Volume 10 Number 2 2018

AUSTROBAILEYA

A Journal of Plant Systematics
and
Conservation Biology

Queensland Herbarium
Department of Environment and Science
Queensland
Government

Volume 10 Number 2 2018

AUSTROBAILEYA

A Journal of Plant Systematics
and
Conservation Biology

Queensland Herbarium

Department of Environment and Science

Queensland
Government

Austrobaileya

Vol. 1, No. 1 was published on 1 December 1977
Vol. 10, No. 1 was published on 18 December 2017 and is available online at
https://www.qld.gov.au/Austrobaileya
Back issues 1(1)– 8(4) are available on the JSTOR website
http://plants.jstor.org/

Austrobaileya is published once per year.

Exchange: This journal will be distributed on the basis of exchange.

Australian Subscribers: Orders for single issues and subscriptions may be placed. The price is (GST included): AUD$48.00 per issue for individuals, AUD$80.00 for institutions, including postage.

Overseas Subscribers: Orders for single issues and subscriptions may be placed. The price is AUD Price On Application per issue for individuals, AUD$100.00 for institutions, including postage.

All correspondence relating to exchange, subscriptions or contributions to this journal should be addressed to: The Editor, Austrobaileya, Queensland Herbarium, Department of Environment and Science (DES), Brisbane Botanic Gardens, Mt Coot-tha Road, Toowong, Queensland 4066, Australia. Email: Paul.Forster@des.qld.gov.au

ISSN 0155-4131

Web site: https://www.qld.gov.au/Austrobaileya

Austrobaileya is the journal of the Queensland Herbarium and publishes peer-reviewed research on plants, algae, fungi and lichens (systematics, morphology, geography, anatomy, karyology, conservation biology and botanical history), with special emphasis on taxa from Queensland.

Austrobaileya 10(2): 207–289 (2018)

Contents

A taxonomic revision of *Argophyllum* J.R.Forst. & G.Forst. (Argophyllaceae) in Australia

A.R. Bean & Paul I. Forster

Summary

Bean, A.R. & Forster, P.I. (2018). A taxonomic revision of *Argophyllum* J.R.Forst. & G.Forst. (Argophyllaceae) in Australia. ***Austrobaileya*** **10(2): 207–235.** The genus *Argophyllum* is taxonomically revised for Australia with eleven species recognised from Queensland and northeast New South Wales. All Australian species are endemic and seven new species are described: *A. curtum* A.R.Bean & P.I.Forst., *A. ferrugineum* A.R.Bean & P.I.Forst., *A. heterodontum* A.R.Bean & P.I.Forst., *A. iridescens* A.R.Bean & P.I.Forst., *A. jagonis* A.R.Bean & P.I.Forst., *A. loxotrichum* A.R.Bean & P.I.Forst. and *A. palumense* A.R.Bean & P.I.Forst. Lectotypes are chosen for *A. cryptophlebum* Zemann and *A. lejourdanii* F.Muell. All species are fully described and illustrated. Notes are provided on their distribution (including maps), habitat and proposed conservation status.

Key Words: Argophyllaceae, *Argophyllum cryptophlebum*, *Argophyllum curtum*, *Argophyllum ferrugineum*, *Argophyllum heterodontum*, *Argophyllum iridescens*, *Argophyllum jagonis*, *Argophyllum loxotrichum*, *Argophyllum nullumense*, *Argophyllum palumense*, *Argophyllum verae*, Australia flora, New South Wales flora, Queensland flora, new species, identification key, distribution maps, conservation status

A.R. Bean & P.I. Forster, Queensland Herbarium, Department of Environment & Science, Brisbane Botanic Gardens, Mt Coot-tha Road, Toowong, Queensland 4066, Australia. Email: tony.bean@des.qld.gov.au; paul.forster@des.qld.gov.au

Introduction

The genus *Argophyllum* was established by Forster and Forster (1776) in their publication *Characteres Generum Plantarum* with the single species *A. nitidum* J.R.Forst. & G.Forst., based on material they collected from New Caledonia. Eleven species are currently accepted for New Caledonia (Guillaumin & Virot 1953; Plant List 2018).

In Australia, the first record of an *Argophyllum* was provided by Mueller (1863) with the description of *A. lejourdanii* F.Muell. from north Queensland. Subsequent descriptions of new species and varieties from Australia have been by Mueller (1892), Baker (1899), Bailey (1900), Zemann (1907), Ewart *et al.* (1909) and Forster (1990). Prior to this account, four published species were recognised for Australia, but collections made over the last 25 years in north Queensland have indicated that further undescribed species are present (Forster 2007, 2010, 2017). This revision names these new species, and clarifies the typification of some published names. An updated key for identification (*cf.* Forster 1990) is also provided.

Argophyllum has been variously placed in the family Grossulariaceae (e.g. Cronquist 1981; Mabberley 1997), Saxifragaceae (e.g. Endlicher 1839; Engler 1890, 1928; Schlechter 1906) or Escalloniaceae (e.g. Willis 1966; Takhtajan 1983; Thorne 2000) along with (to differing degrees) other indigenous non-endemic Australian genera such as *Polyosma* Blume and *Quintinia* A.DC., and the endemic *Abrophyllum* Benth., *Anopterus* Labill., *Cuttsia* F.Muell. and *Tetracarpaea* Hook. (*cf.* Morley 1981a). Ongoing molecular and morphological studies by a number of authors have strongly inferred that this disposition of genera is artificial and that *Argophyllum* is most closely allied to *Corokia* A.Cunn. (included in Cornaceae by Morley (1981b)). These two genera now comprise the Argophyllaceae (Engl.) Taktj. and are unique in the shared characters of T-hairs and corolline ligules (Kårehed *et al.* 1999; Kårehed 2007). The genera *Abrophyllum*

Accepted for publication 10 August 2018

and *Cuttsia*, together with the New Guinean *Carpodetus* J.R.Forst. & G.Forst. are best placed in the family Rousseaceae (Stevens 2001 onwards) and *Anopterus*, *Polyosma* and *Quintinia* in Escalloniaceae (Gustafsson & Bremer 1997; Kårehed *et al.* 1999; Kårehed 2007; Stevens 2001 onwards). *Tetracarpaea* has been recently placed in its own family Tetracarpaeaceae (Stevens 2001 onwards).

Ecology

All species of *Argophyllum* are small to medium sized shrubs with soft foliage and little secondary wood development in the stems. Many species of *Argophyllum* occupy ecotonal areas on the edge of rainforest where light levels are relatively high, although montane species such as *A. cryptophlebum* often grow in areas of low light adjacent to streams. Some species are also abundant on rocky pavements and outcrops (e.g. *A. heterodontum* and *A. iridescens*) where there is little woody competition due to skeletal substrates. Plants of all species usually occur in quite dense colonies often with individuals of similar size indicating recruitment or regrowth after irregular fire events.

Argophyllum species are mainly associated with soils derived from specific volcanic substrates (**Table 1**) although the most widespread species *A. nullumense* is more catholic in this respect and *A. verae* is notable for also occurring on sandstone. The wide substrate occupation by *A. nullumense* is also reflected in the species having the greatest longitudinal distribution of the Australian species.

Table 1. Australian *Argophyllum* species – geological preference and general habitat type

Species	Geological substrate	General habitat type
A. cryptophlebum	granite	ecotone between rainforest and sclerophyll open forest; rainforest stream edges
A. curtum	basalt	sclerophyll open forest; rainforest stream edges
A. ferrugineum	rhyolite	ecotone between rainforest and sclerophyll open forest; rainforest or gallery forest stream edges
A. heterodontum	granite	rainforest or gallery forest stream edges; rock pavement and outcrops
A. iridescens	granite	rock pavement and outcrops on ecotonal edge of rainforest
A. jagonis	granite	rainforest stream edges
A. lejourdanii	granite	rock pavement and outcrops
A. loxotrichum	granite, ignimbrite, metamorphics, rhyolite	rainforest or gallery forest stream edges
A. nullumense	andesite, basalt, basalt intermixed with trachyte, granite, granodiorite, rhyolite, metamorphics/ metasediments	ecotone between rainforest and sclerophyll open forest; rainforest stream edges
A. palumense	granite	sclerophyll open forest
A. verae	granite, sandstone	clifflines above rainforest; ecotone between rainforest and sclerophyll open forest

Speciation Hypothesis

The Australian species of *Argophyllum* comprise a geographic replacement series in eastern Australia from north-eastern New South Wales to the Glennie Tableland on northern Cape York Peninsula in Queensland. This distribution is discontinuous both at the continental scale and at the local population scale with the individual populations occupying specific habitats that are disjunct and sometimes ephemeral (e.g. fire prone ecotones, rock outcrops and pavements). These habitats approximate those where many species of *Plectranthus* L'Hér. and *Zieria* R.Br. also occur, both those genera exhibiting somewhat similar patterns of speciation and distribution to *Argophyllum*. This habitat occupancy pattern has been previously equated (Duretto & Forster 2007; Forster 2011) to the 'islands on islands' effect of Porembski *et al.* (2000) that is hypothesised to drive genetic diversity and subsequent speciation (Carlquist 1974; Grant 1981; Seine *et al.* 2000; Kruckeberg 2002).

The species of *Argophyllum* recognised as a result of this revision differ in characters of the foliage (lamina teeth, venation, indumentum type and cover), inflorescence, flowers and seed; however, they all adhere to the basic pattern of being straggly shrubs with soft, discolorous foliage and small cream to yellow flowers. The subtle differences in morphology with occupation of a relatively narrow range of recurring habitat niches (**Table 1**) in an allopatric disjunct pattern is considered a 'non-adaptive radiation' with a 'high lineage diversification rate' (Savolainen & Forest 2005). This pattern of speciation is widespread both in Australia and elsewhere (Linder 2003) particularly for plants that do not appear to be particularly well adapted to long range dispersal. Webb *et al.* (1986) mentioned that the seeds of *Argophyllum* are wind dispersed; however, there remains no published information to support this observation and casual observations of all the species in the wild does not corroborate this proposal. Speciation is likely to have occurred by the long term process of population fragmentation as a result of recurrent and continuous climatic sifting through millennia with local adaptation following genetic drift resulting in the morphological differences outlined here.

Biogeography

Argophyllum is extant, albeit with no shared species, only in eastern Australia and New Caledonia. Molecular sequencing of the species from both centres remains to be researched hence no analysis of the overall relationships within the genus can be attempted at this time. Miocene fossil leaf cuticles attributed to *Argophyllum* have been described from deposits in New Zealand (Pole 2008) and if these are correctly identified, it would indicate an historical distribution in Australia and components of Zealandia other than New Caledonia.

The distribution of the genus in eastern Australia wholly in rainforest or vegetation communities adjacent to rainforest enables some observations to be made in relation to species disposition in relation to putative biogeographic barriers (Bryant & Krosch 2016). Perhaps the most significant of these observations pertain to the widespread *Argophyllum nullumense* as the species occurs on either side of two major biogeographic barriers, *viz.* Brisbane Valley Barrier and St Lawrence Gap, but not north of the Burdekin Gap. The most biogeographically significant population centre for *A. nullumense* remains the single population at Finch Hatton Gorge in the Eungella Range at *c.* 490 km disjunct from the Mt Castle Tower populations. Surprisingly *A. nullumense* has not been found at the upland 'sky island' refuge at Kroombit Tops (*cf.* Forster 2011) or in the Bulburin uplands in the Bobby Range, although it is present at the nearby Many Peaks Range.

Argophyllum verae is restricted to north of the Laura Basin in two greatly disjunct population centres (*c.* 270 km apart) on radically different geologies yet has not been found in upland areas of the McIlwraith Range inbetween. *Argophyllum iridescens* is known only from north of the Black Mountain Corridor (BMC) in the greater Daintree lowlands. Whilst *A. curtum*, *A.*

heterodontum and *A. jagonis* are Wet Tropics bioregion endemics restricted to south of the BMC, *A. cryptophlebum* and *A. loxotrichum* are especially notable for being north and south of the putative corridor, albeit always at higher altitudes. The northern and southern population centres for *A. cryptophlebum* are disjunct by *c.* 105 km and for *A. loxotrichum* by *c.* 225 km respectively. *Argophyllum ferrugineum* and *A. lejourdanii* are both restricted to north of the Burdekin Gap, but do not extend north throughout the Wet Tropics bioregion beyond the Tully Falls/Koolmoon Creek area and near Cardwell respectively. *Argophyllum palumense* is restricted to high altitudes northwest of Townsville in the Paluma – Mt Spec area.

The overall conclusion from these observations is that populations of the species recognised in this revision occur repeatedly in minor centres of endemism and refugia in areas of higher moisture levels than the norm or with reduced competition from other woody vegetation (rocky pavements and outcrops). Some species (e.g. *A. cryptophlebum*, *A. jagonis* and *A. loxotrichum*) are restricted to refugia of very high rainfall populated by scores of other similarly distributed vascular plants. Whilst some species are geographically restricted in their overall distribution (e.g. *A. curtum*, *A. ferrugineum*, *A. heterodontum*, *A. jagonis*, *A. palumense*), others are widespread and characterised by large disjunctions between population centres (e.g. *A. loxotrichum*, *A. nullumense*, *A. verae*). These latter species are putatively examples of surviving, ancient population fragmentations rather than recent examples of long range dispersal.

Materials and methods

This revision is based on traditional methods utilising data derived from plant morphology. Species are defined on the principal of morphological discontinuity in character states, with a minimum of two such states for taxon distinction. They are arranged alphabetically in the taxonomic account with notes provided about putative affinities between them. Taxa are in all cases allopatric in this particular group. All species have been examined in the field by one or both authors. A number of taxa have been examined from plants cultivated at Tolga by Garry Sankowsky and at Cooroy by Maurie Tucker.

Herbarium holdings at BRI, CANB, CNS, MEL, NSW and W have been utilised as the primary source of data. Common abbreviations in the specimen citations are LA (Logging Area), Mt (Mountain), NP/NPR (National Park/National Park Reserve), SF/SFR (State Forest/State Forest Reserve) and TR (Timber Reserve). Collections originally deposited in the C.S.I.R.O. herbarium at Atherton (QRS) are now housed in the Australian Tropical Herbarium (CNS) at Cairns.

Taxonomy

Argophyllum J.R.Forst. & G.Forst., *Char. Gen. Pl.* ed. 2: 29 (1776). **Type:** *A. nitidum* J.R.Forst. & G.Forst.

Perennial shrubs or small trees. Stipules absent. Branchlets terete. Leaves alternate, discolorous, petiolate; margins crenate, dentate or entire. Indumentum (in Australia) very dense on branchlets and leaf undersides. All hairs biramous, with a very short 'stalk', and two elongated unequal arms, usually parallel to the lamina surface (hence T-shaped), but sometimes spreading at about 40–60° from the lamina surface (hence Y-shaped). Flowers bisexual, actinomorphic. Calyx gamosepalous, the lobes 5, deltate; petals 5, deltate, not fused; corolla appendages 5, attached near the base of each petal on adaxial surface, proximal half fused, distally divided into 15–25 filamentous segments. Stamens 5, antesepalous; anthers versatile. Style simple, stigma swollen, entire, globose. Ovules 50–60 per loculus. Capsules cupular, 2–3-locular; fruiting valves splitting longitudinally from the apex, so that the number of fruiting teeth is always twice the number of locules. Seeds brown, ellipsoidal, surface with a coarse reticulate pattern.

22 species, 11 in Australia (Queensland and New South Wales), and 11 in New Caledonia.

***Etymology*:** From the Greek *argos* meaning white, and *phyllon* meaning a leaf.

Key to *Argophyllum* species in Australia

1 Inflorescences borne strictly in leaf axils **2**
1. Inflorescence wholly or predominantly terminal (basal branch of inflorescence may be in uppermost 1 or 2 leaf axils) **9**

2 New vegetative growth creamy-white **3**
2. New vegetative growth brown or rusty-coloured **6**

3 Biramous hairs on upper leaf surface with arms obliquely ascending (Y-shaped); branchlets and lower leaf surface with spreading hairs . . . . . **8. A. loxotrichum**
3. Biramous hairs on upper leaf surface with arms ± parallel to surface (T-shaped); branchlets and lower leaf surface with ± appressed hairs **4**

4 Lamina marginal teeth 1.7–3.2 mm long . . . . . **10. A. palumense**
4. Lamina marginal teeth absent or up to 0.7 mm long **5**

5 Leaves 2.8–4.5 times longer than wide; marginal teeth 30–45 on each side . . . . . **5. A. iridescens**
5. Leaves 1.8–2.4 times longer than wide; marginal teeth 19–25 on each side or teeth absent . . . . . **11. A. verae**

6 Upper surface of fully expanded leaves glabrous, although hairs are present on young leaves **7**
6. Upper surface of fully expanded leaves with persistent hairs **8**

7 Leaf teeth prominent, unequal, longer ones 1–4.5 mm long; ovary 2 or 3-locular . . . . . **4. A. heterodontum**
7. Leaf teeth small, inconspicuous, ± equal, 0.3–1 mm long; ovary 2-locular . . **2. A. curtum**

8 Tertiary veins on lower leaf surface brown; longest hairs on upper leaf surface 0.5–0.7 mm long; seeds 0.5–0.6 mm long . . . . . **3. A. ferrugineum**
8. Tertiary veins creamy white on fully expanded leaves; longest hairs on upper leaf surface 0.8–1 mm long; seeds 0.4–0.5 mm long . . . . . **7. A. lejourdanii**

9 Leaves (2.6–) 3–4.6 times longer than wide; petioles 7–14 mm long; petals and corolla appendages yellow; hairs on upper leaf surface 0.2–0.3 mm long . . . . . **9. A. nullumense**
9. Leaves 1.3–2.9 times longer than wide; petioles 13–38 mm long; petals and corolla appendages white; hairs on upper leaf surface 0.3–0.7 mm long **10**

10 Branching of inflorescence mostly dichotomous, branches spreading at 60–90° from adjacent branch; petioles and young branchlets with creamy or white indumentum; hairs on upper leaf surface 0.5–0.7 mm long; leaf teeth (sometimes reduced to marginal glands) 11–29 pairs . . . . **6. A. jagonis**
10. Branching of inflorescence mostly monochasial, branches spreading at 30–60° from adjacent branch; petioles and young branchlets with usually brown or rusty-coloured indumentum; hairs on upper leaf surface 0.3–0.5 mm long; leaf teeth (sometimes reduced to marginal glands) 7–14 pairs . . . . . **1. A. cryptophlebum**

1. Argophyllum cryptophlebum Zemann, *Ann. Naturh. Hofm. Wien* 22: 283 (1907). **Type citation:** "Sayer: Mt. Bellenden Ker, 1887 (Granite). – S. Johnson: Mt. Bartle-Frère 1891 (Granite)." **Type:** Queensland. Cook District: Mt Bellenden Ker, in 1887, *W.A. Sayer 84* (lecto [here designated]: MEL 2288067; isolecto: MEL 2288065, MEL 2288066, W 10220).

Argophyllum nitidum var. *fulvum* F.M.Bailey (as 'fulva'), *Queensl. Fl.* 2: 533 (1900). **Types:** Queensland. Cook District: Mount Bellenden Ker, in 1887, *W.A. Sayer 84* (syn: MEL 2288067, MEL 2288066, MEL 2288065); Mt Bartle Frere, *s.dat.*, *S. Johnson s.n.* (syn: BRI [AQ200705], MEL 2288064).

Argophyllum cryptophlebium B.Hyland, *orth. var.*; B.Hyland *et al.* in W.E.Cooper & W.T.Cooper, Appendix I: Provisional Species List, *Fruits of the Rainforest* 305 (1994).

Shrub 2–7 m high, often with decumbent stems. Hairs on new growth brown or rusty; hairs more than 10 cm from growing point brown or rusty. Petiole 13–38 mm long; fully expanded lamina broadly-elliptic, ovate, or broadly ovate, 41–131 mm long, 21–61 mm wide, 1.5–2.9 times longer than wide; 5–7 secondary veins on either side of midrib. Lamina apex usually acute, sometimes shortly acuminate; base cuneate, not oblique. Lamina margins denticulate, with teeth all about the same size, 7–14 on each side of the lamina, the teeth 0.3–0.8 mm long; margins sometimes entire, with teeth reduced to small glands. Upper surface of fully expanded lamina green, glabrous or sometimes with persisting T-shaped hairs 0.3–0.5 mm long. Lower surface of lamina white or rusty-brown, hairs appressed; secondary veins rusty, slightly raised; tertiary veins rusty or white, ± flush with indumentum. Inflorescences terminal, paniculate cymose, 56–122 mm long, densely tomentose, primary axis 12–105 mm long, secondary branches 8–34 mm long; branching of inflorescence mostly monochasial, branches spreading at 30–60° from adjacent branch; bracts narrowly-deltate, 1.5–4 mm long. Pedicels 1–2 mm long; flowering hypanthium cupular, 2.5–3.3 mm diameter. Calyx lobes 0.9–1.5 mm long; petals 1.9–2.5 mm long, white, corolla appendages white, 0.6–1.3 mm long. Staminal filaments 0.8–1.1 mm long; anthers 0.35–0.6 mm long. Style 0.9–1.2 mm long; ovary 2-locular. Capsules with cupular hypanthium, 3–3.6 mm long, 3.3–4 mm diameter, teeth 4, exserted. Seeds 0.55–0.65 mm long. **Fig. 1A–C**.

***Additional specimens examined*: Queensland.** Cook District: Daintree NP, Mt Sorrow track, 4 km W of Cape Tribulation, Dec 1997, *Forster PIF21989 et al.* (BRI, K, L, MEL, NSW); Mt Sorrow, W of Cape Tribulation, Dec 1997, *Jago 4585 & Forster* (BRI); Mt Alexander [Thornton Peak], Daintree River, Dec 1929, *Kajewski 1489* (BRI); Thornton Peak, Sep 1984, *Irvine 2237* (CNS); Mt Pieter Botte, Mar 1992, *Russell 19* (BRI); Mt Hemmant, Jul 1973, *Webb & Tracey 11753* (BRI); North Bell Peak, summit area, Malbon Thompson Range, Nov 1995, *Forster PIF18042 et al.* (BRI, K, L, MEL, NSW); Bell Peak North, Nov 1995, *Jago 3645 & Forster* (BRI); Summit of Bellenden Ker, Aug 1989, *Bostock 990 & Guymer* (BRI); *ibid*, Jun 1985, *Buchanan 7101* (CANB, CNS); Mt Bellenden Ker, Aug 1913, *Cambage 3827* (NSW); Wooroonooran NP, headwaters East Mulgrave River, Nov 2000, *Forster PIF26417 et al.* (BRI, MEL, NSW); Wooroonooran NP near Tower 5 Bellenden Ker cablecar, 5 km W of Bellenden Ker township, Nov 2000, *Forster PIF26420 et al.* (A, BISH, BRI, K, L, MEL, NSW); Wooroonooran NP, East Mulgrave River, Nov 2000, *Forster PIF26439 et al.* (BRI, MEL); Summit of Mt Bellenden Ker, Aug 1971, *Hyland 5319* (BRI, CNS); NE peak of Mt Bartle Frere, Oct 1992, *Jago 1067* (BRI); East Mulgrave River, Nov 1995, *Jago 3697 et al.* (AD, BRI, CANB, DNA, MEL); *ibid*, Nov 1995, *Jago 3713 et al.* (BRI); Mt Bellenden Ker, Dec 1892, *Podenzana s.n.* (CANB 7707927 [ex BM]); NPR 904, Wooroonooran, SE of Bellenden Ker Centre Peak, Dec 1996, *Small 7* (BRI, CNS); Bellenden Ker, summit, Jun 1949, *Smith 4201* (BRI); Mt Bellenden Ker, summit of the Centre Peak, Jun 1969, *Smith 14673a* (BRI, CANB, MEL, NSW); Bellenden Ker, Jan 1923, *White s.n.* (BRI [AQ200706], NSW 190874).

***Distribution and habitat*:** *Argophyllum cryptophlebum* is endemic to the Wet Tropics bioregion of northeast Queensland, occurring in the Cape Tribulation area, the Bellenden Ker – Bartle Frere massif, and on Bell Peak (**Map 1**). It is confined to areas where annual rainfall exceeds 3000 mm, and at altitudes above 600 metres. Plants occur on the edges of rainforest (microphyll moss/fern vinethicket), within rainforest, or along watercourses, always on granite substrates.

***Phenology*:** Flowers are recorded from July to December; fruits from March to December.

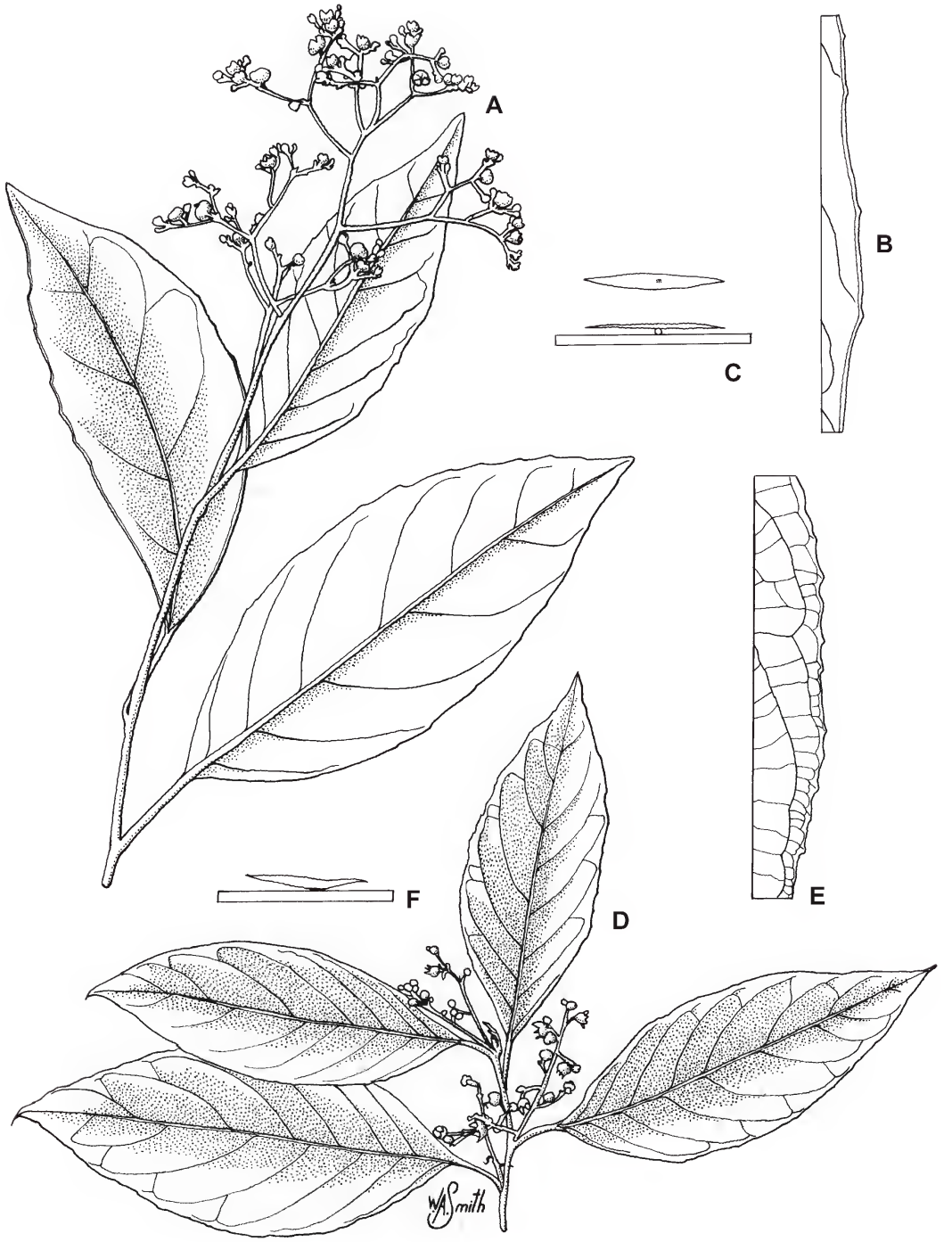


Fig. 1A–C. ***Argophyllum cryptophlebum***. A. flowering branchlet ×0.8. B. lamina margin ×2. C. hair from upper leaf surface ×60; **D–F.** ***A. curtum***. D. flowering branchlet ×0.6. E. lamina margin ×2. F. hair from upper leaf surface ×60. A–C from *Forster PIF26439 et al.* (BRI); D–F from *Forster PIF30959 & Jensen* (BRI, holotype). Del. W. Smith.

***Typification*:** Bailey (1900) treated this species as a variety (*fulvum*) of the New Caledonian *Argophyllum nitidum* and cited the same specimens used by Zemann in the protologue for *A. cryptophlebum*.

The *Sayer 84* collection is fertile and of good quality; the sheet selected as lectotype for the name *Argophyllum cryptophlebum* includes a field label with the number '84' written on it.

***Affinities*:** *Argophyllum cryptophlebum* is putatively closely related to the two Australian species with terminal inflorescences: *A. jagonis* and *A. nullumense* (see Affinities under those species). It is also apparently similar to *A. nitidum* from New Caledonia.

***Notes*:** Populations of *Argophyllum cryptophlebum* from the Cape Tribulation area have somewhat longer petioles than plants further south, and populations from Bell Peak often have smaller laminae than found elsewhere. These differences are not consistent and hence not considered to be taxonomically significant.

***Conservation status*:** *Argophyllum cryptophlebum* is currently classified as **Vulnerable** under the Queensland NCA (1992). The species occurs in six population centres; some of these (e.g. Bellenden Ker/ East Mulgrave River) comprise a number of poorly defined subpopulations insomuch as the area remains poorly explored. There are no immediate threats to these six populations; however, they are in many instances greatly disjunct indicating little recent genetic connectivity. All of these high altitude populations are under threat from environmental changes associated with climate change. The classification of **Vulnerable** based on the criterion **D2** remains relevant for this species.

***Etymology*:** The epithet is from the Greek *crypto-* meaning hidden, and *phlebos*, a vein. This probably alludes to the obscure tertiary venation of the leaves in this species.

2. Argophyllum curtum A.R.Bean & P.I.Forst. **sp. nov.** with affinity to *A. lejourdanii*, but differing by the small and inconspicuous teeth on the leaf margin, and the glabrous upper surface of the fully expanded leaves. **Typus:** Queensland. Cook District: Freshwater Forest Reserve, Lake Morris road, 12 May 2005, *P.I. Forster PIF30959 & R. Jensen* (holo: BRI [2 sheets + spirit]; iso: CNS, L, MEL, NSW, *distribuendi*).

Shrub 2–5 m high. Hairs on new growth rusty or brown; hairs more than 10 cm from growing point white or creamy. Petiole 13–28 mm long; fully expanded lamina elliptic to broadly-elliptic, 109–170 mm long, 42–70 mm wide, 2.3–3.3 times longer than wide; 6–9 secondary veins on either side of midrib. Lamina apex shortly acuminate or acute; base cuneate, not oblique or occasionally oblique by up to 4 mm. Lamina margins denticulate, with teeth all about the same size, 23–38 on each side of the lamina, the longer teeth 0.3–1 mm long. Upper surface of fully expanded lamina green, glabrous. Hairs on upper surface of developing leaves appressed, 0.3–0.6 mm long. Lower surface of lamina white or creamy-coloured, hairs appressed; secondary veins brown to creamy, raised; tertiary veins creamy, ± flush with indumentum. Inflorescences axillary, paniculate, 35–93 mm long, densely tomentose, primary axis 30–82 mm long, secondary branches 9–32 mm long, bracts narrowly-deltate, 1.8–5 mm long. Pedicels 0.5–3 mm long; flowering hypanthium cupular, 2.6–3.5 mm diameter. Calyx lobes 0.9–1.4 mm long; petals 2.3–3.2 mm long, white, corolla appendages white, *c.* 1.3 mm long. Staminal filaments 1–1.2 mm long; anthers 0.7–0.8 mm long. Style *c.* 1.2 mm long; ovary 2-locular. Capsules with hemispherical hypanthium, 2.8–3.5 mm long, 4.3–5.5 mm diameter, teeth 4, exserted. Seeds 0.45–0.55 mm long. **Fig. 1D–F**.

***Additional specimens examined*: Queensland.** Cook District: McKinnon Creek, SW of Edmonton, Jun 1996, *Forster PIF19260 et al.* (A, BRI, MEL, NSW); Lake Morris road, Aug 1995, *Jago 3547* (BRI); Crystal Cascades, Jul 2000, *Cooper 1365 & Cooper* (BRI); Saddle Mountain, near Kuranda, Aug 1967, *Brass 33632* (BRI); *ibid*, Jul 1968, *Brass 33879* (CNS); Barron River gorge, on side of road to Hydro-electric station, Dec 2009, *Dowe s.n.* (CNS 134163.1); Gadgarra, Atherton, Jun 1929, *Kajewski 1090* (BRI); Track SW of Wright's Lookout to Surprise Creek, 5 km S of Kuranda, Jul 1994, *Jobson 3096 & Wiecek* (BRI, CANB, NSW).

***Distribution and habitat*:** *Argophyllum curtum* is endemic to the Wet Tropics bioregion of northeast Queensland where it is found in a relatively small area from Kuranda to Edmonton, near Cairns (**Map 2**). This species grows in open forest with (for example) *Eucalyptus pellita* F.Muell. and *Syncarpia glomulifera* (Sm.) Nied., or on the edges of streams in rainforest (complex notophyll vineforest), on sandy loam derived from granite alluvium. Altitude ranges from 120–630 metres.

***Phenology*:** Flowers are recorded for May to August; fruits from June to August.

***Affinities*:** *Argophyllum curtum* is similar to *A. lejourdanii*, but differing by the shorter marginal teeth on the leaves, up to 1 mm long (up to 2.2 mm long for *A. lejourdanii*), the upper surface of fully expanded leaves glabrous (hairs persistent for *A. lejourdanii*), the leaf hairs 0.3–0.6 mm long (0.8–1 mm long for *A. lejourdanii*), and the capsules 4.3–5.5 mm diameter (3.8–4.3 mm diameter for *A. lejourdanii*).

***Conservation status*:** *Argophyllum curtum* is known from five or six extant populations with the population recorded as 'Gadgarra, Atherton' by Frank Kajewski having not been relocated to date. There are no immediate threatening processes evident for the species; however, the available habitat for potential occurrence within the area of occupancy is relatively small and subject to weed invasion and environmental changes from stochastic events. A suitable conservation status is **Vulnerable** based on the criterion **D2** (IUCN 2012).

***Etymology*:** From the Latin *curtus*, meaning cut short, or short. This is given in reference to the short marginal teeth on the leaves.

3. Argophyllum ferrugineum A.R.Bean & P.I.Forst. **sp. nov.** Distinguished by the axillary inflorescences, persistent hairs on the upper leaf surface, and rusty or brown hairs on the veins of fully expanded leaves. **Typus:** Queensland. North Kennedy District: Tully Falls weir, 23 November 1995, *P.I. Forster PIF18195 & T. Spokes* (holo: BRI [2 sheets + spirit]; iso: CNS, K, MEL, NSW).

Argophyllum sp. (Koolmoon Creek B.Gray 1040); Forster (2007, 2010, 2017).

Shrub 1–4 m high. Hairs on new growth rusty or brown; hairs on branchlets more than 10 cm from growing point rusty or brown. Petiole 18–30 mm long; fully expanded lamina elliptic to obovate or broadly-elliptic, 117–182 mm long, 38–76 mm wide, 1.9–2.7 times longer than wide; 8–10 secondary veins on either side of midrib. Lamina apex shortly acuminate, or occasionally acute; base cuneate, not oblique or occasionally oblique by up to 3 mm. Lamina margins dentate, with teeth all about the same size, or varying in length (alternating long and short), 17–49 on each side of the lamina, the longer teeth 0.7–2 mm long. Upper surface of fully expanded lamina green, with persistent hairs, sparse to moderately dense, appressed, 0.5–0.7 mm long. Lower surface of lamina white or sometimes rusty-coloured, hairs appressed; secondary veins brown, raised; tertiary veins brown, ± flush with indumentum. Inflorescences axillary, paniculate, 33–75 mm long, densely tomentose, primary axis 25–63 mm long, secondary branches 9–30 mm long, bracts narrowly-deltate, 2–6.3 mm long. Pedicels 1.3–2 mm long; flowering hypanthium cupular, 3.1–3.9 mm diameter. Calyx lobes 1.5–1.9 mm long; petals 4–4.2 mm long, white, corolla appendages white, 1–1.4 mm long. Staminal filaments 1–1.6 mm long; anthers 0.8–0.9 mm long. Style 1.1–1.6 mm long; ovary 2-locular. Capsules with cupular to hemispherical hypanthium, 2.8–3.3 mm long, 3.8–5 mm diameter, teeth 4, slightly exserted. Seeds 0.5–0.6 mm long. **Figs. 2A–C, 3**.

