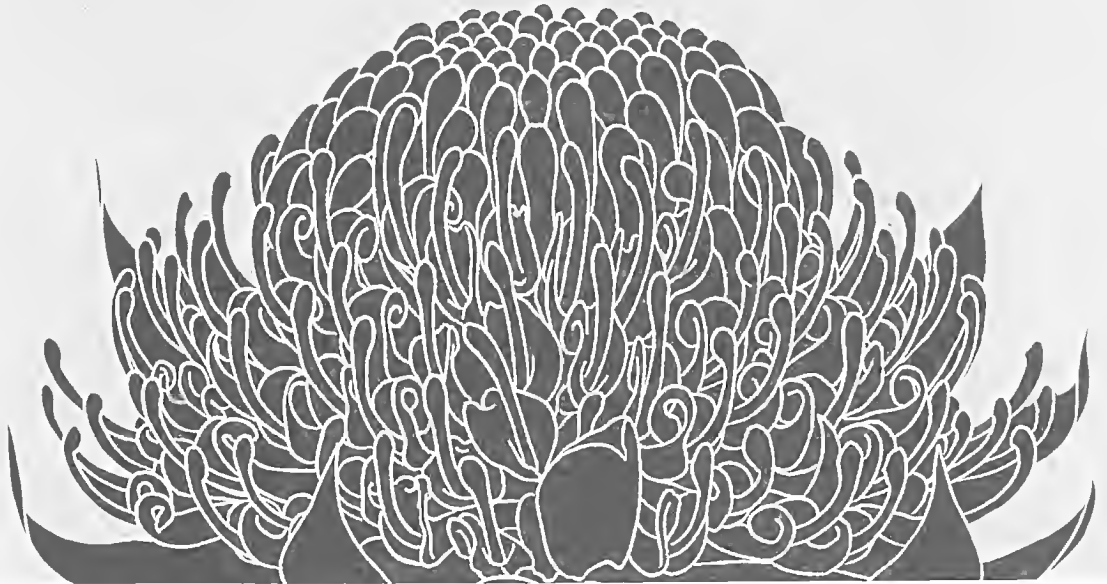


# TELOPEA

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*Paenula storyi*, a new genus and species  
related to *Ixodia* and *Haeckeria*  
(Asteraceae: Gnaphalieae)

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**Abstract**

A plant collected incidentally 40 years ago SSE of Wollar in the Central Western Slopes district of New South Wales is shown to represent a new genus and species, combining the paleae characteristics of *Ixodia* with the leaf characteristics of *Haeckeria* s.str. and the phyllary characteristics of *Cassinia* and *Haeckeria*. As in *Haeckeria*, and some species of *Odixia* and *Cassinia*, it lacks a pappus. The genus *Paenula* and species *Paenula storyi* are described and illustrated, the few available details of ecology summarised, and inter-relationships discussed.

**Introduction**

In an earlier paper (Orchard 1981) I discussed character distribution in a range of genera related to *Ixodia* (*Odixia*, *Haeckeria*, *Anmobiium*, *Cassinia* and *Ozothamnus* (as *Helichrysum*)). It was shown that this group of shrubby Asteraceae showed a braided series of inter-relationships, where characters usually thought to be diagnostic (presence and absence of pappus, presence and absence of paleae, production of a showy 'petal-like' reflexed tip to the inner phyllaries, etc) seemed to be segregating independently of each other. That paper resulted in the description of a new genus *Odixia*, to accommodate two Tasmanian species formerly placed in *Ixodia*. *Odixia* is separated from *Ixodia* in having only 5–6 florets per capitulum, membranous phyllaries, of which the innermost are  $\pm$ linear with a narrow white tip, and either lacking paleae between the florets, or paleae flat, linear or filiform. *Ixodia* has 20–30 florets per capitulum, green  $\pm$ fleshy phyllaries, of which the innermost are clawed with a broad white hooded tip, and the paleae wrap around and envelop the florets. There were other minor character differences: for example, in *Ixodia* the abscising fruits leave peg-like scars on the receptacle, while in *Odixia* the scars are rough but not peg-like. It was suggested that *Odixia* was probably more closely related to *Cassinia* and *Haeckeria* than to *Ixodia*. *Odixia*, *Cassinia* and *Haeckeria* share a  $\pm$ woody shrubby habit, membranous phyllaries which are not noticeably expanded at the tips into petaloid appendages, and paleae which, when present, are planar or at most, longitudinally fluted. *Ixodia* is a short lived shrub, has green fleshy phyllaries, well

developed showy petaloid terminal appendages on the inner phyllaries, and paleae which wrap around the achene and base of the floret. *Ixodia* was last revised by Copley (1982).

In a separate paper (Orchard 2004) I discuss the variation and limits of *Haeckeria*, reducing that genus to just two species, *H. punctulata* and *H. cassiniiformis*. Thus reduced, *Haeckeria* is defined as comprising short-lived woody shrubs bearing fleshy trigonous leaves with embedded dark glands, capitula of 1, 2 or 3 bisexual florets with no paleae, florets epappose, and phyllaries membranous or cartilaginous, each narrowly ovate, slightly hooded, incurved at tip and lacking showy petaloid appendages.

In the course of preparing the above paper and another on *Cassinia*, I came across a specimen from New South Wales which caused me to revisit the *Ixodia* complex. This specimen was collected almost accidentally in 1961 by R. Story. He had collected specimens of *Cassinia quinquefaria* from south-south-east of Wollar, from an unnamed 'nephaline hill'. In addition to flowering material of the *Cassinia* he collected some other material that he thought was fruiting material of the same species. However, during processing at the National Herbarium of New South Wales it was noted that the fruiting material did not belong to *C. quinquefaria*, and it was annotated '*Cassinia* sp. nov.' As the material was rather scrappy, it lay in limbo for the next 40 years.

### Taxonomy

Examination of the above material in the course of my *Cassinia* revision revealed that it was not part of that genus. The leaves are terete-trigonous, rugose, with an obscure midrib, and the leaves have, on all three surfaces, deeply sunken dark pit-glands. The capitula are *Cassinia*-like, with white phyllaries all slightly hooded, incurved at the tip, spirally arranged, and lacking a showy reflexed petaloid tip. The florets are all bisexual, epappose, few in number (6 per capitulum) and each is enclosed in a stiff hyaline sheath formed by its subtending palea.

In its leaf characters (trigonous with dark sunken glands) this plant most closely resembles *Haeckeria* s. str. Some plants of *Ixodia* can also exhibit dark sunken pit-glands, but the leaves in that genus are usually flattened, never trigonous in section. In its capitulum structure the new species mimics *Cassinia*, and it was this allied with its  $\pm$  terete leaves which undoubtedly led to its temporary identification as *Cassinia* sp. nov. However, similar inflorescence structures and capitulum structures are also found in *Ozothamnus* and in *Haeckeria* s.str., and the leaf anatomy of *Paemula* is not reflected in any species of *Cassinia*, where the leaves are uniformly dorsiventral and never exhibit dark sunken pit-glands. The interim close identification of this taxon with *Cassinia* is thus to be disregarded. In lacking a pappus it also resembles *Haeckeria*, *Odixia* and some anomalous *Cassinia* species (see Orchard, in prep.), but in its peculiar sheathing paleae it is obviously linked to *Ixodia*.

The Story material clearly represents a new species, and it does not fit well in any of the existing genera. Expansion of the limits of any of them to accommodate it would introduce unsatisfactory anomalies elsewhere. The most satisfactory solution seems to be to recognise it as a distinct genus, sister to *Ixodia* (or perhaps *Haeckeria*), and distinguished from its near relatives as follows:

- 1. Paleae forming a stiff hyaline sheath around the achenes and base of the florets; leaves often with dark sunken pit-glands.
  - 2. Capitula of 20–30 florets; phyllaries green and subfleshy, leaves decurrent, terete or flattened but not trigonous ..... *Ixodia*
  - 2: Capitula of c. 6 florets; phyllaries white, membranous to cartilaginous; leaves sessile, not decurrent, trigonous ..... *Paenula*
- 1: Paleae (if present) flat or at most longitudinally fluted; leaves glabrous, pubescent or with dark sunken pit-glands; phyllaries membranous to cartilaginous
  - 3. Pappus absent
    - 4. Inner phyllaries with spreading petaloid tips; leaves dorsiventral with well defined midrib, glabrous or pubescent but never with dark sunken pit-glands; paleae present or absent ..... *Odixia*
    - 4: Inner phyllaries lacking spreading petaloid tips
      - 5. Leaves trigonous, lacking prominent midrib below, with dark sunken pit-glands; paleae absent ..... *Haeckeria*
      - 5: Leaves dorsiventral with prominent midrib below, glabrous, cottony pubescent or scabrous but never with dark sunken pit-glands; paleae present ..... *Cassinia*
  - 3: Pappus of shortly toothed bristles
    - 6. Paleae present (or if absent, florets 1–3 per capitulum); often aromatic shrubs with a resinous or ‘curry’ smell; phyllaries all with incurved tips ..... *Cassinia*
    - 6: Paleae absent (florets rarely as few as 3, usually 8–10 or more); usually not aromatic; phyllaries all with incurved tips or innermost spatulate with spreading petaloid tips ..... *Ozothamnus*

### Generic relationships within Asteraceae–Gnaphalieae

The two major papers relevant to how this new genus fits in the Gnaphalieae are Anderberg (1991) and Bayer et al. (2002).

Anderberg (1991) published a number of trees where of all of the above genera (obviously excluding *Paenula*) were in the Cassiniinae. Unfortunately Anderberg included within his concept of *Haeckeria* species that are now considered to belong in *Ozothamnus* (*H. pholidota*), and *Cassinia* (*H. ozothamnoides*). This was reflected in his prophetic statement (p. 87) under *Haeckeria* that “the genus appears to be polyphyletic”. Despite this, it is interesting to note that his strict consensus tree for Cassiniinae (Fig. 12, p. 32) shows *Haeckeria* + *Apalochlamys* as sister taxa to *Ixodia* + *Odixia*, and this group of four genera sister to *Ozothamnus*, and that combined clade in turn sister to *Cassinia*. Other analyses omitted *Haeckeria* and are thus uninformative. On morphological grounds, the inclusion of *Apalochlamys* in Anderberg’s subclade of *Apalochlamys*, *Haeckeria*, *Ixodia* and *Odixia* seems to me problematical, but the grouping of the other three genera is credible morphologically. I would place *Paenula* in this subclade.

Bayer et al. (2002) provided a different set of trees based on molecular sequence data. These trees appeared to show that *Ixodia* and *Haeckeria* were situated on widely different branches (branches E and G, Fig. 1, p. 807). However, the Bayer et al. analysis sequenced only one individual from ‘*Haeckeria*’, and unfortunately this individual was

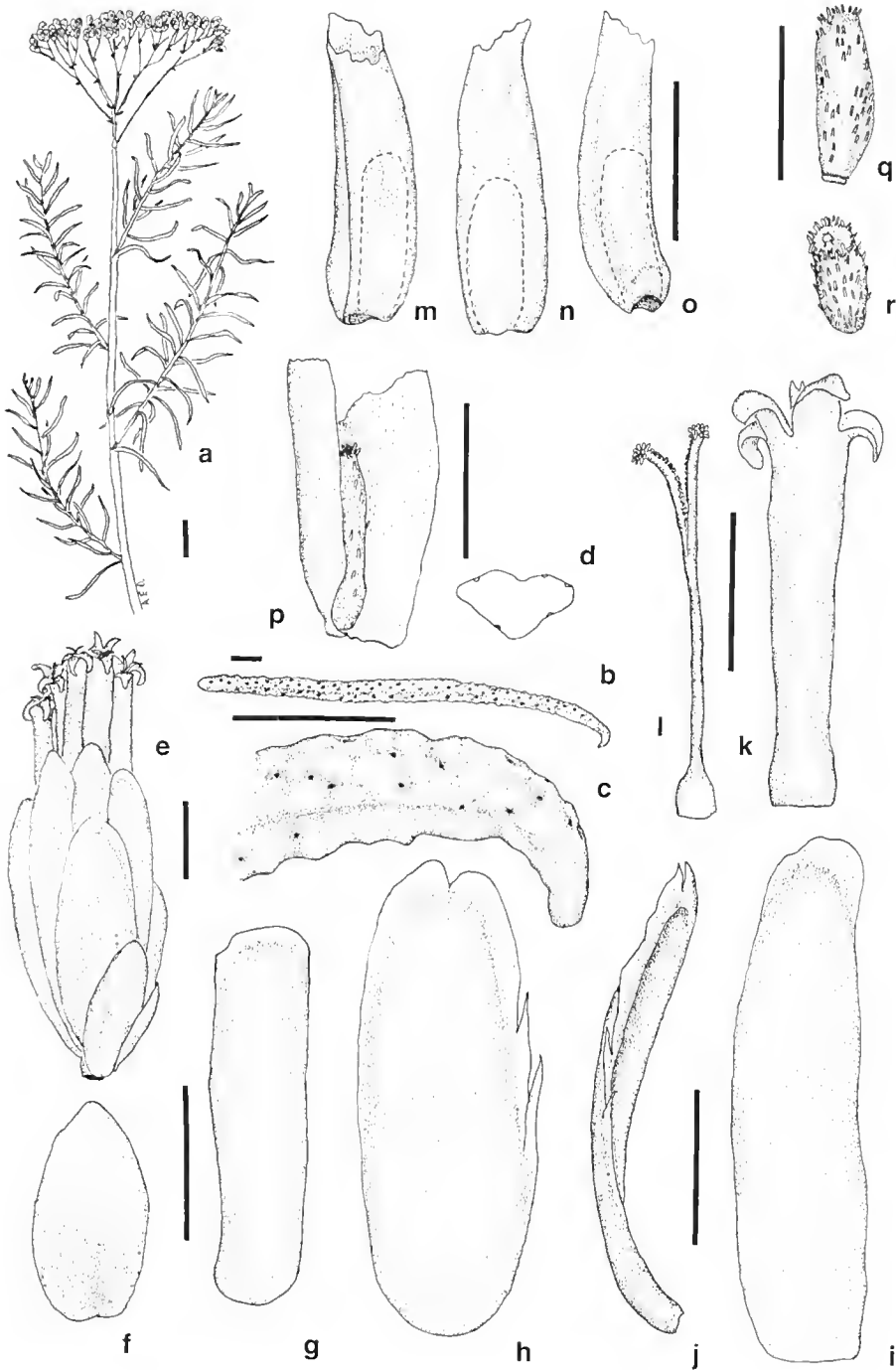


Fig 1. *Paemula storyi*, a, habit; b, leaf; c, leaf tip; d, diagrammatic TS of leaf; e, capitulum; f–i, phyllaries from outer to inner, dorsal views; j, phyllary, lateral view of (h); k, corolla; l, style and stylopodium; m, achene enclosed in palea, axial view; n, same, dorsal view; o, same, lateral view; p, achene unusually only partly sheathed by palea; q, achene, lateral view; r, achene oblique apical view. Scales = 1 cm (a) or 1 mm (b–r). All drawings by author, based on *Story 7587*.



from a taxon that is in fact an undescribed species of *Cassinia* (Orchard 2004). Thus the analysis provides molecular support for my segregation of this taxon (on morphological criteria) as a *Cassinia* (the Bayer et al. analysis placed it as sister to *Cassinia*, represented by a collection of *C. longifolia*), but does not provide any indication of the real relationships of *Haeckeria* to *Cassinia* or *Ixodia*, or any indication of where *Paenula* might fit in this hypothetical phylogeny.

***Paenula* Orchard, *gen. nov.***

Frutices; foliis alternis, teretibus, plusminusve trigonis in sectionis, glandibus inclusis fuscatis depressis; inflorescentiis cymosis, umbelliformibus; capitulis pedunculatis, albis, ovoideis; phyllariis membranaceis vel cartilagineis, parum cucullatis, apicibus petaloideis expansis destitutis; flosculis omnibus bisexualibus, tubularibus; paleis cartilagineis, hyalinis, tubularibus achenia et basis corollae vaginantibus; pappibus destitutis; acheniis exutis in paleam vaginantem.

Shrubs; leaves alternate, terete,  $\pm$ trigonus in section, with embedded dark sunken glands. Inflorescence cymose, umbelliform, with pedunculate capitula. Capitula white, ovoid; phyllaries membranous to cartilaginous, slightly hooded, lacking petaloid spreading tips, with undivided sterome; florets all bisexual, tubular. Paleae tough, hyaline, wrapping around and enclosing achene and base of corolla. Pappus absent. Carpodium well-developed. Achenes shed still enclosed in paleae.

Type: *P. storyi* Orchard

***Paenula storyi* Orchard, *sp. nov.***

Caules glabri. Folia 20 mm longa, 1 mm lata, rugosa glandibus fuscatis depressis in omnis paginis, glabra, sessilia; apice acuto, reflexo, non mucronato. Capitula in pedunculis 2 mm longis. Capitula 3.0–3.5 mm longa, 1.5–1.7 mm lata, ovoidea; phyllariis spiratim dispositis, cucullatis, glabris. Phyllaria externa ovata, 1.2 mm longa, 0.6 mm lata. Phyllaria interna oblonga, 2.4–2.8 mm longa, 0.7–0.8 mm lata. Flosculi c. 6 per capitulum. Corolla cylindrica, tubo 2.2 mm longo, 0.4 mm lato, vix tumido ad basim. Achenium purpureo-brunneum, fusiforme, 1.1 mm longum, 0.3 mm latum, trichomatibus gemellis sparsis appressis tectum.

Type: New South Wales: Central Western Slopes: 18 miles [c. 29 km] north by east of Rylstone (about 12 miles [c. 19 km] S.S.E. of Wollar) *R. Story* 7587, 18 Mar 1961, holotype NSW232395.

Stems glabrous, weakly longitudinally ribbed. Leaves 20 mm long, 1.0 mm wide, rugose with dark sunken glands on all surfaces, glabrous, sessile, not stem clasping; tip acute, reflexed, not mucronate. Inflorescence slightly domed. Capitula on peduncles 2.0 mm long; peduncles and inflorescence branches subtended by keeled deltoid bracts 1.0 mm long. Capitula 3.0–3.5 mm long, 1.5–1.7 mm diam., ovoid; phyllaries spirally arranged, all somewhat hooded, incurved at tip. Outer phyllaries ovate, 1.2 mm long, 0.6 mm wide, glabrous; sterome green, drying brown in lower two thirds; opaque white in upper one third and on wings. Inner phyllaries oblong, 2.4–2.8 mm long, 0.7–0.8 mm wide, glabrous, with poorly defined green-brown sterome in lower half to two thirds; upper part and wings white opaque. Paleae cartilaginous; occasional outer paleae oblong, hyaline, 2.1 mm long, 0.6–0.7 mm wide, longitudinally fluted, with truncate erose tip; most paleae enveloping base of florets and achenes in a stiff 2-lipped tunic. Florets c. 6 per capitulum, all bisexual. Corolla cylindrical; tube 2.2 mm

long, 0.4 mm wide, scarcely swollen at base; corolla lobes deltoid, 0.4 mm long, reflexed, glabrous. Anthers 1.25 mm long incl. 0.13 mm deltoid appendage; anther tails filamentous, 0.25 mm long. Style 2.0 mm overall, divided into 2 branches in upper 0.9 mm; stylopodium transparent, conical, 0.25 mm long, very minutely rugulose. Style arms truncate, with well developed brush of clavate hairs. Achene purple-brown, fusiform, 1.1 mm long, 0.3 mm diam., with sparse appressed twin hairs for entire length, and a denser ring of hairs apically.

**Distribution:** New South Wales, Central Western Slopes. Known only from the type specimen, collected SSE of Wollar.

**Ecology:** Found on a nephaline hill, with *Cassinia quinquefaria* (Story 7577) and *Eucalyptus albens* dominant. Other material collected at the same time and place comprised *Encalyptus goniocalyx* (Story 7574), *Encalyptus laevopinea* (Story 7575), *Grevillea ramosissima* subsp. *ramosissima* (Story 7576), *Eucalyptus blakelyi* (Story 7578) *Eucalyptus dawsonii* (Story 7579) and *Muellerina bidwillii* (Story 7580). Fruits were present in mid-March. At or immediately after seed shed, capitula abscise below the phyllaries, leaving the small subtending bracts and peduncles still attached to the twiggy remains of the inflorescence.

**Etymology:** The generic name *paemula* is a word used by Cicero to describe a coat without sleeves and close to the body, worn on a journey, i.e. a kind of close-fitting cloak. It alludes to the distinctive tightly cloaked fruits of this taxon. The species epithet commemorates the original discoverer, Robert Story, ecologist (1913–1999).

## Notes

It may be argued that this plant really represents an *Haeckeria* which has retained its paleae. After all, in *Haeckeria punctulata* and *H. cassiniiformis*, the character of the missing paleae can not be determined, except by analogy. Wakefield (1951) and Orchard (2004) have noted that in *Cassinia*, which differs from *Haeckeria* in usually having a pappus and paleae, the paleae are apparently absent in capitula with only 1, 2 or 3 florets. In these inflorescences it is argued that the paleae (situated on the abaxial side of the florets) are adjacent to and indistinguishable from the inner phyllaries. Only in capitula with more than 3 florets will paleae be interposed between adjacent florets. By analogy, if the few-flowered capitula of *Haeckeria* have paleae, then they must be similarly indistinguishable from the inner phyllaries and thus  $\pm$ flat. Therefore in *Haeckeria* the paleae are either completely absent (as most believe), or  $\pm$ flat and resembling the inner phyllaries. In either case, the situation differs from that in *Paemula* where the paleae are sheathing.

*Paemula storyi* was searched for unsuccessfully in February 2004 near its original place of discovery, in the vicinity of Growee Gulph, and again, unsuccessfully, in early March 2004 on Barigan Road, SSE of Wollar. The latter seems the most likely source of Story's original collection — the respective reference distances from Rylstone and Wollar turn out to miss each other by about 10 kilometres. At about the correct distance (12 miles) from Wollar there is in fact a small hill composed largely of basaltic boulders, on the property of Mr John Jakes, "Derowen". This hill bears a remnant scrub of *Eucalyptus albens*, *Cassinia quinquefaria* and *Bursaria spinosa* on its summit, with occasional legumes and herbaceous Asteraceae, but there was no sign of *Paemula*. A few kilometres

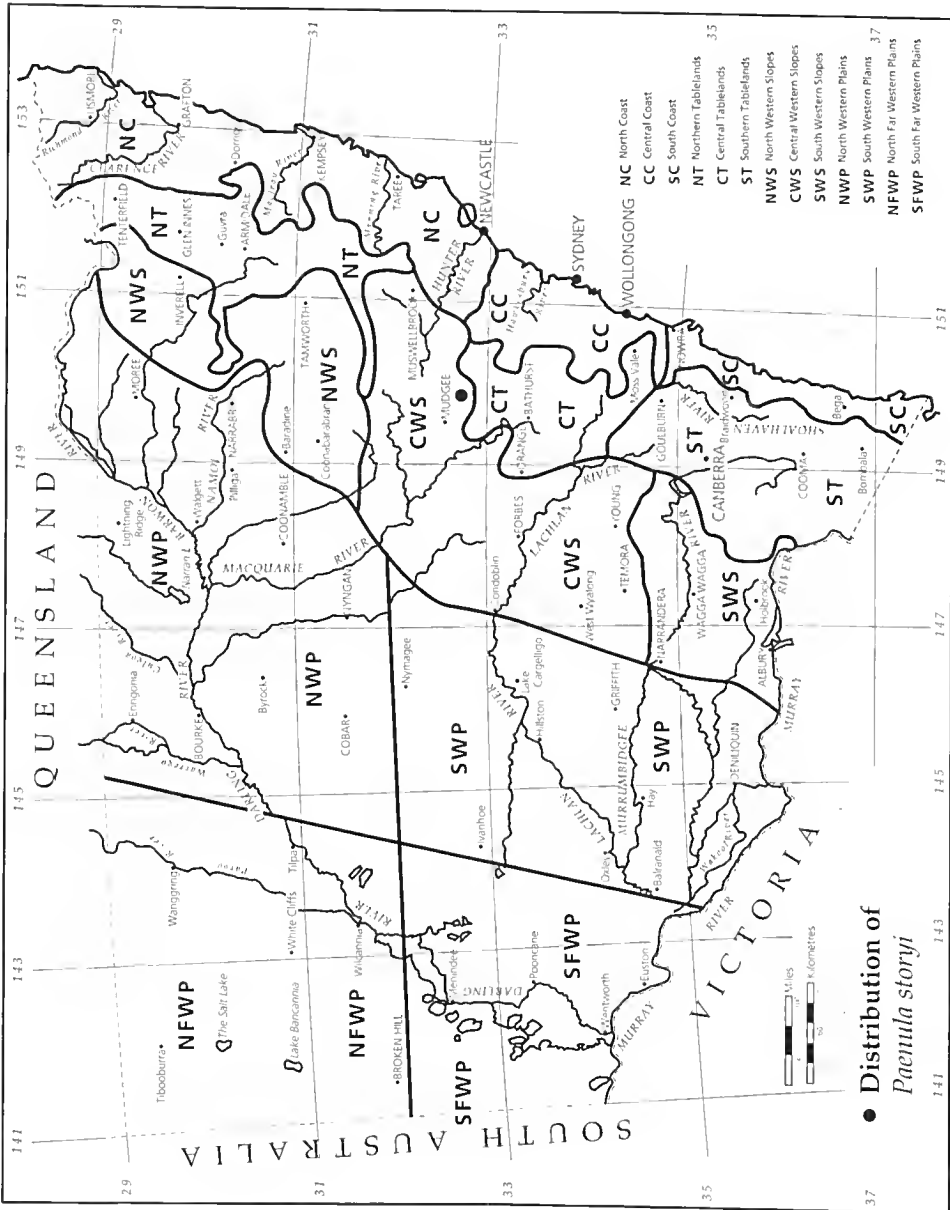


Fig. 2. Distribution of *Paenula storyi*, New South Wales.

further along the same valley there is a volcanic plug, which now has only a grassy covering. All other hills in the near vicinity seemed to be mainly sandstone. The upper slopes of these (generally larger) hills are covered with a dense forest of *Eucalyptus* spp., *Callitris*, *Xanthorrhoea* and *Cassinia quinquefaria*. No material resembling *Paemula* was discovered in a vegetation survey of the adjacent Merriwa area by McRae & Cooper (1985).

This lack of success in rediscovering *Paemula* may signify nothing more than that the plant is short-lived. Reference has already been made to the morphological similarity between *Paemula* and the two *Haeckeria* species. Several collections of *Haeckeria* bear notes on their ephemeral nature. *Haeckeria* species may appear in abundance after major disturbance such as fire or 'chaining' of the mallee scrub in which they grow. However they are usually senescent in 4–5 years and disappear completely within 10 years, awaiting the next disturbance. It is very possible that *Paemula* is behaving similarly and will be re-discovered in the Wollar/Rylstone area after a future disturbance.

It has been suggested by readers of earlier drafts of this paper that *Paemula storyi* might also be explained as a short-lived hybrid or polyploid, but those making this suggestion offer no suggestions as to parent taxa or (diploid) ancestor. However, the possibility is worth exploring. My morphological analysis suggests that the two most diagnostic characteristics of this taxon are its cloaking paleae (in the Cassiniinae shared only with *Ixodia*, the nearest representatives of which are currently found 1000 km to the west of *Paemula*), and the trigonous leaves with sunken pit-glands (in the Cassiniinae shared only with *Haeckeria* s. str., the nearest representatives of which are currently found 900 km south-west of *Paemula*). The only Cassiniinae found near the location of *Paemula* are *Ozothamnus* and *Cassinia* species, none of which exhibit either of these character states. While this does not exclude the possibility of *Paemula* having arisen through a hybridisation or polyploidy event in the distant geological past, when *Haeckeria* and *Ixodia* may have been present in NSW, it begs the question of how long a self-perpetuating taxon needs to exist before it can be recognised as a genus in its own right? I believe that a recent hybrid or polyploidy origin for *Paemula* is extremely unlikely.

### Acknowledgments

The author is grateful to his wife Theresa, patient and observant field assistant on numerous field trips in search of *Cassinia* and related taxa, and who searched the AVH database for other Story collections from the type locality. Laurie Adams supplied background information on Robert Story. The Centre for Plant Biodiversity Research, CSIRO, Canberra, kindly provided excellent institutional support for this study and related fieldwork. Brendan Lepschi patiently joined me in the search for *Paemula* SSE of Wollar. The author is particularly grateful to John Jakes, owner of 'Derowen', for hospitality and advice during the unsuccessful search on his property. I am also grateful to Barry Conn, Karen Wilson and John Benson of the National Herbarium of NSW, for background information on Story's collections and survey of 1961. Finally, I am very grateful to the National Herbarium of NSW for including this interesting material in my loan of *Cassinia*.

## References

- Anderberg AA (1991) Taxonomy and phylogeny of the tribe Gnaphalieae (Asteraceae), *Opera Botanica* 104: 5–195.
- Bayer RJ, Greber DG & Bagnall NH (2002) Phylogeny of Australian Gnaphalieae (Asteraceae) based on chloroplast and nuclear sequences, the *trnL* Intron, *trnL/trnF* Intergenic Spacer, *matK*, and ETS. *Systematic Botany* 27(4): 801–814.
- Copley PB (1982) A taxonomic revision of the genus *Ixodia* (Asteraceae). *Journal of the Adelaide Botanic Gardens* 6: 41–54.
- McRae RHD & Cooper MG (1985) Vegetation of the Merriwa area, New South Wales. *Cunninghamia* 1(3): 351–369.
- Orchard AE (1981) The generic limits of *Ixodia* R.Br. ex Ait. (Compositae – Inuleae). *Brunonia* 4: 185–197.
- Orchard AE (2004) A reassessment of the genus *Haeckeria* (Asteraceae – Gnaphalieae), with definition of a new species in *Cassinia*. *Australian Systematic Botany* 17: 447–467.
- Wakefield NA (1951) Some notes on *Cassinia* with description of a new species. *Victorian Naturalist* 68: 69–70.

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# Morphological and ontogenetic studies on the gynostemium of some Australian members of *Diurideae* and *Cranichideae* (Orchidaceae)

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## Abstract

Gynostemium development of *Genoplesium fimbriatum* (Orchidaceae—Diurideae) is described and documented by means of SEM micrographs. Other Australian representatives of tribes Diurideae and Cranichideae are briefly treated. Particular attention is paid to the early stages which are essential for the correct interpretation of the gynostemium structure. It was found that gynostemium development largely conforms to that of the other Orchidaceae that have been examined in this respect. Several of the species have auricles (filament appendages) next to the anther and a shallowly or prominently three-lobed median stigma lobe in middle ontogeny which are both interesting similarities shared with tribes Orchideae and Diseae. As in the latter two tribes, the mature lateral gynostemium appendages ('column-wings') of some of the study species are of dual origin, comprising both a staminodial and an auricular element.

## Introduction

The available literature on the Australian terrestrial orchids consists mainly of floristic, taxonomic and phylogenetic studies. Although a limited amount of information on the flower structure of many species can be obtained in the existing literature, little detailed work on floral morphology has been carried out on a broad scale. A notable exception is the careful study of Rasmussen (1982) who described gynostemium structure and development of a few Australian terrestrial orchids in great detail. Very recently detailed information on the flower morphology and ontogeny of *Calochilus* has been made available (Perkins 2001).

In the present paper gynostemium development in *Genoplesium fimbriatum* (= *Prasophyllum fimbriatum*) is described in detail and that of several other Australian terrestrial orchids is more briefly characterised. Ontogenetic information on a few more superficially studied species is summarised in a table. Development was found to be basically similar to that described in other orchids where it has been more fully described (Kurzweil 1987a–b). The species examined here represent most subtribes of

tribe Diurideae and subtribe Pterostylidinae of tribe Cranichideae (all taxa *sensu* Pridgeon et al. 2001, 2003; see Table 1). Special attention is paid to the early and middle development of the gynostemium — here defined as comprising the ontogeny before the stage where the column-part (if present) starts elongating, or up to the stage where the stigma starts becoming papillose. An understanding of this particular phase is essential for a correct interpretation of the adult gynostemium architecture. While the examination of a few selected species is obviously insufficient as a character survey in large groups, the present paper is intended as a preliminary analysis and is furthermore aimed at stimulating future research. It is hoped that comparative investigations of a large number of species will be undertaken one day, with the aim of improving our understanding of the fascinating flowers of these orchids and thereby contributing characters for phylogenetic analysis. The results presented here reveal similarities shared by at least some members of all tribes of Orchidoideae that have been examined for floral development. Interestingly, these have a similar phylogenetic distribution to some other morphological features (e.g. root tubers; Dressler 1981, 1993). Recent molecular studies (e.g. Cameron et al. 1999; Kores et al. 2000, 2001; Clements et al. 2002) provide a robust phylogenetic framework within which the evolution of these features can be interpreted.

Ontogeny is probably the best criterion for recognising primary homology (de Pinna 1991) and frequently a reasonable homologisation of organs is not possible without a sound knowledge of their development. Ontogenetic studies have also proven useful in botany and zoology in sometimes allowing the relative generality of homologous character states to be observed directly (Weston 1988, 1994). Furthermore, ontogeny can also contribute valuable taxonomically significant characters. We expect that our knowledge of the phylogeny and morphological evolution of the Australian terrestrial orchids will benefit greatly from a better understanding of its floral and especially gynostemium structure and development.

### Material and methods

Most of the plant material was collected directly in the field in New South Wales (Australia) by the second author. It was preserved in FAA (ethanol 70% : glacial acetic acid : formaldehyde = 18:1:1) and subsequently transferred to 70% ethanol. The exact sources of the material are given in the appendix.

For the present SEM investigations the material was prepared in ethanol 70% under a dissecting microscope. Samples were chemically dehydrated in FDA (= formaldehyde-dimethylacetal) and subsequently critical-point-dried directly from FDA without the use of an intermedium, using CO<sub>2</sub> as the carrier gas (technique after Gerstberger & Leins 1978). The dry samples were coated with AuPd in a 'BALZERS' sputter-coater and viewed and photographed in a CAMBRIDGE STEREOSCAN S200 scanning electron microscope at 10 kV.

