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AUSTROBAILEYA

A Journal of Plant Systematics
and
Conservation Biology

Queensland Herbarium
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Austrobaileya 8(3): 225–440 (2011)

Contents

A taxonomic revision of *Symplocos* Jacq. (Symplocaceae) in Australia

L.W. Jessup

Summary

Jessup, L.W. (2011). A taxonomic revision of *Symplocos* Jacq. (Symplocaceae) in Australia. ***Austrobaileya* 8(3): 225–251.** The Australian taxa in the genus *Symplocos* are revised. Nineteen species are recognised and separate identification keys are provided for flowering and fruiting material. *Symplocos boonjee* Jessup, *S. bullata* Jessup and *S. oresbia* Jessup are described as new species, four taxa are raised in rank to species viz. *S. gittinsii* Jessup, *S. glabra* Jessup, *S. puberula* Jessup and *S. wooroonooran* Jessup and one new variety, *S. cyanocarpa* var. *pilosa* Jessup is described.

Key Words: Symplocaceae, *Symplocos*, Australia flora, Queensland flora, New South Wales flora, *Symplocos boonjee*, *Symplocos bullata*, *Symplocos cyanocarpa* var. *pilosa*, *Symplocos gittinsii*, *Symplocos glabra*, *Symplocos oresbia*, *Symplocos puberula*, *Symplocos wooroonooran*, new species, identification key

Laurence W. Jessup, Queensland Herbarium, Department of Environment and Resource Management, Brisbane Botanic Gardens, Mt Coot-tha Road, Toowong, Queensland 4066, Australia. Email: Laurence.Jessup@derm.qld.gov.au

Introduction

Symplocos Jacq. is a predominantly pantropical genus of over 320 species with highest species diversity in Asia, Malesia and the New World (Wang *et al.* 2004; Fritsch *et al.* 2006, 2008). *Symplocos* has been usually regarded as the sole generic representative of the Symplococeae with division into four subgenera and various sections based upon floral structure (Brand 1901). Molecular phylogenies to date have not supported this classification and have resulted in the elevation of *Symplocos* section *Cordyloblaste* to generic rank (as *Cordyloblaste* Hensch. ex Moritzi) and the recognition of only two subgenera and relatively few sections and series in *Symplocos* (Fritsch *et al.* 2008). This infrageneric classification of the genus is based on DNA sequence data from five genic regions (for 90 species) and 51 morphological characters (Fritsch *et al.* 2008). For the Australian region, all taxa can be classified into *Symplocos* (subgenus *Symplocos*) section *Lodhra* G.Don (Fritsch *et al.* 2008) and represents a major departure from that proposed by Nooteboom (1975).

Accepted for publication 2 September 2011

Mueller (1862) was the first to recognise *Symplocos* in Australia (*S. thwaitesii* F.Muell.) and followed this with a second new species (*S. stawellii* F.Muell.) (Mueller 1865). Bentham (1869) recognised *Symplocos thwaitesii* but applied the name *S. spicata* var. *australis* Benth. to specimens of *S. stawellii*. Bailey (1890) described *Symplocos paucistaminea* F.Muell. & F.M.Bailey ex F.M.Bailey and in Bailey (1900b) treated the other Australian species in the same sense as Bentham (1869). Brand (1901) reinstated the name *Symplocos stawellii* and described the Lord Howe Island species *S. candelabrum* Brand. Nooteboom (1975) revised the Old World species creating a large number of synonyms and four subspecies and thirty-four varieties under the apparently polymorphic species *Symplocos cochinchinensis* (Lour.) S.Moore. He followed with a modified treatment of Australian *Symplocos* in Nooteboom (1981). Smith (1978, 1982) chose not to follow Nooteboom's broad taxonomic concept in his treatment of the Fijian species as did Green (1994) in the Oceanic Islands volume of the *Flora of Australia*.

Since 1981 new taxa from Australia have been recognised and some taxa that were placed in synonymy by Nooteboom have continued to be recognised as distinct in

the field and in the herbarium particularly as more collections have been made (Jessup 1993, 1994, 1997, 2002, 2007, 2010). Also all of the Australian varieties described by Nooteboom under *Symplocos cochinchinensis* subsp. *thwaitesii* (F.Muell.) Noot. are now well-collected throughout their natural range and are represented in the herbarium by quality specimens that exhibit several distinct correlating character states sufficient to allow recognition as species. In this paper four previously described taxa are raised in rank to species and three new species and one new variety are described.

Materials and methods

This paper is based on herbarium collections in BM, BRI, CANB, CNS (previously QRS), K, L, MEL and NSW and some field observations by the author. All specimens cited have been seen by the author. Descriptions of flowers were prepared from material preserved in FAA or 70% alcohol and glycerol or reconstituted by briefly boiling in water. Descriptions of fruit were prepared from both dried and alcohol preserved material. Common abbreviations in the specimen citations are F.R. (Forest Reserve), L.A. (Logging Area), N.P. (National Park), S.F.R./S.F. (State Forest Reserve/State Forest), T.R. (Timber Reserve). The abbreviation *NCA* is for the Queensland Nature Conservation Act 1992 and its associated regulations. The abbreviation *EPBC* refers to the Environment Protection and Biodiversity Conservation Act 1999

Taxonomy

Symplocos Jacq., *Enum. Pl. Carib.* 5, 24 (1760). **Type species:** *S. martinicensis* Jacq.

Trees or shrubs, dioecious, polygamous or hermaphroditic. Leaves mostly spirally arranged, simple, penninerved, serrate, dentate, or entire, exstipulate. Inflorescence spicate, racemose, a thyrse or a panicle, or flowers solitary or fasciculate, axillary, rarely terminal. Flowers actinomorphic, bisexual or often functionally unisexual, subtended by a bract and 2 bracteoles. Ovary inferior or rarely semi-inferior. Hypanthium completely adnate to ovary. Calyx limb epigynous, mostly 5-lobed; lobes imbricate, persistent. Corolla gamopetalous but divided to near base into 3–10 petals (5 in Australian species), quincuncially imbricate, white, cream or pink. Stamens few to many, connate only at base, adnate to the base of the corolla, pentadelphous in alternipetalous bundles or (not in Australia) monadelphous; filaments terete. Anthers bilocular, introrse, dehiscing longitudinally. Disc inside staminal ring. Ovary 2–5-locular (3-locular in Australia) with 2–4 anatropous ovules per locule. Placentation axile but septa separating distally. Style 1, stigma simple, capitate or peltate. Fruit a monopyrenous drupe, crowned by persistent calyx lobes, frequently 1-celled and 1-seeded by abortion; mesocarp fleshy or not; endocarp hard, smooth or longitudinally ridged, with an apical depression. Seed with copious endosperm; embryo straight or curved.

The genus includes 300–350 species in tropical, subtropical and temperate parts of Asia, Malesia, North and South America, the West Indies, the Pacific islands and Australia. Nineteen species occur in Australia.

Fig. 1. ***Symplocos ampulliformis***. A. part of inflorescence with flowers and buds × 4, *Gray 3362* (BRI). B. fruit × 2, *Hyland 13459* (BRI). C. leaf abaxial surface × 1, *Volck 1389* (BRI). ***S. boonjee***. D. inflorescence with flowers × 3, *Gray 5575* (CNS). E. flower × 6, *Hyland 14345* (CNS). F. fruit × 2, *Gray 5575* (CNS). ***S. bullata***. G. inflorescence with flowers × 3. H. leaf adaxial surface × 1. I. leaf abaxial surface × 1. G–I from *Gray 2543* (BRI). Del. W.Smith.

Key to Australian *Symplocos* taxa using flowering specimens

1 Inflorescence racemose or a panicle of shortly pedicellate flowers **2**
1. Inflorescence spicate or a panicle or fascicle of sessile flowers, or flowers solitary, axillary. **10**

2 Lamina margins serrate or dentate, sometimes obscurely denticulate. **3**
2. Lamina margins denticulate or entire. **7**

3 Petiole up to 4 mm long **4**
3. Petiole 5–17 mm long **5**

4 Young branchlets appressed puberulous; petals 1.4–1.6 mm wide; stamens mostly 15–20 . . . . . **2. S. baeuerlenii**
4. Young branchlets sparsely pilose with erect hairs; petals 2–2.5 mm wide; stamens 30–40 . . . . . **11. S. harroldii**

5 Young branchlets, petiole and inflorescence glabrous or nearly so **6**
5. Young branchlets, petiole and inflorescence appressed puberulous or pubescent . . . . . **16. S. puberula**

6 Calyx limb 1.7-2 mm long; stamens more than 40; petiole mostly 5–15 mm long . . . . . **18. S. thwaitesii**

6. Calyx limb 0.7–0.8 mm long; stamens less than 40; petiole mostly 20–30 mm long. . . . . **5. S. candelabrum**

7 Bracts up to 1.2 mm long; bracteoles up to 0.6 mm long; petals up to 4 mm long; stamens up to 20; style up to 2.5 mm long **8**

7. Bracts 1–2.5 mm long; bracteoles 0.6–1.2 mm long; petals 4 mm long or more; stamens 30–50; style 3 mm long or more **9**

8 Secondary veins mostly 7–9 pairs; basal ones not more acute and longer than distal ones; bracts caducous before anthesis; petals 2–2.5 mm long; disc and style glabrous . . . . . **14. S. oresbia**
8. Secondary veins mostly 4–6 pairs; basal ones more acute and longer than distal ones; bracts persistent to after anthesis; petals 3–3.7 mm long; disc and base of style puberulous . . . . . **1. S. ampulliformis**

9 Young branchlets glabrescent; lamina 2–6.5 cm long; inflorescence appressed puberulous; bracts ovate; style 3–3.5 mm long . . . . . **19. S. wooroonooran**
9. Young branchlets glabrous; lamina 7–15 cm long; inflorescence glabrous; bracts oblong; style 4.5–5 mm long . . . . . **8. S. glabra**

10 Young branchlets, petiole or inflorescence pilose, villous or pubescent with erect hairs **11**
10. Young branchlets glabrous or puberulous; petiole glabrous; inflorescence glabrous, puberulous, or shortly appressed pubescent **16**

11 Calyx densely pubescent outside **12**
11. Calyx glabrous or sparsely pubescent outside **13**

12 Secondary veins 6–12 pairs; inflorescence a few-flowered fascicle . . . . . **7. S. cyanocarpa** var. **pilosa**
12. Secondary veins mostly 15–20 pairs; inflorescence spicate with many flowers. . . . . **5. S. crassiramifera**

13 Sterile shoots rarely with cataphylls; twig hairs, reddish brown; midvein above pilose or villous **14**
13. Sterile shoots bearing cataphylls; twig hairs white, hyaline or pale ginger brown; midvein glabrous above **15**

14 Lamina in mature foliage bullate, margins more or less recurved . . . . . **4. S. bullata**
14. Lamina not bullate, margins flat . . . . . **15. S. paucistaminea**

15 Lamina sometimes bullate between veins, base mostly acutely cuneate, margins often recurved; bracts *c.* 2 mm long,; calyx lobes obtuse or rounded, entire or minutely denticulate . . . . . **13. S. hylandii**
15. Lamina not bullate, base rounded or cordate, margins plane; bracts 3–9 mm long; calyx lobes acute, ciliate . . . . . **12. S. hayesii**

16 Inflorescence axes usually branching above the base; **17**
16. Inflorescence axes solitary or clustered, unbranched above the base or flowers fasciculate or solitary **21**

17 Lamina margins crenulate and serrulate . . . . . **17. S. stawellii**
17. Lamina margins entire, rarely some denticulations evident **18**

18 Stamens (12–)15–20 . . . . . **19**
18. Stamens 30–70 . . . . . **20**

19 Secondary veins mostly 7–9 pairs; basal ones not more acute and longer than distal ones; bracts caducous before anthesis; petals 2–2.5 mm long; disc and style glabrous . . . . . **14. S. oresbia**

19. Secondary veins mostly 4–6 pairs; basal ones often more acute and longer than distal ones; bracts persistent to after anthesis; petals 3–3.7 mm long; disc and base of style puberulous . . . . . **1. S. ampulliformis**

20 Petiole 3–10 mm long; inflorescence glabrous; bracts oblong; stamens mostly 30–50; style 4.5– mm long . . . . . **9. S. glabra**

20. Petiole 10–35 mm long; inflorescence sparsely appressed puberulous; bracts broadly ovate or depressed ovate; stamens mostly 60–70; style 3.5–4 mm long . . . . . **8. S. gittinsii**

21 Inflorescence usually several clustered axillary spikes to 1.5 cm long; bracts 1.2–1.5 mm long, sometimes denticulate, pubescent; style 2–2.5 mm long . . . . . **10. S. graniticola**
21. Inflorescence a fascicle, or flowers solitary; bracts 1.5 mm long or more; style 2.5–3.5 mm long **22**

22 Calyx lobes 1–1.4 mm long; petals rounded; filaments pilose . . . . . **7. S. cyanocarpa** var. **cyanocarpa**
22. Calyx lobes 4–5.5 mm long; petals acute; filaments glabrous . . . . . **3. S. boonjee**