***Additional specimens examined*: Queensland.** North Kennedy District: SF 251, Cannanbullen Falls, Nov 1996, *Gray 6921* (BRI, CNS); South Coochimberrum LA, 1.5 km SE of Mt Koolmoon, May 2001, *Ford AF2836* (BRI, CNS); Rhyolite pinnacle *c.* 1.75 km ESE of Mt Koolmoon, Jan 2010, *Jago RLJ7357* (BRI); Koolmoon Creek crossing of old forestry road, Nov 1996, *Jago 4149* (BRI); SFR 251, Tableland LA, Oct 1978, *Gray 1040* (BRI); Koolmoon Creek, Sep 1950, *Smith 4727* (BRI); *ibid*, Oct 1995, *Gray 6354* (BRI, CNS); SFR 251, Tableland LA, Koolmoon Creek, Dec 1995, *Gray 6473* (BRI, CNS); Tully Falls, Jan 1948, *Fielding NQNC11948* (CNS); *ibid*, Oct 1995, *Ford 1631* (BRI, CNS); Tully Falls weir, Jun 1995, *Forster PIF16753* (AD, BRI, CNS, K, MEL, NSW); *ibid*, May 2003, *Forster PIF29391 &*

Fig. 2A–C. ***Argophyllum ferrugineum***. A. flowering branchlet ×0.5. B. lamina margin ×2. C. hair from upper leaf surface ×40; **D–F.** ***A. heterodontum***. D. flowering branchlet ×0.5. E. lamina margin ×2. F. hair from upper leaf surface ×60. A–C from *Forster PIF18195 & Spokes* (BRI holotype); D–F from *Elick 153* (BRI). Del. W. Smith.

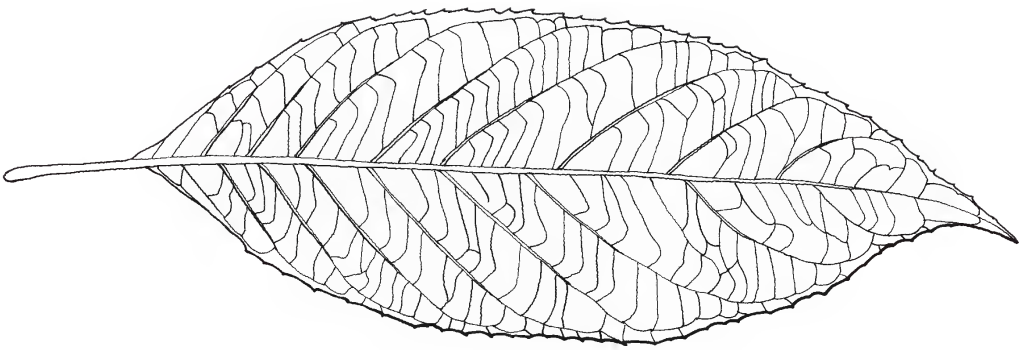


Fig. 3. ***Argophyllum ferrugineum***. Leaf venation ×0.7. From *Forster PIF18195 & Spokes* (BRI, holotype). Del. W. Smith.

Jensen (A, BRI, L, MEL, NSW); Kareeya Power Station weir, *c.* 500 m upstream from Tully Falls, *s.dat.*, *Haig s.n.* (BRI [AQ582641]); SFR 756, Park LA, Tully Weir Road, Aug 1998, *Ford 2092* (BRI, CNS); Mt Collins, Kirrama area, Nov 1995, *Irvine 2370* (CNS); Conn Creek, SE of Kirrama, Nov 1995, *Bradford s.n.* (CNS [QRS 108605]).

***Distribution and habitat*:** *Argophyllum ferrugineum* is endemic to the Wet Tropics bioregion of northeast Queensland where it is mainly confined to a small area southeast and south-south-east of Ravenshoe, in the Tully Falls and Koolmoon Creek areas, with an outlier west of Cardwell near Kirrama (**Map 3**). It grows in rocky rhyolite areas with shallow soil usually along stream edges, either in open forest with *Banksia aquilonia* (A.S.George) A.S.George, *Callitris macleayana* (F.Muell.) F.Muell., *Lophostemon confertus* (R.Br.) Peter G.Wilson & J.T.Waterh., *Melaleuca recurva* (R.D.Spencer & Lumley) Craven, or on the margins of depauperate rainforest (simple notophyll vineforest). Altitude ranges from 600–1080 metres.

***Phenology*:** Flowers are recorded from August to January; fruits from October to June.

***Affinities*:** *Argophyllum ferrugineum* is putatively close to *A. lejourdanii*, but differs by the shorter hairs (0.5–0.7 mm long) of the upper leaf surface, the persistently rusty branchlets, the brown or rusty hairs on the tertiary veins of the lower leaf surface persisting on fully expanded leaves, the longer calyx lobes, and the larger seeds.

***Conservation status*:** *Argophyllum ferrugineum* is known from four or perhaps five poorly defined populations within a relatively small area of occurrence from near Mt Koolmoon to near Kirrama west of Cardwell. There are no obvious immediate threatening process for this species; however, the habitat is subject to weed invasion and environmental changes from stochastic events. The extent to which *A. ferrugineum* occurs away from the mainly roadside collection sites needs to be determined in this area. A suitable conservation status for this species is **Vulnerable** based on the criterion **D2**.

***Etymology*:** The specific epithet is formed from the Latin *ferrugineus* meaning rusty, given in reference to the colour of veins on the lower leaf surface in this species.

4. Argophyllum heterodontum A.R.Bean & P.I.Forst. **sp. nov.** with affinity to *A. lejourdanii*, but differing by the glabrous upper surface of fully expanded leaves, the shorter leaf hairs, the marginal leaf teeth of variable length and the longer pedicels. **Typus:** Queensland. Cook District: Walsh's Pyramid, 2 km SE of Gordonvale, 27 May 2003, *P.I. Forster PIF29378 & R. Jensen* (holo: BRI [1 sheet]; iso: MEL, NSW).

Argophyllum lejourdanii var. *cryptophlebum* F.M.Bailey (as 'cryptophleba'), *Queensland Fl.* 2: 533 (1900); *A. nitidum* var. *cryptophlebum* (F.M.Bailey) Ewart, Jean White & B.Rees

(as 'cryptophleba'), *Proc. Roy. Soc. Vic.* 22: 10 (1909). **Type:** Queensland. Cook District: Mulgrave River, Bellenden Ker Expedition, in 1889, *F.M. Bailey s.n.* (holo: BRI [AQ200726]).

Shrub or small tree 2–6 m high. Hairs on new growth rusty or brown; hairs more than 10 cm from growing point creamy-white. Petiole 17–35 mm long; fully expanded lamina elliptical, broadly-elliptical or ovate, 92–143 mm long, 33–55 mm wide, 2.5–3.3 times longer than wide; 6–10 secondary veins on either side of midrib. Lamina apex acuminate; base cuneate, not oblique or occasionally oblique by up to 2 mm. Lamina margins dentate, with teeth usually varying in length (alternating long and short), 24–61 on each side of the lamina, the longer teeth 1–4.5 mm long. Upper surface of fully expanded lamina green, glabrous; sparse hairs present on young expanding lamina, appressed, 0.5–0.7 mm long. Lower surface of lamina white, hairs appressed; secondary veins brown or white, raised; tertiary veins white, ± flush with indumentum. Inflorescences axillary, paniculate, 35–90 mm long, densely tomentose, primary axis 20–73 mm long, secondary branches 7–14 mm long, bracts narrowly-deltate, 1.5–8.5 mm long. Pedicels 1.4–2.5 mm long; flowering hypanthium cupular, 2.8–4 mm diameter. Calyx lobes 1.2–1.5 mm long; petals 2.6–3.6 mm long, white, corolla appendages white, 1.4–1.5 mm long. Staminal filaments 1.3–1.6 mm long; anthers 0.8–0.9 mm long. Style 1.4–1.5 mm long; ovary 2–3-locular. Capsules with cupular hypanthium, 3–4 mm long, 3.5–4.8 mm diameter, teeth 4 or 6. Seeds 0.45–0.55 mm long. **Figs. 2D–F, 8F**.

***Additional selected specimens examined*: Queensland.** Cook District: Walsh's Pyramid, Mulgrave River, *s.dat., s.coll.* (BRI [AQ200708], MEL, NSW); S of Gordonvale, Sep 1935, *Blake 9751* (BRI); Base of Walsh's Pyramid, near Gordonvale, May 1962, *Blake 21773* (BRI); Walsh's Pyramid, N slopes, Nov 1954, *Blake 19769* (BRI); Middle slopes of Walsh's Pyramid, Jul 1993, *Forster PIF13765* (BRI, CNS); Walsh's Pyramid, Aug 1938, *Flecker NQNC5060* (BRI); *ibid*, Aug 1959, *Thorne et al. 23184* (BRI); *ibid*, Sep 1972, *Webb & Tracey 13783* (BRI, CNS); *ibid*, Jul 1980, *Irvine 2032* (BRI); Massey Creek Falls, Bellenden Ker NP, Feb 1996, *Jago 3791 & Jensen* (BRI); Along track to Clamshell Falls, Oct 1996, *Elick 153* (BRI, CNS); Behana Creek, 2.6 km S from locked gate at water treatment plant on Behana Gorge road, S of Gordonvale, Jul 2005, *Halford Q8485 & Jensen* (BRI); upstream of Butcher Creek Falls, Jun 1995, *Hunter JH4166* (BRI).

***Distribution and habitat*:** *Argophyllum heterodontum* is endemic to the Wet Tropics bioregion of northeast Queensland where it is known from a small area south of Gordonvale mainly centred around Walsh's Pyramid, together with a disjunct population near Butchers Creek Falls (**Map 2**). It occurs in skeletal soil on pavements and rock outcrops (granite at Walsh's Pyramid and Behana Creek; basalt/metamorphics at Butcher Creek Falls) in open situations with woodland dominated by Myrtaceae (*Eucalyptus granitica* L.A.S.Johnson & K.D.Hill, *E. reducta* L.A.S.Johnson & K.D.Hill, *Lophostemon confertus*) or with little other woody vegetation.

***Phenology*:** Flowers are recorded from May to November; fruits are recorded from May to November.

***Typification*:** Mueller wrote the name *A. nitidum* var. *cryptophlebum* on the herbarium label of MEL 2288065, an isolectotype of *A. cryptophlebum* Zemann. Then Bailey (1900) caused confusion by describing *A. lejourdanii* var. *cryptophlebum*, attributing the varietal epithet to "F. v. M. in herb.". However, Bailey used a specimen of his own as the type and not the specimen in MEL annotated by Mueller. Bailey's taxon is not related to *A. cryptophlebum,* but clearly has affinities to *A. lejourdanii*.

Ewart *et al.* (1909) obviously went back to the source of the name (MEL 2288065) and presumed that this was the specimen to which Bailey was referring. On that basis, Ewart *et al.* (1909) stated that the var. *cryptophlebum* should be placed under *A. nitidum* rather than *A. lejourdanii*.

Bailey's var. *cryptophlebum* should be attributed to him alone, rather than "F.Muell. ex F.M.Bailey" because Mueller applied the name to a different taxon from Bailey.

***Affinities*:** *Argophyllum heterodontum* is similar to *A. lejourdanii*, but differs by the longer and markedly unequal marginal teeth

on the leaves, up to 4.5 mm long (up to 2.2 mm long for *A. lejourdanii*), the upper surface of fully expanded leaves glabrous (hairs persistent for *A. lejourdanii*), the leaf hairs 0.5–0.7 mm long (0.8–1.0 mm long for *A. lejourdanii*), the pedicels 1.4–2.5 mm long (1–1.5 mm for *A. lejourdanii*), and the ovaries sometimes 3-locular (consistently 2-locular for *A. lejourdanii*).

***Conservation status*:** *Argophyllum heterodontum* is known from three populations, all occurring in National Park (Gadgarra, Wooroonooran), although the most northerly stands of the species at the base of Walsh's Pyramid are on Freehold title along the walking track up the mountain before it enters the National Park. The *Argophyllum* co-occurs with another localised endemic *Plectranthus gratus* S.T.Blake (listed as **Vulnerable**), although that species is known from at least five populations (Forster 1996), with two lacking *A. heterodontum*. There exists similar habitat to the southwest of Walsh's Pyramid that should be explored for other subpopulations of both species.

A suitable conservation status for *Argophyllum heterodontum* is **Vulnerable** (criterion **D2** from IUCN 2012). There are no pressing threatening processes for the species; however, the populations and subpopulations are likely to be impacted by too frequent burning of the habitat and by weed invasion (e.g. introduced pasture/weed grasses such as *Sporobolus* species) or by stochastic events.

***Etymology*:** From the Greek *heteros* (different), and *odontos* (tooth). This refers to the acute teeth on the leaf margins that vary greatly in size.

5. Argophyllum iridescens A.R.Bean & P.I.Forst. **sp. nov.** with affinity to *A. lejourdanii*, but differing by the small and inconspicuous teeth on the leaf margin, the creamy-white new growth, and the larger seeds. **Typus:** Queensland. Cook District: Mt Hedley, 3 km ENE of Rossville, Timber Reserve 165, 15 April 1999, *P.I. Forster PIF24277 & R. Booth* (holo: BRI [2 sheets + spirit]; iso: AD, CNS, K, L, MEL, NSW, US *distribuendi*).

Shrub *c.* 2 m high. Hairs on new growth white or creamy; hairs more than 10 cm from growing point creamy-white. Petiole 10–15 mm long; fully expanded lamina elliptical, 89–174 mm long, 30–53 mm wide, 2.8–4.5 times longer than wide; 8–11 secondary veins on either side of midrib. Lamina apex acuminate; base cuneate, not oblique or occasionally oblique by up to 5 mm. Lamina margins denticulate, with teeth all about the same length, 30–49 on each side of the lamina, the teeth 0.3–0.7 mm long. Upper surface of fully expanded lamina green, glabrous or sparsely hairy; hairs appressed, 0.8–1.2 mm long. Lower surface of lamina white, hairs appressed; secondary veins white, raised; tertiary veins white, ± flush with indumentum. Inflorescences axillary, paniculate, 33–77 mm long, densely tomentose, primary axis 28–63 mm long, secondary branches 5–15 mm long, bracts narrowly-deltate, 1.3–2.9 mm long. Pedicels 1.5–3 mm long; flowering hypanthium cupular, 3.4–3.6 mm diameter. Calyx lobes 1.3–1.5 mm long; petals 3.2–3.5 mm long, white, corolla appendages white, *c.* 1.2 mm long. Staminal filaments 1.3–1.5 mm long; anthers *c.* 0.7 mm long. Style 1.3–1.5 mm long; ovary 2-locular. Capsules with cupular hypanthium, 3–3.3 mm long, 3.6–4.1 mm diameter, teeth 4. Seeds 0.45–0.6 mm long. **Fig. 4A–C**.

***Additional specimen examined*: Queensland.** Cook District: V.C.L. Noah, Jun 1975, *Hyland 8289* (BRI).

***Distribution and habitat*:** *Argophyllum iridescens* is endemics to the Wet Tropics bioregion of northeast Queensland and known from two locations; Mt Hedley, south of Cooktown, and near Noah Creek, between Daintree and Cape Tribulation (**Map 2**). It grows on large granite outcrops, at the ecotone between sparsely vegetated pavements and notophyll rainforest. Altitudes are between 400 and 500 metres.

***Phenology*:** Flowers and fruits are recorded from April and June.

***Affinities*:** *Argophyllum iridescens* is similar to *A. lejourdanii*, but differs by the small and inconspicuous marginal teeth on the leaves, up to 0.7 mm long (up to 2.2 mm long for *A. lejourdanii*), the long acuminate leaf apex

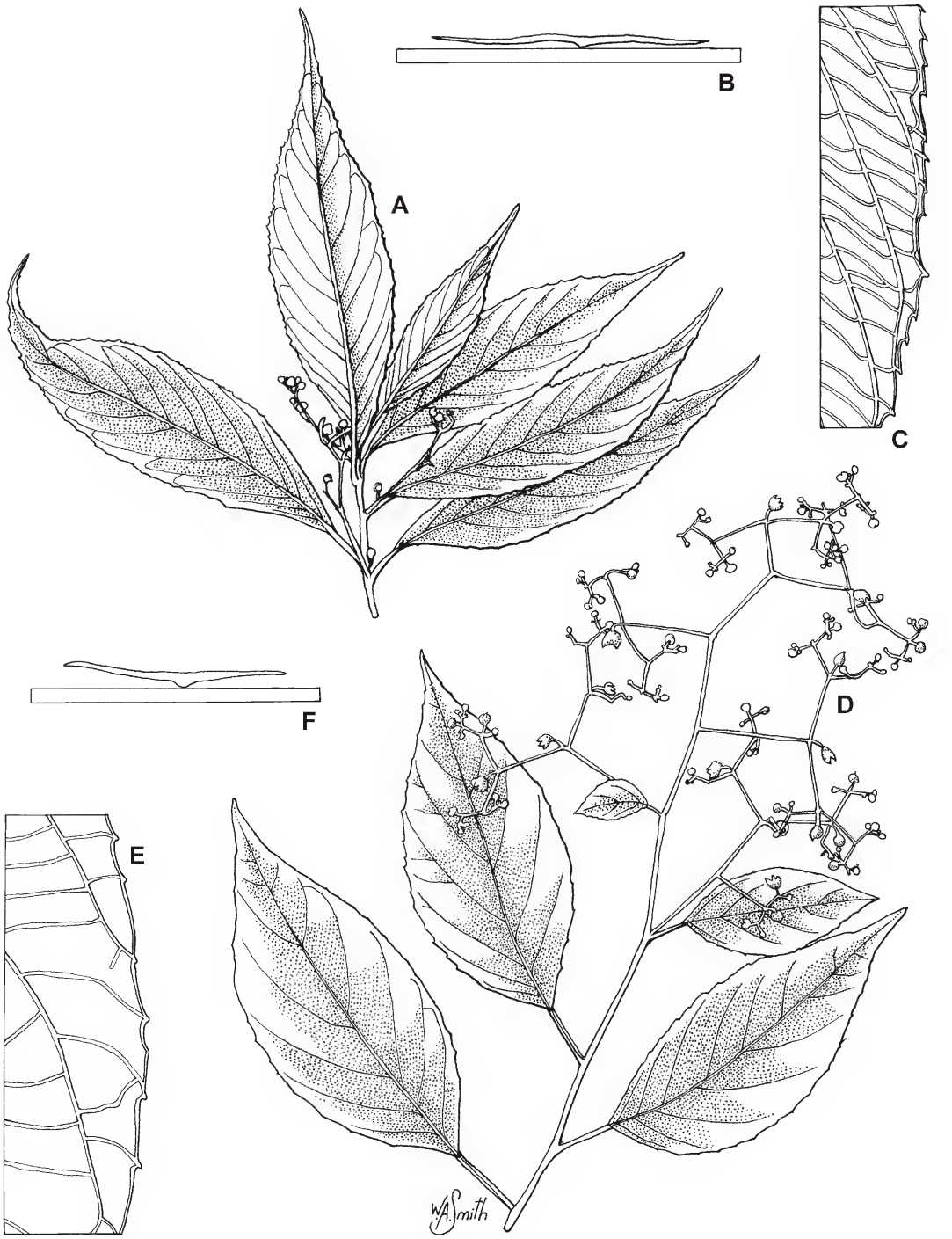


Fig. 4. A–C. *Argophyllum iridescens.* A. flowering branchlet ×0.6. B. hair from upper leaf surface ×40. C. lamina margin ×2; **D–F. *A. jagonis***. D. flowering branchlet ×0.6. E. lamina margin ×2. F. hair from upper leaf surface ×60. A–C from *Forster PIF24277 & Booth* (BRI, holotype); D–F from *Jago 3553* (BRI, holotype). Del. W. Smith.

(shortly acuminate for *A. lejourdanii*), the creamy-white new growth (rusty new growth for *A. lejourdanii*), and the seeds 0.5–0.65 mm long (0.4–0.5 mm long for *A. lejourdanii*). *A. iridescens* differs from *A. palumense* by the petioles 10–15 mm long (21–29 mm long for *A. palumense*), and the marginal teeth on the leaves 0.3–0.7 mm long (1.7–3.2 mm long *A. palumense*).

***Conservation status*:** One population of *Argophyllum iridescens* occurs in Daintree NP and the second at Mt Hedley is closely adjacent (*c.* 100 m distant) to Ngalba Bulal NP in unreserved land and probably will be eventually found in the National Park with further exploration as similar habitat occurs there. There are no obvious threatening processes; however, the species can be categorised as **Vulnerable** based on the criterion **D2** (IUCN 2012).

***Etymology*:** From the Latin *iridescens*, meaning iridescent, displaying different colours when viewed from different angles. The lower leaf surface shows alternating bands of brilliant white and steely-grey which change position depending on the direction of the light source.

6. Argophyllum jagonis A.R.Bean & P.I.Forst. **sp. nov.** with affinity to *A. cryptophlebum*, but differing by the white branchlets and leaf veins, the greater number of leaf marginal teeth, and the dichotomously branched inflorescences. **Typus:** Queensland. Cook District: The Boulders, Babinda Creek, 19 August 1995, *R.L. Jago 3553* (holo: BRI [2 sheets]; iso: AD, CNS, K, L, MEL, NSW, US, *distribuendi*).

Argophyllum sp. (Babinda L.S. Smith 10213); Forster (2007, 2010, 2017).

Shrub 1–3 m high. Hairs on new growth white or creamy; hairs more than 10 cm from growing point white or creamy. Petiole 14–24 mm long; fully expanded lamina broadly-elliptic to broadly-ovate, 79–145 mm long, 40–85 mm wide, 1.3–2.5 times longer than wide; 6–9 secondary veins on either side of midrib. Lamina apex usually acuminate, sometimes acute; base cuneate, not oblique. Lamina margins denticulate, with teeth all about the same size, or alternating smaller and longer teeth, 11–29 on each side of the lamina, the longer teeth 0.2–1 mm long; margins rarely entire, with teeth reduced to small glands. Upper surface of fully expanded lamina green, glabrous; hairs on developing leaves appressed, 0.5–0.7 mm long. Lower surface of lamina white, hairs appressed; secondary veins white, slightly raised; tertiary veins white, ± flush with indumentum. Inflorescences terminal, dichasially cymose, 98–205 mm long, densely tomentose, primary axis 78–185 mm long, secondary branches 15–25 mm long; branching of inflorescence mostly dichotomous, branches spreading at 60–90° from adjacent branch; bracts narrowly-deltate, 1.5–4 mm long. Pedicels 1.3–2.5 mm long; flowering hypanthium cupular, 2.5–3.2 mm diameter. Calyx lobes 1–1.1 mm long; petals 2.1–2.2 mm long, white to pale yellow, corolla appendages white, 1–1.3 mm long. Staminal filaments 0.8–1.1 mm long; anthers 0.5–0.6 mm long. Style 1–1.1 mm long; ovary 2-locular. Capsules with cupular hypanthium, 3.4–4 mm long, 3.3–4 mm diameter, teeth 4, exserted. Seeds 0.4–0.5 mm long. **Fig. 4D–F.**

***Additional specimens examined*: Queensland.** Cook District: R758, Fisher's Creek, South Johnstone River, Jul 1982, *Dansie AFO5187* (CNS); Russell River, Bartle Frere, Nov 1936, *Flecker NQNC2614* (CNS); Babinda Creek, Happy Valley, Jul 1943, *Flecker NQNC8229* (BRI, CNS); The Boulders, near Babinda, Aug 1959, *Thorne 23070 & Tracey* (BRI); *ibid*, Feb 1996, *Forster PIF18564 et al.* (BRI, K, L, MEL, NSW); NPR 904 Wooroonooran, *c.* 0.9 km up Babinda Creek from The Boulders, Jun 1997, *Ford 1937* (BRI, CNS); The Boulders, Babinda, Aug 1968, *Briggs 2049a* (NSW); *ibid*, Oct 1995, *Gray 6326* (BRI, CNS); *ibid*, Oct 1995, *Gray 6328* (CNS); *ibid*, Nov 1995, *Gray 6422* (BRI, CNS); *ibid*, Jan 1996, *Gray 6520* (CNS); *ibid*, Jan 1996, *Gray 6522* (CNS); The Boulders, Babinda Creek, Aug 1963, *Hyland AFO2828* (BRI); The Boulders, Babinda Creek, *c.* 6 km W of Babinda, Aug 1954, *Smith 5333* (BRI); The Boulders, Babinda Creek, 6.5 km W of Babinda, Sep 1957, *Smith 10213* (BRI); East Mulgrave River, Dec 1994, *Hunter JH1705* (BRI); *ibid*, Nov 1995, *Jago et al. 3712* (BRI); Mt Isley W of Edmonton, Dec 1996, *Jago 4218* (BRI); SFR 310, Mulgrave River, Jun 1965, *Dansie AFO3288* (CNS); Russell River, above Jiyer Cave, Oct 2001, *Jago 6047* (BRI); Johnstone River, in 1882, *Berthoud s.n.* (MEL 2234434); *ibid*, Sep 1917, *Ladbrook 93* (BRI); *ibid*, Oct 1917, *Michael s.n.* (BRI [AQ200723]); Innisfail, in 1918, *Michael 263* (NSW); 4.2 km along Woopen Creek Road, NW of Innisfail, Jul 2007, *Bean 26766* (BRI); Fleming Road, South Johnstone, 9 km SW of Innisfail, Jul 2007, *Bean 26633* (BRI, DNA, MEL, NSW).

***Distribution and habitat*:** *Argophyllum jagonis* is endemic to the Wet Tropics bioregion of northeast Queensland from the Babinda – Innisfail area, the Mulgrave River and at Mt Isley, west of Edmonton (**Map 3**). It grows in rainforest (complex mesophyll vineforest) on infertile soils, derived from granite or metamorphics, and often near watercourses. The localities near Babinda are amongst some of the wettest places in the Australian tropics with a mean average rainfall of 3500 mm. Altitudes mostly range from 20–120 metres, but as high as 950 metres at Mt Isley.

***Phenology*:** Flowers are recorded from June to November; fruits between July and February.

***Affinities*:** *Argophyllum jagonis* is closely related to *A. cryptophlebum*, but differs by the white new growth, branchlets, and abaxial leaf veins (all rusty-brown for *A. cryptophlebum*); the branching of the inflorescence mostly dichotomous, branches spreading at 60–90° from adjacent branch (mostly monochasial, branches spreading at 30–60° for *A. cryptophlebum*); the 11–29 pairs of leaf teeth (7–14 for *A. cryptophlebum*); and the seeds 0.4–0.5 mm long (0.55–0.65 mm long for *A. cryptophlebum*).

***Conservation status*:** *Argophyllum jagonis* is known from seven or eight extant populations, four occur in Wooroonooran NP, one in Little Mulgrave NP and two in road reserves. Early collections from 'Innisfail' and 'Johnstone River' may refer to a generalised area that is equivalent to an extant population, extinct populations or the place of specimen dispatch. Much of the lowland vegetation outside of National Parks and State Forests in the Babinda – Innisfail area has now been cleared for agriculture and small remnants on road reserves and private land remain under threat from 'tidy up' clearing or weed invasion. The extant populations are disjunct and occur in relatively small patches of suitable habitat that are also subject to weed invasion; however, there are no obvious threats and the overall area of occurrence has been poorly explored. An appropriate conservation status is **Least Concern** (Queensland *NCA 1992*).

***Etymology*:** This species is named for Robert L. Jago of Stratford, Cairns and is in recognition of his knowledge of the Wet Tropics flora supported by his many excellent collections of herbarium material donated to the Queensland Herbarium.

7. Argophyllum lejourdanii F.Muell. (as 'Lejourdani'), *Fragm.* 4(25): 33 (1863); *A. lejourdanii* F.Muell. var. *lejourdanii*, *Queensl. Fl.* 2: 533 (1900). **Type citation:** "In silvis montis Elliot Australiae orientalis tropicae. Fitzalan et Dallachy". **Type:** Queensland. North Kennedy District: Mt Elliott, 4 August 1863, *J. Dallachy s.n.* (lecto: MEL 568352 [here designated]; isolecto: K 000739401).

Shrub or small tree 2–3 m high. Hairs on new growth rusty or brown; hairs more than 10 cm from growing point creamy-white. Petiole 20–32 mm long; fully expanded lamina elliptical, broadly-elliptical or ovate, 122–173 mm long, 44–79 mm wide, 1.9–2.8 times longer than wide; 7–10 secondary veins on either side of midrib. Lamina apex acuminate or acute; base cuneate, not oblique or occasionally oblique by up to 5 mm. Lamina margins dentate to denticulate, with teeth about the same length, 15–49 on each side of the lamina, the teeth 0.5–2.2 mm long. Upper surface of fully expanded lamina green, sparsely hairy; hairs appressed, 0.8–1 mm long. Lower surface of lamina white, hairs appressed; secondary veins brown or white, raised; tertiary veins white, ± flush with indumentum. Inflorescences axillary, paniculate, 39–101 mm long, densely tomentose, primary axis 23–90 mm long, secondary branches 8–24 mm long, bracts narrowly-deltate, 1.4–12 mm long. Pedicels 1–1.5 mm long; flowering hypanthium cupular, 2.8–3.1 mm diameter. Calyx lobes 1.1–1.3 mm long; petals 2.6–3.5 mm long, white, corolla appendages white, 1.3–1.5 mm long. Staminal filaments 1.3–1.8 mm long; anthers *c.* 0.7 mm long. Style 1.3–1.7 mm long; ovary 2-locular, rarely 3-locular. Capsules with hemispheric hypanthium, 2.4–3 mm long, 3.8–4.3 mm diameter, teeth 4 or rarely 6. Seeds 0.4–0.5 mm long. **Fig. 5D–F**.

***Additional selected specimens examined*: Queensland.** North Kennedy District: 43 km NW of Ingham, Gowrie LA, Aug 1990, *Halford Q307* (BISH, BRI); Murray Falls, *c.* 12 miles [19 km] S of Tully, Dec 1966, *Everist 7967*

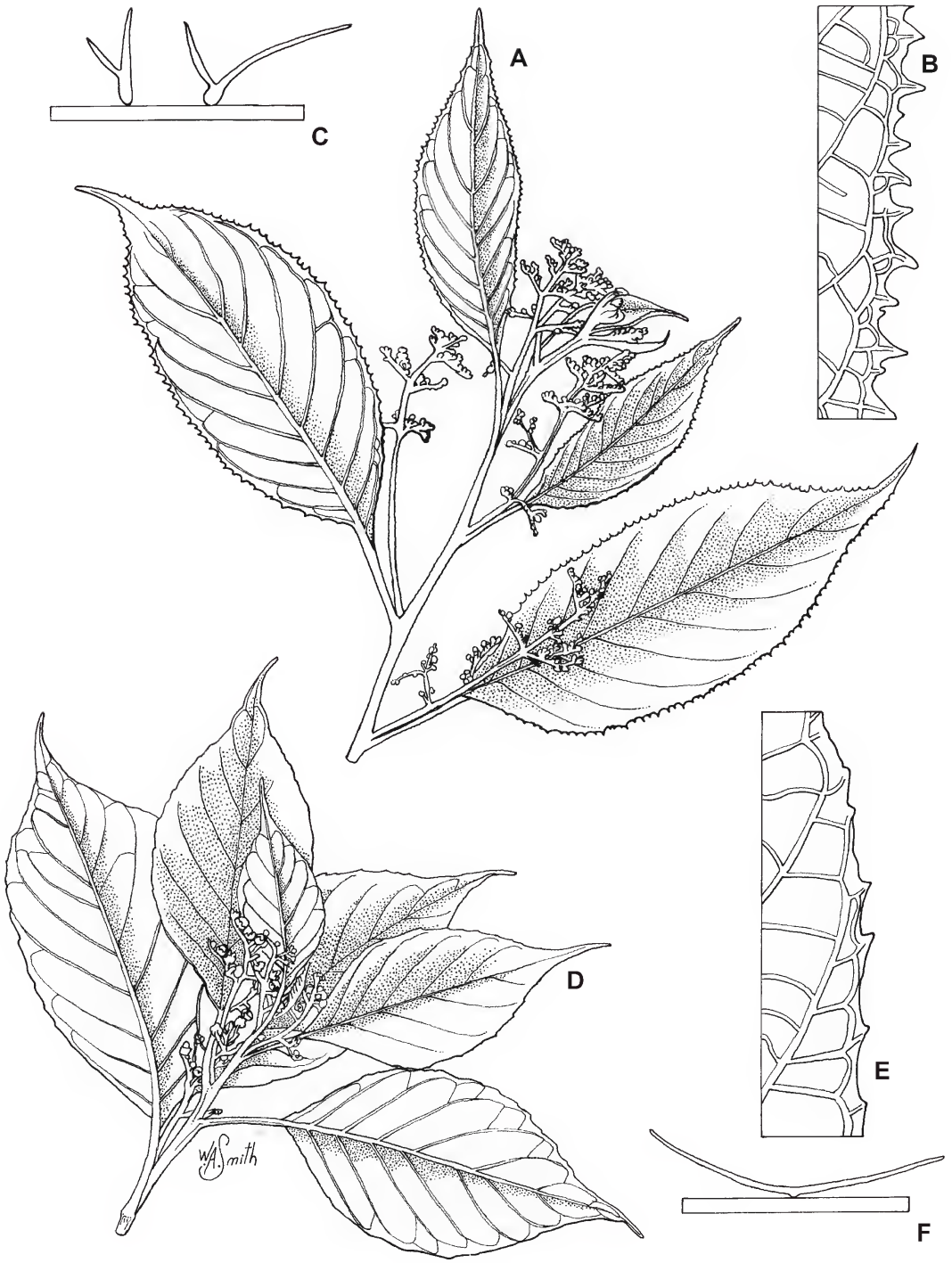


Fig. 5. A–C. *Argophyllum loxotrichum*. A. flowering branchlet ×0.5. B. lamina margin ×2. C. hairs from upper leaf surface ×60; **D–F. *A. lejourdanii*.** D. flowering branchlet ×0.6. E. lamina margin ×2. F. hair from upper leaf surface ×40. A–C from *Ford 4691* (BRI); D–F from *Forster PIF8348 & Bean* (BRI). Del. W. Smith.

(BRI); 37 km along Kirrama Road, towards Kirrama Station, Feb 1996, *Forster PIF18367 & Ryan* (BRI, CNS, MEL); Kirrama Range, 11.5 km from Kennedy, Jun 1994, *Forster PIF15257* (BRI); SF 461, Compartment 7, Nov 1976, *Thorsborne & Thorsborne 324* (BRI); Five Mile Creek near Cardwell, Aug 1979, *Byrnes 3924* (BRI); Near South Pinnacle, 25 km SW of Townsville, Sep 1992, *Bean 5065* (BISH, BRI); Elliot Toe, Bowling Green Bay NP, 9 km NNE of Woodstock, May 1991, *Forster PIF8348 & Bean* (BRI, CANB, CNS, K); Mt Elliot, Jun 1985, *Cumming s.n.* (BRI [AQ398182]); NPR 253 (Mt Elliot), Dec 1977, *Hyland 9586* (CNS).

***Distribution and habitat*:** *Argophyllum lejourdanii* is endemic to the Brigalow Belt and Wet Tropics bioregions of northeast Queensland and occurs from Murray Falls near Cardwell to Mt Elliot, south of Townsville (**Map 1**). It inhabits granite rock outcrops and pavements on slopes or the edges of watercourses. Altitude is typically less than 100 metres around Cardwell, but up to 600 metres near Townsville.

***Phenology*:** Flowers are recorded from May to December; fruits in February, August, November and December.

***Affinities*:** *Argophyllum lejourdanii* is distinguished by its axillary inflorescences, the persistent hairs (longest ones 0.8–1 mm long) of the upper leaf surface, the brown or rusty new growth, and the white hairs on the lower leaf surface of fully expanded leaves. It is morphologically similar to *A. ferrugineum* (see notes there) and the two species can be regarded as an example of an allopatric speciation event.

***Notes*:** Populations from the Cardwell area tend to have longer leaf-teeth than those further south. In some specimens from the Townsville area, the teeth are almost lacking.

Prior to this revision, the name *Argophyllum lejourdanii* has been applied to a number of collections that are now variously assigned to *A. ferrugineum*, *A. heterodontum*, *A. iridescens*, *A. loxotrichum* and *A. palumense*.

***Conservation status*:** *Argophyllum lejourdanii* occurs in a number of National Parks (Bowling Green Bay, Girramay, Girringun) and whilst there are no obvious threats, the rock pavement/outcrop habitat is subject to weed invasion, particularly by introduced pasture/weed grasses such as *Sporobolus* species. There are at least eight populations based on geographical discontinuity and more are likely given the largely unexplored nature of much of the species range of occurrence. At this stage a conservation status of **Least Concern** (Queensland *NCA 1992*) is recommended.

***Etymology*:** Named for Alfred Lejourdan, 'Ingénieur agricole, Directeur du Jardin des Plantes' an agricultural engineer and Director at the Jardin botanique E.M. Heckel (Jardin botanique de Marseille). Lejourdan was one of Mueller's correspondents and supplied seeds to the Royal Botanic Gardens, Melbourne. He was best known for his 1864 treatise *De La Maladie Noire Des Plantes*.

