



## A review of Colletieae and *Discaria* (Rhamnaceae) in Australia

Jürgen Kellermann<sup>a,b</sup> & Frank Udovicic<sup>c</sup>

<sup>a</sup> State Herbarium of South Australia, Botanic Gardens and State Herbarium, Hackney Road, Adelaide, South Australia 5000

Email: juergen.kellermann@sa.gov.au

<sup>b</sup> The University of Adelaide, School of Biological Sciences, Adelaide, South Australia 5005

<sup>c</sup> National Herbarium of Victoria, Royal Botanic Gardens of Victoria, Birdwood Avenue, South Yarra, Victoria 3141  
Email: Frank.Udovicic@rbg.vic.gov.au

**Abstract:** The tribe Colletieae (Rhamnaceae) is reviewed for Australia. It is primarily South American, but two species of *Discaria* Hook., *D. pubescens* (Brongn.) Druce and *D. nitida* Tortosa, occur in south-eastern Australia and Tasmania. The two species are described and illustrated. A hybrid taxon sometimes occurs in areas where the two species are sympatric. The history and typification of the name *D. pubescens* and its synonyms is discussed and clarified.

**Keywords:** Taxonomy, nomenclature, pre-1958 holotype, Rhamnaceae, Colletieae, *Discaria*, South America, Australia, New South Wales, Queensland, Tasmania, Victoria

### Introduction

The tribe Colletieae Reiss. ex Endl. is comprised of 23 species in seven genera: *Adolphia* Meisn., *Colletia* Comm. ex A.Juss., *Discaria* Hook., *Kentrothamnus* Suss. & Overkott, *Ochetophila* Poepp. ex Endl., *Retanilla* (DC.) Brongn. and *Trevoa* Miers ex Hook. The maximal species diversity of the tribe is found south of 30° S and most of the distributions are loosely associated with the Andes in South America, but the tribe also includes a genus of Gondwanan distribution, *Discaria*, with members found in South America, Australia and New Zealand.

The circumscription of Colletieae has never been disputed. Decussate leaves, abundance of spines, and presence of serial meristems in the leaf axils have traditionally been the diagnostic characters of the tribe (e.g. Miers 1860; Suessenguth 1953; Medan & Schirarend 2004). All species of the tribe exhibit the ability to form root nodules and fix nitrogen in symbiosis with *Frankia bacteria*, a feature that is also present in the genus *Ceanothus* L. in Rhamnaceae (Medan & Tortosa 1976, 1981; Rundel & Neel 1978; Clawson *et al.* 1998; Ganguli & Kennedy 2013).

Colletieae is one of the best studied tribes in Rhamnaceae; all genera of the tribe have been revised (Johnston 1973; Tortosa 1983b, 1989, 1992, 1993; Kellermann *et al.* 2005). The morphology of its taxa is well known and reproductive biology, pollination, flower structure and ultramorphology has been studied extensively (e.g. Medan 1985, 1986; Medan & Aagesen 1995; Tortosa *et al.* 1996; Aagesen 1999 and references

therein; Gotelli *et al.* 2012a, 2012b, 2020; Medan & Devoto 2017 and references therein).

Monophyly has been corroborated by a morphological analysis of the tribe (Aagesen 1999), by molecular analyses at family level (Richardson *et al.* 2000; Hauenschild *et al.* 2016, 2018), by analyses of nearly all species of the tribe combining morphology with *trnL-F* sequence data (Aagesen *et al.* 2005) and of *trnL-F* data alone (Kalwij *et al.* 2019). According to Kalwij *et al.* (2019) and Hauenschild *et al.* (2018), the Colletieae clade has a trichotomy at its base, consisting of *Kentrothamnus* and two main clades. The first clade contains *Trevoa* and *Retanilla*. The second clade combines *Adolphia*, *Discaria*, *Colletia* and *Ochetophila*. Until recently, species of *Ochetophila* were included in *Discaria* (Tortosa 1983b; Aagesen 1999), but after Aagesen *et al.* (2005) reported that this renders *Discaria* polyphyletic, the genus *Ochetophila* was reinstated by Kellermann *et al.* (2005).

*Discaria* is now a genus of six species, three of which are found outside South America. *Discaria pubescens* (Brongn.) Druce occurs from Queensland to Victoria and in Tasmania, mainly on the tablelands and at higher altitudes; *Discaria nitida* Tortosa is a rare species known from a few localities in New South Wales and Victoria (Curtis 1956; Walsh & Udovicic 1999; Harden 2000). *Discaria toumatou* Raoul, occurs in New Zealand, where it is most common on the South Island; it has also been recorded on the Chatham Islands (Allan 1961).

Keogh & Bannister (1993) concluded that trans-oceanic dispersal seems highly improbable in the genus, which suggests that the amphiantarctic disjunction

of *Discaria* may be as old as the separation of South America-Antarctica from Australia-New Zealand, i.e. well over 30 million years old (Hinojosa & Vallagrán 1997; McLoughlin 2001). Richardson *et al.* (2004), however, estimate the age of the Colletieae clade to be only  $14.6 \pm 3.0$  MYA, when analysing *rbcl* and *trnL-F* sequence data, but the results of this analysis have also been considered to be a considerable under-estimation (Ladiges *et al.* 2005). Recently, van Santen & Linder (2020) estimate the split between Pomaderreae and Colletieae to be 42.9 MYA using eight chloroplast and nuclear regions, however the confidence intervals in their phylogeny are quite large and *Adolphia* groups with the unrelated Pomaderreae, hence an estimate for the tribe Colletieae cannot be ascertained.

The ecology and distribution of the Australian species have been described for *D. pubescens* in Victoria (Willis 1955; Hall & Parsons 1987; Lunt 1987) and Tasmania (Coates 1991). Wright & Briggs (2000) examined populations of *D. nana* in N.S.W. *Discaria toumatou* has been investigated extensively regarding its breeding system (Primack & Lloyd 1980), seed morphology and dispersal mechanisms (Keogh & Bannister 1993, 1994), structure of root-nodules (Newcomb & Pankhurst 1982) and spine morphology and development (Cockayne 1905, 1922).

*Discaria* including *Ochetophila* has been revised by Tortosa (1983b), who only had access to a limited amount of Australian material. Since then, more collections have become available, enabling us to present an up-dated account of *Discaria* in preparation for the forthcoming *Flora of Australia* treatment of the family.

## Taxonomy

### Rhamnaceae trib. Colletieae Reissek ex Endl.

*Gen. Pl.* 1099 (1840). — **Type:** *Colletia* Comm. ex Juss.

Armed *shrubs* or small trees, usually with opposite-decussate cladodes and reduced leaves; actinorhizal root nodules present. *Fruit* a papery nut, fleshy drupe or (in Australia) capsular, exploding at maturity to disperse the seeds leaving a disc-like hypanthium torus.