Key to Australian *Symplocos* taxa using fruiting specimens

1 Dry fruit ampulliform (flask-shaped) **2**
1. Dry fruit globose, depressed globose, or ellipsoid to subcylindrical, rarely ovoid or obovoid **10**

2 Young branchlets and petiole pilose or villous; infructescence spicate, pilose or villous **3**
2. Young branchlets and petiole glabrous, puberulous, or appressed pubescent; infructescence paniculate, or racemose, glabrous or appressed pubescent **6**

3 Dry fruit 5–6 mm long, 3.5–4 mm wide . . . . . **15. S. paucistaminea**
3. Dry fruit 7–10 mm long, 4–5 mm wide **4**

4 Secondary veins 15–20 pairs . . . . . **6. S. crassiramifera**
4. Secondary veins 7–12 pairs **5**

5 Midvein densely villous on upper (adaxial) surface of lamina . . . . . **4. S. bullata**
5. Midvein glabrous on upper (adaxial) surface of lamina . . . . . **13. S. hylandii**

6 Lamina margins not entire, sometimes teeth scarcely evident on recurved margins **7**
6. Lamina margins entire **8**

7 Young branchlets and petiole glabrous; lamina margins flat . . . . . **18. S. thwaitesii**
7. Young branchlets puberulous or pubescent; petiole glabrescent; lamina margins recurved . . . . . **16. S. puberula**

8 Secondary veins mostly 4–6 pairs; basal pair more acute and longer; style pubescent at base . . . . . **1. S. ampulliformis**
8. Secondary veins 7–12 pairs, not more acute and longer near base; style glabrous **9**

9 Young branchlets puberulous or pubescent, glabrescent; fruit 5.8–6.3 mm long, 4–5.5 mm wide . . . . . **19. S. wooroonooran**
9. Young branchlets glabrous; fruit 10–15 mm long; 7–9 mm wide . . . . . **14. S. oresbia**

10 Infructescence a glomerule or fruit solitary at each node **11**
10. Infructescence spicate or racemose, branched or unbranched **12**

11 Fruit glabrous; calyx lobes 4–5.5 mm long . . . . . **3. S. boonjee**
11. Fruit usually not glabrous; calyx lobes 1–1.4 mm long . . . . . **7. S. cyanocarpa**

12 Lamina margins entire or sometimes obscurely denticulate **13**
12. Lamina margins serrate or dentate **16**

13 Fruit mostly obovoid (Lord Howe Island endemic) . . . . . **5. S. candelabrum**
13. Fruit globose, ovoid or ellipsoid (Australian mainland) **14**

14 Lamina length usually 3-6 times width . . . . . **10. S. graniticola**
14. Lamina length usually less than 3 times width **15**

15 Petioles 10–35 mm long. Pedicels 0–0.2 mm long; fruit 6–7 mm long; 4–5 mm wide . . . . . **8. S. gittinsii**
15. Petioles 3–10 mm long. Pedicels 0.2–2 mm long; fruit 9–11 mm long; 8–10 mm wide . . . . . **9. S. glabra**

16 Secondary and tertiary veins raised above (adaxially) (dried leaves) **17**
16. Secondary and tertiary veins not raised above (adaxially) **19**

17 Young branchlets, bud scales and infructescence axis glabrous . . . . . **18. S. thwaitesii**
17. Young branchlets, bud scales and infructescence axis not glabrous **18**

18 Young branchlets sparsely appressed puberulous; petiole 6–25 mm long; fruit 3.5–4.5 mm wide . . . . . **17. S. stawellii**
18. Young branchlets sparsely pilose with erect hairs; petiole 3–4 mm long; fruit 6–7 mm wide . . . . . **11. S. harroldii**

19 Shoots usually without cataphylls; lamina 0.7–2 cm wide, sparsely appressed puberulous on underside (abaxially), base acutely cuneate; fruit 4–9 mm long. . . . . **2. S. baeuerlenii**
19. Shoots usually bearing scattered cataphylls; lamina 2.5–5.5 cm wide, sparsely pilose on underside (abaxially), base rounded or cordate; fruit 15–20 mm long . . . . . **12. S. hayesii**

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1. Symplocos ampulliformis C.T.White, *Proc. Roy. Soc. Queensland* 50: 81 (1939). **Type:** Queensland. Cook District: Mt Spurgeon, September 1936, *C.T.White 10581* (holo: BRI; iso: A *n.v.*; BM).

***Illustrations*:** Hyland *et al.* (2010).

Shrub or small tree to 10m. Shoots sparsely appressed puberulous, glabrescent; young branchlets glabrous. Leaves chartaceous; lamina oblanceolate or elliptic, 4.5–12 cm long, 2–5 cm wide, acuminate at apex, acute or attenuate at base, glabrous; margins recurved, entire or nearly so; secondary veins mostly 4–6 pairs, the basal pair often longer and more acute; petiole 4–10 mm long, glabrous. Inflorescence usually a cluster of racemose axes to 2 cm long, glabrous or sparsely appressed puberulous, sometimes shortly branched near base; bracts and bracteoles ovate, puberulous or ciliate, persistent to anthesis, bracts *c.* 0.5 mm long, bracteoles *c.* 0.4 mm long. Calyx limb 0.6–0.8 mm long, sparsely puberulous, glabrescent; lobes depressed ovate or rounded, 0.3–0.5 mm long, glabrescent, margins ciliate. Petals oblong or narrowly obovate, 2.5–3.5 mm long, white, glabrous. Stamens (12–)15, 1.5–4 mm long. Disc puberulous. Style *c.* 2.5 mm long, puberulous at base. Fruit ampulliform to narrowly ovoid, 10–15 mm long, 5–6 mm wide, blue to blue-black or purple-black. **Fig. 1A–C.**

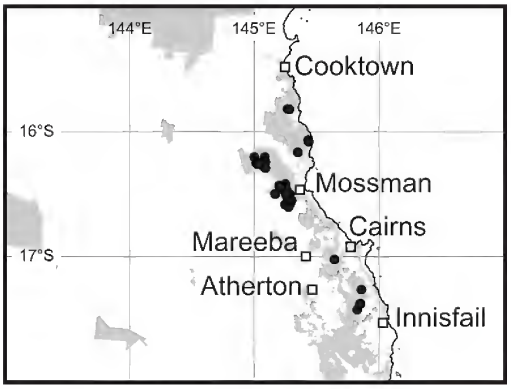
***Additional selected specimens examined*: Queensland.** Cook District: N.P.R. 133, summit of Mt Sorrow walking track, Cape Tribulation, Nov 2000, *Ford AF2524 et al.* (BRI); S.F.R.144, Parish of Whypalla, Bower Bird L.A., Dec 1987, *Hyland 13459* (BRI, CNS); *loc. cit.*, May 1989, *Gray 5046* (BRI, CNS); S.F.R.144, Dasyurid L.A., Apr 1980, *Gray 1682* (BRI, CNS); S.F.R.144, Chowchilla L.A., Jul 1982, *Gray 2663* (BRI, CNS); Mt Lewis, SW of Mossman, Aug 1957, *Volck 1389* (BRI); S.F.R.143, Parish of Riflemead, North Mary L.A., Dec 1984, *Gray 3758* (BRI); S.F.R.143, South Mary L.A., Aug 1973, *Irvine 612* (BRI); S.F.R.143, Parish of Riflemead, South Mary L.A., *Gray 3362* (BRI, CNS); S.F.R.143, Parish of Riflemead, Carbine L.A., Nov 1987, *Hyland 25249RFK* (BRI); *loc. cit.*, Jan 1985, *Gray 3835* (BRI); S.F.R. 143, Bushy L.A., Feb 1982, *Hyland 11691*(BRI); T.R.143, Zarda L.A., Sep 1973, *Hyland 2884RFK* (BRI); Along Falchetti Track to the Mitchell Bomber crash site on the NE peak of Mt Bartle Frere, Jul 2001, *Jago 6011 & Gandini* (BRI); Upper E Mt Bartle Frere, Oct 1985, *Godwin C2900* (BRI).

***Distribution and habitat*:** This species is endemic to Queensland in the Wet Tropics and occurs on Mt Sorrow near Cape Tribulation, the Mt Windsor Tableland, Mt Carbine Tableland, in the vicinity of Mount Lewis, and on Mt Bartle Frere (**Map 1**), in upland and montane notophyll and microphyll vineforest on granite, granodiorite (all upper montane localities) and phyllite substrates.

***Phenology*:** Flowers are recorded from March to May; fruit from January to July.

***Notes*:** This species was treated as *Symplocos cochinchinensis* var. *montana* (C.T.White) Noot. (as *S. cochinchinensis* subsp. *thwaitesii* var. *montana*) in Nooteboom (1982).

***Conservation status*:** *Symplocos ampulliformis* is currently listed as Near Threatened under the *NCA*.



Map 1. Distribution of *Symplocos ampulliformis*

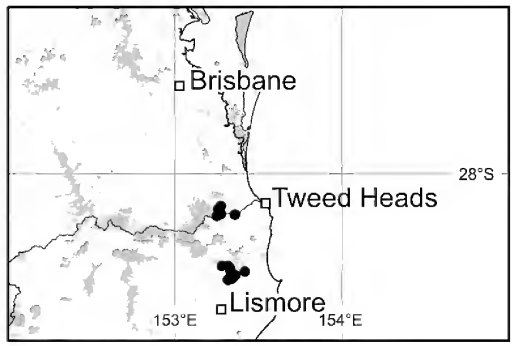
2. Symplocos baeuerlenii R.T.Baker, *Proc. Linn. Soc. New South Wales* 27: 594, t. 28 (1902). **Type:** New South Wales. Tumbulgum, Murwillumbah, *s.dat.*, *W. Bäuerlen s.n.* (holo: NSW; iso: MEL).

***Illustrations*:** Floyd (1989: 396); Leiper *et al.* (2008: 336).

Shrub or small tree to 10 m. Shoots and young branchlets puberulous. Leaves coriaceous; lamina narrowly elliptic or lanceolate, 1.5–8 cm long, 0.7–2 cm wide, acuminate at apex, acute at base, glabrous or with a few hairs on midvein and undersurface; margins mostly serrate; secondary veins mostly 7–10 pairs; petiole 2–4 mm long, puberulous, glabrescent. Inflorescence racemose, to 0.6 cm or flowers solitary, puberulous; pedicels to 1 mm long; bracts and bracteoles puberulous, semi-persistent, bracts acutely triangular, 0.8–1.2 mm long, bracteoles ovate, 0.3–0.5 mm long. Calyx limb 0.7–1.1 mm long, glabrous; lobes depressed ovate or rounded, 0.5–0.8 mm long, glabrous. Petals obovate, 2–3 mm long, 1.4–1.6 mm wide, white, glabrous. Stamens mostly 15–20, 1.5–3 mm long. Disc pubescent. Style 1.5–2.5 mm long, pubescent at base. Fruit ovoid, to 9 mm long, red.

***Additional selected specimens examined*: Queensland.** Moreton District: Lyrebird Ridge Road, Springbrook Plateau, Dec 1993, *Grimshaw G259* (BRI); Springbrook, Aug 1945, *Blake 15892* (BRI); *loc. cit.*, Sep 1929, *Rudder 4022* (BRI, L); *loc. cit.*, Sep 1929, *White 6265* (BRI); *loc. cit.*, Aug 1930, *White 7059* (BM, BRI); Track to 'Best of All' Lookout, Springbrook, Jul 1977, *McDonald 1946 & Elsol* (BRI); End of Currumbin Valley road, Mt Cougal N.P., Nov 1992, *Thomas 96 & Barry* (BRI). **New South Wales.** Mt Nardi, Goonimbar S.F., Feb 1979, *Floyd 1194* (BRI); Whian Whian S.F., Jun 1945, *White 12758* (BRI); *loc. cit.*, Jun 1947, *Hayes s.n.* (BRI [AQ537353]); *loc. cit.*, Nov 1949, *White s.n.* (BRI [AQ335709]); *loc. cit.*, 1953–1958, *Webb & Tracey s.n.* (BRI [AQ84368]); Minyon, near Mullimbimby, Aug 1936, *White 10480* (BRI); Whian Whian, N of Lismore, Jun 1965, *Smith 12303 et al.* (BRI); *c.* 6 km W of Minyon Falls, Whian Whian S.F., Jul 1975, *Williams s.n.* (BRI [AQ504389]).

***Distribution and habitat*:** This species is endemic to south-east Queensland and north-east New South Wales where it occurs from the Macpherson Range near Springbrook, south to Lismore (**Map 2**), in microphyll and notophyll vineforests on substrates derived from basalt and enriched rhyolite.



Map 2. Distribution of *Symplocos baeuerlenii*

***Phenology*:** Flowers are recorded from July to September; fruit in January and February.

***Notes*:** This species was included under *Symplocos cochinchinensis* var. *montana* (as *S. cochinchinensis* subsp. *thwaitesii* var. *montana*) in Nooteboom (1982).