8. Argophyllum loxotrichum A.R.Bean & P.I.Forst. **sp. nov.** with affinity to *A. lejourdanii*, but differing by the leaf hairs with obliquely ascending arms, the shorter overall hair length, and the creamy-white new growth. **Typus:** Queensland. North Kennedy District: Stony Creek, near Wallaman Falls, west of Ingham, 12 August 1951, *S.T. Blake 18791A* (holo: BRI; iso: CANB, K, MO).

Shrub or small tree 2–3.5 m high. Hairs on new growth white or creamy; hairs more than 10 cm from growing point creamy-white. Petiole 16–24 mm long; fully expanded lamina elliptical, broadly-elliptical or ovate, 108–178 mm long, 43–73 mm wide, 1.7–2.8 times longer than wide; 7–9 secondary veins on either side of midrib. Lamina apex acuminate; base cuneate, not oblique or occasionally oblique by up to 12 mm. Lamina margins dentate, with teeth all about equal in length or sometimes varying in length (alternating long and short), 12–87 on each side of the lamina, the longer teeth 0.8–3.5 mm long. Upper surface of fully expanded lamina pale green, with a moderately dense indumentum of biramous hairs, the arms obliquely ascending, the longer arm 0.4–0.6 mm long, the shorter arm 0.1–0.3 mm long. Lower surface of lamina white, hairs ascending (not appressed); secondary veins white or creamy, raised; tertiary veins white, ± flush with indumentum. Inflorescences

axillary, paniculate, 48–146 mm long, densely tomentose, primary axis 40–131 mm long, secondary branches 6–29 mm long, bracts narrowly-deltate, 2.2–7.5 mm long. Pedicels 0.5–1.2 mm long; flowering hypanthium cupular, 3.1–3.8 mm diameter. Calyx lobes 0.7–1.8 mm long; petals 2.1–3.2 mm long, white, corolla appendages white, 1–1.5 mm long. Staminal filaments 1.1–1.3 mm long; anthers 0.5–0.9 mm long. Style 0.9–1.1 mm long; ovary 2-locular. Capsules with cupular hypanthium, 2.6–3 mm long, 3.8–4.5 mm diameter, teeth 4. Seeds 0.5–0.6 mm long. **Fig. 5A–C, 8E**.

***Additional specimens examined*: Queensland.** Cook District: Mt Somerset, N of Mossman, Aug 2003, *Jago 6513* (BRI); Black Mountain, Jul 1999, *Jago 5309 et al.* (BRI); Road from Mossman to Mt Molloy, Mowbray Forest, Nov 2000, *Gottsberger 21-261100* (CNS); Rex Range, Feb 1995, *Gray 5958* (CNS); *ibid*, Oct 1995, *Gray 6333* (CNS); Rex Range, lower slopes, Sep 1993, *Sankowsky 1421* (CNS); Spring Creek Falls, Mar 1996, *Jago 3891* (BRI); *c.* 1.5 km W of Captain Cook Highway, N of Cairns; junction of Viever and Hartley Creeks, Jul 2005, *Halford Q8521 & Jensen* (BRI). North Kennedy District: Lannercost Range, *c.* 30 km W of Ingham, Jun 1982, *Telford 8772* (BRI, CANB, NSW); walking track, Wallaman Falls NP, *c.* 50 km W of Ingham, Jan 1997, *Bean 11587* (BRI); Girringun NP, *c.* 1 km from Stony Creek bridge along road to Garrawalt Creek, W of Ingham, Sep 2005, *Ford 4691* (BRI); 400 metres E of Stony Creek on the Seaview Range, Dec 1995, *Irvine 2373* (CNS); Mt Fox, Jan 1949, *Clemens s.n.* (BRI [AQ417080]); Princess Hills section of Lumholtz NP, 314 km by road NNW of Charters Towers, Sep 2002, *Thomas 2411* (BRI).

***Distribution and habitat*:** *Argophyllum loxotrichum* is endemic to the Wet Tropics bioregion of northeast Queensland and occurs in two distinct and greatly disjunct population centres that are *c.* 225 km apart. The southern populations are west of Ingham and the northern populations between Cairns and Mossman (**Map 1**). The southern populations occur in grassy woodland with *Corymbia intermedia* (R.T.Baker) K.D.Hill & L.A.S.Johnson, *Lophostemon suaveolens* (Sol. ex Gaertn.) Peter G.Wilson & J.T.Waterh. and *Allocasuarina torulosa* (Aiton) L.A.S.Johnson, or on the ecotone between this forest and rainforest (simple notophyll vineforest), or in "light" rainforest. The northern populations inhabit stunted complex notophyll vineforest. The geological substrate may be granite, metamorphics or rhyolite. Altitudes range from 100–1060 metres, but mostly around 500 metres.

***Phenology*:** Flowers are recorded for January and February, and from May to November; fruits are recorded from January, July, September and October.

***Affinities*:** *Argophyllum loxotrichum* is similar to *A. lejourdanii*, but differs by the hairs on the upper leaf surface having obliquely ascending arms (arms parallel to the leaf surface for *A. lejourdanii*), the overall hair length (sum of the length of the two arms) 0.6–0.8 mm long (0.8–1 mm long for *A. lejourdanii*), and the creamy-white new growth (rusty new growth for *A. lejourdanii*).

***Notes*:** Collections of this species prior to this revision have been usually identified as *Argophyllum lejourdanii*.

Specimens from the Cairns – Mossman area populations tend to have fewer teeth on the leaf margins, and the teeth are often shorter than those from the Ingham area.

***Conservation status*:** *Argophyllum loxotrichum* is known from at least ten populations based on geographical discontinuity. At least six of these occur in National Parks (Girrungun, Kuranda, Macalister Range, Mowbray). There are no known threats, although the rocky habitats are subject to invasion from introduced pasture/ weed grasses such as *Sporobolus* species. The area of occupancy is small within the overall area of occurrence due to the limited occurrence of the habitat patches. At this stage a conservation status of **Least Concern** (Queensland *NCA 1992*) is recommended.

***Etymology*:** From the Greek *loxos* (slanting or oblique) and *trichos* (hair). This refers to the slanting arms possessed by the biramous hairs in this species, resulting in Y-shaped hairs.

9. Argophyllum nullumense R.T.Baker, *Proc. Linn. Soc. N.S.W.* 24: 439 (1899); *A. nitidum* var. *nullumense* (R.T.Baker) Ewart, Jean White & B.Rees, *Proc. Roy. Soc. Victoria*, ser. 2, 22: 10 (1909). **Type citation:** "a plant from Nullum Mt., Murwillumbah (W.B.)" **Type:** New South

Wales. Nullum Mt, Murwillumbah, December 1896, *W. Baeuerlen 1873* (lecto: NSW 371693 [here designated]; isolecto: BRI [AQ342381], CANB 00552737, MEL 2234901, NSW 505695, NSW 372756).

[*Argophyllum nitidum auct. non* J.R.Forst. & G.Forst.; F.Muell., *Vict. Nat.* 9: 5 (1892); R.T.Baker, *Proc. Linn. Soc. N.S.W.* 22: 232 (1897); F.M.Bailey, *Queensl. Fl.* 2: 533 (1900)].

Shrub 1.5–4 m high. Hairs on new growth white or creamy; hairs more than 10 cm from growing point white or creamy. Petiole 9–14 mm long; fully expanded lamina elliptic to narrowly-elliptic, 81–186 mm long, 23–56 mm wide, 2.6–4.6 times longer than wide; 7–11 secondary veins on either side of midrib. Lamina apex shortly acuminate, or occasionally acute; base cuneate, not oblique. Lamina margins serrate, with teeth all about the same size, or varying in length (alternating long and short), 2–9(–12) on each side of the lamina, the longer teeth 0.3–2 mm long. Upper surface of fully expanded lamina green, glabrous; hairs on developing leaves appressed, 0.2–0.3 mm long. Lower surface of lamina white or creamy, hairs appressed; secondary veins white, raised; tertiary veins white, ± flush with indumentum. Inflorescences terminal, paniculate cymose, 53–130 mm long, densely tomentose, primary axis 32–108 mm long, secondary branches 17–58 mm long, bracts narrowly-deltate, 2–8 mm long. Pedicels 1.3–2 mm long; flowering hypanthium cupular, 2.9–3.5 mm diameter. Calyx lobes 0.8–1.5 mm long; petals 2.4–2.9 mm long, white, corolla appendages white, 1.8–2 mm long. Staminal filaments 1.2–1.3 mm long; anthers 0.6–0.7 mm long. Style 1.7–2 mm long; ovary 2-locular. Capsules with cupular hypanthium, 3.4–4.3 mm long, 3.4–4.2 mm diameter, teeth 4, exserted. Seeds 0.55–0.7 mm long. **Figs. 6, 8A–D**.

***Additional selected specimens examined*: Queensland.** South Kennedy District: R 573 Eungella, Finch Hatton Gorge, May 1975, *Hyland 8243* (CNS); Finch Hatton Gorge, Eungella NP, Jan 1991, *Pearson 431* (BRI). Port Curtis District: Portion 36, Castletower, 17 km SE of Calliope, Oct 1988, *Gibson TOI333* (BRI, MO, NSW); Mt Castletower NP, W slopes, Feb 1995, *Forster PIF16196* (BRI, MEL); TR 99, Many Peaks Range, 12 km SSW of Bororen, Jan 1992, *Gibson TOI1143* (BRI); Colosseum Creek, SF 645, Oct 1993, *Thomas et al. RFR193* (BRI, NSW). Wide Bay District: Marsupial LA, SF 391, ENE of Kalpowar, Sep 1995, *Bean 8926 & Robins* (BRI, MEL); TR 375, Palm Valley, Coast Range, Dec 1989, *Forster PIF6159* (BRI, CANB, CNS, K, NSW); *c.* 15 km SSE of Biggenden, in the Coast Range at 'Utopia', Oct 1986, *Russell-Smith 1847 & Lucas* (BRI). Moreton District: 4.3 km past bridge over Little Nerang Creek, Mudgeeraba to Springbrook Road, Feb 1991, *Forster PIF7799 & Leiper* (BRI, CNS); Egg Rock, Numinbah Valley, Jan 1991, *Bean 2855* (BRI); Warrie Circuit track, Springbrook NP, Jan 1993, *Thomas & Barry s.n.* (BRI [AQ363323]); Springbrook NP, Twin Falls Circuit track, Aug 2006, *Forster PIF31816* (BRI); Waterfall Creek, Numinbah Valley, Gold Coast City Council Conservation Area, Oct 2013, *Forster PIF40574 & Leiper* (BRI); Camp Eden, Currumbin Valley, Dec 1997, *Forster PIF22031 & Leiper* (BRI, CNS, MEL); Lamington NP, Echo Point Bithongabel, May 1948, *Smith 3630 & Webb* (BRI); Lamington NP, track above Picnic Rock, West Canungra Creek, May 2012, *Forster PIF38711 et al.* (BRI, US). **New South Wales.** Mt Warning, Sep 1972, *Rodd 2240* (BRI, NSW); Head of Goolmangar Creek, Feb 1980, *Floyd 1456* (BRI); beside road following Bilambil Creek to Bilambil, 9.2 km W of Stotts Island, Feb 1990, *Davies 1559 & Richardson* (AD, BRI, CANB, MEL, NSW); Tumbulgum, Feb 1897, *Baeuerlen s.n.* (BRI [AQ342385]); Mt Neville track, Mt Nardi, NE of Nimbin, Feb 2000, *Bean 16015* (BRI, MEL, NSW).

***Distribution and habitat*:** *Argophyllum nullumense* has the largest distribution range and greatest number of populations of the Australian species in the genus. The species is endemic to eastern Australia with three population centres (from Terania Creek, northeast NSW, to Lower Beechmont in the South East Queensland bioregion; Mt Walsh NP north to Castle Tower NP in the South East Queensland bioregion; Finch Hatton Gorge in Eungella NP in the Central Queensland Coast bioregion) (**Map 4**). The single population at Finch Hatton Gorge in the Eungella Range is *c.* 490 km disjunct from the Castle Tower populations.

This species is also the most catholic in its habitat preferences, occurring variously on the edges of rainforest streams and the ecotonal margins of rainforest (complex notophyll vineforest) and wetter sclerophyll open forest, on diverse substrates (andesite, basalt, basalt intermixed with trachyte, granite, granodiorite, rhyolite, metamorphics/ metasediments). Altitudes range between *c.* 100 and 1050 m.

Fig. 6. ***Argophyllum nullumense***. A. flowering branchlet ×0.6. B. lamina margin ×2. C. hair from upper leaf surface ×60. A–C from *Forster PIF6159* (BRI). Del. M. Saul & W. Smith.

***Phenology*:** Flowers are recorded from September to February; fruits are recorded for every month of the year.

***Typification*:** The name *Argophyllum nitidum*, based on a collection from New Caledonia, was first misapplied to this species by Mueller (1892).

The fertile and dated William Baeuerlen gathering from Mt Nullum is the only possible candidate for the type of *A. nullumense* and the best sheet at NSW is here selected as lectotype for the name.

***Affinities*:** *Argophyllum nullumense* appears to be allied to *A. cryptophlebum*, but differs by the creamy-white new growth (brown or rusty for *A. cryptophlebum*); the leaves (2.6–3–4.6 times longer than broad (1.5–2.9 times for *A. cryptophlebum*); the petioles 7–14 mm long (13–38 mm long for *A. cryptophlebum*), and the hairs on the leaves 0.2–0.3 mm long (0.3–0.5 mm long for *A. cryptophlebum*).

***Conservation status*:** This species is widespread with many populations. It occurs in a number of National Parks in New South Wales and Queensland (Bulburin, Castle Tower, Eungella, Lamington, Mt Walsh, Mt Warning, Nightcap, Springbrook, Warro). The appropriate conservation status for the species is **Least Concern**.

***Etymology*:** The epithet refers to the type locality, Mt Nullum, in north-eastern New South Wales.

10. Argophyllum palumense A.R.Bean & P.I.Forst. **sp. nov.** with affinity to *A. lejourdanii*, but differing by the white or creamy new vegetative growth, the mostly narrower leaves, the shorter hairs of the upper leaf surface, and the larger seeds. **Typus:** Queensland. North Kennedy District: 1.5 km east of Mt Zero, Mt Zero – Taravale sanctuary, NW of Townsville, 17 May 2009, *A.R. Bean 28892 & R. Jensen* (holo: BRI).

Shrub or small tree 1–6 m high. Hairs on new growth white or creamy; hairs more than 10 cm from growing point creamy-white. Petiole 21–29 mm long; fully expanded lamina elliptical, 116–178 mm long, 36–60 mm wide, 2.4–3.8 times longer than wide; 6–8 secondary veins on either side of midrib. Lamina apex acuminate; base cuneate, not oblique. Lamina margins dentate, with teeth of varying length (alternating long and short), 26–61 on each side of the lamina, the longer teeth 1.7–3.2 mm long. Upper surface of fully expanded lamina green, sparsely hairy; hairs appressed, 0.6–0.8 mm long. Lower surface of lamina white, hairs appressed; secondary veins white, raised; tertiary veins white, ± flush with indumentum. Inflorescences axillary, paniculate, 35–113 mm long, densely tomentose, primary axis 25–92 mm long, secondary branches 9–27 mm long, bracts narrowly-deltate, 2–12 mm long. Pedicels 1.2–1.5 mm long; flowering hypanthium cupular, 3–3.5 mm diameter. Calyx lobes 1.1–1.4 mm long; petals 3.3–3.5 mm long, white, corolla appendages white, 1.2–1.3 mm long. Staminal filaments 1.3–1.6 mm long; anthers 0.9–1 mm long. Style 1–1.8 mm long; ovary 2-locular. Capsules with cupular hypanthium, 2.6–3.2 mm long, 3.4–4 mm diameter, teeth 4. Seeds 0.5–0.6 mm long. **Fig. 7A–C**.

***Additional specimens examined*: Queensland.** North Kennedy District: Mt Spec, Mar 1933, *White 8972* (BRI); 6 km from Hidden Valley towards Paluma, May 1991, *Bean 3060* (BRI); Ewan Road, Mt Spec area, *c.* 17.6 km from Paluma, Sep 1974, *Williams 51* (BRI); Hidden Valley road, west of Paluma township, Dec 2001, *Franks AJF0112004* (BRI); 17 km past Paluma on road to Hidden Valley, Jan 1992, *Forster PIF9478* (BRI, DNA, K, MEL); 8.5 km from Paluma along road to Hidden Valley, Aug 1996, *Telford 12143* (BRI, CANB, NE); Crystal Creek on lower slopes of Mt Spec, Feb 1980, *Stanley 8032A* (BRI); Near Palm Tree Creek, Thornton Gap Road, Mar 2001, *Ford AF2754* (BRI, CNS); Paluma Range, Bluewater area, Nov 1990, *Jackes 9056* (BRI).

***Distribution and habitat*:** *Argophyllum palumense* is endemic to the Wet Tropics bioregion of northeast Queensland from a restricted area of mountainous terrain northwest of Townsville, including the Paluma – Hidden Valley area, Bluewater State Forest, and Thornton Gap (**Map 1**). It inhabits creek banks or hillsides on sandy soils derived from granite, in wet sclerophyll forest dominated by (for example) *Corymbia intermedia* and *Eucalyptus portuensis* K.D.Hill, and often with a rainforest understorey. Altitude ranges from 500 to 900 metres.

***Phenology*:** Flowers are recorded from May to December; fruits from November to March.

***Affinities*:** *Argophyllum palumense* is morphologically similar to *A. lejourdanii*, but differs by the white or creamy new vegetative growth (rusty or brown for *A. lejourdanii*), the leaves 2.4–3.8 times longer than broad (1.9–2.8 times for *A. lejourdanii*), the hairs of the upper leaf surface 0.6–0.8 mm long (0.8–1 mm long for *A. lejourdanii*), and the seeds 0.5–0.6 mm long (0.4–0.5 mm long for *A. lejourdanii*).

***Conservation status*:** *Argophyllum palumense* has a narrow range of occurrence with probably three known populations. One of these occurs in Paluma Range NP (Crystal Creek) and another in the Mt Zero – Taravale Nature Refuge. Most collections have been made from adjacent to the Ewan – Paluma road between Paluma and Hidden Valley; however, this population (with a number of subpopulations) is not conserved. There are no obvious threatening processes; however, the species has a relatively small overall area of occupancy within the known area of occurrence and is subject to stochastic events. A suitable conservation status is **Vulnerable** based on the criterion **D2** (IUCN 2012).

***Etymology*:** The epithet refers to the small township of Paluma, near where most collections have been made.

11. Argophyllum verae P.I.Forst., *Austrobaileya* 3: 173 (1990). **Type:** Queensland. Cook District: 1 km N of Maloney's Springs, 19 June 1989, *P.I. Forster PIF5285 & M.C.*

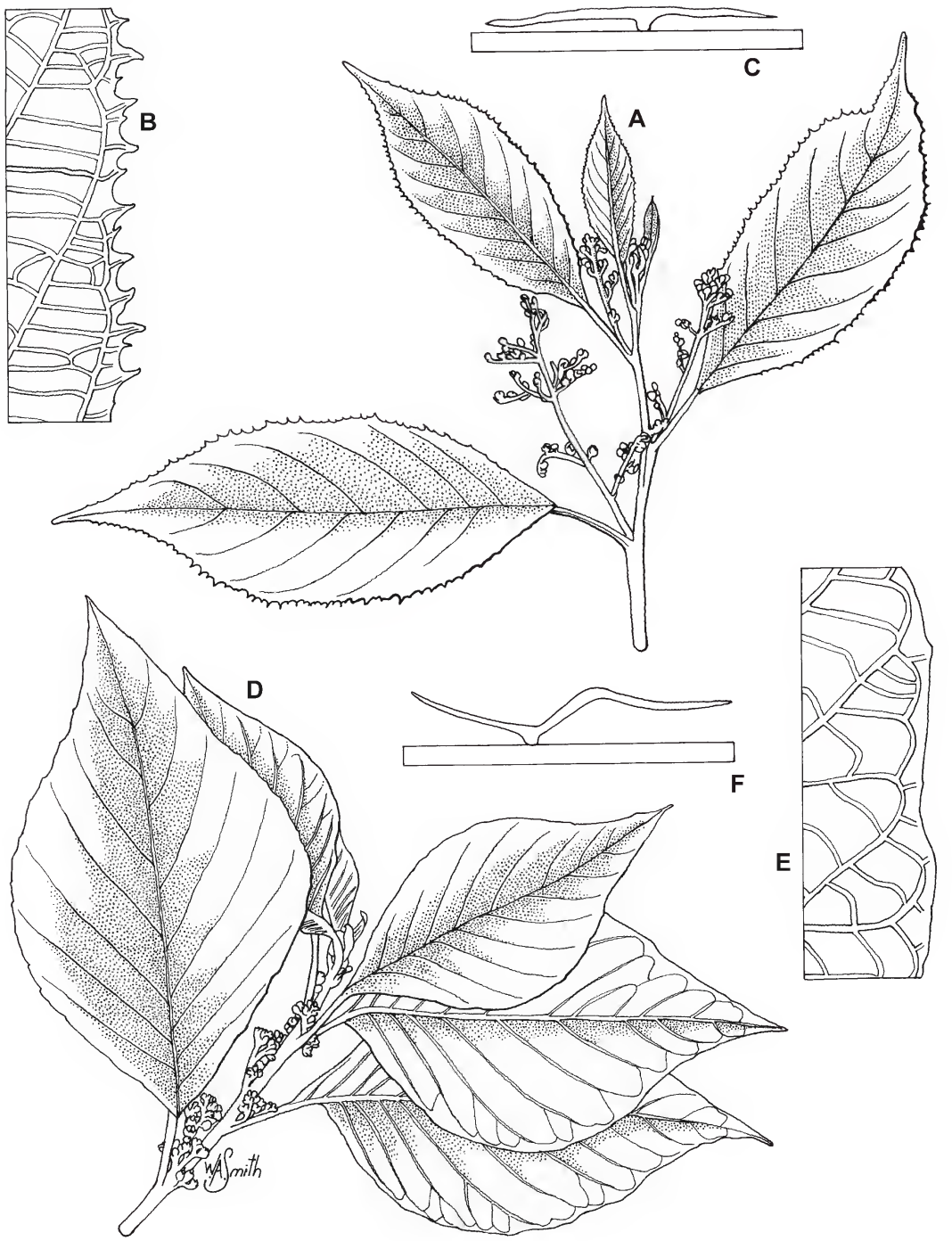


Fig. 7. A–C. *Argophyllum palumense*. A. flowering branchlet ×0.6. B. lamina margin ×2. C. hair from upper leaf surface ×60; **D–F. *A. verae*.** D. flowering branchlet ×0.5. E. lamina margin ×2. F. hair from upper leaf surface ×60. A–C from *Bean 28892 & Jensen* (BRI); D–F from *Gray 6810* (BRI). Del. W. Smith.

Tucker (holo: BRI [3 sheets + spirit material]; iso: CANB, CNS, K, MEL, MO, P).

Shrub 1.5–2 m high. Hairs on new growth white or creamy; hairs more than 10 cm from growing point creamy-white. Petiole 12–30 mm long; fully expanded lamina broadly elliptical, 89–174 mm long, 30–95 mm wide, 1.8–2.4 times longer than wide; 8 or 9 secondary veins on either side of midrib. Lamina apex acute; base cuneate, not oblique or oblique at base by up to 9 mm. Lamina margins entire or denticulate, with teeth all about the same length, 19–25 on each side of the lamina, the teeth 0.3–0.7 mm long. Upper surface of fully expanded lamina grey-green, with sparse to moderately dense hairs; hairs appressed or sometimes ascending, 0.7–1 mm long. Lower surface of lamina white, hairs obliquely ascending; secondary veins white, raised; tertiary veins white, ± flush with indumentum. Inflorescences axillary, paniculate, 23–68 mm long, densely tomentose, primary axis 10–47 mm long, secondary branches 5–20 mm long, bracts deltate, 1.5–7.5 mm long. Pedicels 0.6–2 mm long; flowering hypanthium cupular, 3–3.4 mm diameter. Calyx lobes 1.5–2.3 mm long; petals 2.7–3.3 mm long, white, corolla appendages white, 1.1–1.5 mm long. Staminal filaments 1–1.6 mm long; anthers 0.5–0.8 mm long. Style 0.8–1.4 mm long; ovary 2-locular. Capsules with cupular hypanthium, 2.6–3 mm long, 2.6–4 mm diameter, teeth 4. Seeds 0.4–0.5 mm long. **Fig. 7D–F**.

***Additional specimens examined*: Queensland.** Cook District: Maloneys Springs, Bromley, Jun 1996, *Forster PIF19320* (BRI, MEL); Mahoneys [*sic*] Springs, head of Hann River, Jun 1996, *Gray 6810* (BRI, CNS); *ibid*, Jun 1996, *Gray 6813* (BRI, CNS); Glennie Tableland, Aug 2008, *Wannan 5357 et al.* (BRI); NW slopes of Melville Range, Cape Melville, Oct 1992, *Neldner 4160 & Clarkson* (BRI); Cape Melville NP, 11 km SW of Cape Melville, Oct 1992, *Fell DGF2692 & Stanton* (BRI); Cape Melville NP, Melville Range, May 2014, *Forster PIF41463* (BRI). Cultivated. Kholo, ex NW slopes of Melville Range, Cape Melville, Jan 2004, *Tucker s.n.* (BRI [AQ743188]).

***Distribution and habitat*:** *Argophyllum verae* is endemic to the Cape York Peninsula bioregion of far north Queensland where it is known from two population centres (**Map 2**) that are greatly disjunct by *c.* 270 km. On the Glennie Tableland it inhabits clifflines bordering microphyll vinethicket or notophyll vineforest on shallow soils over sandstone at a distance of *c.* 20 km from the coast. At Cape Melville it occurs in wind-sheared (due to the constant high velocity wind) microphyll/notophyll vineforest on granite boulder slopes in immediate vicinity or within 3 km to the sea. These two habitats are markedly different both in substrate, marine influence and the vegetation mix that is present.

***Phenology*:** Flowers are recorded in June; fruits in June, August and October.

***Affinities*:** *Argophyllum verae* is perhaps closest to *A. loxotrichum*, but differs from that species by the less consistently Y-shaped hairs on the leaves, the overall hair length (sum of the length of the two arms) 0.6–0.8 mm long (0.7–1.0 mm long for *A. loxotrichum*); the marginal leaf teeth absent or 0.3–0.7 mm long (0.8–3.5 mm long for *A. loxotrichum*); the marginal leaf teeth (when present) in 19–25 pairs (12–87 pairs for *A. loxotrichum*); and the primary axis of the inflorescence 10–47 mm long (40–131 mm long for *A. loxotrichum*).

***Notes*:** Given the considerable disjunction between the two population centres for this species, it is remarkable that plants from either centre are still quite similar in overall features. The main difference between the two is that those from the Glennie Tableland always have thicker leaf laminae in comparison to those from Cape Melville. It is not known if this variation is due to anatomical differences; however, it is maintained when the plants are grown in a common garden situation.

***Conservation status*:** *Argophyllum verae* is currently listed as **Vulnerable** under the Queensland *NCA* (1992). The two subpopulations at the Glennie Tableland are separated by *c.* 5 km and are wholly within the Olive River Environmental Reserve. However, the rugged sandstone escarpment and gorges of the Glennie Tableland remain poorly explored away from the few access points, so it is feasible that further subpopulations exist. At Cape Melville, all three subpopulations are within Cape Melville NP and similarly the area remains poorly explored. Whilst there are

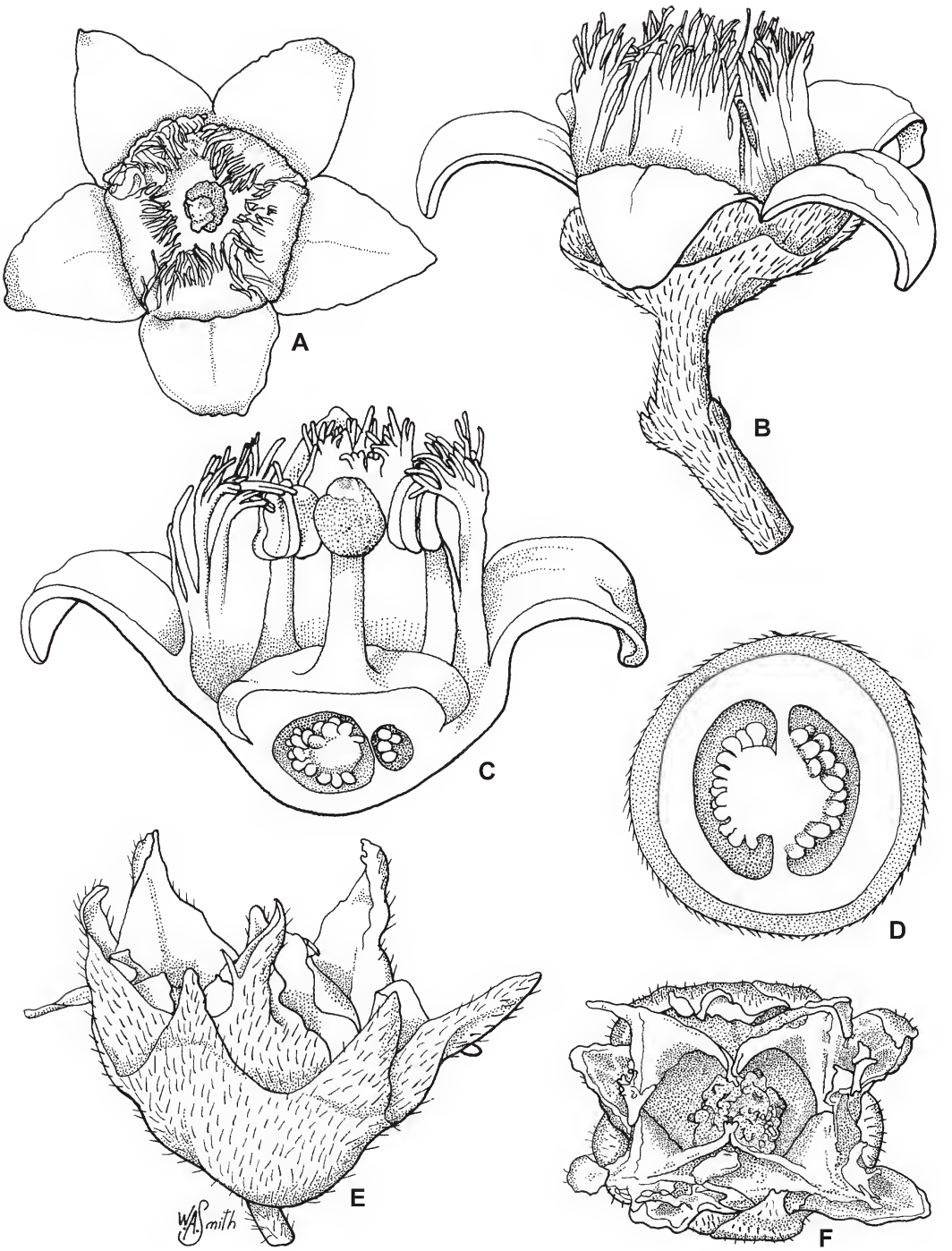


Fig. 8. ***Argophyllum*** flowers and fruits. A. flower from above ×9. B. side view of flower including calyx and pedicel ×12. C. half flower × 15. D. transverse section of ovary ×18. E. side view of fruit ×12. F. fruit from above ×12. A–D, ***A. nullumense*** (*Forster PIF22031 & Leiper*, BRI); E, ***A. loxotrichum*** (*Bean 11587*, BRI); F, ***A. heterodontum*** (*Blake 19769*, BRI).

no immediate threats to this species, the area of available habitat for potential occupancy within the overall area of occurrence is relatively small and the species is subject to stochastic events. The category of **Vulnerable** based on the criterion **D2** remains suitable for this species.

***Etymology*:** The species was named for Vera Scarth-Johnson (b. 1912, d. 1999), a botanical collector and noted botanical artist (Forster 1990).

Acknowledgements

We thank Will Smith (BRI) for producing the excellent illustrations, and for editing the distribution maps; Ron Booth, Glenn Leiper, Rigel Jensen, Garry Sankowsky and Maurie Tucker for assistance with field collections and photographs. The Directors of CANB, CNS, MEL, NSW and W kindly allowed access to their collections of *Argophyllum* on loan or on visits to their institutions.

References

Bailey, F.M. (1900). *The Queensland Flora* 2: 533. H.J. Diddams & Co: Brisbane.

Baker, R.T. (1899). Contributions to a knowledge of the flora of Australia. No III. *Proceedings of the Linnean Society of New South Wales* 24: 437–447.

Bryant, L.M. & Krosch, M.N. (2016). Lines in the land: a review of evidence for eastern Australia's major biogeographical barriers to closed forest taxa. *Biological Journal of the Linnean Society* 119: 238–264.

Carlquist, S. (1974). *Island Biology*. Columbia University Press: New York.

Cronquist, S.L. (1981). *An Integrated System of Classification of Flowering Plants*. Columbia University Press: New York.

Duretto, M.F. & Forster, P.I. (2007). A taxonomic revision of the genus *Zieria* Sm. (Rutaceae) in Queensland. *Austrobaileya* 7: 473–544.

Endlicher, S.L. (1839). Saxifragaceae. In *Genera plantarum secundum ordines naturales disposita*, part 11. pp. 813–823. Fr. Beck: Wien.

Engler, A. (1890). Saxifragaceae. In A. Engler & K. Prantl (eds.), *Die naturlichen Pflanzenfamilien* 3, 2a: 42–93. Verlag von Wilhelm Engelmann: Leipzig.

—— (1928). Saxifragaceae. In A. Engler (ed.) *Die naturlichen Pflanzenfamilien*, 2nd ed., Vol. 18a: 74–226. Verlag von Wilhelm Engelmann: Leipzig.

Ewart, A.J., White, J. & Rees, B. (1909). Contributions to the Flora of Australia. *Proceedings of the Royal Society of Victoria* 22 (n.s.): 6–23.

Forster, J.R. & Forster, G. (1776). *Characteres generum plantarum, quas initinere ad insulas maris australis collegerunt, descripserunt, delinearunt annis* 1772–1775. B.T. White *et al.*, London.

Forster, P.I. (1990). *Argophyllum verae* (Saxifragraceae), a new species from northern Queensland. *Austrobaileya* 3: 173–176.

—— (1996). *Plectranthus alloplectus*, *P. gratus*, and *P. spectabilis* (Lamiaceae), a trio of rock-outcrop succulents from Queensland. *Hasettonia* 5: 47–56

—— (2007). Argophyllaceae. In P.D. Bostock, & A.E. Holland (eds.), *Census of the Queensland Flora 2007*, 22. Queensland Herbarium, Environmental Protection Agency: Brisbane.

—— (2010). Argophyllaceae. In P.D. Bostock, & A.E. Holland (eds.), *Census of the Queensland Flora 2010*, 17. Queensland Herbarium, Department of Environment & Resource Management: Brisbane.

—— (2011). Five new species of *Plectranthus* L.Hér. (Lamiaceae) from New South Wales and Queensland. *Austrobaileya* 8: 387–404.

—— (2017). Argophyllaceae. In P.D. Bostock & A.E. Holland (eds), *Census of the Queensland Flora 2017*. Queensland Department of Science, Information Technology and Innovation: Brisbane. https://www.qld.gov.au/environment/plants-animals/plants/herbarium/flora-census, accessed 10 June 2018.

Grant, V. (1981). *Plant Speciation*, 2nd edition. Colombia University Press: New York.

Guillaumin, A. & Virot R. (1953). Contributions à la Flore de la Nouvelle Calédonie, CII. Plantes récoltées par M.R. Virot. *Mémoires du Museum National d'Histoire Naturelle*, Serie B. *Botanique* 4: 1–82.

Gustafsson, M.H. & Bremer, K. (1997). The circumscription and systematic position of Carpodetaceae. *Australian Systematic Botany* 10: 855–862.

IUCN (2012). International Union for the Conservation of Nature. *IUCN Red List Categories and Criteria, version 3.1*, 2nd ed. https://portals.iucn.org/library/efiles/documents/RL-2001-001-2nd.pdf, accessed 20 February 2018.

Kårehed, J. (2007). Argophyllaceae. In J.W. Kadereit & C. Jeffrey (eds.), *The Families and Genera of Vascular Plants, VIII Flowering Plants. Eudicots. Asterales*, pp. 13–18. Springer-Verlag: Berlin & Heidelberg.

Kårehed, J., Lundberg, J., Bremer, B. & Bremer. K. (1999). Evolution of the Australasian families Alseuosmiaceae, Argophyllaceae and Phelinaceae. *Systematic Botany* 24: 660–682.

Kruckeberg, A.R. (2002). *Geology and Plant Life*. University of Washington Press: Seattle.

Linder, H.P. (2003). The radiation of the Cape flora, southern Africa. *Biological Reviews* 78: 597–638.

Mabberley, D.J. (1997). *The Plant Book. A Portable Dictionary of the Vascular Plants*. Cambridge University Press: Cambridge.

Morley, B.D. (1981a). Saxifragaceae. In B.D. Morley & H.R. Toelken (eds.), *Flowering Plants in Australia*, pp. 143–144. Rigby: Adelaide.

—— (1981b). Cornaceae. In B.D. Morley & H.R. Toelken (eds.), *Flowering Plants in Australia*, p. 214. Rigby: Adelaide.

