidium* ovate, c. 0.4 mm long; *pollinia* white, mealy. *Stigma* situated at base of column, ovate-quadrate, 2–2.5 mm long, 1.5–2 mm wide, margins irregular. *Capsules* obovoid, 6–12 mm long, 3–7 mm wide, erect, ribbed. (Fig. 2 a–c; Fig. 6)

**Figure 6.** *Thelymitra latiloba* York area, Western Australia (photograph by J.A. Jeanes).

*Specimens examined*: **Western Australia**: Dragon Rocks Nature Reserve No. 36128. NE section N of Jilakin Rocks Road, 24 x. 1991, *A.M. Coates 3316* (PERTH *05153433*); Dumbleyung, x. 1924, *B.T. Goadby s.n.* (PERTH *00330337*); Bruce Rock, x., *O.H. Sargent s.n.* (PERTH *00293393*); York, x. 1904, *A. Purdie s.n.* (PERTH *00293903*); Cut Hill, W of York, 8 x. 1905, *?O.H. Sargent s.n.* (PERTH *00293458*); 2 km S of Wongan Hills/Piawaning Road, Wongan Hills, 194 km NE of Perth, 21 ix. 1974, *K.F. Kenneally 2264* (PERTH *01220497*); 2 km S of Wongan Hills/Piawaning Road, Wongan Hills, 194 km NE of Perth, 6 x. 1974, *K.F. Kenneally 2342* (PERTH *01220519* & PERTH *3318/B*); Dryandra State Forest, Crossman map 1:100000, Grid Reference 955793, 28 x. 1987, *D.M. Rose 438* (PERTH *01699520*); Brookton area. Moorumbine South Rd, c. 100 m SE of Schultz Rd. 15 x. 2000, *J.A. Jeanes 843*, *C. French & H. Beyrle* (MEL *2089280*, PERTH); Dryandra State Forest, NW corner of reserve, 17 x. 2000, *J.A. Jeanes 847* (MEL *2089275*, PERTH); c. 6 km W of York. Balladong Rd c. 4 km from Southern Hwy, 16 x. 2000, *J.A. Jeanes 846* (MEL *2089277*, PERTH); Corner of Qualen Rd and Kittlers Rd. SW of York, 14 x. 2000, *J.A. Jeanes 838*, *C. French & H. Beyrle* (MEL *2089282*, PERTH).

*Distribution and habitat*: Endemic to southwest Western Australia, where apparently confined to the wheatbelt region between Wongan Hills and Dumbleyung (Fig. 8). Grows in 'Wandoo' open forest and woodland (*Eucalyptus drummondii*, *E. gardnerii*, *E. ornata* and *E. transcontinentalis* are also sometimes present), usually on slopes below laterite outcrops. Soils are sandy or gravelly loams over laterite, and are often covered by copious leaf and bark litter. Altitude: 200–400 m.

*Conservation Status*: Poorly known, but reasonably widespread and represented in reserves.

*Flowering period*: Late September to early November.

*Pollination biology*: The large, freely opening flowers, coherent pollen, functional viscidium and sporadic capsule development, indicate that this species is most likely entomophilous.

*Notes*: *Thelymitra latiloba* has been confused with *Thelymitra canaliculata*, but the two species are quite distinct (see notes under the latter species). *Thelymitra occidentalis* from dry mallee scrublands of southern Western Australia and South Australia differs from *T. latiloba* in its narrower auxiliary lobes (0.5–0.8 mm wide), generally less robust habit, often smaller flowers (15–32 mm across) and yellow-tipped column lobes.
Hybrids between *Thelymitra latiloba* and *Thelymitra macrophylla* Lindl. *sensu lato* have been observed near York and Brookton where the two species grow sympatrically.

*Etymology*: Latin *latus*, broad, wide; *lobus*, lobe; an allusion to the very broad auxiliary lobes on the column.

***Thelymitra occidentalis*** Jeanes, *sp. nov.*

*T. azureae* R.S.Rogers affinis sed loba post-antherae latiore, incisa profunde magis, florescentia praecociore et distributione occidentalioribus differt.