***Conservation status*:** *Symplocos baeuerlenii* is currently listed as Vulnerable under the *NCA*.

3. Symplocos boonjee Jessup **species nova** *S. cyanocarpam* simulans sed bracteis longioribus (2–5 mm contra 1.5–1.7 mm longis) bracteolis longioribus (2–3 mm contra 0.5–1 mm) sepalis longioribus (4–5.5 mm contra 1–1.4 mm) petalis ovatis acutis et filamentis glabris differt. **Typus:** Queensland. Cook District: Wooroonooran National Park, Stockwellia site, 10 July 2000, *P.I.Forster*

PIF25915, R.Booth & R.Jensen (holo: BRI; *isotypi distribuendi*).

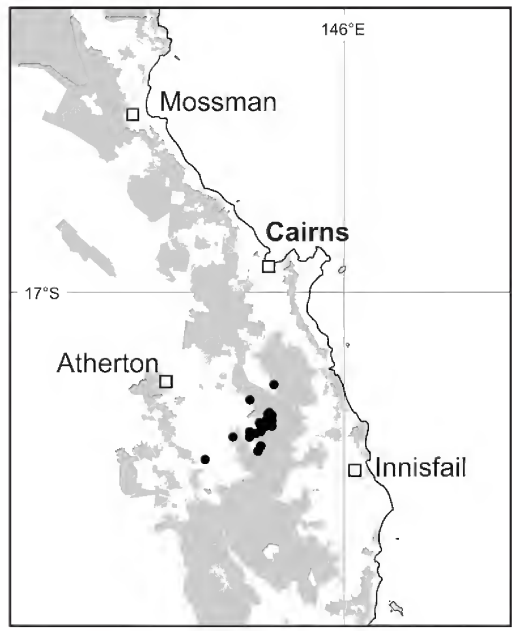
Symplocos sp. (Boonjie B.P.Hyland 2753); (Jessup 1994, 1997, 2002, 2007, 2010).

***Illustrations*:** Cooper & Cooper (2004: 538), under *Symplocos* sp. (Boonjee); Hyland *et al.* (2010), under *Symplocos* sp. (Boonjie B.P.Hyland 2753).

Shrub to 3 (–5) m. Shoots, cataphylls and young branchlets glabrous; cataphylls usually caducous. Leaves chartaceous; lamina narrowly obovate or narrowly oblanceolate, 4.5–11 cm long, 1–3 cm wide, acuminate at apex, acute or attenuate at base, glabrous; margins usually entire, slightly recurved; secondary veins mostly 5–7 pairs; petiole 3–7 mm long, glabrous. Inflorescence a solitary flower in axil of a leaf or cataphyll; the axis *c.* 1.5 mm long with up to 9 bracts or a fascicle with one open flower surrounded by several buds; lower bracts broadly ovate to depressed ovate, upper ones ovate to narrowly ovate, 3.5–5 mm long, persistent, sparsely appressed pubescent to nearly glabrous; margins denticulate, ciliate; bracteoles 2–3 mm long, similar to upper bracts. Calyx limb 4–5.5 mm long; lobes narrowly ovate, acute, sparsely puberulous; margin denticulate, ciliate; tip incurved. Petals narrowly ovate, acute or obtuse, 3–3.5 mm long, 1.5–1.7 mm wide, cream to white, glabrous. Stamens 35–40 in males, 25–30 in females, 0.8–3 mm long, filaments glabrous. Disc pilose. Style 3–3.5 mm long (*c.* 0.5 mm in males), with a few hairs at base, otherwise glabrous. Fruit oblong or ellipsoidal, *c.* 17 mm long and 3.5 mm wide, glabrous, blue. **Fig. 1D–F.**

***Additional selected specimens examined*: Queensland.** Cook District: E side of Mulgrave River, Goldsborough Valley, Jun 1995, *Hunter JH3704* (BRI); Gadgarra S.F., S of Butchers Creek, Jun 1995, *Hunter JH3904* (BRI); S.F.R. 310, Swipers L.A., E of Malanda, Aug 1963, *Hyland AFO/2753* (BRI); Swipers Flat, Wooroonooran N.P., Jul 1995, *Forster PIF17138 & Figg* (BRI); Boonjee L.A., near Bartle Frere track, Nov 1988, *Jessup GJM362 et al.* (BRI); Russell River, *Johnson s.n.* (MEL46567); Palmerston Track ridge, Feb 1995 *Hunter JH1158* (BRI); Breeden Property, Hughes Road, Topaz, Mar 1992, *Cooper & Cooper 221* (CNS); T.R. 1230, Bartle Frere, Boonjee L.A., Sep 1992, *Gray 5575* (CNS); S.F.R. 755, Bartle Frere, Gosschalk L.A., Nov 1991, *Hyland 14345* (CNS); R.926, Kauri Reserve, Dirran, Oct 1987, *Dansie 20166* (CNS); N.P.R. 904, along track between Coolamon Creek and Combo Creek, Oct 2000, *Ford AF2462* (BRI); Wooroonooran N.P., Combo Creek, Nov 1998, *Forster PIF23990 et al.* (BRI).

***Distribution and habitat*:** This species is endemic to the Wet Tropics of Queensland where it is known from notophyll and mesophyll vineforests mostly on the western side of Wooroonooran N.P., and nearby forest remnants (**Map 3**), on metamorphic or basalt substrates.



Map 3. Distribution of *Symplocos boonjee*

***Phenology*:** Flowers are recorded from June to February; fruit in July and August.

***Notes*:** Specimens of this species (e.g. *Hyland 2753*) were tentatively included in *Symplocos cyanocarpa* C.T.White in Nooteboom (1982).

***Etymology*:** The species epithet commemorates a botanically rich but loosely defined locality on the eastern edge of the Atherton Tableland known as Boonjee or Boonjie. For the sake of consistency the first alternative spelling is used as it has been used in the names *Syzygium boonjee* B.Hyland and *Bulbophyllum boonjee* B.Gray & D.L.Jones (= *Adelopetalum boonjee* (B.Gray & D.L.Jones) D.L.Jones & M.A.Clem.).

***Conservation status*:** *Symplocos boonjee* is only known from Wooroonooran N.P. At a few sites it has been recorded as common.

Additional collections and observations are required to determine its area of occupancy and population numbers.

4. Symplocos bullata Jessup **species nova** *S. paucistamineam* simulans sed foliis bullatis, marginibus recurvis, stylis longibus (2–2.5 mm, contra 1.2–1.8 mm) et fructibus majoribus (8–9 × 3.5–4 mm, contra 5–5.8 × 7.5–8 mm) differt. **Typus:** Queensland. Cook District: State Forest Reserve 143, North Mary Logging Area, 25 April 1982, *B.Gray 2543* (holo: BRI; iso: BRI, CNS).

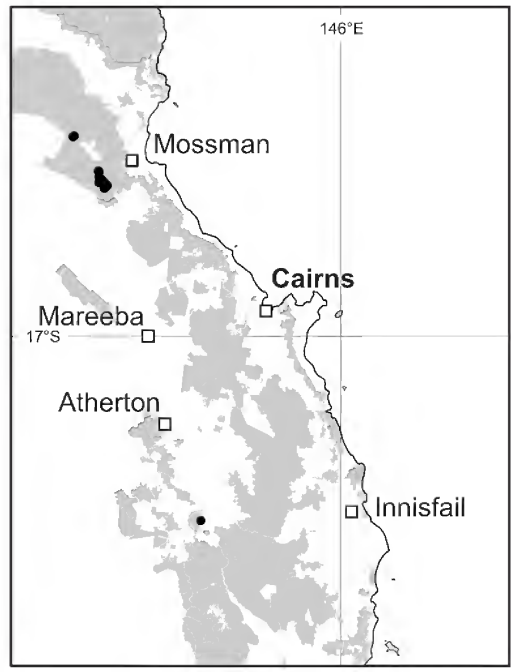
Symplocos sp. (North Mary B.Gray 2543); (Jessup 2002, 2007, 2010).

***Illustrations*:** Hyland *et al.* (2010), under *Symplocos* sp. (North Mary B.Gray 2543).

Dioecious tree to 15 m. Shoots and young branchlets yellowish brown or reddish-brown to dark brown villous, cataphylls rarely evident. Leaves thinly coriaceous or chartaceous; lamina lanceolate, elliptic, obovate or oblanceolate, 4–14 cm long, 1.2–5 cm wide, acuminate at apex, cuneate, acute or scarcely obtusely so or obtuse, truncate or rounded at base, mature leaves bullate between main veins, glabrescent above, pilose below; margins obscurely denticulate or entire, recurved; secondary veins mostly 7–12 pairs, usually depressed on upper surface; petiole 4–11 mm long, pilose. Inflorescences spicate, to 5 cm, pilose; bracts and bracteoles ovate, densely reddish-brown pilose or villous, persistent, bracts 1.8–2.5 mm long, bracteoles 1.3–1.5 mm long. Calyx limb 1.2–1.5 mm long; lobes ovate, 1–1.2 mm long, pubescent in middle near apex with reddish-brown hairs, sometimes glabrescent. Petals obovate, 3–3.5 mm long, 1–1.5 mm wide, cream to white, mostly glabrous. Hypanthium glabrous. Stamens (15–) 20–25 in males, 7–10 in females and apparently sterile, 1–2.5 mm long. Disc glabrous. Style 2–2.5 mm long, glabrous; females with peltate stigma. Fruit broadly ovoid or ampulliform 8–9 mm long, 7.5–8 mm wide, colour unknown. **Fig. 1G–I.**

***Additional selected specimens examined*: Queensland.** Cook District: Daintree N.P., NW of Black Mountain, May 1998, *Forster PIF22903 et al.* (BRI); Daintree N.P., near end of Mt Lewis road, Nov 1988, *Jessup et al. GJM155* (BRI); S.F.R.143 Riflemead, North Mary L.A., Jun 1995, *Gray 6226* (BRI); *loc. cit.*, Dec 1995, *Gray 6479* (CNS photo); S.F.R. 652, Mt Fisher, May 1975, *Hyland 3175RFK* (BRI, CNS).

***Distribution and habitat*:** Endemic to the Wet Tropics of Queensland where it occurs in the Mt Lewis to Mt Carbine Tableland area west of Mossman and with an outlier at Mt Fisher, south of Millaa Millaa (**Map 4**). Grows in montane microphyll and notophyll vineforests on granite substrates.



Map 4. Distribtution of *Symplocos bullata*

***Phenology*:** Flowers are recorded from April to June; fruit in December.

***Etymology*:** The specific epithet is derived from the Latin adjective *bullatus* (bullate, blistered or puckered) and refers to the appearance of the upper surface of the lamina between the veins.

***Conservation status*:** *Symplocos bullata* is only known from the localities cited above. Additional collections are required to determine its area of occupancy and population numbers.

5. Symplocos candelabrum Brand in Engl., *Pflanzenr.* 6: 39 (1901); *S. cochinchinensis* var. *candelabrum* (Brand) Noot., *Brunonia* 4: 323 (1982). **Type:** New South Wales. Lord Howe Island, April 1898, *J.H.Maiden s.n.* (holo: B [destroyed]; iso: BM, BRI).

***Illustration*:** Green (1994).

Tree to 13 m, usually much smaller. Shoots and young branchlets glabrous or glabrescent. Leaves thinly coriaceous; lamina elliptic or lanceolate, 6–16 cm long, 2–6 cm wide, acute to acuminate at apex, attenuate at base, glabrous; margins entire to remotely serrulate-denticulate near apex, more or less recurved near base; secondary veins mostly 8–11 pairs; petiole 20–30 mm long, glabrous. Inflorescence predominately racemose to 6 cm, glabrous or with few very sparse hairs; pedicels to 5 mm long; bracts and bracteoles triangular, ciliate; bracts 1–1.5 mm long, caducous before anthesis; bracteoles 0.8–1.5 mm long, often persisting a little longer than the bracts. Hypanthium glabrous; calyx limb 0.6–0.8 mm long; lobes broadly ovate, glabrous with ciliate margin. Petals obovate, mostly 6–7 mm long, 3–3.5 mm wide, white, glabrous. Stamens mostly 30–40, 5–6 mm long. Disc with a few hairs. Style 4–5 mm long, pubescent at base. Fruit mostly obovoid, 10–16 mm long, 7–10 mm wide, blue.

***Additional selected specimens examined*: New South Wales.** Lord Howe Island: Mt Gower walking track, Nov 2000, *Conn 4320* (BRI); Halfway to saddle from Erskines Creek on summit track, Nov 2000, *Le Cussan 1056* (BRI); *loc. cit.*, Feb 2004, *Le Cussan 1375* (BRI); Intermediate Hill track, Mar 2003, *Le Cussan 1280* (BRI).

***Distribution and habitat*:** Occurs only in submontane forest at the southern part of Lord Howe Island.

***Phenology*:** Flowers are recorded from March to June; Mature fruit in February.

***Notes*:** This species was included under *Symplocos cochinchinensis* var. *candelabrum* (C.T.White) Noot. (as *S. cochinchinensis* subsp. *thwaitesii* var. *candelabrum*) in Nooteboom (1982).

***Conservation status*:** *Symplocos candelabrum* is currently not listed under the EPBC Act despite its highly restricted distribution.