Mueller, F. (1863). Brexiaceae. *Argophyllum Lejourdani*. *Fragmentae Phytographie Australiae* 4: 33. Government Printer: Melbourne.

—— (1892). In Exhibition of Specimens. *Victorian Naturalist* 9: 5.

Plant List (2018). https://www.theplantlist.org/, accessed 20 February 2018.

Pole, M. (2008). Dispersed leaf cuticle from the early Miocene of southern New Zealand. *Palaeontologia Electronica* 11(3, 15A): 117p; https://palaeo-electronica.org/2008_3/153/index.html.

Porembski, S., Becker, U. & Seine, R. (2000). Islands on islands: habitats on inselbergs. In S. Porembski & W. Barthlott (eds.), *Inselbergs. Ecological Studies* 146: 48–67.

Queensland Nca (1992). Queensland *Nature Conservation Act 1992*. https://www.legislation.qld.gov.au/view/pdf/2013-11-07/act-1992-020, accessed 2 June 2018.

Savolainen, V. & Forest, F. (2005). Species–level phylogenetics from continental biodiversity hotspots. In F.T. Bakker *et al.* (eds.), *Plant Species–Level Systematics: New Perspectives on Pattern and Process,* pp. 17–30. A.R.G. Ganter Verlag K.G.: Ruggell.

Schlechter, R. (1906). Beiträge zur Kenntnis der Flora Neu-Kaledonien. *Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie* 39: 1–274.

Seine, R., Porembski, S. & Becker, U. (2000). Phytogeography. In S. Porembski & W. Barthlott (eds.), *Inselbergs. Ecological Studies* 146: 435–449.

Stevens, P.F. (2001 onwards). *Angiosperm Phylogeny Website*. Version 14, July 2017 [and more or less continuously updated since]. https://www.mobot.org/MOBOT/research/APweb/, accessed 29 June 2018.

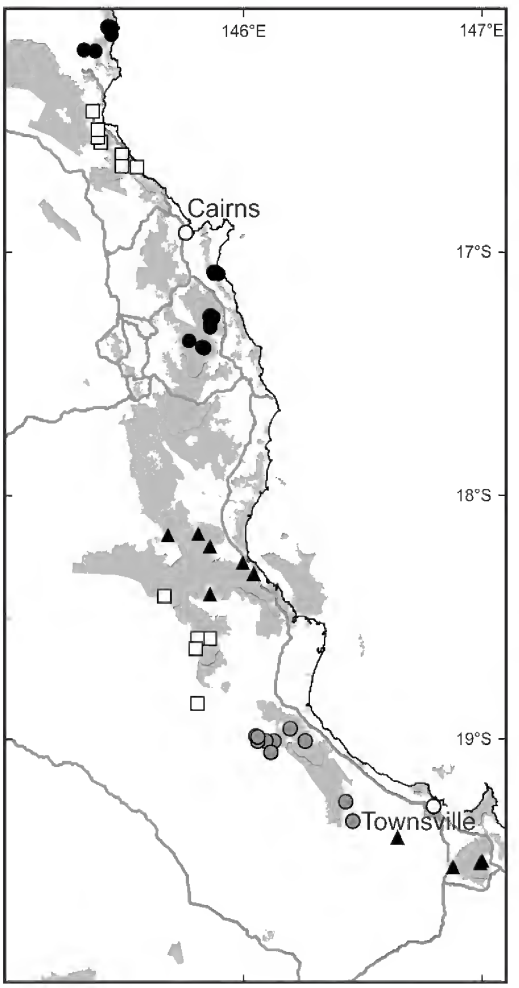
Takhtajan, A. (1983). The systematic arrangement of dicotyledonous families. In C.R. Metcalfe & L. Chalk (eds.), *Anatomy of the dicotyledons*, 2nd ed., 2: 180–201. Clarendon Press: Oxford.

Thorne, R.F. (2000). Classification and geography of the flowering plants: dicotyledons of the class Angiospermae. *Botanical Review* 66: 441–647.

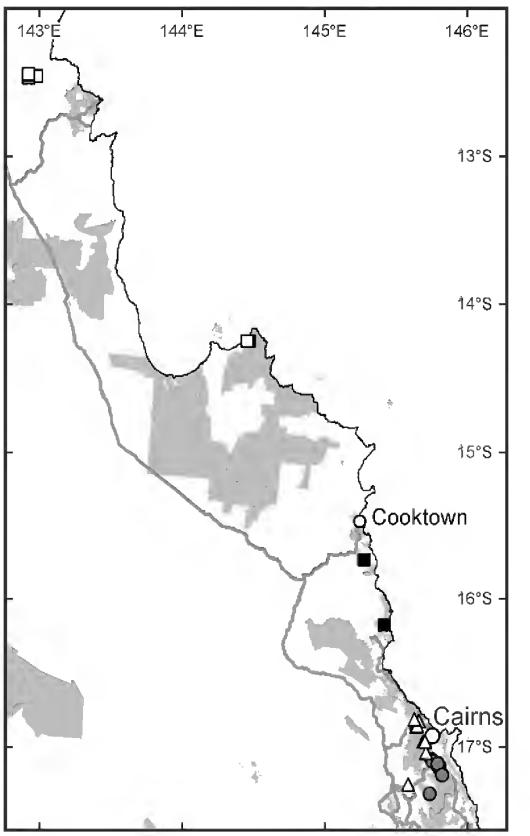
Webb, L.J., Tracey, J.G. & Jessup, L.W. (1986). Recent evidence for autochthony of Australian tropical and subtropical rainforest floristic elements. *Telopea* 2: 575–589.

Willis, J.C. (1966). *A dictionary of the flowering plants and ferns*, 7th ed. revised by H.K. Airy Shaw. Cambridge University Press: Cambridge.

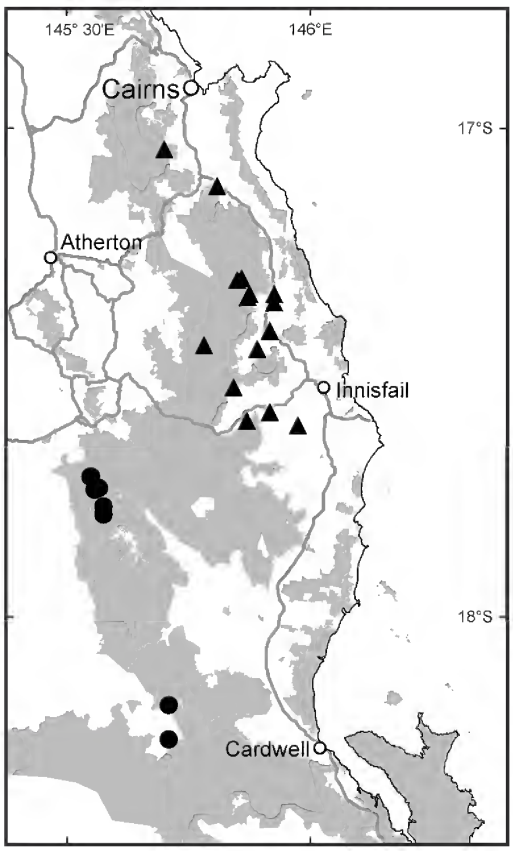
Zemann, M. (1907). Studien zu einer monographie der gattung *Argophyllum* Forst. *Annalen des K. K. Naturhistorischen Hofmuseums* 22: 277–292.



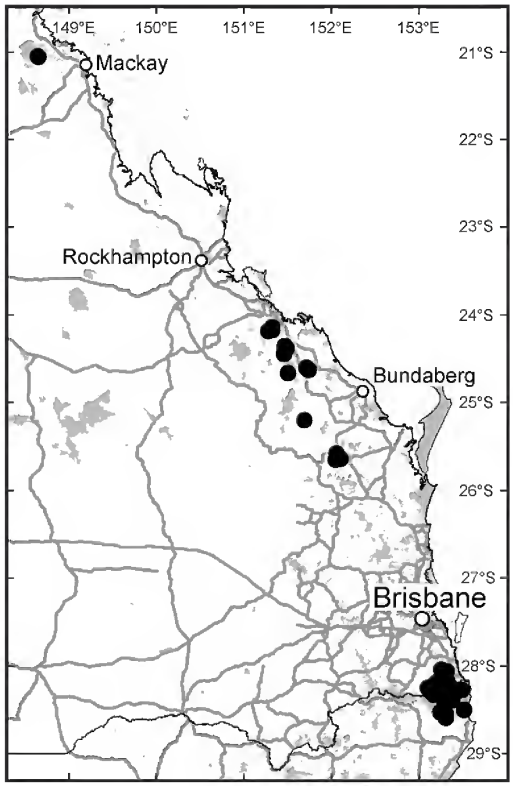
Map 1. Distribution of ***Argophyllum*** species. ● ***A. cryptophlebum***, ▲ ***A. lejourdanii***, □ ***A. loxotrichum***, ● ***A. palumense***.



Map 2. Distribution of ***Argophyllum*** species. △ ***A. curtum***, ● ***A. heterodontum***, ■ ***A. iridescens***, □ ***A. verae***.



Map 3. Distribution of ***Argophyllum*** species. ● ***A. ferrugineum***, ▲ ***A. jagonis***.



Map 4. Distribution of ***Argophyllum nullumense***.

Drummondita borealis Duretto (Rutaceae), a new species from the Northern Territory, and a revised description for *D. calida* (F.Muell.) Paul G.Wilson from Queensland

Marco F. Duretto

Summary

Duretto, M. (2018). *Drummondita borealis* Duretto (Rutaceae), a new species from the Northern Territory, and a revised description for *D. calida* (F.Muell.) Paul G.Wilson from Queensland. ***Austrobaileya* 10(2): 236–241.** *Drummondita calida* is revised and two species are recognised. *Drummondita calida* is endemic to north Queensland and plants from the Northern Territory previously assigned to the species are here described as *D. borealis* Duretto. Descriptions, ecological notes and illustrations are provided for both species and amendments to the key to the genus are provided.

Key Words: Myrtaceae, *Drummondita*, *Drummondita borealis*, *Drummondita calida*, Northern Territory Flora, Queensland flora, new species, taxonomy, identification key

M.F. Duretto, National Herbarium of New South Wales, Royal Botanic Gardens and Domain Trust, Mrs Macquaries Road, Sydney, New South Wales 2000, Australia. Email: marco.duretto@rbgsyd.nsw.gov.au

Introduction

Drummondita Harv. (Rutaceae) is a genus of nine species, eight of which are confined to south-west Western Australia, and the ninth, *D. calida* (F.Muell.) Paul G.Wilson, to the Northern Territory and north Queensland (Wilson 2013). *Drummondita* has received little attention since it was described by Harvey (1855). It was placed in synonymy under *Philotheca* Rudge by Mueller (1869) and later reinstated by Wilson (1971). Five of the nine species were recognised and described relatively recently (Mollemans 1993; Wilson 1998; Meissner & Markey 2007).

Drummondita calida is found disjunctly in the north-eastern Northern Territory and in north Queensland, areas separated by *c.* 1000 km. Like the genus, the species has received little attention and only Wilson (2013), in the *Flora of Australia*, provides an account covering its full geographic range. The description in Wilson (2013) appears to be based largely on material from the Northern Territory though the type of the species is from the Gregory River area, Queensland. There are significantly more herbarium specimens collected from the Northern Territory than Queensland.

During phylogenetic studies of the *Philotheca* / *Phebalium* Vent. group of genera it became apparent that *D. calida* contained two distinct forms. The material from the Northern Territory differs from the Queensland material in having pedicellate flowers (versus sessile), branches being minutely puberulous (versus glabrous or nearly so), narrower leaves that are glabrous (versus glabrous to ciliate) and stamens that barely exceed the corolla tube (versus clearly exserted) (**Figs. 1 & 2**). *Drummondita borealis* Duretto is newly described for the populations found in the Northern Territory. A description for *D. calida sensu stricto* is provided.

Material and methods

Species descriptions are based on examination of herbarium collections held at the Australian Tropical Herbarium (CNS), the National Herbarium of New South Wales (NSW), the Northern Territory Herbarium (DNA) and the Queensland Herbarium (BRI), as well as images of herbarium collections available at JSTOR Global Plants (https://plants.jstor.

Accepted for publication 16 July 2018

org/).

Taxonomy

1. Drummondita calida (F.Muell.) Paul G.Wilson, *Nuytsia* 1: 206 (1971); *Philotheca calida* F.Muell., *Fragm.* 7: 21 (1869). **Type:** Queensland. Cook District: Gilbert River, *s.dat.*, *Daintree s.n.* (holo: MEL232711; iso: BRI [AQ0151566], K 717312).

Dense shrub to 4 m high. Branchlets smooth, glabrous apart from the presence of 2 to several minute and usually dark hairs (similar to stipular excrescences seen in *Philotheca*) at the base of the adaxial surface of the leaves, cream-coloured, leaf scars dark and often giving the branchlets a distinctive geometric pattern, becoming corky and fissured with age. Leaves alternate, often crowded at ends of branches, though sometimes evenly spread, simple, glabrous or ciliate (glabrous only at Bulleringa Range); hairs simple, 0.2–0.7 mm long, sometimes deciduous; sessile or with petiole to 0.5 mm long; lamina slender, trigonous or semi-terete, 8–20 mm long, 0.75–1.2 mm wide, acuminate, glossy, sulcate adaxially. Flowers solitary, 5-merous, sessile, bracteoles absent. Sepals free, ± subequal, orbicular, 6–8 mm long, 4–6 mm wide, leathery, sparsely ciliate to ciliate but otherwise glabrous (colour not recorded). Petals free, erect and forming a tube, narrowly orbicular, 12–17 mm long, sparsely ciliate or ciliate but otherwise glabrous (colour not recorded). Stamens 5, antipetalous, exceeding petals, alternating with 5 slightly longer, antisepalous staminodes; filaments united into a cylinder for *c.* ¾ length, white-sericeous abaxially; anthers 2.5–3 mm long, lacking appendages and obvious glands. Style slender; stigma exserted. Fruit and seed not observed. **Fig. 1**.

***Additional specimens examined*: Queensland.** Cook District: Bulleringa NP, 80 km NW of Mt Surprise, Red River area, Apr 1998, *Forster PIF22556 & Booth* (BRI, CNS, DNA); Bulleringa NP, Sep 2008, *McDonald KRM7945 & Smith* (BRI); Bulleringa NP, May 2000, *O'Keefe s.n.* (BRI [AQ731864]); Wall Creek, W of Gilbert River near 'North Head' Nov 1985, *Jackes s.n.* (BRI [AQ431603]); Gilbert River, plateau between Dingo Creek and Fish Hole Creek, Apr 2010, *Ford 5742 et al.* (BRI, CNS); Gilbert River, upper reaches of Dead Horse Creek, Apr 2010, *Ford 5704 et al.* (BRI, CNS); Gregory Range Station, 120 km NE of Richmond, 27 km ENE of Middle Park Station Airstrip, Apr 2004, *Kahler TH7907 & Appelman* (BRI); Rungulla – Fog Creek boundary, Gregory Range, upper reaches of Clara River, Apr 2010, *Ford 5726 et al.* (BRI, CNS).

***Distribution and habitat*:** *Drummondita calida* is endemic to Queensland and is found on the Gregory Range, at the headwaters of the Gilbert River, and *c.* 150 km to the north in the Bulleringa Range. The species has been found on the tops and bases of sandstone plateaux and ridgelines in heath, shrubland, *Eucalyptus whitei* Maiden & Blakely, *Corymbia* species woodland, and *Acacia shirleyi* Maiden thicket, often with *Triodia*. It can dominate the shrub layer.

***Phenology*:** Flowers have been recorded in April, September and November.

***Notes*:** The leaves of the plants from the Bulleringa Range are glabrous and smaller (**Fig. 1A, C**) than those from the Gregory Range which may be glabrous or ciliate (**Fig. 1E, G**). Further collections and research are needed to determine if this variation warrants taxonomic recognition.

***Conservation status*:** The Bulleringa Range populations are all found within the Bulleringa National Park. The Gregory Range populations are found in Rungalla National Park and North Head Nature Refuge. The species is known from few collections and population data is lacking with most herbarium collections. It is currently listed as **Vulnerable** under the Queensland *Nature Conservation Act 1992.*

2. Drummondita borealis Duretto **sp. nov.** with affinity to *D. calida* but differing in having pedicellate flowers (versus sessile), smaller petals (8–11 mm long versus 12–17 mm long), branches being minutely puberulous (versus with few hairs near base of leaves or nearly glabrous), usually narrower leaves that are glabrous (versus glabrous to ciliate). **Typus:** Northern Territory. Darwin and Gulf: Near Dinner Creek, Kakadu Stage 3, 21 April 1995, *G. Leach 4571 & L. Greschke* (holo: DNA 12551; iso: BRI [AQ531897], CANB [*n.v.*], PERTH [*n.v.*]).

Dense shrub to 1.5 m high. Branchlets smooth, sparsely and minutely puberulous, often with

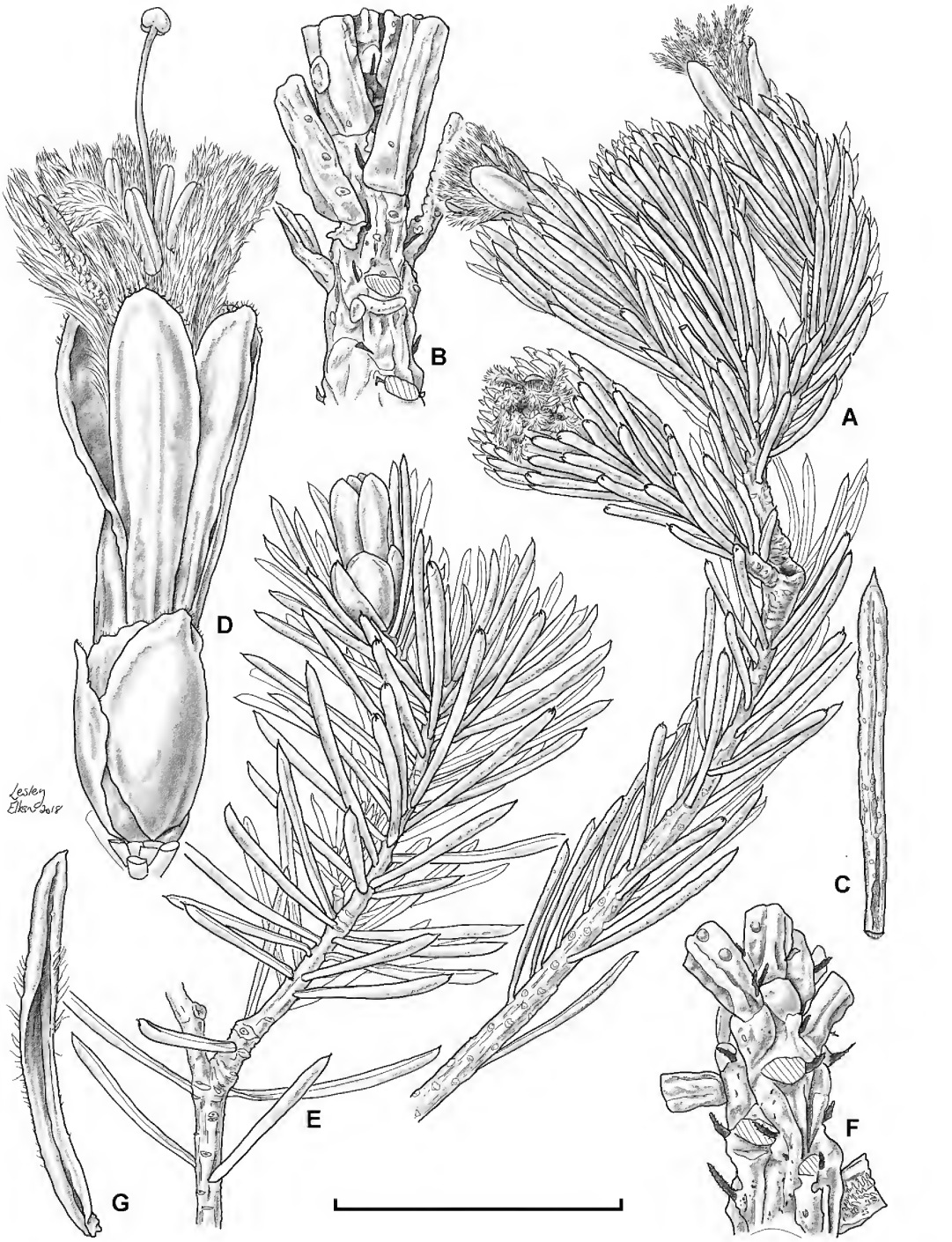


Fig. 1. ***Drummondita calida*** (Bulleringa Range). A. branchlet with flowers. B. stem detail. C. leaf, adaxial surface. D. flower. ***D. calida*** (Gilbert River). E. branchlet with flower. F. stem detail. G. leaf, adaxial surface. A–D from *McDonald 7945* (BRI); E–G from *Ford 5704* (BRI). Scale Bar = 24 mm for A & E, 3.3 mm for B & F, 10 mm for C, D & G. Del. L. Elkan.

small dark hairs (stipular excrescences) at base of adaxial surface of leaves, becoming glabrous with age, cream-coloured, with very little or no cork development. Leaves alternate, usually spread along branches though sometimes crowded at ends, simple, glabrous, sessile or with petiole to 0.5 mm long; lamina slender, trigonous or semi-terete, 12–30 mm long, 0.5–0.75 mm wide, acuminate, glossy, sulcate adaxially. Flowers solitary, 5-merous; pedicel 1.5–2 mm long, fleshy, bracteoles absent. Sepals free, ± subequal, orbicular, 4–6 mm long, 3.5–4 mm wide (enlarging with fruit), leathery, ciliate but otherwise glabrous, green and pink. Petals free, erect and forming a tube, narrowly orbicular, 8–11 mm long, ciliate but otherwise glabrous, white to pink with orange tips. Stamens 5, antipetalous, exceeding petals, alternating with 5 slightly longer, antisepalous staminodes; filaments united into a cylinder for *c.* ¾ length, white-sericeous abaxially; anthers *c.* 2 mm long, lacking appendages and obvious glands. Style slender; stigma exserted. Fruit 5–5.5 mm long, 4 mm wide, glabrous. Seed oblong, minutely patterned, 3.5–4 mm long, black, shiny, *c.* 2 mm wide. **Fig. 2**.

***Additional specimens examined*: Northern Territory**. Darwin and Gulf: Kakadu NP, 4 km SW of Bloomfield Springs, Jan 1995, *Russell-Smith 9115* (DNA); Kakadu NP, source of south Alligator River, Apr 1995, *Russell-Smith 10442* (DNA); Kakadu NP, Bloomfield Springs, Jan 1992, *Russell-Smith 8552* (BRI, DNA); Turnoff Creek – Upper South Alligator catchment, Apr 2001, *Brock 241* (DNA); Kakadu NP, 18.5 km S of Gimbat homestead (below E edge of Marawal Plateau), Apr 1990, *Slee & Craven 2691* (BRI, CANB [*n.v.*], DNA); Kakadu NP, Apr 1990, *Dunlop 8537 & Munns* (BRI, DNA, MEL [*n.v.*], NSW, PERTH [*n.v.*]); Kakadu NP, 4 km SW of Bloomfield Springs, Apr 1989, *Menkhorst 364* (DNA, PERTH *n.v.*); Gimbat Station, source of South Alligator River, July 1983, *Russell-Smith 763* (CANB [*n.v.*], DNA); Edge of Marrawal Plateau, W of Bloomfield Springs, Mar 2008, *Brennan 7494* (DNA); Marrawal Plateau, Apr 1990, *Brennan Bre39 & Orr* (DNA); Marrawal Plateau, near Bloomfield Springs, Apr 1990, *Brennan Bre17* (DNA); Marrawal Plateau, S of Bloomfield Springs, Feb 1996, *Brennan 3198* (DNA); Nitmiluk NP, Douglas Springs area, edge of Murrawal Plateau, May 2001, *Mitchell 2882* (BRI [*n.v.*], DNA); Nitmiluk NP, May 2001, *Mitchell 2785* (DNA); *ibid*, Apr 2002, *Leach & Pritchard 4695* (DNA); *ibid*, NW corner of Murrawal Plateau, May 2002, *Mitchell 3596* (DNA); *ibid*, May 2001, *Risler 1539 & Diechmann* (DNA).

***Distribution and habitat*:** *Drummondita borealis* is endemic to the Northern Territory where it is found from southern Kakadu NP to Nitmiluk NP, mainly in the catchment areas of the South Alligator and Katherine Rivers. The species is found mainly in heath and shrubland, but also in *Melaleuca nervosa* (Lindl.) Cheel or eucalypt woodland, on sandstone, mudstone and ironstone.

***Phenology*:** Flowering material has been collected from January to May, and fruiting material from March to May.

***Conservation status*:** All known populations of *Drummondita borealis* are in Kakadu and Nitmiluk National Parks, and this and the rugged terrain the species is found in, offers excellent protection. Population data are usually lacking with herbarium specimens though the collectors sometimes note that the species was common where found.

***Etymology*:** The specific epithet is derived from the Latin, *borealis* (north or northern), and refers to this species being the most northerly species in *Drummondita*.

Amended key to the species of *Drummondita*

Adapted from Wilson (2013, *Flora of Australia*: p. 427); to replace couplets 1 and 2

1 Leaves mostly >14 mm long, acuminate or apex rounded with a short mucro

2a. Flowers shortly pedicellate; petals 8–11 mm long; sepals 4–6 mm long (NT) . . . . . **D. borealis**

2a. Flowers sessile; petals 12–17 mm long; sepals 6–8 mm long (Qld, SW WA)

2b Petals and sepals ciliate (Qld) . . . . . **D. calida**

2b. Petals and sepals glabrous (SW WA) . . . . . **D. longifolia**

1. Leaves <12 mm long or if longer then with a rounded apex

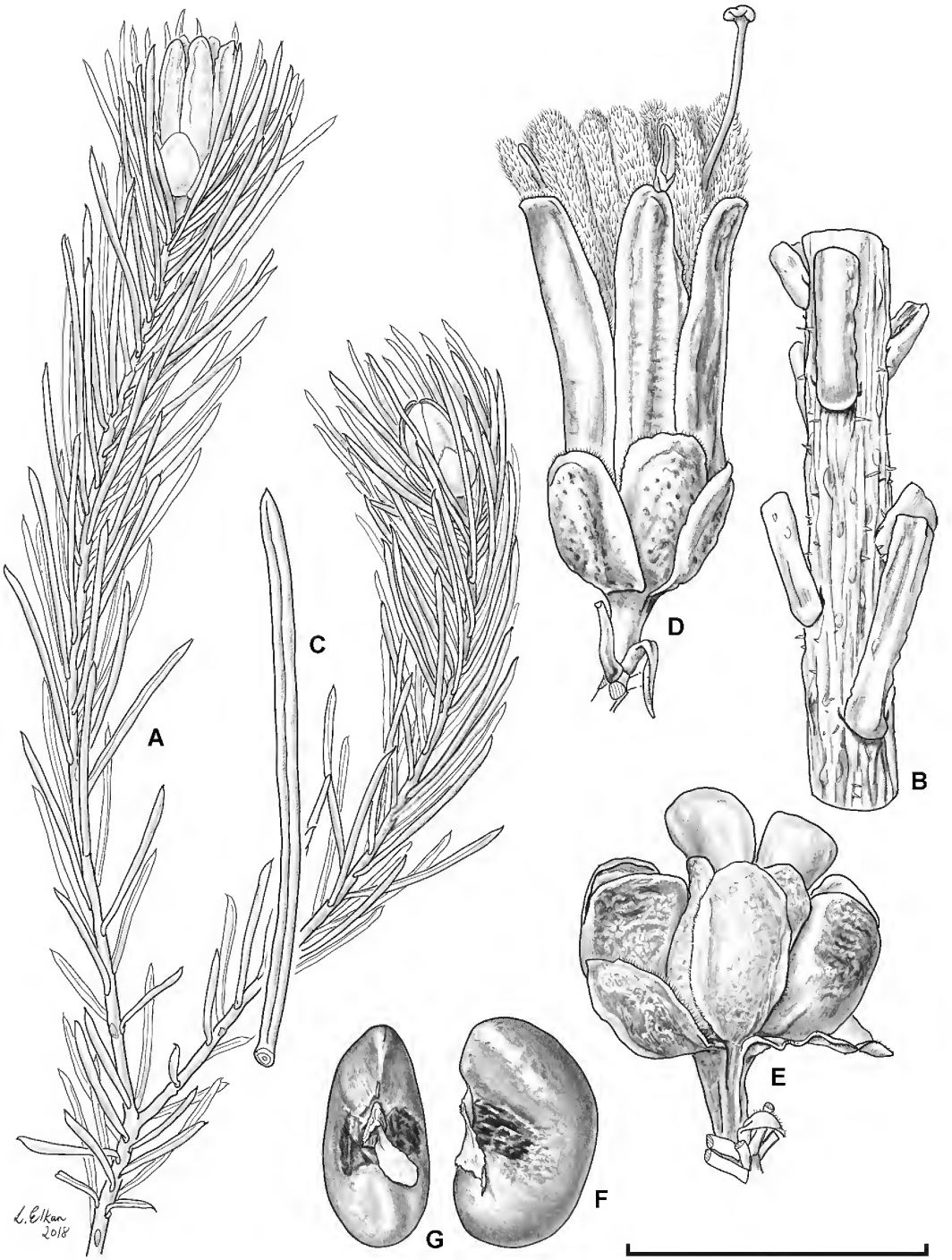


Fig. 2. *Drummondita borealis*. A. branchlet with flowers. B. stem detail. C. leaf, adaxial surface. D. flower. E. fruit. F. seed, lateral view. G. seed, ventral view. A–D from *Leach 4571 & Greschke* (DNA, holotype); E–G from *Russell-Smith 10442* (DNA). Scale Bar = 24 mm for A, 3.3 mm for B, 10 mm for C, D & E, 6 mm for F & G. Del. L. Elkan.

Acknowledgements

I would like to thank the Directors of BRI, CNS and DNA for the loan of material; and Lesley Elkan (NSW) for her excellent line drawings in Figures 1 and 2.

References

Harvey, W.H. (1855). Characters of some new genera of plants recently discovered by Mr. James Drummond in Western Australia. *Hooker's Journal of Botany and Kew Garden Miscellany* 7: 51–58.

Meissner, R.A. & Markey, A.S. (2007). Two new Western Australian species of *Drummondita* (Rutaceae: Boronieae) from banded ironstone ranges of the Yilgarn Craton. *Nuytsia* 17: 273–280.

Mollemans, F.H. (1993). *Drummondita wilsonii*, *Philotheca langei* and *P. basistyla* (Rutaceae), new species from south-west Western Australia. *Nuytsia* 9: 95–109.

Mueller, F.J.H. (1869). *Fragmenta Phytographiae Australiae* 7(51): 21. Government Printer: Melbourne.

Wilson, P.G. (1971). Taxonomic notes on the family Rutaceae, principally from Western Australia. *Nuytsia* 1: 197–207.

—— (1998). Nomenclatural notes and new taxa in the genera *Asterolasia*, *Drummondita* and *Microcybe* (Rutaceae: Boronieae). *Nuytsia* 12: 83–88.

—— (2013). *Drummondita* (Rutaceae). *Flora of Australia* 26: 427–431. CSIRO Publishing: Melbourne.

Stemodia anisata A.R.Bean (Plantaginaceae), a new species from Queensland and the Northern Territory

A.R. Bean

Summary

Bean, A.R. (2018). *Stemodia anisata* A.R.Bean (Plantaginaceae), a new species from Queensland and the Northern Territory. ***Austrobaileya* 10(2): 242–246.** *Stemodia anisata* A.R.Bean is described, illustrated and compared to related taxa. A key to the *Stemodia* species occurring in Queensland is provided.

Key Words: Plantaginaceae, *Stemodia*, *Stemodia anisata*, Australia flora, Northern Territory flora, Queensland flora, taxonomy, new species, identification key

A.R. Bean, Queensland Herbarium, Department of Environment & Science, Brisbane Botanic Gardens, Mt Coot-tha Road, Toowong, Queensland 4066, Australia. Email: tony.bean@des.qld.gov.au

Introduction

The genus *Stemodia* L. is distributed in both the New and Old world, with an estimated total number of 49 species (Turner & Cowan 1993). Some Australian members of the genus were formerly included in the genus *Morgania* R.Br. (Bentham 1869). Barker (1981) foreshadowed the formal transfer of *Morgania*, and later made the necessary combinations in *Stemodia* (Barker 1990), stating that both groups of species have the same fruit dehiscence, and that the Australian species show no correlated differences from their congeners in the Americas.

The taxonomy of the Australian *Stemodia* species is difficult, as many of the species are morphologically similar, and variation within them means that consistent differences are sometimes hard to find. A thorough examination of all available Queensland *Stemodia* specimens has revealed the presence of a new and distinctive species recently collected from the far western part of the state that also extends into the adjacent Northern Territory. It is described here. A key to the identification of all Queensland *Stemodia* species is also included.

Accepted for publication 16 July 2018

Materials and methods

This study is based on a morphological examination of specimens held at BRI, and photographic images of specimens held at DNA. The measurements for corolla, stamens and style are based on material reconstituted with hot water; other plant parts were measured from dried material. The distribution map was compiled using DIVA-GIS Version 7.5.0 (http://www.diva-gis.org), from localities or geocodes given on the labels of specimens at BRI and DNA.

Taxonomy

Stemodia anisata A.R.Bean **sp. nov.** with affinity to *S. glabella* W.R.Barker, but differing by the prostrate habit, the densely hairy obovate leaves, the relatively long hairs on the pedicels and sepals, and the black non-papillose seeds. **Typus:** Queensland. Burke District: Ardmore Station, S of Mount Isa, 25 July 2004, *R. Booth 3572 & D. Kelman* (holo: BRI [1 sheet]; iso: CANB, DNA, NSW, NY, *distribuendi*).

Prostrate shrub to 10 cm high and 80 cm diameter with woody stems, branches not rooting at the nodes. Indumentum on branchlets of spreading, eglandular hairs, 0.2–0.5 mm long. Leaves opposite, ± sessile, obovate, chartaceous, 8–25 mm long, 2.4–6.2 mm wide, 2.4–4 times longer than broad; midvein readily seen, but no other veins

visible, both surfaces densely hairy with white eglandular spreading hairs, and with numerous sessile yellow glands; margins entire or with a few obscure teeth; apex obtuse. Flowers solitary in leaf axils; pedicel 10–24 mm long at anthesis, shorter before anthesis, longer at fruiting stage, with a mixture of glandular and eglandular hairs. Bracteoles 2, opposite to sub-opposite, positioned at distal end of pedicel, linear to narrowly deltate, 1.1–1.9 mm long, 0.3–0.6 times as long as sepals. Sepals 5, equal, narrowly-deltate, 3.1–4.1 mm long, with many glandular hairs and some eglandular hairs throughout. Corolla 11–14 mm long, fused for most of its length, 2-lipped, the lower lip with 3 obtuse lobes 3–4.5 mm long, purple or mauve; the upper lip with 2 mostly fused lobes, 2–3.5 mm long, purple; corolla tube 6.5–9 mm long, inner surface pale yellow, with very sparse hispid eglandular hairs; outer surface pale yellow to brown, with very sparse glandular and eglandular hairs. Stamens 4, all fertile, epipetalous, didynamous; anthers 2-celled, 0.9–1.1 mm long, white; outer filaments 2.5–3 mm long, inner filaments 4–4.5 mm long. Ovary 2-locular, stigma a broad flap, glabrous. Capsule included in the persistent calyx, narrowly-ovoid, 3.7–4.5 mm long, splitting loculicidally; seeds ellipsoidal, 0.2–0.3 mm long, black; surface lacunose, without papillae. **Figs. 1 & 2.**

***Additional specimens examined*: Northern Territory.** Georgina Downs Station, 5 km NNW of no. 8 bore, Aug 2001, *Risler & Duguid 986* (DNA); 7 km WSW of no. 3 bore, Manners Creek Station, Mar 1995, *Albrecht 6319 & Latz* (DNA). **Queensland.** Gregory North District: 2 km NNW of Cravens Peak homestead, on road to Sand Hill bore, Apr 2007, *Thomas 3421 & Turpin* (BRI); Ethabuka, Simpson Desert interdune swale near Field River, Aug 2011, *Nicholson cjnEthabuka12* (BRI); Ethabuka Station, 7.8 km N of homestead, Jun 2011, *Gillen JSG7b* (AD, BRI); Ethabuka Station, *c.* 375 km SSW of Mt Isa, near border with Northern Territory, Aug 2010, *Kemp JEK11756 & Radford* (BRI); Ethabuka campground, *c.* 3 km S of homestead, 112 km NW of Bedourie, Jun 2010, *Halford QM64 & Forster* (BRI, DNA, MEL); 25 km W of Ethabuka homestead, 10 km S of Field River Road, Aug 2011, *Silcock JLS961* (BRI).