**Size & Distribution:** Seven genera with 20 species, mainly distributed in extra-tropical South and Central America: *Adolphia* Meisn. (1 sp.), *Colletia* Comm. ex A.Juss. (5 spp.), *Discaria* Hook. (6 spp.), *Kentrothamnus* Suess. & Overkott (1 sp.), *Ochetophila* Poepp. ex Endl. (2 spp.), *Retanilla* (DC.) Brongn. (4 spp.) and *Trevoa* Miers ex Hook. (1 spp.).

*Adolphia* spreads to southern North America. *Discaria* extends to New Zealand and Australia. One species, *O. nana* (Clos) Kellermann, Medan & Aagesen, has been dispersed to subantarctic Marion Island by vagrant birds (Kalwij *et al.* 2019).

### *Discaria* Hook.

*Bot. Misc.* 1: 156 (1829). — *Discaria* sect. *Pentapasma* Endl., *Gen. Pl.* 1: 1099 (1840), *nom. inval.* (= sect. *Discaria*). — *Discaria* Hook. sect. *Discaria*: Rchb., *Deut. Bot. Herb.-Buch* 144 (1841); Suess., *Mitt. Bot. Staatssamml. München* 1(8): 355 (1953). — **Type:** *Discaria americana* Gillies & Hook., *fide* Pfeiff., *Nomencl. Bot.* 1: 1108 (1874).

*Tetrapasma* G.Don, *Gen. Hist.* 2: 22, 40 (1832). — *Discaria* sect. *Tetrapasma* (G.Don) Reissek ex Endl., *Gen. Pl.* 1: 1099 (1840). — *Tetrasperma* Steud., *Nomencl. Bot. ed. 2*, 2: 673 (1841), *orth. var.* — *Tetraspora* Hook., *Fl. Tasman.* 1: 69 (1855), *orth. var.*, non Link ex Desv., *Observ. Pl. Angers* 17 (1818). — **Type:** *Tetrapasma juncea* G.Don (by monotypy).

*Solenantha* G.Don, *Gen. Hist.* 2: 22, 39 (1832). — **Type:** *Solenantha spinosa* G.Don (by monotypy).

×*Notophaena* Miers, *Ann. Mag. Nat. Hist. ser. 3*, 5: 267 (1860). — *Discaria* sect. *Notophaena* (Miers) Suess., *Mitt. Bot. Staatssamml. München* 1(8): 355 (1953). — **Type:** *Colletia* ×*serratifolia* Vent. ≡ *Notophaena* ×*serratifolia* (Vent.) Miers ≡ *Discaria* ×*serratifolia* (Vent.) Benth. & Hook.f. ex Mast. = *Discaria chacaye* (G.Don) Tortosa × *D. articulata* (Phil.) Miers.

Evergreen or semideciduous *shrubs*, usually with spinescent short shoots. *Leaves* opposite, petiolate; stipules triangular, connate behind the petiole, persistent. *Flowers* bisexual, 4–5-merous, white or cream, in axillary clusters of up to 50 flowers. *Hypanthium* shortly tubular. *Sepals* erect to recurved, caducous. *Petals* cucullate, not clawed, incurved or erect, or absent. *Stamens* shorter than or subequal to petals, incurved or erect. *Disc* conspicuous, lining the hypanthium or forming a sinuous ring around the ovary, smooth, glabrous. *Ovary* half-inferior; carpels 3 (or 4); style entire or branched, glabrous. *Fruit* brown, a globular capsule; torus basal. Seed brown.

**Typification of ×*Notophaena*.** When Miers (1860) described *Notophaena*, he included eight species and stated that “[T]he type of the genus is the *Colletia serratifolia* by Ventenat”. Of these eight names, four are now synonyms of *D. chacaye* (G.Don) Tortosa, *N. tomentosa* (Phil.) Miers is a synonym of *Colletia hystrix* Clos and one is still accepted, but in *Discaria*: the new Zealand *D. toumatou*. Two other taxa have shown to be of hybrid origin (Tortosa 1983a), including the type, *C. serratifolia*. As such, this synonym of *Discaria* is listed here as a nothogenus, ×*Notophaena*.

**Size & distribution.** A genus of six species, mostly in extra-tropical South America, with one species in New Zealand and two in south-eastern Australia.

**Notes.** *Discaria* is notable for usually having two meristems in the axil of each leaf. The distal meristem usually develops into a spiny branch, whilst the proximal meristem develops into a short shoot that bears leaves and flowers (see Tortosa *et al.* 1996 for detailed discussion). Both Australian species are

**Key to species of *Discaria* in Australia**

1. Spines (15–) 25–70 mm long; leaves usually caducous; petals present; style entire or minutely lobed . . . . . **1. *D. pubescens***
- 1: Spines 5–15 (–18) mm long; leaves usually persistent; petals absent; style branched. . . . . **2. *D. nitida***

uncommon and many declining populations are threatened by agricultural clearing and grazing.

The basic chromosome number of most Colletieae, including the New Zealand *D. toumatou* is  $x=11$  (Dawson 2000; Medan & Schirarend 2004). No chromosome counts have been published for the Australian species.

**Etymology.** Derived from the Greek δίσκος (discos), in reference to the disc-like hypanthium base remaining after the capsule has dehisced.

**1. *Discaria pubescens* (Brongn.) Druce**

*Bot. Soc. Exch. Club Brit. Isles Rep.* 1916, *Suppl.* 2: 620 (1917). — *Colletia pubescens* Brongn., *Mém. Fam. Rhamnées* 59 (1826). — *Discaria australis* Hook., *Bot. Misc.* 1: 157, t. 45 (1829), *nom. illeg.* — *Discaria pubescens* (Brongn.) Domin, *Biblioth. Bot.* 89: 919 (1927), *isonym.* — **Type citation:** “Novâ Hollandiâ, ad Cox flumen, ad septentrionem Bathurstii. (V. in herb Hooker.)”. **Holotype:** “Genus allied to *Colletia*, Cox’ River, Macquarie do + Country North of Bathurst”, [*A. Cunningham 70 (10<sup>th</sup> despatch*)] (multi-sheet type: K000356670, ex Herb. Hook., annotated by M.C. Johnston as “Holotype”; K00356707, specimen in middle and on the left, ex Herb. Hook., annotated “*Colletia pubescens* Brongn. – from thi[s] his description was made W. J. H.[ooker]”; Fig. 2). **Possible isotypes:** Cox’s River, New South Wales, Oct. 1822, *A. Cunningham 70 (10<sup>th</sup> despatch)* (K000356667, photo seen, donated to K by R. Heward in 1862; cited as “holótipo” by Tortosa, *Bol. Soc. Argent. Bot.* 22: 317 (1983), as “Kew Negative 13460”); “specm. with leaves (Oct. 1822 list)”, *A. Cunningham 70 (10<sup>th</sup> despatch)* (MEL56191).