*Type*: Western Australia. 32 miles E of Cranbrook, on Chester Pass Rd, 14 xi. 1959, *A.S. George 406* (holotype PERTH *00293415*).
*Thelymitra azurea sensu* N. Hoffman & A. Brown, *Orchids of South-west Australia* edn 2, 258 (1998) *p.p.*, *non* R.S.Rogers (1917).

*Illustrations*: Hoffman & Brown (1998) page 258; Bates & Weber (1990) plate 199

Glabrous, terrestrial *herb*. *Tubers* ovoid to obloid, 6–12 mm long, 3–6 mm wide, fleshy. *Leaf* linear to linear-lanceolate, 8–25 cm long, 3–10 mm wide, erect, fleshy, canaliculate, dark green with a purplish base, ribbed abaxially, sheathing at base, apex acuminate. *Scape* 12–40 cm tall, 0.8–2.5 mm diam., straight, green to purplish. *Sterile bract* usually 1, rarely 2, linear to linear-lanceolate, 1–5.5 cm long, 2–7 mm wide, closely sheathing, green or purplish, apex acuminate to long-acuminate. *Fertile bracts* ovate-acuminate to obovate-acuminate, 3–19 mm long, 2–6 mm wide, sheathing the pedicels, green or purplish. *Pedicels* 2–8 mm long, slender. *Ovary* narrow-obovoid, 3.5–12 mm long, 1–3 mm wide. *Flowers* 2–15, (15–)21–32 mm across, blue with darker blue longitudinal veins,

sometimes flushed mauve towards centre and at extremities, opening freely in warm weather. *Perianth segments* (7–)10–15 mm long, 3–6 mm wide, concave, often shortly apiculate; *dorsal sepal* ovate-lanceolate to ovate, obtuse to acute; *lateral sepals* ovate-lanceolate to ovate, acute; *petals* ovate-lanceolate to ovate, obtuse to acute; *labellum* lanceolate to ovate-lanceolate, often smaller than other segments, acute. *Column* erect from the end of ovary, 3–5 mm long, 1.8–3 mm wide, winged, whitish or pale blue, wings with distal flanges; *post-anther lobe* hooding the anther, 0.8–1.4 mm long, 2–2.5 mm wide when flattened, purplish black at base, apex a more or less semicircular, occasionally bilobed or incised, fleshy, irregularly undulate, yellow crest; *auxiliary lobes* converging, 0.6–1 mm long, 0.5–0.8 mm wide, flat, usually longer than wide, purplish black at base, apex shallowly toothed, fleshy but not greatly thickened, yellow; *lateral lobes* converging, 1.5–2.5 mm long, flat, porrect or obliquely erect, 0.7–1 mm wide at base, tapering abruptly, distal half oblong, each with a mass of erect and spreading trichomes on distal margins, the individual trichomes 0.7–1 mm long, white or purplish. *Anther* situated about mid-way along column, mostly obscured behind stigma, ovoid, 1.5–2.5 mm