***Distribution and habitat*:** *Stemodia anisata* occurs in far western Queensland, from Mount Isa to Ethabuka Nature Refuge, and the immediately adjacent parts of the Northern Territory (**Map 1**). It inhabits seasonally inundated low-lying areas, either treeless or with scattered *Eucalyptus coolabah* Blakely & Jacobs, gidgee (*Acacia georginae* F.M.Bailey or *A. cambagei* R.T.Baker), or *A. chisholmii* F.M.Bailey. The soils are sandy, at least near the surface.

***Phenology*:** Flowers have been recorded from April to August; fruits from June to August.

***Affinities*:** *Stemodia anisata* resembles *S. glabella* in its corolla size, short bracteoles and long pedicels; however, the former differs by the prostrate habit, hairy branchlets, obovate leaves (versus linear for *S. glabella*), the relatively long hairs on the pedicel and calyx, and black, non-papillose seeds (versus yellow to brown, papillose for *S. glabella*). It differs from *S. tephropelina* W.R.Barker by the prostrate habit (erect for *S. tephropelina*), the lack of glandular hairs on the branchlets (glandular hairs moderately dense for *S. tephropelina*), the entire leaf margins (serrate for *S. tephropelina*), the pedicels 10–24 mm long (1–10 mm long for *S. tephropelina*) and the lacunose seeds without papillae (minutely papillose for *S. tephropelina*).

***Notes*:** The two specimens cited from the Northern Territory (above) have the name *Stemodia* sp. Manners Creek. The voucher specimen for the phrase name '*Stemodia* sp. Manners Creek (T.S.Henshall 1779) NT Herbarium', is present at AD and NT. Bill Barker has identified the AD duplicate as *Elacholoma prostrata* (Benth.) W.R.Barker & Beardsley, syn. *Mimulus prostratus* Benth. (AVH 2018). The NT specimen is also thought to be *Elacholoma* (P. Jobson *pers. comm.*, Jun 2017).

An image of *Stemodia* sp. Tanami (P.K. Latz 8218) on the Flora NT website (Northern Territory Herbarium 2015) shows an upright plant with small lanceolate leaves, very short pedicels, and strongly two-lipped flowers with a narrow throat. All of these features are quite unlike *S. anisata*.

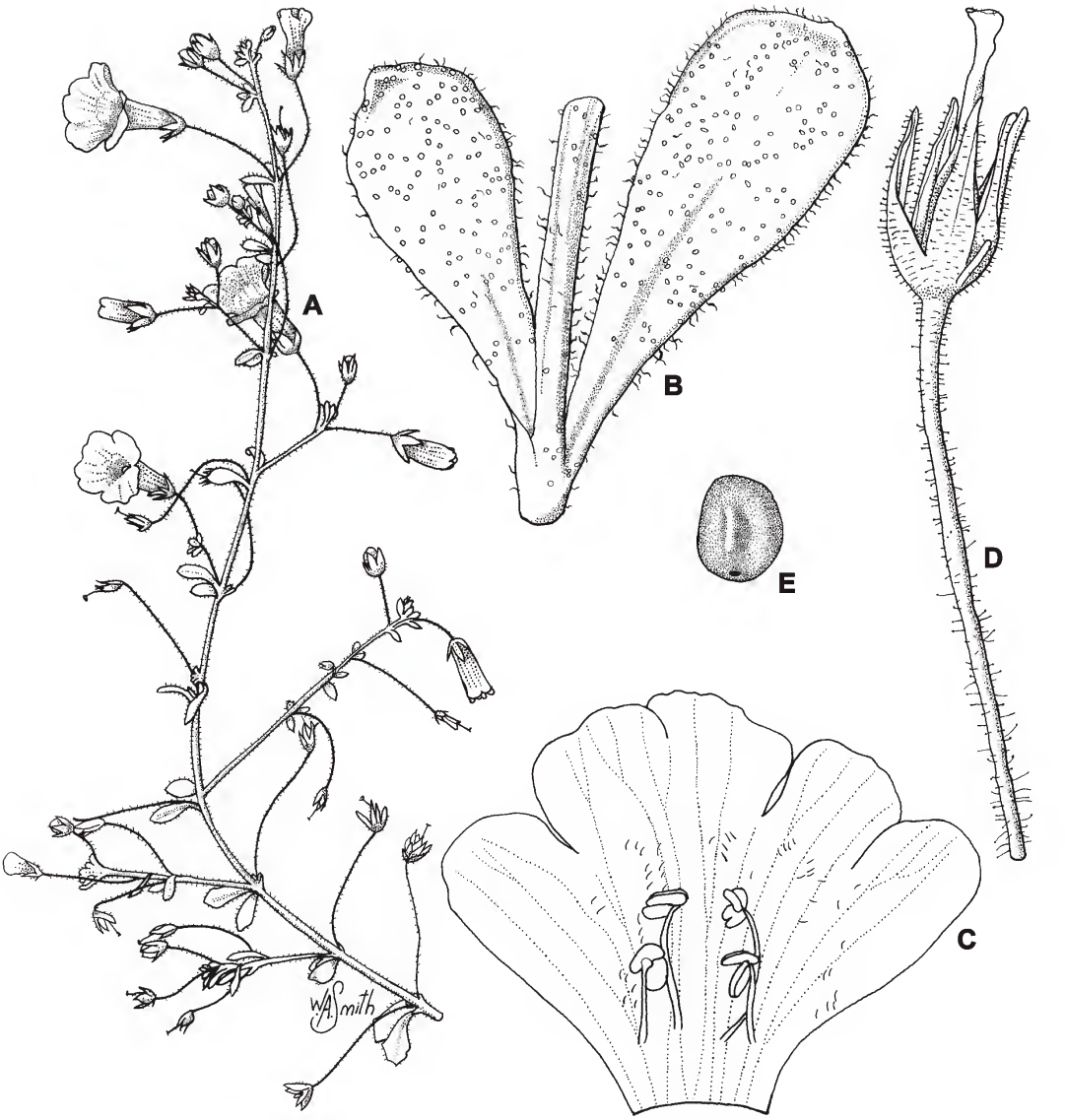


Fig. 1. ***Stemodia anisata.*** A. flowering branchlet ×1. B. a pair of leaves ×6. C. corolla and stamens ×4. D. old flower (the corolla shed) showing pedicel, calyx, ovary and style ×6. E. seed ×50. All from *Booth 3572 & Kelman* (BRI, holotype). Del. W. Smith.

***Conservation status*: Least Concern**. The geographical north-south range of the species is around 400 kilometres, and as the area is poorly known botanically, it is likely that many more populations exist. No substantial threats to the species are known.

***Etymology*:** The Latin epithet *anisata* refers to the aniseed aroma of the crushed leaves, mentioned independently by two collectors.

Fig. 2. Young plant of ***Stemodia anisata*** (*Booth 3572 & Kelman*). Photo: D. Kelman.

Key to the Queensland species of *Stemodia*

1 Inflorescence/infructescence spicate with more than 10 sessile flowers/fruits . . . . . **S. lythrifolia**
1. Inflorescence/infructescence with 1–3-pedicellate flowers/fruits in leaf axil **2**

2 Some leaf axils with 2 or 3 flowers/fruits, some leaf axils with a single flower . . . . . **S. florulenta**
2. Flowers always solitary **3**

3 Bracteoles 0.7–1.4 times as long as sepals, and about as wide as sepals **4**
3. Bracteoles 0.3–0.6 times as long as sepals, and considerably narrower than sepals **5**

4 Pedicels 7–29 mm long at anthesis; leaves in whorls of three; corolla 11–16 mm long; bracteoles 0.9–1.4 times as long as sepals . . . . . **S. viscosa**
4. Pedicels 0.5–3 mm long at anthesis; leaves opposite; corolla 9–11 mm long; bracteoles 0.7–0.9 times as long as sepals . . . . . **S. pubescens**

5 Prostrate forb; leaves obovate, 2.4–4 times longer than wide . . . . . **S. anisata**
5. Erect forbs; leaves linear, 8–27 times longer than wide **6**

6 Corolla 6–9 mm long; sepals with long glandular hairs . . . . . **S. lathraia**
6. Corolla 11–16 mm long; sepals with short glandular hairs or glabrous . . . . . **S. glabella**

Acknowledgements

I am grateful to Will Smith for the illustrations, to Dan Kelman for the use of his photograph of the species, and to Ian Cowie for providing images of specimens held at DNA.

References

AVH (2018). *The Australasian Virtual Herbarium*. Council of Heads of Australasian Herbaria. https://avh.chah.org.au, accessed 28 February 2018.

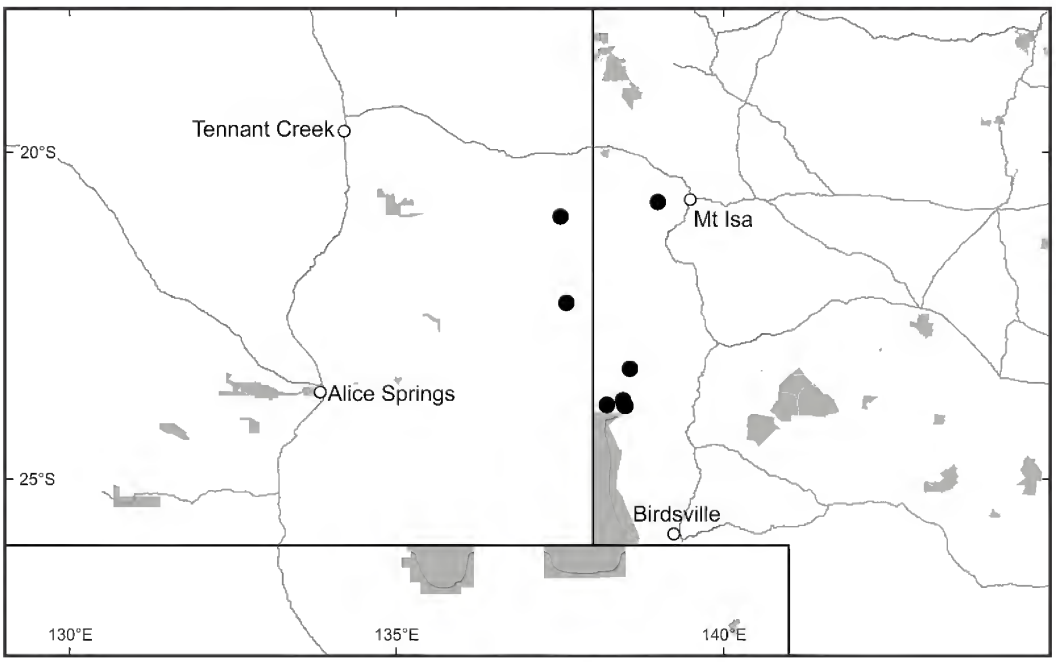
BARKER, W.R. (1981). Scrophulariaceae. In J. Jessop (ed.), *Flora of Central Australia*, pp. 326–334. Reed: Sydney.

—— (1990). New taxa, names and combinations in *Lindernia*, *Peplidium*, *Stemodia* and *Striga* (Scrophulariaceae), mainly of the Kimberley region, Western Australia. *Journal of the Adelaide Botanic Gardens* 13: 79–93.

BENTHAM, G. (1869). Scrophulariaceae. In *Flora Australiensis* 4: 470–523. L. Reeve & Co.: London.

NORTHERN TERRITORY HERBARIUM (2015). *FloraNT Northern Territory Flora Online*. Department of Land Resource Management. https://eflora.nt.gov.au, accessed27 February 2018.

TURNER, B.L. & COWAN, C.C. (1993). Taxonomic overview of *Stemodia* (Scrophulariaceae) for South America. *Phytologia* 74: 281–324..



Map 1. Distribution of ***Stemodia anisata***.

Elaeocarpus carbinensis J.N.Gagul & Crayn (Elaeocarpaceae), a new species endemic to the Mt Carbine Tableland of northeast Queensland, Australia

J.N. Gagul[1, 2, 4], L. Simpson[1, 2, 3] & D.M. Crayn[1, 3]

Summary

Gagul, J.N., Simpson, L. & Crayn, D.M. (2018). *Elaeocarpus carbinensis* J.N.Gagul & Crayn (Elaeocarpaceae), a new species endemic to the Mt Carbine Tableland of northeast Queensland, Australia. ***Austrobaileya* 10(2): 247–259.** *Elaeocarpus carbinensis* from montane areas of the Wet Tropics bioregion of northeast Queensland, Australia is described and compared with similar species. Notes on habitat, distribution, and relationships, and a key to allied large-fruited species is provided. The conservation outlook for the species was determined with environmental niche modelling analyses using a range of carbon dioxide emission scenarios. The results indicate that by the year 2080, suitable climate for the species will have disappeared from its current range. Thus, an IUCN Red List category of **Vulnerable** under criterion 'restricted distribution, and plausibility and immediacy of threat' is recommended.

Key Words: Elaeocarpaceae, *Elaeocarpus*, *Elaeocarpus carbinensis*, Australia flora, Queensland flora, Wet Tropics bioregion, taxonomy, new species, environmental niche modelling, identification key

[1]Australian Tropical Herbarium, James Cook University, Cairns Campus, McGregor Road, Smithfield, Queensland 4878, Australia; [2]College of Science and Engineering, James Cook University, Australia; [3]Centre for Tropical Environmental Sustainability Science, James Cook University, Australia; [4]Biological Sciences, University of Papua New Guinea, Port Moresby, Papua New Guinea. Email: janet.gagul@my.jcu.edu.au; lalita.simpson@my.jcu.edu.au; darren.crayn@jcu.edu.au

Introduction

Elaeocarpus L., the largest genus in Elaeocarpaceae, comprises more than 350 species with a mainly Indo-Pacific distribution (Coode 2004; Phoon 2015). New Guinea (*c.* 97 spp.) and Borneo (*c.* 70 spp.) have the highest species diversity (Coode 2004). Australia contains 34 taxa (30 endemic), the majority of which occur along the east coast with a few extending to the Northern Territory and one species (*E. costatus* M.Taylor) on Lord Howe Island (Baba & Crayn 2012). The genus is particularly diverse in the Wet Tropics bioregion of northeast Queensland where 23 species are found, 16 of which are endemic to the bioregion.

The Wet Tropics (**Fig. 1**) is a small bioregion of *c.* 20,000 ha (less than 0.3% of Australia's landmass) and includes extensive tropical mountain top habitat (*c.* 1000 ha, *c.* 5% of the bioregion, is above 1000 m elevation; Costion *et al.* 2015). This habitat is considered highly vulnerable to the effects of climate change (Murphy *et al.* 2012) because the warming signal in the tropics is amplified with elevation (Beniston *et al.* 1997) and the critical moisture provided by cloud cover is expected to decrease significantly with an upward shift in the elevation of cloud formation (Foster 2001; Still *et al.* 1999). Impacts of climate change including range shifts and species extinctions have already been observed on tropical mountain tops (Pounds *et al.* 1999, 2006). A recent study predicted similar impacts on the Wet Tropics bioregion – distribution modelling of endemic montane tree species under future climate scenarios predicted 86% of species included in the study would have no suitable climate in the bioregion by 2080 (Costion *et al.* 2015). Among the taxa modelled in that study was a putative new species of *Elaeocarpus* (*E.* sp. Mt Misery (L.J.Webb+ 10905) (Guymer 1997, 2017).

Accepted for publication 10 August 2018

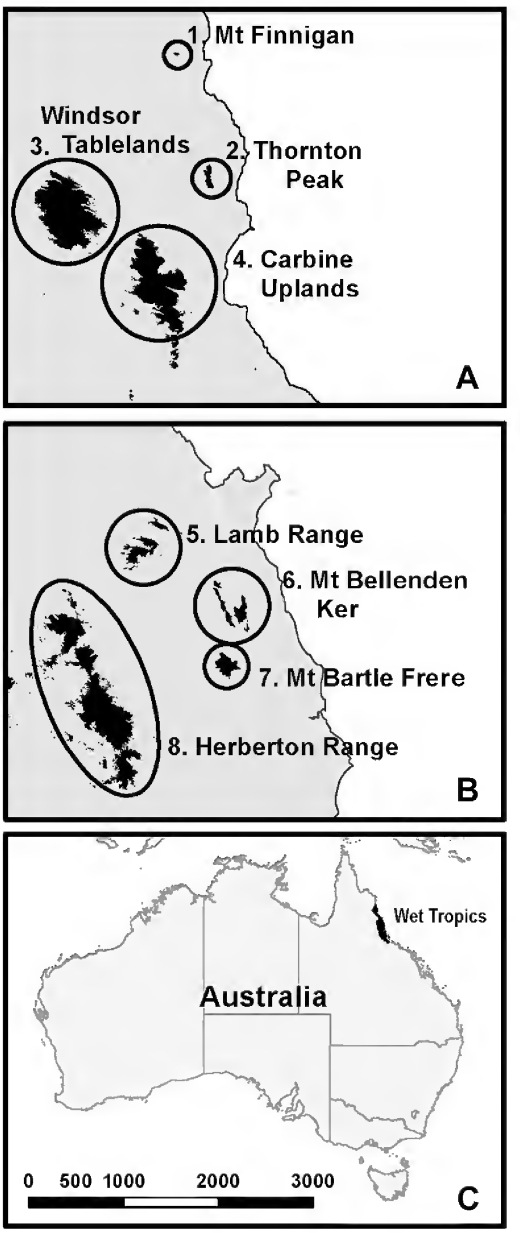


Fig. 1. Upland regions are shown for a) the northern Wet Tropics and b) the southern Wet Tropics, and the location of the Wet Tropics in Australia is shown in c).

Material of *Elaeocarpus* sp. Mt Misery (L.J.Webb+ 10905) was first collected by B. Hyland on 17 May 1973 from State Forest Reserve 143, North Mary Logging Area. The species is similar to *E. stellaris* L.S.Sm. but differs mainly in the mesocarp (equivalent to the fruit 'stone' and that is formed from the lignified inner mesocarp: Dettman & Clifford 2000) being smaller, with less pronounced flanges and less deeply grooved inter-flange valleys, and punctate abaxial leaf surfaces. This species is herein described as *E. carbinensis* J.N.Gagul & Crayn, and modelling of its environmental niche undertaken to inform a conservation status recommendation.

Materials and methods

Specimen preparation and examination

Observations were made using the naked eye and light microscopy on dried and spirit preserved (FAA or Bang mix) material held at CNS and BRI, and on living material in the field. Dried material was rehydrated by boiling with water and a small amount of detergent. Measurements were made with a ruler or microscope eyepiece graticule. Information on plant growth habit and size, colour of fresh floral parts and fruit, habitat and locality were taken from the collector's notes recorded on the herbarium label and from field observations by the authors.

Specimens originally deposited in the C.S.I.R.O. QRS herbarium at Atherton are now incorporated in CNS at the Australian Tropical Herbarium in Cairns.

Species distribution modelling

Environmental niche modelling (ENM) was utilised to predict the potential distribution of *E. carbinensis* under contemporary and future climates. Species distribution models were produced in MaxEnt v. 3.3.3 (Phillips *et al.* 2006).

The distribution models used in the previous ENM study (Costion *et al.* 2015) omitted several point records of this species. To ensure the species' full distribution was represented in the present analysis, Australia's Virtual Herbarium (AVH 2016) was queried for all known synonyms, returning 13 unique locational records. All specimens used in the modelling analysis have been seen and verified by the authors and are cited below*.

Climate layers were sourced from the Australian Wet Tropics Decadal Climate Change Predictions dataset sourced from the James Cook University Tropical Data Hub (VanDerWal 2011), and consisted of bioclimatic variables mapped at ~250 m resolution across the Wet Tropics bioregion. These layers had previously been created using the "climates" package in R (VanDerWal *et al.* 2011) using baseline climate surfaces from ANUCLIM 6.1 software with a climate baseline of 1975–2005 (Hutchinson *et al.* 2000). Four uncorrelated bioclimatic variables were used, previously selected from 19 bioclimatic variables using a jackknife test for importance (Costion *et al.* 2015): Temperature Seasonality, Maximum Temperature of Warmest Month, Mean Temperature of Wettest Quarter and Annual Precipitation. Suitable climate is defined as an area or areas providing a climate niche that the species currently occupies. This was used as a surrogate for habitat suitability following VanDerWal *et al.* (2009) and is referred to throughout the text as suitable habitat.

Habitat suitability was modelled with 10 replicates using the cross-validation option with linear, quadratic, product and hinge features enabled. To model habitat suitability under future climates, models were run for the years 2040, 2060 and 2080 under the intermediate (A1b), extreme (A2) and best case (B1) emission scenarios of Nakićenović *et al.* (2000).

Abbreviations

LA (Logging Area), NP (National Park), SF/SFR (State Forest/State Forest Reserve)

Taxonomy

Elaeocarpus carbinensis J.N.Gagul & Crayn **sp. nov.** Similar to *E. stellaris* L.S.Sm. but differs in having smaller fruits (50–55 × 35–50 mm versus 43–65 × 50–60 mm) with thinner mesocarp flanges (3–5 mm versus 5–10 mm) that are more closely spaced (15–20 mm versus 20–25 mm), less deeply grooved inter-flange valleys, punctate abaxial leaf surfaces, longer petals (35–40 mm versus 20–25 mm) and filaments (10–15 mm versus 6–8 mm), and petals hairy outside only (both sides in *E. stellaris*). **Typus:** Queensland. Cook District. SFR 143, Kanawarra, Carbine LA, 25 January 1995, *B. Gray 5938** (holo: CNS [2 sheets]; iso: B, BO, BRI, CANB, E, K, L, MEL, MO, NY, NSW, SING *distribuendi*).

Elaeocarpus sp. (=RFK/2907); Hyland (1982: 139).

Elaeocarpus sp. Mt Lewis (B.P.Hyland RFK2907); Thomas & McDonald (1987: 24).

Elaeocarpus sp. Mt Misery (L.J.Webb+ 10905); Guymer (1997: 67; 2017).

Elaeocarpus sp. (Mt Spurgeon BH 2907RFK); Hyland *et al.* (1999: 63).

Elaeocarpus sp. (Mt Spurgeon); Cooper & Cooper (2004: 162).

Elaeocarpus sp. 'Mount Spurgeon'; Crayn & Kupsch (2006).

Elaeocarpus sp. Mt Spurgeon (B.Hyland 2907RFK); Hyland *et al.* (2010).

Trees to 30 m tall, buttressed, outer bark blaze yellow, white, cream or brown, speckled markedly with longitudinal stripes; stipules ± triangular, *c.* 2 mm long, caducous; branchlets covered in short, white, appressed hairs <0.5 mm long. **Leaves** simple, alternate, crowded toward the branchlet tips; petiole (15–)20–45(–58) mm long, ± glabrous, usually with pulvinus at both ends, more pronounced at distal end; lamina obovate, oblanceolate or elliptic, 45–180 mm long, 19–80 mm wide, abaxial surface punctate, densely covered with small dark dots (? glands) visible (barely) to the naked eye, base cuneate, apex obtuse or slightly retuse; domatia present in secondary vein axils, 2–8(–10) per leaf, foveolate, glabrous; margins entire or crenate; venation reticulate, ± flush with adaxial leaf surface when fresh (slightly raised in dried material), prominent abaxially, ± glabrous. **Inflorescences** 2–5-flowered, usually arising behind leaves, occasionally axillary, racemose but appearing ± umbellate; peduncle 12–15 mm long, pubescent, hairs <0.5 mm, appressed. **Flowers** white or cream; pedicels 10–18 mm long, pubescent, hairs 0.5–1 mm, spreading; calyx cream or greenish cream

to brown, lobes narrowly triangular, 24–26 mm long, 5–6 mm wide at base, apex acute, densely pubescent to velvety outside, hairs 0.5–1 mm long, spreading to erect, golden-brown when dried, sericeous inside, hairs 2–3 mm long, appressed; petals 5, free, 35–40 mm long, *c.* 10 mm wide, apex 2–3 lobed, lobes *c.* 5 mm long, rounded to acuminate or acute, with dense hairs on the outside, glabrous or with very few scattered hairs on the inside, indumentum extending across middle half, and along 3/4 of the length of the petal, hairs appressed, 2–3 mm long, margins entire, glabrous; ovary hairy, globular, 5-locular, *c.* 10 ovules per locule, sericeous, hairs *c.* 2 mm long, erect to appressed; style 18–22 mm long, tapering to ovary, sericeous over the lower 2/3, hairs similar to ovary, stigma not expanded; stamens numerous (*c.* 55), filaments very slender, 10–15 mm long, sericeous, anthers tubular, *c.* 8 mm long, with very short ascending hairs, longer (to *c.* 1 mm) along midline on back, awned, posterior tooth longer (*c.* 1.5 mm), backward-tilted. **Fruits** drupaceous, broadly ovoid to ellipsoid, 50–55 mm long, 35–50 mm wide, dark blue, or slatey to brownish grey, glabrous, shrinking and cracking irregularly upon drying; pedicel 15–25 mm long; outer mesocarp 1.7–2.2 mm thick, detaching cleanly from inner mesocarp (stone). **Mesocarps** ovoid-ellipsoid, 30–45 mm long, 32–40 mm wide, robust, woody; sutures 5, forming grooves on prominent longitudinal ridges (flanges), grooves becoming shallower basally; flanges 3–4 mm high, 3–5 mm thick (mesocarp appearing 5-angled in transverse section, wall *c.* 11 mm thick), base attenuate, apex rounded to slightly pointed; surface punctate. **Seeds** 1–3 per fruit, ellipsoid, 18–20 mm long, 8–10 mm wide; embryo straight, endosperm entire. **Figs. 2 & 3A.**

***Additional specimens examined*: Queensland.** Cook District: TR 140 Cow LA, Jan 1975, *Hyland 7971** (BRI); Along the main path, *c.* 400 m from Mr Cooper's Camp, Mt Spurgeon NP, May 2010, *Baba 426 et al.** (BRI, CNS); Mt Misery E of Mt Spurgeon 15.4 km NNE of Mt Carbine, Nov 1988, *Jessup GJM919** (BRI); Mt Spurgeon, Jun 1990, *Gray 5196** (CNS), *5197* (BRI, CNS); TR 143, Zarda LA, near Zarda clearing, Sep 1973, *Hyland 2907RFK** (CNS), *2908RFK* (BRI, CANB, CNS); Mt Misery, Mt Carbine Tableland, Nov 1972, *Webb 10905** (BRI); SFR 143, Kanawarra, Carbine LA, Nov 1994, *Gray 5825* (CNS); *ibid*, Mar 1991, *Gray 5294* (BRI, CNS); *ibid*, Jul 1990, *Hyland 25789RFK** (CNS); *ibid*, Nov 1990, *Hyland 14087** (BRI, CNS); SFR 143, North Mary LA, May 1973, *Hyland 6731** (BRI); 32.5 km along Mt Lewis Road from Mossman – Mt Molloy Road, Dec 1989, *Jessup GJD3364** (BRI); Daintree NP, NW of Black Mountain, May 1998, *Forster PIF22897 et al.* (BRI); Cultivated Tolga, ex-Mt Lewis area beyond hut, May 2005, *Ford 4312 & Sankowsky* (CNS).

Key to large-fruited *Elaeocarpus* species allied to *E. carbinensis*

1 Leaf domatia present; mesocarps with flanges **2**
1. Leaf domatia absent; mesocarps without flanges **3**

2 Mesocarp 30–45 mm long, 32–40 mm wide; flanges 3–5 mm thick, distance between flanges 15–20 mm, valley between flanges shallow, weakly grooved; abaxial leaf surface with small dark dots; elevational range 940–1260 m, NE QLD . . . . . **E. carbinensis**
2. Mesocarp 41–50 mm long, 35–42 mm wide; flanges 5–10 mm thick, distance between flanges 20–25 mm, valley between flanges deeply grooved; abaxial leaf surface without dots; elevational range 50–500 m, NE QLD . . . . . **E. stellaris**

3 Fruits blackish, dark blue or dark green, 40–75 mm long, 30–50 mm wide; fibres permanently attached to mesocarp surface; anther awns present; elevational range 25–2500 m, New Guinea, Papuan Islands and the Moluccas . . . . . **E. womersleyi**
3. Fruits dull greenish-blue to khaki, 40–55 mm long, 33–40 mm wide; fibres detaching cleanly from mesocarp surface, ornamentation punctate and pitted with irregularly scattered pits; anther awns absent; elevational range near sea level–1200 m, NE QLD . . . . . **E. bancroftii**

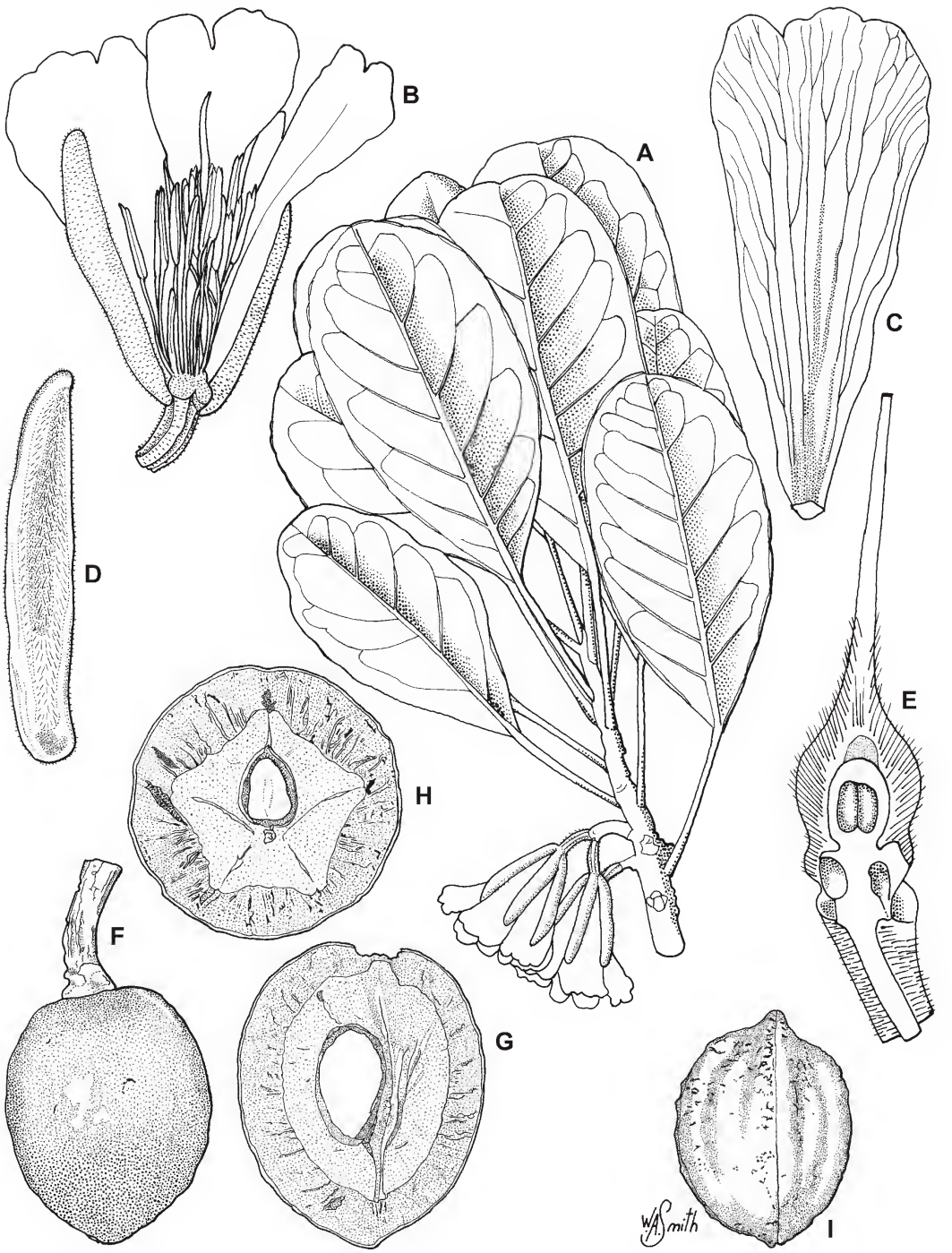


Fig. 2. ***Elaeocarpus carbinensis.*** A. leafy twig with flowers ×0.5. B. mature flower with two petals and sepals removed ×1.5. C. petal showing adaxial surface ×2. D. sepal showing abaxial surface ×2. E. pistil (ovary and pedicel partly sectioned longitudinally) ×3. F. lateral view of fruit ×0.8. G. lateral section of fruit ×1. H. transverse section of fruit showing 5-angled mesocarp ×1. I. lateral view of whole mesocarp with flesh removed ×1. A–E from *Gray 5938* (BRI, isotype); F from *Hyland 14087* (BRI); G–I from *Gray 5294* (CNS). Del. W. Smith.

Fig. 3. Mesocarps of ***Elaeocarpus carbinensis*** and similar species. A. ***E. carbinensis*** (*Gray 5197*, CNS). B. ***E. stellaris*** (*Stocker 1774*, CNS). C. ***E. bancroftii*** (*Gray 2328*, CNS). D. ***E. womersleyi*** (*Gagul 039*, CNS). Photos: Nick Rockett.

***Affinities*:** On the basis of similarities in mesocarp morphology (Gagul *et al.* unpublished; Rozefelds & Christophel 2002) and its close molecular phylogenetic relationship with *Elaeocarpus bancroftii* F.Muell. & F.M.Bailey and *E. stellaris* (Baba 2014; Phoon 2015), *E. carbinensis* seems best placed in Group VI, Subgroup B (Coode 1978, 1984) which comprises *E. bancroftii*, *E. stellaris* and *E. womersleyi* Wiebel (**Table 1**). The three Australian species *E. bancroftii*, *E. carbinensis* and *E. stellaris* are distinguished from the New Guinea species *E. womersleyi* by outer mesocarp fibres, which detach cleanly from the mesocarps (persistent and permanently attached in *E. womersleyi*, Coode 1984, **Fig. 3**). *E. womersleyi* has not been included in any molecular phylogenetic study to date so its evolutionary relationships remain unclear.

A fossil mesocarp (*Elaeocarpus peteri* Rozefelds & Christophel) from late Oligocene-early Miocene (Rozefelds 1990) deposits at Glencoe in central Queensland resembles *E. carbinensis* and *E. stellaris* in having pronounced ridges and punctate ornamentation (Rozefelds & Christophel 1996), but its precise relationships to extant lineages is unknown.

***Distribution and habitat*:** *Elaeocarpus carbinensis* is restricted to the Carbine Tableland west of Mossman and has been recorded on Mt Spurgeon, Mt Lewis and Mt Misery at elevations ranging from 940–1260 m. It occurs in notophyll vine forest and mixed mesophyll vine forest on soils derived from granite or a mixture of granite and basic volcanic rocks. Across the recorded localities mean annual temperature ranges between 19–20 °C, mean minimum and maximum temperatures of the coldest and warmest months range between 11–12 °C and 27–28 °C respectively, mean annual rainfall ranges between 1942–2319 mm and the mean rainfall of the driest month ranges between 123–161 mm.

Predicted future distribution

Environmental Niche Modelling (ENM) under contemporary climatic conditions predicts that suitable climate for *E. carbinensis* exists across several upland regions in the northern Wet Tropics including the Windsor and Carbine Tablelands, Thornton Peak and Mt Finnigan (**Fig. 4**). Herbarium records, however, indicate the realised distribution of the species includes only the Carbine Tableland. Explanations for the apparent failure of the species to fully occupy its predicted climate niche were not investigated in this study but may include a range of biotic and abiotic factors such as competitive exclusion, predation, disease, unsuitable geology/soil, or failure to recolonise after past extinction.

ENM models under future climates predict a complete loss of highly and moderately suitable habitat by 2040 and of all suitable habitat by 2080 across the Wet Tropics bioregion (**Figs. 4 & 5**). Although this study did not examine whether suitable habitat is predicted in other bioregions, the closest area of substantial upland rainforest outside the Wet Tropics is the Eungella region of central Queensland, located *c.* 250 km to the south east. Lowland tropical savanna and cleared land separates the Wet Tropics and Eungella therefore dispersal of the large fruits of this species, which is probably achieved only by rodents (which predate the seeds) and cassowaries, to suitable habitat elsewhere (should it exist) is highly unlikely.

***Phenology*:** Data from herbarium specimens indicate that flowering occurs in January and fruiting in March.

***Conservation status*:** All known wild plants of *Elaeocarpus carbinensis* are restricted to 940–1620 m altitude, and occur within protected areas (Daintree NP, Mt Lewis NP and Mt Spurgeon NP), but complete loss of suitable habitat by 2080 is predicted by the environmental niche modelling analysis. Assessment against the IUCN red list guidelines suggests this species should be recognised as **Vulnerable** under criterion **D2** (restricted distribution, and plausibility and immediacy of threat) due to climate change (IUCN 2012).

If the model predictions are realised then the survival of the species *in situ* will depend on rapid evolutionary change and/or inherent physiological plasticity to tolerate novel climates and the novel ecological communities that differential extinction and migration will bring about. The population demographics of the species have not been studied in detail but field observations indicate all known plants are large, old trees; to date no seedlings or juveniles have been located. This suggests that generation length is likely measured

Fig. 4. Potential distribution of ***Elaeocarpus carbinensis*** for contemporary and future climates under an intermediate emission scenario: a) MAXENT species distribution models of *Elaeocarpus carbinensis* mapping habitat suitability in the Wet Tropics under current conditions and years 2040, 2060 and 2080 under an intermediate emission scenario. Highly suitable habitat is mapped in black, moderately suitable habitat in dark grey, lowly suitable habitat in light grey and unsuitable habitat in the lightest grey.

in decades and that the potential for rapid evolutionary change is limited. Published studies on the physiology of the species are lacking therefore its capacity to tolerate novel climates is unknown.