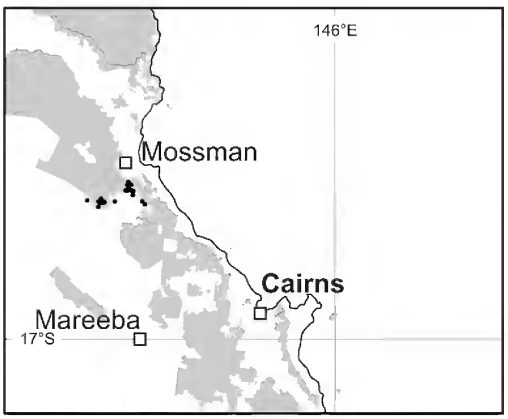
6. Symplocos crassiramifera Noot., *Leiden Bot. Ser.* 1: 186 (1975). **Type:** Queensland. Cook District: Devil Devil Creek, a few miles NE of Rumula and *c.* 8 miles [13.3km] SSW of Mossman, 1 September 1948, *L.S. Smith 3965* (holo: BRI; iso: L).

***Illustrations*:** Hyland *et al.* (2010).

Shrub or small tree to 8 m with few branches. Shoots and young branchlets with caducous cataphylls, pilose. Leaves coriaceous; lamina narrowly elliptic to narrowly oblanceolate, 20–41 cm long, 3.5–8.5 cm wide, acuminate at apex, acute or obtuse at base, glabrous above, pilose below; margins revolute, remotely denticulate to entire; secondary veins mostly 15–20 pairs; petiole 8–20 mm long, pilose. Inflorescences comprising clustered spicate axes to 15 cm, villous or pilose; bracts and bracteoles ovate, brown pubescent, persistent, bracts 2–2.5 mm long, bracteoles 1.7–2 mm long. Calyx limb 1.5–2 mm long, lobes broadly ovate or rounded, pubescent. Petals obovate, 4–4.5 mm long, 1.7–2 mm wide, pink, glabrous. Stamens *c.* 25, 3–4 mm long. Disc inconspicuous. Style 2.5–4 mm long, pubescent at base. Fruit ampulliform, 7–10 mm long, 4–5 mm wide, pink.

***Additional selected specimens examined*: Queensland.** Cook District: Little Mossman L.A., S.F.143, Jul 1994, *Forster PIF15513 et al.* (BRI); Rex Range, *c.* 1 km from Mossman–Julatten Road, on forest track *c.* 9 km NE of Julatten, Dec 1988, *Jessup 880 et al.* (BRI); Rex Highway, near Julatten, Apr 1962, *Webb & Tracey 5961* (BRI); The Gate, property of G. & S. Kurmond, 105 Salisbury Drive, Flin Creek, Julatten, Jan 2002, *Ford AF3260* (BRI); T.R. 66, Mt Lewis, May 1979, *Moriarty 2603* (BRI, CNS); 7 km along Mt Lewis Road, Mt Lewis F.R., Apr 2002, *Booth 3092 & Jensen* (BRI); T.R. 66, 8 km along Mt Lewis Road, Jun 1997, *Forster PIF21233 et al.* (BRI); Mt Lewis forestry road, SW of Mossman, May 1972, *Wrigley & Telford NQ140* (BRI, CANB); Rumula, Apr 1962, *McKee 9106* (BRI); Portion 203 Garioch, Jun 1973, *Hyland 6758* (BRI, CNS).

***Distribution and habitat*:** Endemic to the Wet Tropics of Queensland where it is known only from the vicinity of the headwaters of the South Mossman River to Mt Lewis (**Map 5**), in notophyll and mesophyll vineforests on granite and metamorphic substrates.



Map 5. Distribution of *Symplocos crassiramifera*

***Phenology*:** Flowers are recorded from May to July; fruit in September.

***Conservation status*:** *Symplocos crassiramifera* is currently listed as Vulnerable under the *NCA*.

7. Symplocos cyanocarpa C.T.White, *Proc. Roy. Soc. Queensland* 47: 69 (1936). **Type:** Queensland. Cook District: Mossman River, 4 February 1932, *L.J.Brass 2050* (holo: A, *n.v.*; iso: BRI, MEL).

Shrub or small tree to 5 m. Shoots and young branchlets pilose, glabrescent or glabrous, sometimes with pubescent cataphylls. Leaves chartaceous to coriaceous; lamina oblanceolate, narrowly obovate or elliptic, 8–23 cm long, 2.5–7 cm wide, mostly acuminate, sometimes acute or obtuse at apex, acute or attenuate at base, glabrous or with scattered hairs on midvein below; margins remotely serrate towards tip or entire; secondary veins 7–12(–15) pairs; petiole 3–10 mm long, glabrous or pilose. Inflorescence a fascicle of mostly 2–10 flowers, axillary or ramal; bracts and bracteoles ovate to triangular, sometimes denticulate, pubescent, persistent, bracts 1.5–1.7 mm long, bracteoles 1–1.2 mm long. Calyx limb 1.5–2 mm long; lobes ovate, often denticulate and ciliate, 1–1.4 mm long, pubescent. Petals oblong to obovate, 2.5–4 mm long, 1.4–1.8 mm wide, white or cream-pink, glabrous or with a few hairs, sometimes ciliolate. Stamens 15–30, 2.5–3.5 mm long, filaments pilose. Disc pilose. Style 2.5–3 mm long, shorter and without stigma in males, sparsely pilose. Fruit cylindrical to narrowly ellipsoidal, 15–25 mm long, 6–10 mm wide, glabrescent, blue to purple.

***Distribution and habitat*:** Endemic to the Wet Tropics of Queensland where it occurs from Big Tableland, north of Mt Finnigan, south to the Mossman River, in mesophyll and notophyll vine forest.

Two varieties are recognised.

Key to varieties

Young branchlets, petiole and lamina glabrous . . . . . var. **cyanocarpa**
Young branchlets, petiole and midvein of lamina pilose below . . . . . var. **pilosa**

7a. Symplocos cyanocarpa var. **cyanocarpa**

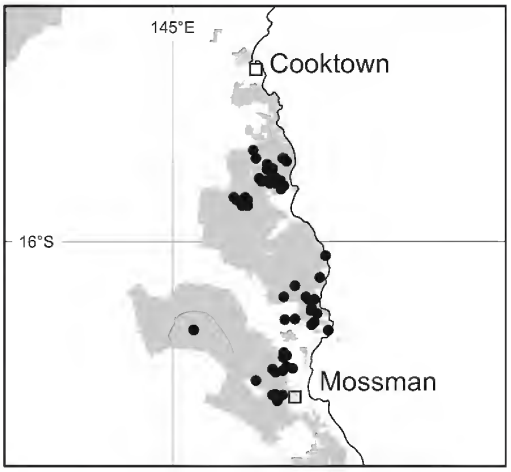
Shrub or small tree to 5 m. Shoots, young branchlets, petiole and lamina glabrous or nearly so. Bracts, bracteoles, and calyx appressed puberulous. **Fig. 2A–C.**

***Illustrations*:** Hyland *et al.* (2010).

***Additional selected specimens examined*: Queensland.** Cook District: Mt Finnigan, W slopes, Sep 1948, *Brass 20043* (BRI); Cedar Bay N.P., W slopes of Mt Finnigan, Oct 1999, *Forster PIF25014 & Booth* (BRI); Mt Misery, Jun 1992, *Forster PIF10751 et al.* (BRI); Daintree N.P., Cedar Bay section, Gap Creek, Nov 2000, *Forster PIF26464 et al.* (BRI); Cedar Bay N.P., Jul 1994, *Forster PIF15585 et al.* (BRI); N of Daintree River, on road to Cape Tribulation, Nov 1985, *Tucker 37* (BRI); Palm Road, 3 km W of Alexander Bay, Dec 2001, *Forster PIF27907 et al.* (BRI); Whyanbeel, Dec 1978, *Gray 1181* (BRI, L); *loc. cit.*, Dec 1978, *Gray 1187* (BRI); *c.* 2 km along Whyanbeel – Daintree track, from Whyanbeel Creek, Jan 1986, *Guymer 2060* (BRI); Near Cooper Creek, Aug 1987, *Sankowsky 639 & Sankowsky* (BRI); Mossman Gorge, W of Mossman, Jun 1972, *Wrigley & Telford NQ1137* (BRI).

***Distribution and habitat*:** Endemic to the Wet Tropics of Queensland where it occurs from the vicinity of Mt Finnigan to south of Mossman (**Map 6**) in mesophyll and notophyll vineforest on granitic and metamorphic derived soils.

Fig. 2. ***Symplocos cyanocarpa*** var. ***cyanocarpa***. A. portion of stem with inflorescences and leaf base × 3. B. flower × 8. C. fruit × 2. A–C from *Forster PIF10751 et al.* (BRI). ***S. cyanocarpa*** var. ***pilosa***. D. inflorescence and leaf base × 4, *Hyland 10582* (BRI). ***S. glabra***. E. branchlet with fruit × 0.8, *Hyland 11798* (BRI). ***S. hayesii***. F. inflorescence with flowers × 4, *Hyland 14628* (CNS). G. fruit × 2, *Smith 10839* (BRI). H. leaf abaxial surface × 1, *Smith 10839* (BRI). Del. W.Smith.



Map 6. Distribution of *Symplocos cyanocarpa* var. *cyanocarpa*

***Phenology*:** Flowers are recorded from July to January; fruit from November to March.

***Conservation status*:** *Symplocos cyanocarpa* var. *cyanocarpa* occurs mostly in National Parks and other reserves throughout its range and is not considered to be threatened.

7b. Symplocos cyanocarpa var**. pilosa** Jessup **varietas nova**, differt a var. *cyanocarpa* ramulis juvenibus, petiolo et costa abaxialiter pilosis. **Typus:** Queensland. Cook District: Timber Reserve 146, Tableland Logging Area, 11 September 1980, *B.P.Hyland 10582* (holo: BRI; iso: CNS).

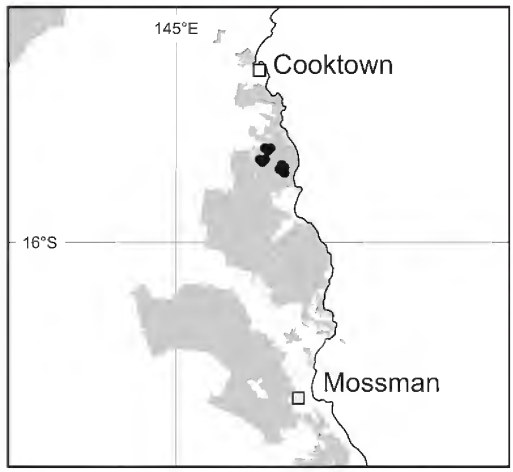
Symplocos sp. (Big Tableland B.P.Hyland 10582); (Jessup 1997, 2002, 2007, 2010).

***Illustrations*:** Hyland *et al.* (2010), under *Symplocos* sp. (Big Tableland B.P.Hyland 10582).

Shrub or small tree to 3 m. Shoots, young branchlets, petiole and main veins of leaves on underside pilose with scattered erect hairs, glabrous above. Bracts, bracteoles and calyx pilose with more or less erect hairs. **Fig. 2D.**

***Additional specimens examined*: Queensland.** Cook District: T.R. 146, Tableland L.A., Jul 1975, *Hyland 8324* (BRI, CNS); Hartley Creek at end of Mt Hartley track, Oct 1996, *Ford 1774* (BRI); Along track from Hartley Creek to Mt Hartley, Oct 1996, *Ford 1782* (BRI); Mt Hartley, western slopes, T.R. 165, Jul 1995, *Forster PIF17296 & Figg* (BRI).

***Distribution and habitat*:** Endemic to the Wet Tropics of Queensland where it occurs on Big Tableland and Mt Hartley, northwest of Cedar Bay (**Map 7**) in notophyll vineforest on granite substrates.



Map 7. Distribution of *Symplocos cyanocarpa* var. *pilosa*

***Phenology*:** Flowers are recorded in July, September and October and very immature fruit in October.

***Etymology*:** The varietal epithet is formed from the Latin word *pilosus* (covered with short, weak, thin hairs) and refers to the indumentum on the young branchlets, petiole and adaxial surface of the midvein.

***Conservation status*:** *Symplocos cyanocarpa* var. *pilosa* is only known from the localities cited above. Additional collections are required to determine its area of occupancy and population numbers.

8. Symplocos gittinsii Jessup **nom. et stat. nov.**; *S. cochinchinensis* var. *gittonsii* Noot., *Leiden Bot. Ser.* 1: 162 (1975). **Type:** Queensland. North Kennedy District: Mt Spec Range, May 1962, *C.H.Gittins 494* (holo: BRI; iso: L).