The terminology used here follows that published in earlier papers of the first author (particularly in Kurzweil 1987a–b).



**Table 1. Systematic distribution of the species studied among the Australian representatives of Diurideae and Cranichideae, and the extent of our investigation.**

The classification follows Pridgeon et al. (2001, 2003): early ontogeny ... up to the three-carpel-apex stage; middle ontogeny ... up to the start of the elongation of the column-part (if present) or up to the stage where the stigma starts becoming papillose; late ontogeny ... up to anthesis. The figure gives the number of different stages observed.

Taxon	Total	Ontogeny		
		early	middle	late
TRIBE DIURIDEAE				
Subtribe Acianthinae				
<i>Acianthus fornicatus</i>	12	3	3	6
<i>Corybas fimbriatus</i>	8	-	1	7
Subtribe Caladeniinae				
<i>Caladenia carnea</i>	1	-	-	1
<i>C. catenata</i>	1	-	-	1
<i>Eriochilus autumnalis</i>	4	-	-	4
<i>Glossodia minor</i>	4	-	-	4
Subtribe Cryptostylidinae				
<i>Cryptostylis erecta</i>	20	7	9	4
Subtribe Diuridinae				
<i>Diuris longifolia</i>	12	1	7	4
<i>Orthoceras strictum</i>	22	-	19	3
Subtribe Drakaeinae				
<i>Caleana major</i>	16	6	1	9
<i>Chiloglottis</i> sp.	4	-	-	4
Subtribe Megastylidinae				
<i>Lyperanthus suaveolens</i>	2	-	-	2
<i>Rimacola elliptica</i>	13	5	5	3
Subtribe Prasophyllinae				
<i>Microtis parviflora</i>	8	1	4	3
<i>Genoplesium fimbriatum</i>	31	-	20	11
Subtribe Rhizanthellinae				
-				
Subtribe Thelymitrinae				
<i>Calochilus campestris</i>	14	6	4	4
<i>C. robertsonii</i>	4	-	-	4
<i>Thelymitra carnea</i>	13	-	4	9
TRIBE CRANICHIDEAE				
Subtribe Goodyerinae				
-				
Subtribe Pterostylidinae				
<i>Pterostylis concinna</i>	15	-	6	9
Subtribe Spiranthinae				
-				

## Observations

**Table 2. Various features observed in the species studied:**

**lc ... lateral carpel apices/stigma lobes; mc ... median carpel apex/stigma lobe.**

The ontogenetic stages correspond to those defined in Table 1. x = character present, (x) = character obscure/weakly developed, - = character not present, ? = not clear, 0 = stages not observed, sep = separate, con = connate to a ridge, emarg = connate to an emarginate ridge.

Taxon (in brackets numbers of illustrations in the present paper)	Staminodes		Aurides		lc		mc (middle stage)
	early/ middle late		middle late		middle late		
<i>Acianthus fornicatus</i> (Fig. 7A-D)	x	x	-	-	con	con	clearly 3-lobed
<i>Caladenia carnea</i>	0	x	0	0	0	emarg	0
<i>C. catenata</i> (Fig. 5D)	0	x	0	0	0	emarg	0
<i>Caleana major</i> (Fig. 3D-F)	x	x	-	x?	0	emarg	obscurely 3-lobed
<i>Calochilus campestris</i> (Fig. 6)	x	x	(x)	x	con	con	clearly 3-lobed
<i>C. robertsonii</i>	0	0	0	x	0	0	0
<i>Chiloglottis</i> sp. (Fig. 5E)	0	x	-	-	0	0	0
<i>Corybas fimbriatus</i> (Fig. 5F-H)	0	x	-	-	0	emarg	clearly 3-lobed
<i>Cryptostylis erecta</i> (Fig. 4A-B)	x	x	-	-	sep	emarg	unlobed
<i>Diuris longifolia</i> (Fig. 4C-E)	x	x	-	?	con	con	unlobed
<i>Eriochilus autumnalis</i>	0	?	0	-	0	emarg	0
<i>Genoplesium fimbriatum</i> (Fig. 1A-H, 2A-C)	x	x	x	x	sep	emarg	obscurely 3-lobed
<i>Glossodia minor</i>	0	x	0	-	0	0	0
<i>Lyperanthus suaveolens</i> (Fig. 5I)	0	x	0	x	0	emarg	0
<i>Microtis parviflora</i>	x	x	-	-	0	con	obscurely 3-lobed
<i>Orthoceras strictum</i> (Fig. 4F-I)	x	x	(x)	?	sep	emarg	obscurely 3-lobed
<i>Pterostylis concinna</i> (Fig. 7E-I)	x	x	(x)	(x)	sep	sep	obscurely 3-lobed
<i>Rimacola elliptica</i> (Fig. 3A-C)	x	x	(x)	x	emarg	emarg	unlobed
<i>Thelymitra carnea</i> (Fig. 5A-C)	x	x	(x)	0	emarg	0	unlobed

### *Genoplesium fimbriatum* (R. Br.) D.L. Jones & M.A. Clem.

Commonly called 'Midge Orchid', the genus *Genoplesium* (tribe Diurideae) comprises about forty species in open situations in sclerophyllous forest and heathland in Australia (particularly in the south-eastern areas), New Zealand and New Caledonia. Vegetative as well as floral morphological features mark affinities to *Prasophyllum* in which genus *Genoplesium* was included in the past. All species are sympodial herbs with root tubers and have a single terete and hollow leaf (Jones 2001). The inflorescence bursts through the leaf at a predetermined point near its tip. Flowers are non-resupinate and have a mobile lip. Pollination is mainly carried out by small flies of the superfamily Chloropoidea, which may be attracted by nectar, fruity perfumes or mobile lips (Bower 2001). A few species are self-pollinating. Molecular phylogenetic analyses of small samples of species (Kores et al. 2001; Clements et al. 2002) suggest that *Genoplesium* s.l. is paraphyletic to *Prasophyllum* s.s.. Jones et al. (2002) transferred *G. fimbriatum* and 45 other species to the genus *Corumastylis* on the basis of these results. However, we prefer to retain the existing taxonomy until more species in the Prasophyllinae have been phylogenetically analysed and relationships are more clearly resolved.

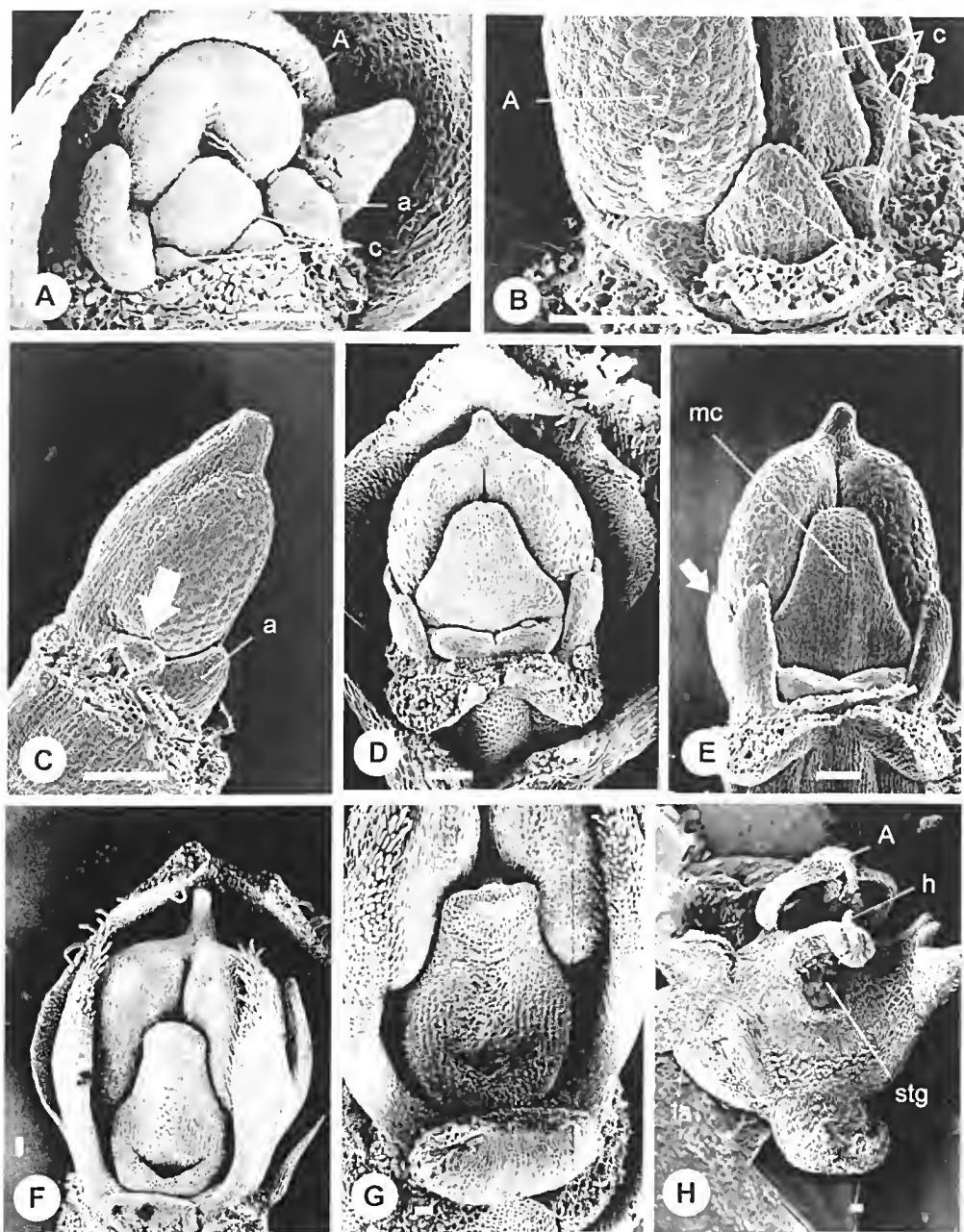


Fig. 1. *Genoplesium fimbriatum*; gynostemium development. A, D–F, Front views of the gynostemium in different stages. B–C, Base of gynostemium and whole gynostemium in side view. G, Stigma in a late stage seen from the front. H, Adult anther-stigma complex, lateral gynostemium appendages (column-wings) largely removed. — SEM micrographs. Bars: 0.1 mm. Abbreviations: A = anther, a = staminodes, c = carpel apices, h = hamulus, la = lateral gynostemium appendages, mc = median carpel apex, stg = stigma. The arrowheads mark suspected auricles (= filament appendages; see Kurzweil 1987b). Source: Weston 1277.

*Genoplesium fimbriatum*, the 'Fringed Midge Orchid', is endemic to south-eastern Queensland and the coastal areas of New South Wales where it is rather common in suitable habitats. Its flowers measure about 9-11 mm across and are prominently hairy. Sepals and petals are yellowish green with red stripes and the lip is generally pale red. The ovate median sepal is hooded and has long marginal cilia, and the divergent or spreading lateral sepals are linear to lanceolate in shape and have entire margins. Cilia are also present on the narrowly ovate or ovate and pointed petals. A characteristic feature of the species is the linear lip which is hinged on a short strap and has many long pink or red marginal cilia which tremble in the wind. It is conspicuously recurved at its apex and has a long median callus consisting of two narrow ridges. The stout gynostemium (Fig. 1H) lacks a long column-part and has a pronounced basal column-foot. Its most prominent organs are the erect column-wings which are approximately as tall as the anther. They are deeply two-lobed and basally fused to the anther-stigma-complex. The erect anther is comparatively narrow, measuring about one third of the gynostemium. An elongate, apical connective process is visible on top of the anther. The entire stigma is papillose and funnel-shaped.

In the earliest stage available (Fig. 1A) the anther is erect and its division into two thecae is made visible by a prominent gap between them which is especially pronounced in its lower part. All three carpel apices have already emerged with the median one being the largest. The latter is an erect and entire lobe in front of the anther. The two lateral carpel apices are separate structures in front of the median carpel apex. Prominent bulges are visible at the inner base of the petals, i.e. in a position superposed to them (a in Fig. 1A). On account of their position and their early initiation they are here interpreted as vestiges of the staminodes  $a_1$  and  $a_2$  which corresponds well with the situation in other groups of monandrous Orchidaceae (Kurzweil 1985, 1987a). They will be simply referred to as 'staminodes' below.

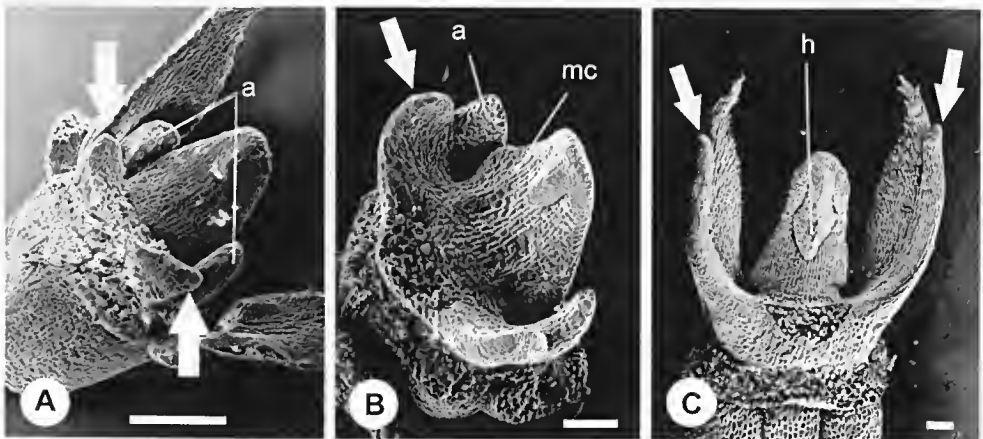


Fig. 2. *Genoplesium fimbriatum*; gynostemium in different developmental stages with the anther removed, showing the median carpel apex, the staminodes and the suspected auricles. A–B, side views; C, dorsal view. — SEM micrographs. Bars: 0.1 mm. Abbreviations: a = staminodes, h = hamulus, mc = median carpel apex. The arrowheads mark suspected auricles (= filament appendages; see Kurzweil 1987b). Source: Weston 1277.

These staminodes later grow into the anterior lobes of the prominent two-lobed wings next to the anther (Fig. 1D-H). In slightly later stages additional structures appear as small but clearly visible bulges, emerging in a dorsolateral position on the anther (arrowheads in Fig. 1B-C). They obviously do not occupy a position superposed to the petals and are thus distinct from the staminodes. They are also not simply posterior outgrowths of the staminodes which one would expect to develop late in ontogeny. It is here suggested that the dorsolateral structures in question are appendages of the filament of the anther, constituting auricles comparable to those in Orchideae (Kurzweil 1987b). The further development of these auricles is also visible in gynostemium where the anther has been removed (arrowheads in Fig. 2A-C). Later in ontogeny they become basally fused with the staminodes and grow up together with them while their common base elongates. The prominent lateral gynostemium appendages ('column-wings' in taxonomic and floristic treatments) are thus of dual origin as in some other Orchidaceae (see discussion), being derived from both lateral staminodes of the inner staminal whorl and filament appendages of the fertile anther (termed auricles). Rather early, the median carpel apex develops into an obscurely three-lobed organ (Fig. 1D-G). The lateral carpel apices become fused at their base and the resulting ridge-like structure remains significantly emarginate. Its derivation from two separate structures is thus clearly visible.

In middle and late ontogenetic stages the staminodial (= anterior) portions of the lateral gynostemium appendages become pointed and minutely lacerate (Fig. 1F, 2C). The posterior auricular portions remain rounded and oblong lobes and their surface remains smooth throughout ontogeny. In middle and late stages they are slightly shorter than the staminodial portions (Fig. 2C). The three carpel apices form an oval pad with a flat front face in late development (Fig. 1G), and the median carpel apex is by far the largest of the three carpel apices. It is a long erect tongue-like lobe. As in other monandrous orchids the rostellum of the mature gynostemium is entirely derived from the upper part of this organ. Its apical portion develops into a prominent hamulus-type stipe (*sensu* Rasmussen 1982) (Fig. 1H, 2A-C). The lower portion of the median carpel apex and the two lateral carpel apices become conspicuously papillose (Fig. 1G). They eventually form the receptive stigma surface and are thus referred to as the stigma lobes. In late stages the lower portion of the anterior part of the funnel-rim which is derived from the lateral stigma lobes grows forward (Fig. 1H). The prominent elongate apical connective process of the anther develops in late ontogenetic stages.

### Notes on other species

#### *Rimacola elliptica* (R. Br.) Rupp

*Rimacola elliptica*, the sole species of its genus, is endemic to the Sydney region, including the Blue Mountains (New South Wales). It is most closely related to the monotypic New Zealand genus *Waireia* (Clements et al. 2002), which, together, were originally included in the rather more distantly related genus *Lyperanthus* (Kores et al. 2001). The arching inflorescences bear a few resupinate flowers with narrowly lanceolate sepals, falcate petals, and an unlobed or obscurely three-lobed lip with a basal callus. The mature gynostemium has a long column-part and prominent column-wings are present. The apex of the anther is broadly rounded in the early and middle developmental stages but exhibits a short subacute connective process in late stages (Fig. 3C). Prominent staminode primordia are visible in early stages

(a in Fig. 3A) and later develop into the obscure column-wings (a in Fig. 3C). In addition, obscure bulges probably homologous with auricles are developed in middle stages (arrowhead in Fig. 3A) and grow into the posterior portion of the shallowly two-lobed lateral gynostemium appendages that are visible in the late stages (arrowhead in Fig. 3B). In the mature flower the suspected auricles are visible as small dorsolateral teeth next to the anther (arrowhead in Fig. 3C). The median carpel apex is unlobed in all stages observed (not shown). The initiation of the lateral carpel apices was not observed but a slightly later stage reveals that they are partly fused to an emarginate ridge (not shown).

### *Caleana major* R. Br.

*Caleana* is a small genus in eastern Australia and New Zealand. *C. major* has erect inflorescences with a few non-resupinate flowers. The median sepal is hood-like while the lateral sepals are linear and reflexed. A most conspicuous part of the flower is the duck's head-shaped lip. The gynostemium is very prominent with its wide column-

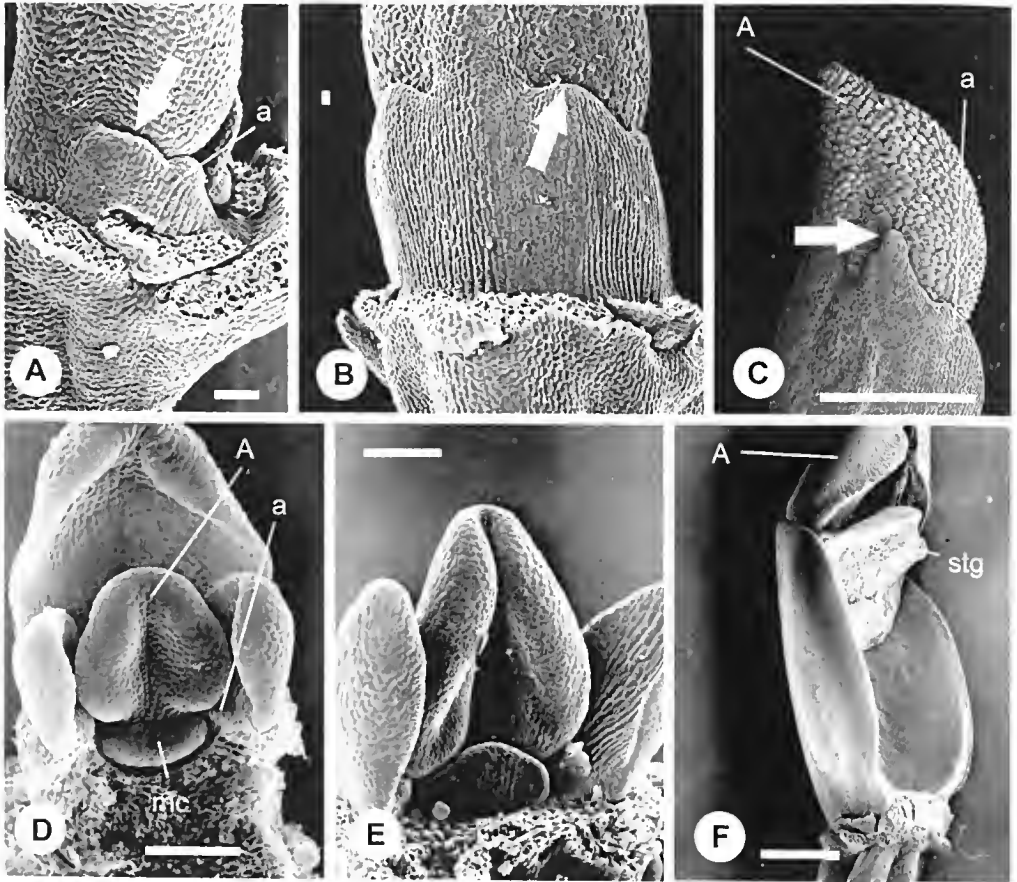


Fig. 3. Gynostemium development of various species. A–C, *Rimacola elliptica*, side/dorsal views; D–F, *Caleana major*, front views. — SEM micrographs. Bars: 0.1 mm in A–B, D–E; 1 mm in C, F. Abbreviations: A = anther, a = staminodes, mc = median carpel apex, stg = stigma. The arrowheads mark suspected auricles (= filament appendages; see Kurzweil 1987b). Sources: a–b: Weston 1586; c: Bishop J67/31–37; d–f: Weston 1229.

wings, “... so broad that they form an inverted cup-like basket” (Bernhardt 1993: 194). In the mature flower these column-wings extend over the full length of the column-part while in other orchids marked column-wings are confined to the upper portion of the column-part (for example in *Rimacola elliptica*). In early ontogeny staminode primordia are clearly visible (a in Fig. 3D), and later develop into the prominent column-wings of the adult gynostemium (Fig. 3F). The anther is somewhat narrow and pointed in early and middle ontogeny (Fig. 3E). No prominent additional lateral or dorsolateral gynostemium appendages are visible in early or middle ontogenetic stages. However, an obscure tooth on the side of the gynostemium is visible in a late stage (illustrated in Kurzweil 1998, Fig. 11D). The present investigations are inconclusive with regard to the ontogenetic derivation of the tooth, but the presence of staminodial column-wings and dorsolateral gynostemium teeth may suggest a dual origin of the lateral gynostemium appendages from staminodes and auricles like in many other orchids. The median carpel apex is obscurely three-lobed in middle and late stages (not shown).

### *Cryptostylis erecta* R. Br.

*Cryptostylis* is a primarily Australasian genus of about twenty species. The erect inflorescences bear a few non-resupinate flowers with linear sepals and petals and a large ovate-oblong lip. The gynostemium development of *C. erecta* (endemic to Queensland, New South Wales and Victoria) has been briefly examined. In middle stages prominent staminode primordia occur (Fig. 4A). Structures likely to be auricles were not observed in any stage. In late stages the lateral appendages are several-toothed lobes (Fig. 4B), and their lobed appearance may suggest that they incorporate auricular tissue as in many other orchids. The median carpel apex is a large erect, entire lobe and is strongly bulging to the front (Fig. 4A). The stigma is an erect pad with the papillose area derived from all three stigma lobes. Lateral carpel apices are separate structures at their time of initiation (not shown).

### *Diuris longifolia* R. Br.

The genus *Diuris* ( $\pm$  55 species, Jones 2001) is amongst the most attractive of the Australian terrestrial orchids with their fairly large resupinate flowers. The slender lateral sepals are mostly reflexed while the median sepal is developed as a shallow hood. Most prominent are the ear-like clawed petals. The gynostemium lacks a basal column-part as anther, style and column-wings are free-standing structures and are only fused at their base. Only a few developmental stages of the Western Australian *D. longifolia* were available for study. The large erect lateral appendages of the mature gynostemium arise from prominent staminode primordia that are visible in early ontogeny (Fig. 4C). Auricles are not visible in any early or middle stage. However, the lateral appendages of the gynostemium are shallowly two-lobed in late stages which may point to a dual origin of the lateral appendages from staminodes and auricles. The median carpel apex is unlobed in all stages (Fig. 4C–E). In middle stages it is somewhat infolded in its central portion which grows into the gap between the two thecae (Fig. 4D), and in late ontogeny this central portion forms the viscidium. The lateral carpel apices emerge connate as an undivided edge (Fig. 4C).

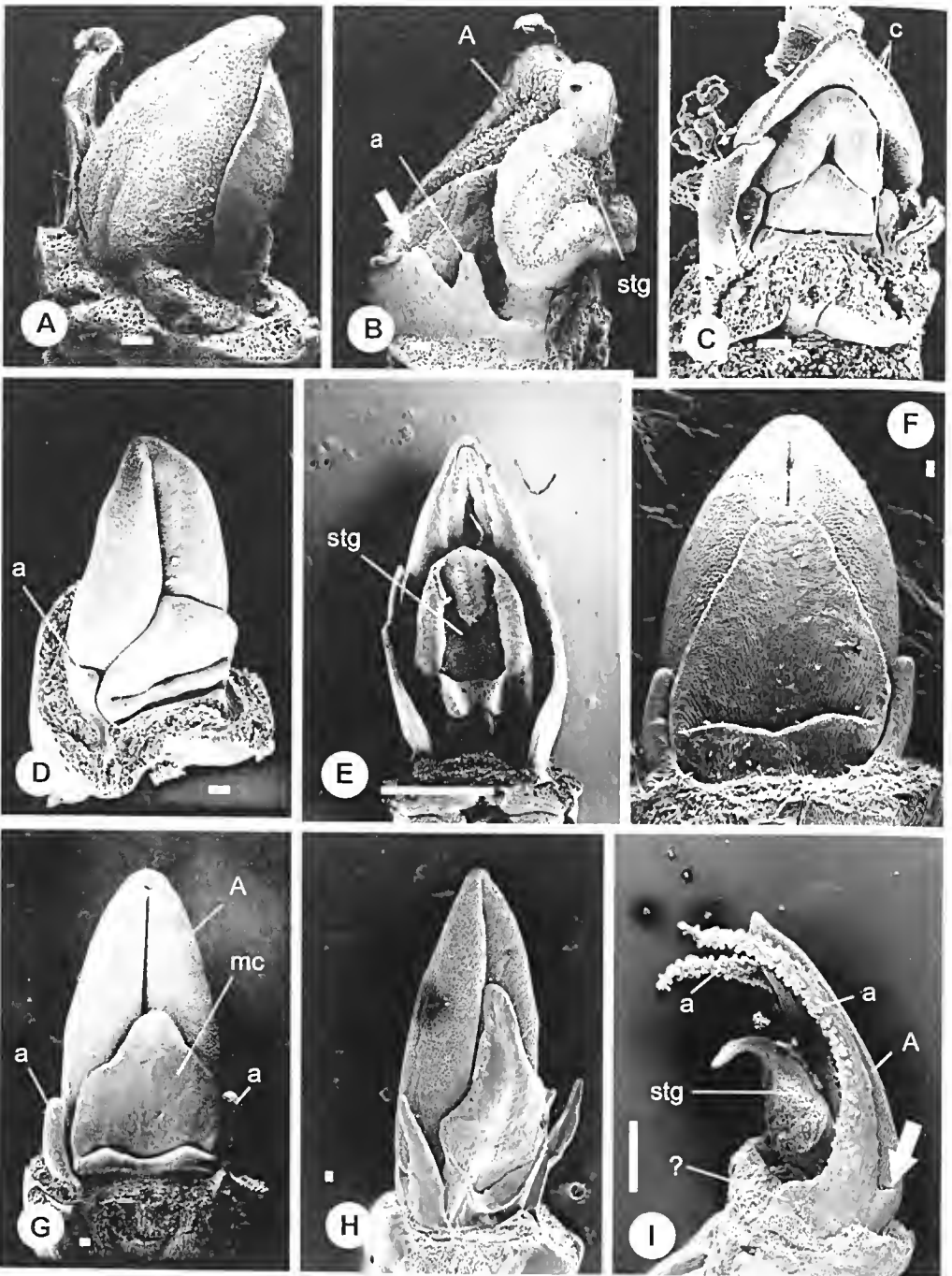


Fig. 4. Gynostemium development of various species. A–B, *Cryptostylis erecta*, side views; C–E, *Diuris longifolia*, front views; F–I, *Orthoceras strictum*. F–H, front views; H, three-quarter view; I, adult gynostemium in side view. — SEM micrographs. Bars: 0.1 mm in A–D, F–H; 1 mm in E, I. Abbreviations: A = anther, a = staminodes, c = carpel apices, mc = median carpel apex, stg = stigma. The arrowheads mark suspected auricles (= filament appendages; see Kurzweil 1987b). Sources: A–B: Weston 2473; C–E: sine collector; F, H: Weston 1584; G: Weston 1271; I: Weston 1279.



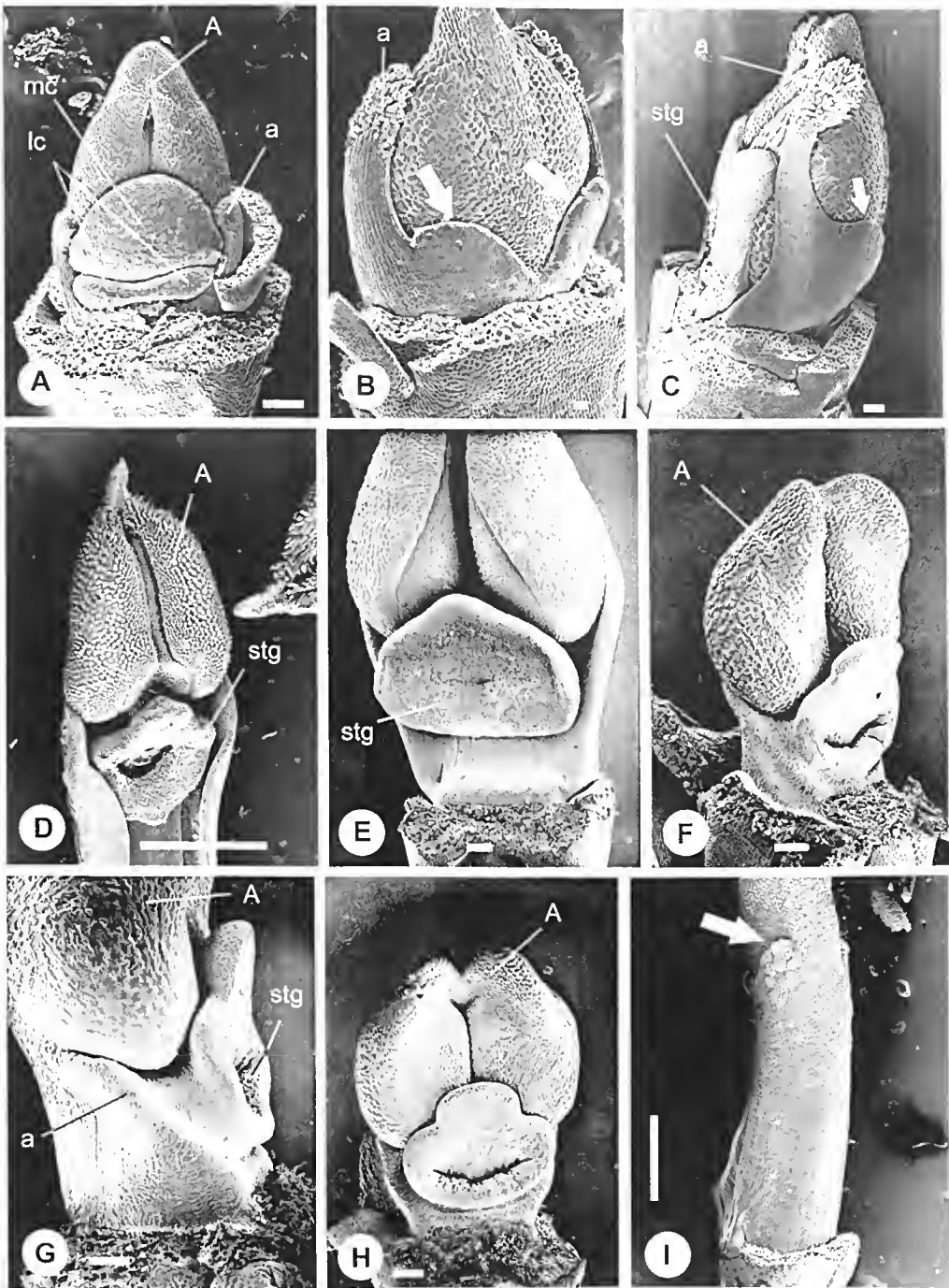


Fig. 5. Gynostemium development of various species. For reference see Table 2. A–C, *Thelymitra carnea*. A, front view; B, dorsal view; C, side view; D, *Caladenia catenata*, front view; E, *Chiloglottis* sp., front view; F–H, *Corybas fimbriatus*. F–G, side views; H, front view; — i, *Lyperanthus suaveolens*, dorsal view. — SEM micrographs. Bars: 0.1 mm in A–C, E–H; 1 mm in D, I. Abbreviations: A = anther, a = staminodes, lc = lateral carpel apices, mc = median carpel apex, stg = stigma. The arrowheads mark suspected auricles (= filament appendages; see Kurzweil 1987b). Sources: A: Weston 1227; B–C: Weston 1232; D: Abell 67; E: Weston 1278; F–H: Weston 1392; I: Weston 1224.

***Orthoceras strictum* R. Br.**

The small genus *Orthoceras* shares many floral features with *Diuris* and is therefore placed in subtribe Diuridinae (Dressler 1993), differing from the latter genus most obviously in its horn-like and spreading lateral sepals and minute petals. *O. strictum*, from Australia, New Zealand and New Caledonia has erect inflorescences with a few small resupinate flowers. Its gynostemium ontogeny has been examined. Staminode primordia can be seen in early and middle stages (Fig. 4F). Staminodes are prominent throughout ontogeny and develop directly into the large tooth-like lateral gynostemium appendages which are visible in late stages and in the mature gynostemium (Fig. 4H–I). An obscure dorsolateral tooth reminiscent of an auricle was observed in one gynostemium in a middle stage (illustrated in Kurzweil 1998, Fig. 11F). However, this bulge does not appear to be a constant feature as many gynostemium without it were also observed. An obscure dorsal process is also visible in the adult gynostemium at the base of the large staminodes (arrowhead in Fig. 4I), and it is possible that it is derived from such an auricle. In addition, there is also a ventral bulge at the base of the staminodes in late stages and in the mature flower (? in Fig. 4I). Due to its very late ontogenetic origin it is most probably only a secondary outgrowth of the staminodes. The median carpel apex is obscurely three-lobed in middle and late ontogeny (Fig. 4G–H). Lateral carpel apices emerge as separate structures but soon become connate into an emarginate ridge.