**Figure 7.** *Thelymitra occidentalis* Ravensthorpe, Western Australia (photograph by C.J. French).

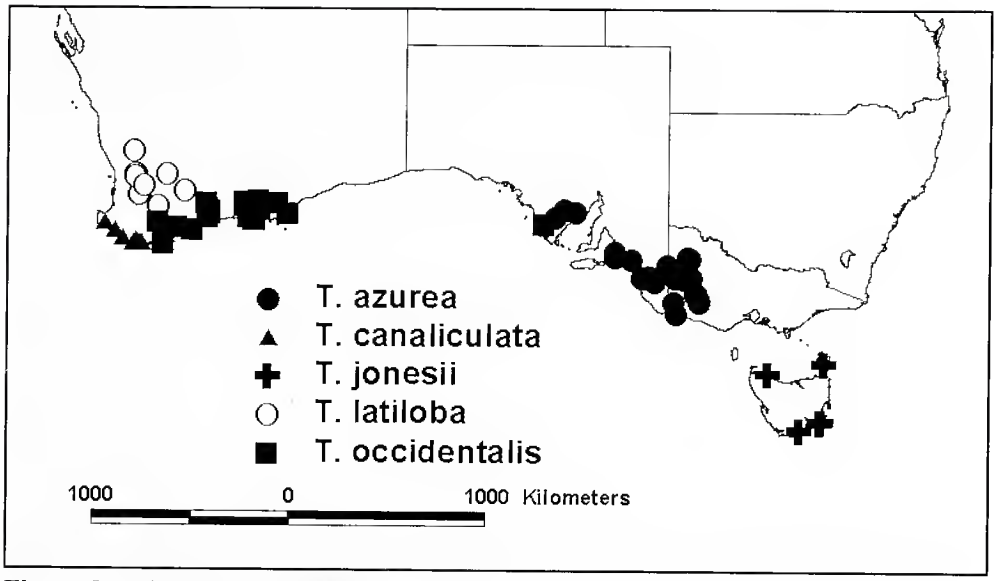


**Figure 8.** Distribution of *Thelymitra canaliculata, T. azurea, T. jonesii, T. latiloba* and *T. occidentalis.*

long, 1–1.5 mm wide, connective produced into an apical beak 0.4–0.6 mm long; *pollinarium* 1.2–2 mm long; *viscidium* more or less circular, c. 0.3 mm diam.; *pollinia* white, friable, mealy. *Stigma* situated at base of column, oblong, 2–2.5 mm long, 1–1.5 mm wide, margins irregular. *Capsules* obovoid, 6–12 mm long, 4–7 mm wide, erect, ribbed. (Fig. 2 d–f; Fig. 7)

*Selected specimens examined*: WESTERN AUSTRALIA: Mt Merivale, 20 km E of Esperance, 30 x. 1995, *B. Archer 174* (MEL *2032837* & MEL *2032838*); Norseman–Esperance Rd, c. 5 miles S of Grass Patch, 7 ix. 1963, *J.H. Willis s.n.* (MEL *221698*); Lower southern slopes of East Mt Barren, 13 km WNW of Hopetoun, 4 x. 1966, *T.B. Muir 4176* (MEL *565673*); Roe Botanical District, 32 km NE of Mt Ridley, 14 ix. 1991, *W.R. Archer 1409935* (MEL *2013882*); 6 km E of Mt Buraminya, 11 x. 1992, *W.R. Archer 1110923* (MEL *2034244*); 6 km ENE of Mt Buraminya, 11 x. 1992, *W.R. Archer 1110922* (MEL *2034243*); Mount le Grand, near Esperance, 11 ix. 1971, *A.S. George 11017* (PERTH *00300632*); Ravensthorpe–Hopetoun Rd, *W. Rogerson 258* (PERTH *00293407*); Ravensthorpe, ix. 1967, *Mrs V.M. Bennett s.n.* (PERTH *00293466*); 10 miles ESE of Tambellup, 30 ix. 1971, *A.S. George 11081* (PERTH *00300659*).

*Distribution and habitat*: Western Australia and South Australia (Fig. 8). In Western Australia it is found in southern regions between Katanning and the South Australian border, with isolated inland records for the southern fringe of the Great Victoria Desert (Hoffman & Brown 1998). In South Australia, apparently found on the Eyre Peninsula (eg. Mt Hope), based on unpublished information (R. Bates pers. comm.) and on plate 199 in *Orchids of South Australia* (Bates & Weber 1990). Grows in sand or sandy clay soils in heathland or shrubby mallee woodland, often near rock outcrops or around winter-wet depressions. Altitude: 5–200 m.

*Conservation Status*: This species is very widespread and represented in reserves.

*Flowering period*: September to early November.

*Pollination biology*: The large, freely opening flowers, coherent pollen, functional viscidium and sporadic capsule development, indicate that this species is most likely entomophilous.

*Notes*: *Thelymitra occidentalis* is apparently most closely related to *Thelymitra azurea*, but the two species are quite distinct (see notes under the latter species). *Thelymitra occidentalis* has also been confused with *Thelymitra canaliculata* (see notes under the latter species).