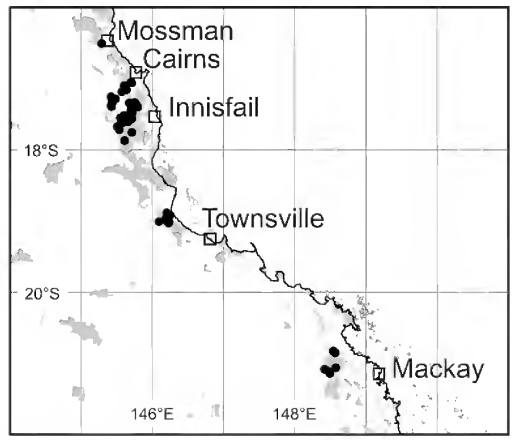
***Illustrations*:** Nooteboom (1982: Fig. 11); Cooper & Cooper (2004: 537); Hyland *et al.* (2010), all under *Symplocos cochinchinensis* var. *gittonsii*

Tree to 30 m. Shoots and young branchlets glabrous; cataphylls glabrous and ciliate. Leaves coriaceous; lamina obovate,

sometimes elliptic, 8–18 cm long, 3.5–9.5 cm wide, acuminate, acute or obtuse at apex, acute or attenuate at base, glabrous; margins entire, revolute; secondary veins mostly 7–11 pairs; petiole 10–35 mm long, glabrous. Inflorescence axes branched, to 13 cm long, spicate, sparsely appressed puberulous; bracts and bracteoles broadly or depressed ovate, glabrous with ciliate margin, persistent to after anthesis, sometimes to fruiting, bracts 0.8–1.5 mm long, bracteoles 0.7–1 mm long. Calyx limb 0.7–1.5 mm long, glabrous; lobes depressed obovate, mostly glabrous with ciliate margin. Petals broadly obovate, 4–6 mm long, 3.5–4.5 mm wide, white, glabrous. Stamens 60–70, 2.5–6 mm long. Disc slightly raised, 5-lobed, glabrous. Ovary 3-locular, with *c.* 3 ovules per locule. Style 4 mm long, glabrous. Fruit ellipsoidal or ovoid, 6–7 mm long, 4–5 mm wide, blue to black.

***Additional selected specimens examined*: Queensland.** Cook District: T.R. 30, Mt Lewis area, Oct 1967, *Hyland 1048* (BRI); Ridge between McKinnon & Wrights Creeks, southwest of Edmonton, Jun 1996, *Forster PIF19263 et al.* (BRI); S.F.R. 310, Gadgarra, Feb 1981, *Bragg s.n.* (BRI [AQ874875]); T.R. 1230, Boonjie L.A., May 1977, *Gray 533* (BRI, MEL); S.F.R. 310, Gadgarra, Windin L.A., May 1990, *Hyland 14017* (BRI); S.F.R. 310, Windin L.A., Jan 1978, *Gray 850* (BRI, MEL); Topaz to Boonjee Road, May 1987, *Starkey 74* (BRI); On Topaz Road, Dec 1985, *Sankowsky 459 & Sankowsky* (BRI); Topaz Road, Nov 1992, *Jessup 905* (BRI); Palmerston Highway, 1 km south-east of Beatrice River, Jan 1993, *Bean 5401* (BRI); Wooroonooran N.P., Palmerston section, Dec 1999, *Forster PIF25209* (BRI); S.F. 756, Mt Father Clancy, May 2000, *Forster PIF25726 & Booth* (BRI); Portion 297, Parish of Dirran, Apr 1984, *Gray 3992* (BRI, CNS). North Kennedy District: 4.5 km south along Culpa Road, S.F. 605 Koombooloomba, Culpa L.A., May 2002, *Forster PIF28705 & Booth* (BRI); Mt Spec near Paluma village, May 1985, *Jackes 14* (BRI); Paluma, May 1980, *Horton s.n.* (BRI [AQ343157]); Paluma, Sep 1990, *Cumming 10650* (BRI); Mt Spec N.P., Paluma, behind Rangers barracks, May 1989, *Fell DF1851* (BRI). South Kennedy District: S.F. 652 Cawley, near Mt Macartney, Jun 1995, *Forster PIF16714 & Tucker* (BRI); Clarke Range, 13.7km from Eungella township, Eungella N.P., Apr 1991, *Forster PIF8057 & McDonald* (BRI); Roadside *c.* 15 km N of Eungella township on Dalrymple Road, Nov 1989, *McDonald 4465* (BRI); Dalrymple Heights, Eungella Range, Fredrickson's Farm, May 1987, *Champion 227* (BRI).

***Distribution and habitat*:** Endemic to Queensland where it occurs from Mt Lewis south to Culpa L.A. in the Wet Tropics, then disjunct to Paluma and the Clarke Range near Eungella (**Map 8**). Grows in upland notophyll or mesophyll vine forest on diverse substrates (basalts, granites, metamorphics, rhyolites).



Map 8. Distribution of *Symplocos gittinsii*

***Phenology*:** Flowers are recorded in April and May; fruit from November to January.

***Notes*:** This species was treated as *Symplocos cochinchinensis* var. *gittonsii* Noot. (as *S. cochinchinensis* subsp. *thwaitesii* var. *gittonsii*) in Nooteboom (1982).

***Etymology*:** The name commemorates Clifford Halliday Gittins (1904–1995), an amateur botanical collector of mostly Queensland plant specimens.

***Conservation status*:** *Symplocos gittinsii* occurs in several National Parks and other reserves throughout its range and is not considered to be threatened.

9. Symplocos glabra Jessup **nom. et stat. nov.**; *S. cochinchinensis* var. *glaberrima* Noot., *Brunonia* 4: 319–320 (1982). **Type:** Queensland. Cook District: State Forest Reserve 194, Compartment 54, 17 March 1971, *G.C. Stocker 622* (holo: L; iso: BRI, CNS, MEL).

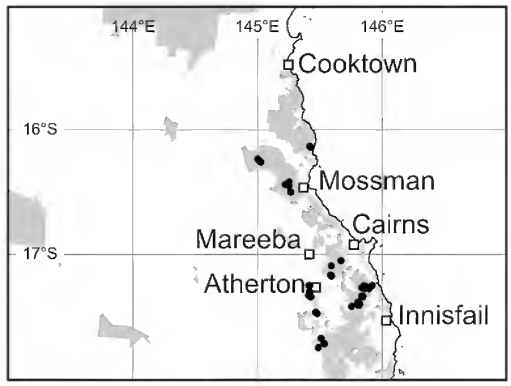
***Illustrations*:** Nooteboom (1982, Fig. 11); Hyland *et al.* (2010), both under *Symplocos cochinchinensis* var. *glaberrima.*

Small tree to 9 m. Shoots and young branchlets glabrous. Leaves coriaceous; lamina oblanceolate or narrowly obovate, rarely elliptic, 7–15 cm long, 2–7 cm wide, acuminate, acute or obtuse at apex, acute or attenuate at base, glabrous; margins entire,

revolute; secondary veins mostly 8–12 pairs; petiole 3–10 mm long, glabrous. Inflorescence axes 2 or 3, racemose, to 3 cm long, glabrous, branching near base, sometimes single; pedicels 0.2–2 mm long; bracts and bracteoles glabrous but ciliate, caducous or persistent to anthesis, bracts broadly ovate or oblong, 1.2–2.5 mm long, bracteoles ovate, 0.7–1.2 mm long. Calyx limb 1.2–1.5 mm long, glabrous; lobes depressed obovate, glabrous with ciliate margin. Petals narrowly obovate, 4.5–6 mm long, 2–3 mm wide, cream to white, glabrous. Stamens mostly 30–50, 2–5 mm long. Disc 5-lobed, sparsely puberulous. Style 4.5–5 mm long, glabrous. Fruit subglobose or ellipsoidal, 8–11 mm long, (5–) 8–10 mm wide, blue-black to purple-black. **Fig. 2E.**

***Additional selected specimens examined*: Queensland.** Cook District: V.C.L. Noah, Mt Hemmant, Oct 1975, *Hyland RFK3339* (BRI); Mt Windsor F.R, *c.* 5.7 km from Spencer Creek Forestry barracks, Jun 2004, *Ford 4341 & Hewett* (BRI); S.F.R. 144 Whypalla, Bower Bird L.A., Dec 1987, *Hyland 13454* (BRI); Mt Spurgeon, W of Mossman, Sep 1936, *White 10557* (BRI); Mt Bellenden Ker, Jun 1969, *Smith 14682B* (BRI); Wooroonooran N.P., Mt Bellenden Ker summit area, Dec 2000, *Forster PIF26510 et al.* (BRI); *loc. cit.*, Dec 2001, *Forster PIF27945 et al.* (BRI); Mt Bellenden Ker, *c.* 0.5 miles [0.8 km] SW of centre peak, Jun 1969, *Smith 14638 & 14638a* (BRI); Summit of Centre Peak, Bellenden Ker, Nov 1972, *Webb & Tracey 11920* (BRI); S.F.R. 194 Herberton, *c.* 10 miles [16 km] S of Atherton, May 1964, *Rudder s.n.* (BRI [AQ84400], L); Bellenden Ker, Jan 1923, *White s.n.* (BRI [AQ84393]); S.F.R. 310 Bellenden Ker Range, Jan 1980, *Hyland 10205* (BRI); Mt Bellenden Ker, Feb 1982, *Irvine 2210* (BRI, CNS); Mt Bellenden Ker, Dec 2000, *Jago 5779 & Forster* (BRI); Summit of Mt Bellenden Ker, Aug 1971, *Hyland 5312* (BRI); S.F.R. 755 Gosschalk L.A., Jun 1982, *Hyland 11798* (BRI); 100 m W of summit of NW peak of Bartle Frere, Jul 1995, *Hunter JH4461* (BRI); Wooroonooran N.P., summit of South Peak, Oct 1997, *Forster PIF21771 et al.* (BRI); Mt Bartle Frere, Jun 1961, *Martin & Hyland AFO/1890* (BRI); S.F.R. 194 Barron, Jan 1983, *Gray 2909* (BRI); S.F.R. 251, Ravenshoe – Tully Falls Road, Aug 1968, *Hyland 1737* (BRI).

***Distribution and habitat*:** Endemic to the Wet Tropics of Queensland where it occurs at Mt Hemmant, Mt Windsor Tableland, Mt Carbine Tableland, on the Lamb Range, Bellenden Ker, Cardwell and Herberton Ranges (**Map 9**) in simple to complex microphyll and notophyll vineforests on granites (upper montane localities) and rhyolites.



Map 9. Distribution of *Symplocos glabra*

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

***Note*:** The superlative epithet 'glaberrima' is not available for use at the rank of species. This species was treated as *Symplocos cochinchinensis* var. *glaberrima* Noot. (as *S. cochinchinensis* subsp. *thwaitesii* var. *glaberrima*) in Nooteboom (1982).

***Conservation status*:** *Symplocos glabra* occurs in several National Parks and other reserves in the Wet Tropics and is not considered to be threatened.

***Etymology*:** The specific epithet is derived from the Latin adjective *glaber* (glabrous) and refers to the lack of indumentum on all parts of the plant.

10. Symplocos graniticola Jessup, *Austrobaileya* 4: 9 (1993) **Type:** Queensland. Cook District: Mt Lewis, 24 December 1986, *G. Sankowsky 598 & N. Sankowsky* (holo: BRI).

Symplocos sp. 'Mt Lewis'; (Thomas & McDonald 1989).

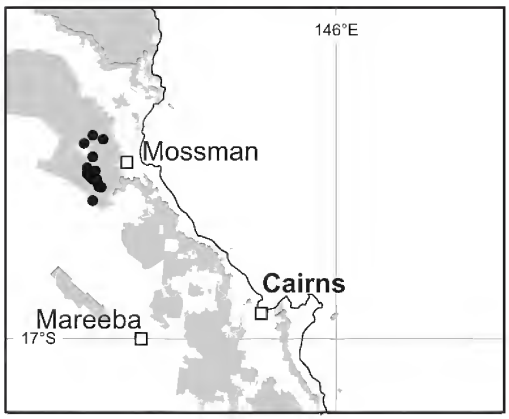
***Illustrations*:** Jessup (1993: 10); Hyland *et al.* (2010).

Shrub to 3 m. Shoots and cataphylls with very sparse appressed hairs, glabrescent; cataphylls caducous. Twigs glabrous. Leaves coriaceous; lamina narrowly obovate or narrowly oblanceolate, obtuse or shortly acuminate, 9–23 cm long, 2–7.5 cm wide, glabrous; margins entire, recurved, sometimes remotely serrulate or denticulate, acute or

attenuate at base; secondary veins mostly 6–12 pairs; petiole 8–20 mm long, glabrous. Inflorescence axes clustered, spicate, to 1.5 cm, puberulous; bracts and bracteoles ovate, slightly keeled, sometimes denticulate, pubescent, persistent, bracts 1.2–1.5 mm long, bracteoles 1–1.3 mm long. Calyx limb tube 1–1.3 mm long, glabrous; limb 1–1.2 mm long; lobes ovate or depressed ovate, 0.8–1 mm long, sparsely puberulous to nearly glabrous and with a ciliate margin. Petals oblong to obovate, 2.5–3.5 mm long, 1.5–2 mm wide, white, glabrous. Stamens 25–30, 2.5–4 mm long, filaments glabrous. Disc pilose. Style 2.5 mm long, pilose. Fruit ovoid or ellipsoid, 10–18 mm long, 6–12 mm wide, black.