***Calochilus campestris* R. Br.**

*Calochilus* is a genus of approximately 18 species (Jones 1988; Jones & Lavarack 1989; Jones & Gray 2002; Jones & Clements 2004). All species have a single fleshy leaf up to 40 cm long. Fertile plants produce a raceme 20 to 100 cm tall bearing two to sixteen resupinate flowers. Most species have multicellular hair-like processes that cover the surface and margins of the obscurely three-lobed labellum; these are usually green, red, crimson or purple in colour. These floral features give rise to their common name 'Beardies' or 'Bearded Orchids', and their scientific name '*Calos*' meaning beautiful, and '*cheilos*' meaning lip (Jones, 1988).

In *C. campestris*, the mature gynostemium is short and arched forward. Column-wings are present but obscure and fused to the anther filament to form a mitra or hood, which dorsally covers the gynostemium. The apex of the anther is narrowly elongate with a terminal, subacute connective process visible in the early and middle developmental stages (Fig. 6A), becoming obtuse and densely papillate in late developmental stages (Fig. 6B). Staminode primordia are clearly visible in early stages and are already connate, forming a mitra (Mi in Fig. 6A, C). The mitra later grows up to the base of the anther (Mi in Fig. 6C, D, F). Mature apices of the mitra are covered with tuberculate appendages and are likely to be homologous with auricles (arrowhead in Fig. 6C–D). During the middle stages of development the auricles become heavily sculptured (arrowhead in Fig. 6E–F). During late developmental stages, two orbicular bulges form on the ventral surface of the mitra, on both sides of the base of the stigma (g in Fig. 6F). Their anatomical homology and function are unknown but they form the prominent gland-like "eyes" of the mature flower. The median carpel apex is strongly elongate (mc in Fig. 6A, F) and connate to the lateral carpel apices, appearing three-lobed in all stages observed. In mature flowers, a viscidium forms on the ventral surface of the median carpel apex (mc in Fig. 6F).

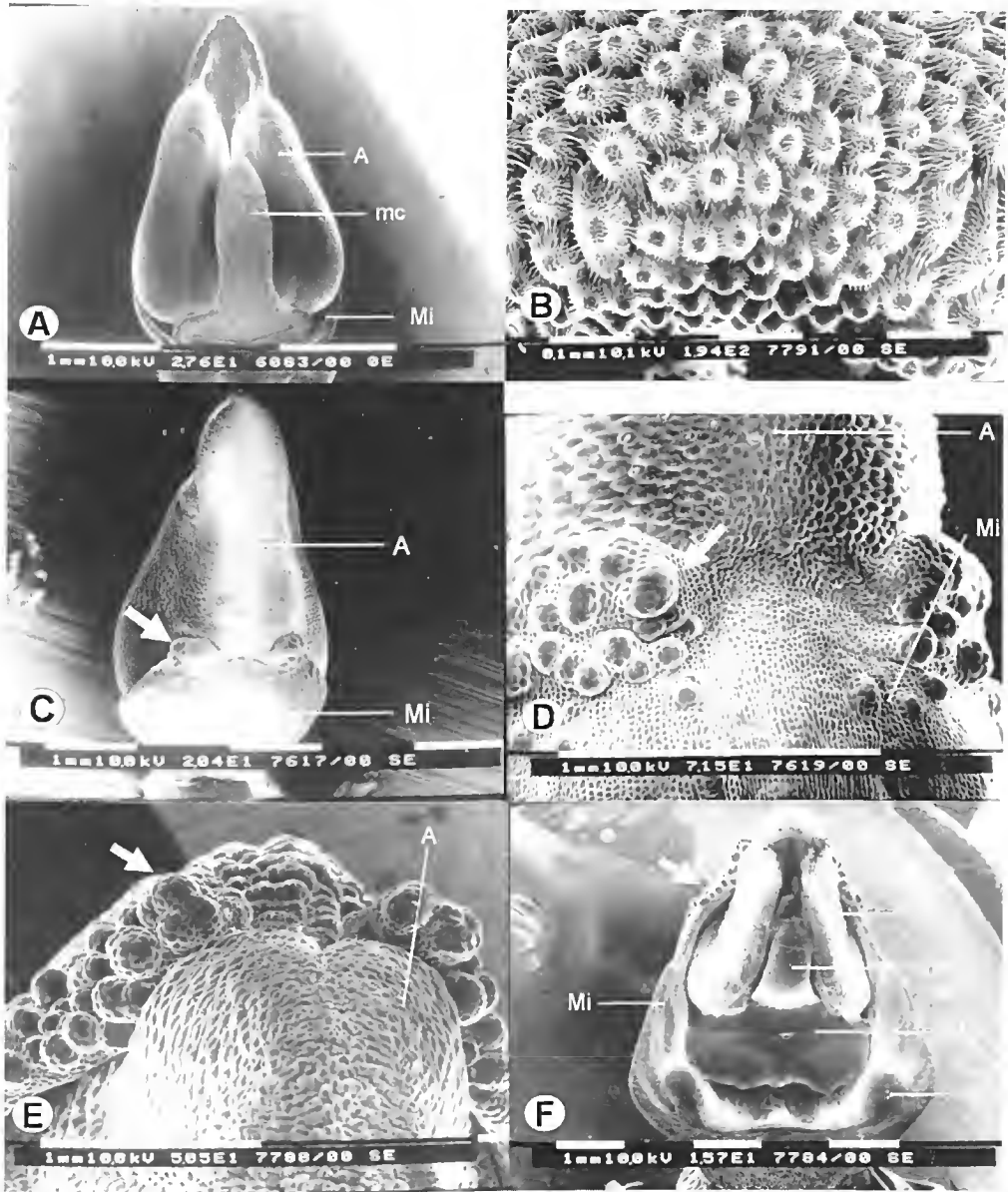


Fig. 6. Gynostemium of *Calochilus campestris* in different developmental stages. A, during early development in front view; B, papillae on connective apex during late development; C, during early development in dorsal view; D, during middle development in dorsal view; E, auricles during late development in front view; F, during anthesis in front view. — SEM micrographs. Bars: 1 mm in A, C-F; 0.1 mm in B. Abbreviations: A = anther, Mi = mitra, mc = median carpel apex, g = gland-like “eyes” on mitra, stg = stigma. The arrowheads mark suspected auricles (= filament appendages; see Kurzweil 1987b). Sources: NSW446115.

### *Acianthus fornicatus* R. Br.

The genus *Acianthus*, as re-circumscribed by Jones et al. (2002), includes eight species in Australia and New Zealand. *A. fornicatus* from New South Wales and Queensland has erect inflorescences with a few small resupinate flowers. The sepals and the petals are free, unlobed and spreading. The ovate lip is unstalked and bears a median callus. A long column-part is present in the knee-like bent gynostemium. Lateral gynostemium appendages (column-wings) are rather small. Small staminode primordia are visible in early ontogeny (Fig. 7A) and later develop into the small lateral appendages of the mature gynostemium as seen in Fig. 7D. Structures likely to be auricles are not visible in any stage. A prominent feature of the ontogeny is the median carpel apex which is conspicuously three-lobed in middle stages with its lobes roughly equally long (Fig. 7B). Its central lobe loses its prominent appearance later on and grows into the gap between the two thecae which is reminiscent of the intrathecal rostellum portion of tribe Orchideae (Fig. 7C-D). The lateral carpel apices emerge connate to an undivided edge and also remain undivided later on (not shown). The anther is apically emarginate throughout ontogeny.

### *Pterostylis concinna* R. Br.

A single species of the large genus *Pterostylis* (subtribe Pterostylidinae *sensu* Jones & Clements 2002 – about 120 species in Australia, New Zealand, New Guinea and New Caledonia) was available for study, and is of considerable interest as it is the only study species outside tribe Diurideae, having been transferred to tribe Cranichideae recently (Pridgeon et al. 2003). The terminal inflorescences bear a single or a few resupinate flowers with a prominent galea made up of median sepal and petals, two basally fused lateral sepals and a mobile lip. In *P. concinna* the slender and curved gynostemium has a long column-part. Large lateral gynostemium appendages (column-wings) are present in the apical portion and are expanded next to the anther so that they almost obscure it. They consist of rather wide and obtuse lobes pointing down, and narrow and acute lobes pointing up. The stigma of the mature gynostemium is an entire pad at the base of the column-part. Early stages of the gynostemium ontogeny of this species were not available for study. In a middle stage ('three-carpel-apex stage') the large anther is erect and the three carpel apices are visible with the median one being as usually the largest (Fig. 7E). Prominent staminode primordia are clearly visible in this stage. As could be expected they develop directly into the large apical wings of the late stages and the mature gynostemium (Fig. 7E-I). From the ontogeny it is evident that both the acute upper and the obtuse lower part of the mature lateral gynostemium appendages are derived from these staminodes. In middle ontogenetic stages there is also an insignificant suspected auricle visible (arrowhead in Fig. 7H), and in the mature gynostemium the structure takes the shape of an obscure small tooth next to the anther (arrowhead in Fig. 7I). The median carpel apex is an obscurely three-lobed organ in middle ontogeny (Fig. 7F-G). Lateral carpel apices are separate structures soon after their initiation and remain separate until the column-part starts elongating.

## Discussion

The ontogeny of the anther and the three carpel apices, as well as the late formation of the gynostemium of the species examined here, conform basically with that of all other

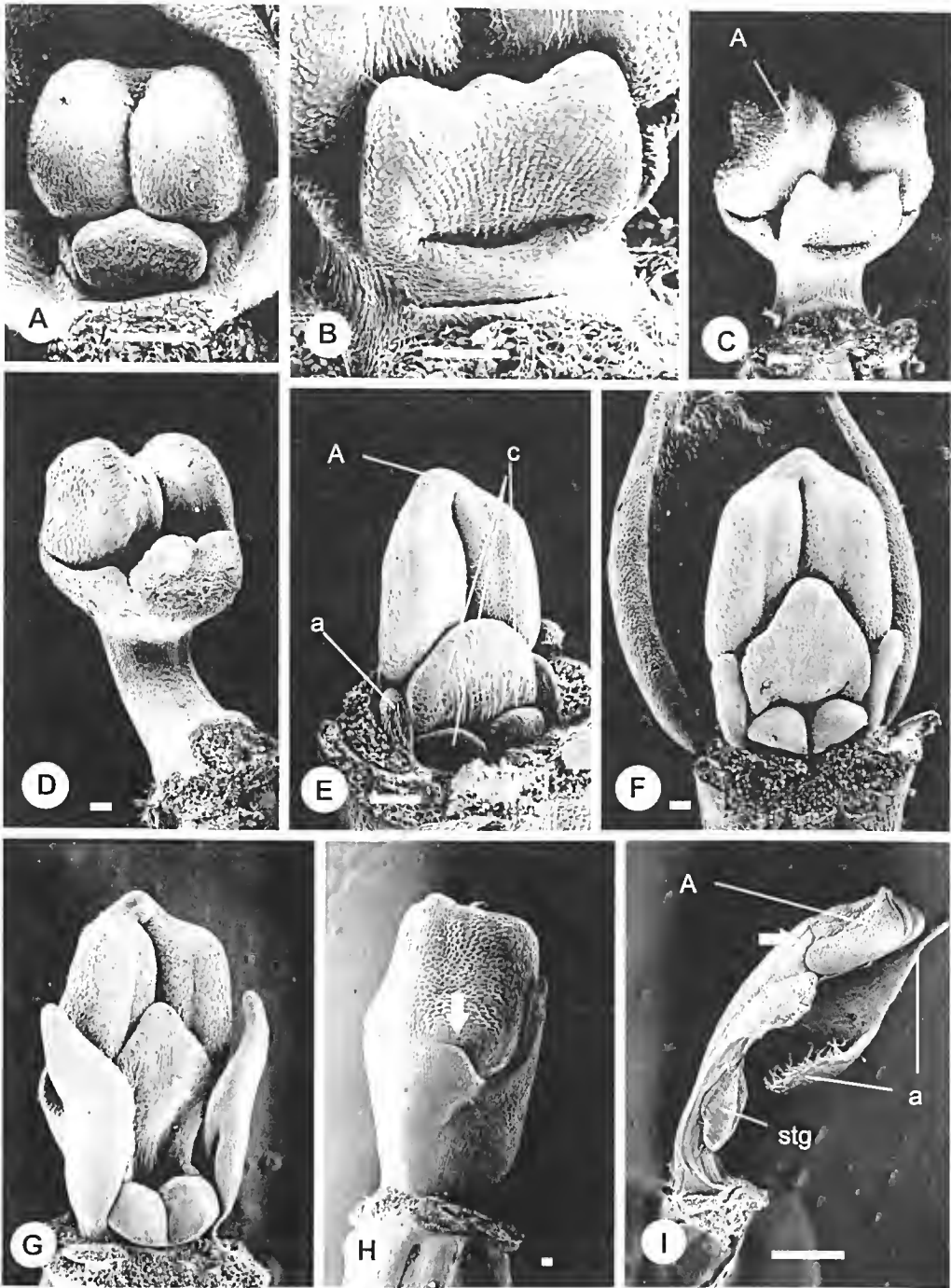


Fig. 7. Gynostemium development of various species. A–D. *Acianthus fornicatus*. Gynostemium/base of gynostemium in front view. E–I. *Pterostylis concinna*. E–G. Front views. H. Side view. I. Adult gynostemium in side view with the left lateral gynostemium appendage removed. — SEM micrographs. Bars: 0.1 mm in A–H; 1 mm in I. Abbreviations: A = anther, a = staminodes, c = carpel apices, mc = median carpel apex

monandrous orchids studied so far (e.g. Irmisch 1842; Payer 1859; Wolf 1865; Pfitzer 1888; Capeder 1898; Heusser 1915; Hirmer 1920; Jeyanayaghy & Rao 1966; Rao 1967; Sattler 1973; Yang 1982; Rasmussen 1982, 1985b; Kurzweil, several papers; Leins et al. 1988; Schill et al. 1992; Linder & Kurzweil 1996; Luo & Chen 2000).

The anther is the first organ of the gynostemium to become visible. Like the six perianth organs, it develops from the marginal parts of a transversally elliptic floral primordium. The anther is erect in early stages and the gap between its two thecae is of very early ontogenetic origin. As in other orchids it is the largest organ of the gynostemium throughout early development, but in many species its growth later decreases; the anther is therefore often comparatively small in the mature gynostemium.

The three carpel apices emerge in front of the anther in early ontogeny and later develop directly into the stigma lobes of the mature flower. The median carpel apex is the first carpel apex to be initiated. It is erect and unlobed in early stages, and measures approximately  $\frac{3}{4}$  of the width of the anther soon after its initiation. It remains the largest carpel apex in the early and middle ontogeny, but like the anther it often loses its prominent appearance later on and is fairly small in the mature flower. Its apical portion becomes structurally modified in late ontogeny and develops into the rostellum. The derivation of the non-receptive rostellum from the median carpel apex is also found in all other orchids examined so far. The two lateral carpel apices emerge just after the median one in a position directly in front of it. Just after their initiation they are either separate (*Genoplesium fimbriatum*, *Pterostylis concinna*, *Cryptostylis erecta*, *Orthoceras strictum*) or connate into an entire or emarginate ridge (*Rimacola elliptica*, *Acianthus fornicatus*, *Diuris longifolia*, *Thelymitra carnea*, *Calochilus campestris*). Both these character states are also found in the other orchids (Kurzweil 1998; Kurzweil & Kocyan 2002). The lateral carpel apices are initially about one third to half as wide as the median carpel apex which is clearly visible where the lateral carpel apices are separate or connate into an emarginate ridge. On the basis of outgroup comparisons with other basally diverging families of Asparagales, the most recent common ancestor of the orchids probably had three spreading stigma lobes, and therefore the separate emergence of the lateral carpel apices is most likely the more primitive condition for the family as a whole. In late ontogeny the two lateral stigma lobes are generally basally united and also marginally fused with the median stigma lobe to form a funnel-like structure. Finally, the lateral stigma lobes develop into the receptive stigma and also a portion of varying size is contributed by the median stigma lobe. The surface of the stigma is papillose in the late stages.

In some species the organ-complex of the three stigma lobes is elevated together with the anther and the column-wings in that the common base of all of these organs elongates, and thus the column-part of the gynostemium is formed. The formation of this column-part takes place in the late stages. The resulting gynostemium can be very long (e.g. *Rimacola elliptica*, *Caleana major*, *Pterostylis concinna*, *Acianthus fornicatus*). The fusion may also be absent or very weak and is then confined to the base of the organs of the gynostemium (*Genoplesium fimbriatum*, *Diuris longifolia*, *Orthoceras strictum*). The weak fusion of the gynostemium in *Diuris*, *Orthoceras* and *Genoplesium* has been thought to be a primitive condition (see Dressler 1986: 10). However, recent molecular phylogenetic analyses of the Diurideae and outgroups (Kores et al. 2000, 2001; Clements et al. 2002) strongly imply that weak fusion has been secondarily derived in these taxa. Such a reversal is readily explicable as the result of neotenic loss

of gynostemium fusion and elongation late in floral organogeny. In the other monandrous orchids the parts of the gynostemium are completely fused, and very elongate column-parts occur in Epidendroideae and two genera in the the Orchidoideae-Diseae: *Satyrium* and *Pachites*.

### Lateral gynostemium appendages

Of particular interest are the lateral gynostemium appendages which are often referred to as column-wings in floristic and taxonomic works. It was found that they are ontogenetically directly derived from massive bulges superposed to the petals which can be observed in early and middle ontogeny. On account of their early initiation and the position in front of the petals they are here interpreted as vestiges of the lateral stamens of the inner staminal whorl (i.e. staminodes in a position a<sub>1</sub> and a<sub>2</sub>) which corresponds well with most other Orchidaceae (e.g., Kurzweil 1987a, 1988). Previously, similar prominent staminodes were also observed and illustrated in middle stages of the gynostemium development of *Gavilea glandulifera*, a member of the tribe Chloraceae, and the diurids *Diuris punctata*, *Prasophyllum concinnum* and *Microtis parviflora* (Rasmussen 1982). Since orchids have most probably evolved from ancestors with 3+3 stamens (see also Rasmussen 1982) the presence of pronounced staminodes must be interpreted as an ancestral feature in each of the two clades of monandrous orchids, the Vanilloideae and Orchidoideae-Epidendroideae. The primitive feature of massive staminodes has apparently constantly been retained in the orchid subfamily Epidendroideae (Kurzweil 1998; Kurzweil & Kocyan 2002). Interestingly, in Epidendroideae the staminodes sometimes disappear in late ontogeny as they become incorporated into the gynostemium. In most species of tribes Cranichideae, Diseae and Orchideae (*sensu* Pridgeon et al. 2001, 2003) the staminodes a<sub>1</sub> and a<sub>2</sub> are small or obscure in early ontogeny (Kurzweil 1987b, 1988). Given the sister group relationship between Diurideae and Cranichideae-Chloraceae on the one hand and Diseae and Orchideae on the other (Kores et al. 2001; Chase et al. 2001) staminode reduction has probably evolved independently in Cranichideae and Orchideae-Diseae.

In a few species examined here there are also additional lateral gynostemium appendages which become visible in middle developmental stages. They are initiated as small or obscure but clearly visible bulges in a dorsolateral position on the anther. Their time of initiation and place of origin corresponds well with that of the filament appendages termed auricles of tribe Orchideae (Kurzweil 1987b; Luo & Chen 2000), and the structures are here also interpreted as such. The homology of the auricles of Orchideae with filament appendages was originally suggested by Vermeulen (1966) whose investigations were based on the study of adult and especially teratological flowers. In *Orthoceras strictum* such auricles are not constant in their appearance. This points to the possibility that the auricles may be genetically fixed even if they are externally not always expressed. In superficial appearance the auricles observed here are mostly unsculptured, differing from those of Orchideae which are usually strongly sculptured. In the present study heavily sculptured auricles were only observed in *Lyperanthus snaveolens* and *Calochilus campestris*, and previously a heavily sculptured auricle was illustrated in an unidentified *Calochilus* species (Kurzweil 1998, Fig. 11L). No sign of any auricles was here found in *Acianthus fornicatus*, *Cryptostylis erecta*, *Chiloglottis* sp., *Corybas fimbriatus* and *Microtis parviflora*. Auricles in Diurideae have been reported before by Dressler (1986: cladogram on p. 13) although it is not clear whether the term was used in the sense of filament appendages (however, Dressler

included Chloraeinae in his tribe Diurideae which are now recognised as a distinct tribe Chloraeaceae; Pridgeon et al. 2003). In other orchids, auricles have so far only been reported in tribes Orchideae and Diseae. While they are usually prominent in Orchideae they are mostly small and reduced in Diseae. The only exception known as yet is the genus *Bartholina* (Orchideae) where the auricles are absent (Kurzweil & Weber 1991), and this is probably the result of secondary loss in this genus. The shared occurrence of auricles in Diurideae, Orchideae + Diseae, Chloraeaceae and *Pterostylis*, a basally diverging lineage of Cranichideae, is most parsimoniously interpreted as a synapomorphy for these tribes that has been secondarily lost in most Cranichideae.

The appearance of the auricles in the mature flowers differs among the species examined. In *Genoplesium fimbriatum* the staminodes and the auricles become fused in the course of development while their common base elongates. These two organs together develop into the prominent lateral gynostemium appendages (column-wings) which are therefore of dual origin. The auricles of *Rimacola elliptica* develop into small processes on top of the staminodial wings. In *Caleana major* and *Dinris longifolia* prominent auricles were not observed in early and middle stages but the lateral appendages of the late-ontogenetic gynostemium have a small apical tooth or are shallowly two-lobed, respectively. Compared with the other species examined here this may again suggest an involvement of both staminodes and auricles, although there is obviously no clear ontogenetic evidence for a dual origin. The auricles of *Pterostylis concinna* are small lobes next to the anther behind the column-wings. Previously, a distinct two-lobing of the lateral gynostemium appendages was found in middle developmental stages in *Gavilea glandulifera* and *Prasophyllum concinnum* but a possible ontogenetic derivation from two different structures was not suspected (Rasmussen 1982). In view of the present findings the two-lobing found in these two species may be suggestive of the origin from both staminodes and auricles. It is also noteworthy that the dorsal lobe of the lateral gynostemium appendages of *Prasophyllum concinnum* is said to contain raphides (Rasmussen 1982) which is an anatomical feature frequently associated with auricles. In other orchids, a dual origin of the lateral gynostemium appendages is common in Orchideae where the auricles are frequently heavily sculptured appendages on top of or at the posterior end of a staminodial base (Kurzweil 1987b, 1990; Kurzweil & Weber 1991, 1992; Luo & Chen 2000).

### Three-lobing of the median carpel apex

It was found that the median carpel apex of *Acianthus fornicatus*, *Calochilus campestris* and *Corybas fimbriatus* is clearly three-lobed in middle developmental stages, and *Genoplesium fimbriatum*, *Caleana major*, *Pterostylis concinna*, *Microtis parviflora* and *Orthoceras strictum* have a shallowly three-lobed median carpel apex in this stage. This is remarkable as the vast majority of Orchidaceae have an unlobed median carpel apex throughout middle and late development, which is apparently the basic condition in the family. The three-lobing observed here is reminiscent of tribes Orchideae and Diseae where the median carpel apex is usually deeply three-lobed throughout ontogeny (Vogel 1959; Vermeulen 1959, 1966; Dressler 1981, 1993; Kurzweil, several papers) although it has been reduced to a two-lobed or unlobed structure in some Diseae (Kurzweil 1991, 1996; Linder & Kurzweil 1996). This shared feature might be another morphological synapomorphy for the Orchidoideae, albeit one that has been secondarily lost in a number of different lineages.



Alternatively, the three-lobing of the median carpel apex observed here may also merely be a precondition for the formation of an apical viscidium in late ontogeny, and is therefore not necessarily evidence of phylogenetic relationship. However, this explanation is unlikely as one would not expect this feature to already be expressed early in ontogeny.

### Phylogenetic considerations

The phylogenetic relationships and the delimitation of diurid orchids have been rather disputed among taxonomists.

In the past the diurid orchids were often treated in a subgroup of Orchidaceae that contains terrestrial orchids with a large number of primitive characters (e.g. 'Acrotonae-Polychondreae', Schlechter 1926; 'Neottioideae', Garay 1960, 1972; 'Epidendroideae-Contribe Neottianthae', Vermeulen 1966; 'Neottioideae', Brieger et al. 1970-2000). After realising that this group is an artificial aggregation that contains several basally diverging lineages of both Orchidoideae and Epidendroideae (e.g. Rasmussen 1982; Dressler 1993; Cameron et al. 1999), its tribes and subtribes were either transferred to other subfamilies or raised to the rank of separate new subdivisions (e.g. subfamily Spiranthoideae; Dressler 1979, 1981, 1993). Although the diurid orchids, as circumscribed by Dressler (1981, 1993), were in the past treated as a natural group, it is now evident that they are not monophyletic (Kores et al. 1997, 2000; Cameron et al. 1999; Molvray et al. 2000; Pridgeon et al. 2001). Groups which do not belong to the core clade of diurid orchids are the *Pterostylis* and *Chloraea* groups.

A relationship of the diurid orchids with the Orchideae and Diseae (subfamily Orchidoideae) is now widely accepted on the basis of morphological and anatomical data (Dressler 1979, 1981, 1993; Rasmussen 1985a; Pridgeon et al. 2001) and was also confirmed by molecular investigations (Kores et al. 1997, 2000; Cameron et al. 1999; Molvray et al. 2000). The most frequently cited morphological feature shared by diurid orchids on the one hand and Orchideae and Diseae on the other are root tubers. Some authors have expressed doubt about the homology of these structures because of their anatomical diversity (see Pridgeon & Chase 1995 and references therein). However, the unusual structural similarities that the root tubers of all of these groups share prompted Dressler (1993) and Pridgeon & Chase (1995) to postulate their homology. An implication of this idea in the light of more recently published molecular phylogenetic analyses (Kores et al. 1997, 2000; Cameron et al. 1999; Molvray et al. 2000) is that root tubers are a synapomorphy for the subfamily Orchidoideae but that they have been secondarily lost in several different lineages.

### Conclusions

Two interesting similarities shared by Diurideae and *Pterostylis* (Cranichideae) with tribes Orchideae and Diseae were found in the present study, namely the auricles and the early three-lobing of the median carpel apex, which add further support to the theory of a close relationship of the groups.

A) Definite auricles or obscure structures suggestive of such auricles were here found in eight of 11 species where the early or middle ontogeny was examined. Auricles of diurid orchids have been observed before but due to the lack of ontogenetic

studies the similarity in their ontogeny to the auricles of the Orchideae and Diseae was not noted.

B) The second point of interest relates to the early three-lobing of the median carpel apex in six of the 11 species where relevant stages were observed. The median carpel apex is frequently only shallowly lobed but in three species the three-lobing is rather pronounced.

An extensive discussion of the systematics of the diurid orchids which is based on morphological-ontogenetic gynostemium characters would obviously require far more complete sampling.

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### References

- Bernhardt P (1993) *Calceana*. Pp. 194–195 in GJ Harden (ed.), *Flora of New South Wales, Vol. 4* (New South Wales University Press: Sydney)
- Bower C (2001) Tribe Diurideae, pollination. Pp. 59–213 in AM Pridgeon, PJ Cribb, MW Chase & FN Rasmussen (eds) *Genera Orchidacearum*, vol. 2 (Oxford University Press: Oxford)
- Brieger FG, Maatsch R, & Senghas K (1970–2000) *Die Orchideen – R. Schlechter*, 3<sup>rd</sup> ed. (Paul Parey: Berlin)
- Cameron KM, Chase MW, Whitten WM, Kores PJ, Jarrell DC, Albert VA, Yukawa T, Hills HG & Goldman DH (1999) A phylogenetic analysis of the Orchidaceae: evidence from *RBCL* nucleotide sequences. *American Journal of Botany* 86: 208–224.
- Capeder E (1898) Beiträge zur Entwicklungsgeschichte einiger Orchideen. *Flora* 85: 368–423.
- Chase MW, Kurzweil H, Linder P & Cribb PJ (2001) Phylogenetics of Orchidoideae. Pp. 7–9 in Pridgeon AM, Cribb PJ, Chase MW & Rasmussen FN (eds) *Genera Orchidacearum*, vol. 2 (Oxford University Press: Oxford)
- Clements MA, Jones DL, Sharma IK, Nightingale ME, Garratt MJ, Fitzgerald KJ, Mackenzie AM & Molloy BPJ (2002) Phylogenetics of Diurideae (Orchidaceae) based on the internal transcribed spacer (ITS) regions of nuclear ribosomal DNA. *Lindleyana* 17: 135–171.
- de Pinna MCC (1991) Concepts and tests of homology in the cladistic paradigm. *Cladistics* 7: 367–394.
- Dressler RL (1979) The subfamilies of the Orchidaceae. *Selbyana* 5: 197–206.
- Dressler RL (1981) *The orchids — natural history and classification* (Harvard University Press: Cambridge, Massachusetts and London)
- Dressler RL (1986) Recent advances in orchid phylogeny. *Lindleyana* 1: 5–20.
- Dressler RL (1993) *Phylogeny and classification of the orchid family* (Cambridge University Press)
- Garay LA (1960) On the origin of the Orchidaceae. *Botanical Museum Leaflets [Harvard University]* 19: 57–96.

- Garay LA (1972) On the origin of the Orchidaceae II. *Journal of the Arnold Arboretum* 53: 202–215.
- Gerstberger P & Leins P (1978) Rasterelektronenmikroskopische Untersuchungen an Blütenknospen von *Physalis philadelphica* (Solanaceae). *Berichte der Deutschen Botanischen Gesellschaft* 91: 381–387.
- Heusser K (1915) Die Entwicklung der generativen Organe von *Himantoglossum hircinum* Spr. *Beihfte zum Botanischen Centralblatt* 32, 1. Abt.: 218–277.
- Hirmer M (1920) Beiträge zur Organographie der Orchideenblüte. *Flora* 113: 213–310.
- Irmisch T (1842) Bemerkungen über die *Epipactis*-Arten der deutschen Flora. *Linnaea* 16: 417–462.
- Jeyanayaghy S & Rao AN 1966. Flower and seed development in *Bromheadia finlaysoniana*. *Bulletin of the Torrey Botanical Club* 93: 97–103.
- Jones DL (1988) Native Orchids of Australia (Read Books: Sydney)
- Jones DL (2001) Tribe Diurideae, distributions of the genera. Pp. 59–213, in A.M. Pridgeon AM, Cribb PJ, Chase MW & Rasmussen FN (eds) *Genera Orchidacearum*, vol. 2 (Oxford University Press: Oxford)
- Jones DL & Clements MA (2002) A review of *Pterostylis* (Orchidaceae). *Australian Orchid Research* 4.
- Jones DL & Clements MA (2004) Miscellaneous new species, new genera, reinstated genera and new combinations in Australian Orchidaceae. *The Orchadian, Scientific Supplement* 14(8).
- Jones DL & Gray B (2002) *Calochilus ammobius* (Orchidaceae). *The Orchadian* 14(2): 85–86.
- Jones DL & Lavarack PS (1989) New Species of *Calochilus* (Orchidaceae) from North-Eastern Queensland. *Proceedings of the Royal Society of Queensland* 100: 101.
- Jones DL, Clements MA, Sharma IK, Mackenzie AM & Molloy BPJ (2002) Nomenclatural notes arising from studies into the tribe Diurideae (Orchidaceae). *The Orchadian* 13: 437–468.
- Kores PJ, Cameron KM, Molvray M & Chase MW (1997) The phylogenetic relationships of Orchidoideae and Spiranthoideae (Orchidaceae) as inferred from *rbcL* plastid sequences. *Lindleyana* 12: 1–11.
- Kores PJ, Weston PH, Molvray M & Chase MW (2000) Phylogenetic relationships within the Diurideae (Orchidaceae): inferences from plastid *MATK* DNA sequences. Pp. 449–456, in Wilson KL & Morrison DA (eds) *Monocots: systematics and evolution* (CSIRO: Collingwood)
- Kores PJ, Molvray M, Weston PH, Hopper SD, Brown A, Cameron KM & Chase MW (2001) A phylogenetic analysis of Diurideae (Orchidaceae) based on plastid DNA sequence data. *American Journal of Botany* 88: 1903–1914.
- Kurzweil H (1985) *Entwicklungsgeschichtliche Untersuchungen an Orchideenblüten, unter besonderer Berücksichtigung des Gynostemiums* (unpublished Ph. D. thesis, University of Vienna).
- Kurzweil H (1987a) Developmental studies in orchid flowers I: epidendroid and vandoid species. *Nordic Journal of Botany* 7: 427–442.
- Kurzweil H (1987b) Developmental studies in orchid flowers II: orchidoid species. *Nordic Journal of Botany* 7: 443–451.
- Kurzweil H (1988) Developmental studies in orchid flowers III: neottiid species. *Nordic Journal of Botany* 8: 271–282.
- Kurzweil H (1990) Floral morphology in Orchidaceae subtribe Disinae. *Botanical Journal of the Linnean Society* 102: 61–83.
- Kurzweil H (1991) The unusual structure of the gynostemium of the Orchidaceae-Coryciinae. *Botanische Jahrbücher für Systematik* 112: 273–293.
- Kurzweil H (1996) Floral morphology and ontogeny in subtribe Satyriinae (Orchidaceae). *Flora* 191: 9–28.
- Kurzweil H (1998) Floral ontogeny of orchids: a review. *Beiträge zur Biologie der Pflanzen* 71: 45–100.
- Kurzweil H & Kocyan A (2002) Ontogeny of orchid flowers. Pp. 2–138, in J. Arditti (ed) *Orchid Biology — Reviews and Perspectives* (Kluwer Academic Publishers: Dordrecht, Netherlands)
- Kurzweil H & Weber A (1991) Floral morphology of southern African Orchideae. I. Orchidinae. *Nordic Journal of Botany* 11: 155–178.
- Kurzweil H & Weber A (1992) Floral morphology of southern African Orchideae. II. Habenariinae. *Nordic Journal of Botany* 12: 39–61.