A few collections of *T. occidentalis* from near Esperance are unusual in having two sterile bracts and mauve hair tufts on the lateral lobes. This variant also appears to multiply vegetatively as one specimen examined had a developing daughter tuber on a lateral root.

*Etymology*: Latin *occidentalis*, western; the species has a generally more western distribution than its closest congener, *Thelymitra azurea*.

The following key is provided to distinguish the five members of the *Thelymitra canaliculata* complex.

1. Auxiliary lobes of the column held in close proximity to the post-anther lobe and only differentiated from the latter by two shallow incisions in, or by two inward folds of, the distal margin; lateral lobes of the column to 1 mm long; perianth segments usually to 10 mm long; Tasmania only ..... ***T. jonesii***
1. Auxiliary lobes of the column held well away from the post-anther lobe and differentiated from the latter by two obvious broad recesses in the distal margin; lateral lobes of the column >1 mm long; perianth segments usually more than 10 mm long; mainland Australia only ..... 2
2. Auxiliary lobes of the column 0.8–2.1 mm wide, usually wider than long; post-anther lobe of the column >2.5 mm wide when flattened, distal margin greatly convoluted and often deeply dissected; Western Australia only (far south-west corner and western wheatbelt) ..... 3
2. Auxiliary lobes of the column 0.5–0.8 mm wide, usually longer than wide; post-anther lobe of the column to 2.5 mm wide when flattened, distal margin not greatly convoluted or deeply dissected; Southern Australia (extending from Albany in Western Australia to the Victorian Grampians) ..... 4
3. Auxiliary lobes of the column 1.1–2.1 mm wide, 0.4–0.7 mm long; post-anther lobe of the column often a dorsally compressed tube; apex of column lobes white or pale pink; flowers mostly in October; plants growing in 'Wandoo' open forests and woodlands of the western edge of the Western Australian wheatbelt ..... ***T. latiloba***
3. Auxiliary lobes of the column 0.8–1.3 mm wide, 0.8–1.1 mm long; post-anther lobe of the column rarely a dorsally compressed tube; apex of column lobes bright yellow; flowers mostly November to December; plants growing in moist situations around swamp margins of far southwest Western Australia ..... ***T. canaliculata***
4. Post-anther lobe of the column usually <2 mm wide when flattened, apex forming an arc-like rim subtended by an angle of about 90 degrees; flowers mostly October and November; South Australia and Victoria ..... ***T. azurea***
4. Post-anther lobe of the column 2–2.5 mm wide when flattened, apex forming a more or less semicircular arc-like rim; flowers mostly September to October; southern Western Australia and South Australia (Eyre Peninsula) ..... ***T. occidentalis***

## Concluding remarks

This paper is based primarily on the quantitative and qualitative study of dried and spirit preserved herbarium specimens, supplemented by field observations, photographs and illustrations from the literature. Although the specimens within each species show considerable variation, no intermediates were encountered and remarkably few were difficult to classify, and these were generally dried specimens that had either been pressed poorly and lost important diagnostic features or had deteriorated with age. A few aberrant specimens were encountered, and comment is made on these under the species in question. The size, shape and position of the auxiliary lobes are the most important diagnostic features of this complex, and most specimens can be identified positively from these alone.

The size and shape of the post-anther lobe are particularly important in distinguishing between *Thelymitra azurea* and *Thelymitra occidentalis*, which appear to be close sister taxa. The yellow pigment at the apex of the post-anther lobe and auxiliary lobes of four of the five species is highly durable and obvious in most dried specimens regardless of age. Dried specimens of *Thelymitra latiloba* are usually readily identified by their lack of this yellow pigmentation. Annotations on herbarium sheets concerning flowering times and habitat preferences are also useful aids to identification.

The presence of *T. occidentalis* in South Australia is not supported by any preserved specimens that I had access to during this study. A more complete picture of its distribution would be facilitated by field research, particularly on the Eyre Peninsula.