***Additional selected specimens examined*: Queensland.** Cook District: Platypus Creek, Jan 1936, *Flecker 1216a* (CNS); Pinnacle Rock track, Jun 1992, *Forster PIF10716 et al.* (BRI); North Mary L.A., S.F. 143, 31.5 km along Mt Lewis road, Jun 1995, *Forster PIF16774A* (BRI); S.F.R. 143, South Mary L.A., May 1976, *Hyland 8773* (BRI, CNS); 32.6 km along Mt Lewis Road from Mossman – Mt Molloy Road, Dec 1989, *Jessup GJD3359 et al.* (BRI). S.F.R. 143, Kanawarra, Carbine Tableland, Nov 1995, *Gray 6400* (BRI); Mt Lewis F.R., off Mt Lewis Road, Jan 2008, *Ford AF5188 et al.* (BRI).

***Distribution and habitat*:** This species is endemic to the Wet Tropics of Queensland where it is known from Mt Spurgeon to Mt Lewis, Platypus Creek and Pinnacle Rock near Mossman (**Map 10**). It grows in simple microphyll and notophyll vineforests on granite or granodiorite substrates.



Map 10. Distribution of *Symplocos graniticola*

***Phenology*:** Flowers are recorded from December to May; green fruit from June to September, mature fruit in November.

***Conservation status*:** *Symplocos graniticola* is currently listed as Vulnerable under the *NCA*.

11. Symplocos harroldii Jessup, *Austrobaileya* 4: 7 (1993). **Type:** Queensland. Moreton District: Moggill State Forest, just downstream of road crossing Pullen Creek, 16 November 1980, *L.W.Jessup 268* (holo: BRI; iso: K, NSW).

Symplocos sp. 1.; Stanley & Ross (1986).

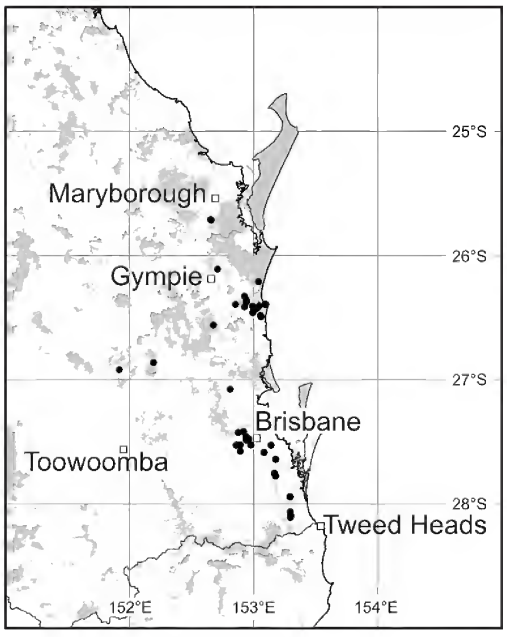
***Illustrations*:** Jessup (1993: 8); Leiper *et al.* (2008: 336).

Shrub or small tree to 6 m. Shoots and twigs pilose. Leaves coriaceous; lamina narrowly obovate or oblanceolate, 3–10 cm long, 0.8–3.5 cm wide, acuminate at apex, acute at base, glabrous or with a few hairs on underside, particularly on midvein; margins denticulate to serrate towards tip; secondary veins mostly 6–12 pairs; petiole 3–4 mm long, usually with scattered hairs. Inflorescence racemose, to 2 cm, puberulous; pedicels 0.2–2 mm long; bracts and bracteoles ciliate, semi-persistent, bracts broadly triangular, 0.7–1 mm long, bracteoles triangular, 0.3–0.4 mm long. Hypanthium glabrous. Calyx lobes broadly ovate, 0.5–0.7 mm long, glabrous, often with a ciliate margin. Petals obovate to oblong, 3–4 mm long, 2–2.5 mm wide, white, glabrous. Stamens 30–40, 1.8–5 mm long. Disc puberulous. Ovary 3-locular with up to 4 ovules per locule. Style 3.5–4 mm long, glabrous, dilated at stigma. Fruit narrowly ovoid or ellipsoid, 8–10 mm long, 6–7 mm wide, red.

***Additional selected specimens examined*: Queensland.** Wide Bay District: Tinana Creek, 7 km E Tiaro, Dec 1992, *Forster PIF12503 & Smyrell* (BRI); Tinana Creek, 7 km ENE of Tiaro, Mar 1992, *Smyrell s.n.* (BRI [AQ541786]); S.F. 502, Veteran L.A., Gympie, Sep 1992, *Thomas 8 & Barry* (BRI); 1 km ENE of Timberwah [Tinbeerwah] Hall, junction forestry road & tributary of Wooroi Creek, S.F. 959, Sep 1992, *Thomas 1 & Barry* (BRI); Gum Tree Drive off Cooroy – Tewantin Road, Sep 1992, *Thomas 5 & Barry* (BRI); Noosa N.P., off Viewland Drive, Jan 1993, *Thomas & Gayle s.n.* (BRI [AQ636338]); Panorama Drive via Duke Road, 8 km SE of Cooroy, Apr 1993, *Bean 5928* (BRI); N of Ringtail

Creek Road, Noosa Shire, Portion 8V, near S.F. 997, Oct 1994, *Thomas 102* (BRI); Noosa Shire hinterland N of Collwood Road, near Lake McDonald, Lot 3 Rp 800331 Parish of Tewantin, Sep 1995, *Thomas 33* (BRI); Compartment 1, Ringtail S.F., NE of Pomona, Sep 1997, *Bean 12412* (BRI); Doonan Wetland Conservation Area, Jan 2007, *Thomas MS112* (BRI); Maroochy Shire Bushland Conservation Reserve, Doonan Creek East (BCR), Jul 2007, *Thomas MS139* (BRI); Near Doonan Creek, Feb 2002, *Thomas 420M* (BRI). Moreton District: 650 Campbells Pocket Road, Caboolture, Jan 2006, *Weber s.n.* (BRI [AQ735727]); 0.5 km SW of McAfees Lookout, S.F. 309, Feb 1991, *Forster PIF7790 & Bird* (BRI); Dillon Road, The Gap *c.* 0.5 km from intersection with Payne Road, Jul 1999, *Harris WKH124 & Thompson* (BRI); Greenford Street, Chapel Hill, Sep 1999, *Stephens s.n.* (BRI [AQ664972]); Cubberla Creek, Fig Tree Pocket, Sep 1998, *Stephens 2* (BRI); Daisy Hill S.F., Logan City, Dec 1993, *Thompson MOR323* (BRI); Hinze Dam, Mar 2007, *Jinks s.n.* (BRI [AQ784176]); Hinze Dam, *c.* 3.5 km SW of Mudgeeraba, Apr 2007, *Jinks D13A* (BRI).

***Distribution and habitat*:** This species is endemic to southeast Queensland. Collections of this species made since it was described in 1993 have extended the known range from Tinana Creek near Tiaro to the Hinze Dam near Mudgeeraba (**Map 11**).



Map 11. Distribution of *Symplocos haroldii*

***Phenology*:** Flowers are recorded from September to November; fruit in January.

***Note*:** The phrase in the description in Jessup (1993) stated 'peduncles 0.2–2 mm long'; this should have read 'pedicels 0.2–2 mm long'.

***Conservation status*:** *Symplocos harroldii* is currently listed as Near Threatened under the *NCA*.

12. Symplocos hayesii C.T.White & Francis, *Proc. Roy. Soc. Queensland* 33: 158, t.2 (1921). **Type:** Queensland. Cook District: Glenallan [Glen Allyn], Malanda, *s.dat., H.C.Hayes* (holo: BRI [AQ23234]).

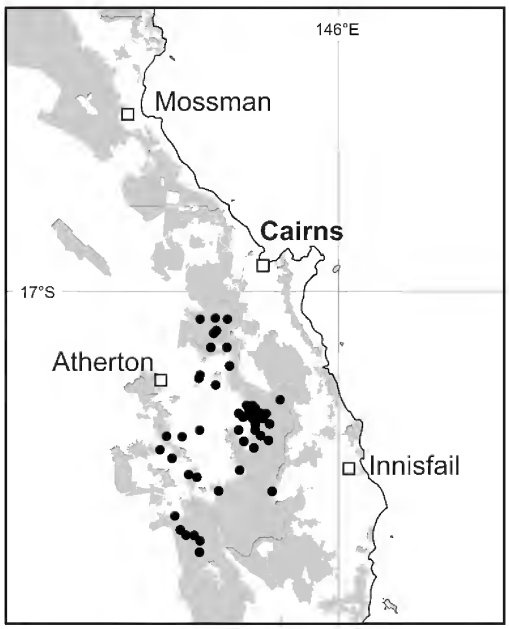
***Illustrations*:** Cooper & Cooper (2004: 538); Hyland *et al.* (2010).

Shrub or small tree to 2 m. Shoots and young branchlets with persistent cataphylls, pilose. Leaves chartaceous; lamina narrowly ovate or narrowly obovate or elliptic, 6–12 cm long, 2.5–5.5 cm wide, acuminate at tip, rounded or cordate at base, glabrous except midvein on underside; margins serrate; secondary veins mostly 7–10 pairs; petiole 3–7 mm long, pilose. Inflorescence spicate, to 1.5 cm, or a fascicle, pilose; bracts and bracteoles sparsely pilose and ciliate, persistent, bracts ovate to narrowly triangular, 3–9 mm long, bracteoles ovate, 2–3 mm long. Calyx limb 1–1.5 mm long, glabrous; lobes ovate, acute, glabrous or with a few hairs, margin often ciliate. Petals ovate or oblong, denticulate, 2.2–2.5 mm long, white, glabrous. Stamens mostly 12–15, as long as petals in males, shorter in females. Disc pilose. Style 1.5–2 mm long in females, glabrous, stigma peltate. Fruit narrowly ovoid to ellipsoidal, usually curved, 15–20 mm long, 3.5–5 mm wide; blue to black, mesocarp thin, fleshy; endocarp smooth; seed 1. **Fig. 2F–H.**

***Additional selected specimens examined*: Queensland.** Cook District: S.F. 185 Danbulla, 1 km N of Hoop Pine Triangle on C road, Jul 1994, *Forster PIF15609 et al.* (BRI); Danbulla, 12 miles [19.3 km] NE of Atherton, Jun 1949, *Smith 4181* (BRI); Yungaburra, near Lake Barrine, *Blake 9602* (BRI, CANB); near Lamond's Hill, 7.5 miles [12 km] SE of Malanda, Sep 1959, *Smith 10839* (BRI); S.F.R. 310, Gadgarra, Boonjee L.A., Jan 1993, *Hyland 14628* (CNS); T.R. 1230, Boonjee L.A., *Gray 1246* (BRI); S.F. 756, Mt Father Clancy, May 2000, *Forster PIF25720 & Booth* (BRI); Vacant Crown Land, Bartle Frere, E of Glen Allyn Trig., *Webb & Tracey 5795* (BRI). North Kennedy District: tributary of Chunum Creek, May 2005, *Wannan 3986 & Sinclair* (BRI); Tableland L.A.,

0.5 km S of Koolmoon Creek near junction of Ebony Road and Tully Falls Road, 6 km NW of Tully Falls, Oct 1998, *Jessup GJM2670 et al.* (BRI).

***Distribution and habitat*:** Endemic to the Wet Tropics of Queensland where it occurs from Tinaroo Range to Koolmoon Creek, southeast of Ravenshoe (**Map 12**). Grows in mesophyll and notophyll vineforests on substrates derived from basalts, granites and metamorphics.



Map 12. Distribution of *Symplocos hayesii*

***Phenology*:** Flowers are recorded from December to February; fruit from May to September.

***Conservation status*:** *Symplocos hayesii* occurs in several National Parks and other reserves on the Atherton Tableland is not considered to be threatened.

13. Symplocos hylandii Noot., *Brunonia* 4: 323 (1982). **Type:** Queensland. Cook District: State Forest Reserve 755 Boonjee, 21 March 1968, *B.Hyland RFK1395* (holo: CNS).