- Leins P, Tucker SC & Endress PK (1988) *Aspects of floral development* (J. Cramer/Gebrüder Bornträger: Berlin)
- Linder HP & Kurzweil H (1996) Ontogeny and phylogeny of *Brownleca* (Orchidoideae: Orchidaceae). *Nordic Journal of Botany* 16: 345–357.
- Luo Y-B & Chen S-C (2000) The floral morphology and ontogeny of some Chinese representatives of orchid subtribe Orchidinae. *Botanical Journal of the Linnean Society* 134: 529–548.
- Molvray M, Kores PJ & Chase MW (2000). Polyphyly of mycoheterotrophic orchids and functional influences on floral and molecular characters. Pp. 441–448, in Wilson KL & Morrison DA (eds) *Monocots: systematics and evolution* (CSIRO: Collingwood)
- Payer J-B (1857) *Traite d' Organographie comparée de la fleur* (Paris)
- Perkins AJ (2001) Phylogenetic Systematics of the Genus *Calochilus* (Orchidaceae). (unpublished Ph.D. thesis, University of Sydney, Australia)
- Pfitzer E (1888) Untersuchungen über Bau und Entwicklung der Orchideenblüte. I. Theil: Cypripedilinae, Ophrydinae, Neottiinae. *Pringsheim Jahrbuch für die wissenschaftliche Botanik* 19: 155–177.
- Pridgeon AM & Chase MW (1995) Subterranean axes in tribe Diurideae (Orchidaceae): morphology, anatomy, and systematic significance. *American Journal of Botany* 82: 1473–1495.
- Pridgeon AM, Cribb PJ, Chase MW & Rasmussen FN (eds) (2001) *Genera Orchidacearum*, vol. 2 (Oxford University Press: Oxford)
- Pridgeon AM, Cribb PJ, Chase MW & Rasmussen FN (eds) (2003) *Genera Orchidacearum*, vol. 3 (Oxford University Press: Oxford)
- Rao AN (1967) Flower and seed development in *Arundina graminifolia*. *Phytomorphology* 17: 291–300.
- Rasmussen FN (1982) The gynostemium of the neottioid orchids. *Opera Botanica* 65: 1–96.
- Rasmussen FN (1985a). Orchids. Pp. 249–274, in Dahlgren RMT, Clifford HT & Yeo PF (eds) *The families of the Monocotyledons* (Springer Verlag: Berlin, Heidelberg, New York, Tokyo)
- Rasmussen FN (1985b) The gynostemium of *Bulbophyllum ecorntum* (J.J. Smith) J.J. Smith (Orchidaceae). *Botanical Journal of the Linnean Society* 91: 447–456.
- Sattler R (1973) *Organogenesis of flowers* (University of Toronto Press: Toronto)
- Schill R, Dannenbaum C & Eckert C (1992) Zur Blütenentwicklung von *Thecostele alata* (Roxb.) Par. et Rchb. f. 1874 (Orchidaceae). *Flora* 186: 271–285.
- Schlechter R (1926) Das System der Orchidaceen. *Notizblatt des Botanischen Gartens und Museums zu Berlin-Dahlem* 88, 9: 563–591.
- Vermeulen P (1959) The different structure of the rostellum in Ophrydeae and Neottieae. *Acta Botanica Neerlandica* 8: 338–355.
- Vermeulen P (1966) The system of the Orchidales. *Acta Botanica Neerlandica* 15: 224–253.
- Vogel S (1959) Organographie der Blüten kapländischer Ophrydeen. *Akademie der Wissenschaften und der Literatur, Abhandlungen der Mathematisch–Naturwissenschaftlichen Klasse* 6–7: 268–532.
- Weston PH (1988) Indirect and Direct Methods in Systematics. Pp. 27–56, in Humphries CJ (ed.) *Outogeny and Systematics* (Columbia University Press: New York)
- Weston PH (1994) Methods for rooting cladistic trees. Pp. 125–155, in Siebert DJ, Scotland RW & Williams DM (eds) *Models in phylogeny reconstruction* (Oxford University Press: Oxford)
- Wolf T (1865) Beiträge zur Entwicklungsgeschichte der Orchideenblüte. *Pringsheim Jahrbuch für die wissenschaftliche Botanik* 4: 261–384.
- Yang S-H (1982) Studies on the development of flower in *Gastrodia elata* Bl. *Acta Botanica Sinica* 24: 21–27. (in Chinese language)

**Appendix: List of material studied**

The following list cites all specimens which have been studied in their floral ontogeny. In most cases herbarium vouchers were deposited in the herbarium of the Royal Botanic Gardens Sydney (NSW). The nomenclature follows mainly Jones (1988). PHW is an abbreviation for the second author of the paper, P.H. Weston; NSW indicates a number in the National Herbarium of New South Wales.

- Aciantlus fornicatus* R. Br. – PHW 1393  
*Caladenia carnea* R. Br. – Kurzweil 1928  
*C. catenata* (Smith) Druce – Abell 67  
*Caleana major* R. Br. – PHW 1229, Kurzweil s.n.  
*Calochilus campestris* R. Br. – NSW446115  
*C. robertsonii* Benth. – Abell 72  
*Chiloglottis* sp. – PHW 1278  
*Corybas fimbriatus* (R. Br.) Rehb. f. – PHW 1392  
*Cryptostylis erecta* R. Br. – PHW 2473  
*Dirris longifolia* R. Br. – sine collector  
*Eriochilus autumnalis* R. Br. – PHW 1382  
*Genoplesium fimbriatum* R. Br. – PHW 1277, PHW s.n.  
*Glossodia minor* R. Br. – PHW 1235, PHW 1401  
*Lyperanthus suaveolens* R. Br. – PHW 1224  
*Microtis parviflora* R. Br. – PHW 1251  
*Orthoceras strictum* R. Br. – PHW 1271, PHW 1279, PHW 1584  
*Pterostylis concinna* R. Br. – PHW 1398  
*Rimacola elliptica* (R. Br.) Rupp – Bishop J67/31–37, PHW 1586  
*Thelymitra carnea* R. Br. – PHW 1227, PHW 1232, PHW 1242, PHW 1404



# A new species of *Goodenia* (Goodeniaceae) from Nocoleche Nature Reserve, Far Western Plains, New South Wales

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## Abstract

*Goodenia nocoleche* was cultivated in sediment collected from a freshwater temporary wetland in Nocoleche Nature Reserve. Here it is newly described and illustrated with additional notes on its ecology.

## Introduction

A species of *Goodenia* was cultivated from sediments collected in Nocoleche Nature Reserve during a study on seed banks of arid zone wetlands of the Paroo-Bulloo River region of New South Wales (Porter 2002). It represents a new species. An ephemeral herb, it has also been observed growing in its natural habitat at Pied Stilt Swamp and a clay pan on the Wanaaring-Hungerford Rd. (29°28'00"S, 144°24'00"E).

## Methods

Non-dormant seed banks of wetlands were sampled in June and September 1997 following the methods of Brock et al. (1994) to collect sediment cores. Sixty sediment samples were collected randomly from each wetland, (depth = 2.5 cm, surface area = 0.012m<sup>2</sup>). Sediment samples were placed in shallow plastic trays for drying, then submerged in water (60 cm depth) to stimulate germination.

Examination of the cultivated specimens revealed a yellow corolla with ovules and seeds numerous in two rows on either side of the septum, characters which placed them in the section *Porphyranthus* of the genus *Goodenia*. However, the small flowers with calyx lobes which are just short of or equalling the corolla lobes distinguish it from others in this section.

## Taxonomy

*Goodenia nocoleche* B. Pellow & J. L. Porter *sp. nov.*

Herba ephemera a speciebus duabus artissime cognatis (*G. lamprosperma* atque *G. paniculata*) corolla parva 5–5.5 mm longa, lobis calycis 4–6 mm longis corollam subaequantibus distinguenda.

Holotype: NEW SOUTH WALES: cultivated from seed collected 15 km S of Wanaaring, Pied Stilt Swamp, Nocoleche Nature Reserve, *J. Porter*, 29 Mar 2000 (NSW 458574).

Ephemeral amphibious herb to 40 cm high, vegetative parts glabrous. Basal leaves with floating lamina 20–40 mm long, 7–14 mm wide, thin, glossy green above, flat, lanceolate, margins undulate and minutely toothed, apex acute with tooth. Petioles elongated to 60 cm long, much longer than lamina, lengthening with water depth. Cauline leaves present at base of flowering stem 10–40 mm long, 2–3 mm wide. Flowers in racemes. Bracts longer towards base of inflorescence, linear and sometimes resembling leaves, 10–40 mm long. Bracteoles linear, 8–10 mm long, 0.6–1 mm wide, with minute simple and glandular hairs; bracteoles occasionally producing axillary buds which extend into new inflorescence branches. Pedicels 2–5 mm long without articulation. Floral tube 3–5 mm long with minute simple and glandular hairs. Calyx lobes linear, 4–6 mm long, 0.8–1 mm wide, numbering 5 or sometimes 6, attaching in top 1/3 of floral tube and covered with minute simple and glandular hairs. Corolla yellow, 5–5.5 mm long, lobe tips often tinged with pink or purple; glandular and simple hairs present externally, glabrous internally; no enations observed; anterior pocket obscure; abaxial lobes 2 mm long with wings approximately 0.5 mm wide; adaxial lobes 2.5 mm long with wings approximately 0.5 mm wide. Staminal filaments 1.8–2.0 mm long, anthers 0.5–0.8 mm long. Ovary with numerous ovules in 2 rows on either side of the septum; septum almost as long as the ovary. Style 2–2.5 mm long with scattered long simple hairs; indusium 1–1.5 mm long, 1–1.3 mm wide, purplish in colour, hairs present on adaxial rim, abaxial rim without hairs. Fruit pale, obconical, 5–6.5 mm long, 2–3 mm wide, hispid with short simple and glandular hairs. Seed 1 mm long, 2.5 mm wide, light brown, glossy, reticulation faint, winged. Figures 1 and 2.

**Selected specimens examined:** New South Wales: Far North Western Plains: Cultivated from sediment collected from Pied Stilt Swamp, Nocoleche Nature Reserve. 15 km south of Wanaaring. 29°52'18"S, 144°05'12"E. 100 m alt. *J.L. Porter JLP 255*, 29 Mar 2000 (8107-WOLL, 8108-WOLL, 8111-WOLL, 8113-WOLL).

**Distribution:** This species has been recorded in the seed banks of five wetlands in the Paroo-Bulloo River region. It was common (mean density 1,511 m<sup>-2</sup> ± 189 se) in the seed bank of one freshwater temporary wetland, Pied Stilt Swamp and uncommon (mean density < 15 m<sup>-2</sup>) in Momba Swamp (29°52'45"S 144°06'30"E), Waitchie Lake (30°10'00"S 144°01'15"E), Lake Altibouka (29°49'00"S 142°45'00"E) and Lake Numalla (28°44'00"S 144°19'00"E) (Fig. 3). It has also been recorded from field observations growing in Pied Stilt Swamp and another unnamed wetland c. 70 km north of Wanaaring. Three of these locations (Pied Stilt, Momba and Numalla) are within conservation reserves on the Paroo river floodplain (Fig. 3).

**Habitat:** *Goodenia nocoleche* was most abundant in temporary freshwater wetlands. Pied Stilt and Momba Swamps are small (22 and 61 ha), shallow (1.3 and 1.4 m)





**Fig. 1.** *Goodenia nocolche* B. Pellow & J.L. Porter. **a**, habit; **b**, flower; **c**, fruit. Scale bar: **a** = 80 mm, **b** = 6mm; **c** = 6 mm.

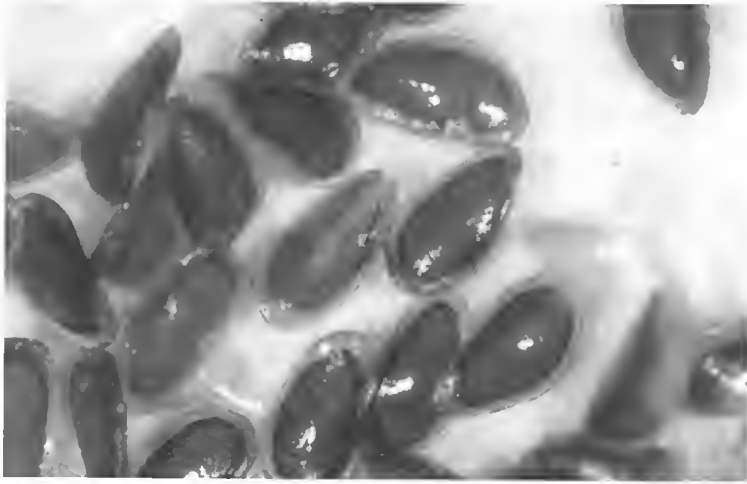


Fig. 2. Seeds of *Goodenia nocoleche* B. Pellow & J.L. Porter.

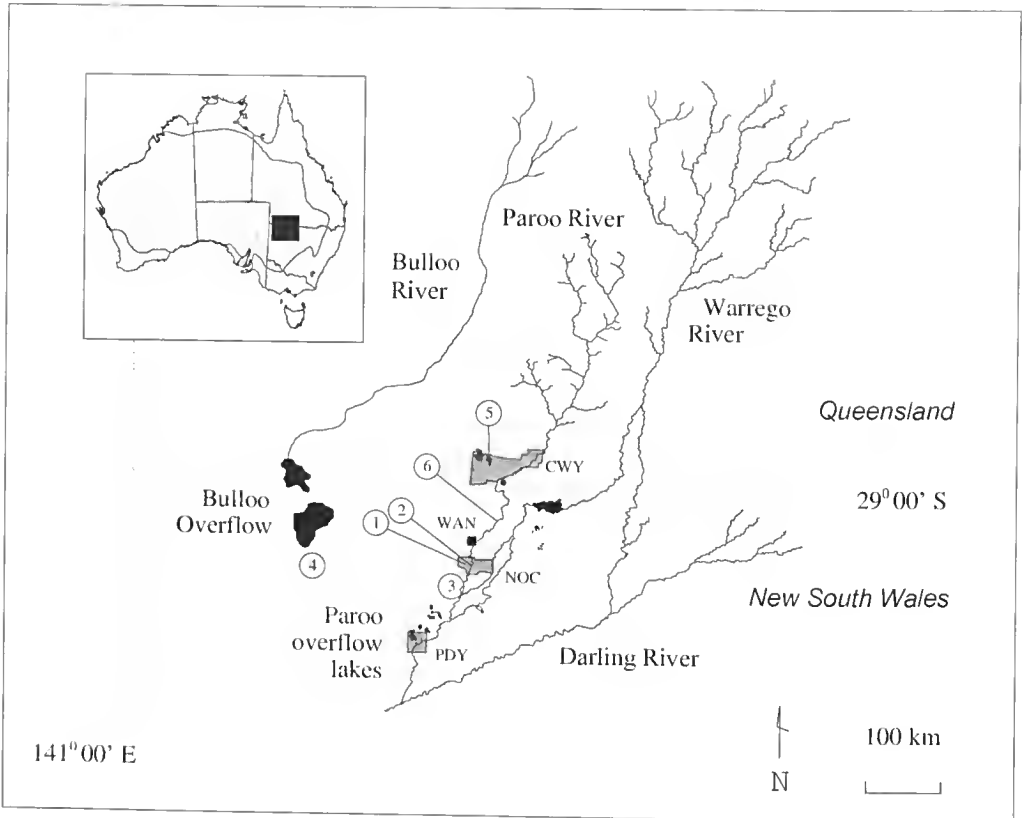


Fig. 3. Occurrence of *Goodenia nocoleche* (inset, dark square) in Australia's arid zone (< 500 mm annual average rainfall, stippled) and five wetland seed banks sampled: Pied Stilt Swamp (1), Momba Swamp (2), Waitchie Lake (3), Lake Altibouka (4), Lake Numalla (5). Unnamed claypan wetland where *Goodenia nocoleche* was observed growing (6). Conservation reserves on the Paroo River are Currawinya National Park (CWY), Nocolche Nature Reserve (NOC) and Paroo Darling National Park (PDY). Town (dark square) is Wanaaring (WAN).

'claypan' basins with uneven substrates, caused partly by expansion and contraction of grey or brown cracking clays. They fill predominantly from local rainfall and only connect to the Paroo floodplain via Momba Creek after heavy local rain. From 1990–2000 the swamps held water for a total of 17 and 22 months respectively. Their water is turbid after flooding, clearing gradually during the drying phase, especially in Pied Stilt Swamp. Plant communities in these temporary wetlands undergo considerable changes during erratic filling and drying cycles, as aquatic plants, sedges, annual grasses, herbs and forbs become abundant during and after inundation, before declining again. During prolonged dry periods ground cover may be virtually absent and many species remain hidden below the surface as propagules in seed banks or underground storage organs.

Vegetation around the swamp margins consists of a narrow band of trees, mostly *Encalyptus largiflorens* and *E. populnea* subsp. *bimbil*. Within the swamps trees are absent, and perennial shrub understories are absent or sparse with occasional grasses. After flooding sedges are common at the margins, and in open water floating-leaved submergent or partially emergent species may occur. (Kingsford & Porter 1999).

**Ecology:** *Goodenia nocoleche* can germinate and grow in standing water up to 0.6 m deep, with floating leaves on greatly extended petioles (Fig. 4), similar in appearance to *Potamogeton octandrus*. As water recedes inflorescences emerge and grow rapidly. The plants die back rapidly as sediments dry completely. *Goodenia nocoleche* has been observed growing in Pied Stilt Swamp during several flood events (December 1998, 2000) and appears to be a summer annual needing inundation in shallow temporary freshwater wetlands to stimulate a germination response from the persistent seed bank, followed by partial drying to initiate flowering. These observations are supported by the behaviour of the species in cultivation. Ability to initiate vegetative growth and



Fig. 4. *Goodenia nocoleche* B. Pellow & J.L. Porter in cultivation.

form floating leaves early in the drying cycle of temporary wetlands may confer some advantage compared to other low growing amphibious species that also colonise the exposed sediments of drying wetlands (e.g. *Minulus repens*, *Ranunculus sessiliflorus* var. *pilulifer*, *Pratia darlingensis*). In functional group terms, *Goodenia nocoleche* is an 'amphibious fluctuation-responder' because it alters its growth pattern or morphology in response to the presence or absence of water (Brock & Casanova 1997). Amphibious and aquatic plants in arid zone wetlands are generally poorly known, because many species are short-lived and access to these remote areas is difficult when water is present. Potential threats to this species include invasive weeds that are spread by water such as *Pistia stratiotes* and *Xanthium occidentale* and alterations to flow regimes of rivers and floodplains.

**Etymology:** the epithet is taken from the name of the Nature Reserve where this species was found. It is derived from an aboriginal word meaning 'place of many waterholes'

**Notes:** In his description of two new species of *Goodenia* from the Northern Territory, Albrecht (2002) defines bracteoles according to Briggs and Johnson (1979) calling the structures opposite or sub-opposite bracteoles due to the presence of buds in their axils. We have chosen to keep the term bracteole for these occurrences, according to Carolin (1990, 1992). Although buds do occur within the axis of some bracteoles of the inflorescence the majority of the bracteoles do not exhibit them.

A specimen of *Goodenia launprosperma* (NSW 460174) collected in a semi-aquatic environment exhibits similar leaf morphology to that of *G. nocoleche*. Other specimens of *G. launprosperma* not recorded as growing in semi-aquatic situations exhibited different leaf morphology. The characters of extended leaf petiole, larger lamina and reduced stem length may be related to the semi-aquatic habitat. *Goodenia nocoleche* has been observed in the field with terrestrial leaves immediately prior to flowering in situations where the water levels have receded but no specimens have been collected for examination. Seedlings of *G. nocoleche* (8110-WOLL) show a number of delicate, lanceolate leaves 12mm long and 2mm wide which are produced prior to the development of the basal leaves with extended petioles.

## Acknowledgments

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## References

- Albrecht DE (2002) New species and notes on central Australian *Goodenia* (Goodeniaceae). *Nuytsia* 15: 1–9.
- Briggs BG & Johnson LAS (1979) Evolution in the Myrtaceae—evidence from inflorescence structure. *Proceedings of the Linnean Society of New South Wales* 102: 157–256.
- Brock MA & Casanova MT (1997) Plant life at edge of wetlands: ecological responses to wetting and drying patterns. In N Klomp & LI Klomp (eds) *Frontiers in ecology: building the links*. (Elsevier Science: Oxford, UK)

- Brock MA, Theodore K & O'Donnell L (1994) Seed-bank methods for Australian wetlands. *Aquatic Botany* 45: 483–493.
- Carolin RC (1990) Nomenclatural notes and new taxa in the genus *Goodenia* (Goodeniaceae). *Telopea* 3: 517–570.
- Carolin RC (1992) *Goodenia*. Pp. 147–281 in AS George (ed.) *Flora of Australia*, vol. 35. (Australian Government Publishing Service: Canberra)
- Kingsford RT & Porter J (1999) Wetlands and waterbirds of the Paroo and Warrego Rivers. Pp. 23–50 in RT Kingsford (ed.) *A free-flowing River: The Ecology of the Paroo River* (NSW NPWS: Sydney Australia)
- Porter J (2002) Effects of salinity, turbidity and water regime on arid zone wetland seed banks. *Verh. Internat. Verein. Limnol.* 28: 1486–1471.

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# Reassessment of *Indigofera pratensis* var. *coriacea* Domin and var. *angustifoliola* Domin (Fabaceae: Faboideae) with the recognition of a new species

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## Abstract

The two varieties of *Indigofera pratensis* described by Karel Domin are reassessed. *Indigofera pratensis* var. *coriacea* is distinct from the widespread *Indigofera pratensis* sens. str. in a number of reproductive and vegetative characters and is here raised to specific rank as *Indigofera scabrella*. *Indigofera pratensis* var. *angustifoliola* is judged to be an environmental or rare geographic variant of *Indigofera pratensis* sens. str. and not worthy of continued recognition. Lectotypes are designated for both names.

## Introduction

The *Indigofera pratensis* complex is widespread in open habitats in forest, woodland and shrubland or in savanna. Plants are usually found as low to tall shrubs with purplish-pink flowers that are usually more than 10 mm long and borne in dense, showy axillary racemes. In eastern Queensland, its range extends from the northern part of Cape York (c. 12°35') to just north of Brisbane (c. 27°15') but there are also scattered populations in inland Queensland, particularly between Townsville and Hughenden and in the vicinity of Mount Isa, with a few records from the north-eastern part of the Northern Territory. A survey of herbarium specimens of *I. pratensis* was carried out as part of a review of this complex (Kazandjian 2002) and revealed considerable variation such that some morphotypes in this complex are apparently distinct at species or subspecies level. The inland populations of the complex were largely unknown when Domin (1926) divided *Indigofera pratensis* into three varieties: *I. pratensis* var. *typica* (= *I. pratensis* var. *pratensis*), *I. pratensis* var. *coriacea* and *I. pratensis* var. *angustifoliola*. The two new varieties were described from limited material and distinguished primarily on leaflet characters. In the present paper, we reassess and lectotypify these infraspecific taxa.

### ***Indigofera pratensis* var. *coriacea* and *Indigofera pratensis* var. *pratensis***

Domin (1926) distinguished variety *coriacea* as having fewer, smaller leaflets with a more coriaceous texture, somewhat prominent lateral venation but obscure reticulate venation. Indeed, he suggested that *I. pratensis* var. *coriacea* might possibly be treated as a new species ('vielleicht eine selbständige Art').

#### **Hairs**

Hairs in these two taxa can be divided into two types, here designated T1 and T2. The T-shaped hairs are the most commonly encountered type in *Indigofera* and have been described as 'uniseriate macroform biramous hairs' often with  $\pm$  equal arms (Prabhakar et al. 1985, Schrire 1995). T1 hairs are 'appressed' following the definition proposed by Hewson (1988), that is, the angle of elevation above the surface is in the range  $0^{\circ}$ – $15^{\circ}$ . T2 hairs have their arms ascending at angles greater than this, to around  $45^{\circ}$ , with arms straight. *Indigofera pratensis* var. *pratensis* has both kinds, with the T2 type less frequent but tending to have longer arms, while var. *coriacea* has hairs of the T1 type only (Fig. 1 c, f). Hair density on the leaflets varies somewhat between the two taxa. In *I. pratensis* var. *pratensis* the leaflets have sparser hairs and are usually markedly discoloured with the additional feature of rather conspicuous reticulate venation, particularly on the lower surface (Fig. 2 a, b), whereas in var. *coriacea*, the leaflets have moderately dense hairs on both surfaces and are more or less concolorous (Fig. 2 c, d).

#### **Stipules**

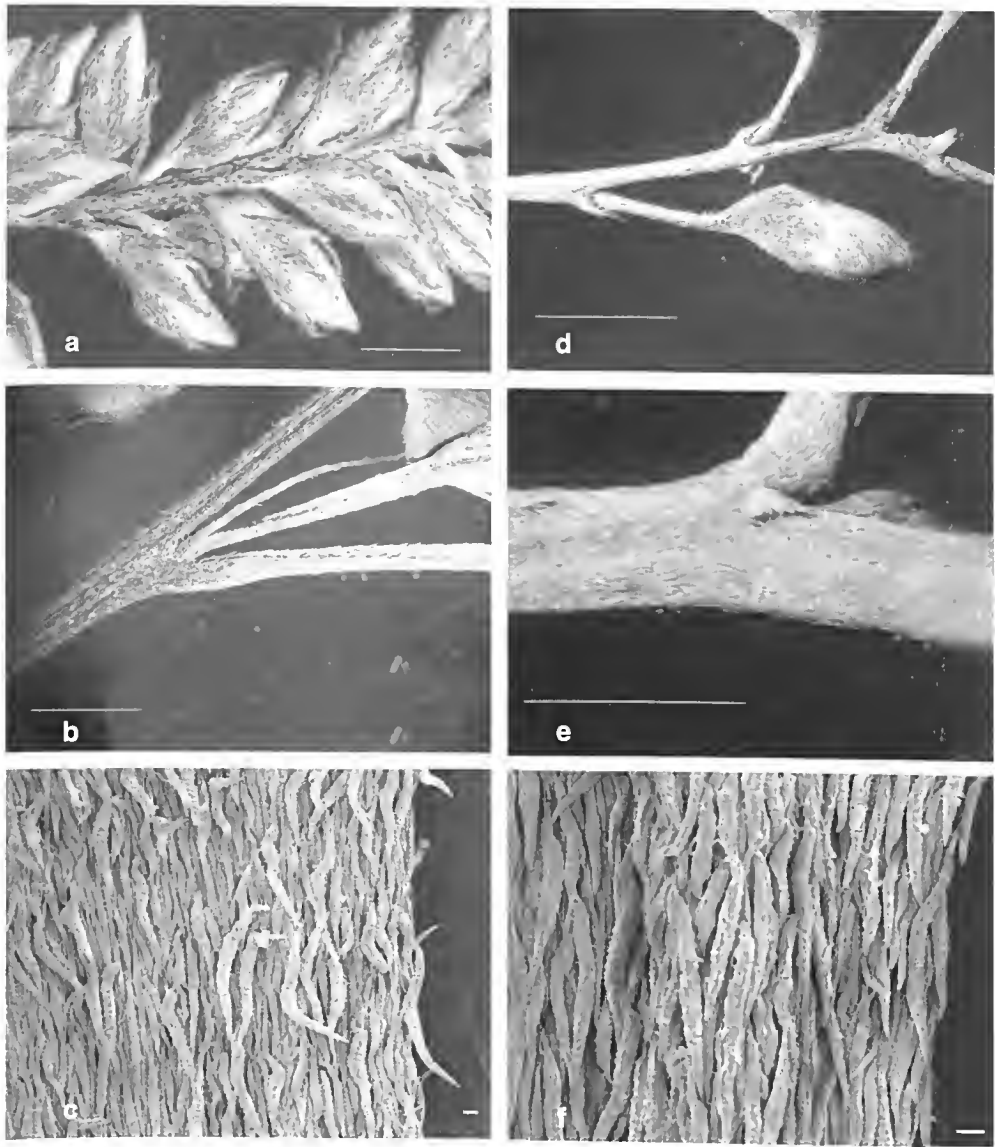
Stipules differ markedly in length between these two taxa (Fig. 1 b, e): they are triangular-linear and 5–12 mm long in var. *pratensis*, but deltate and 1.0–1.5(–2) mm long in var. *coriacea*. These length differences are paralleled in the inflorescences (Fig 1 a, b) where the bracts match the stipules in shape and relative length, being 2–3 mm and c. 0.5 mm long, respectively. There is a similar contrast in the size and shape of the calyx teeth: in var. *pratensis* they are 0.9–1.5 mm long and acute, while in var. *coriacea* they are 0.5–0.9 mm long and obtuse.

#### **Inflorescence characters**

Overall inflorescence characters also differ. The inflorescences of *I. pratensis* var. *pratensis* appear to be denser than those of var. *coriacea* (Fig. 1 a, d). This is due to two features, the spacing of flowers and the length of the pedicels. On the racemes, the flowers are not always equally spaced and are often in loose groups of two or three with a longer space between the groups. In this study, density of flowers was measured as the distance between adjacent recently opened flowers (or groups of flowers) and was found to be (4–) 5–8 mm in var. *coriacea* but only 2–3(–4) mm in var. *pratensis*. Pedicel length is clearly distinct: only 1.5–2.5 mm in var. *pratensis* compared with 3–5(–7) mm in var. *coriacea*.

Plants grown under standardised environmental conditions were also well separated using the same morphological criteria (Kazandjian 2002), confirming that these character variations are not environmentally induced. Furthermore, the measurable morphological differences between the two taxa are maintained even though their populations are (at least partially) sympatric. *Indigofera pratensis* var. *coriacea* has a restricted distribution to the west of the Atherton Tableland, primarily around Chillagoe and the Walsh River but extending to the Mount Surprise area, and





**Fig. 1.** Morphological characters. *Indigofera pratensis* var. *pratensis*. **a**, inflorescence showing long bracts, short pedicels and crowded flowers; **b**, stipule. **c**, SEM of stem showing T1- and T2-type hairs. *Indigofera pratensis* var. *coriacea* **d**, inflorescence showing short bracts, long pedicels, short sepals and well-spaced flowers; **e**, stipule; **f**, SEM of stem showing T1-type hairs. (a,b from *Puttock UNSW 14239*; c from *G. Wilson 5 (JCT)*; d,e from *Kazandjian NSW 705606*; f from *Jackes 9954 (JCT)*. Scale bar: a = 3mm, b = 3 mm, c = 400  $\mu$ m, d = 3mm, e = 6 mm, f = 500  $\mu$ m.

*Indigofera pratensis* var. *pratensis* has a wide range in eastern Queensland. The two taxa co-occur in the Chillagoe area without any sign of intergradation. Since there is no indication of any hybridisation between them, we therefore conclude, on both morphological and biological grounds, that Domin's var. *coriacea* should be recognised at specific rank.

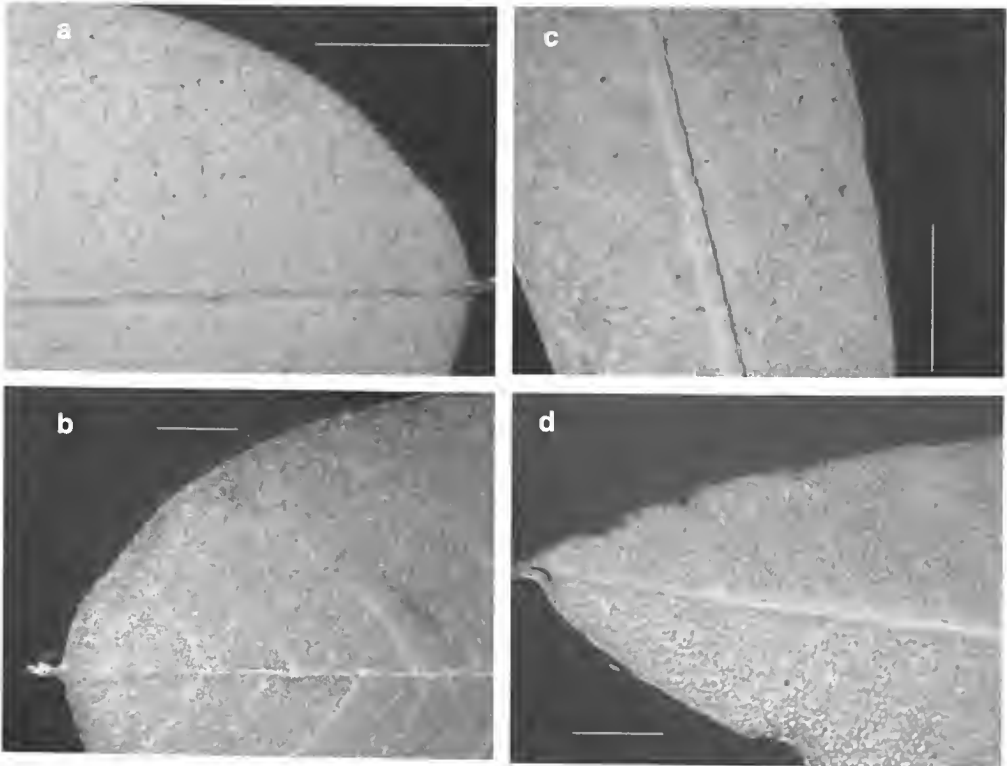
*Indigofera scabrella* Kazandj. & Peter G. Wilson, *nom. et stat. nov.*

*Indigofera pratensis* var. *coriacea* Domin, *Biblioth. Bot.* 89 (3): 191 (1926), non *I. coriacea* Aiton, 1789.