*Solantha spinosa* G.Don, *Gen. Hist.* 2: 39 (1832). — *Cryptandra spinosa* G.Don, *Gen. Hist.* 2: 39 (1832), *nom. inval., pro syn.* — *Cryptandra spinosa* (G.Don.) Steudel, *Nomencl. Bot. ed.* 2, 1: 449 (1840). — **Type citation:** “Native of New Holland, on rocky hills, Cox’s River.” **Lectotype (here designated):** “Genus allied to *Colletia*, Cox’ River, Macquarie do + Country North of Bathurst”, [*A. Cunningham 70 (10<sup>th</sup> despatch*)] (multi-sheet type: K000356670 & K00356707).

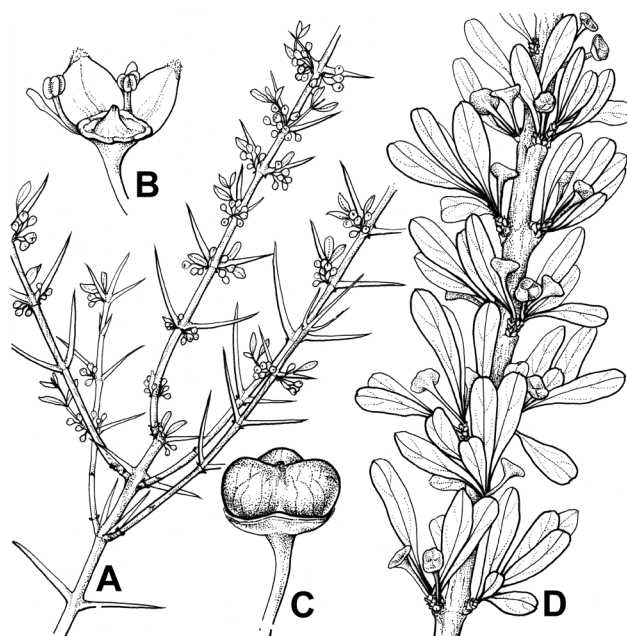
*Tetrasperma juncea* G.Don, *Gen. Hist.* 2: 40 (1832). — *Tetrasperma juncea* Steudel, *Nomencl. Bot. ed.* 2, 2: 673 (1841), *orth. var.* (in error for *Tetrasperma*). — *Tetraspora juncea* Hook., *Fl. Tasman.* 1: 69 (1855), *orth. var.* (in error for *Tetrasperma*). — **Type citation:** “Native of New Holland, at Cox’s River, Bathurst, and on the banks of the Macquarie.” **Lectotype (here designated):** “specm. with leaves (Oct. 1822 list)”, *A. Cunningham 70 (10<sup>th</sup> despatch)* (MEL56191). **Isolectotype:** Cox’s River, New South Wales, Oct. 1822, *A. Cunningham 70 (10<sup>th</sup> despatch)* (K000356667, photo seen, donated to K by R. Heward in 1862).

*Colletia cunninghamii* Fenzl in Endl. *et al.*, *Enum. Pl.* 23 (1837). — **Type citation:** “New South Wales, in collibus ad Hunters River, (Cunningham.)”.

**Lectotype (here designated) or perhaps holotype:** New South Wales ad Hunters River, *A. Cunningham s.n.* (W0002220, photo seen, left hand specimen).

*Pomaderris oxyphylla* Fenzl in Endl. *et al.*, *Enum. Pl.* 23 (1837), *nom. inval., pro syn.*

Semideciduous *shrub* 0.3–2.4 m high, with glabrous or sparsely pubescent young stems; spines (15–) 25–70 mm long. *Leaves* caducous, concolorous or distinctly discolorous; stipules 0.8–2 mm long; petiole 0.5–2 mm long; lamina ovate, oblong to obovate, 3–6.5 (–12) mm long, 1–2.6 (–5.5) mm wide, base narrowly cuneate to cuneate, entire or serrulate, apex emarginate, apiculate or tridentate, venation obscure. *Inflorescence* of up to 50 flowers; bracts persistent, 0.5–0.7 mm long. *Pedicels* 2–5 (–7.5) mm long. *Hypanthium* tube 0.5–0.8 mm long, 1.8–2.7 mm diameter. *Sepals* 1.1–1.6 mm long. *Petals* 0.7–1.2 mm long. *Stamens* 0.6–1.1 mm long. *Disc* lining the base of the hypanthium tube around the ovary, slightly sinuate. *Style* 0.5–1 mm long, entire (rarely minutely lobed). *Fruit* 2.6–4 mm long. *Seed* 2.2–3 mm long. **Fig. 1A–C.**



**Fig. 1. A–C *Discaria pubescens*:** **A** flowering branch  $\times 0.5$ . **B** half flower  $\times 6$ . **C** fruit  $\times 3$ . **D *Discaria nitida*,** branch with remnant pedicels, after fruits have fallen  $\times 1$ . — A A.C. Beaglehole 34884 (MEL0544194), B J.H. Willis s.n. (MEL2254026), C D. Parkes EG 93 (MEL1543486), D A.N. Rodd 5359 (MEL1581796). Illustration by Mali Moir, first published in *Flora of Victoria* 4: 84, Fig. 14 (1999). Reproduced with permission from the Royal Botanic Gardens Victoria.



**Illustrations:** W.R. Hooker, *Bot. Misc.* 1: pl. 45 (1829), flower only, as *D. australis*; R.D. Tortosa, *Bol. Soc. Argent. Bot.* 22: 330, fig. 7A–C (1983); T.D. Stanley & E.M. Ross, *Fl. south-eastern Queensl.* 2: 49, fig. 6D (1986); N.T. Burbidge & M. Gray, *Fl. A.C.T.* 253, fig. 250 (1970); G.J. Harden, *Fl. New S. Wales.* 1: 373 (1990); F. Coates, *Conserv. Ecol. Managem. Five Rare Spp. Rhamnaceae* 68, fig. 9.1 (1991); N.G. Walsh in N.G. Walsh & T.J. Entwistle, *Fl. Victoria* 4: 84, fig. 14a (1999).

**Nomenclatural history.** Cunningham (1825) first described specimens of *D. pubescens* from plants he collected in Oct.–Dec. 1822 between Sydney and Bathurst. But he assumed that he dealt with two taxa, namely “80. Rhamneae. A genus related to *Colletia*” and “81. Rhamneae. Another genus of this order related to *Colletia*”. He based his no. 80 on specimens with 5-merous flowers and leaves, whereas no. 81 had 4-merous flowers and was leafless, i.e. only had spiny green stems. Specimens of *D. pubescens* from this collecting trip were sent to Kew as no. 70 in his 10<sup>th</sup> despatch of specimens (Orchard & Orchard 2020). While Cunningham used his 1822 collection for the publication, he certainly would have also had access to specimens collected a few years earlier from the

Macquarie River, in 1817, which were sent to Kew as no. 389 (2<sup>nd</sup> despatch). Both lots of specimens were also accompanied by annotated lists, in which he described the specimens (Tab. 1).