***Illustrations*:** Hyland *et al.* (2010).

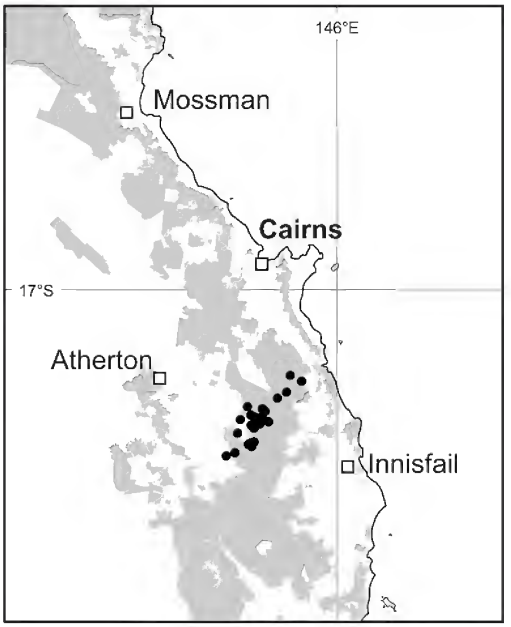
Shrub or small tree to 3 m. Shoots and young branchlets with persistent cataphylls, pilose. Leaves coriaceous; lamina narrowly obovate, 10–16 cm long, 1.7–3.5 cm wide, often bullate and brittle, acuminate at apex, acute at base, glabrous or with a few hairs on underside, particularly midvein; margins serrate; secondary veins mostly 5–12 pairs, raised below, sunken above; petiole 3–5 mm long, pilose. Inflorescence spicate, to 1.5 cm, pilose; bracts and bracteoles ovate, sparsely pilose and ciliate, persistent, bracts, *c.* 2 mm long, bracteoles, *c.* 1 mm long. Calyx limb 1.3–1.7 mm long, glabrous; lobes ovate or broadly oblong, puberulous or nearly glabrous, margins entire or minutely denticulate. Petals ovate or oblong, *c.* 3 mm long, white, glabrous. Stamens 10–15. Disc pulvinate, glabrous. Fruit ampulliform to ovoid, (7–) 10–12 mm long, 8–9 mm wide, blue, mesocarp thin, endocarp shallowly grooved; seed 1. **Fig. 3A,B.**

***Additional selected specimens examined*: Queensland.** Cook District: Mt Bellenden Ker, *c.* 7/8 mile [1.5 km] SE of centre peak, Jun 1969, *Smith 14717* (BRI); East Mulgrave River Falls, May 2002, *Jago 6212* (BRI); T.R. 1230, Stockwellia Track, 4.9 km from Lamins Hill turnoff (headwaters of Russell River), Aug 1989, *Bostock 912 & Guymer* (BRI); Swipers Flat, Wooroonooran N.P., Jul 1995, *Forster PIF17136 & Figg* (BRI); Wooroonooran N.P., track to Chuck Lunga Creek, E of Boonjee, Jun 1996, *Forster PIF19284 & Tucker* (BRI); Wooroonooran N.P., lower reaches of Russell River Track, Jan 2007, *Ford AF4913 & Metcalfe* (BRI); N.P.R. 904 Wooroonooran, Coolamon Creek, Oct 2001, *Ford AF3047 et al.* (BRI); Coolamon Creek, end of Towalla Road, Wooroonooran N.P., Oct 2001, *Cooper WWC1606* (BRI).

***Distribution and habitat*:** This species is endemic to the Wet Tropics of Queensland where it occurs from Mt Bellenden Ker to near Millaa Millaa (**Map 13**) mostly in mesophyll vineforests on substrates derived from granites and metamorphics.

***Phenology*:** Flowers are recorded in May; fruit from October to January.

***Conservation status*:** *Symplocos hylandii* is located mostly in Wooroonooran N.P. and is not considered to be threatened.



Map 13. Distribution of *Symplocos hylandii*

14. Symplocos oresbia Jessup **species nova** *S. wooroonooran* simulans sed innovationibus et axibus inflorescentiarum glabris, bracteis et bracteolis ante anthesin caducis, petalis 2–2.5 mm longis (non 4–5 mm) et 1–1.3 mm latis (non 1.4–2.5), staminibus paucioribus (16–19 non 30–35), stylis brevioribus (1.5–1.8 mm non 3–3.5 mm) et fructibus amplissimus (10–15 × 7–9 mm non 5.8–6.3 × 4–5.5 mm) differt. **Typus:** Queensland. Cook District: Summit area of Thornton Peak, 12 November 1973, *T.G.Hartley 14045* (holo: BRI; iso: CANB).

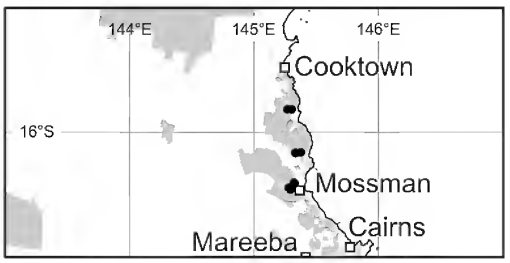
Symplocos sp. (Mt Finnigan L.J.Brass 20129); (Jessup 1994, 1997, 2002, 2007, 2010).

***Illustrations*:** Hyland *et al.* (2010), under *Symplocos* sp. (Mt Finnigan L.J.Brass 20129).

Shrub or small tree to 8 m. Shoots and young branchlets glabrous. Leaves coriaceous; lamina elliptic, 3–8 cm long, 1–3 cm wide, acuminate at apex, acute or attenuate at base, glabrous; margins entire, revolute; secondary veins mostly 7–9 pairs; petiole 3–7(–12) mm long, glabrous. Inflorescence axes 2 or 3, racemose, to 3 cm long, glabrous, branching near base, sometimes single; pedicels 0–0.2 mm long, bracts broadly ovate, 1–1.2 mm long, bracteoles ovate, 0.5–0.6 mm long, glabrous or ciliate, caducous before anthesis; pedicel 0.2–1.5 mm long. Calyx limb 1–1.5 mm long, lobes depressed ovate or rounded, 0.5–0.7 mm long, glabrous with ciliate margin. Petals obovate, 2–2.5 mm long, 1–1.3 mm wide, rounded, ?white, glabrous. Stamens 16–19; filaments glabrous. Disc glabrous. Style 1.5–1.8 mm long, glabrous; stigma indistinct. Fruit ampulliform, 7.8–8.5 mm long, 4.6–5.5 mm wide, colour unknown. **Fig. 3C,D.**

***Additional selected specimens examined*: Queensland.** Cook District: Mt Finnigan, Apr 1948, *Brass 20129* (BRI, CANB); Cedar Bay N.P., Mt Finnigan summit area, campsite on Horans Creek, Oct 1999, *Forster PIF25035 & Booth* (BRI); Summit of Devils Thumb, Mossman Gorge N.P., Apr 1986, *Godwin C3093* (BRI); Pinnacle Rock Track, Whyanbeel, Feb 1996, *Gray 6566* (BRI); Mossman Bluff, about 10 km W of Mossman, Dec 1988, *Fell DF1686* (BRI).

***Distribution and habitat*:** This species is endemic to the Wet Tropics of Queensland where it occurs from Mt Finnigan to Mossman Bluff (**Map 14**) in exposed montane rainforest (microphyll to nanophyll vineforests and vinethickets) on substrates derived from granite.



Map 14. Distribution of *Symplocos oresbia*

***Phenology*:** Flowers are recorded from February to April; fruit from December to January.

***Notes*:** Specimens of this species (e.g. *Brass 20129*) were included under *Symplocos cochinchinensis* subsp. *thwaitesii* var. *montana* in Nooteboom (1982).

***Conservation status*:** *Symplocos oresbia* (as *Symplocos* sp. (Mt Finnigan L.J.Brass 20129)) is currently listed as Near Threatened under the *NCA*.

Fig. 3. ***Symplocos hylandii***. A. node with leaf base and budding inflorescence × 4, *Jago 6212* (BRI). B. fruit × 2, *Ford AF4913 & Metcalfe* (BRI). ***S. oresbia***. C. flower bud × 8, *Godwin C3093* (BRI). D. leaf base and inflorescence with fruit × 2, *Hartley 14045* (BRI). ***S. wooroonooran***. E. node with leaf base and inflorescence with buds and flowers × 3, *Forster PIF21767 et al.* (BRI). F. Flower × 6, *Forster PIF21767 et al.* (BRI). G. fruit × 3, *Hyland 5775* (BRI). Del. W.Smith.

15. Symplocos paucistaminea F.Muell. & F.M.Bailey ex F.M.Bailey, *Syn. Queensland Fl., Supp.* 3: 46 (1890). **Type:** Queensland. Cook District: Harvey's Creek, in 1889 (Bellenden Ker Expedition), *F.M. Bailey s.n.* (holo: BRI [AQ23235]; iso: BM, K, L, MEL46497).

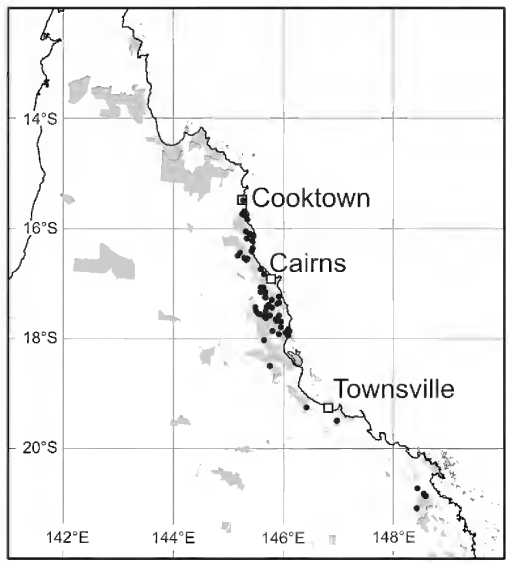
***Illustrations*:** Cooper & Cooper (2004: 538); Hyland *et al.* (2010).

Dioecious shrub or tree to 18 m. Shoots and young branchlets reddish-brown to dark brown pilose, cataphylls rarely evident. Leaves thinly coriaceous or chartaceous; lamina narrowly

obovate, oblanceolate or elliptic, 5–22 cm long, 2–8.5 cm wide, acuminate at apex, acutely or obtusely cuneate or rounded at base, glabrescent above, pilose below, slightly glossy; margins serrulate and denticulate; secondary veins mostly 7–12 pairs, depressed, flush or indistinct on upper surface; petiole 4–12 mm long, pilose. Inflorescences clustered or not, spicate, to 5 cm, pilose; bracts and bracteoles ovate, reddish-brown pilose or villous, persistent, bracts 1.5–2.5 mm long, bracteoles 1.2–1.5 mm long. Calyx limb 1.2–1.5 mm long; lobes narrowly ovate or oblong, 1–1.2 mm long, glabrous or sparsely pubescent towards apex. Petals obovate, 2.5–3.5 mm long, 1.3–1.5 mm wide, cream to white, mostly glabrous. Stamens 15–20 in males, 7–10 in females and apparently sterile, 1–2.5 mm long. Disc glabrous. Style 1.2–1.8 mm long, glabrous; females with peltate stigma. Fruit ampulliform (when dry), globular when fresh, 5–5.8 mm long, 3.5–4 mm wide, dark blue to purple.

***Additional selected specimens examined*: Queensland.** Cook District: Mt Cook, Aug 1985, *Scarth-Johnson 1641A* (BRI); Gap Creek, T.R. 146, Fritz L.A., Jul 1973, *Stocker 997* (BRI); Cooper Creek, Cape Tribulation Area, Aug 1996, *Telford 12207* (BRI); V.C.L. Noah, Jun 1975, *Hyland 8291* (BRI); Portion 188, Alexandra, Palm Road, Jun 1985, *Gray 4074* (BRI); Baileys Creek area, *c.* 0.2 miles [0.3 km] E of sawmill, *c* .7.5 miles [12 km] ENE of Daintree, Oct 1962, *Smith 11516* (BRI); Mt Spurgeon, Apr 1968, *Hyland RFK1508* (BRI); Nissen Creek, Mt Perseverance Road, Jul 1995, *Forster PIF17169 & Figg* (BRI); Churchill Creek, Churchill L.A., S.F. 143, Jul 1995, *Forster PIF17204 & Figg* (BRI); Churchill Creek, S.F. 143, Churchill L.A., Nov 1998, *Forster PIF24008 et al.* (BRI); F.R. 185, Kalorama L.A. near Danbulla, Jun 1961, *Hyland 2047* (BRI); T.R. 1230, Boonjie L.A., May 1977, *Gray 526* (BRI); Wooroonooran N.P., Palmerston section, South Johnston Forestry Track., May 2005, *Forster PIF30970 & Jensen* (BRI); S.F. 756 Mt Father Clancy, May, 2000, *Forster PIF25723 & Booth* (BRI); 5.6 km S of Mena Creek township, SSW of Innisfail, Jul 2007, *Bean 26546* (BRI). North Kennedy District: 27.5 km south along Culpa Road, S.F. 605 Koombooloomba, May 2002, *Forster PIF28789 & Booth* (BRI); Paluma Range, Dotswood Holding, Jun 1974, *Hyland 3001* (BRI). South Kennedy District: Mt Macartney, S.F. 652 Cawley, May 1992, *Forster PIF9911 & Tucker* (BRI); Dalrymple Heights and vicinity, Jun–Nov 1947, *Clemens s.n.* (BM, BRI [AQ84447]).

***Distribution and habitat*:** This species occurs from the northern end of the Wet Tropics at Cooktown south to the Clarke Range near Eungella (**Map 15**). It grows in upland and lowland mesophyll and notophyll vineforests on substrates derived from basalts and metamorphics.



Map 15. Distribution of *Symplocos paucistaminea*

***Phenology*:** Flowers are recorded from May to August; fruit from September to December.

***Conservation status*:** *Symplocos paucistaminea* is widely distributed in north and central eastern Queensland and is not considered to be threatened.