Type citation: 'Bei Chillagoe und besonders in den Savannenwäldern zwischen Crooked Creek und dem Walsh River (Domin II. 1910)' [near Chillagoe and particularly in the savanna woodland between Crooked Creek and the Walsh River].

Lectotype (**designated here**): Queensland: in xerodrymio inter riv. Crooked Creek et Walsh River, *K. Domin* 4515, Feb 1910 (PR 527226) (Fig. 3).

Residual syntype: Queensland: in xerodrymio inter fl. Walsh River et opp. Chillagoe, *K. Domin* 4514, Feb 1910 (PR 527225).



**Fig. 2.** Leaflet characters. *Indigofera pratensis* var. *pratensis*. a, undersurface showing conspicuous reticulum; b, upper surface. *Indigofera pratensis* var. *coriacea*. c, undersurface showing inconspicuous reticulum; d, upper surface. (a,b from Puttock UNSW 14239; b,c from Kazandjian NSW 705606). Scale bars: 3mm.



HERBARIUM MUSEI NATIONALIS PRAGAE 527226

Dr. K. DOMIN, Iter Australiense a. 1909—1910 (No. 527226)
<i>Indigofera pratensis</i> MUELL.
var. <i>coriacea</i> DOMIN var. n.
Queensland: In aerodromio inter riv. Crooked Creek et Walsh River
legi 11. 19 10.

ako.no.23/1960

NATIONAL HERBARIUM N.S.W.

*Indigofera pratensis* F. Muell

DETERMINATI: Peter G. Wilson 21 July 1998  
NATIONAL HERBARIUM N.S.W.

PR 527226

LECTOTYPE

*I. pratensis* F. Muell. var. *coriacea*  
Domin

DETERMINATI: Peter G. Wilson 21 July 1998

NO. 3005  
1909-1910

Fig. 3. Lectotype of *Indigofera pratensis* var. *coriacea*.



Fig. 4. Lectotype of *Indigofera pratensis* var. *angustifolia*.

Shrub or sub-shrub 0.5–0.8(–1.5) m high. Young stems angular, densely covered with hyaline appressed T1-type biramous hairs. Leaves pinnate, 47–83 mm long, with (5–) 7–11 leaflets; stipules deltoid, 1.0–1.5(–2) mm long, (0.5–)0.7–0.9 mm wide; petiole c. 5–9 (–12) mm long; rachis furrowed. Leaflets coriaceous, green above and paler beneath; stipellae inconspicuous, to 0.7 mm long; lamina ovate to elliptical; the basal leaflets are (9–)11–23(–30) mm, the lateral leaflets c. 12–25 mm and the apical leaflets 13–29 mm long; upper surface with sparse, appressed hairs, lower surface with moderately dense hairs; apex mucronate; secondary veins conspicuous but not prominent, the reticulum usually inconspicuous. Inflorescence a lax axillary raceme up to 150(–220) mm long, much longer than the subtending leaf; distance between adjacent mature flowers more than 4 mm. Bracts deltoid to narrowly triangular, 0.7–1.4 mm long. Flowers purple, 10–12 mm long; pedicels long, 3–5(–7) mm. Calyx 1.7–2 mm long; teeth 0.5–0.9 mm long, slightly shorter than the tube. Standard purple, 9–11 mm long, 5.5–7 mm wide, moderately hairy on the back, the apex obtuse-acute when the standard is fully expanded. Wings shorter than or equal to the standard, darker in colour towards the apex, 7–10.5 mm long, 2–3 mm wide. Keel as long as the standard, lateral pockets c. 1 mm long; hairs few and scattered at the base, becoming moderately dense towards the apex and margin. Staminal tube 7.5–8.5 mm long, purplish. Ovary appressed-hairy. Pods straight, cylindrical, 27–44 mm long, 2–3 mm wide, moderately densely pubescent; endocarp spotted. Seeds 6–10 per fruit, cylindrical to almost cubic, 1.5–2 mm long and wide; testa dark brown to light olive, the surface smooth to rough.

**Phenology:** flowers mostly in Summer; fruits mostly Autumn.

**Distribution and habitat:** This species is restricted to an area west of Atherton Tableland with the known distribution extending from “Nychum”, NNW of Chillagoe, south to the Mount Surprise area (ie, between c. 16°50' and 18°10'S). It is recorded from savannah woodland and open forest on red or grey gravelly soils.

**Notes:** As the epithet ‘coriacea’ is pre-occupied, a new epithet is proposed. The proposed epithet, ‘scabrella’, is taken from the Latin meaning ‘minutely scabrous’, a reference to the leaflets being slightly rough to the touch.

Domin described this taxon as having 5–7 leaflets but leaves with 5 leaflets are uncommon, except for the early leaves of a new season’s growth.

**Other specimens examined:** Queensland: Cook: 13 km from the Walsh River crossing on the road to Wrotham Park, *Clarkson 4255*, 14 Jan 1982 (BRI, CANB, NSW, UNSW); Mungana Red Hill, *Cole 5114*, 8 Aug 1963 (BRI); Petford–Chillagoe Rd, 11 km W of Almaden., *Hacker 397*, 16 July 1983 (BRI); 5 km W of Chillagoe, *Jackes 9954, 9956*, May 1999 (JCT, NSW); 22 km W of Walsh river, *Kazandjian AK0012An, AK0013Au* & *Dowe*, 14 May 2001 (JCT, NSW); Nychum holding on Elizabeth Creek near homestead, *Macdonald 1*, 4 Dec 1970 (BRI, CANB, MEL, NSW); 29 km W of Mount Surprise, *Puttock UNSW 13439*, 20 Apr 1982 (NSW, UNSW); Lyndbrook, Etheridge Line, *Towers s.n.*, 11 Apr 1960 (BRI); 0.8 km E of Mungana Yards, *Wilson UNSW 13388* & *Puttock*, 17 Apr 1982 (NSW, UNSW); 10.5 km E of Chillagoe, *Wilson UNSW 13404* & *Puttock*, 17 Apr 1982 (NSW, UNSW); 18.1 km E of Petford, *Wilson UNSW 13407* & *Puttock*, 17 Apr 1982 (NSW, UNSW); 73 km from Almaden on road to Mt. Surprise, 5 km past Bullock Creek Station turnoff, *Forster 9635*, 29 Jan 1992 (BRI, NSW).

**Cultivated specimens:** James Cook University, Townsville (seed ex *Jackes 9954*) *Kazandjian s.n.*, 15 Jan 2002 (NSW 705631); James Cook University, Townsville (seed ex *Wilson UNSW 13388* & *Puttock*) *Kazandjian s.n.*, 15 Jan 2002 (NSW 705606).

*Indigofera pratensis* var. *angustifoliola*

The name *I. pratensis* var. *angustifoliola* Domin was based on specimens, collected near Gladstone by Amalie Dietrich, that were characterised by narrow leaflets 15–20 mm long and 2.75–3.75 mm wide. When Mueller (1860) described *I. pratensis*, from specimens collected in the Burdekin area, he gave the leaflet dimensions as 10–40 mm long and 6–13 mm wide. More recent measurements, over the geographic range of the *Indigofera pratensis* sens. str., indicate that the leaflet size is commonly in the range 10–30(–44) mm long and 5–15(–24) mm wide (Wilson & Rowe, unpublished data). When specimens that had been collected from the Queensland coast between 20° and 25°S (ex BRI, CANB, MBA, MEL and NSW) were examined, only one had leaflets that matched Domin's description. This was a specimen (MEL586535) collected by Eugene Fitzalan in 1874 at Port Denison (Bowen), a considerable distance north of Gladstone. Apart from this, the only other specimen to approach the Dietrich collection is one of Robert Brown's found in the vicinity of Keppel Bay (near Rockhampton, just north of Gladstone); this appears to be a depauperate plant with leaflets 3–5.2(–6) mm wide. A field trip to the Gladstone area did not locate any living plant with leaflets matching Domin's description, although plants of typical *Indigofera pratensis* were commonly encountered. These observations suggest that Dietrich (and Brown and Fitzalan) may have collected the specimens in a dry year when the size of the leaflets was affected by the availability of water. *I. pratensis* occurs in open *Encalyptus* woodland in eastern Queensland where water and nutrient availability vary markedly from season to season. Field observations of other species suggest that features such as plant height, leaflet number and size, pedicel and petiolule length, and fruit size are likely to be affected by such environmental conditions. Hence, we judge var. *angustifoliola* to be an environmentally induced variant not worthy of recognition.

**Typification**

Domin listed two Dietrich collections in the protologue of this species, so lectotypification is required.

*Indigofera pratensis* var. *angustifoliola* Domin, Biblioth. Bot. 89 (3): 191 (1926)

Type citation: 'Gladstone, A. Dietrich s.n. und n. N. 16a, beide als *I. macrophylla* Venten. bestimmt.'

Lectotype (**designated here**): Queensland: Gladstone, A. Dietrich s.n. (PR 527229) Fig. 4. Isolectotype: HBG.

Residual syntype: Queensland: Gladstone, A. Dietrich 16a (PR 527230, HBG).

At PR, the two syntypes are mounted on a single sheet but with separate numbers; the lectotype is the upper specimen on the sheet. The typed label calls this taxon var. 'angustifolia' rather than *angustifoliola*, but there is no way of knowing if this was an error or if Domin changed his mind about the epithet when publishing the name. Also, Domin erred in the type citation since Dietrich had, in fact, determined the species as *I. macrostachya* Vent. (a synonym of the Himalayan species, *Indigofera heterantha* Wall. ex Brandis) not *I. macrophylla* Schumach. & Thonn., an African species.

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## References

- Domin K (1926) *Indigofera*. *Bibliotheca Botanica* 89 (3): 741–746.
- Hewson H (1988) *Plant Indumentum*. Australian Flora & Fauna Series No. 9. (Australian Government Publishing Service: Canberra)
- Kazandjian AA (2002) *Systematics of the Indigofera pratensis Complex (Fabaceae): a Morphological and Molecular Approach*. (Unpublished PhD thesis, James Cook University, Townsville)
- Mueller F (1860) *Essay on the plants collected by Mr. Eugene Fitzalan, during Lieut. Smith's expedition to the estuary of the Burdekin*. (Government Printer: Melbourne)
- Prabhakar M, Vijay Kumar BK, Ramayya N & Leelavathi P (1985) Structure, distribution and taxonomic significance of trichomes in some *Indigofera* L. (Fabaceae). *Proceedings of the Indian Academy of Science (Plant Science)* 95: 309–314.
- Schrire BD (1995) Evolution of the tribe Indigoferae (Leguminosae Papilionoideae). Pp. 161–244 in Crisp MD & Doyle JJ (eds), *Advances in Legume Systematics*, vol. 7. (Royal Botanic Gardens: Kew)

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# Lectotypification of *Schoenodum tenax* (Restionaceae) and a note on the type of *Lyginia imberbis* (Anarthriaceae)

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## Abstract

Robert Brown in 1810 made clear that the original description of *Schoenodum tenax* Labill. was based on collections of more than one taxon. The male material is the species currently known as *Lyginia imberbis* R. Br. but the female specimens include both the species currently known as *Leptocarpus tenax* (Labill.) R. Br. (basionym *S. tenax*) and *Apodasmia brownii* (Hook. f.) B.G. Briggs & L.A.S. Johnson (basionym *Leptocarpus brownii*). A female specimen in the Willdenow Herbarium in Berlin (B), of the species currently known as *Leptocarpus tenax*, is designated as **lectotype** of *S. tenax*; this matches the illustration and text of the protologue and preserves current usage. The type specimen of *Lyginia imberbis* R. Br. is a lectotype rather than a holotype.

## Introduction

In a recent publication, Briggs and Johnson (1998) divided the then recognised species of *Leptocarpus* among four existing and three new genera. In that work we maintained the name *L. tenax* for the commonest, most widespread species and the one that epitomises *Leptocarpus* for most Australian biologists. There we pointed out that this use could only be maintained if the type of the conserved name *Leptocarpus* R. Br. were changed. Later I made a formal proposal (Briggs 2001) to change the conserved type of *Leptocarpus* from *L. aristatus* R. Br. to *L. tenax* (Labill.) R. Br. Since that proposal was made, it has become clear that there are additional issues concerning the typification of *Leptocarpus tenax* and *Lyginia imberbis*.

## Lectotypification of *Schoenodum tenax*

Labillardière (1806) based his description of *Schoenodum* and *S. tenax* on material of both male and female plants, and both sexes are illustrated in his Tab. 228. I have now examined the relevant Labillardière specimens in Florence (FI) and Paris (P) and a microfiche of sheet 18267 in the Willdenow herbarium in Berlin (B). The male material in FI belongs to the taxon currently known as *Lyginia imberbis* R. Br. Labillardière's female specimen in FI (sheet 188031 of the Webb Herbarium) is referable to the taxon currently known as *Apodasmia brownii* (Hook. f.) B.G. Briggs &

L.A.S. Johnson (= *Leptocarpus brownii* Hook. f.). However, the female material in P and B is referable to the species to which the name *Leptocarpus tenax* R. Br. is presently applied. These specimens are thus considered to represent three taxa, so that only lectotypification can fix the application of the names *Schoenodum* and *S. tenax*.

Labillardière's statement in the protologue of the source of the collections is 'Habitat in capite Van-Diemen', a designation given to collections from several locations in Tasmania. This appears to be intended to apply to both the male and female specimens, but only the females could have been collected there. Nelson (1974) has drawn attention to a number of specimens of Western Australian endemics cited by Labillardière that are labelled 'capite van-Dieman'. Using the names currently in use, *Lyginia imberbis* is a Western Australian endemic that is common on the southern coast which was visited on the voyage of d'Entrecasteaux, when Labillardière's collections were made; *Apodasmia brownii* occurs in Tasmania and Victoria; while *Leptocarpus tenax* is found in Tasmania, the south of Western Australia and widely distributed in eastern Australia.

In determining whether previous authors have lectotypified *S. tenax*, the following four publications are relevant.

(1) Brown (1810) was the first to recognize that Labillardière's material of *Schoenodum tenax* included more than one taxon. In the *Prodromus*, Brown adopted the name *L. tenax* for the seventh species of his genus *Leptocarpus* and cited '*Schoenodum tenax* femina. Labill. nov. holl. 2. t. 229' under his entry for that species. In the protologue of *Lyginia imberbis* he cited '*Schoenodum tenax* mas. Labill. nov. holl. 2. t. 229'. Brown also referred to his own material, using his customary style: '(M.) v.v.' and '(M. J. D.) v.v.' respectively. Since he had not examined Labillardière's specimens (D. Mabberley pers. comm.), Brown's citation of Labillardière would refer to the excellent illustrations, rather than directly to Labillardière's specimens. Also, Brown did not use the word 'type', or equivalent.

(2) In his *Enumeratio Plantarum*, Kunth (1841) widened the circumscription of *Schoenodum*, equating it with 'Leptocarpi species Brown' and excluded Labillardière's male plant. Although he referred specifically to Labillardière's collection in the Willdenow herbarium he did not formally refer to it as lectotype.

(3) Rickett & Stafleu (1959), in their review of Appendix III of the *International Code of Botanical Nomenclature (Paris 1956)*, state about *Lyginia*, 'Conservation superfluous: *Schoenodum* Labillardière ... need not be rejected because its type *S. tenax* is typified by the female plant of Labillardière, which is *Leptocarpus* R. Brown ... and not *Lyginia*.' [In reference to the conserved name *Leptocarpus*, Rickett & Stafleu listed the type of the rejected name *Schoenodum* as '*S. tenax* Labillardière (vide Kunth, Enum. 3: 445. Jul 1841)', a reference that has persisted to the current edition of the ICBN.]

(4) Johnson and Evans (1966) observed that 'The female specimen was, in effect, selected as lectotype by R. Brown when he based *L. tenax* upon it'.

None of the publications mentioned effected lectotypification since they did not differentiate between the two taxa of Labillardière's female material or, in some cases, distinguish between Labillardière's female material and his illustration. Of these references, (1) and (2) did not use the term 'type', whereas (3) and (4) did not refer to a gathering of a single species.

In the Webb Herbarium at FI there are male and female specimens relevant to *S. tenax* mounted separately on two sheets. Sheet FI 188030 bears flowering male culms, identifiable as *Lyginia imberbis*, and has a packet attached to the upper right corner labelled 'foem. flores', this contains an inner packet labelled 'semen cum fragmentiis capsulae'. The two pieces of material in the inner packet, however, appear to be staminal columns from male flowers of a *Lyginia* species. Four small handwritten sheets in Labillardière's hand are pinned to the sheet of this male material (FI 188030); the writing on two of these matches the text of the protologue of *Schoenodum* (p. 79) and *S. tenax* (p. 80); the other two are descriptive notes that appear to be a first draft of the description. Sheet FI 188031 bears groups of slender, unbranched culms, with three of the culms terminating in female inflorescences referable to what is now called *Apodasmia brownii*. Also attached to FI 188031 are (1) a packet containing numerous female flowers of *A. brownii*, (2) a small packet labelled 'masculi flores' which contains male flowers of *Lyginia* and (3) a note 'facies chondropetali rotb.' in Labillardière's hand.

The relevant sheet in P, of the taxon currently known as *L. tenax*, has a handwritten label (but not by Labillardière) '*Schoenodum tenax*' and a printed label 'Van Diemén Labillardière Donné par M. Webb'. It bears a female plant with several culms and two inflorescences.

Sheet number 18267 in the Willdenow herbarium in B also bears a female specimen of the taxon currently known as *L. tenax*. It is labelled, in Labillardière's hand, '*Schoenodum tenax* ♂' (sic.). The right-hand piece shows an inflorescence; the left-hand piece is only part of a culm, but its culm sheaths, and the ascending curve of a culm arising from a rhizomatous base, identify it as the same taxon.

It is now clear that Labillardière's female material is a mixture of two species, one represented by the material in FI and the other by the specimens in B and P. These are sufficiently similar to have been taken as conspecific (especially in the context of the male *Lyginia* material also being considered conspecific) when parts of the collections were chosen for close study and when duplicates were distributed. The description of vegetative structures may be based on all of the original material, of the three taxa, but with emphasis on the structures of the male, *Lyginia*, as in the description of the roots. However, it appears that material of only one of the female species was examined in detail and illustrated. The protologue of *S. tenax* describes the female inflorescence as 'panicula contracta, palmaris, spiculis elliptico-oblongis, sessilibus pedunculatisque, imbricatis squamis ovato-oblongis, acuminatis, unifloris.' The reference to elliptic-oblong, single-flowered pedunculate spikelets is consistent with Labillardière's illustration (which shows a female inflorescence of distinct, elongated spikelets) and with the specimens in both B and P. These features are characteristic of *L. tenax*, as that name is presently applied, and are not shown by the taxon known as *A. brownii*, which has much more condensed inflorescences, the spikelets not clearly distinguishable within the densely aggregated compound inflorescences, and the small flower-clusters each multiflowered.

Although the FI specimen is in the herbarium that houses Labillardière's main collection, it does not agree with the description and illustration of the female inflorescence in the protologue, which therefore cannot have been based upon it. Moreover, if the FI female specimen were chosen as lectotype, this would change the application of the names *Leptocarpus tenax* and *Apodasmia brownii*, causing confusion in the naming of two widespread and ecologically important species.

The female specimens in B and P agree with the description and illustration of the protologue (in accord with Article 9.17 of the ICBN) and choice of either of them would preserve current usage of the names *Leptocarpus* and *L. tenax*. Only the specimen in B has been annotated by Labillardière, so this would appear the obvious choice among them. I therefore here **designate as the lectotype** of *Schoenodum tenax* Labill. the specimen on sheet 18267 of the Willdenow herbarium in B, which is female plant material of the taxon currently known as *Leptocarpus tenax*. A photograph of the lectotype is included in the microfiche set of the Willdenow herbarium (Inter Documentation Company microfiche set 7440). This lectotypification preserves the usage established by other authors who identified *Schoenodum tenax* with Labillardière's female gathering(s).

### The lectotype of *Lyginia imberbis* R.Br.

*Lyginia imberbis* R. Br., the species to which Labillardière's male material is referred, is one of three species of the sole genus of Lyginiaceae (Briggs & Johnson 2000), or a member of one of three genera of Anarthriaceae if a more inclusive family concept is adopted (Chase et al. 2000, Bremer 2002, APG II 2003), by which the Anarthriaceae encompasses the *Anarthria* clade of Briggs et al. (2000). Since the original material consists of Brown's collection and also Labillardière's illustration, lectotypification was necessary. Briggs & Johnson (2000) overlooked the need for lectotypification and cited a sheet of Brown's collection, bearing both male and female plants, as the holotype. That incorrect use of a term to describe the type is an error to be corrected (ICBN Art. 9.8); it did not prevent the action of specifying a type among the original material effecting lectotypification. Thus the lectotype (designated [as 'holo'] by Briggs & Johnson, *Telopea* 8: 496, 2000) is the specimen King George III<sup>d</sup> S<sup>d</sup> [Sound], *R. Brown* (*Bennett No. 5837*), 1802–5 (BM, ♂, ♀ mounted together on one sheet, annotated by Brown 'Restio', isolectotypes E, K, P).

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## References

- APG II (2003) An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG II. *Bot. J. Linn. Soc.* 141: 399-436.
- Bremer K (2002) Gondwanan evolution of the grass alliance of families (Poales). *Evolution* 56: 1374–1387.
- Briggs BG (2001) (1489) Proposal to conserve the name *Leptocarpus* (Restionaceae) with a conserved type. *Taxon*: 50: 919–921.
- Briggs BG & Johnson LAS (1998) New genera and species of Australian Restionaceae (Poales). *Telopea* 7: 345-373.
- Briggs BG & Johnson LA (2000) Hopkinsiaceae and Lyginiaceae, two new families of Poales in Western Australia, with revisions of *Hopkinsia* and *Lyginia*. *Telopea* 8: 477–502.
- Briggs BG, Marchant AD, Gilmore S & Porter CL (2000) A molecular phylogeny of Restionaceae and allies. Pp. 661–671 in KL Wilson & D Morrison (eds) *Monocots–Systematics and Evolution*. (CSIRO: Melbourne)
- Brown R (1810) *Prodromus Florae Novae Hollandiae et Insulae Van Diemen*
- Chase MW, Fay MF & Savolainen V (2000) Higher-level classification in the angiosperms: new insights from the perspective of DNA sequence data. *Taxon* 49: 685–704.
- Kunth CS (1841) *Emmeratio Plantarum*, vol. 3.
- Labillardière JJH de (1806) *Novae Hollandiae plantarum specimen*, part 23.
- Nelson EC (1974) The locations of collection and collectors of specimens described by Labillardière in 'Novae Hollandiae Plantarum Specimen' – additional notes. *Pap. & Proc. Roy. Soc. Tasmania* 108: 159–170.
- Rickett HW & Stapf FA (1959) Nomina generica conservanda et rejicienda spermatophytorum. *Taxon* 8: 213–243.

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# New combinations and synonymies in the Australian Graphidaceae

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## Abstract

Species of the Australian Graphidaceae have been re-allocated to the genera proposed in a recent revision of the family. Forty-one new combinations are made, a new name, *Graphis elixiana*, is published, and the following synonymies are proposed: *Diorygma erythrellum* replaces *Graphina atramontana*; *Graphis leucoparypha* replaces *G. turgidula* var. *norstictica*; *Hemithecium chlorocarpoides* replaces *Graphina replata* var. *monospora*; *Hemithecium chryserveron* replaces *Graphina replata*; *Leiorreuma hypomelaenum* replaces *Phaeographis necopinata*; *Phaeographis lindigiana* replaces *Phaeographis pseudomelana*, and *Platygramme pudica* replaces *Phaeographina echinocarpica*. Keys to the genera and species in Australia are given.

## Introduction

The lichen family Graphidaceae has recently been rearranged, with new genera described, some older genera resurrected and existing genera revised (Staiger & Kalb 1999; Staiger 2002; Kalb, Staiger & Elix 2004). This re-arrangement necessitates a number of name changes, new combinations and new synonymies in the Australian Graphidaceae which are listed below, together with keys to the taxa in each genus.

As a result of this revision, the following genera are now known from Australia:

*Acanthothecis* Clem., *Carbacanthographis* Staiger & Kalb (new), *Diorygma* Eschw., *Dyplolabia* A. Massal., *Fissurina* Fée, *Glyphis* Ach., *Graphis* Adans. (revised), *Hemithecium* Trevis., *Leiorreuma* Eschw., *Phaeographis* Müll. Arg. (revised), *Platygramme* Fée, *Platythecium* Staiger (new), *Sarcographa* Fée, *Sarcographina* Müll. Arg., *Thallolooma* Trevis., *Thecaria* Fée. The genus *Phaeographina* Müll. Arg. has also been revised but there are now no Australian taxa in the revised genus.

The genus *Gymnographa* Müll. Arg. is rejected as it is based on an old specimen of *Phaeographis eludens* (Stirt.) Shirley with degenerate ascospores; consequently the genus *Sarcographina* Müll. Arg., which had been reduced to synonymy with *Gymnographa*, is retained.

Many specimens, including a large number of type specimens, were examined in detail, some for the first time, in the course of this revision of the Graphidaceae (Staiger 2002); the majority were from one collector and biased in favour of South

American material but few Australian specimens were examined. Consequently, the circumscription of the genera fits the specimens examined and some of the combinations made below must be regarded as tentative until the revised genera are better defined.

### New synonymies and new reports

In addition to the synonymies recently described (Archer 2004, 2005), the following synonyms are reported.

*Graphina atramontana* A.W. Archer is morphologically indistinguishable from *Diorygma erythrellum* (Mont.) Kalb, Staiger & Elix and the two species are considered to be synonymous.

*Graphina pertenella* (Stirt.) Shirley and *Graphina laevigata* (Müll. Arg.) A.W. Archer possess the same chemistry and similar ascospores and differ only in the degree to which the lirellae are open. The two species are considered to be synonymous and are here combined under the earlier name and transferred to the genus *Platythecium* as *P. pertenellum*.

The ascospores in *Graphina repleta* (Stirt.) Shirley are usually hyaline, with some gradually becoming pale brown, but all give a red-brown colour with iodine, in contrast to the hyaline ascospores present in other *Graphina* species which usually give a blue or blue-violet colour. Stirton reported the ascospores to react brownish blue "spores caeruleo-infusatae" (Stirton 1881). This colour reaction of the ascospores with iodine, the pale reddish-brown exciple and the presence of stictic acid are identical to those of *Hemithecium chryserveron* (Mont.) Trevis.; the two species are here reduced to synonymy. Similarly, *Graphina repleta* var. *monospora* A.W. Archer, with larger ascospores, is identical with *Hemithecium chlorocarpoides* (Nyl.) Staiger, a species originally described from Java and recently reported from Australia (Staiger 2002). The two *Hemithecium* species differ only in the size of the ascospores and may be synonymous (Staiger *op. cit.*).

*Phaeographina echinocarpica* A.W. Archer & Elix is a later name for *Platygramme pudica* (Mont. & Bosch) M. Nakan. & Kashiw (Nakanishi et al. 2003). The chemistry of the latter species was originally reported as 'an unknown substance' (Nakanishi 1977) but the compound was recently identified as echinocarpic acid (Nakanishi et al. 2003) so *P. pudica* is identical to *P. echinocarpica*.

The morphology and chemistry of *Phaeographis necopinata* A.W. Archer & Elix are identical to those of *Leiorrenma hypomelaenum* (Müll. Arg.) Staiger, recently reported from Australia. Both contain the uncommon hypostictic acid as the major lichen compound.

*Phaeographis pseudomelana* Müll. Arg. is indistinguishable from *Phaeographis lindigiana* Müll. Arg., recently reported from Australia.

In addition, the following species in the Graphidaceae have recently been reported from Australia:

*Phaeographis brasiliensis* (A.Massal.) Kalb & Matthes-Leicht, *P. hypomelaena* Müll. Arg., *P. lindigiana* Müll. Arg., *P. lobata* (Eschw.) Müll. Arg. and *P. platycarpa* Müll. Arg.



(Kalb 2001) and *Hemithecium chlorocarpoides* (Nyl.) Staiger [*Phaeographina chlorocarpoides* (Nyl.) Zahlbr.] (Staiger 2002).

The key to the genera is adapted from Staiger (*op. cit.*, pp. 62–67) with genera not found in Australia omitted. Detailed descriptions of the genera are also given in Staiger (*op. cit.*).

### Key to genera of Graphidaceae in Australia

- |      |  |  |
|------|--|--|
| 1a.  | Exciple with distinctly carbonised areas .....   | 2  |
| 1b.  | Exciple uncarbonised with, at the most, small brownish areas .....   | 15   |
| 2a.  | Mature ascospores hyaline, I+ blue or blue-violet, or I-ve .....   | 3  |
| 2b.  | Mature ascospores brown or brownish, I+ red, red-brown or red-violet .....   | 9  |
| 3a.  | Lirellae with white powdery cover containing lecanoric acid (C+ red) .....   | <i>Dyplolabia</i>                              |
| 3b.  | Lirellae lacking a white powdery cover, or, if present, lacking lecanoric acid (C-ve) .....  | 4  |
| 4a.  | Hymenia in well-developed carbonised stromata; discs open, brownish granular   | <i>Glyphis</i>                                 |
| 4b.  | Hymenia not in well-developed carbonised stromata; discs closed or, if open, not brownish granular .....   | 5  |
| 5a.  | Labia or exciple divergent; discs visible in surface view .....  | 6  |
| 5b.  | Labia or exciple convergent; discs completely covered by the labia .....   | 7  |
| 6a.  | Carbonisation restricted to the base of the exciple, lateral exciple poorly developed; ascospores 20 µm long; testacein A and/or B present .....   | <i>Platythecium</i>                            |
| 6b.  | Lateral exciple and labia well-developed; ascospores > 20 µm long; lichen compounds absent .....   | <i>Glyphis</i> sub. gen. <i>Pallidoglyphis</i> |
| 7a.  | Labia carbonised, often completely, and convergent, with a thalline cover or a white pruinose layer; ascospores I- or I+ weak violet .....   | <i>Carbacanthographis</i>                      |
| 7b.  | Carbonised layer lacking a white pruinose layer; ascospores I+ blue-violet .....   | 8  |
| 8a.  | Lirellae fissurine, apically or laterally carbonised; ascospores ovoid-ellipsoid, 4-locular or muriform, with or without halo .....  | <i>Fissurina</i>                               |
| 8b.  | Lirellae not fissurine; labia distinctly developed and carbonised or, if fissurine, ascospores not ovoid but elongate and lacking halo .....   | <i>Graphis</i>                                 |
| 9a.  | Carbonised exciple and excipular labia usually well-developed .....  | 10   |
| 9b.  | Carbonised exciple lacking thalline cover .....  | <i>Phaeographina</i>                           |
| 10a. | Hypothecium becoming carbonised with age, giving a thick carbonised base .....   | 11   |
| 10b. | Hypothecium not becoming carbonised with age but base may be carbonised .....  | 14   |
| 11a. | Lirellae embedded in stromata [raised, paler, whitish areas] .....   | 12   |
| 11b. | Lirellae not embedded in stromata but may be crowded or branched .....   | 13   |
| 12a. | Ascospores septate with lenticular locules .....   | <i>Sarcographa</i>                             |
| 12b. | Ascospores muriform .....  | <i>Sarcographina</i>                           |
| 13a. | Proper margin and lateral exciple well-developed, discs open, ± sunken, red or white pruinose [ascospores in known species muriform] .....   | <i>Thecaria</i>                                |
| 13b. | Proper margin and lateral exciple poorly developed or, if well-developed upper part not covered by thalline layer; discs not sunken, brown to black, epruinose or weakly pruinose [ascospores in known species transversely septate] ..... | <i>Leiorrenna</i>                              |

- 14a. Proper margins well-developed, convergent, apices wedge-shaped and carbonised, or laterally carbonised; disc sunken and white- or greyish white pruinose; ascocarps large and prominent ..... *Platygramme*
- 14b. Proper margins poorly developed and weakly carbonised,  $\pm$  brown, divergent or well-developed but discs not concealed and not pruinose ..... *Phaeographis* p.p.
- 15a. Ascospores brown ..... 16
- 15b. Ascospores hyaline ..... 18
- 16a. Labia well-developed, convergent, sulcate, disc not visible [stictic acid] ..... *Hemithecium* p.p.
- 16b. Labia poorly developed, no sulcate, not convergent; discs  $\pm$  open but narrow or margins well-developed and slightly striate; discs visible and distinctly open ..... 17
- 17a. Ascospores ovoid,  $< 20 \mu\text{m}$  long,  $4 \times 1-2$  -locular, discs open, brownish black, epruinose ..... *Platythecium* p.p.
- 17b. Ascospores elongate,  $> 20 \mu\text{m}$  long,  $> 4 \times 1-2$  -locular; if ascospores ovoid, then discs not brownish black and epruinose ..... *Phaeographis* p.p.
- 18a. Paraphysis tips warty ..... 19
- 18b. Paraphysis tips not warty ..... 20
- 19a. Ascospores ovoid or globose,  $\pm$  halonate; lirellae fissurine; exciples and margins poorly developed ..... *Fissurina* p.p.
- 19b. Ascospores elongate; lirellae not fissurine ..... *Acanthothecis*
- 20a. Labia well-developed, crenate, convergent; disc slit-like, not visible, completely concealed by margins; apothecia raised from thallus ..... 21
- 20b. Labia poorly developed or not distinctly convergent, with discs  $\pm$  open; apothecia usually not raised from thallus ..... 22
- 21a. Ascospores ovoid, 4 -locular or muriform  $\pm$  halonate ..... *Fissurina* p.p.
- 21b. Ascospores lacking halo, I+ blue-violet,  $> 25 \mu\text{m}$  long,  $> 6$  -locular; labia often distinctly crenate ..... *Hemithecium* p.p.
- 22a. Apothecia fissurine; thalline margins project over disc; ascospores ovoid  $\pm$  halonate, I+ weak blue or I -ve, rarely I+ blue violet ..... *Fissurina* p.p.
- 22b. Apothecia otherwise; ascospores distinctly I+ blue or blue violet ..... 23
- 23a. Ascospores small,  $< 20 \mu\text{m}$  long,  $4-5 \times 1-2$ -locular ..... *Platythecium*
- 23b. Ascospores larger,  $> 20 \mu\text{m}$  long ..... 24
- 24a. Discs open, sometimes  $\pm$  narrow, brown or reddish; paraphysis tips brown, granular nor stictic and stictic acids absent ..... *Thallolooma*
- 24b. Discs open, distinctly white pruinose; norstictic or stictic acids may be present ..... *Dioryguia*