Currently, the species is known from only 13 unique locational records on the Mt Carbine Tableland. Further studies are urgently required to increase knowledge of its realised distribution, population demographics, physiology and ecology to enable a revised assessment of conservation status. In the meantime application of the precautionary principle justifies the establishment of an *ex situ* conservation program including both germplasm banking and cultivation of living plants.

***Etymology*:** The specific epithet *carbinensis* refers to the Carbine Tableland in northeast Queensland, the area to which the species is restricted.

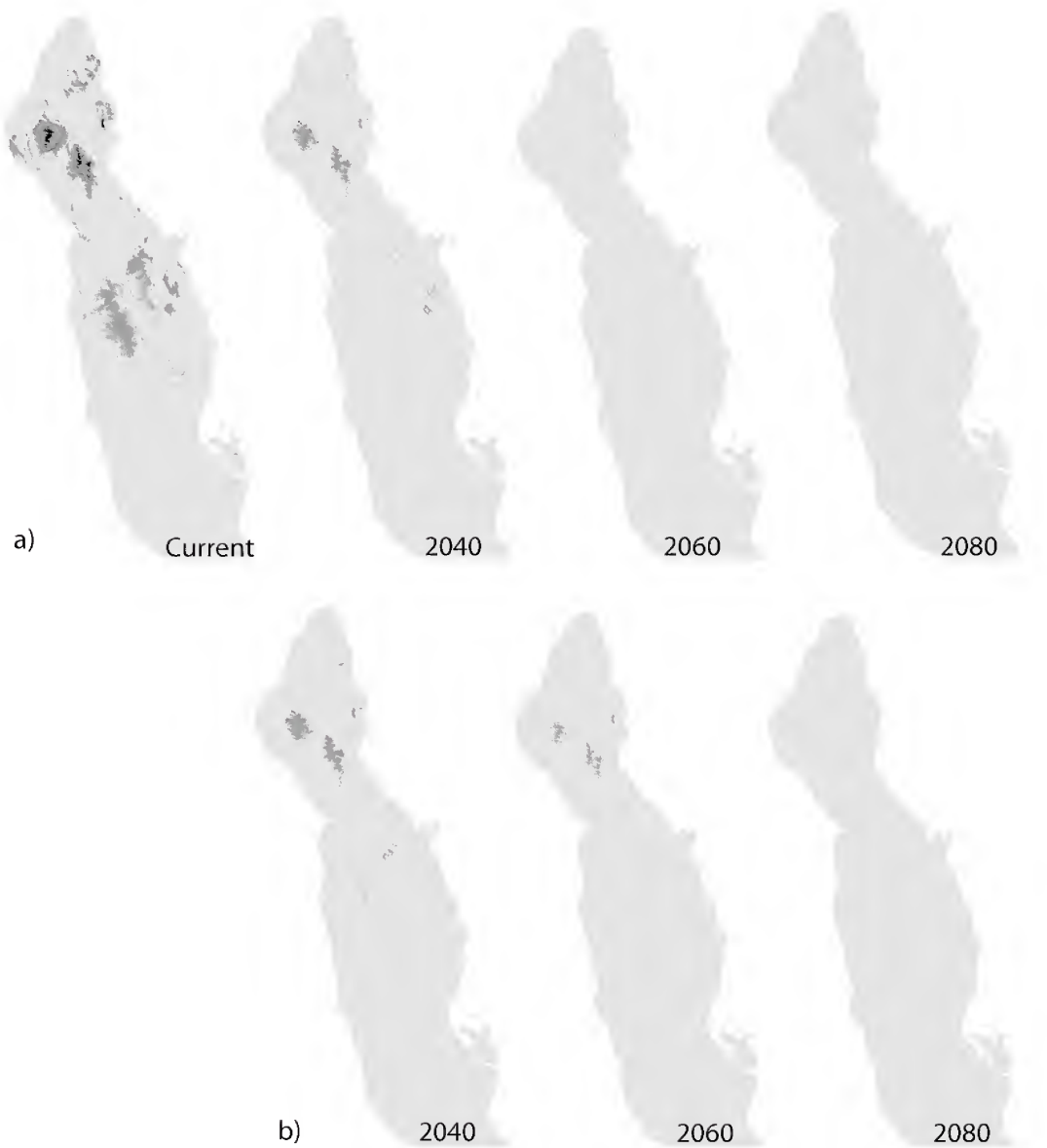


Fig. 5. Potential distribution of ***Elaeocarpus carbinensis*** for contemporary and future climates under extreme and best-case emission scenarios: a) MAXENT species distribution models of *Elaeocarpus carbinensis* mapping habitat suitability in the Wet Tropics under current conditions and years 2040, 2060 and 2080 under an extreme emission scenario. b) Habitat suitability modelled for the years 2040, 2060 and 2080 under a best-case emission scenario. Highly suitable habitat is mapped in black, moderately suitable habitat in dark grey, lowly suitable habitat in light grey and unsuitable habitat in the lightest grey.

Acknowledgements

The authors wish to thank Will Smith (BRI) for the botanical illustrations, Peter Bannink for GIS support, Wendy Cooper for general comments, Nick Rockett for assistance with digital image formatting, the Directors of BRI and CANB for loans of specimens, and Frank Zich (CNS) for administration of loaned specimens at CNS.

References

AVH (2016). *Australia's Virtual Herbarium*. Council of Heads of Australasian Herbaria, http://avh.chah.org.au, accessed 10 June 2016.

BABA, Y. (2014). *Evolution, systematics and taxonomy of* Elaeocarpus *(Elaeocarpaceae) in Australasia.* PhD Thesis, James Cook University.

BABA, Y. & CRAYN, D. (2012). *Elaeocarpus hylobroma* (Elaeocarpaceae): a new species endemic to mountain tops in north-east Queensland, Australia. *Kew Bulletin* 67: 1–8.

BENISTON, M., DIAZ, H.F. & BRADLEY, R.S. (1997). Climatic change at high elevation sites: an overview. *Climate Change* 36: 233–251.

COODE, M.J.E. (1978). A conspectus of Elaeocarpaceae in Papuasia. *Brunonia* 1: 131–302.

—— (1984). *Elaeocarpus* in Australia and New Zealand. *Kew Bulletin* 39: 509–586.

—— (2004). Elaeocarpaceae. In K. Kubitzki *et al.* (eds.) *The Families and Genera of Vascular Plants.* 6: 135–144. Springer Verlag: Berlin.

COOPER, W. & COOPER, W.T. (2004). *Fruits of the Australian Tropical Rainforest*. Nokomis Editions: Melbourne.

COSTION, C.M., SIMPSON, L., PERT, P. & CRAYN, D.M. (2015). Will tropical mountaintop plant species survive climate change? Identifying key knowledge gaps using species distribution modeling in Australia. *Biological Conservation* 191: 322–330.

CRAYN, D.M. & KUPSCH, K. (2006). Elaeocarpaceae in Australia. *Australian Plants* 23: 366.

DETTMANN, M.E. & CLIFFORD, H.T. (2000). The fossil record of *Elaeocarpus* L. fruits. *Memoirs of the Queensland Museum* 46: 461–497.

FOSTER, P. (2001). The potential negative impacts of global climate change on tropical montane cloud forests. *Earth-Science Reviews* 55: 73–106.

GUYMER, G.P. (1997). Elaeocarpaceae. In R.J.F. Henderson (ed.), *Queensland Plants: Names and Distribution.* Queensland Department of Environment & Heritage: Brisbane.

—— (2017). Elaeocarpaceae. In P.D.Bostock & A.E. Holland (eds.), *Census of the Queensland flora 2017.* https://www.qld.gov.au/environment/plants-animals/plants/herbarium/flora-census

HUTCHINSON, M.F., HOULDER, D.J., NIX, H.A. & MCMAHON, J.P. (2000). *ANUCLIM User Guide*, Version 5.1. Centre for Resource and Environmental Studies, Australian National University: Canberra.

HYLAND, B.P.M. (1982). *A Revised Card Key to Rainforest Trees of North Queensland.* CSIRO: Melbourne.

HYLAND, B.P.M., WHIFFIN, T., CHRISTOPHEL, D.C., GRAY, B., ELICK, R.W. & FORD, A.J. (1999). *Australian Tropical Rain Forest Trees and Shrubs, User Guide.* CD-ROM. CSIRO Publishing: Melbourne.

HYLAND, B.P.M., WHIFFIN, T., ZICH, F.A., DUFFY, S., GRAY, B., ELICK, R., VENTER, S. & CHRISTOPHEL, D. (2010). *Australian Tropical Rainforest Plants.* Edition 6. CSIRO Publishing. http://www.anbg.gov.au/cpbr/cd-keys/rfk/Index.html.

IUCN (2012). *IUCN Red List Categories and Criteria: Version 3.1.* Second edition. IUCN: Gland/Cambridge.

MURPHY, H., LIEDLOFF, A., WILLIAMS, R.J., WILLIAMS, K.J. & DUNLOP, M. (2012). Queensland's biodiversity under climate change: terrestrial ecosystems. CSIRO Climate Adaptation Flagship Working Paper No. 12C. https://www.csiro.au/resources/CAF-working-papers.html.

NAKIĆENOVIĆ, N., ALCAMO, J., DAVIS, G., DE VRIES, B., FENHANN, J., GAFFIN, S., GREGORY, K., GRÜBLER, A., JUNG, T.Y., KRAM, T., LEBRE LA ROVERE, E., MICHAELIS, L., MORI, S., MORITA, T., PEPPER, W., PITCHER, H., PRICE, L., RIAHI, K., ROEHRL, A., ROGNER, H.-H., SANKOVSKI, A., SCHLESINGER, M., SHUKLA, P., SMITH, S., SWART, R., VAN ROOIJEN, S., VICTOR, N. & DADI, Z. (2000). *Emissions Scenarios - Special Report of Working Group III of the Intergovernmental Panel on Climate Change*. Cambridge University Press: Cambridge.

PHILLIPS, S.J., ANDERSON, R.P. & SCHAPIRE, R.E. (2006). Maximum entropy modeling of species geographic distributions. *Ecological Modelling* 190: 231–259.

PHOON, S.N. (2015). *Systematics and biogeography of* Elaeocarpus *(Elaeocarpaceae).* PhD Thesis, James Cook University.

Pounds, J.A., Fogden, M.P.L. & Campbell, J.H. (1999). Biological response to climate change on a tropical mountain. *Nature* 398: 611–615.

Pounds, J.A., Bustamante, M.R., Coloma, L.A., Consuegra, J.A., Fogen, M.P.L., Foster, P.N., La Marca, E., Masters, K.L., Merino-Viteri, A., Puschendorf, R., Ron, S.R., Sanchez-Azofeifa, G.A., Still, C.J. & Young, B.E. (2006). Widespread amphibian extinctions from epidemic disease driven by global warming. *Nature* 439: 161–167.

Rozefelds, A.C. (1990). A mid-Tertiary rainforest flora from Capella, central Queensland. In J.G. Douglas & D.C. Christophel (eds.), *Third International Organization of Palaeobotany Symposium 1988*, pp. 123–136. A–Z Printers: Melbourne.

Rozefelds, A.C. & Christophel, D.C. (1996). *Elaeocarpus* (Elaeocarpaceae) endocarps from the Oligo-Miocene of Eastern Australia. *Papers and Proceedings of the Royal Society of Tasmania* 130: 41–48.

—— (2002). Cenozoic *Elaeocarpus* (Elaeocarpaceae) fruits from Australia. *Alcheringa* 26: 261–274.

Still, C.J., Foster, P.N. & Schneider, S.H. (1999). Simulating the effects of climate change on tropical montane cloud forests. *Nature* 398: 608–610.

Thomas, M.B. & Mcdonald, W.J.F. (1987). *Rare and threatened plants of Queensland: a checklist of geographically restricted, poorly collected and/or threatened vascular plant species.* Edition 1. Queensland Department of Primary Industries: Brisbane.

Vanderwal, J.J. (2011). *Australia Wet Tropics decadal climate change predictions (~250m resolution).* James Cook University. https://research.jcu.edu.au/researchdata/default/detail/a362856a7a8b3be223b9adcde47fdd76/.

Vanderwal, J.J., Beaumont, L., Zimmermann, N.E., Lorch, P. & Blodget, D. (2011). *Climates.* v.0: 1-1.4: Methods for working with weather and climate. Software package www.rforge.net/climates/.

Vanderwal, J., Shoo, L.P., Johnson, C.N. & Williams, S.E. (2009). Abundance and the environmental niche: environmental suitability estimated from niche models predicts the upper limit of local abundance. *American Naturalist* 174: 282–291.

Table 1. Comparison of features of *Elaeocarpus carbinensis* and similar species

	E. carbinensis	*E. stellaris*	*E. bancroftii*	*E. womersleyi*
Distribution	940–1260 m, Mt. Spurgeon – Mt. Lewis – Mt. Misery area on Carbine Tableland.	50–500 m, Alexandra Creek – McDowall Range to Innisfail.	0–1200 m, Cooktown to Innisfail.	25–2500 m, New Guinea, Papuan Islands, Moluccas.
Habit	tree to 30 m, buttressed	tree to 25 m, may be buttressed	tree to over 30 m, buttressed, flanged or fluted	tree to 45 m, may be buttressed
Leaf margin	entire or crenate	entire or crenate	entire or sinuate	entire to slightly dentate, or sinuate
Leaf surfaces	glabrous or sparsely hairy (hairs visible with a lens), densely covered with small, barely visible, dark dots (? glands) below	glabrous above, sparsely hairy below	glabrous above, sparsely hairy below (hairs visible with a lens)	glabrous on both sides
Leaf dimensions	45–180 × 19–80 mm	80–180 × 40–90 mm	50–180 × 25–50 mm	100–150 × 40–80 mm
Petiole	(15–) 20–45 (–58) mm long; pulvinus at both ends, more pronounced at distal end	20–55 mm long; pronounced pulvinus at both ends	10–45 mm long; pulvinus at base, apex, or both	10–30 mm long; pulvinus generally absent, sometimes weakly present at base, apex or both
Stipules	*c.* 2 mm long, caducous	*c.* 2 mm long, caducous	1–2 mm long, deciduous	1–2 mm long, deciduous, sometimes caducous
Leaf domatia	present as foveoles in secondary vein axils, glabrous, 2–8(–10) per leaf	present as foveoles in secondary vein axils, glabrous, (–5)10–17 per leaf	absent	absent
Petals	5, white or cream, obovate, 35–40 mm long and 10 mm wide, with dense hairs on the outside, glabrous or with very few scattered hairs on the inside, divided at apex into 2–3 lobes, lobes *c.* 5 mm long	5, white or cream, obovate, 20–25 mm long and 10 mm wide, with dense hairs on both sides, divided at the apex into 3 lobes, lobes *c.* 3 mm long	4, white, obovate, 20–24 mm long and 10–18 mm wide, with sparse hairs on the outside, glabrous or with very few scattered hairs on keel on the inside, divided at apex into *c.* 3(–5) lobes, lobes *c.* 3 mm long	4, white or cream, obovate, 30–40 mm long and 15–20 mm wide, with hairs on the inside of basal half, divided at apex into 3–5 lobes, lobe length unknown
Anther awns	1–1.5 mm long	present, *c.* 1 mm long	absent	present, *c.* 2 mm long
Stamens	*c.* 55	50–60	30–50	*c.* 40
Filaments	10–15 mm long, with long appressed or slightly ascending hairs	6–8 mm long, with long ascending or appressed hairs	5–9 mm long, with long scattered ascending hairs	6–13 mm long, hairs unknown
Fruit colour	dark blue, or slatey to brownish grey	blue, shiny	dull greenish-blue to khaki	blackish, dark blue or dark green

	E. carbinensis	*E. stellaris*	*E. bancroftii*	*E. womersleyi*
Fruit shape & dimensions	broad ovoid to ellipsoid, 50–55 × 35–50 mm	globose to ellipsoid, 43–65 × 50–60 mm	globose to ellipsoid, 40–55 × 33–40 mm	globose or obovoid, 40–75 × 30–50 mm
Pedicel	15–25 mm long	23–25 mm long	10–35 mm long	9–26 mm long
Mesocarp dimensions	30–45 × 32–40 mm	41–50 × 35–42 mm	30–80 × 20–70 mm	40–55 × 30–50 mm
Mesocarp fibres	detach cleanly from mesocarp	detach cleanly from mesocarp	detach cleanly from mesocarp	persistent and permanently attached to mesocarp
Mesocarp flanges	5, 3–5 mm thick, distance between flanges 15–20 mm, valley between flanges shallow	5, 5–10 mm thick, distance between flanges 20–25 mm, valley between flanges deeply grooved	absent	absent
Mesocarp ornamentation	punctate	punctate	punctate and pitted with irregularly scattered pits	fibres permanently attached
Sutures	5, prominent on flanges, becoming less grooved distally	5, prominent on flanges grooved	4 (–5), grooved, sometimes on weak ridges distally	difficult to see due to persistent fibres permanently attached to surface, but mesocarp 4–partite in TS
Locules	5	5	(2–) 4 (–5)	4 (–5)
Ovules	*c.* 10 per locule	4–8 per locule	9–10 per locule	6 per locule
Seeds	1–3 per fruit	1–3 per fruit	1–2 per fruit	1–2 per fruit

Where necessary, information was also taken from other sources (Coode 1978, 1984; Dettman & Clifford 2000; Rozefelds & Christophel 2002; Cooper & Cooper 2004; Phoon 2015). Mesocarp characters for each species are illustrated in **Fig. 3**.

Taeniophyllum baumei B.Gray (Orchidaceae), a new species from Cape York Peninsula, Queensland

B. Gray

Summary

Gray, B. (2018). *Taeniophyllum baumei* B.Gray (Orchidaceae), a new species from Cape York Peninsula, Queensland. ***Austrobaileya* 10(2): 260–265.** *Taeniophyllum baumei* B.Gray, a new species closely related to *T. muelleri* Lindl. ex Benth. but differing on floral characteristics, is described and illustrated. The new species is restricted to northern Cape York and the McIlwraith Range on Cape York Peninsula in Queensland, where it is relatively common in various forest types.

Key Words: Orchidaceae, *Taeniophyllum*, *Taeniophyllum baumei*, Australia flora, Queensland flora, Cape York, McIlwraith Range, new species, taxonomy, identification key

B. Gray, Australian Tropical Herbarium, James Cook University, Cairns Campus, McGregor Road, Smithfield, Queensland 4878, Australia.

Introduction

A survey of mainland Australian *Taeniophyllum* was conducted recently and a total of nine species were recorded, including four new species (Gray 2015, 2017). However, another recent collection made by David Baume in 2015 from northern Cape York has shown yet another distinct species exists. Although closely resembling *T. muelleri* Lindl. ex Benth., a widespread species of the east coast of Queensland and New South Wales (Jones *et al.* 2018), certain floral characteristics of Baume's specimen differ significantly to those of *T. muelleri*. The taxonomy of *T. muelleri* was revisited and it was discovered that all northern Cape York Peninsula *Taeniophyllum* collections previously identified as *T. muelleri* were in fact the same as David Baume's specimen. This new Cape York Peninsula *Taeniophyllum* is here described as *T. baumei* (**Fig. 1**). A revised key to the mainland Australian *Taeniophyllum* is provided.

Materials and methods

This study is based on living plants observed in the field, as well as herbarium specimens including spirit collections deposited in BRI, CANB and CNS (herbaria acronyms follow Thiers (continuously updated)). All measurements of floral parts were made from spirit material. An illustration depicting the inflorescences of *Taeniophyllum baumei* and *T. muelleri* is provided for comparison purposes, (**Fig. 2**), as well as photographs of the two species observed in the field (**Figs. 3 & 4**).

Taxonomy

Key to mainland Australian *Taeniophyllum* species (revised from Gray 2015)

1 Sepals and petals fused near the base forming a tube; flowers <3 mm diameter **2**

1. Sepals and petals free to the base not forming a tube; flowers >3 mm diameter **6**

2 Roots triangular or flattened in cross section **3**

2. Roots terete in cross section **9**

Accepted for publication 19 July 2018

3 Roots triangular in cross section (having a raised longitudinal ridge) . . . **T. triquetroradix**
3. Roots flattened in cross section **4**

4 Peduncle not filiform, roots 2–3 mm broad; floral bracts overlapping, hiding the rachis; flowers 4–5 mm long . . . . . **T. confertum**
4. Peduncle filiform, roots 1–1.5 mm broad; floral bracts not overlapping; flowers 2–2.5 mm long **5**

5 Roots 1–1.5 mm broad; peduncle 12–15 mm long; rachis filiform; floral bracts small, alternating 0.5 mm apart, all in one plane; flowers *c.* 2.5 mm long . . . . . **T. explanatum**
5. Roots up to 1 mm broad; peduncle 2–5 mm long; rachis not filiform, fleshy, parallel sided, twice as wide as peduncle; floral bracts alternating less than 0.5 mm apart; flowers <2 mm long . . . . . **T. clementsii**

6 Peduncle, rachis and ovary sparsely covered with erect short-bristly hairs; flowers green, turning yellow with age . . . . . **T. lobatum**
6. Peduncle, rachis and ovary glabrous **7**

7 Peduncle filiform, 20–50(60) mm long; floral bracts overlapping; flower 7–11 mm wide; roots 1.5–2.5 mm broad, mostly hanging free from host, some appressed . . . . . **T. malianum**
7. Peduncle not filiform **8**

8 Roots greyish green, flat in cross section, 2–3.5(–4) mm broad; peduncle and rachis reddish, zig-zag from the base, 8–10 mm long; floral bracts alternating 2–3 mm apart; flower 4.5–5mm wide . . . . . **T. epacridicola**
8. Roots green, ± terete in cross section, 1.5–2.1 mm diameter; peduncle up to 1 mm long, floral bracts overlapping hiding the rachis; flower *c.* 4.5 mm wide . . . . . **T. walkeri**

9 Inflorescence with 4–8(–9) flowers, self-pollinating; somewhat sparsely arranged flowers, 1.7–3 mm apart . . . . . **T. muelleri**
9. Inflorescence with 6–20(–more) flowers, not self-pollinating; somewhat tightly arranged flowers, 0.8–1.5 mm apart . . . . . **T. baumei**

Taeniophyllum baumei B.Gray **sp. nov.** Similar to *T. muelleri* Lindl. ex Benth. but differs in having inflorescences with 6–20(–more) flowers (versus 4–8(–9) flowers in *T. muelleri*), flowers tightly arranged (0.8–1.5 mm apart) (versus flowers sparsely arranged (1.7–3 mm apart) in *T. muelleri*), and non-self-pollinating flowers (versus self-pollinating flowers in *T. muelleri*). **Typus:** Queensland. Cook District: Wasp Creek north of Bamaga, 1 July 2015, *D.F. Baume DFB55* (holo: BRI [1 sheet + spirit]; iso: CNS).

Plants epiphytic, single or in colonies. **Roots** several, 15–60 mm long, round in cross section 0.8–1 mm diameter, green. **Inflorescences** filiform, peduncle 4–8 × 0.3–0.4 mm with 1–3 bracts. **Rachis** increasing in length as flowering progresses, producing 9–20 or more flowers one at a time over several weeks; buds, flowers and capsules can be present at the same time. **Floral bracts** acute, alternate, 0.7–0.9 mm long, 0.8–1.5 mm apart and all in one plane. **Flowers** opening singly, *c.* 3 mm long including the spur and *c.* 2.2 mm across when open, pale green. **Sepals** and **petals** connate at the base into a short tube 0.5–0.8 mm long then spreading. **Dorsal sepal** narrowly lanceolate, *c.* 1.5 × 0.5 mm. **Lateral sepals** linear to slightly falcate, *c.* 1.5 × 0.6 mm. **Petals** lanceolate, *c.* 1.5 × 0.7 mm, apex acuminate. **Labellum** cymbiform, narrowly triangular, 1.8–1.9 × *c.* 0.5 mm, channel deepest at the base, apex acute with an erect spur *c.* 0.5 mm long. **Spur** subglobose, flattish

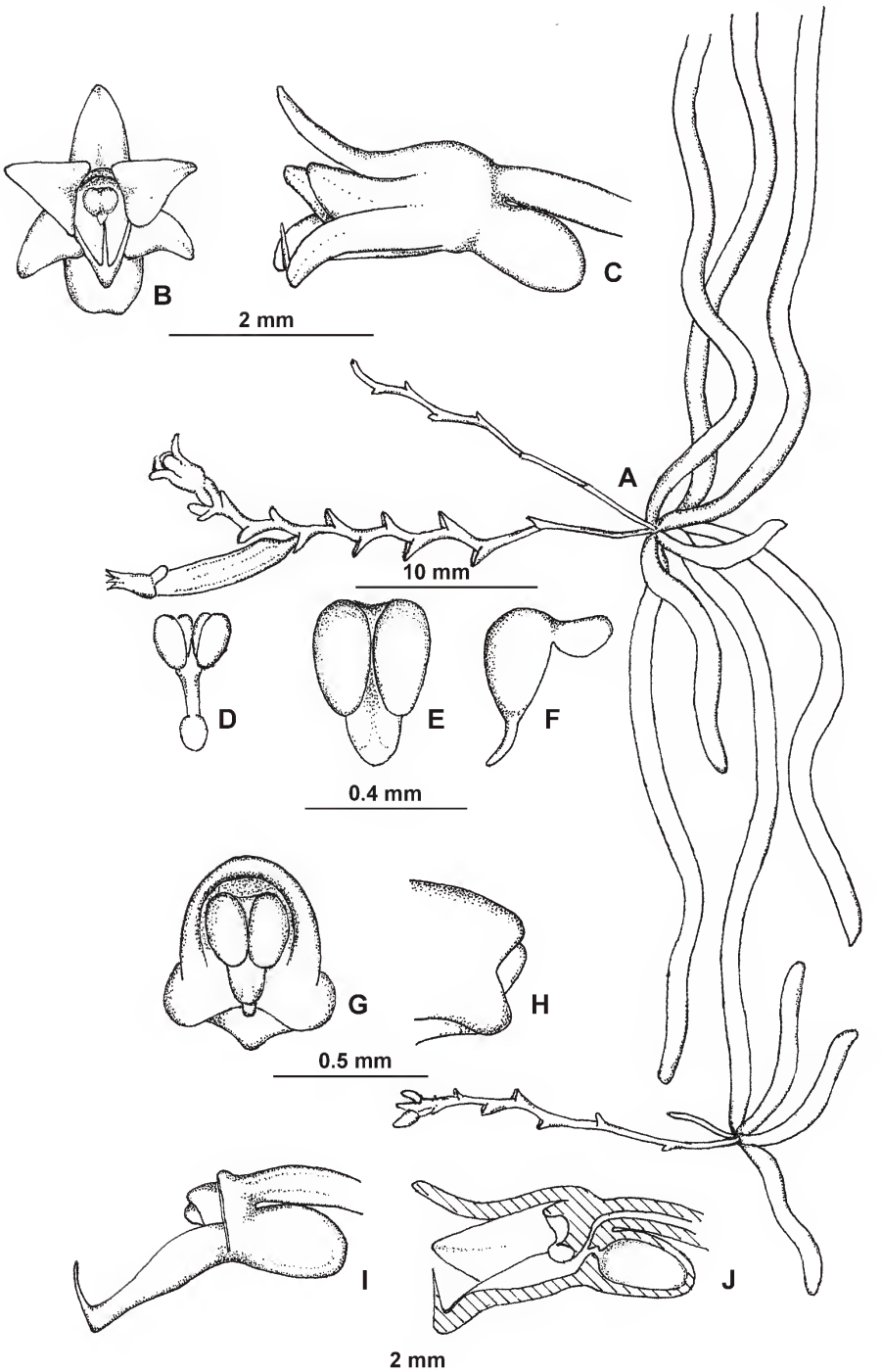


Fig. 1. ***Taeniophyllum baumei.*** A. habit of mature flowering plant. B.face view of flower. C. lateral view of flower. D. pollinium. E. face view of anther. F. lateral view of anther. G. face view of column. H. lateral view of column. I. lateral view of labellum and column. J. longitudinal section through flower. All from *Baume DFB55* (CNS, isotype). Scale as indicated. Del. B. Gray.

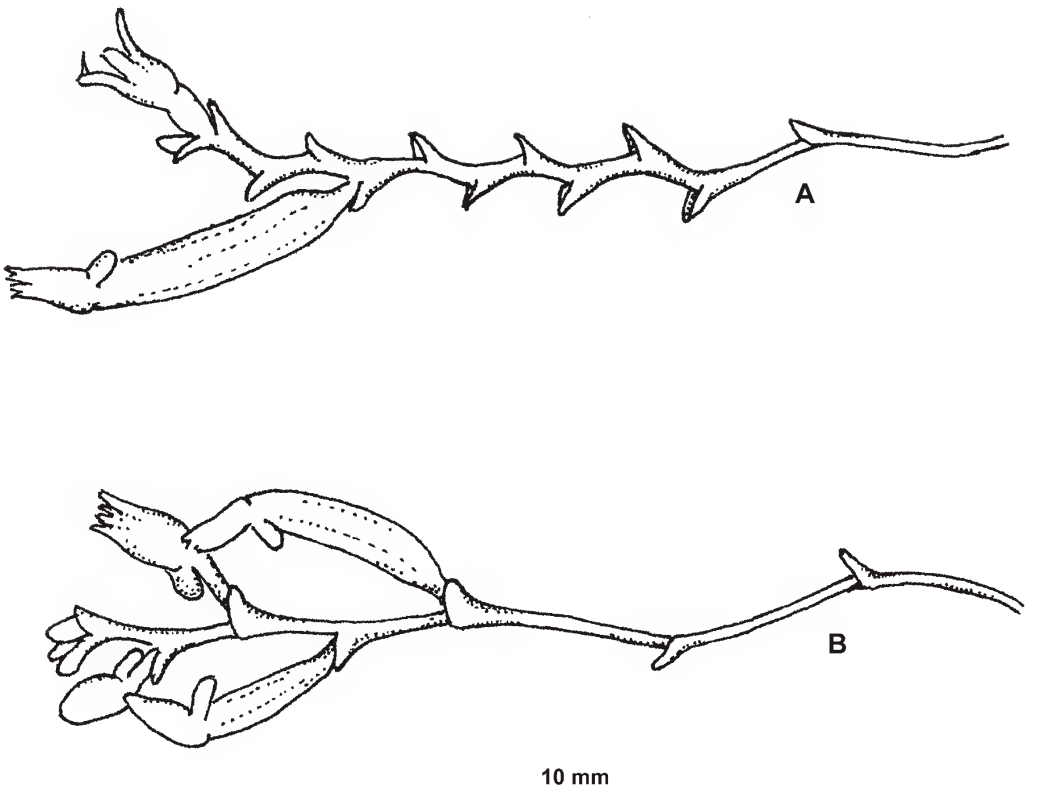


Fig. 2. Lateral view of inflorescences of A. ***Taeniophyllum baumei*** and B. ***T. muelleri***. A from *Gray BG9795* (CNS); B from *Gray BG9661* (CNS). Scale as indicated. Del. B. Gray.

on the underside, 0.9–1 mm. **Column** domed, *c.* 0.6 × 0.5 mm. **Anther cap** 0.3.5–4 × *c.* 0.3 mm. **Pollinia** 4 in two pairs, yellow. **Capsule** linear 6–7 × 2–2.5 mm. **Figs. 1, 2A, 3.**

***Additional specimens examined*: Australia. Queensland.** Cook District: Punsand Bay, Cape York, Sep 1989, *Gray 5116* (CNS); Adjacent to Laradenia Creek north of Bamaga, Sep 2017, *Gray 9794 & Nowochatko* (CNS); Mt Tozer, Jul 1986, *Collins 20151* (CNS); Foot of Garraway Range, Sep 2017, *Gray 9796 & Nowochatko* (CNS); McIlwraith Range, Leo Creek Mine Road, Nov 1985, *Gray 4243* (CNS); McIlwraith Range, Leo Creek Mine Road, Sep 2017, *Gray 9802 et al.* (CNS); Pandanus Creek, McIlwraith Range E of Coen, Jul 1978, *Clarkson 2453* (BRI); Klondike Mine Road, S end of McIlwraith Range, Dec 2001, *Gray 7921* (CNS).

***Distribution and habitat*:** *Taeniophyllum baumei* is presently known to occur from the tip of Cape York, to as far south as the McIlwraith Range (**Map 1**). Specimens have been collected in Ericaceae dominated scrubs and both outside and inside rainforest margins at elevations from sea level to over 400 m.

***Phenology*:** Flowering and fruiting has been recorded between April and December.

***Notes*:** *Taeniophyllum baumei* was previously confused with *T. muelleri*, a widespread species occurring from the Wet Tropics in northern Queensland to northern New South Wales.

Fig. 3. Flowering and fruiting plant of ***Taeniophyllum baumei*** (*Gray BG9795*, CNS).

Fig. 4. Flowering and fruiting plant of ***Taeniophyllum muelleri*** (*Gray BG9661*, CNS).

***Etymology*:** The species is named after David Baume, collector of the type material who brought my attention to this remarkable plant.

Acknowledgements

Special thanks to David Baume who brought *Taeniophyllum baumei* to my attention. I am indebted to Prof. Dr Darren Crayn and Frank Zich for their assistance with loans from (BRI) and (CANB), and permission to access herbarium collections at the Australian Tropical Herbarium (CNS); Yee Wen Low, Herbarium, Singapore Botanic Gardens for assistance with the manuscript; Kieran Aland, James Walker and Mark Nowochatko for assistance with field work and Will Smith (BRI) for the distribution map.

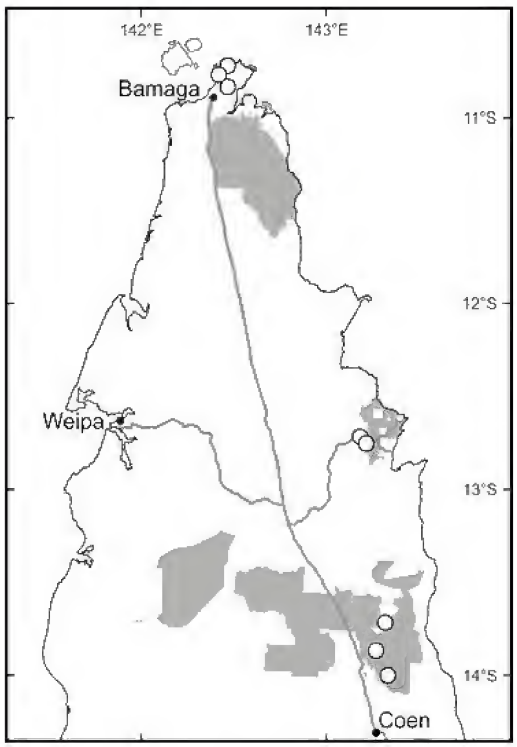
References

Gray, B. (2015). Three new species of *Taeniophyllum* Blume (Orchidaceae) from northern Queensland. *Austrobaileya* 9: 382–392.

—— (2017). *Taeniophyllum walkeri* B.Gray (Orchidaceae), a new species from north Queensland. *Austrobaileya* 10: 65–69.

Jones, D.L., Hopley, T. & Duffy, S.M. (2018). *Australian Tropical Rainforest Orchids, ver. 1.1.* CSIRO. https://keys.trin.org.au/key-server/data/08090a09-0d0e-410b-860c-020705070e0e/media/Html/index.htm, accessed on 8 June 2018.

Thiers, B. (continuously updated). *Index Herbariorum: A global directory of public herbaria and associated staff.* New York Botanical Garden's Virtual Herbarium. https://sweetgum.nybg.org/ih/, accessed on 11 June 2018.



Map 1. Distribution of ***Taeniophyllum baumei***.

Lomandra ramosissima Jian Wang ter (Laxmanniaceae), a new species from southern central Queensland

Jian Wang

Summary

Wang, J. (2018). *Lomandra ramosissima* Jian Wang ter (Laxmanniaceae), a new species from southern central Queensland. ***Austrobaileya* 10(2): 266–272.** *Lomandra ramosissima* Jian Wang ter is described and illustrated. Notes on its distribution including maps, habitat, phenology and affinities are provided. A conservation status of Least Concern is proposed.

Key Words: Laxmanniaceae, *Lomandra*, *Lomandra multiflora*, *Lomandra multiflora* subsp. *multiflora*, *Lomandra patens*, *Lomandra ramosissima*, Australia flora, Queensland flora, taxonomy, new species, conservation status.

J. Wang, Queensland Herbarium, Department of Environment & Science, Brisbane Botanic Gardens, Mt Coot-tha Road, Toowong, Queensland 4066, Australia. E-mail: jian.wang@des.qld.gov.au

Introduction

Lomandra Labill. is a genus of four sections with 55 species, all occurring in Australia, with two species extending to New Guinea and one species in New Caledonia (Lee & Macfarlane 1986; Macfarlane & Conran 2014; Wang & Bean 2017). The genus was revised by Lee who recognised 10 species and four subspecies from Queensland (Lee 1966). Currently, there are 19 recognised species in Queensland, as well as three non-autonymic subspecies (Wang 2017; Wang & Bean 2017).