Brongniart visited Britain during the completion of his *Mémoire sur la famille des Rhamnées* to examine original specimens in the herbaria of Banks, Lambert and Hooker. He describes *Colletia pubescens* from material in Hooker’s herbarium, who then resided in Glasgow, stating that leaves are rarely present and that the species has both, 4- and 5-merous flowers (Brongniart 1826; Tab. 1). It is curious that he did not seem to have examined material of the species collected by Robert Brown in Tasmania, which would have been present in Banks’ herbarium.

Hooker (1829) erected the genus *Discaria* and published the illegitimate name *D. australis* for the same species, not using Brongniart’s epithet, because he thought that “the name *pubescens* is scarcely applicable, for in general, the stems, branches, and thorns are quite glabrous” (Hooker 1829: 157). This name was in use until the early 20<sup>th</sup> century, when Druce (1917) finally transferred *Colletia pubescens* to *Discaria*, using the correct epithet.

**Table 1.** Comparison of the publications of Cunningham, Brongniart, Hooker and Don on *Discaria pubescens* with Cunningham’s notes accompanying his collections. Extracts from Cunningham’s annotated list of specimens sent to Joseph Banks and W.T. Aiton from Orchard & Orchard (2020).

Cunningham’s Lists	Cunningham (1825)	Brongniart (1826)	Hooker (1829)	Don (1832)
<b>10<sup>th</sup> despatch, no. 70 [1822 collection].</b>  Rhamneae related to <i>Colletia</i> . Perianthium monophyllum quadrifidum. Cor. 0, squamae 4 cucullatis inter segmenta perianthia. Antherae 2-locularis subsingulis squamis, stigma 3-lobatum 3-loculare. An erect shrubby plant (at this season) without leaves, with brachiate strong thorns beneath which precedes clusters of flowers, Cox’ River, 9 Oct., Macquarie River and Country north of Bathurst, Dec.	80. RHAMNEÆ. A genus related to <i>Colletia</i> .  <i>Calyx</i> quinquefidus persistans. <i>Corolla</i> 5-petala in tubum conniventia decidua. <i>Antherae</i> 5, biloculares subsingulis squamis insertae. <i>Germen</i> bilobum. <i>Frutex</i> rigidus ramosus spinescens, folia oblongo-lanceolata pauci serrata sparsa et fasciculata, flores axillares et laterales. Rocky hills. Cox’s River.	COLLETIA. Kunth. – COLLETIAE spec. Vent. Decand. [...]  4. COLLETIA PUBESCENS, ramis subaphyllis, pubescentibus; ramulis simplicibus, spinescentibus; foliis raris, oppositis, obovatis, minutis, integerrimis, pubescentibus. Flores axillares, racemose; racemis brevibus, multifloris, infra spinas nascentibus.  <i>Calyx</i> urceolato-campanulatus, 4–5-fidus. <i>Petala</i> parva, linearia, convolute; <i>Antherae</i> ovatae, bioculares. <i>Discus</i> cupularis, margine integro. <i>Stylus</i> brevis.	DISCARIA [...]  <i>Calyx</i> brevi-campanulatus, 4–5 fidus, coloratus. <i>Petala</i> 4–5 staminibus minora. <i>Antherae</i> biloculares, longitudinaliter dehiscentes. <i>Discus</i> basin germinis cingens, pateriformis, carnosus, margine angusto elevato, libero, subintegro. <i>Germen</i> superum. <i>Stylus</i> brevis. <i>Stigma</i> trilobum. [...]  To this genus must unquestionably be referred the <i>Colletia pubescens</i> * of Brongniart [...].  * This plant, a native of Cox’s River at Bathurst, and the banks of the Macquarie, New Holland, is described by Mr. Allan Cunningham [...] in Mr. Barron Field’s Memoirs on New South Wales, p. 352, n.fl., as “a second new genus of the order <i>Rhamneae</i> , and related to <i>Colletia</i> ”. [...]	XXI. SOLENANTHA [...]  <i>Calyx</i> permanent, 5-cleft. Petals 5, conniving into a tube, deciduous. Disk? Anthers 5, 2-celled, each inserted under a scale. Ovary 2-lobed. – A stiff-branched spiny shrub with oblong-lanceolate, somewhat serrated leaves, scattered and in fascicles. Flowers axillary and lateral, white.  1 S. SPINOSA. f. G. Native of New Holland, on rocky hills, Cox’s River.  <i>Spiny Solenantha</i> . Fl. Ap. Ju. Clt. 1826. Shrub 1 to 2 feet.
	<b>2<sup>nd</sup> despatch, no. 389 [1817 collection].</b>  <i>Frutex</i> rigida, spinis oppositis. Gullies and rocky descent near Macquarie River, 27 Aug’.	81. RHAMNEÆ. Another genus of this order related to <i>Colletia</i> .  <i>Calyx</i> s. <i>Perianthium</i> monophyllum quadrifidum. <i>Corolla</i> o. s. squamae 4-cucullatae inter segmenta perianthii. <i>Antherae</i> 2-loculares, subsingulis squamis. <i>Stigma</i> 3-lobatum. <i>Germen</i> 3-loculare. A junceous shrubby plant, with brachiate strong thorns. Cox’s River. Bathurst—on the banks of the Macquarie.	Hab. In Nová Hollandiâ, ad Cox flumen, ad septentrionem Bathurstii. (V. in herb. Hooker.)	Discaria <i>australis</i> ; calyce 4-fido, segmentis erectis.

Domin (1927) republished that combination, because he was apparently unaware of Druce's paper.

In addition to accepting *Discaria* and the species *D. australis* (i.e. *D. pubescens*), George Don (1832) also created two new genera for Cunningham's (1825) taxa, describing no. 80 as *Solenantha spinosa* and no. 81 as *Tetrapasma juncea*. Don does not seem to have examined specimens, he only recycled Cunningham's written Latin descriptions and translated them into English. However, all three species, *Discaria australis*, *Solenantha spinosa* and *Tetrapasma juncea* are based on the same specimens (Tab. 1).

While Brongniart and Don do not mention the collector, it is very clear after examining Hooker's herbarium at K, that specimens from north of Bathurst and the Cox and Macquarie Rivers were collected by Cunningham.

*Cryptandra spinosa* is a name that was first mentioned by Don (1832) in synonymy with *Solenantha spinosa* and attributed to Cunningham. However, Cunningham never published that name and it is an invention of Don that was later also republished by Steudel (1840). The name *Tetrapasma* was mis-spelt as *Tetrasperma* and *Tetraspora* by Steudel (1840) and Hooker (1855), respectively.