## Keys to species of Graphidaceae in Australia

### *Acanthothecis*

- 1a. Thallus saxicolous; ascospores 19–22  $\mu\text{m}$  long, 4-locular [in Australian specimen] ..... *A. silicicola*
- 1b. Thallus corticolous; ascospores muriform ..... 2
- 2a. Ascospores 20–30  $\mu\text{m}$  long; norstictic acid present ..... *A. subaggregans*
- 2b. Ascospores 14–24  $\mu\text{m}$  long; stictic acid present ..... *A. gyridia*

**Carbacanthographis**

- 1a. Exciple laterally carbonised; ascospores 12–17 µm long, 4–5 × 2 -locular ..... *C. marcescens*
- 1b. Exciple completely carbonised; ascospores 19–23 µm long, 8 × 1–2 -locular ..... *C. salazinica*

**Diorygma**

- 1a. Ascospores septate with lenticular locules; norstictic acid only present ..... 2
- 1b. Ascospores muriform; norstictic acid and/or other depsides present ..... 3
- 2a. Ascospores 60–90 µm long ..... *D. circumfusum*
- 2b. Ascospores 45–55 µm long ..... *D. wilsonianum*
- 3a. Ascospores < 80 µm long ..... 4
- 3b. Ascospores ≥ 80 µm ..... 5
- 4a. Ascospores 30–65 µm long ..... *D. erythrellum*
- 4b. Ascospores 18–23 µm long ..... *D. nothofagum*
- 5a. Stictic acid present; ascospores 95–150 µm long ..... *D. hieroglyphicum*
- 5b. Norstictic or protocetraric acid present ..... 6
- 6a. Norstictic acid only present; ascospores 80–105 µm long ..... *D. junghuhnii*
- 6b. Protocetraric acid ± norstictic acid present ..... 7
- 7a. Protocetraric acid only present; ascospores 95–150 µm long ..... *D. pruininum*
- 7b. Protocetraric and norstictic acid present; ascospores 120–150 µm long ..... *D. rufopruinosum*

**Fissurina**

- 1a. Thallus saxicolous ..... 2
- 1b. Thallus corticolous ..... 3
- 2a. Ascospores 14–16 µm long, 4 -locular; psoromic acid absent ..... *F. howeana*
- 2b. Ascospores 16–20 µm long, 4 × 2 -locular; psoromic acid present ..... *F. streimannii*
- 3a. Ascospores muriform, 4–6 × 1–3 -locular ..... 4
- 3b. Ascospores 4 -locular ..... 6
- 4a. Lichen compounds absent; ascospores 21–28 µm long, 4–5 × 2 -locular ..... *F. elaiocarpa*
- 4b. Lichen compounds present ..... 5
- 5a. Ascospores 28–35 µm long; stictic acid present ..... *F. abdita*
- 5b. Ascospores 8–14 µm long; 2-methoxy-psoromic acid present ..... *F. globulifica*
- 6a. 2-Methoxy-psoromic acid present ..... 7
- 6b. Lichen compounds absent ..... 8
- 7a. Proper exciple laterally carbonised; ascospores 16–20 µm long ..... *F. elixii*
- 7b. Proper exciple uncarbonised; ascospores 16–26 µm long ..... *F. paradoxica*
- 8a. Lirellae inconspicuous, visible only as a slit ..... 9
- 8b. Lirellae conspicuous, raised; ascospores 15–22 µm long ..... *F. insidiosa*
- 9a. Proper exciple laterally carbonised; ascospores 10–11 µm long ..... *F. albonitens*
- 9b. Proper exciple uncarbonised ..... 10

- 10a. Lirellae (slit) with thin black margin; ascospores 18–22  $\mu\text{m}$  long ..... *E. nigririmis* var. *deficiens*  
 10b. Lirellae lacking black margins; ascospores 11–20  $\mu\text{m}$  long ..... *E. dumastii*

### *Glyphis*

- 1a. Ascospores septate with lenticular locules, 30–60  $\mu\text{m}$  long, 8–13 -locular .. *G. cicatricosa*  
 1b. Ascospores muriform ..... 2  
 2a. Lirellae raised from the thallus; ascospores 30–45  $\mu\text{m}$  long, 8–10  $\times$  2–4 -locular ..... *G. scyhpuliferum*  
 2b. Lirellae not raised from thallus; ascospores 40–50  $\mu\text{m}$  long, 12–14  $\times$  2–5 -locular ..... *G. montoensis*

### *Graphis*

- 1a. Ascospores septate with lenticular locules ..... 2  
 1b. Ascospores muriform ..... 38  
 2a. Lirellae immersed ..... 3  
 2b. Lirellae not immersed ..... 9  
 3a. Proper exciple completely carbonised ..... 4  
 3b. Proper exciple laterally or apically carbonised ..... 6  
 4a. Norstictic acid present; ascospores 30–44  $\mu\text{m}$  long, 8–12 -locular ..... *G. inamoena*  
 4b. Lichen compounds absent ..... 5  
 5a. Ascospores 20–25  $\mu\text{m}$  long ..... *G. immersicans*  
 5b. Ascospores 55–65  $\mu\text{m}$  long, 13–16 -locular ..... *G. propinqua*  
 6a. Proper exciple apically carbonised; lichen compounds absent; ascospores 38–55  $\mu\text{m}$  long, 9–12 -locular ..... *G. sayeri*  
 6b. Proper exciple laterally carbonised; lichen compounds present ..... 7  
 7a. Lichexanthone and norstictic acid present; ascospores 15–20  $\mu\text{m}$  long, 5–6 -locular ..... *G. stipitata*  
 7b. Stictic acid present ..... 8  
 8a. Ascospores 50–65  $\mu\text{m}$  long, 10–15 -locular ..... *G. crassilabra*  
 8b. Ascospores 24–35  $\mu\text{m}$  long, 8–11 -locular ..... *G. immersella*  
 9a. Lirellae open; norstictic acid present ..... 10  
 9b. Lirellae closed; lichen compounds present or absent ..... 12  
 10a. Proper exciple completely carbonised; ascospores 20–34  $\mu\text{m}$  long, 6–8 -locular..... *G. semiaperta*  
 10b. Proper exciple laterally carbonised ..... 11  
 11a. Ascospores 28–40  $\mu\text{m}$  long, 8–11 -locular ..... *G. apertella*  
 11b. Ascospores 45–60  $\mu\text{m}$  long, 10–16 -locular ..... *G. streimannii*  
 12a. Lirellae sulcate ..... 13  
 12b. Lirellae not sulcate ..... 19  
 13a. Norstictic acid present; proper exciple laterally carbonised; ascospores 60–72  $\mu\text{m}$  long, 10–14 -locular ..... *G. elegans*  
 13b. Norstictic acid absent ..... 14

14a.	Lichen compounds absent .....	15
14b.	Stictic acid present .....	18
15a.	Proper exciple completely carbonised; ascospores 40–55 µm long, 8–13 -locular .....	<i>G. rimulosa</i>
15b.	Proper exciple laterally carbonised .....	16
16a.	Ascospores 36–50 µm long, 9–14 -locular .....	<i>G. leptoclada</i>
16b.	Ascospores ≤ 35 µm long .....	17
17a.	Lirellae large, conspicuous, predominantly simple, terminally rounded; ascospores 23–35 µm long, 6–8 -locular .....	<i>G. endoxantha</i>
17b.	Lirellae small, inconspicuous, branched, terminally acute; ascospores 21–34 µm long 8–10 -locular .....	<i>G. subtenella</i>
18a.	Proper exciple laterally carbonised; ascospores 26–40 µm long, 7–10 -locular .....	<i>G. stenotera</i>
18b.	Proper exciple apically carbonised; ascospores 40–55 µm long, 10–16 -locular .....	<i>G. treubii</i>
19a.	Lichen compounds absent .....	20
19b.	Lichen compounds present .....	28
20a.	Proper exciple completely carbonised .....	21
20b.	Proper exciple apically or laterally carbonised .....	23
21a.	Lirellae weakly sulcate; ascospores 62–80 µm long, 13–16 -locular .....	<i>G. longula</i>
21b.	Lirellae smooth .....	22
22a.	Ascospores 28–42 µm long, 8–11 -locular .....	<i>G. anfractuosa</i>
22b.	Ascospores 50–65 µm long, 12–15 -locular .....	<i>G. catherinae</i>
23a.	Proper exciple apically carbonised .....	24
23b.	Proper exciple laterally carbonised .....	25
24a.	Lirellae inconspicuous; ascospores 40–60 µm long, 10–12 -locular .....	<i>G. epimelaena</i>
24b.	Lirellae conspicuous; ascospores 30–40 µm long, 8–10 -locular .....	<i>G. xanthospora</i>
25a.	Ascospores ≥ 50 µm long .....	26
25b.	Ascospores < 50 µm long .....	27
26a.	Lirellae 1–3 mm long; ascospores 54–70 µm long, 12–16 -locular .....	<i>G. stenospora</i> var. <i>deficiens</i>
26b.	Lirellae short, simple, < 1 mm long; ascospores 50–60 µm long, 12–14 -locular .....	<i>G. subregularis</i>
27a.	Ascospores 20–30 µm long, 6–8 -locular .....	<i>G. tenella</i> (auct.)
27b.	Ascospores 30–41 µm long, 10–12 -locular .....	<i>G. albissima</i>
28a.	Norstictic acid present .....	29
28b.	Stictic or protocetraric acid present .....	35
29a.	Proper exciple completely, or almost completely, carbonised .....	30
29b.	Proper exciple laterally carbonised; ascospores 40–50 µm long, 10–14 -locular .....	<i>G. vinosa</i>
30a.	Lirellae much-branched; ascospores 15–26 µm long, 6–8 -locular .....	<i>G. intricata</i>
30b.	Lirellae simple or little branched .....	31

- 31a. Lirellae completely lacking a thalline margin [cf. *Opegrapha*]; ascospores 30–40  $\mu\text{m}$  long, 8–11 -locular ..... *G. emersa*
- 31b. Lirellae with a thalline margin ..... 32
- 32a. Ascospores 55–85  $\mu\text{m}$  long, 15–20 -locular ..... *G. leucoparypha*
- 32b. Ascospores < 50  $\mu\text{m}$  long ..... 33
- 33a. Lirellae 2–6 mm long; ascospores 25–35  $\mu\text{m}$  long, 8–11 -locular ..... *G. kakaduensis*
- 33b. Lirellae < 3 mm long ..... 34
- 34a. Proper exciple completely carbonised; ascospores 25–35  $\mu\text{m}$  long, 6–9 -locular .....  
..... *G. desquamescens*
- 34b. Proper exciple completely, or almost completely carbonised; ascospores 15–30  $\mu\text{m}$  long, 6–8 -locular ..... *G. librata*
- 35a. Protocetraric acid present; proper exciple laterally carbonised; ascospores 25–32  $\mu\text{m}$  long, 8–10 -locular ..... *G. supracola*
- 35b. Stictic acid present ..... 36
- 36a. Proper exciple laterally carbonised; ascospores 24–33  $\mu\text{m}$  long, 6 -locular .....  
..... *G. leptocarpa*
- 36b. Proper exciple completely carbonised ..... 37
- 37a. Ascospores 28–40  $\mu\text{m}$  long, 8–11 -locular ..... *G. descissa*
- 37b. Ascospores 66–84  $\mu\text{m}$  long, 14–18 -locular ..... *G. rustica*
- 38a. Thallus saxicolous ..... 39
- 38b. Thallus corticolous ..... 40
- 39a. Proper exciple laterally carbonised; ascospores 70–90  $\mu\text{m}$  long; lichen compounds absent  
..... *G. celata*
- 39b. Proper exciple completely carbonised; ascospores 40–55  $\mu\text{m}$  long; norstictic acid present  
..... *G. saxicola*
- 40a. Carbonised exciple concealed in thalline margin; norstictic or hirtiructic acid present ....  
..... 41
- 40b. Carbonised exciple visible; lichen compounds present or absent ..... 43
- 41a. Exciple completely carbonised; ascospores terminally muriform only ..... 42
- 41b. Exciple laterally carbonised; ascospores 120–140  $\mu\text{m}$  long, fully muriform; *G. atrocelata*
- 42a. Ascospores 85–105  $\mu\text{m}$  long; norstictic acid present ..... *G. aquilonia*
- 42b. Ascospores 102–130  $\mu\text{m}$  long; hitiructic acid present ..... *G. elixiana*
- 43a. Lirellae short and simple, 1–2 mm long ..... 44
- 43b. Lirellae > 2 mm long, simple or branched ..... 46
- 44a. Proper exciple completely carbonised; ascospores 95–150  $\mu\text{m}$  long ..... 45
- 44b. Proper exciple laterally carbonised; ascospores 90–100  $\mu\text{m}$  long; norstictic acid present  
..... *G. hiascens*
- 45a. Norstictic and protocetraric acids present; ascospores 115–150  $\mu\text{m}$  long .... *G. lumbuschii*
- 45b. Lichen compounds absent; ascospores 95–120  $\mu\text{m}$  long ..... *G. lumbuschii* var. *deficiens*
- 46a. Lichen compounds present; proper exciple laterally carbonised ..... 47
- 46b. Lichen compounds absent; proper exciple laterally or completely carbonised ..... 51
- 47a. Norstictic acid present ..... 48
- 47b. Stictic acid present ..... 50

48a.	Ascospores < 60 µm long .....	49
48b.	Ascospores 100–130 µm long .....	<i>G. subserpentina</i>
49a.	Lirellae immersed, visible as a thin black line; ascospores 37–50 µm long .....	<i>G. borealis</i>
49b.	Lirellae conspicuous, black; ascospores 25–35 µm long .....	<i>G. gracilescens</i>
50a.	Ascospores 37–50 µm long .....	<i>G. polyclades</i>
50b.	Ascospores 70–90 µm long .....	<i>G. streblocarpa</i>
51a.	Proper exciple completely carbonised; ascospores 100–145 µm long, terminally muriform only .....	<i>G. vestitoides</i>
51b.	Proper exciple laterally carbonised .....	52
52a.	Ascospores ≥ 35 µm long .....	53
52b.	Ascospores < 35 µm long .....	54
53a.	Ascospores 60–80 µm long .....	<i>G. daintriensis</i>
53b.	Ascospores 35–45 µm long .....	<i>G. subvelata</i>
54a.	Lirellae closed; ascospores 2-seriate, 19–23 µm long .....	<i>G. temuirima</i>
54b.	Li--rellae open; ascospores 1-seriate, 20–28 µm long .....	<i>G. dimidata</i>

### *Hemithecium*

1a.	Ascospores septate with lenticular locules, .....	2
1b.	Ascospores muriform .....	3
2a.	Lirellae sessile; ascospores 80–95 µm long, 15–24 -locular .....	<i>H. aphanes</i>
2b.	Lirellae immersed; ascospores 28–32 µm long, 6–10 -locular .....	<i>H. argopholis</i>
3a.	Lirellae with grooves; stictic acid present .....	4
3b.	Lirellae lacking grooves .....	5
4a.	Ascospores 50–75 µm long .....	<i>H. chrysenderon</i>
4b.	Ascospores 80–100 µm long; .....	<i>H. chlorocarpoides</i>
5a.	Ascospores 8 per ascus, 35–40 µm long; stictic acid present .....	<i>H. radicolola</i>
5b.	Ascospores 1 per ascus; stictic acid absent .....	6
6a.	Ascospores 155–225 µm long .....	<i>H. hadrospora</i>
6b.	Ascospores ≥125 µm long.....	7
7a.	Ascospores 80–100 µm long .....	<i>H. incerta</i>
7b.	Ascospores 57–80 µm long .....	<i>H. contorta</i>

### *Leiorreuma*

1a.	Lichen compounds absent; ascospores 20–33 µm long, 6 -locular .....	<i>L. exaltum</i>
1b.	Lichen compounds present .....	2
2a.	Stictic or hypostictic acid present .....	3
2b.	Nornotatic acid present; ascospores 21–25 mm long, 6 -locular .....	<i>L. nornotaticum</i>
3a.	Hypostictic acid present; ascospores 25–40 µm long, 7–8 -locular .....	<i>L. hypomelaennm</i>
3b.	Stictic acid present; ascospores 25–37 µm long, 8–9 -locular .....	<i>L. melanostalazans</i>

*Phaeographis*

1a.	Ascospores muriform .....	2
1b.	Ascospores septate with lenticular locules .....	7
2a.	Ascospores 1 per ascus, 100–135 µm long; norstictic acid present .....	<i>P. atromaculata</i>
2b.	Ascospores 8 per ascus; norstictic acid absent .....	3
3a.	Stictic acid present .....	4
3b.	Lichen compounds absent .....	5
4a.	Ascospores 36–53 µm long, 8–11 × 2–5 -locular; proper exciple carbonised ..	<i>P. wilsonii</i>
4b.	Ascospores 25–35 µm long, 6–8 × 2–3 -locular; proper exciple yellow-brown .....	<i>P. montiscalvi</i>
5a.	Ascospores 15–18 µm long, 4 × 2 -locular .....	<i>P. exilior</i>
5b.	Ascospores > 20 µm long .....	6
6a.	Ascospores 40–60 µm long, 10–14 × 2–3 -locular .....	<i>P. litoralis</i>
6b.	Ascospores 23–35 µm long, 6–8 × 2–3 -locular .....	<i>P. caesioradians</i>
7a.	Thallus saxicolous; ascospores 4 -locular .....	8
7b.	Thallus corticolous; ascospores ≥ 4 -locular .....	10
8a.	Lirellae open, disc visible; ascospores 12–15 µm long .....	<i>P. hypoglaucoides</i>
8b.	Lirellae closed or only slightly open .....	9
9a.	Thallus smooth; thalline margins absent; ascospores 12–15 µm long .....	<i>P. eludens</i>
9b.	Thallus tuberculate; thalline margins conspicuous; ascospores 10–12 µm long .....	<i>P. tuberculifera</i>
10a.	Ascospores 4 -locular .....	11
10b.	Ascospores ≥ 4 -locular .....	16
11a.	Norstictic acid present .....	12
11b.	Norstictic acid absent .....	13
12a.	Ascospores 15–15 µm long .....	<i>P. subtigrina</i>
12b.	Ascospores 14–23 µm long .....	<i>P. brasiliensis</i>
13a.	Carbonised exciple present; .....	14
13b.	Carbonised exciple absent; ascospores 8–12 µm long .....	<i>P. ceratoides</i>
14a.	Proper exciple completely carbonised; ascospores 15–22 µm long .....	<i>P. elaeina</i>
14b.	Proper exciple laterally or apically carbonised .....	15
15a.	Proper exciple laterally carbonised; ascospores 14–24 µm long .....	<i>P. subintricata</i>
15b.	Proper exciple apically carbonised; ascospores 17–20 µm long .....	<i>P. lindigiana</i>
16a.	Ascospores 4–6 -locular .....	17
16b.	Ascospores > 6 -locular .....	19
17a.	Norstictic acid present; ascospores 16–20 µm long .....	<i>P. intricans</i>
17b.	Norstictic acid absent .....	18
18a.	Lichen compounds absent; ascospores 16–22 µm long .....	<i>P. subdividens</i>
18b.	Neotricone present; ascospores 12–23 µm long .....	<i>P. neotricosa</i>
19a.	Norstictic acid present .....	21
19b.	Norstictic acid absent; lirellae carbonised .....	20



- 20a. Lichen compounds absent; lirellae apically carbonised; ascospores 27–47  $\mu\text{m}$  long, 8–10 -locular ..... *P. lobata*  
 20b. Stictic acid present; thin carbonised exciple present; ascospores 20–37  $\mu\text{m}$  long, 6–8 -locular ..... *P. dendroides*
- 21a. Lirellae carbonised; ascospores 30–55  $\mu\text{m}$  long, 7–11 -locular ..... *P. mncronata*  
 21b. Lirellae uncarbonised; ascospores 6–8 -locular ..... 22
- 22a. Ascospores 23–36  $\mu\text{m}$  long, ..... *P. nardiensis*  
 22b. Ascospores 15–31  $\mu\text{m}$  long ..... *P. platycarpa*

### *Platygramme*

- 1a. Ascospores 8 per ascus .....2  
 1b. Ascospores 1 per ascus .....3
- 2a. Carbonised exciple visible; ascospores 20–40  $\mu\text{m}$  long, 4–6 x 2–3 -locular .....  
 .....*P. arechavelatae*  
 2b. Carbonised exciple concealed; ascospores 13–18  $\mu\text{m}$  long, 4 x 2 -locular .....*P. fuscescens*
- 3a. Carbonised exciple visible; lichen compounds absent .....4  
 3b. Carbonised exciple concealed; echinocarpic acid present; ascospores 162–200  $\mu\text{m}$  long .....  
 .....*P. pudica*
- 4a. Lirellae conspicuously open; ascospores .....5  
 4b. Lirellae not conspicuously open; ascospores 135–180  $\mu\text{m}$  long .....*P. impudica*
- 5a. Ascospores 145–180  $\mu\text{m}$  long ..... *P. muelleri*  
 5b. Ascospores 40–75(–100)  $\mu\text{m}$  long ..... *P. australiensis*

### *Sarcographa*

- 1a. Lichen compounds absent; ascospores 14–18 x 5–6  $\mu\text{m}$ , 4-locular ..... *S. subtrigosa*  
 1b. Stictic acid present ..... 2
- 2a. Ascospores 7–10 -locular, 25–37  $\mu\text{m}$  long ..... *S. oculata*  
 2b. Ascospores  $\leq 6$  -locular..... 3
- 3a. Ascospores 17–22  $\mu\text{m}$  long, 4 -locular ..... *S. labyrinthica*  
 3b. Ascospores 23–32  $\mu\text{m}$  long, 6 -locular ..... *S. verrucosa*

### *Thecaria*

- 1a. Disc red; hymenium with red pigment [isohypocrellin]; ascospores 125–175  $\mu\text{m}$  long, muriform ..... *T. montagnei*  
 1b. Disc white pruinose; hymenium lacking red pigment; ascospores 75–100  $\mu\text{m}$  long .....  
 ..... *T. quassicola*

## List of species in Australia

### *Acanthothecis* Clem.

1. *Acanthothecis gyridia* (Stirt.) A.W. Archer, *comb. nov.*  
*Graphis gyridia* Stirt., *Trans. Proc. R. Soc. Vic.* 17: 77 (1881)  
*Graphina gyridia* (Stirt.) Zahlbr., *Cat. Lich. Univ.* 2: 412 (1923)
2. *Acanthothecis cf. silicicola* (Redinger) Staiger & Kalb, *Mycotaxon* 73: 112 (1999)  
*Graphis cf. silicicola* Redinger, *Ark. Bot.* 27A (3): 56 (1935)
3. *Acanthothecis subaggregans* (Müll. Arg.) A.W. Archer, *comb. nov.*  
*Graphina subaggregans* Müll. Arg. *Bull. Herb. Boissier* 1: 58 (1893)  
*Acanthothecis gracilis* Staiger & Kalb, *Mycotaxon* 73: 99 (1999), *syn. nov.*

### *Carbacanthographis* Staiger & Kalb

1. *Carbacanthographis marcescens* (Feé) Staiger & Kalb, *Biblioth. Lichenol.* 85: 109 (2002)  
*Graphis marcescens* Feé, *Essai Crypt.*: 38 (1825)
2. *Cabacanthographis salazinica* (A.W. Archer) A.W. Archer, *comb. nov.*  
*Graphina salazinica* A.W. Archer, *Mycotaxon* 77: 176 (2001)

### *Diorygma* Eschw.

1. *Diorygma circumfusum* (Stirt) Kalb, Staiger & Elix, *Symb. Bot. Ups.* 34(1): 145 (2004)  
*Graphis circumfusa* Stirt., *Trans. & Proc. Roy. Soc. Victoria* 17: 73 (1881)
2. *Diorygma erythrellum* (Mont. & Bosch) Kalb, Staiger & Elix, *Symb. Bot. Ups.* 34(1): 150 (2004)  
*Ustalia erythrella* Mont. & Bosch, *Plant. junghuhn.*, *Fasc.* IV: 478 (1855)  
*Graphina erythrella* (Mont. & Bosch) Zahlbr., *Cat. Lich. Univ.* 2: 405 (1923)  
*Graphina incisa* A.W. Archer, *Mycotaxon* 77: 169 (2001)  
*Graphina atramontana* A.W. Archer, *Mycotaxon* 77: 161 (2001), *syn. nov.*
3. *Diorygma junghuhnii* (Mont. & Bosch) Kalb, Staiger & Elix, *Symb. Bot. Ups.* 34(1): 157 (2004)  
*Ustalia junghuhnii* Mont. & Bosch, *Plant. junghuhn.*, *Fasc.* IV: 477 (1855)  
*Graphis mendax* Nyl., *Ann. Sci. Nat. Bot. ser.* 4, 11: 244 (1859)
4. *Diorygma hieroglyphicnm* (Pers.) Staiger & Kalb, *Symb. Bot. Ups.* 34(1): 151 (2004)  
*Opegrapha hieroglyphica* Pers., *Ann. Wetterauischen Ges. Gesammthe Naturk.* 2:16 (1811)  
*Graphis pallido-ochracea* Kremp., *Nuovo. Giorn. Bot. Ital.* 7: 32 (1875)
5. *Diorygma nothofagi* (A.W. Archer) A.W. Archer, *Australasian Lichenology* 56: 10(2005)  
*Graphina nothofagi* A.W. Archer, *Mycotaxon* 77:172 (2001)
6. *Diorygma pruinosum* (Eschw.) Kalb, Staiger & Elix, *Symb. Bot. Ups.* 34(1): 166 (2004)  
*Leiogamma pruinosum* Eschw., in Martius, *Icon. select. cryptogam.* *Fasc.* 1: 12 (1828)

*Graphis platyleuca* Nyl., *Syn. Lich. Nov. Cal.*: 75 (1868)

7. *Diorygma rufopruinosum* (A.W. Archer) Kalb, Staiger & Elix, *Symb. Bot. Ups.* 34(1): 169 (2004)

*Graphina rufopruinosa* A.W. Archer, *Mycotaxon* 77: 175 (2001)

*Graphina howeniana* A.W. Archer, *Mycotaxon* 77: 164 (2001)

8. *Diorygma wilsoniana* (Müll. Arg.) A.W. Archer, *Australasian Lichenology* 56: 10 (2005)

*Graphis wilsoniana* Müll. Arg., *Bull. Herb. Boissier* 1: 57 (1893)

### *Dyplolabia* A. Massal.

1. *Dyplolabia afzelii* (Ach.) A. Massal. *Neogenea lichenum*: 6 (1854)

*Graphis afzelii* Ach., *Syn. Lich.*: 85 (1814)

### *Fissurina* Fée

1. *Fissurina abdita* (A.W. Archer) A.W. Archer, **comb. nov.**

*Graphina abdita* A.W. Archer, *Mycotaxon* 77: 160 (2001)

2. *Fissurina albonitens* (Müll. Arg.) A.W. Archer, **comb. nov.**

*Graphis albonitens* Müll. Arg., *Hedwigia* 30: 53 (1891)

3. *Fissurina dumastii* Fée, *Essai Crypt.*:1–59 (1825)

*Fissurina glauca* (Müll. Arg.) Staiger, *Biblioth. Lichenol.* 85: 159 (2002)

*Graphis glauca* Müll. Arg., *Bull. Herb. Boissier* 1:58 (1893)

4. *Fissurina elaiocarpa* (A.W. Archer) A.W. Archer, **comb. nov.**

*Graphina elaiocarpa* A.W. Archer, *Mycotaxon* 77: 167 (2001)

*Fissurina marginata* Staiger, *Biblioth. Lichenol.* 85: 144 (2002), **syn. nov.**

5. *Fissurina elixii* (A.W. Archer) A.W. Archer, **comb. nov.**

*Graphis elixii* A.W. Archer, *Australasian Lichenology* 43: 16 (1998)

6. *Fissurina globulifica* (Nyl.) Staiger, *Biblioth. Lichenol.* 85: 137 (2002)

*Graphis globulifica* Nyl., *Bull. Soc. Linn. Normandie, sér. 2, 2*: 117 (1868)

7. *Fissurina howeana* (A.W. Archer) A.W. Archer, **comb. nov.**

*Graphis howeana* A.W. Archer, *Aus. Syst. Bot.* 14: 259 (2001)

8. *Fissurina insidiosa* C. Knight & Mitt., *Trans. Linn. Soc. London* 23: 102 (1860)

*Graphis insidiosa* (C.Knight & Mitt.) J.D.Hooker, *Handbook NZ Flora*: 586 (1867)

*Fissurina subcontexta* (Nyl.) Nyl., *Lich. Nov. Zel.*: 125 (1888)

*Graphis subcontexta* Nyl., *Bull. Soc. Linn. Normandie, sér. 2, 2*: 118 (1868)

*Graphis robustior* Müll. Arg., *Nuovo Giorn Bot. Ital.* 23: 398 (1891)

9. *Fissurina nigririmis* var. *deficiens* (A.W. Archer) A.W. Archer, **comb. nov.**

*Graphis nigririmis* (Nyl.) Müll.Arg. var. *deficiens* A.W.Archer, *Aus. Syst. Bot.* 14: 264 (2001)

10. *Fissurina paradoxica* (A.W. Archer) A.W. Archer, **comb. nov.**

*Graphis paradoxica* A.W. Archer, *Mycotaxon* 80: 367 (2001)

11. *Fissurina psoromica* (A.W. Archer) A.W. Archer, **comb. nov.**

*Graphina psoromica* A.W. Archer, *Mycotaxon* 77: 173 (2001)

12. *Fissurina streimannii* (A.W. Archer) A.W. Archer, **comb. nov.**

*Graphina streimannii* A.W. Archer, *Mycotaxon* 88: 143 (2003)

**Glyphis** Ach.

1. *Glyphis cicatricosa* Ach., *Syn. Lich*: 107 (1814)

2. *Glyphis montoensis* (A.W. Archer) Staiger, *Biblioth. Lichenol.* 85: 173 (2002)

*Graphina montoensis* A.W. Archer, *Mycotaxon* 77: 172 (2001)

3. *Glyphis scyphulifera* (Ach.) Staiger, *Biblioth. Lichenol.* 85: 175 (2002)

*Lecidea scyphulifera* Ach., *Syn. Lich.*: 27 (1814)

*Gyrostommm scyphuliferemm* (Ach.) Nyl. *Bull. Soc. Linn. Normandie*, sér. 2, 2: 78 (1867)

**Graphis** Adans.

1. *Graphis albissima* Müll. Arg., *Bull. Herb. Boissier* 3: 319 (1895)

2. *Graphis anfractuosa* (Eschw.) Eschw., in C.F.P. von Martius, *Fl. Bras. emmn. pl.* 1: 86 (1833)

*Scaphis anfractuosa* Eschw., *Syst. Lich.*: 25 (1824)

3. *Graphis apertella* A.W. Archer, *Ans. Syst. Bot.* 14: 258 (2001)

4. *Graphis aquilonia* (A.W. Archer) Staiger, *Biblioth. Lichenol.* 85: 209 (2002)

*Graphina aquilonia* A.W. Archer, *Mycotaxon* 77: 160 (2001)

5. *Graphis atrocelata* (A.W. Archer) A.W. Archer, **comb. nov.**

*Graphina atrocelata* A.W. Archer, *Mycotaxon* 77: 163 (2001)

6. *Graphis borealis* (A.W. Archer) A.W. Archer, **comb. nov.**

*Graphina borealis* A.W. Archer, *Mycotaxon* 77: 164 (2001)

7. *Graphis catherinae* A.W. Archer, *Ans. Syst. Bot.* 14: 259 (2001)

8. *Graphis celata* (A.W. Archer) A.W. Archer, **comb. nov.**

*Graphina celata* A.W. Archer, *Mycotaxon* 77: 166 (2001)

9. *Graphis crassilabra* Müll. Arg., *Flora* 65: 502 (1882)

10. *Graphis daintriensis* (A.W. Archer) A.W. Archer, **comb. nov.**

*Graphina daintriensis* A.W. Archer, *Mycotaxon* 77: 166 (2001)

11. *Graphis dimidata* Vain., *Acta Soc. Fanna Flora Fenn.* 7(2): 108 (1890)

12. *Graphis descissa* Müll. Arg., *Bull. Herb. Boissier* 3: 318 (1895)

13. *Graphis desquamescens* (Fée) Zahlbr., *Denkschr. Akad. Wiss. Wien math.-naturwiss. Kl.* 83: 108 (1909)

*Opegrapha desquamescens* Fée, *Bull. Soc. Bot. France* 21: 24 (1874)

14. *Graphis elegans* (Smith) Ach., *Syn. Lich*: 85 (1814)

*Opegrapha elegans* Smith, in J.E. Smith & J. Sowerby *English Botany*: 16 (1807)