## Acknowledgments

I am grateful to the Australian Biological Resources Study (ABRS) and the Australian Orchid Foundation (AOF) for their financial support of my work on *Thelymitra* during 2000 and 2001. I wish to thank Bob Bates, Chris French, Les Rubenach and Hans Wapstra for supplying me with locality information, specimens or photographs of the new taxa. My colleague Neville Walsh (MEL) kindly wrote the Latin diagnoses and made helpful comments on the text. My appreciation also goes to Enid Mayfield (MEL) for executing the line drawings, Peter Neish (MEL) for the distribution map and the directors and curatorial staff at AD, CANB, HO, MEL, NSW and PERTH for access to specimens.

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## Errata

D.J. Carr 'The stomata of bluegums (*Eucalyptus* spp.), Vol 14, p. 34

On Table 1, under Mueller, Juvenile leaves, the '132' under 'Size µm' belongs under Juvenile leaves, 'Frequency $mm^2$

**Table 1.** Stomatal size* and frequency in *E. globulus*

| Author | | Juvenile | | | Adult | |
|---|---|---|---|---|---|---|
| | | Size µm | Frequency $mm^2$ | | Size µm | Frequency $mm^2$ |
| *Mueller* | upper | | 70 | upper | 60 | |
| | lower | | 132 | lower | 51 | 87 |
| Briosi | upper | | | upper | | |
| | lower | 40–60 | 162 | lower | 80–100 | 59 |
| Johnson | upper | | | upper | 53 | 86 |
| | lower | 29 | 83.8 | lower | 54 | 86 |
| Carr and Carr (1) | lower | 27 | 142 | lower | 53 | |
| Carr and Carr (2) | upper | | | upper | (na) | |
| | lower | 26.5 | 191 | lower | (na) | |
| Carr and Carr (3) | lower | 27.6 | 127 | lower | 53.3 | |
| Carr and Carr (4) | lower | 35.4 | | lower | 58.3 | |
| Maiden & Mansfield (1968) | lower | 31 | | | | |
| Ridge, R.W. (1980) | upper | | | upper | 56 | 129 |
| | lower | | | lower | 57 | 63.6 |

*The size measurements in all Tables are of stomatal length (micrometres) (means of 30 determinations) .

S.Ford, M. Gibson and G. Duke 'The lichens of *Nothofagus cunninghamii*-dominated rainforests and *Acacia melanoxylon*-dominated forest in the Otways, Victoria.'

The following figure should replace **Figure 2.**

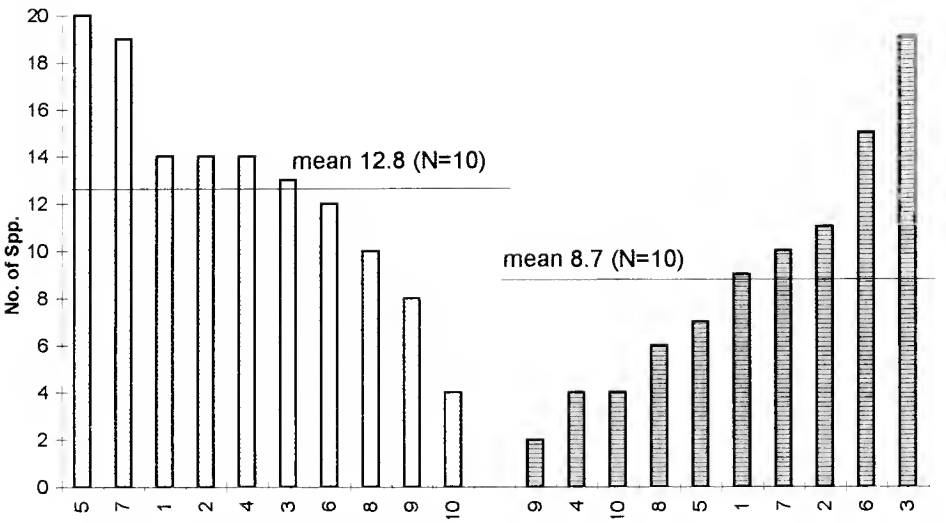


**Figure 2.** Species richness per quadrat in the two forest types. A *t* test on the difference between the means was not significant with $p = 0.085$.