Examination of herbarium material has revealed the existence of a distinctive species that was in the past misidentified as either *Lomandra patens* A.Lee or *L. multiflora* (R.Br.) Britten subsp. *multiflora*. Therefore, a new species *L. ramosissima* (**Figs. 1 & 2**), restricted to southern-central Queensland, is described in this paper.

The three species *Lomandra multiflora*, *L. patens* and *L. ramosissima* share similar characteristics of being robust plants forming tussocks from condensed ascending rhizomes, having leaf apices broadly rounded to obtuse without teeth and whorled branching male flower clusters. However, *L. ramosissima* can be easily distinguished from *L. patens* by the reddish to dark brown leaf sheaths (white, grey or brown in *L. patens*), the strongly verrucous rachis and scapes (smooth *in L. patens*), the smaller male flowers, the much shorter filaments (filaments are 0.8–1 mm long for *L. patens*), the much smaller and poorly formed pistillode, and the shorter fruiting styles (fruiting styles 1.8–2.5 mm long for *L. patens*). *L. ramosissima* differs from *L. multiflora* subsp. *multiflora* by the more robust spreading habit, the much shorter pedicellate male flowers (pedicels 3–8 mm long in *L. multiflora* subsp. *multiflora*) and the much branched female inflorescences.

Materials and methods

This study is based on morphological examination of *Lomandra* material at BRI; especially specimens identified as *Lomandra patens* and *L. multiflora* subsp. *multiflora*, as well as specimens received on loan from DNA, MEL, NSW and NT. All measurements are based on dried material, except the dimensions of flowers which are based on material reconstituted with hot water.

Abbreviations in the specimen citations include NP (National Park) and SF (State Forest).

Accepted for publication 16 July 2018

Taxonomy

Lomandra ramosissima Jian Wang ter **sp. nov**.; resembling *L. patens* but differing in the reddish to dark brown leaf sheaths (leaf sheaths are white, grey or brown in *L. patens*), the strongly verrucous rachis and scapes (the surfaces of rachis and scapes are smooth in *L. patens*), the smaller male flowers, the filaments connate to the inner tepals for almost all their length, the poorly formed pistillode, the much shorter fruiting styles and smaller sized fruits. **Typus:** Australia. Queensland. Leichhardt District: Precipice National Park, Precipice Creek Catchment, 25 September 1996, *P.I. Forster PIF19692* (holo: BRI [1 sheet]).

Robust plants forming tussocks from condensed ascending rhizomes. Each tussock comprising usually 1 to 6 tufts. Each tuft up to 2 cm in diameter with leaves arranged irregularly at first becoming distichous with age. Leaves tough and upright. Leaf sheath margins at first membranous or cartilaginous, fraying into strips or fibres up to 15 cm long, reddish to dark brown. Leaf blades flat or slightly convex on the abaxial side, 40–80 cm long, 2.5–5 mm wide, usually glaucous, scabrid, with up to 45 parallel veins on both sides; leaf apex broadly rounded to obtuse without teeth; the margins smooth to minutely denticulate. Male and female inflorescences similar in appearance, 1–3 per tuft, usually longer than the longest leaf. Male inflorescence paniculate; the peduncle flattened, verruculose, reddish to dark brown near the base, light brown elsewhere, (20–)30–60 cm long, usually 0.3–0.4 cm wide; the primary rachis 4-angled or channelled, verrucate, (10–)25–45(–60) cm long, bearing numerous branches and flower clusters; branches and flower clusters appearing whorled or opposite at nodes; inflorescence branches 4-angled, verruculose, usually 5–25 cm long; flower clusters with branches 1.5–10 cm apart on the primary rachis, 1–7 cm apart on the secondary rachis (first branch), 0.5–2.5 cm apart on the tertiary rachis (second branch); inflorescences occasionally developing a quaternary rachis (third branch) up to 1 cm apart. Cluster bracts usually 3–6, long- to short-deltoid, up to 1.2 cm long, 0.1–0.3 cm wide at the widest point, with 1–6 veins, often longest at the basal node of primary rachis, shorter upwards along primary rachis as well as on secondary and tertiary rachis. Male flowers in groups of 6–14; bracteoles 3, cucullate, *c.* 1.1 mm long and 0.7–1 mm wide, membranous, completely encircling each flower. Male flowers becoming pedicellate, the pedicels when mature 1–1.5(–2) mm long, 0.3–0.4 mm wide, terete, pale yellow to brown, usually various ages within each cluster (**Fig. 1F & G**); buds ellipsoid, pale yellow with purple tinge, at anthesis becoming campanulate; perianth segments 6 with distinct outer and inner whorls; outer tepals (sepals) 3, broadly elliptical, thin, free except at the very base, uniform in size and texture, 2.3–2.6 mm long, 1.3–1.5 mm wide, pale yellow with purple tinges; inner tepals (petals) 3, elliptical, free except on the basal 1/4–1/3 proportion, uniform in size and texture, 2.5–2.9 mm long, 0.9–1.1 mm wide, mostly creamy yellow except for brighter yellow in the middle of outer surface. Stamens 6, 3 adnate basally to the inner tepals, 3 alternating with them and adnate basally to antetepals; the filament not obvious *c.* 0.3 mm long and 0.2 mm diameter; anthers all similar, versatile, 0.5–0.6 mm long and 0.4–0.5 mm wide, creamy yellow to bright yellow; anthers of inner tepals slightly distal than the antetepalous anthers (**Fig. 1H**). Pistillode poorly formed, 0.3–0.4 mm long, 0.2–0.3 mm diameter, hyaline or pale yellow. Female inflorescences paniculate; the peduncle flattened, verruculose, pale green to pale purple, 15–60 cm long, 0.25–0.35 cm broad; the primary rachis 4- or irregular angled or channelled, verruculose, (10–)20–35 cm long, bearing numerous branches and flower clusters; branches and flower clusters appearing whorled or opposite at nodes; inflorescence branches 4- or irregular angled or sometimes rounded, verruculose, usually 5–15 cm long; flower clusters with branches 1.5–9 cm apart on the primary rachis, 1–6 cm apart on the secondary rachis (first branch), 0.5–2 cm apart on the tertiary rachis (second branch); rarely developing a quaternary rachis (third branch) as male inflorescences. Cluster bracts usually 5–7, with 1–7 veins,

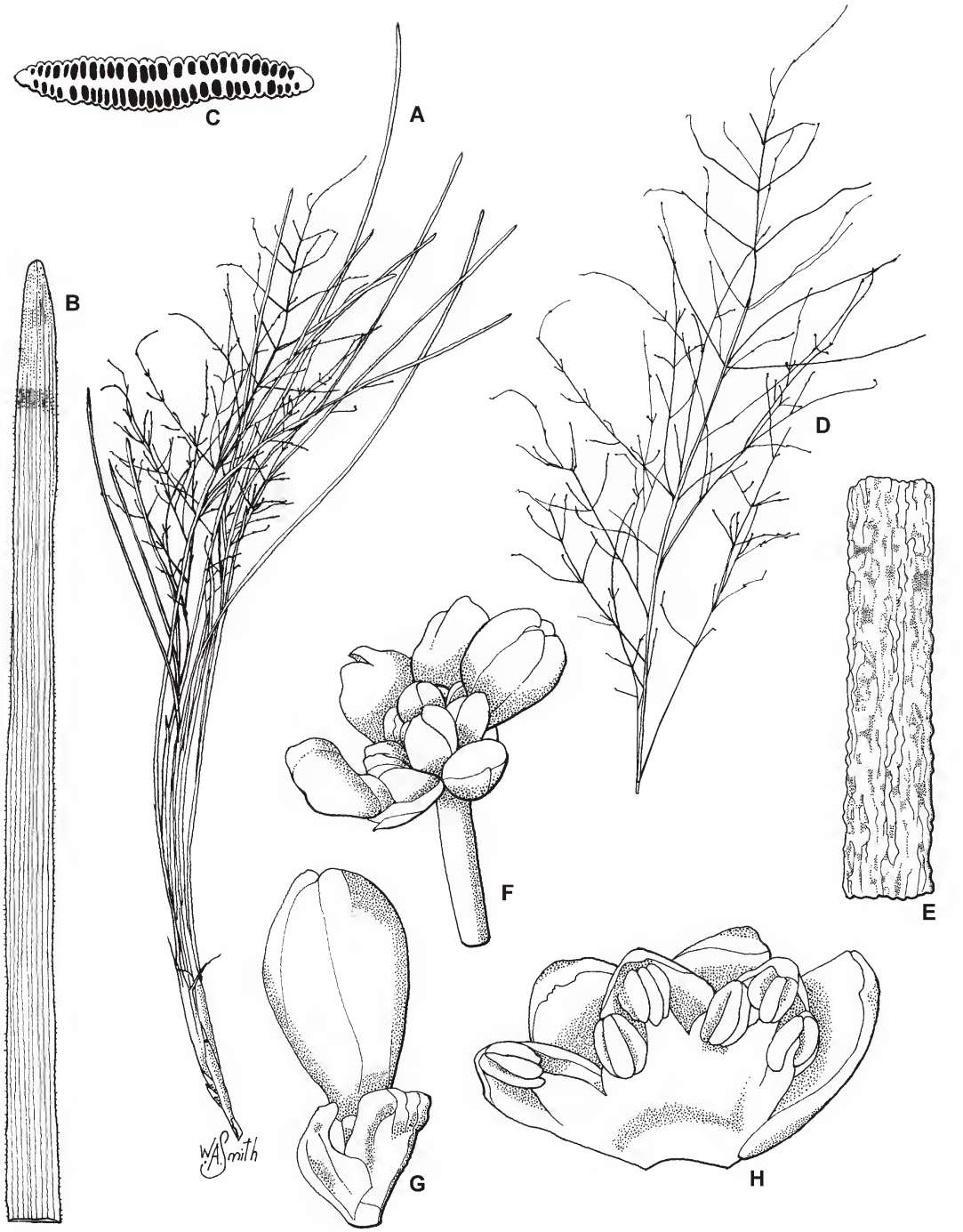


Fig. 1. ***Lomandra ramosissima*** (male). A. habit of tuft with young inflorescence ×0.2. B. distal part of leaf ×3. C. transverse section of leaf ×16. D. young inflorescence (basal part of rachis removed) ×0.3. E. section of rachis showing the verrucous surface ×16. F. cluster of flowers with various ages ×8. G. unopened flower with bracteoles ×16. H. flower spread open ×16. A, D & E from *Olsen 3573 & Byrnes* (BRI); B, C, F–H from *Forster PIF19692* (BRI, holotype). Del. W. Smith.

long- to short-deltoid, up to 3 cm long, *c.* 0.3 cm wide at the base, often largest at the basal node of primary rachis, shorter and narrower distally. Female flowers usually in group of 2–9(–12), each subtended by up to 6 cucullate bracteoles, 0.8–1.3 mm long, 0.7–1.5 mm wide, membranous, pale yellow with purple tinges, completely encircling the flower base; sessile or shortly pedicellate, the pedicels usually 0.3–0.5 (–1.5) mm long, 0.4–0.5 mm wide, different ages within each cluster; outer 3 tepals (sepals) broadly ovate, 3–3.3 mm long, 2–2.5 wide, creamy to pale yellow with purple tinges in the middle, adnate at the base; inner 3 tepals (petals) ovate, *c.* 3.2 mm long and 1.5 mm wide, adnate near base. Staminodes 6, whitish-transparent, filaments absent, anthers vestigial, 3 inserted on lower middle part of inner tepals, 3 alternating with them on the margin of lower side of each inner tepals (**Fig. 2D–F**). Pistil conspicuous, styles very short and fused with 3 stigmatic lobes (**Fig. 2C**); ovary sessile obovoid, 1.5–1.6 mm long, 1.1–1.3 mm diameter, with 3 locules; ovules 1 per loculus. Fruits sessile, usually in groups of 1–4 of similar ages. Fruiting styles 0.2–0.5 mm long. Capsules usually 4–5 mm long, 4–5 mm diameter with 3 transverse wrinkled carpels at maturity; carpels dark grey outside, orange-yellow inside; the carpel margins slightly ridged; the 6 hardened perianth segments persistent, 2.8–3.8 mm long, 2.1–2.4 mm wide; the hardened bracts occasionally persistent, *c.* 1 mm long, up to 1 mm wide (**Fig. 2J**). Seeds 1 per locule, ovoid, *c.* 4 mm long and 2.5 mm wide, 2-angled on inner face, rounded on outer face, rough or slightly wrinkled, translucent, light orange to brown (**Fig. 2K & L**).

***Additional specimens examined*: Queensland.** Leichhardt District: Grasstree Mt, NE tip of SF 6, *c.* 30 km along Alpha Road and 4 km on track S of Alpha Road, Feb 1999, *Johnson DCJ31 & Turpin* (BRI); Blackdown Tableland, 12 miles [20 km] SSE of Bluff, Sep 1959, *Johnson 1066* (BRI); Blackdown Tableland *c.* 32 km SE of Blackwater, campsite on Mimosa Creek, Apr 1971, *Henderson 757 et al.* (BRI); Crest of mountain 6.75 km NE of Rutland Station, Jul 1999, *Ryan 1613* (BRI); Spring Hill, Expedition Range, Nov 2003, *Forster PIF29627* (BRI, MEL); 24.4 km SSW of Emu Plains Homestead, May 1999, *Stephens Q94503 & Dowling* (BRI); SF 46, about 2.5 km directly W of the Dawson Highway, Jun 1999, *Schmeider MS122 & Appelman* (BRI); 2 miles [3.3 km] S of Ghinghinda, Oct 1963, *Speck 1875* (BRI, MEL); Glenhaughton – Mapala Road, May 1977, *Olsen 3573 & Byrnes* (BRI); 4 km along road to Robinson Gorge, off Glenhaugton to Mapala road, Sep 1992, *Forster PIF11242 & Sharpe* (BRI, MEL); Beilba Section, Expedition NP, Baffle Creek lookout, May 2001, *Semple 306* (BRI, NE, SYD). Burnett District: Nour Nour NP, Hungry Hills, off Possum Creek Pinches Road, Apr 2015, *Forster PIF42500 & Thomas* (BRI); Pile Gully, SF 220, Oct 1996, *Grimshaw PG2580 & Ryan* (BRI, MEL); South of Well Station Creek, *c.* 50 km SW of Mundubbera, Nov 2008, *Bean 28201 & Grimshaw* (BRI). Warrego District: Brigalow Dam exclosure Winneba Section of Chesterton Range NP, Sep 1995, *Grimshaw PG2183 & Bean* (BRI); W of Angellala Creek, 7 km WNW of 'Rocky', Jul 1977, *Purdie 674E* (BRI). Maranoa District: 3.5 km E along Redford – Forestvale road from junction Redford – Hoganthulla road, Jul 2007, *Halford Q9352 & Booth* (BRI); Mount Mobil NP, Jul 1992, *McRae 14* (AD, BRI); Barabanbel SF 3, *c.* 16 km NNW of Mitchell, Oct 2014, *Mathieson MTM1892 & Ferguson* (BRI). Darling Downs District: Yuleba SF, *c.* 47 km W of Condamine toward Surat, Oct 1983, *Canning 5941* (BRI); Glenmorgan, Oct 1969, *Smith s.n.* (BRI [AQ410731], MO, NSW).

***Distribution and habitat*:** *Lomandra ramosissima* is endemic to southern central Queensland where it is distributed as far north as Clermont, and south to Glenmorgan, and from Charleville in the west to Gayndah in the east (**Map 1**). This species mainly grows in eucalypt open forests or woodlands on sandstone ridges with sandy soils. The dominant tree species include: *Angophora leiocarpa* (L.A.S.Johnson ex G.J.Leach) K.R.Thiele & Ladiges, *Corymbia citriodora* subsp. *variegata* (F.Muell.) A.R.Bean & M.W.McDonald, *C. leichhardtii* (F.M.Bailey) K.D.Hill & L.A.S.Johnson, *C. scabrida* (Brooker & A.R.Bean) K.D.Hill & L.A.S.Johnson, *C. watsoniana* (F.Muell.) K.D.Hill & L.A.S.Johnson, *Eucalyptus apothalassica* L.A.S.Johnson & K.D.Hill, *E. baileyana* F.Muell., *E. beaniana* L.A.S.Johnson & K.D.Hill, *E. chloroclada* (Blakely) L.A.S.Johnson & K.D.Hill, *E. cloeziana* F.Muell., *E. crebra* F.Muell., *E. decorticans* (F.M.Bailey) Maiden, *E. exserta* F.Muell., *E. mediocris* L.A.S.Johnson & K.D.Hill, *E. melanophloia* F.Muell., *E. panda* S.T.Blake, *E. populnea* F.Muell., *E. suffulgens* L.A.S.Johnson & K.D.Hill and *E. tenuipes* (Maiden & Blakely) Blakely & C.T.White. It

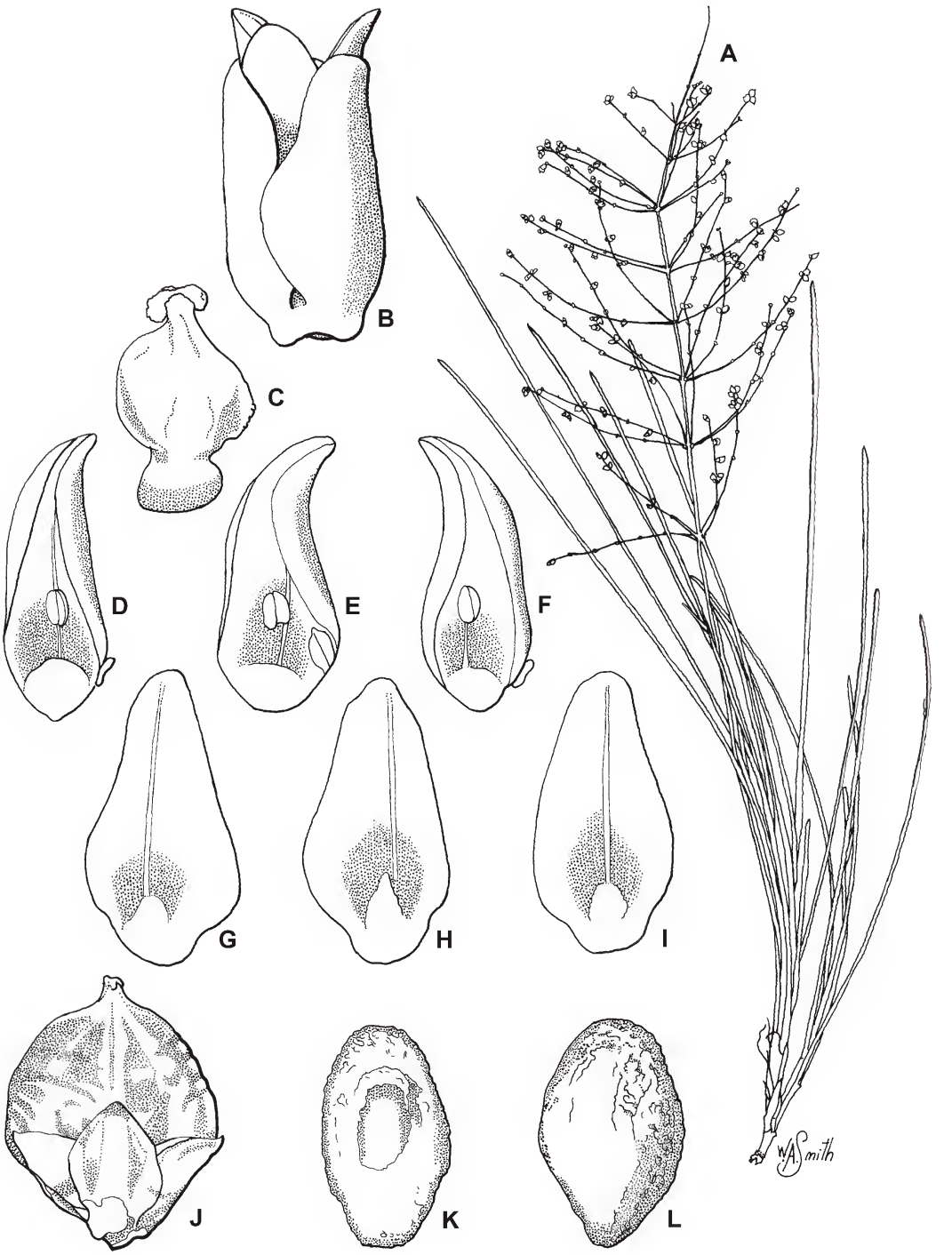


Fig. 2. ***Lomandra ramosissima*** (female). A. habit of plant with fruiting inflorescences ×0.25. B. flower with bracteoles removed ×12. C. pistil ×16. D–F. petals of the flower with staminodes ×12. G–I. sepals of the flower ×12. J. fruit with hardened persistent perianth ×6. K. ventral face of seed ×8. L. dorsal face of seed ×8. A, J from *Bean 28201 & Grimshaw* (BRI); B–I from *Forster PIF42500 & Thomas* (BRI); K & L from *Purdie 674E* (BRI). Del. W. Smith.

also grows in *Acacia sparsiflora* Maiden tall shrubland and cypress pine forests of *Callitris glaucophylla* Joy Thomps. & L.A.S.Johnson on grey or brown sandy loams. Other non-eucalypt tree species such as *Allocasuarina littoralis* (Salisb.) L.A.S.Johnson, *A. luehmannii* (R.T.Baker) L.A.S.Johnson, *A. torulosa* (Aiton) L.A.S.Johnson and *Lysicarpus angustifolius* (Hook.) Druce were also recorded where *L. ramosissima* occurs.

***Phenology*:** Male flowering was recorded in September and October. However, male plants with flowering buds were recorded as early as May. Female flowering was recorded in April, October and November, and female plants with buds were found in February, April through July. Mature fruits were collected from July and November.

***Affinities*:** *Lomandra ramosissima* is closely related to *L. patens*, *L. multiflora* subsp. *multiflora, L. multiflora* subsp. *dura* and *L. decomposita.* All of these species are robust plants (*L. multiflora* subsp. *multiflora* and *L. decomposita* can be slender occasionally) with tussocks from condensed ascending rhizomes, have leaf apices broadly rounded to obtuse without teeth, paniculate male inflorescences and whorled branches (*L. multiflora* subsp. *multiflora* and *L. decomposita* rarely branched), and whorled flower clusters.

Lomandra ramosissima differs from *L. patens* by the reddish to dark brown leaf sheath, the strongly verrucous rachis and scapes (smooth in *L. patens*), the smaller male flowers, the much shorter filament (filament is 0.8–1 mm long for *L. patens*), the much smaller and poorly formed pistillode, and the shorter fruiting styles (fruiting styles 1.8–2.5 mm long for *L. patens*).

Lomandra ramosissima differs from *L. multiflora* subsp. *multiflora* by the more robust spreading habit, the much shorter pedicellate male flowers (pedicels 3–8 mm long in *L. multiflora* subsp. *multiflora*) and the much branched female inflorescences.

Lomandra ramosissima differs from *L. multiflora* subsp. *dura* by the much larger and much branched male and female inflorescences.

Lomandra ramosissima differs from *L. decomposita* by the larger and ellipsoid male flower bud, the shorter pedicel male flower and a much branched female inflorescences.

***Conservation status*:** *Lomandra ramosissima* can be a common species where it occurs. It is recorded from several National Parks and is not known to be at risk. It is **Least Concern** using the IUCN (2012) criteria.

***Etymology*:** From the Latin *ramosissima* meaning 'very much branched'. This refers to the much branched male and female inflorescences, especially for male inflorescence that often develops quaternary rachis (third branch).

Acknowledgements

I am grateful to the following staff at the Queensland Herbarium who helped me in the preparation of this manuscript: Will Smith for producing the illustrations and distribution map; Tony Bean for reading a draft and making constructive suggestions; Gordon Guymer and Paul Forster for useful comments. I also wish to thank the Directors of DNA, MEL, NSW and NT for providing loan specimens. The anonymous reviewers are acknowledged for useful remarks.

References

IUCN (2012). *IUCN Red List Categories and Criteria: Version 3.1.* 2nd edition. Gland, Switzerland and Cambridge, UK: IUCN. iv + 32pp.

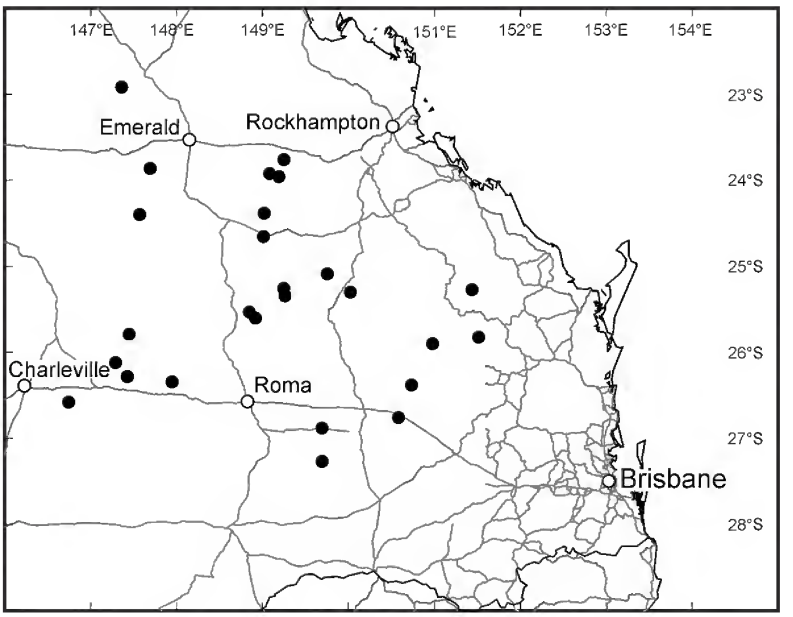
LEE, A.T. (1966). Xanthorrhoeaceae. *Contributions from the New South Wales National Herbarium, Flora Series* 34: 16–42.

LEE, A.T. & MACFARLANE, T.D. (1986). *Lomandra.* In A.S. George (ed.), *Flora of Australia* 46: 100–141. Australian Government Publishing Service: Canberra.

MACFARLANE, T.D. & CONRAN, J.G. (2014). *Lomandra marginata* (Asparagaceae), a shy-flowering new species from south-western Australia. *Australian Systematic Botany* 27: 421–426.

Wang, J. (2017). Laxmanniaceae. In P.D. Bostock & A.E. Holland (eds.), *Census of the Queensland Flora 2017*. Queensland Department of Science, Information Technology and Innovation: Brisbane. https://data.qld.gov.au/dataset/census-of-the-queensland-flora-2017, accessed 1 December 2017.

Wang, J. & Bean, A.R. (2017). *Lomandra decomposita* (R.Br.) Jian Wang ter & A.R.Bean (Laxmanniaceae), a new species for Queensland. *Austrobaileya* 10: 59–63.



Map 1. Distribution of ***Lomandra ramosissima***.

Vrydagzynea albostriata Schltr. (Orchidaceae) – new to the flora of Australia, with notes on the identity of *V. grayi* D.L.Jones & M.A.Clem.

B. Gray & P. Ormerod

Summary

Gray, B. & Ormerod, P. (2018). *Vrydagzynea albostriata* Schltr. (Orchidaceae) – new to the flora of Australia, with notes on the identity of *V. grayi* D.L.Jones & M.A.Clem. ***Austrobaileya* 10(2): 273–281.** *Vrydagzynea albostriata* Schltr. (Orchidaceae) is newly recorded for the flora of Australia from northern Queensland and a lectotype selected for the name. *V. grayi* Jones & M.A. Clem. is found to be a synonym of *V. elongata* Blume. A key to the genus *Vrydagzynea* in Australia is provided, along with a description and illustration based on the recently discovered material of *V. albostriata.*

Key Words: Orchidaceae, *Vrydagzynea*, *Vrydagzynea albostriata*, *Vrydagzynea elongata*, *Vrydagzynea grayi*, Australia flora, Queensland flora, new record, taxonomy, identification key

B. Gray, Australian Tropical Herbarium, James Cook University, Cairns Campus, McGregor Road, Smithfield, Queensland 4878, Australia; P. Ormerod, P.O. Box 8210, Cairns, Queensland 4870, Australia. Email: wsandavel@bigpond.com

Introduction

Vrydagzynea Blume is a genus of small, tender, shade-loving, terrestrial orchids with about 40 species distributed from northeast India to Samoa. It has two centres of diversity, one in Borneo where 16 species are recorded (Wood & Cribb 1994; Wood *et al.* 2011), and another in New Guinea from where about 10 taxa are recorded (Ormerod 2017). In Australia, a single species of *Vrydagzynea* has been reported, firstly as *V. paludosa* J.J.Sm. (Jones 1988), then reidentified as *V. elongata* Blume (Ormerod 1994), before finally being described as an endemic taxon, *V. grayi* D.L. Jones & M.A. Clem. (Jones & Clements 2004). We find that *V. grayi* is conspecific with *V. elongata,* and here reduce it to synonymy. At the same time we add *V. albostriata* Schltr. to the flora of Australia, based on recent collections from tropical northern Queensland. Thus two species are to be found in Australia, both shared with the island of New Guinea.

Materials and methods

This study is based on the examination of living specimens, dried materials, and spirit collections held at A, AMES, BM, BRI, C, CNS, K, LAE, and NSW. Measurements were taken from dried specimens, flowers of which were rehydrated, and from material in spirit.

Taxonomy

Key to Australian *Vrydagzynea* species

1 Leaves dark green above with a central white stripe; flowers with a pubescent ovary and base of sepals; dorsal sepal 4–5 mm long . . . . . **V. albostriata**

1. Leaves pale to dark green above, unicoloured; flowers with a glabrous ovary and sepals; dorsal sepal *c.* 3 mm long . . . . . **V. elongata**

Accepted for publication 19 July 2018

Vrydagzynea albostriata Schltr., in Schum. & Laut., *Nachtr. Fl. Deutsch. Schutzgeb. Südsee,* 2: 83 (1905). **Type citation:** "Papua New Guinea – Schumann River, 200 m, January 1902, *R. Schlechter 13835*; New Ireland, near Punam, 600 m, July 1902, *R. Schlechter 14694*". **Type:** Papua New Guinea. Schumann River, 200 m, January 1902, *R. Schlechter 13835* (lecto [here designated]: K; isolecto: BM, P image!).

Plants terrestrial. **Rhizome** terete, creeping, rooting at nodes. **Roots** terete, pubescent. **Stem** erect, laxly 3–9-leaved, up to 70 mm tall. **Leaves** obliquely oblong-lanceolate, acute, shortly petiolate, 15–60 × 5–19 mm, dark green above with a central white stripe; petiole and sheath up to 20 mm long. **Inflorescence** terminal, racemose, pubescent, 30–32 mm long; peduncle 18–19 mm long; rachis densely flowered, 12–13 mm long; floral bracts lanceolate, acute, pubescent, up to 6 mm long, green. **Flowers** with green sepals, white petals and labellum, and a greenish spur. **Pedicel with ovary** narrowly fusiform, pubescent, *c.* 4 mm long. **Dorsal sepal** oblong-lanceolate, obtuse, thickened apically, externally pubescent in lower half, forming with the petals a galea 5–5.5 × *c.* 2.5 mm. **Lateral sepals** obliquely oblong-lanceolate, obtuse, externally pubescent in lower half, 4.5–5 × 1.8–2 mm. **Petals** obliquely oblong-lanceolate, shortly clawed basally, obtuse, *c.* 3 × 0.8–1 mm. **Labellum** oblong, obtuse, calceolate, medially with a low bicarinate ridge, *c.* 3 × 1.2 mm; spur obliquely fusiform, obtuse, inside with two stalked glands, *c.* 1.3 mm long. **Column** short, *c.* 1.2 mm long. **Figs. 1 & 2.**

***Additional specimens examined*: Papua New Guinea.** West Sepik Province: Torricelli Mountains, near Miwaute Village, Aug 1961, *Darbyshire 178* (LAE); Lumi District, East Au Census Division, Torricelli Mountains, Mt Sulen, near Sikel, Jul 1981, *Reeve 3828* (K, NSW); Torricelli Mountains, Lipan Pass, Aug 1981, *Reeve 4066* (K); Carpentaria Exploration Base Camp, from K1 to K8 helipad, Jan 1978, *Hoover 824* (A). New Ireland Province: near Punam, Jul 1902, *Schlechter 14694* (AMES, BRI, K). Oro Province: Kokoda, May 1936, *Carr 17173* (BM). Milne Bay Province: Raba Raba Subdistrict, junction of Ugat and Mayu Rivers, near Mayu 1, Jul 1972, *Streimann & Katik NGF34035* (K). **Australia. Queensland.** Cook District: Whyanbeel Creek N of Mossman, *Gray BG9970, Hawkes & de Groot* (CNS).

***Distribution and habitat*:** *Vrydagzynea albostriata* has been recorded in Indonesia (Papua Province), Papua New Guinea and Australia (northeast Queensland). In New Guinea this species is found growing amongst leaf litter in shady lowland and lower montane rainforest, occasionally near stream margins, from 30–945 m. In Queensland, this species has been found growing in wet lowland rainforest near creeks (**Map 1**).

***Phenology*:** Flowering and fruiting has been observed in January, May, July, and August in New Guinean material of *Vrydagzynea albostriata*. It is likely however that these reproductive events are year-round in the less seasonal rainforests of New Guinea. In Queensland, *V. albostriata* is currently known to flower December to March.

***Typification*:** The protologue for *Vrydagzynea albostriata* lists two Schlechter collections, both of which are extant. The Kew specimen of *Schlechter 13835* is chosen as lectotype because it is the best of the available syntypes and is a fertile (flowering) specimen.

***Notes*:** *Vrydagzynea albostriata* is distinctive among taxa found in New Guinea and Australia in having pubescent ovaries and flowers, whereas the nine other known species have glabrous (or rarely papillate) ovaries and flowers.

***Vernacular name*:** Wubungu (Wapi Language, Miwaute, West Sepik Province, Papua New Guinea).

Vrydagzynea elongata Blume, *Fl. Javae Ins. Adj.* n.s. 1: 61 (1858); *Coll. Orch. Arch. Ind.* 74 (1858). **Type:** Indonesia. Papua Province: Triton Bay, *s.dat.*, *E.J.F. Le Guillou s.n.* (holo: L, image!).

Vrydagzynea grayi D.L.Jones & M.A.Clem., *Orchadian* 14, 8 (Scientific Suppl.): xii (2004), **syn. nov. Type:** Australia. Queensland. Cook District: Stewart Creek, Portion 24, Parish of Whyanbeel, 16 July 1983, *B. Gray 3162* (holo: CNS).

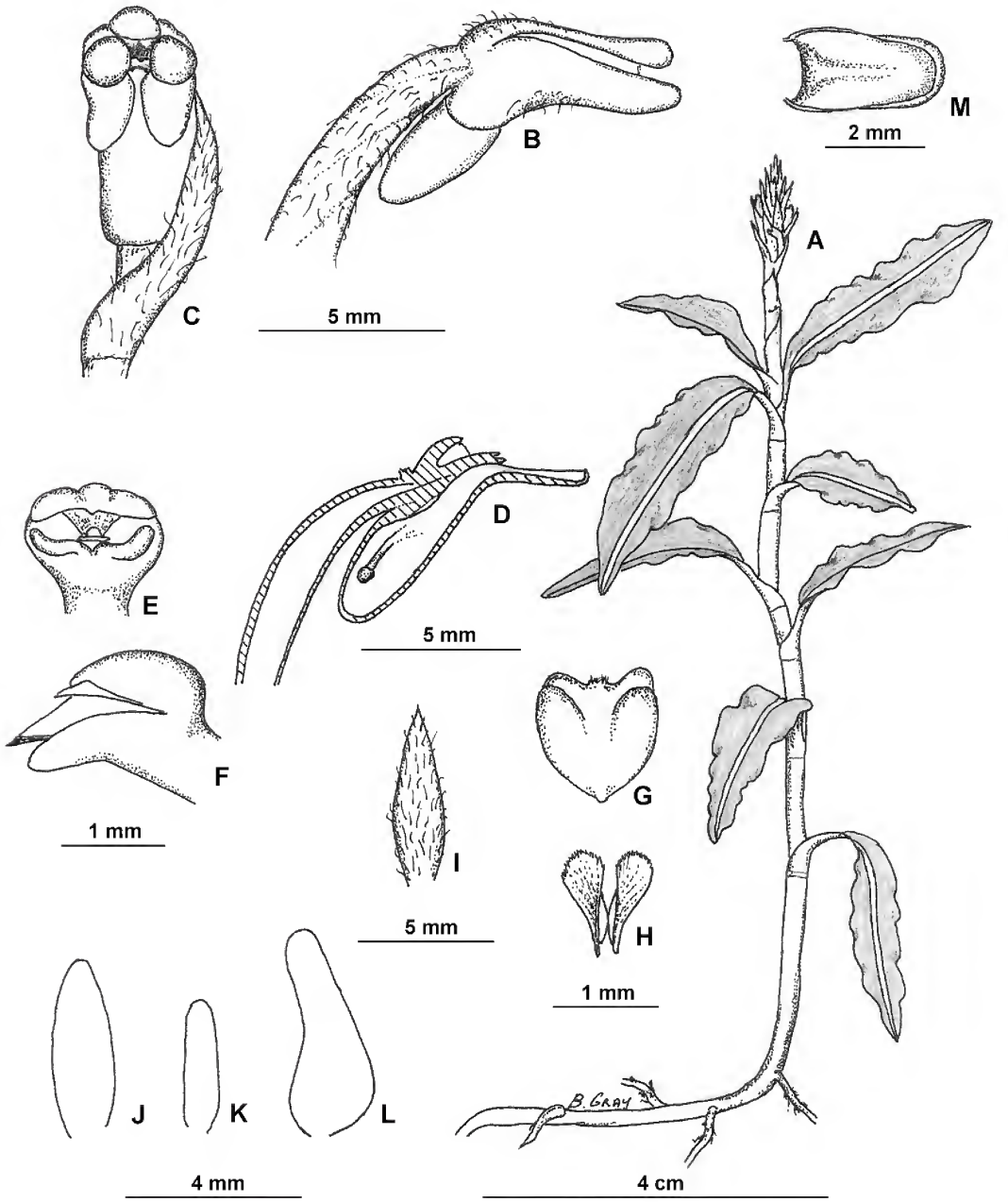


Fig. 1. ***Vrydagzynea albostriata.*** A. habit of mature flowering plant. B. lateral view of flower. C. face view of flower. D. longitudinal section through flower. E. face view of column. F. lateral view of column. G. face view of anther. H. pollinia. I. floral bract. J. dorsal sepal. K. petal. L. lateral sepal. M. face view of labellum. Scale as indicated. All from *Gray BG9970, de Groot & Hawkes* (CNS). Del. B. Gray.