**Typification of *Colletia pubescens*.** The type at K was cut into two halves, which were then mounted on separate sheets: the left half of the sheet (Fig. 2A) contains one branch with an original label in Cunningham's hand (branch A<sub>1</sub>: K000356670), a pencil drawing by Hooker of the flower is also attached; the right half of the sheet (Fig. 2B) contains three branches: the left and middle branch (B<sub>1</sub> and B<sub>2</sub>) are very similar and belong to one collection without collection details (K000356707), the right branch (B<sub>3</sub>) is of a later collection from Tasmania (K000356708).

When the two halves of the sheets are united (Fig. 2C), then it becomes clear that the three branches A<sub>1</sub>, B<sub>1</sub> and B<sub>2</sub> are very similar and seem to belong to one gathering, whereas branch B<sub>3</sub>, with its own label, is slightly different: it has more leaves and very densely packed flowers, which are a slightly lighter colour. Assuming that branches A<sub>1</sub>, B<sub>1</sub> and B<sub>2</sub> are from the same gathering, then the absence of a label and collecting information for branches B<sub>1</sub> and B<sub>2</sub> also makes sense.

The collecting information is on Cunningham's handwritten label attached to branch A<sub>1</sub>, namely "Cox' River, Macquarie do + Country North of Bathurst". This is the same information given in Brongniart's account of *Colletia pubescens*, in particular the statement "north of Bathurst" ("ad septentrionem Bathurstii"; Brongniart 1826, see also Table 1) is not repeated on any other label.

McNeill (2014) and Mosyakin *et al.* (2019) discuss the typification of names that were published before the

adoption of the type-method. Names published before 1958 did not require that a type specimen was indicated in the protologue, and usually all gatherings cited by the author, and any duplicates of these gatherings, are regarded to be syntypes and isosyntypes. However, when it can be shown that an author only used one particular specimen "when preparing the account of a new taxon" then this specimen can be seen to be the holotype (Art. 9.1. & Art. 9 Note 1; Turland *et al.* 2018; see also Turland *et al.* 2020), in particular, if the author stated that he examined a gathering from one particular herbarium, and if there is only one specimen of that gathering present in that herbarium (Mosyakin *et al.* 2019).

We regard the combined sheet (Fig. 2C) to be a rare example of a pre-1958 holotype, for the following reasons:

- Brongniart (1826) stated in the protologue that he described the species from material in "Herb. Hooker". Hooker (1829: 151) reiterated this and stated that Brongniart described "*C. pubescens*, a New Holland one [i.e. species] from my Herbarium".

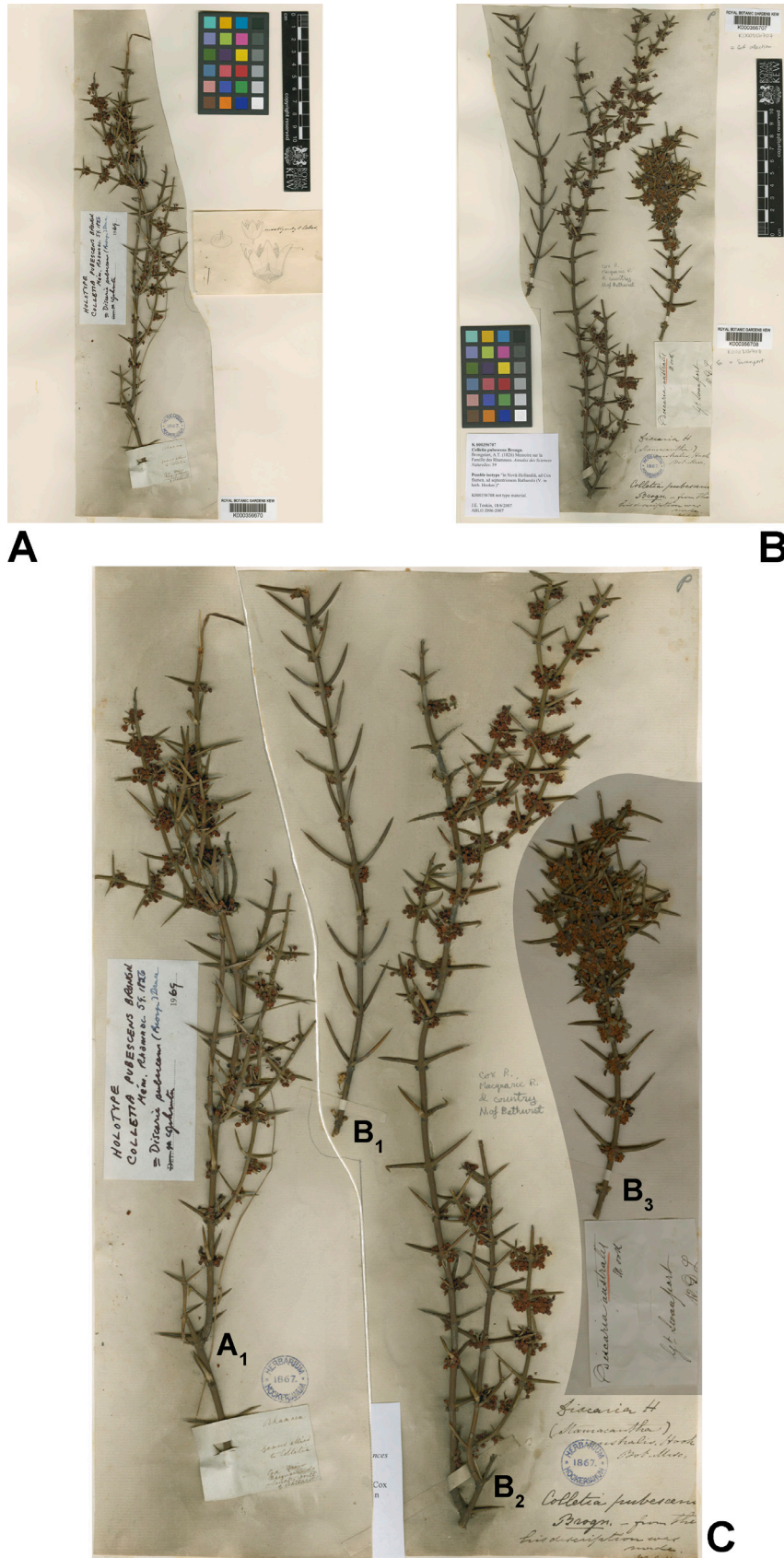
Later, when Hooker's herbarium was incorporated into the K collection in 1867, all specimens received a circular "Herbarium Hookerianum" stamp and can so be identified (Orchard & Orchard 2013). The branches on the combined holotype specimens have such a round stamp, and the original label agrees with the location given in the protologue.

- The combined holotype sheet is annotated in the bottom corner with "*Colletia pubescens* Brogn. – from thi[s] his description was made" with the cut-off and barely legible initials "W.J.H.", i.e. W.J. Hooker indicated that this was the very sheet that Brongniart examined when drafting the description of *Colletia pubescens*.