15. *Graphis elixiana* A.W. Archer, **nom. nov.**  
 [The name *Graphis elixii* already exists; see *Fissurina elixii*]  
*Phaeographina elixii* A.W. Archer, *Biblioth. Lichenol.* 78: 13–16 (2001)
16. *Graphis emersa* Müll. Arg., *Hedwigia* 32: 132 (1893)
17. *Graphis endoxantha* Nyl., *Bull. Soc. Linn. Normandie*, ser. 2, 2: 110 (1868)
18. *Graphis epimelaena* Müll. Arg., *Bull. Herb. Boissier* 3: 319 (1895)
19. *Graphis gracilescens* Vain., *Ann. Acad. Sci. Fenn.* ser. A, 15, 6: 203 (1920)
20. *Graphis hiaseus* (Fée) A.W. Archer, **comb. nov.**  
*Opegrapha hiaseus* Fée, *Suppl. Ess. Crypt. Ecorc.*: 25 (1837)
21. *Graphis immersella* Müll. Arg., *Bull. Herb. Boissier* 3: 319 (1895)
22. *Graphis immersicans* A.W. Archer, *Aust. Syst. Bot.* 14: 262 (2001)
23. *Graphis inamoena* Zahlbr., *Ann. Crypt. Exot.* 1: 126 (1928)
24. *Graphis intricata* Fée, *Essai Crypt.*, 42 (1825)  
*Graphis centrifuga* Räs., *Arch. Soc. Zool. Bot. Fenn.* “Vanamo” 3:187 (1949)
25. *Graphis kakaduensis* A.W. Archer, *Aus. Syst. Bot.* 14: 264 (2001)
26. *Graphis leptocarpa* Fée, *Essai Crypt.*: 36 (1824)
27. *Graphis leptoclada* Müll. Arg., *Flora* 65: 335 (1882)
28. *Graphis leucoparypha* Kremp., *Nuovo Giorn. bot. ital.* 7: 35 (1875)  
*Graphis turgidula* var. *norstictica* A.W. Archer, *Aus. Syst. Bot.* 14:267 (2001), **syn. nov.**
29. *Graphis librata* C. Knight, *Trans. N.Z. Instit.* 16: 404 (1884)
30. *Graphis longula* Kremp., *Flora* 59: 414 (1876)
31. *Graphis lumbschii* (A.W. Archer) A.W. Archer, **comb. nov.**  
*Graphina lumbschii* A.W. Archer, *Mycotaxon* 77: 166 (2001)
- 31a. *Graphis lumbschii* var. *deficiens* (A.W. Archer) A.W. Archer, **comb. nov.**  
*Graphina lumbschii* var. *deficiens* A.W. Archer, *Mycotaxon* 77: 167 (2001)
32. *Graphis pertriosa* (Kremp.) A.W. Archer, **comb. nov.**  
*Enterographa pertriosa* Kremp., *Nuovo Giorn. Bot. Ital.* 7: 39 (1875)
33. *Graphis polyclades* Kremp., *Verh. K.K. Zool.-Bot. Ges. Wien* 30: 341 (1880)
34. *Graphis propinqua* Müll. Arg., *Flora* 65: 502 (1882)
35. *Graphis rimulosa* (Mont.) Trevis., *Spighe e Paglie*: 11 (1853)  
*Opegrapha rimulosa* Mont., *Ann. Sci. Nat. Bot.*, ser.2, 18: 271 (1842)
36. *Graphis rustica* Kremp., *Nuovo Giorn. bot. ital.* 7: 61 (1875)  
*Graphis turgidula* Müll. Arg., *J. Linn. Soc. Bot. London* 30: 457(1895)

37. *Graphis saxicola* (Müll. Arg.) A.W. Archer, *comb. nov.*  
*Graphina saxicola* Müll. Arg., *Flora* 70: 401 (1887)
38. *Graphis sayeri* Müll. Arg., *Flora* 70: 401 (1887)
39. *Graphis semiaperta* Müll. Arg., *Nuovo Giorn. bot. ital.* 23: 397 (1891)
40. *Graphis stenospora* Müll. Arg. var. *deficiens* A.W. Archer, *Mycotaxon* 80: 370 (2001)
41. *Graphis stenotera* Vain., *Ann. Acad. Sci. Fenn. ser. A*, 15: 209 (1920)
42. *Graphis stipitata* A.W. Archer, *Mycotaxon* 80: 368 (2001)
43. *Graphis streblocarpa* (Bél.) Nyl., *Flora* 49: 133 (1866)  
*Opegrapha streblocarpa* Bél., *Voy. Indies. Or., Botanique II, Cryptogamie*: 134 (1834)  
*Graphis fissofurcata* Leight., *Trans. Linn. Soc. London, Bot.* 27: 177 (1869)  
*Graphina streblocarpa* (Bél.) Müll. Arg., *Flora* 65: 502 (1882)
44. *Graphis streimannii* A.W. Archer, *Ans. Syst. Bot.* 14: 265 (2001)
45. *Graphis subregularis* A.W. Archer, *Ans. Syst. Bot.* 14: 266 (2001)
46. *Graphis subserpentina* Nyl., *Acta Soc. Sci. Fenn.* 7: 465 (1863)  
*Graphina subtartarea* Müll. Arg., *Flora* 70: 402 (1887)  
*Graphina palmicola* Müll. Arg., *Flora* 70: 402 (1887)  
*Graphina subserpentina* (Nyl.) Müll. Arg., *Bull. Bot. Soc. Belgique* 32: 152 (1893)
47. *Graphis subteuella* Müll. Arg., *Flora* 70: 400 (1887)
48. *Graphis subvelata* Stirt., *Queensland Agric. J.* 5: 488 (1899)  
*Graphina subvelata* (Stirt.) Zahlbr., *Cat. Lich. Univ.* 2: 428 (1923)
49. *Graphis supracola* A.W. Archer, *Ans. Syst. Bot.* 14: 267 (2001)
50. *Graphis tenella* auct, non Ach., *Syn. Lich.*: 81 (1814)
51. *Graphis tenuirima* (Shirley) A.W. Archer, *comb. nov.*  
*Graphina tenuirima* Shirley, *Bot. Bull. Dept. Agric. Qld., Bot. Bull.* V:34 (1892)
52. *Graphis treubii* Zahlbr., *Ann. Cryptog exot.* 1: 129 (1928)
53. *Graphis vestitoides* (Fink) Staiger, *Biblioth. Lichenol.* 85: 263 (2002)  
*Graphina vestitoides* Fink, *Mycologia* 19: 218 (1927)  
*Graphina acharii* auct.
54. *Graphis vinosa* Müll. Arg., *Bull. Herb. Boissier* 3: 318 (1895)
55. *Graphis xanthospora* Müll. Arg., *Bull. Herb. Boissier* 3: 320 (1895)

### *Hemitheciium* Trevis.

1. *Hemitheciium aphanes* (Mont. & Bosch) M. Nakan. & Kashiw.,  
*Bull. Natn. Sci. Mus., Tokyo, Ser. B*, 29(2): 88 (2003)  
*Graphis aphanes* Mont. & Bosch, *Plant. Jmnglmhm.* 4, 474 (1855)  
*Graphis vermifera* Müll. Arg., *Flora* 70, 401 (1887)
2. *Hemitheciium argopholis* (C.Knight in Müll. Arg.) A.W. Archer, *comb. nov.*  
*Graphis argopholis* C.Knight in Müll. Arg., *Flora* 70: 401 (1887)

3. ***Hemithecium chlorocarpoides*** (Nyl.) Staiger, *Biblioth. Lichenol.* 85: 283 (2002)  
*Graphis chlorocarpoides* Nyl. *Flora* 49: 133 (1866)  
*Graphina repleta* var. *macrospora* A.W. Archer, *Telopea* 8: 291 (1999), **syn. nov.**
4. ***Hemithecium chrysenferon*** (Mont.) Trevis, *Spighe e Paglie* 1: 13 (1853)  
*Phaeographina chrysenferon* (Mont.) Müll. Arg., *Hedwigea* 30: 52 (1891)  
*Graphis chrysenferon* Mont., *Ann. Sci. Nat., Bot.* 18(2): 268 (1842)  
*Graphis repleta* Stirt., *Trans. & Proc. Roy. Soc. Victoria* 17: 73 (1881), **syn. nov.**
5. ***Hemithecium contorta*** (Müll. Arg.) A.W. Archer, **comb. nov.**  
*Graphina contorta* Müll. Arg., *Rev. Mycol.* 9: 81 (1887)
6. ***Hemithecium hadrospora*** (A.W. Archer) A.W. Archer, **comb. nov.**  
*Phaeographina hadrospora* A.W. Archer, *Telopea* 9: 337 (2001)
7. ***Hemithecium incerta*** (Redinger) A.W. Archer, **comb. nov.**  
*Graphina incerta* Redinger, *Ark. Bot.* 26A(1): 59 (1933)
8. ***Hemithecium raditicola*** (A.W. Archer) A.W. Archer, **comb. nov.**  
*Graphina raditicola* A.W. Archer, *Mycotaxon* 77: 175 (2001)
- Leiorrenma*** Eschw.
1. ***Leiorrenma exaltatum*** (Mont. & Bosch) Staiger, *Biblioth. Lichenol.* 85: 298 (2002)  
*Phaeographis exaltata* (Mont. & Bosch) Müll. Arg., *Flora* 65: 381 (1882)  
*Lecanactis exaltata* Mont. & Bosch, in Junghuhn, *Plant. junghuhn.*, Fasc. IV: 475 (1855)
2. ***Leiorrenma hypomelaenum*** (Müll. Arg.) Staiger, *Biblioth. Lichenol.* 85: 300 (2002)  
*Phaeographis hypomelaena* Müll. Arg., *Flora* 69: 313 (1886)  
*Phaeographis necopinata* A.W. Archer & Elix, *Mycotaxon* 72: 92 (1999), **syn. nov.**
3. ***Leiorrenma melanostalazans*** (Leight.) A.W. Archer, **comb. nov.**  
*Phaeographis melanostalazans* (Leight.) Müll. Arg., *Flora* 65: 336 (1882)  
*Platygrapha melanostalazans* Leight., *Trans. Linn. Soc. London* 27: 180 (1869)
4. ***Leiorrenma nornotaticum*** (A.W. Archer) A.W. Archer, **comb. nov.**  
*Phaeographis nornotatica* A.W. Archer & Elix, *Mycotaxon* 72: 93 (1999)
- Phaeographis*** Müll. Arg.
1. ***Phaeographis atromaculata*** (A.W. Archer) A.W. Archer, **comb. nov.**  
*Phaeographina atromaculata* A.W. Archer, *Telopea* 9: 331 (2001)
2. ***Phaeographis brasiliensis*** (A. Massal.) Kalb & Matthes-Leicht, *Biblioth. Lichenol.* 78: 148 (2001)
3. ***Phaeographis caesioradians*** (Leight.) A.W. Archer, **comb. nov.**  
*Phaeographina caesioradians* (Leight.) Redinger, *Ark. Bot.* 26A: 99 (1933)  
*Graphis caesioradians* Leight., *Trans. Linn. Soc. London* 27: 176 (1869)
4. ***Phaeographis ceratoides*** (Vain.) Zahlbr. *Cat. Lich. Univ.* 2: 365 (1923)  
*Graphis ceratoides* Vain., *Ann. Acad. Sci. Fenn. ser. A.* 15 (6): 227 (1920)
5. ***Phaeographis dendroides*** (Leight.) Müll. Arg., *Flora* 65: 336 (1882)  
*Platygrapha dendroides* Leight., *Trans. Linn. Soc. London* 27: 179 (1869)

6. *Phaeographis elaeina* (C. Knight) Müll. Arg., *Bull. Herb. Boissier* 3: 321 (1895)  
*Graphis elaeina* C. Knight, *Trans. Linn. Soc. London, Bot.* 2: 41 (1882)
7. *Phaeographis eludens* (Stirt.) Shirley, *Proc. Roy. Soc. Queensland* 6: 197 (1889)  
*Graphis eludens* Stirt., *Trans. Proc. Roy. Soc. Victoria* 17: 72 (1881)
8. *Phaeographis exilior* (Vain.) A.W. Archer, **comb. nov.**  
*Phaeographina exilior* (Vain.) Zahlbr., *Cat. Lich. Univ.* 2: 438 (1923)  
*Graphis exilior* Vain., *Ann. Acad. Sci. Fenn., ser.A*, 15, 6: 200 (1920)
9. *Phaeographis hypoglaucoides*, K.P. Singh & Awasthi, *Bull. Bot. Survey India* 21: 109 (1979)
10. *Phaeographis intricans* (Nyl.) Staiger, *Biblioth. Lichenol.* 85: 329 (2002)  
*Sarcographa intricans* (Nyl.) Müll. Arg., *Flora* 70: 77 (1887)  
*Graphis intricans* Nyl., *Acta Soc. Sci. Fenn.* 7: 473 (1863)
11. *Phaeographis lindigiana* Müll. Arg., *Flora* 65: 383 (1882)  
*Phaeographis pseudomelana* Müll. Arg. *Bull. Herb. Boissier* 3: 321 (1895), **syn. nov.**
12. *Phaeographis litoralis* (A.W. Archer) A.W. Archer, **comb. nov.**  
*Phaeographina litoralis* A.W. Archer, *Telopea* 9: 339 (2001)
13. *Phaeographia lobata* (Eschw.) Müll. Arg., *Flora* 65: 383 (1882)  
*Lecanactis lobata* Eschw., *Syst. Lich.*: 25 (1824)
14. *Phaeographis montiscalvi* (A.W. Archer) A.W. Archer, **comb. nov.**  
*Phaeographina montiscalvi* A.W. Archer, *Telopea* 9: 341 (2001)
15. *Phaeographis mucronata* (Stirt.) Zahlbr., *Cat. Lich. Univ.* 2:382 (1923)  
*Graphis mucronata* Stirt., *Trans. Glasgow Field Naturalists* 4: 95 (1876)
16. *Phaeographis nardiensis* A.W. Archer, *Telopea* 9: 674 (2001)
17. *Phaeographis neotricosa* Redinger, *Ark. Bot.* 27A(3): 93 (1935)
18. *Phaeographis platycarpa* Müll. Arg., *Bot. Jahrb. Syst.* 20: 284 (1894)
19. *Phaeographis subdividens* (Leight.) Müll. Arg., *Flora* 65: 383 (1882)  
*Graphis subdividens* Leight., *Trans. Linn. Soc. London* 27: 177 (1869)
20. *Phaeographis subintricata* (C. Knight) Müll. Arg., *Bull. Herb. Boissier* 3: 320 (1895)  
*Graphis subintricata* C. Knight, *Trans. Linn. Soc. London, Bot.* 2: 40 (1882)
21. *Phaeographis subtigrina* (Vain.) Zahlbr., *Cat. Lich. Univ.* 2: 287 (1923)  
*Graphis subtigrina* Vain., *Hedwigia* 46: 177 (1907)
22. *Phaeographis tuberculifera* A.W. Archer, *Telopea* 9: 675 (2001)
23. *Phaeographis wilsonii* (A.W. Archer) A.W. Archer, **comb. nov.**  
*Phaeographina wilsonii* A.W. Archer, *Telopea* 9: 343 (2001)

#### *Platygramme* Fée

1. *Platygramme arechavaletae* (Müll. Arg.) A.W. Archer, **comb. nov.**  
*Phaeographina arechavaletae* Müll. Arg., *Rev. Mycol.* 10: 5 (1888)  
*Phaeographina banksiae* Müll. Arg., *Bull. Herb. Boissier* 1: 59 (1893)



2. *Platygramme australiensis* Staiger & Matthes-Leicht, *Biblioth. Lichenol.* 85: 355 (2002)

[*Phaeographina caesiopruinosa* (Fée) Müll. Arg., *auct. australis*].

3. *Platygramme fuscescens* (A.W. Archer) A.W. Archer, *comb. nov.*

*Phaeographina fuscescens* A.W. Archer, *Telopea* 9: 337 (2001)

4. *Platygramme impudica* (A.W. Archer) A.W. Archer, *comb. nov.*

*Phaeographina impudica* A.W. Archer, *Telopea* 9: 339 (2001)

5. *Platygramme muelleri* (A.W. Archer) Staiger, *Biblioth. Lichenol.* 85: 364 (2002)

*Phaeographina muelleri* A.W. Archer, *Telopea* 8: 473 (2000)

*Phaeographina caesiopruinosa* (Fée) Müll. Arg. var. *monospora* Müll. Arg., *Bull. Herb. Boissier* 3: 322 (1895)

6. *Platygramme pudica* (Mont. & Bosch) M. Nakan. & Kashiw., *Bull. Natn. Sci. Mus., Tokyo*, ser.B, 29(2): 89 (2003)

*Graphis pudica* Mont. & Bosch, *Plant. junghuhn.*, Fasc.4: 474 (1855)

*Phaeographina echinocarpica* A.W. Archer & Elix, *Mycotaxon* 72: 91 (1999), *syn. nov.*

#### *Platythecium* Staiger

1. *Platythecium pertenellum* (Stirt.) A.W. Archer, *comb. nov.*

*Graphis pertenella* Stirt., *Trans. & Proc. Roy. Soc. Victoria* 17: 72 (1881)

*Graphina brachyspora* Müll. Arg., *Flora* 66: 79 (1883)

*Graphis laevigata* Müll. Arg., *Nuovo Giorn. Bot. Ital.* 23:398 (1891)

#### *Sarcographa* Fée

1. *Sarcographa labyrinthica* (Ach.) Müll. Arg., *Mém. Soc. Phys. Genève* 29: 62 (1887)

*Glyphis labyrinthica* Ach. *Syn. Lich.*: 107 (1814)

2. *Sarcographa oculata* Müll. Arg., *Bull. Herb. Boissier* 3:323 (1895)

3. *Sarcographa subtriosa* (Leight.) Müll. Arg., *Flora* 70: 78 (1887)

*Glyphis subtriosa* Leight., *Trans. Linn. Soc. London (Botany)* 27: 181 (1869)

4. *Sarcographa verrucosa* (Mont. & Bosch) Zahlbr., *Cat. Lich. Univ.* 2: 467 (1923)

*Glyphis verrucosa* Mont. & Bosch, in Miquel, *Plant. junghuhn.* Fasc. IV: 489 (1855)

#### *Sarcographina* Müll. Arg.

1. *Sarcographina cyclospora* Müll. Arg., *Flora* 70: 425 (1887)

*Glyphis cyclospora* (Müll. Arg.) Shirley, *Proc. Roy. Soc. Qld.* 6: 215 (1889)

#### *Thalloloma* Trevis.

1. *Thalloloma atronitens* (A.W. Archer) A.W. Archer, *comb. nov.*

*Graphina atronitens* A.W. Archer, *Mycotaxon* 77: 163 (2001)

#### *Thecaria* Fée

1. *Thecaria montagnei* (Bosch) Staiger, *Biblioth. Lichenol.* 85: 446 (2002)

*Graphis montagnei* Bosch, in Miquel, *Plant. junghuhn.*, Fasc. IV: 472 (1855)

2. *Thecaria quassiicola* Fée, *Essai Crypt.* 97 (1824) as 'quassiaecola',

*Phaeographina quassiicola* (Fée) Müll. Arg., *Mém. Soc. Phys. Genève* 29: 47 (1887)

## References

- Archer AW (2004) Additional synonymy in the Australian Graphidaceae. *Australasian Lichenology* 55: 16–27.
- Archer AW (2005) Australian species in the genus *Diorygma* (Graphidaceae). *Australasian Lichenology* 56: 10–11.
- Kalb K (2001) New or otherwise interesting lichens.1. *Bibliotheca Lichenologica* 78: 141–167.
- Kalb H, Staiger B, & Elix JA (2004) A monograph of the lichen genus *Diorygma*—a first attempt. *Symb. Bot. Ups.* 34(1): 133–181
- Nakanishi M (1977) Notes on Japanese species of *Phacographina*. *Hikobia* 8: 91–100.
- Nakanishi M, Kashiwadani H & Moon KH (2003) Taxonomical notes on Japanese Graphidaceae (Ascomycotina), including some new combinations. *Bull. Natn. Sci. Mus., Tokyo*, ser.B, 29: 83–90.
- Staiger B & Kalb K (1999) Acanthothecis and other graphidioid lichens with warty periphysoids or paraphysis tips. *Mycotaxon* 73: 69–134.
- Staiger B (2002) Die Flechtenfamilie Graphidaceae. *Bibliotheca Lichenologica* 85: 1–526.

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# A new species of *Pomaderris* (Rhamnaceae) from the Central Tablelands of New South Wales

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## Abstract

*Pomaderris walshii*, a shrub of the Central Tablelands of New South Wales, is described and illustrated. The species is apparently restricted to the upper Kangaroo River, south-east of Robertson. It is threatened because of its small population size and possible future changes in land use, and fire and flood frequencies. As a result of morphometric analyses on *P. walshii* and related taxa, *P. argyrophylla* subsp. *graniticola* is raised to specific rank (as *P. graniticola*).

## Introduction

*Pomaderris* comprises 70 species throughout Australia and New Zealand. Of the 65 species that occur in Australia, 45 of these occur within New South Wales (Harden 2000). Much of the genus has been reviewed over the last two decades resulting in a significant increase in the number of known species, particularly in south eastern Australia (Walsh 1988a; Walsh 1988b; Walsh 1990; Walsh 1992; Walsh & Coates 1997).

*Pomaderris parrisiae* N.G. Walsh, *P. nitidula* (Benth.) N.A. Wakef. and *P. argyrophylla* N.A. Wakef. form a closely related group within *Pomaderris* (Walsh and Coates 1997) and can be difficult to distinguish as they are morphologically very similar. Collectively, they are found along the east coast of Australia from south-east NSW to Queensland and are usually found in small, disjunct and isolated populations both within and between species (Fig. 1).

A small population of a *Pomaderris* species was recently discovered near Carrington Falls in the Central Tablelands of NSW and was found to have close affinities to the above group of taxa. Surveys of the nearby area revealed that its distribution appears to be limited to two small populations in the riparian zone in the upper Kangaroo River catchment (Millott 2003). The smaller population, located in Budderoo National Park, consists of 13 individual plants. The larger population is located on private land approximately 2.5 km upstream, and consists of approximately 30 plants.

A morphometric analysis was undertaken to compare plants from the populations in the upper Kangaroo River with *P. parrisiae*, *P. nitidula*, *P. argyrophylla* subsp. *argyrophylla* and *P. argyrophylla* subsp. *graniticola* to assess its level of differentiation and taxonomic status.

## Methods

A total of 76 dried collections were used in the morphometric analysis: 17 specimens of the *Pomaderris* from Carrington Falls were measured and compared against 13 specimens of *P. argyrophylla* subsp. *argyrophylla*, 10 of *P. argyrophylla* subsp. *graniticola*, 29 of *P. parrisiae* and 7 of *P. nitidula*. The sample sizes reflect availability of material.

The nine morphological characters measured were selected from a larger set used in preliminary analyses (Millott 2003). These nine characters were found to fully describe the variation amongst the selected taxa. Five of these characters were foliar and the remaining four were floral (Table 1).

Each character was measured on either 10 leaves or 10 flowers per specimen and the mean used in the statistical analysis. The two exceptions to this were leaf hair length and lateral vein overtopping. These characters were measured once per specimen because they were taken in a single visual inspection of the leaf. Only leaves that were more than two nodes removed from the growth apex were chosen for measurement to avoid taking measurements on juvenile leaves; this method appeared to be the most reliable for choosing mature leaves. The leaf base angle was taken as the angle at the base of the leaf between the two leaf margins at points approximately 5 mm along the margins from the base. The inflorescence diameter was taken as the widest point across the inflorescence which was at or near the base of the inflorescence for these species.

The morphometric data were analysed using the CLUSTER program of Primer for Windows 5.2.8. A matrix of Bray-Curtis similarity coefficients from  $\log(x+1)$  transformed data was constructed to enable CLUSTER. The significance of differences in characters between species groupings was determined by multiple ANOVA.

## Results and Discussion

In the CLUSTER analysis, all but one collection was grouped with the other collections of the taxon it had previously been determined as (Fig. 2). The aberrant collection (ag5) had the highest values for five of the eight quantitative measures within that taxon — the values were 1.8 to 2.5 standard deviations above the mean. As a consequence, collection ag5 was omitted from subsequent analyses. Further collections from the ag5 population would be useful to clarify its identity and status.

Although five clusters appear to be naturally separable, there was less similarity within *P. argyrophylla* subsp. *graniticola* collections than between the other taxa groups. Despite this, subsp. *graniticola* as an entity is distinct from the other taxa and a new status is proposed here for it. The plants from Carrington Falls appear to be most closely allied to *P. nitidula*. *Pomaderris parrisiae* is most closely allied to *P. argyrophylla* subsp. *argyrophylla*.

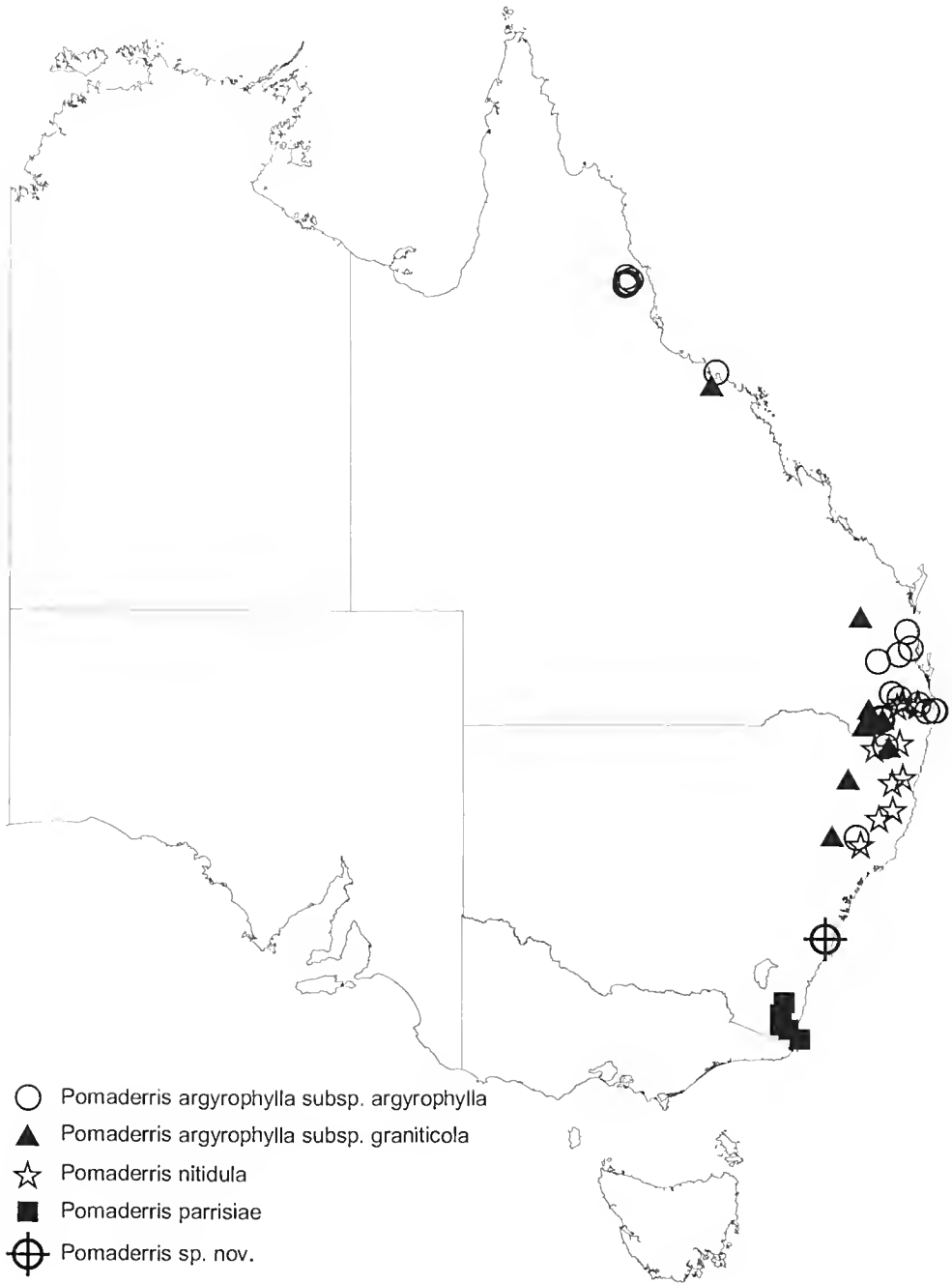


Fig. 1. Distribution of the *Pomaderris* species that are the subject of this paper: ● = *P. argyrophylla* subsp. *argyrophylla*; ▲ = *P. argyrophylla* subsp. *graniticola*; \* = *P. sp. nov.*; ☆ = *P. nitidula*; ■ = *P. parrisiae*.

There were significant differences between taxa for each of the characters measured (Table 1). The plants from Carrington Falls are separable from *P. argyrophylla* subsp. *argyrophylla* by their larger leaf base angle, shorter leaves, and leaf vein indumentum, from *P. argyrophylla* subsp. *graniticola* by their broader inflorescences, longer and broader leaves, and presence of leaf vein indumentum, from *P. nitidula* by their shorter anthers, narrower hypanthia, larger leaf base angle, and shorter sepals, and from *P. parrisiae* by all characters except hypanthium diameter.

Because of the differences between the Carrington Falls *Pomaderris* and the four related taxa, we believe it warrants recognition at the species level.

**Table 1. 99% confidence intervals for each quantitative character measured, and presence/absence of overtopping of abaxial vein indumentum.**

All measurements used to determine character means were used to calculate the confidence intervals. Within each character, identical superscript letters indicate that the means are not significantly different as determined by single classification ANOVA ( $P < 0.05$ ).

Character	<i>P. argyrophylla</i> subsp. <i>argyrophylla</i>	<i>P. argyrophylla</i> subsp. <i>graniticola</i>	<i>P. nitidula</i>	<i>P. parrisiae</i>	<i>P. walshii</i>
Anther length (mm)	0.9 – 1.1 <sup>a</sup>	0.8 – 1.0 <sup>a</sup>	1.2 – 1.5 <sup>b</sup>	1.3 – 1.4 <sup>b</sup>	0.9 – 1.0 <sup>a</sup>
Hypanthium diameter (mm)	0.9 – 1.2 <sup>a</sup>	1.0 – 1.1 <sup>a</sup>	1.2 – 1.4 <sup>b</sup>	1.2 – 1.3 <sup>b</sup>	1.0 – 1.1 <sup>a</sup>
Inflorescence diameter (mm)	43 – 58 <sup>ac</sup>	19 – 41 <sup>b</sup>	26 – 49 <sup>ab</sup>	49 – 57 <sup>c</sup>	45 – 59 <sup>ac</sup>
Leaf base angle (°)	45 – 61 <sup>a</sup>	74 – 121 <sup>b</sup>	56 – 74 <sup>a</sup>	63 – 68 <sup>c</sup>	71 – 84 <sup>b</sup>
Leaf simple hair length	0.1 – 0.3 <sup>a</sup>	0.1 – 1.1 <sup>a</sup>	0.2 – 0.5 <sup>a</sup>	1.1 – 1.3 <sup>b</sup>	0.8 – 1.0 <sup>a</sup>
Leaf length (mm)	54 – 77 <sup>a</sup>	19 – 36 <sup>b</sup>	38 – 52 <sup>c</sup>	61 – 66 <sup>a</sup>	43 – 52 <sup>c</sup>
Leaf width (mm)	16 – 21 <sup>a</sup>	9 – 14 <sup>b</sup>	14 – 19 <sup>a</sup>	21 – 23 <sup>c</sup>	15 – 19 <sup>a</sup>
Sepal length (mm)	1.7 – 1.9 <sup>a</sup>	1.9 – 2.0 <sup>b</sup>	2.3 – 2.6 <sup>c</sup>	2.5 – 2.6 <sup>c</sup>	1.8 – 2.0 <sup>ab</sup>
Overtopping of leaf lateral vein hair by lacuna hair	absent	absent	present	absent	present

***Pomaderris walshii* J.C. Millott & K.L. McDougall, *sp. nov.***

*Pomaderris nitidula* (Benth.) N.A. Wakef. proxime affinis sed statura maiore, floribus minoribus, lamina basi obtusiore et distributione geographica magis ad meridiem differt.

Holotype: New South Wales: Central Tablelands: Budderoo National Park, Douglas Creek, c. 0.7 km upstream of Carrington Falls, S of disused quarry, J. Millott, 1 Nov 2003 (NSW656890).