Fig. 2. ***Vrydagzynea albostriata***. Whole plant with flowering inflorescence (*Gray BG9970, de Groot & Hawkes*, CNS)

Vrydagzynea sp., D.L.Jones, *Nat. Orch. Austral.* 351 (1988).

Vrydagzynea paludosa auct. non J.J. Sm.: D.L.Jones, *Nat. Orch. Austral.* 637 (1988); M.A. Clem., *Austral. Orch. Res.* 1: 147 (1989); Dockr., *Austral. Indig. Orch.* ed. 2, 1: 42 (1992); Lavarack & B.Gray, *Austral. Trop. Orch.* 22 (1992).

For further synonymy see Ormerod (2017). **Figs. 3–5.**

***Additional specimens examined*: Indonesia.** Maluku Province: Aru Islands, Pulau Kobroor, upstream from Kampong Jierlai, Apr 1993, *Nooteboom 5720* (A, C). Papua Province: Arfak Range, ridge behind Roon Village, Jan 1914, *Gibbs 6240* (K). **Papua New Guinea.** West Sepik Province: near Sumo Village, on Rahinbrum River, Jul 1961, *Darbyshire & Hoogland 8075* (LAE); Leitre Village, Mar 1964, *Sayers NGF18089* (LAE). East Sepik Province: Victoria Bay, Jul 1840, *Barclay 3567* (BM). Madang Province: Kaulo Base, Jan 1908, *Schlechter 17188* (NSW); Bismarck Range, Jan 1902, *Schlechter 14039* (BM, K, NSW); on the way from the Ramu River to the coast, Mar 1902, *Schlechter s.n.* (AMES); Erimahafen, Dec 1901, *Schlechter s.n.* (AMES); Josephstaal FMA area, near Guam River, Aug 1999, *Takeuchi et al. 13886* (A). Morobe Province: Markham River, 1890, *Weinland 203* (BRI, NSW); Markham River mouth, Aug 1964, *van Royen NGF20073* (A, BRI, LAE); *ibid*, Oct 1974, *Clunie LAE63004* (A, BRI, K, LAE); 12 km NW of Lae, Markham Swamp, Aug 1982, *Streimann 8512* (LAE); Huon Gulf, Cape Arkona, Aug 1890, *Lauterbach 644* (BRI). East New

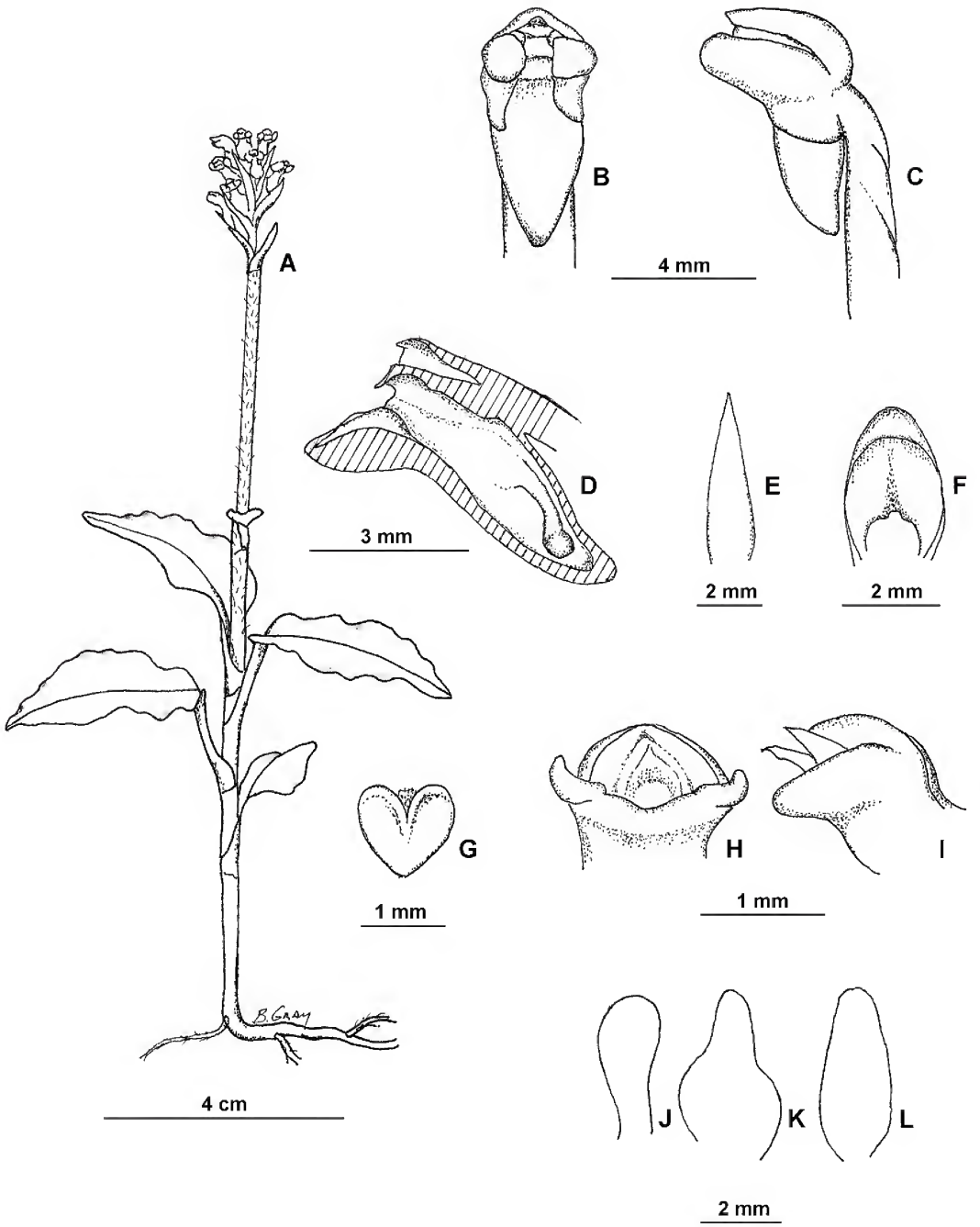


Fig. 3. ***Vrydagzynea elongata***. A. habit of mature flowering plant. B. face view of flower. C. lateral view of flower. D. longitudinal section through flower. E. floral bract. F. face view of labellum. G. face view of anther. H. face view of column. I. lateral view of column. J. petal. K. lateral sepal. L. dorsal sepal. Scale as indicated. All from *Gray BG9691, de Groot & Hawkes* (CNS). Del. B. Gray.

Fig. 4. ***Vrydagzynea elongata***. Whole plant with flowering inflorescence (*Gray BG9691, de Groot & Hawkes*, CNS).

Fig. 5. ***Vrydagzynea elongata***. Inflorescence with flowers and buds (*Gray BG9691, de Groot & Hawkes*, CNS).

Britain Province: Hoskins Subdistrict, Nuau Logging Area, Feb 1971, *Lelean & Stevens LAE51274* (BRI, K, LAE); Sabuite Creek, SW of Rikau Village, Apr 1959, *White NGF10499* (BRI); Kapiura River, *c.* 1 km from confluence with Aum River, May 1979, *Sohmer et al. LAE75288* (BRI, K, LAE). Oro Province: Isuarava, Feb 1936, *Carr 10562* (BM, K). Milne Bay Province: Sudest (=Tagula) Island, Apr 1898, *Micholitz s.n.* (K). **Australia. Queensland.** Cook District: Daintree area, upper Stewart Creek, Aug 1986, *Gray BG4327* (CNS); *ibid*, May 2017, *Gray BG9782* (CNS); Whyanbeel, N of Mossman, Sep 2015, *Gray BG9691* (CNS).

***Distribution and habitat*:** *Vrydagzynea elongata* has been found in Indonesia (Maluku and Papua Provinces), Papua New Guinea and Australia (northeast Queensland). In New Guinea this species is found in lower montane forest and lowland forest, including forest in swamps near the mouths of rivers, from 0–1220 m. In Queensland it is found in wet lowland rainforest near streams in the Mossman to Daintree area (**Map 1**). A sterile collection from Moa Island, Torres Strait (*Jones 3615*, BRI) is a good match for this species on foliage characters and indicates that it may have a wider distribution in Australia.

***Phenology*:** Flowering and fruiting has been observed in January, February, March, April, July, August, October, and December in New Guinean specimens of *V. elongata.* This indicates that reproductive events are year-round for the New Guinean plants. In Australia *V. elongata* has been found to flower in May, July, August and September, which corresponds to late autumn through to late winter in northern Queensland.

***Notes*:** *Vrydagzynea elongata* may be distinguished from its congeners in New Guinea and Australia by its small flowers (dorsal sepal 3 mm long versus 5 mm long), and labellum lamina that forms a right angle (versus obtuse to 180°) with the spur. *V. brassii* Ormerod is the only other New Guinean species with a 3 mm long dorsal sepal, but it differs in having two divergent, pubescent, laminate ridges (versus two low, close, broadly rounded ridges) on the labellum, and the labellum lamina is at an obtuse angle to the spur.

In describing *Vrydagzynea grayi,* Jones & Clements (2004) noted that it did not match any species described from New Guinea. Their comments are partly correct because the descriptions of *V. elongata* and its synonyms are somewhat general, and the only published floral analysis by Schlechter (1923–1928; 1982, of the synonym *V. pachyceras* Schltr.) is not wholly correct in its depiction of the labellum. This analysis shows the labellum to have involute margins but we find it to be calceolate with two flaps covering a cavity (see **Fig. 3**). Nevertheless, the confusion surrounding *V. elongata* was clarified by Smith (1929), who identified the critical characters of the species, and added *V. pachyceras* and his own *V. rectangulata* J.J. Sm. to the synonymy.

We have studied material of *V. elongata* from throughout its range, and have no doubt that *V. grayi* is a synonym of this widespread taxon. The species exhibits some variability, especially in leaf number (3–11 per stem), leaf shape (obliquely ovate to almost symmetrically lanceolate), flower number (few to many), and shape of the spur in lateral view (oblong-elliptic to fusiform).

***Vernacular names*:** Lai tutur (Aru Islands, Maluku Province, Indonesia); Tume (Pogatumo Language, Sumo Village, West Sepik Province, Papua New Guinea).

Acknowledgements

We wish to thank herbaria and library staff at A, AMES, BRI, C, CNS, K, LAE and NSW for their help and hospitality during our visits, W. Smith (BRI) for the distribution map and T. Hawkes and T. de Groot who first located *Vrydagzynea albostriata* in Australia and for assistance with field work.

References

Jones, D.L. (1988). *Native Orchids of Australia.* Reed Books, Australia.

Jones, D.L. & Clements, M.A. (2004). Miscellaneous new species, new genera, reinstated genera and new combinations in Australian Orchidaceae. *Orchadian* 14, 8 (Scientific Supplement: i–xvi).

Ormerod, P. (1994). Some comments regarding the identity of the Australian *Vrydagzynea* species. *Orchadian* 11: 218–219.

—— (2017). *Checklist of Papuasian Orchids.* Nature & Travel Books: Australia.

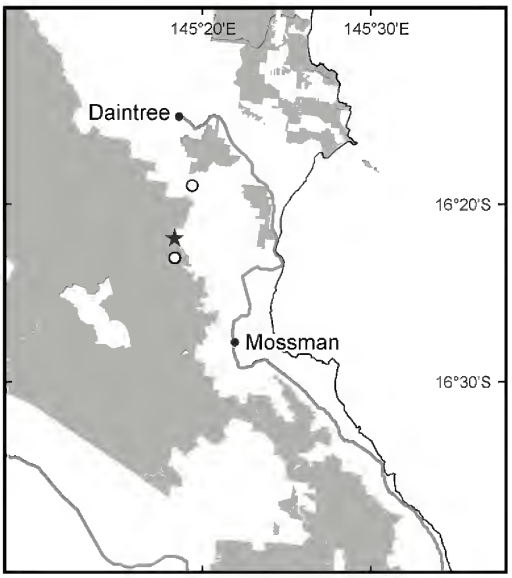
Schlechter, R. (1923–1928). Figuren-Atlas zu den Orchidaceen von Deutsch-Neu-Guinea. *Repertorium Specierum Novarum Regni Vegetabilis. Centralblatt für Sammlung und Veroffentlichung von Einzeldiagnosen neuer Pflanzen. Beihefte* 21: Taf. I–CCCLXXII.

—— (1982). *The Orchidaceae of German New Guinea.* English translation. D.F. Blaxell (ed.). Australian Orchid Foundation: Melbourne.

Smith, J.J. (1929). Orchidaceae (pp.). *Nova Guinea* 14: 357–516, plates 41–87.

Wood, J.J. & Cribb, P.J. (1994). *A checklist of the Orchids of Borneo.* Royal Botanic Gardens: Kew.

Wood, J.J., Beaman, T.E., Lamb, A., Chan, C.L. & Beaman, J.H. (2011). *The Orchids of Mount Kinabalu.* Natural History Publications: Kota Kinabalu.



Map 1. Distribution of ***Vrydagzynea albostriata*** ★ and ***V. elongata*** ○ in Queensland, Australia.

Hibbertia ferox Jackes (Dilleniaceae), a new species from the White Mountains area of north Queensland

Betsy R. Jackes

Summary

Jackes, B.R. (2018). *Hibbertia ferox* Jackes (Dilleniaceae), a new species from the White Mountains area of north Queensland. ***Austrobaileya* 10(2): 282–285.** *Hibbertia ferox* Jackes is described as new. This species with ericoid, needle-like leaves is morphologically similar to *H. acicularis* (Labill.) F.Muell., and *H. exutiacies* N.A.Wakef. from south-eastern Australia. *H. ferox* is endemic to the White Mountains and Lake Buchanan area of north Queensland. It forms a low shrub usually growing on sandstone or lateritic derived soils and is unusual in exhibiting diallagy in the foliage.

Key Words: Dilleniaceae, *Hibbertia*, *Hibbertia ferox*, Australia flora, Queensland flora, taxonomy, new species, diallagy

B.R. Jackes, College of Science and Engineering, James Cook University, Townsville, Queensland 4811. Email: betsy.jackes@jcu.edu.au

Introduction

The genus *Hibbertia* Andrews was traditionally divided into sections based on the arrangement of the androecium; however, Horn (2009) divided the species into two subgenera based on a molecular phylogenetic analysis. All the species with needle-like, ericoid leaves are in *Hibbertia* subgenus *Hemistemma* (Thouars) Horn. These taxa also have revolute leaf margins which hide the undersurface of the leaf except for the midrib.

A distinctive and undescribed species of *Hibbertia* belonging to this subgenus has been known from the White Mountains area of central Queensland since its apparent, first collection in 1992 by Tony Bean. Whilst an overall revision of the genus is ongoing by Hellmut Toelken, the species under consideration requires a name and this is undertaken here with his approval.

Materials and methods

All vegetative measurements were made on dried material and compared with fresh material, except for the flowers where measurements were based on fresh material. All material was obtained from the Burra Range section of the White Mountains National Park under a permit held by the author.

Abbreviations used in the specimen citation includes NP (National Park).

Taxonomy

Hibbertia ferox Jackes **sp. nov.** Distinguished from *H. acicularis* (Labill.) F.Muell. by the sessile flowers and 9 stamens, rarely 10, as compared with the flowers on peduncles and stamens 6–8. It may be distinguished from *H. exutiacies* N.A.Wakef., by stamens 4–6 and the terminal awn on the leaf deciduous rather than persistent. **Typus:** Queensland. Mitchell District: Poison Valley Road, White Mountains National Park, 12 April 2000, *K.R. McDonald KRM425* (holo: BRI [1 sheet]).

Shrub 0.3–0.7 m high, much branched from near the base up to 1 m wide, resprouting from rootstock after fire; branches not ridged; young shoots pubescent, soon becoming glabrous, hairs simple and erect. Leaves crowded on short shoots, ericoid, alternate, almost sessile, breaking off when dry leaving a protuberance; axillary hair tufts vary in length from *c.* 0.1 mm long near the edge of the protuberance, increasing up to 0.5 mm long in the centre before decreasing again; petiole *c.* 0.5 mm long, 0.2–0.3 mm wide, hairs simple,

Accepted for publication 29 August 2018

semi-adpressed; lamina 5–11 mm long, *c.* 1.5 mm wide, margins revolute so that only the midrib of the abaxial surface is visible; apex narrowing into a pungent reddish point, persistent awn *c.* 0.5 mm long; adaxially with simple tubercle-based hairs, papillae are present on the margins interlocking with papillae on the side of the midrib; abaxial midrib bears scattered tubercle-based hairs. Flowers terminal, sessile, subtended by 4 or 5 broadly lanceolate, brown, scarious bracts, 2–2.5 mm long and 1.8–2 mm wide, papillate on the margins. Sepals unequal, broadly lanceolate, 3 outer sepals *c.* 8 mm long, 2 inner sepals to 10 mm long, apiculate, inside glabrous, midrib prominent forming a ridge along the back, hairs chiefly on midrib and margins, scattered to 0.5 mm long. Petals obovate, deeply emarginate, 10–15 mm long, 7.5–10 mm wide, yellow. Stamens 9, or rarely 10, erect, on one side of carpels, yellow; filaments 2–2.5 mm long, free to base; anthers to 2 mm long, dehiscing by introrse, longitudinal slits; staminodes absent. Carpels 2, free, obovoid, glabrous; styles *c.* 3 mm long, attached to outer apex of each carpel, then curving outwards and upwards to the side of the anthers. Fruit not seen. **Figs. 1–3.**

***Additional specimens examined*: Queensland.** MITCHELL DISTRICT: Old Poison Valley road, White Mountains NP, Apr 1992, *Bean 4302* (BRI); 5 km NW of Burra, Apr 1993, *Thompson HUG341 et al.* (BRI); 4.8 km N of Burra Microwave Tower, Aug 1997, *Bean 12278* (BRI); 8 km from Townsville – Mt Isa Highway on Poison Valley Road, White Mountains NP, Sep 2012, *Townsend s.n.* (CNS, JCT). SOUTH KENNEDY DISTRICT: 24 km SE of Torrens Creek, Oct 1997, *Thompson HUG502 & Baumgartner* (BRI); *c.* 31 km E of Lake Buchanan, Jun 1998, *Thompson BUC2022 & Turpin* (BRI).

***Distribution and habitat*:** *Hibbertia ferox* is endemic to north Queensland where it is common in the Burra Range area of the White Mountains NP, with a further southern disjunction to an area east of Lake Buchanan (21° 34'S, 146° 12'E) where the same geological formation occurs. Within the Burra Range area it appears to be widespread, growing on sandy soils derived from sandstone or laterite, often in association with species of *Acacia*, *Grevillea sessilis* C.T.White and *Calytrix microcoma* Craven.

***Affinities*:** Morphologically *Hibbertia ferox* appears to be closely related to *H. acicularis* and *H. exutiacies*. *Hibbertia acicularis* has been recorded from all eastern states and is particularly common in New South Wales, Victoria and Tasmania, although there are populations in coastal and subcoastal areas of eastern Queensland with a much higher rainfall than the White Mountains. *Hibbertia acicularis* differs in the flowers with 6–8 stamens being borne on peduncles in the leaf axils rather than with 9 (–10) stamens and terminal and sessile as in *H. ferox*.

Hibbertia exutiacies is commonly found in Victoria and South Australia with isolated records elsewhere, although it is probable that its apparent occurrence in southern Queensland may apply to other species. It differs from *H. ferox* by the smaller flowers, 3.5–8.5 mm long versus 10–15 mm long, and only 4–6 stamens. Also in this species the apical awn on the leaf is reported to be deciduous unlike the persistent apical awn in *H. ferox*.

***Notes*:** *Hibbertia ferox* exhibits diallagy, a term used by George (2002) to describe a reversible physiology strategy in plants. Under normal environmental conditions the plants are green and the lower leaves spread at an angle of about 75° degrees to the stem; however, under dry conditions the colour changes to yellowish-brown to brown and the angle is reduced to under 25° degrees (**Figs. 4 & 5**). Colour returns to green when adequate moisture becomes available. It has been noticed that the leaves closest to the roots are the last to change colour and the first to regain colour.

***Phenology*:** Flowering chiefly occurs in late August and September, but flowering material has been collected in other months, fruiting material has not been observed.

***Etymology*:** The epithet is from the Latin *fero* (fierce) referring to the pungent awn on the apex of the lamina. Dry leaves readily detach and then reattach to fingers and clothes.

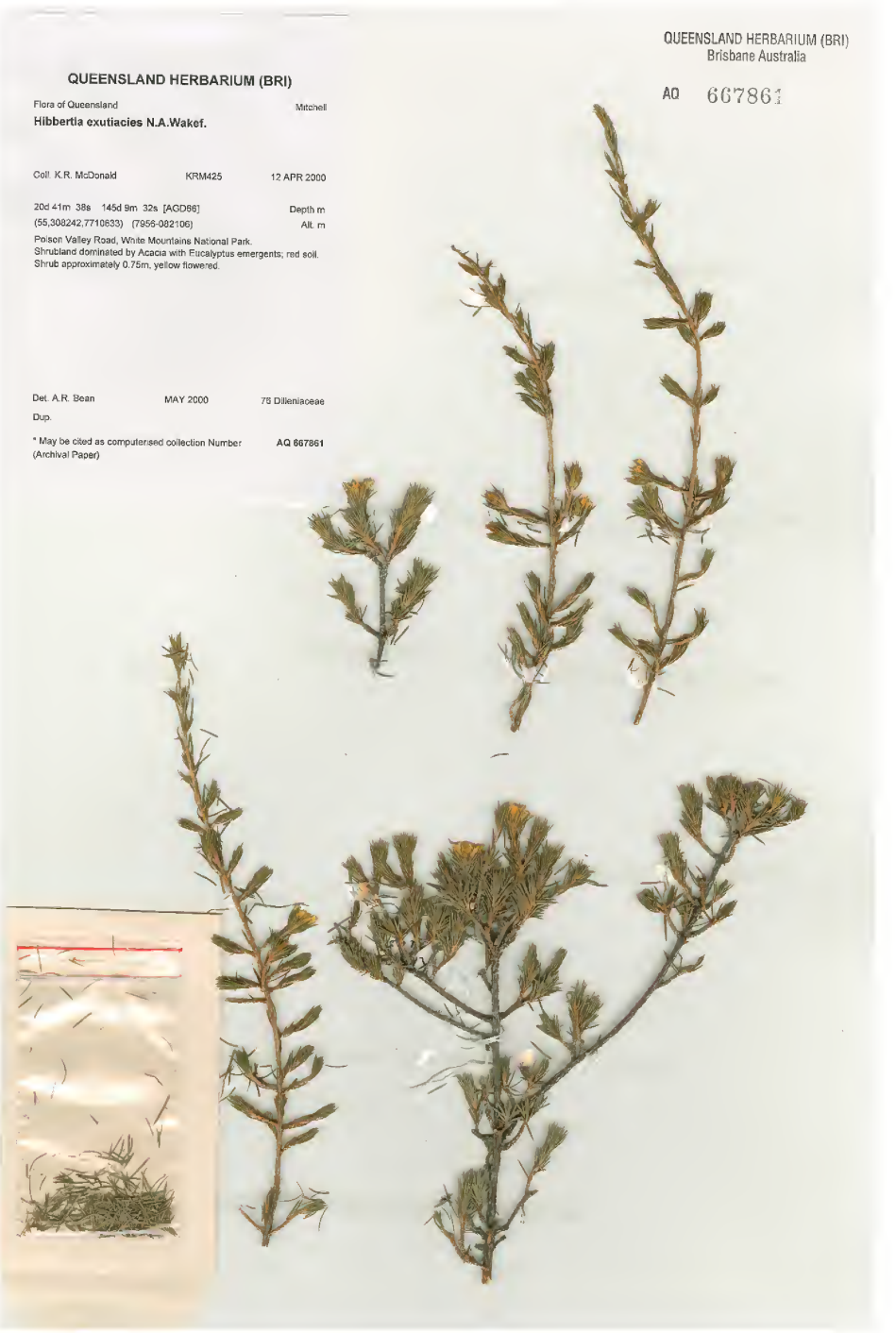


Fig. 1. Holotype of ***Hibbertia ferox*** (*McDonald KRM425*, BRI).

Fig. 2. ***Hibbertia ferox.*** Flower (*Townsend s.n.*, JCT). Photo: J.W. Elliott.

Fig. 4. ***Hibbertia ferox.*** Portion of plant showing diallagy developing, Poison Valley Road, Burra Range (no voucher). Photo: K. Townsend.

Acknowledgements

Many thanks to the Townsville Branch of Native Plants Queensland who made a number of collections, as well as contributing to knowledge of the distribution of this endemic species. Thank you to Hellmut Toelken who suggested the epithet, and to Kevin Thiele for guidance and constructive comments.

Fig. 3. ***Hibbertia ferox.*** Habit of flowering plant (*Townsend s.n.*, JCT). Photo: K. Townsend.

Fig. 5. ***Hibbertia ferox.*** Plant showing diallagy with *Calytrix microcoma* in background, Poison Valley Road, Burra Range (no voucher). Photo: K. Townsend.

References

George, A.S. (2002). The south-western Australian flora in autumn: 2001 Presidential Address. *Journal of the Royal Society of Western Australia* 85: 1–15.

Horn, J.W. (2009). Phylogenetics of Dilleniaceae using sequence data from four plastid loci (*rbcL, infA, rps4, rpl116* Intron). *International Journal of Plant Science* 170: 794–813.

SHORT COMMUNICATION

Psychotria hebecarpa Merr. & L.M.Perry (Rubiaceae), a new record for Queensland and Australia

Paul I. Forster

Queensland Herbarium, Department of Environment & Science, Brisbane Botanic Gardens, Mt Coot-tha Road, Toowong, Queensland 4066, Australia. Email: paul.forster@des.qld.gov.au

The genus *Psychotria* L. is predominantly pantropical with estimates of species diversity around 2000 (Sohmer 1998; Davis *et al.* 2001; Sohmer & Davis 2007). In Australia where it extends to the subtropics, the genus is in need of revision with the last overall account being Bailey (1900) who enumerated eight species, one of which is now classified in *Amaracarpus* Blume (Forster 2010). More recent listings of taxa enumerate 16 species, with the majority of these endemic to Queensland (Forster & Halford 2007, 2010, 2017). The non-climbing species in adjacent New Guinea and the Bismarck Archipelago were revised by Sohmer (1988) with a handful of more recent additions (Takeuchi 2001, 2009, 2013); however, there is little overlap with the Australian taxa.

In this short communication, the presence in Queensland and Australia of *Psychotria hebecarpa* Merr. & L.M.Perry is documented and a phrase name applied at the Queensland Herbarium and in census accounts (Forster & Halford 2007, 2010, 2017) placed into synonymy. Collection of this species from Australia was first made by the entomologist and natural history collector Eduard F. Dämel (Daemel) (*c.* 1821–1900) prior to 1868 and probably in 1867 (ANBG 2018; Beiler & Petit 2012; JSTOR 2018), with an intervening period of 120 years before further collections were made.

Accepted for publication 6 August 2018

Taxonomy

Psychotria hebecarpa Merr. & L.M.Perry, *J. Arnold Arbor.* 27: 212–213 (1946). **Type:** Papua New Guinea. Central Province: Aisa River, 13 May 1926, *L.J. Brass 1419* (holo: A *n.v.*; iso: BRI).

Psychotria sp. Pajinka, **syn. nov.**; Cooper & Cooper (2004: 450).

Psychotria sp. (Pajinka W.Cooper+ WWC1435), **syn. nov.**; Forster & Halford (2007, 2010, 2017).

***Illustration*:** Sohmer (1988: 121, holotype).

Shrub or subshrub with erect to prostrate stems up to 1.5 m tall; foliage densely ferruginous-tan pubescent throughout. Stipules valvate, ovate, 11–18 mm long, deeply bilobed with the lobes aristate and 5–7 mm long. Leaves petiolate; petiole 8–40 mm long, *c.* 2 mm diameter, deeply channelled adaxially; laminae weakly coriaceous to somewhat chartaceous, lanceolate-oblong, 115–200 × 48–80 mm; secondary lateral veins 10–19 per side of primary vein, heavily pubescent below; apex acute, base obtuse to round. Inflorescence shortly pedunculate to 37 mm long, with 3 or 5 flower clusters, each subtended by foliose linear-lanceolate bracts up to 20 × 5 mm. Flowers sessile, subtended by linear bracts 10–15 mm long, 1–3 mm wide; calyx tube short and < 1.5 mm long, lobes lanceolate-subulate, 7–15 mm long, 1.8–2 mm wide, apices sharply acute; corolla tube *c.* 4.5 mm long. Fruit fleshy, *c.* 12 mm long and 10 mm wide, white. Pyrenes 4–4.5 mm long, *c.* 2 mm wide, strongly ridged; endosperm not ruminate. **Fig. 1.**

Fig. 1. ***Psychotria hebecarpa*** (*Cooper WWC1435 & Jensen*, BRI).

***Additional specimens examined*: Papua New Guinea.** Western Province: Wuroi, Oriomo River, Jan 1934, *Brass 5720* (BRI); *c.* 2 miles [*c.* 3.3 km] SE of Morehead Patrol Post, Aug 1967, *Pullen 7192* (BRI). **Australia. Queensland**. Cook District: Cape York, *s.dat.*, *Daemel s.n.* (BM [purchased 1868], MEL 1583718); Near Bamaga, New Mapoon, Sep 1987, *Gitay s.n.* (BRI [AQ437548]); Pajinka Water intake, Cape York, *s.dat.*, *Cooper WWC1435 & Jensen* (BRI, DNA).

***Distribution and habitat*:** *Psychotria hebecarpa* is known from Papua New Guinea (Central and Western provinces) and the tip of Cape York, Queensland in Australia where it is restricted to the Lockerbie Scrub. It occurs in lowland rainforest, with the Australian population in semi-deciduous complex notophyll vineforest on volcanic substrate.

***Notes*:** This is a highly distinctive species in the Australian context due to the heavily pubescent foliage, the very large and characteristic bilobed stipules and the large bracts on the inflorescence. Sohmer (1988: 122) was of the opinion that the pubescence was an adaptation to drier habitats (no doubt from the perspective of other taxa in New Guinea); however, other Australian species from seasonal communities are not noticeably pubescent (e.g. some of the varieties of *P. daphnoides* A.Cunn.).

***Conservation status*:** In Australia and Queensland, *Psychotria hebecarpa* is known from a single population (with probably a number of subpopulations) in the greater Lockerbie Scrub at the tip of Cape York. There are at least six recorded populations in Papua New Guinea (Sohmer 1988); although it is not possible to ascertain if these are extant, nor what their extent of occupancy or population numbers might be. Once again, this species in its Australian occurrence is a good example of a peripheral population at the outer edge of the distribution envelope (Forster 2016) with the majority of the populations elsewhere. It is not common and widespread in the Lockerbie Scrub indicating that only certain environmental conditions are suitable for its persistence. Peripheral populations are important in terms of enabling species to expand their range or to respond to environmental conditions that select for evolutionary diversification through disjunct speciation (*cf.* Levin 2000).

It is not known if any of the populations in Papua New Guinea are conserved. The population at Cape York is not in a formal conservation reserve; however, the Lockerbie Scrub is effectively managed for conservation by the locally based The Apudthama Lands Trust rangers.

Within the Australian jurisdiction, an appropriate conservation status for *Psychotria hebecarpa* is **Vulnerable** based on the criterion **D2** (IUCN 2012).

Acknowledgements

The curators of BM and MEL for loans of *Psychotria* material to Sally Reynolds who made an initial examination of Australian material from this genus. Will Smith (BRI) for the photographic image.

References

Anbg (2018). Dämel, C. F. Eduard (c. 1821–1900). https://www.anbg.gov.au/biography/daemel-eduard.html, accessed 27 July 2018.

Bailey, F.M. (1900). *Psychotria*. *The Queensland Flora* 3: 770–772. H.J. Diddams & Co.: Brisbane.

Bieler, R. & Petit, R.E. (2012). Molluscan taxa in the publications of the Museum Godeffroy of Hamburg, with a discussion of the Godeffroy Sales Catalogs (1864–1884), the *Journal des Museum Godeffroy* (1873–1910), and a history of the museum. *Zootaxa* 3511: 1–80.

Cooper, W. & Cooper, W.T. (2004). *Fruits of the Australian Tropical Rainforest.* Nokomis Editions: Melbourne.

Davis, A.P., Bridson, D., Jarvis, C. & Govaerts, R. (2001). The typification and characterization of the genus *Psychotria* L. *Botanical Journal of the Linnean Society* 135: 35–42.

Forster, P.I. (2010). The genus *Amaracarpus* Blume (Rubiaceae) in mainland Australia. *Austrobaileya* 8: 155–158.

—— (2016). *Mallotus pleiogynus* Pax & K.Hoffm. (Euphorbiaceae), a new species record and range extension for Australia from Cape York Peninsula, Queensland. *Austrobaileya* 9: 534–538.

Forster, P.I. & Halford, D.A. (2007). Rubiaceae. In P.D. Bostock & A.E. Holland (eds.), *Census of the Queensland Flora 2007*, pp. 175–179. Queensland Herbarium. Queensland Government. Environmental Protection Agency: Brisbane.

—— (2010). Rubiaceae. In P.D. Bostock & A.E. Holland (eds.), *Census of the Queensland Flora 2010*, pp. 169–174. Queensland Herbarium. Queensland Department of Environment & Resource Management: Brisbane.

—— (2017). Rubiaceae. In P.D. Bostock & A.E. Holland (eds.), *Census of the Queensland Flora 2017*. Queensland Department of Science, Information Technology and Innovation: Brisbane. https://data.qld.gov.au/dataset/census-of-the-queensland-flora-2017, accessed 1 May 2018.

Iucn (2012). International Union for the Conservation of Nature. *IUCN Red List Categories and Criteria, version 3.1*, 2nd ed. https://portals.iucn.org/library/efiles/documents/RL-2001-001-2nd.pdf, accessed 20 February 2018.

Jstor (2018). Daemel, Eduard (*c.* 1821–1885). https://plants.jstor.org/stable/10.5555/al.ap.person.bm000331181, accessed 27 July 2018.

Levin, D.A. (2000). *The origin, expansion, and demise of plant species*. Oxford University Press: New York/Oxford.

Sohmer, S.H. (1988). The nonclimbing species of the genus *Psychotria* (Rubiaceae) in New Guinea and the Bismarck Archipelago. *Bishop Museum Bulletins in Botany* 1: 1–338.

Sohmer, S.H. & Davis, A.P. (2007). The genus *Psychotria* (Rubiaceae) in the Philippine Archipelago. *Sida, Botanical Miscellany* No 27: 1–247.

Takeuchi, W. (2001). New and noteworthy plants from recent botanical surveys in Papua New Guinea, 7. *Edinburgh Journal of Botany* 58: 159–172.

—— (2009). New taxa from the Mamberamo River of Papua Province, Indonesia: *Ardisia lammersiana* (Myrsinaceae) and *Psychotria leptothyrsa* var. *defretesiana* (Rubiaceae). *Harvard Papers in Botany* 14: 173–183.

—— (2013). Additions to the rubiaceous flora of Papua New Guinea: *Psychotria stolonifera* and *P. ternatifolia*, two remarkable species from the Muller limestone. *Phytotaxa* 7: 25–34.

Contents