The detailed pencil drawing of the flower has the note "mostly only 5 lobes" in Hooker's hand, which is consistent with the description by Brongniart (1826) of the flowers being 4–5-merous.

- Orchard & Orchard (2020) identified K000356670 and K00356707 to be part of the gathering *A. Cunningham 70*, which was sent by Cunningham to London in his 10<sup>th</sup> despatch of specimens in March 1823. The only other sheet of the species in Hooker's herbarium is annotated "Frutex rigida, M.R. [Macquarie River]", i.e. has a different location than given in the protologue, and is from another gathering, namely *A. Cunningham 389* (2<sup>nd</sup> despatch) (Orchard & Orchard 2020). Hence the combined type sheet is the only type specimen in the Hooker Herbarium.

Cunningham's collections were sent to Hooker in Glasgow by his brother Richard Cunningham (London) and also by Charles Telfair. For example, specimens from north of Bathurst were sent to Hooker on 22 Oct. 1824, others from around Sydney later on (Orchard 2014). This means



**Fig. 2.** Holotype of *Colletia pubescens* Brongn., collected by Allan Cunningham and stored in the Hooker Herbarium at the Royal Botanic Gardens, Kew. **A** Sheet with the left hand part of the type (K000356670), with field collecting label around stem: "Genus allied to *Colletia*, Cox' River, Macquarie do + Country North of Bathurst". **B** Sheet containing the right hand part of the type (K000356707) and an unrelated specimen (K000356708), labelled at bottom of sheet with: "*Colletia pubescens* Brongn. - from thi[s] his description was made W. J. H. [ooker]". **C** Composite image, combining the two type sheets along the cutting line; the holotype collection consists of branches A<sub>1</sub>, B<sub>1</sub> and B<sub>2</sub>. The unrelated specimen B<sub>3</sub> which was not collected by Cunningham is shaded. — Images copyright of the Board of Trustees of the Royal Botanic Gardens, Kew.



that specimens from that location were present in Hooker's herbarium when Brongniart visited him, presumably either late in 1825 or early in 1826.

As the holotype was later cut and mounted on two sheets (K000356670 & K00356707; Fig. 2), both sheets are part of the type collection, i.e. it is a multi-sheet type (Art. 8.3; Turland *et al.* 2018).

Specimens labelled as *Cunningham 70* are accepted as possible isotypes, but a *Cunningham 70* collection from "South of Bathurst" is not regarded to be type material, as the location does not agree with the protologue. Specimens without collecting number or date are also excluded from the type series (see below).

Tortosa (1983b) stated in error that he had seen "una fotografía del holótipo: New South Wales, Cox's River, A Cunningham 70, Oct. 1822 (Kew negative n° 13460)" (the collection now has the barcode K000356667). As there is a holotype for the name *Colletia pubescens*, this does not constitute inadvertent lectotypification (according to Art. 9.10; Turland *et al.* 2018). Tortosa was simply not sent photographs of all Cunningham collections at K and assumed that the specimen was the holotype, but in fact, it is one of the possible isotype specimens of the name. That collection was donated to Kew by Robert Heward in 1862 from the estate of Allan Cunningham, i.e. it was from Cunningham's own herbarium (Orchard 2014) and not present in Hooker's herbarium when Brongniart examined specimens.

**Notes on *Solenanthes spinosa* and *Tetrapasma juncea*.** Don (1832) cites "Cryptandra spinosa, Cuning. In Field's new south wales, p. 352" in synonymy of his *Solenanthes spinosa*. However, Cunningham (1825) only lists the taxon [his no. 80] as "A genus related to *Colletia*". For *Tetrapasma juncea*, Don does not cite any previously published names in synonymy, even though Cunningham (1825) described a second taxon [his no. 81] as "Another genus of this order related to *Colletia*". Comparing the two publications (Tab. 1), it is clear that Don (1832) simply translated the Latin descriptions of Cunningham (1825): both species are based on Cunningham's collections from 1822, which he used to prepare his enumeration of plants from the Blue Mountains. This means that the specimens of *Cunningham 70* (10<sup>th</sup> collection) are syntypes of these two names.

A specimen at MEL that has only 4-merous flowers is designated as lectotype of *Tetrapasma juncea*; an isolectotype at K also seems to have mainly 4-merous flowers, but we could not examine the actual specimen, only photographs. According to the protologue, *Solenanthes spinosa* has 5 sepals and petals: the specimen of *Cunningham 70* that has mostly 5-merous flowers is the combined type-sheet mentioned above (Fig. 2), i.e. also the holotype of *Discaria pubescens*. This specimen is here designated as lectotype of *Solenanthes spinosa*.

**Notes on *Colletia cunninghamii* and *Pomaderris oxyphylla*.** Fenzl's *Colletia cunninghamii* was described from a Cunningham collection from Hunter's River, which is preserved at W. The only specimen found that was annotated with that name is accepted as holotype, but, since Cunningham collections are available in many herbaria and it is possible that a duplicate is extant elsewhere, the advice of McNeill (2014) is followed here and this specimen is simultaneously designated as lectotype. As Cunningham had not explored the Hunter River in New South Wales in the period covered by Orchard & Orchard (2020), the specimen is probably from his 1825 expedition (A.E. Orchard, pers. comm.).

When describing *Colletia cunninghamii*, Fenzl (1837) also cites the name "*Pomaderris oxyphylla* Cunningham msc." in synonymy, but this must have been done in error. It seems that the synonyms of *C. cunninghamii* and the following species, *Cryptandra buxifolia* Fenzl [now *Spyridium buxifolium* (Fenzl) K.R.Thiele], have been mixed up. All specimens seen that were annotated by Cunningham with his manuscript name *P. oxyphylla* are of *Spyridium buxifolium*, which is the next species treated by Fenzl in his overview of Australian Rhamnaceae. The synonym mentioned under *Cryptandra buxifolia*, however, is "*Discaria australis* Cunn. msc. non Hook."; this would be the correct synonym for *C. cunninghamii*.

**Distribution & habitat.** Occurs on the Central Plateau and Midlands (Tas.), Ballarat district and eastern ranges (Vic.), N.S.W. tablelands to the Darling Downs district of southern Qld; in heathland, shrubland, or woodland, often in shallow rocky soils derived from granite, limestone or basalt, at 450–1450 m altitude.

**Phenology.** Flowers (Aug.–) Oct.–Jan.; fruits Oct.–Mar.

**Conservation status.** The species is listed as 'near threatened' in Queensland (*Nature Conservation Act 1992*) and as 'endangered' in Victoria (*Flora and Fauna Guarantee Act 1988*; Humphries 2003) and Tasmania (*Threatened Species Protection Act 1995*; TSS 2012).