Shrub or small tree to 3 m high. Young stems and petioles with appressed, silvery to rusty simple hairs and medium to dense, white stellate hairs. Leaves narrowly ovate; (36–)43–52(–60) mm long; 14–19(–22) mm wide; base cuneate to obtuse; margins

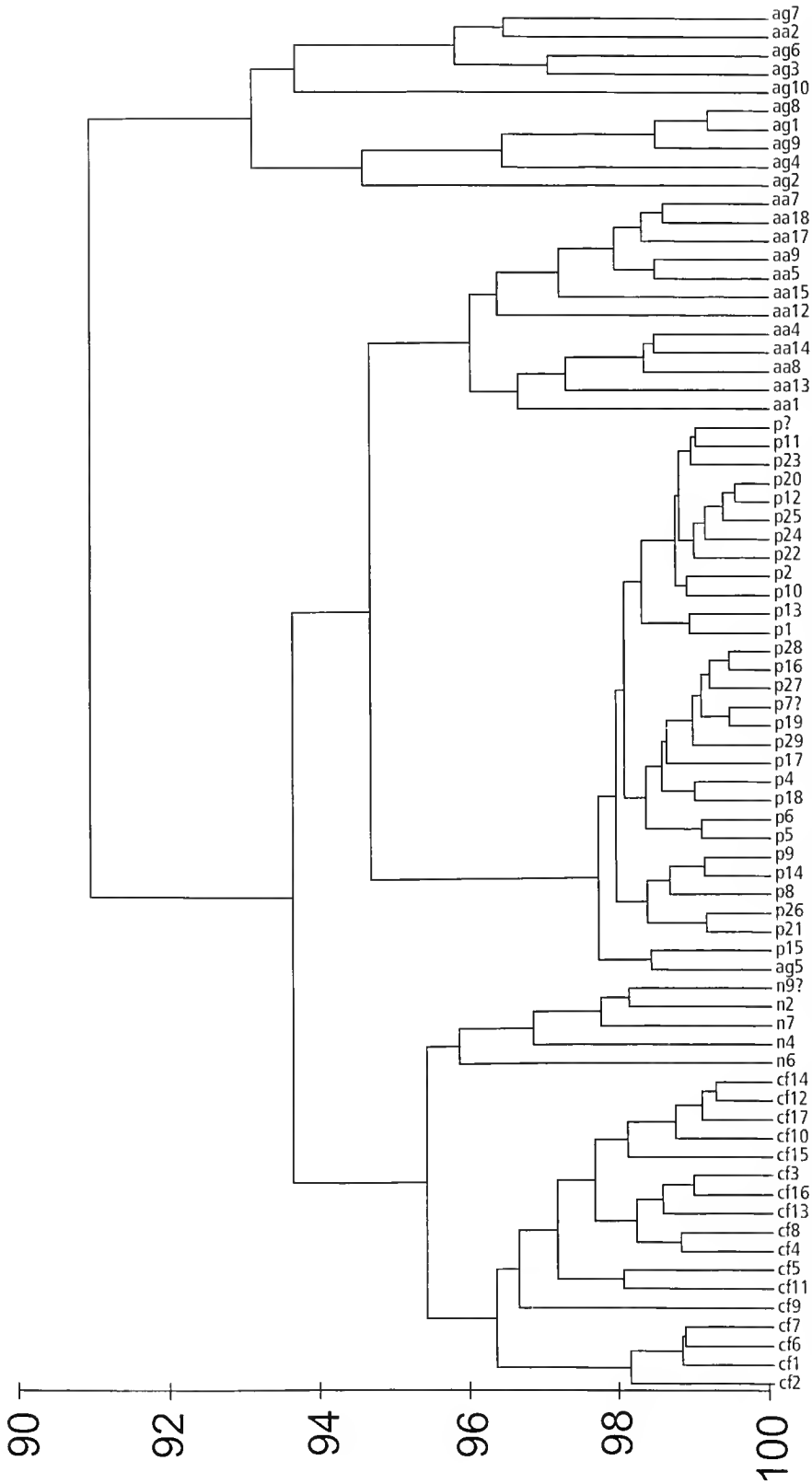


Fig. 2. Cluster analysis of 79 specimens of five apparent *Pomaderris* taxa. The herbarium determination is indicated by the following labels; aa = *P. argyrophylla* subsp. *argyrophylla*; ag = *P. argyrophylla* subsp. *graniticola*; cf = *P. sp. nov.*; n = *P. nitidula*; p = *P. parrisiae*.

entire, plane or slightly recurved; apex acute to acuminate; adaxial surface green and glabrous; abaxial surface moderately hairy with loosely appressed, white-silvery simple hairs and dense white stellate hairs; lateral veins not or slightly impressed above, clearly visible below and covered with an indumentum of moderately dense, appressed rusty simple hairs and sparsely to moderately dense white stellate hairs; abaxial lateral vein indumentum overtopped by, or level with, lacuna indumentum; petiole 4–10 mm long. Stipules narrowly triangular, apex acute, 2–6 mm long, soon deciduous. Inflorescence of 20–c. 100 flowers, pyramidal to hemispherical, terminal, 4–6.5(–7.5) cm long and wide at base; bracts deciduous; pedicels 1.5–4.3 mm long. Flowers cream-coloured to yellow; externally pubescent to villous with loosely appressed, silvery simple hairs and dense stellate hairs (sepals less densely indumented than hypanthium); hypanthium (0.8–)1–1.4 mm in diameter, 0.8–1.2 mm long; sepals 1.8–2.0 mm long; petals present, 1.7–1.9 mm long, spreading, spathulate; stamens 2–2.5 mm long; anthers (0.7)–0.8–1.2 mm long; ovary inferior, summit simple-pubescent; style glabrous, 1.6–1.9 mm long, branched in lower or middle third. Fig. 3.

**Etymology:** Named in recognition of botanist Neville Walsh of the National Herbarium of Victoria for his work on the revision of this genus.

**Distribution:** Currently only known from the upper Kangaroo River and its tributaries (above Carrington Falls) on the Central Tablelands of New South Wales.

**Habitat and ecology:** Populations have been recorded in riparian shrubland dominated by *Callicoma serratifolia*, *Ceratopetalum apetalum* and *Grevillea rivularis*, and open grassy forest (partly cleared for grazing) dominated by *Eucalyptus fastigata*. An unnamed *Pomaderris* species was recorded close to Carrington Falls on the Kangaroo River by Jordan (1989) in *Eucalyptus piperita* / *E. sieberi* forest but this has not been relocated in recent times. The upper Kangaroo River is underlain by Hawkesbury Sandstone and the soils in populations are sandy alluvium. Annual rainfall is about 1800 mm and populations range in elevation from about 550–600 m above sea level. The Budderoo population was last burnt in 1983, however, the response of the species to fire is unknown. Plants possibly resprout following flood damage. Old, dead prostrate stems were observed on small plants closest to the river, a possible consequence of the last major flood event in 1999.

**Conservation status:** Two populations of this species have been recorded over a lineal range of about 3 km. One population of approximately 13 plants is reserved in Budderoo National Park but most of these plants are apparently young. The remaining plants are on freehold land. Populations may be threatened by changes in fire or flood frequencies, or by future use of private land. A conservation code of 2ECi is suggested for this species.

**Other specimens examined:** New South Wales: Central Tablelands: Douglas Creek (a tributary of Kangaroo River) above Carrington Falls, SE of Robertson, *K. McDougall* 567, June 1998 (MEL 2117356).

### **New status for *Pomaderris argyrophylla* subsp. *graniticola***

As a result of our analysis we elevate *P. argyrophylla* subsp. *graniticola* to specific rank because it is clearly morphometrically distinct from the other four taxa analysed.





Fig. 3. *Pomaderris walshii*. a, habit; b, flower; c, petal; d, stamen, showing petal attachment; e, abaxial leaf indumentum; f, leaf venation; g, cross section of leaf. Scale bar: a = 5 cm; b = 0.4 cm; c = 0.25 cm; d = 0.25 cm; e = 0.5 cm; f = 3 cm; g = 0.25 cm.

*Pomaderris graniticola* (N.A. Wakef.) K.L. McDougall & J.C. Millott, *comb. & stat. nov.*

*Pomaderris argyrophylla* N.A. Wakef. subsp. *graniticola* N.G. Walsh & F. Coates, *Muelleria* 10: 46 (1997).

Type: Queensland, Girraween National Park, c. 50 m W of Dr Roberts Waterhole, towards its southern reach, N.G. Walsh 3883, 15.ix.1994 (holotype MEL; isotypes BRI, CANB, NSW, UNE).

**Notes:** The apparent preference of this taxon for growing on granitic substratum is retained in the new name. Notes on the distinctions between *P. graniticola* and *P. argyrophylla* are given in Walsh and Coates (1997), who indicate that in the area east of Stanthorpe in Queensland, the two taxa may be difficult to distinguish. The significant diagnostic characters identified above — inflorescence diameter (19–41 mm in *P. graniticola*, 43–58 mm in *P. argyrophylla*), leaf base angle (74–121° in *P. graniticola*, 45–61° in *P. argyrophylla*), leaf length (19–36 mm in *P. graniticola*, 54–77 mm in *P. argyrophylla*), leaf width (9–14 mm in *P. graniticola*, 16–21 mm in *P. argyrophylla*), and sepal length (1.9–2.0 mm in *P. graniticola*, 1.7–1.9 mm in *P. argyrophylla*) — will hopefully assist in identification.

### Acknowledgments

The authors wish to thank Neville Walsh for much useful advice on *Pomaderris* taxonomy. Sam Demuth assisted in both locating and helping to protect the populations of this particularly vulnerable species. Belinda Pellow and Louisa Murray gave their valuable assistance in curation of specimens at WOLL and NSW, respectively. Many thanks also to Peter Wilson for the latin diagnosis and to Catherine Wardrop for the illustration.

### References

- Harden GJ (2000) *Pomaderris*. Pp. 590–604 in GJ Harden (ed.), *Flora of New South Wales*. Volume 1 (Revised edition). (University of New South Wales Press: Kensington)
- Jordan P (1989) *Grevillea rivularis*. Unpublished report. (NSW National Parks and Wildlife Service: Hurstville)
- Millott JC (2003) The taxonomy and ecology of a *Pomaderris* population near Carrington Falls, NSW, (Honours Thesis: University of Wollongong)
- Walsh NG (1988) Two new species of *Pomaderris* Labill. (Rhamnaceae) from south-eastern New South Wales. *Muelleria* 6(6): 429–435.
- Walsh NG (1988) Two new species of *Pomaderris* Labill. (Rhamnaceae) from south-eastern Australia. *Muelleria* 7(1): 81–87.
- Walsh NG (1990) Two new species of *Pomaderris* Labill. (Rhamnaceae) from New South Wales. *Muelleria* 7(2): 207–212.
- Walsh NG & Coates F (1997) New taxa, new combinations and an infrageneric classification in *Pomaderris* (Rhamnaceae). *Muelleria* 10: 27–56.

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# A colligate *Spirogyra* (Zygnemataceae, Zygnematophyceae) in Australia

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## Abstract

A species of *Spirogyra*, *Spirogyra yuin*, with external collar-like sleeves holding cells in filaments is described for the first time in Australian freshwater systems. Similar in form and dimensions to *S. silesiaca*, it is distinct in possessing an irregularly honeycombed mesospore wall and golden mesospore.

## Introduction

No reports of colligate *Spirogyra* have been published for the southern hemisphere. In describing *Spirogyra colligata*, Hodgetts noted a 'most curious feature': the 'H shaped piece of membrane' between each touching pair of cells. 'This connecting-clamp is a thin cylindrical piece of cell-wall...' Hodgetts (1920). Hodgetts saw this taxon as unique in the genus. *Spirogyra colligata* with vegetative cells 29–40 µm diam. and lenticular zygospores with verrucose, golden brown mesospore walls is reported from Europe and North America (Kadlubowska 1984). Kadlubowska (1969) investigated further the connecting clamp, or collar, and amended Hodgetts' description to point out that the collar does not have a septum as described by Hodgetts but rather a furrow or band, and was completely detachable. Two further colligate taxa have been described for *Spirogyra*: *Spirogyra silesiaca* Kadl. has vegetative cells 43–52 µm diam., and lenticular zygospores with verrucose, brown mesospores, described from Poland (Kadlubowska 1967). *Spirogyra subcolligata* Bi has vegetative cells 37–41 µm diam., and smooth-walled, lenticular to ovoid zygospores, the mesospore wall quite thick, and sulcate, described from Huaiyang, China (Bi 1979).

*Spirogyra yuin* Skinner & Entwisle *sp. nov.*

Type: NSW: South Coast: Dry River, below bridge at Quaama, *Skinner 0522*, 2 Jan 2002 (holo NSW).

*Spirogyrae silesiaca* similis sed mesosporis bilaminatis, rugosis externe, et inaequaliter faveolatis atque aureis interne.

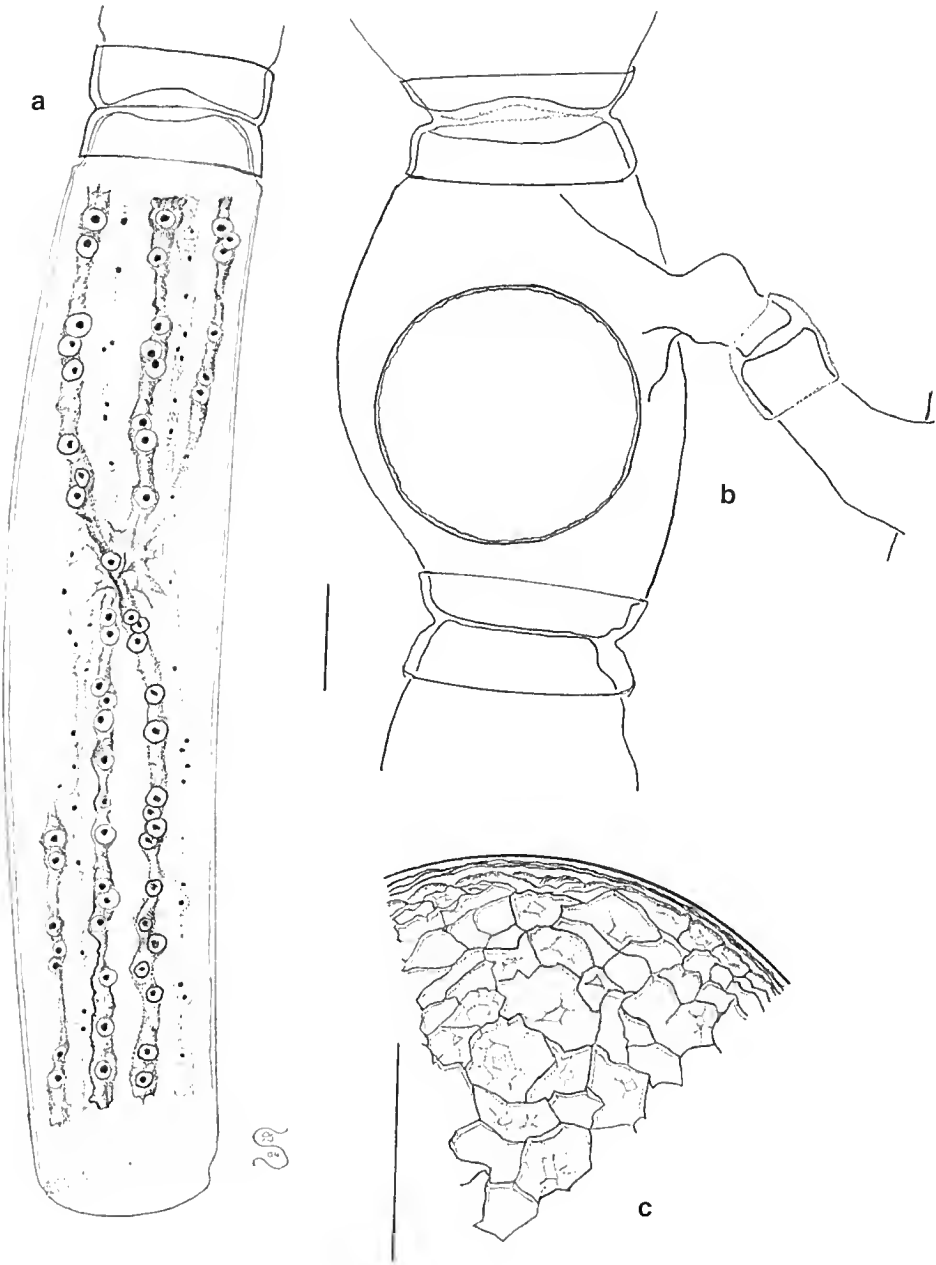


Fig. 1. a–c. *Spirogyra yuin*, Skinner 0522 (NSW). a, vegetative cell, with and without collar; b, receptor gametangium and sigmoid connecting tube; c, zygospore (part) with sculpturing. Scales 20  $\mu$ m.

Vegetative cells cylindrical, L/D 4.5–12, 45–50(–55)  $\mu\text{m}$  diam., end-wall colligate, chloroplasts ribbon-like, 4–5, straight or weakly spiralled; pyrenoids numerous, with wide starch haloes. Conjugation scalariform, occasionally terminal; donor cell as vegetative cells, receptor cell inflated ovoid in the middle of the cell, 79–95  $\mu\text{m}$  across the inflation; conjugation tubes from both sides, cylindrical to vermiform, funnel ended with mucilage collar at junction, 23–27  $\mu\text{m}$  diam. Zygospore lenticular, ovoid in side view, 68–82  $\mu\text{m}$  diam., c. 50  $\mu\text{m}$  thick, exospore smooth, clear, thin, mesospore two-layered, outer pearly, finely furrowed, inner wrinkled, honeycombed, golden yellow. Fig. 1 a–c.

**Etymology:** named in recognition of the Yuin people, the traditional owners of the area in which the collection was made and the river rises.

**Distribution:** New South Wales, in fluctuating river with cobblestone bed, endemic.

**Specimen examined:** New South Wales: South Coast: Dry R., below bridge at Quaama, *Skinner 0522*, 2 Jan 2002 (NSW).

While the specimens found at Quaama were similar to the published species in general form, and are closest to *S. silesiaca* in dimensions, the furrowed, irregularly honeycombed mesospore, golden in colour, is distinctive.

### Acknowledgments

We thank Ms Alice Cheung for Chinese translations. Representatives of New South Wales south coast aboriginal peoples agreed to the use of the Yuin name.

### References

- Bi Liejiu (1979) New Zygnemataceous algae from Henan Province. *Oceanologica Limnologia Sinica* 10: 354–361.
- Hodgetts WJ (1920) A new species of *Spirogyra*. *Annals of Botany* 34: 519–524, Pl. 22.
- Kadlubowska JZ (1967) *Spirogyra silesiaca* sp. n. *Fragmenta Floristica Geobotanica* 13: 163–164.
- Kadlubowska JZ (1969) Structure of cell-wall of *Spirogyra colligata* Hodgetts (1920) and changes of diagnosis of this species — Budowa ściany komórkowej *Spirogyra colligata* Hodgetts (1920) oraz zmiana diagnozy tego gatunku. *Fragmenta Floristica Geobotanica* 15: 255–257.
- Kadlubowska JZ (1984) Chlorophyta VIII Conjugatophyceae I: Zygnematales *Süßwasserflora von Mitteleuropa* 16 (Gustav Fischer Verlag: Jena)

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# A new *Zygnemopsis* species (Zygnemataceae, Zygnematophyceae), with mature zygospores, from Australia

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## Abstract

A species of *Zygnemopsis*, *Zygnemopsis faveosrobiculata*, with a distinctive cup-like concave horn in the exospore at each corner of the zygospore is reported from the Dumaresq River. It is similar in other respects to *Z. quadrata* and *Z. areolata* from China in vegetative dimensions and mesospore sculpturing, but there is little or no separation between the exospore and mesospore in the Australian material.

## Introduction

As part of a recent survey of macroalgae of the Dumaresq, Macintyre, Severn and Gwydir Rivers in northern New South Wales adjacent to the Queensland border, the authors made numerous collections of various Zygnemataceae. Among these we found a *Zygnemopsis* species as the dominant macroalga in riffle banks in the Dumaresq at the point where the low-level bridge marks the border between the states, two kilometres north-east of Mingoola. Here it formed numerous yellowish to apple green rafts, especially in the pools between the larger cobblestones, and among the *Azolla pinnata* and *Ludwigia peploides* ssp. *montevidensis* plants in the same shallow, warm-water pools. It was notable, not only as the dominant species, fertile and so distinguishable from *Zygnema*, but also in that many of the zygospores in most conjugation ladders were mature. There have been eleven collections of *Zygnemopsis* lodged at NSW from Western Australia, Northern Territory, New South Wales and Queensland but these have rarely contained sufficient mature zygospores to distinguish them with confidence to more than genus. No descriptions of taxa from this genus have been published from Australian material (Kadlubowska 1984).

*Zygnemopsis faveosrobiculata* Skinner, H. McPherson & Towler *sp. nov.*

Type: NSW: North Western Slopes: Dumaresq R., at low level bridge on NSW-Qld border, north of Mingoola, Skinner 0684, McPherson & Towler, 7 Oct 2004 (holo NSW 910473).

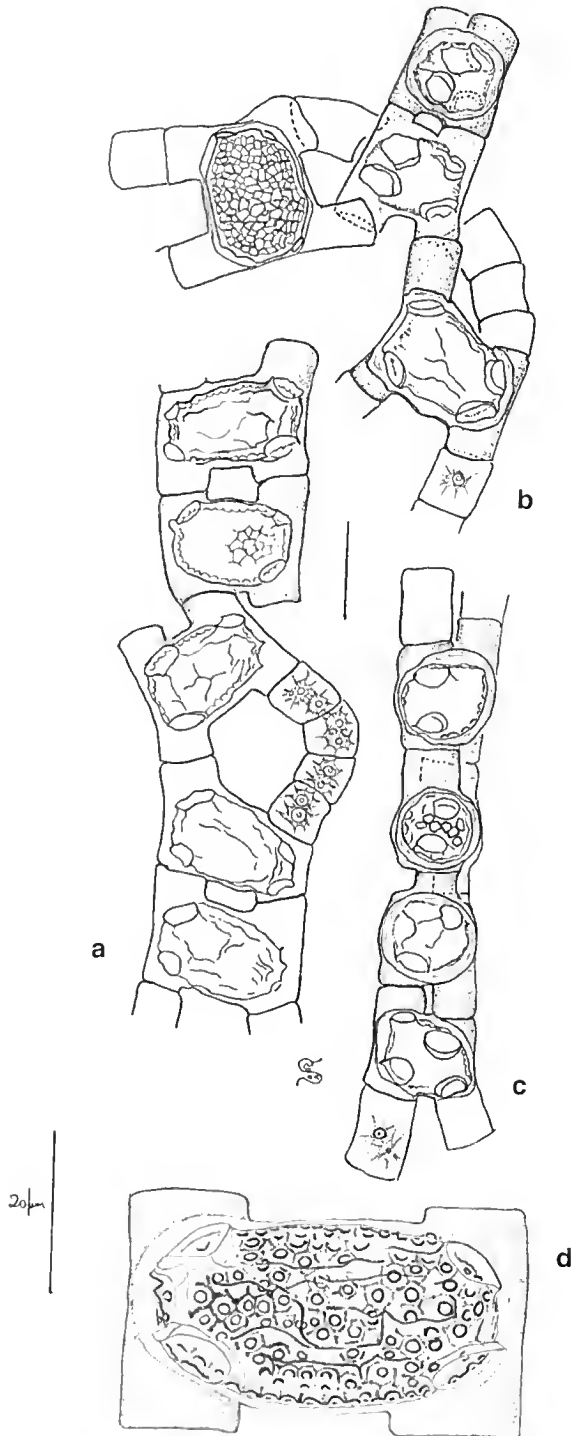


Fig. 1 a–d. *Zyguemopsis faveoscribiculata*, Skinner 0684, McPherson & Towler (NSW). a–c, various stages of maturity of zygospores, top and side views; d, mature zygospore and gametangia. Scales = 20 µm.



*Zygnemopsis areolatae* similis sed membrana exosporae ad mesosporae adiacenta cornuibusque concavatis, atque mesospora aspectu laterali globosa.

Vegetative cells narrow cylindrical, 11–14  $\mu\text{m}$  diam, L/D 1.2–3, endwall plane; chloroplasts stellate, (1–)2(–3), each with central pyrenoid; basal attachment of filament not seen. Conjugation scalariform, zygospore filling conjugation canal and reaching outer walls of both gametangia; gametangia pectin-filled post-zygote, not markedly laminate. Zygospore rectangular ovoid in face view, subglobose in side view, 34–42  $\mu\text{m}$  long, 25–27  $\mu\text{m}$  diam., 20–25(–27)  $\mu\text{m}$  thick, with pectinate halo (most visible in side view); exospore wall clear, close-fitting, wrinkled with four concave corners, mesospore wall thick, faveolate-scrobiculate, golden brown, scrobiculae 2–2.8  $\mu\text{m}$  diam. Fig. 1 a–d.

**Etymology:** the name derives from the honeycomb patterns of dimples on the mesospore.

**Distribution:** New South Wales-Queensland border, in river riffle banks.

**Other specimen examined:** New South Wales: North Western Slopes: Bakers Creek, near Bundara, Skinner 0790, McPherson & Towler, 13 Oct 2004 (NSW).

**Notes:** The four cup-like concave horns of the exospore clearly distinguish this taxon from similar species including *Zygnemopsis stephaniae* Transeau (Transeau et al. 1934), *Z. quadrata* Jao (Jao 1935), and *Z. areolata* Zhu (Zhu 1980). *Zygnemopsis stephaniae* has a more quadrate zygospore, without distinctive corners on the exospore. *Zygnemopsis quadrata* has an exospore which is widely separate from the mesospore, and which has convex corner processes (or horns) and the mesospore has an equatorial ridge. *Zygnemopsis areolata* has a wide separation between mesospore and exospore, and is more narrow, and lozenge-like in side view. The significance and developmental origin of these remarkable features are unknown.

## Acknowledgments

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## References

- Jao Chin-Chih (1935) Studies on the freshwater algae of China, I. Zygnemataceae from Szechwan. *Sinensia* 6: 551–564.
- Kadlubowska JZ (1984) Chlorophyta VIII Conjugatophyceae I: Zygnemales. *Süßwasserflora von Mitteleuropa* 16 (Gustav Fischer Verlag: Jena)
- Transeau EN, Tiffany LH, Taft CE & Li LC (1934) New species of Zygnemataceae. *Trans. Am. Microscopical Soc.* 53: 208–230.
- Zhu Wan-Jia (1980) Some new species of the Zygnemataceae from Guangdong (Kwangtung). *Acta Phytotaxonomica Sinica* 18: 106–109.



# Justice for Justice Barron Field

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## Abstract

Botanical tributes to Mr Justice Barron Field are reviewed, a correction in *Senna* is pointed out, and the new combination *Senna barronfieldii* (Colla) Hewson is made.

## Introduction

It is overdue that we revisit the botanical tributes given to Mr Justice Barron Field (1786–1846), judge in the Supreme Court of New South Wales (1816–1824), to review them and to make a correction. Two genera and one species were named in his honour.

Mr Justice Barron Field took a wide interest in the Colony during his posting. This included observing the plants and animals, composing poetry about them, collecting and drawing them, communicating collections to scientists in Britain and Europe, being a founding member of the Philosophical Society of Australasia and being the inaugural President of the Agricultural Society of New South Wales. Much evidence of this is revealed in his book, *Geographical Memoirs on New South Wales* (1825) (see also, Desmond (1977) and Currey (1966)). While he seems to have been a controversial figure at judicial, political, sociological and literary levels, his contributions to natural history were sufficiently valued for some scientists to commemorate him by naming some plants in his honour.

*Fieldia* A.Cunn., in Field, *Geographical Memoirs on New South Wales* 364, t. (Apr. 1825).

Type: *Fieldia australis* A.Cunn.

Syn: *Basileophyta* F.Muell. Type: *B. friderici-augusta* F.Muell., *1<sup>st</sup> Gen. Rept. Veg of the Colony* 16 (1853), *nom inval.*, *nom. nud.*

*Fieldia australis* A.Cunn., *Geographical Memoirs on New South Wales* 364, t. (Apr. 1825).

Type: “Blue Mountains ... about twenty-two miles from the entrance of the new route which has recently been traced out by Mr Bell, jr., 1823, A.Cunningham. It is found likewise at the Five Islands or Red-point of the charts.”

Cunningham’s tribute to Barron Field is as follows: “The name now proposed for the genus is intended to commemorate that of a gentleman who has, in his judicial

capacity, much aided the advancement of the colony of New South Wales to its present flourishing state; and whose important researches there, in various branches of physical science, will materially tend to confer that interest upon our distant settlement which it so richly deserves, and which yet remains in a great measure to be appreciated."

This was reinforced by Hooker in 1827 when he quoted Cunningham's tribute and stated in a concluding remark regarding his three volume work, *Exotic Flora* (1821–1827): "To this work do I owe the acquaintance of the gentleman after whom the present plant is named, together with the possession of a valuable collection of New Holland plants, and the use of many excellent drawings made in that country."

Another genus, *Fieldia*, was described by Gaudichaud-Beaupré and named in Field's honour: *Fieldia* Gaud., in Freycinet, *Voy. Uranie* 10: 424, t.36 (1829).

Type: *Fieldia lissochiloides* Gaud. Type: "In insulis Moluccis (Rawak)."

The name of this genus is a later homonym. The taxon is now regarded as a species of the orchid genus *Vandopsis* (*V. lissochiloides* (Gaud.) Pfitzer). Gaudichaud's tribute to Barron Field is as follows: "J'ai consacré ce genre, comme un témoignage de ma profonde reconnaissance, à M. Barron Field, juge de la cour supreme au Port-Jackson, qui nous a facilité les moyens de traverser les Montagnes-Bleus."

From this it is clear that Barron Field assisted members of Louis Freycinet's team to cross the Blue Mountains when they visited the Colony in 1819.

A species in the genus *Cassia* was also named in Field's honour.

*Cassia barronfieldii* Colla [as *barrenfieldii*], *Hort. Ripul.* App. 2: 343 (Jan. 1826); App. 4: 23, t.11 (July 1830). [Dates follow Stafleu and Cowan (1976).]

Type: "Botany Bay." Symon (1966) indicated that a holotype exists at TO. A specimen at K (bearing no collector detail), transferred from TO, is regarded by Randell (1989) as a syntype. Randell lectotypified the name by this specimen.

Named in "honorem Cl. Barrenfieldii hanc novam pulcherrimamque stirpem dicavi e seminibus absque nimine specifico a Schultesio nissis enatam." And, "in honorem cl. J. C. Barrenfieldio utpote primus qui illum invenerit in regionibus Botany-Bay, ac semina sine nomine praeclaro Schrankio miserit quae nobis humanissimus hic Professor communicaverat."

Bentham (1864: 285) treated this as a taxonomic synonym of *C. australis* Sims, *Bot. Mag.* 53: t.2676 (Aug. 1826), and recorded the synonym as "afterwards corrected to *C. Fieldii*". The correction, noted by Bentham, has not been located. Symon (1966: 102) stated that he found no record of the change; Randell (1989) stated that it was a "nomen nudum"; and Chapman (1991) does not record the name. Similarly any such "correction" is not treated by Vogel (1837). The name *C. Fieldii* Colla is, however, recorded by Steudel (1841) where he clearly refers back to the *C. barrenfieldii* of Colla (without specified reference). He also refers to the record of *C. barrenfieldii* in Vogel. We do not know if Steudel was first to "correct" the name. Nor do we know if Colla published an earlier "correction", as indicated in *Index Kewensis* (though the record in *Index Kewensis* is erroneous). Until a specified correction is located in the literature, it is impossible to be sure if *C. fieldii* is a *nom. inval.*, *nom. nud.* or, a *nom. illeg.*, *nom.*

*superfl.* It is also possible that the name is based on a different type, though Bentham's use of the term "corrected" does not lend support to this alternative.

More recently, the taxon to which this nomenclatural confusion applies has been treated by Symon (1966) as a taxonomic synonym of *Cassia odorata* Morris, *Fl. Conspicua*: t. 57 (Sept. 1826) [date from Stafleu & Cowan (1976)]. This is currently treated as *Senna odorata* (Morris) Randell (1989: 202); Harden (1991: 322); and Orchard (1998: 98). The type citation for *C. odorata* is: "this plant has very recently been introduced from New South Wales; and the present specimen was kindly forwarded by Aylmar Bourke Lambert, Esq., from Boynton House, Wilts, where it flowered in the greenhouse in the month of May." Symon (1966) and Randell (1989) have lectotypified this with the plate, no type specimen having been located. Whilst there is no overt evidence, it is possible that the original material of this taxon was collected by Field. Field did send collections to Lambert (see Miller 1970).

## Conclusion

The Colla epithet predates that of Morris and must take precedence based on the dates indicated by Stafleu and Cowan (1976) The correct name for this taxon is:

*Senna barronfieldii* (Colla) Hewson *comb. nov.*

Basionym: *Cassia barronfieldii* Colla [as "barrenfieldii"], *Hort. Ripul.* App. 2: 343 (Jan. 1826). Type: "Botany Bay"; lecto: K, *vide* Randell (1989).

*Cassia australis* Sims, *Bot. Mag.* 53: t.2676 (Aug. 1826) *nom. illeg.* (*non* Velloso (1825)) Type: "from New Holland"; lecto: plate 2676, *vide* Randell (1989).

*Senna odorata* (Morris) Randell, *J. Adelaide Bot. Gard.* 12(2): 202 (1989); *Cassia odorata* Morris, *Fl. Conspicua*: t.57 (Sept. 1826). Type: "introduced from New South Wales"; lecto: plate 57, *vide* Symon (1966), Randell (1989).

The spelling of Field's Christian name is here corrected for the first time. Inadvertently, a nasty jibe was perpetuated by Colla. Amongst Field's enemies in Australia he was taunted with being "barren" of ideas (Elliott 1947), a cruel play on the name of a man who was quite the opposite, as attested in his essays in the *Geographical Memoirs*. The man may have been irascible but his intellect is defensible. Indications in the literary world (Byrne 1961) that Field "hated botanists", cannot be borne out. His contribution to the knowledge of Australia's flora through botanists, scientists and horticulturists such as Allan Cunningham, William Hooker, Aylmer Lambert, Luigi Colla, Charles Gaudichaud, Josef Schultes and Franz Schrank (representing Australia, Britain, Italy, France and Germany), demonstrate that his contribution was tangible and valued.

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## References

- Bentham G (1864) *Flora Australiensis*, vol. 2. (Lovell, Reeve & Co.: London)
- Byrne JV (1961) Barron Field — Recultivated. *Southerly* 21(3): 6–18.
- Chapman AD (1991) *Australian Plant Name Index*. (AGPS: Canberra)
- Currey CH (1966) In Pike D. (ed.) *Australian Dictionary of Biography* 1: 73–376. (Melbourne University Press: Melbourne)
- Desmond R (1977) *Dictionary of British and Irish Botanists and Horticulturists*. (Taylor & Francis: London)
- Elliott B (1947) *The First Austral Harmonist in Singing to the Cattle*. (Georgian House: Melbourne)
- Field B (1825) *Geographical Memoirs on New South Wales*. (Murray: London)
- Harden GJ (1991) *Flora of New South Wales*, vol. 2. (New South Wales University Press: Kensington)
- Hooker WJ (1825–1827) *Exotic Flora*, vol. 3. (Printed for William Blackwood: Edinburgh; and T. Cadell: London)
- Miller HS (1970) The Herbarium of Aylmer Bourke Lambert. *Taxon* 19: 522.
- Orchard AE (1998) (ed.) *Flora of Australia*, vol. 12. Mimosaceae (excl. *Acacia*), Caesalpiniaceae. (CSIRO Publishing: Collingwood)
- Randell BJ (1989) Revision of the *Cassiinae* in Australia. *J. Adelaide Bot. Gard.* 12(2): 165–272.
- Stafleu F & Cowan RS (1976) *Taxonomic Literature* 2<sup>nd</sup> edn 1: 523.
- Steudel EG (1841) *Nomenclator botanicus* 2<sup>nd</sup> edn. (Stuttgardiae et Tubingae)
- Symon D (1966) A revision of the genus *Cassia* in Australia. *Trans. Roy. Soc. S. Australia* 90: 73–146.
- Vogel T (1837) *Synopsis Generis Cassiae*. (Logier: Berlin)

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