The figure caption remains the same.

J.A. Jeanes, 'Two new species of *Thelymitra* (Orchidaceae) from south-eastern Australia.'

Figures 1 and 3 are reproduced here.

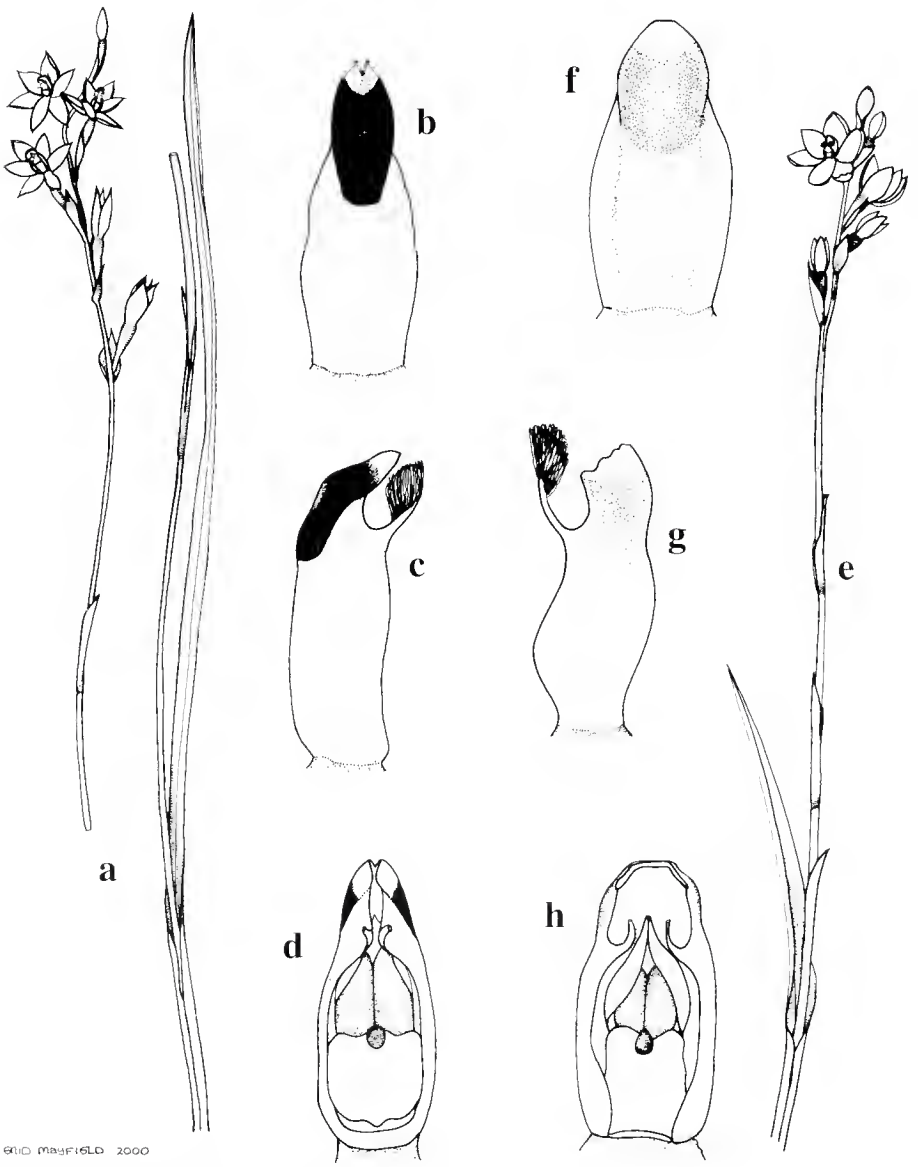


**Figure 1.** *Thelymitra atronitida*: **a** habit × 0.5; **b** column from rear × 6; **c** column from side × 6; **d** column from front × 6. *Thelymitra planicola*: **e** habit × 0.5; **f** column from rear × 6; **g** column from side × 6; **h** column from front × 6.

**Figure 3.** *Thelymitra atronitida* Mallacoota area

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