**Common name.** Australian anchor plant.

**Specimens examined** (c. 160 seen)

QUEENSLAND. 7.7 km along Branch Road, nr Maryvale, alt. 550 m, 4 Oct. 1996, *A.R. Bean 10835* (BRI, HO, MEL, NSW); Property of H. Hall, Swan Ck Road, E of Warwick, alt. 625 m, 5 Oct. 1996, *A.R. Bean 10946* (MEL; CANB, NSW, BRI, *n.v.*).

NEW SOUTH WALES. Apsley R., East Lynne Road, SE of Walcha, alt. 1015 m, 25 Dec. 2006, *A.R. Bean 25920* (NSW); Mt Kaputar National Park (N.P.), The Governor Lookout, alt. 1432 m, 16 Nov. 2000, *J.J. Bruhl 1978 & I.R. Telford* (AD, NSW; CANB, NE, *n.v.*); Moredur Ck, 20.3 km SE of Jingha P.O., 13 Dec. 1986, *R. Coveny 12388, W. Bishop & L. Murray* (HO, MEL, NSW); Track to Clarke Gorge, Cave Ck, Coolamon Caves area, 44 km NNE of Kiarandra, alt. 1180 m, 26 Jan. 1997, *P.C. Jobson 4588* (MEL; NSW, *n.v.*); c. 50 m west of ANU Lodge building, Siding Spring

Anglo-Australian Observatory, alt. 1130 m, 17 Dec. 2007, *R.L. Johnstone 2324* (AD, NSW); c. 300 m downstream from Snowy Mtns Hwy bridge along Yarrangobilly R. (at bend in river), at Yarrangobilly Village, 24 Feb. 2009, *A.E. Orme 682* (NSW; CANB, *n.v.*); Kosciuszko N.P., first creek crossing below Blue Waterhole along tk to Clarkes Gorge, alt. 1190 m, 11 Dec. 2013, *N.G. Walsh 8065* (MEL).

AUSTRALIAN CAPITAL TERRITORY. Brindabella Ra., between Uriarra and Piccadilly Circus on Brindabella Road, 20 Nov. 1956, *H. Eichler 13278* (AD).

VICTORIA. 0.5 miles NW of junction of Benambra–Snowy River Road at Wulgulmerang, 7 Jan. 1970, *A.C. Beauglehole 33350* (MEL; NSW, *n.v.*); Cobungra, 1 km S of road and beside Victoria R., 19 Nov. 1973, *D.J. McGillivray 3191* (MEL, NSW); Alpine N.P., Snowy Ra., 10 m NE from the junction of Guys Hut Tk and Piemans Falls Tk, alt. 1430 m, 12 Feb. 2006, *V. Stajsic 4967* (MEL); MacFarlane Flat, on the true right bank of main ck flowing NW to Berrima R[iver], near NW end of open grassy plain, alt. 1000 m, 29 Dec. 1998, *R. Thomas 748* (MEL); Limestone Ck, Caves area c. 2.2 km due N from junction of Limestone Ck Track with Limestone Road (Black Mtn Road), alt. 960 m, 30 Nov. 1989, *N.G. Walsh 2866* (MEL).

TASMANIA. Waddamana Road, 12 Dec. 2003, *B. French s.n.* (HO539688); Grassy Hut Ck, S of Bothwell, 10 Nov. 1991, *L. Gilfedder 57* (HO); Shannon R., escarpment on S bank, 20 Dec. 1998, *A.M. Gray 856* (HO); 3 km S of Perth above the banks of the South Esk R., 14 Dec. 2001, *A.J. North & I. Riley s.n.* (HO522950); Bashan Road verges from 100 m S of Ouse River bridge for 3.6 km, 6 Mar. 2009, *M. Visoiu, J. Wood & N. Gill 610* (HO); Fordell Ck, NW of Bothwell, 13 July 2011, *M. Wapstra 1267* (HO).

### Other Cunningham collections

Specimens listed as “*n.v.*” are reported in Orchard & Orchard (2020).

NEW SOUTH WALES. Macquarie R., 1817, *A. Cunningham 389* (2<sup>nd</sup> despatch) (BM *n.v.*); Macquarie R., New South Wales, Aug. 1817, *A. Cunningham 389* (2<sup>nd</sup> despatch) (K000356668, photo seen, donated to K by R. Heward in 1862; cited as “sintipo” by Tortosa, *Bol. Soc. Argent. Bot.* 22: 317 (1983), as “Kew Negative 13460”); Macquarie R., N.S.Wales, Aug. 1817, *A. Cunningham 389* (2<sup>nd</sup> despatch) (MEL56184, sterile, annotated by Tortosa as “Isotypus a *D. australis* Hook”); “South of Bathurst, Colony”, 1822, *A. Cunningham 70* (10<sup>th</sup> despatch) (BM *n.v.*); “in the rocky bed of rivers”, N.S. Wales, Apr. [sic] 1817, *A. Cunningham s.n.* (CGE *n.v.*, ex Herb. Lindley; the month “Apr.” most likely a transcription error); “Frutex rigida, M.R. [Macquarie River]”, *A. Cunningham s.n.* (K *n.v.*, ex Herb. Hook.); New South Wales, *A. Cunningham s.n.* (P06887642, photo seen, ex MEL with a blue “Phytologic Museum of Melbourne” label; possibly separated from MEL56184 or MEL56191 and sent to Paris, labelled as “Reçu de 26 juillet 1906”); “147. Trevoa like”, “N<sup>cl</sup>. Hollande, Voyage de la Vénus, 1839”, *A. Cunningham s.n.* (P06887638, photo seen, ex Herb. Petit-Thouars).

## 2. *Discaria nitida* Tortosa

*Hickenia* 1: 109 (1977). — **Type citation:** “Australia: Victoria. Cobungra, about 3,000 ft. alt. (10 feet high, trunk 3” in diam.) H.B. Williamson, XII-1928 (MEL 56204).” **Holotype:** Spring Creek, Cobungra,

“spineless form / ten feet high / trunk 3” in diam.”, Dec. 1928, *H.B. Williamson s.n.* (MEL56204). **Isotypes:** BAA00004337 (photo seen, labelled as “clastotipo ex MEL”); MEL0236591 (formerly in Ref. Herb.); NSW 721829, *n.v.* **Possible Isotypes:** Spring Creek, Cobungra, “tall form / 10ft high stem / 6 ½ inches in circum.”, *H.B. Williamson s.n.* (MEL2103601); Cobungra, Dec. 1928, *H.B. Williamson s.n.* (MEL2103602).

*Discaria pubescens* auct. non (Brongn.) Druce: J.H. Willis, *Victorian Naturalist* 72: 51 (1955).

Evergreen or semideciduous shrub, 2.5–3 m high, with sparsely pubescent young stems; spines 5–15 (–18) mm long, rarely absent. *Leaves* persistent, ± concolorous; stipules 1–1.5 mm long; petiole 0.5–3.5 mm long; lamina narrowly obovate to obovate, (5–) 9–17 mm long, 2.2–5 (–7.3) mm wide; base narrowly cuneate; entire or serrulate; apex obtuse, emarginate or apiculate; venation clear (at least below). *Inflorescence* of up to 10 flowers; bracts persistent, c. 1.5 mm long. *Pedicels* 2.4–4 mm long. *Hypanthium* tube 1–1.1 mm long, 2–2.5 mm diameter. *Sepals* 1.4–2 mm long. *Petals* absent. *Stamens* 0.8–1.3 mm long. *Disc* forming a wide ring around the ovary, deeply scalloped between the staminal bases. *Style* 1–1.2 mm long, branched. *Fruit* 3–3.5 mm long. *Seed* 2.7–3 mm long. **Fig. 1D.**

**Illustrations:** R.D. Tortosa, *Hickenia* 1: 111, fig. 1 (1977); R.D. Tortosa, *Bol. Soc. Argent. Bot.* 22: 330, fig. 7G–I (1983); G.J. Harden, *Fl. New S. Wales.* 1: 373 (1990); N.G. Walsh in N.G. Walsh & T.J. Entwistle, *Fl. Victoria* 4: 84, fig. 14b (1999).

**Distribution & habitat.** Occurs from Cooleman Caves (N.S.W.) to Cobungra (Vic.); usually along watercourses in sandy or rocky soils, often in woodlands, particularly of black sallee (*Eucalyptus stellulata* Sieber ex DC.) or snow gum (*Eucalyptus pauciflora* Sieber ex Spreng.), at 915–1200 m altitude.

**Phenology.** Flowers Nov.–Jan.; fruits Jan.–Apr.

**Conservation status.** The species is listed as ‘vulnerable’ in New South Wales (*Biodiversity Conservation Act 2016*) and as ‘endangered’ in Victoria (*Flora and Fauna Guarantee Act 1988*).

**Common name.** Leafy anchor plant.

### Specimens examined

NEW SOUTH WALES. Blue Waterholes, Cooleman Caves area, 44 km NNE of Kiandra, alt. 1180 m, 26 Jan. 1997, *P.C. Jobson 4586* (NSW; CANB, MEL, *n.v.*); c. 350 m downstream from Snowy Mtns Hwy bridge along Yarrangobilly R., at Yarrangobilly Village, 24 Feb. 2009, *A.E. Orme 678* (NSW; CANB, MEL, *n.v.*); Alpine Ck fire Trail at Tantangara Ck crossing, approx. 9.4 km N of Snowy Mtns Hwy, alt. 1362 m, 7 Feb. 2017, *G.P. Phillips 274* (NSW); Snowy Mtns Hwy, Alpine Ck crossing, 14.2 km SE of Kiandra, *A.N. Rodd 5359* (MEL, NSW; PRC, *n.v.*); Kosciuszko N.P., Gulf Plain, c. 150 m above Murrumbidgee R., c. 500 m E from Tantangara Dam spillway, alt. 1200 m, 21 Nov. 2002, *N.G. Walsh 5676* (MEL); Thredbo



R., southern bank, c. 4.8 km downstream of Thredbo Alpine Village, 26 Nov. 2015, *G.T. Wright 377* (NSW; CANB, *n.v.*).

VICTORIA. Beside the Victoria R. about 1.5 km downstream from Malcolm Plain, Cobungra area, alt. 1315 m, 18 Feb. 2011, *J.A. Jeanes 2606* (MEL); Spring Ck, Cobungra, Jan. 1929, *H. Morgan 1* (MEL); Rocky sides of the Victoria R., May 2000, *K.C. Norris s.n.* (MEL2109146); Thredbo R., Kosciuszko N.P., 19 Nov. 1998, *G.T. Wright 71* (MEL).

### 3. *Discaria nitida* × *D. pubescens*

Wright & Briggs (2000) report hybrids between *D. pubescens* and *D. nitida* at several populations in New South Wales where both species occur. Hybrids have also been found in Victoria. They exhibit intermediate characteristics (e.g. in habit, height or leafiness) and usually have some flowers with ruminant petals inserted on or at the base of stamens.

Intra- and intergeneric hybrids are quite well-known in Colletieae and have been reported from South America (Tortosa 1983a, 1988; Medan *et al.* 2012).

### Specimens examined

NEW SOUTH WALES. Sawpit, Kosciusko N.P., 17 Dec. 1971, *A.M. Ashby 4437* (AD97304154 & AD97419255); 0.5 km downstream from Blue Waterholes on Cave Ck, alt. 1180 m, 19 Nov. 1997, *J.D. Briggs 2731* (NSW; CANB, *n.v.*); c. 300 m downstream from Snowy Mtns Hwy bridge along Yarrangobilly R. (at bend in river), at Yarrangobilly Village, 24 Feb. 2009, *A.E. Orme 681* & *E. Mills* (NSW); Sawpit Ck, approx. 200 m downstream from bridge that crosses Pillabo Tk, 5 Nov. 1998, *G.T. Wright 41* & *D.T. Woods* (MEL, NSW, CANB); Yarrangobilly R., 600 m downstream of bridge that crosses Snowy R., alt. 1005 m, 12 Nov. 1998, *G.T. Wright 69* (NSW; CANB, *n.v.*); Unnamed creek, 100 m W of the intersection of Nungar Ck and Alpine Ck fire trails, Boggy Plain, alt. 1360 m, 7 Jan. 2000, *G.T. Wright 141* (NSW; CANB, *n.v.*); Yarrangobilly R., 600 m downstream of bridge that crosses the Snowy Mtns Hwy, alt. 1005 m, 12 Nov. 1998, *G.T. Wright s.n.* (NSW509610).

VICTORIA. Spring Ck, Cobungra, Jan. 1929, *H. Morgan 2* (MEL).

### Acknowledgements

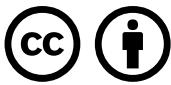
We thank Tony Orchard (Canberra) for advice on Cunningham's collections and Judy West (CANB) for examining the type of *Colletia cunninghamii* in Vienna. Brendan Lepschi, Anna Monro (both CANB) and Juliet Wege (PERTH) advised on nomenclature and typification. Llywela Williams (Adelaide) read through drafts of this manuscript. Andrew Thornhill (The University of Adelaide & AD) edited the paper. The project "A new phylogeny of the Australian Rhamnaceae, revision of *Cryptandra* and *Spyridium*, and completion of the *Flora of Australia* treatment of the family" is supported through funding from the Australian Government's Australian Biological Resources Study (ABRS) National Taxonomy Research Grant Programme. The line drawing was prepared by Mali Moir; the permission to reproduce the illustration by the Royal Botanic Gardens Victoria is gratefully acknowledged.

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