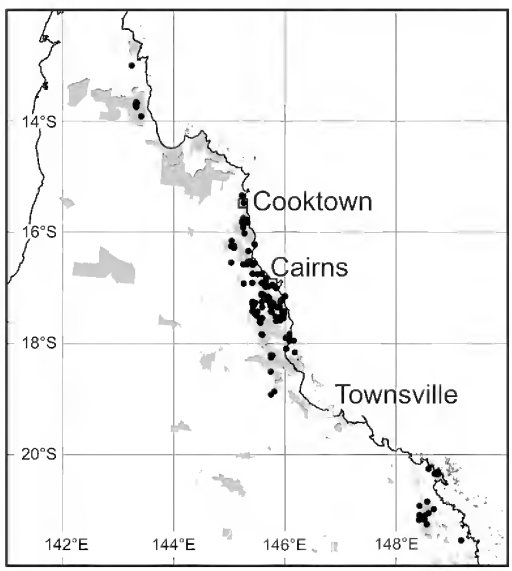
16. Symplocos puberula Jessup **nom. et stat. nov.**; *S. cochinchinensis* var. *pilosiuscula* Noot., *Brunonia* 4: 320 (1982). **Type:** Queensland. Cook District: Speewah, Upper Clohesy River, 5 June 1966, *W.Rijkers NQNC14754* (holo: L; iso: BRI, CNS).

***Illustrations*:** Nooteboom (1981: Fig. 11); Hyland *et al.* (2010), both under *Symplocos cochinchinensis* var. *pilosiuscula.*

Tree to 25 m. Shoots and young branchlets appressed puberulous, young branchlets glabrescent. Leaves coriaceous; lamina oblanceolate or obovate, sometimes elliptic, 6–15 cm long, 2.5–6 cm wide, acuminate at apex, acute at base, glabrous or with a few hairs on midvein on underside; margins shallowly recurved, denticulate, nearly entire; secondary veins mostly 6–12 pairs; petiole 5–17 mm long, sparsely appressed puberulous,

glabrescent. Inflorescence paniculate or racemose to 7 cm, puberulous; pedicels 0.6–2 mm long; bracts and bracteoles pubescent, caducous, bracts ovate, *c.* 1.5 mm long, bracteoles narrowly triangular, *c.* 0.8 mm long. Calyx limb 1–1.5 mm long, glabrous; lobes depressed ovate or rounded, glabrous with ciliate or denticulate margin. Petals oblong or narrowly obovate, 3.5–5 mm long, 1.7–3.5 mm wide, white, glabrous. Stamens mostly 50–70, 2–6 mm long. Disc annular, shallowly lobed, glabrous or with a few hairs. Style 3–4 mm long, glabrous or with a few hairs at base, dilated at stigma. Fruit ampulliform, 7–10 mm long, 4–6 mm wide, dark blue to black.

***Additional selected specimens examined*: Queensland.** Cook District: 33 km along Leo Creek road, McIlwraith Range, Jun 1995, *Forster PIF16822* (BRI); T.R. 14, Head of Peach Creek, McIlwraith Range, 26.5 km NE of Coen, Cape York Peninsula, Aug 1993, *Fell DGF3543 & Jensen* (BRI); Hopevale Aboriginal Reserve, 13.2 km ESE of Hopevale Community, Endeavour River right arm, Nov 1993, *Fell DGF3859 & Stanton* (BRI); Mt Poverty Mine Road, near Normanby Tin Mines, Jun 2003, *McDonald KRM1447* (BRI); Gap Creek, Cedar Bay N.P., Jun 1992, *Forster PIF10732 et al.* (BRI); Daintree N.P., Adeline Creek headwaters, top of hill 929, May 1999, *Forster PIF24538 & Booth* (BRI); S.F. 144, Mt Windsor Tableland, May 1979, *Moriarty 2614* (BRI); T.R. 66, 3 km along Mt Lewis Road, Jun 2000, *Forster PIF25821 & Booth* (BRI); S.F.R. 607, Shoteel L.A., Oct 1982, *Gray 2779* (BRI); S.F.R. 933, Little Pine L.A., Feb 1983, *Gray 2963* (BRI); Longlands Gap, S.F. 194, Sep 2001, *Forster PIF27514 et al.* (BRI). North Kennedy District: S.F.R. 605, Hilton L.A., Sep 1979, *Dockrill 1615* (BRI); Goold Island [Goold Island N.P.], Aug 1997, *Cumming 16252* (BRI); Conway S.F., 2 km E of Impulse Creek, along Timber Road, Sep 1994, *Perry 2* (BRI); S.F. 299 Conway, Brandy Creek Road, 8 km S of Airlie Beach, Feb 2004, *Forster PIF29974 et al.* (BRI). South Kennedy District: 1 km SW of Mt Macartney, Kangaroo Creek, Cathu S.F., Aug 1989, *Thompson 148* (BRI); St Helens Creek, Eungella N.P., Aug 1992, *Bean 4949* (BRI); Sarina Range, East Funnel Creek Road, Sarina Shire, May 2006, *Von Fahland 2* (BRI).



Map 16. Distribution of *Symplocos puberula*

***Distribution and habitat*:** This species occurs from the McIlwraith Range on Cape York Peninsula south to the Sarina Range south of Sarina (**Map 16**). Grows in mesophyll and notophyll vineforests on substrates derived from granites and metamorphics.

***Phenology*:** Flowers are recorded from May to November; fruit from December to February.

***Notes*:** This species was treated as *Symplocos cochinchinensis* var. *pilosiuscula* Noot. (as *S. cochinchinensis* subsp. *thwaitesii* var. *pilosiuscula* Noot.) in Nooteboom (1982).

***Conservation status*:** *Symplocos puberula* is widely distributed from Cape York Peninsula to central eastern Queensland and is not considered to be threatened.

17. Symplocos stawellii F.Muell., *Fragm.* 5: 60 (1865); *S. stawellii* var. *stawellii*, C.T.White, *Proc. Roy. Soc. Queensland* 50: 82 (1939); *S. cochinchinensis* var. *stawellii* (F.Muell.) Noot., *Leiden Bot. Ser.* 1: 161 (1975). **Type:** Queensland. Rockingham Bay, *s.dat.*, *J.Dallachy s.n.* (syn: MEL).

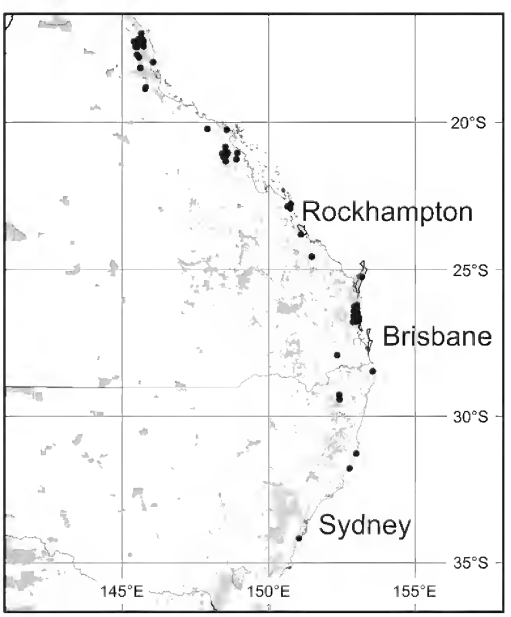
Symplocos spicata var. *australis* Benth., *Fl. Austral.* 4: 292 (1868). **Type:** Queensland. Rockingham Bay, *s.dat. J.Dallachy s.n.* (syn: MEL); New South Wales. Richmond River, *s.dat.*, *C. Moore s.n.* (syn: NSW).

***Illustrations*:** Nooteboom (1982, Fig. 11); Hyland *et al.* (2010), both under *Symplocos cochinchinensis* var. *stawellii*; Floyd (1989: 397); Leiper *et al.* (2008: 336) both as *S. stawellii*.

Shrub or tree to 30 m. Shoots sparsely appressed pubescent, glabrescent; young branchlets glabrescent. Leaves coriaceous; lamina elliptic to oblanceolate or obovate, 6–18 cm long, 2–6 cm wide, acuminate at apex, mostly acute or attenuate at base,

glabrous or with a few hairs on midvein on underside; margins serrulate and crenulate, sometimes slightly recurved; secondary veins mostly 7–10 pairs; petiole 6–25 mm long, glabrescent or glabrous. Inflorescence axes branched, spicate, to 6 cm long, pubescent; bracts and bracteoles broadly or depressed ovate, sparsely pubescent or glabrous, ciliate, persistent to fruiting, bracts 0.8–1.5 mm long, bracteoles 0.6–0.8 mm long. Calyx limb 0.3–0.5 mm long, glabrous; lobes very shallowly rounded or depressed ovate, 0.1–0.4 mm long, glabrous or nearly so and with a ciliate margin. Petals obovate, 3.2–3.5 mm long, 1.7–2.5 mm wide, white, glabrous. Stamens mostly 30–50, 1.5–3 mm long. Disc 5-lobed, glabrous. Style 2.5–3.5 mm long, glabrous. Fruit mostly ovoid, 5–5.5 mm long, 3.5–4.5 mm wide, blue to black.

***Additional selected specimens examined*: Queensland.** Cook District: Lake Barrine, Atherton Tableland, Sep 1929, *Kajewski 1237* (BRI, L, P); Malanda – Atherton Road, May 1976, *Stocker 1438* (BRI, CNS, L). North Kennedy District: S.F.R. 251, Parish of Ravenshoe, Jun 1988, *Gray 4844* (BRI, CNS). South Kennedy District: Dalrymple Road, Eungella N.P., Apr 2000, *Forster PIF25512 & Booth* (BRI); S.F.R. 679, Range L.A., 1 km S of Crediton, Clarke Range, Jun 2001, *Ford AF2887* (BRI). Port Curtis District: Byfield N.P., 9 km ENE of Byfield township, Sep 2000, *Forster PIF26237 et al.* (BRI). Wide Bay District: Verrierdale Road, 8 km W of Peregian Beach, May 1990, *Bean 1589* (BRI). Moreton District: Running Creek, *c.* 2 miles [3.2 km] NW of Yandina, May 1969, *Smith 14616* (BRI). **New South Wales.** Coombadjha Creek Road, Apr 1980, *Floyd 1477* (BRI); Johns River near Newcastle, May 1956, *Webb & Tracey 3691* (BRI).



Map 17. Distribution of *Symplocos stawellii*

***Distribution and habitat*:** This species is widespread in eastern Queensland and New South Wales from the Hann Tableland, northwest of Mareeba to near Windsor, New South Wales (**Map 17**). It generally grows in notophyll vineforests, although it sometimes occurs as an understorey tree in moist eucalypt forest. Substrates are diverse.

***Phenology*:** Flowers are recorded from April to August; fruit from November to January.

***Conservation status*:** *Symplocos stawellii* is widely distributed from north Queensland to central eastern New South Wales and is not considered to be threatened.

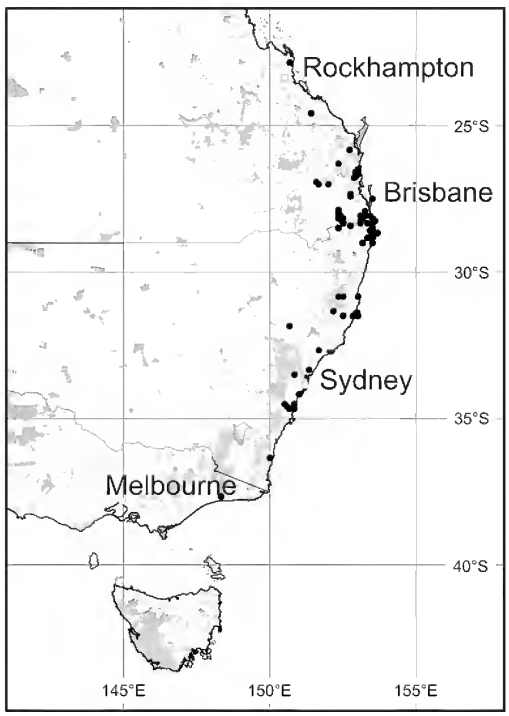
18. Symplocos thwaitesii F.Muell., *Fragm.* 3: 22 (1862); *S. cochinchinensis* subsp. *thwaitesii* (F.Muell.) Noot., *Leiden Bot. Ser.* 1: 159 (1975); *S. cochinchinensis* var. *thwaitesii* (F.Muell.) Noot., *Leiden Bot. Ser.* 1: 160 (1975). **Type:** New South Wales. Hastings River, *s.dat.*, *Beckler s.n.* (holo: MEL46540, 46541; iso: BRI, P).

***Illustrations*:** Nooteboom (1982, Fig. 11) under *S. cochinchinensis* var. *thwaitesii*; Floyd (1989: 397) as *S. thwaitesii*.

Shrub or tree to 20 m. Shoots and young branchlets glabrous. Leaves coriaceous; lamina oblanceolate, narrowly obovate or elliptic, mostly 6–16 cm long, 1.5–5 cm wide, acuminate, acute or obtuse at apex, acute or attenuate at base, glabrous; margins serrate; secondary veins mostly 8–11 pairs; petiole 5–15 mm long, glabrous. Inflorescence paniculate or racemose to 7 cm, glabrous; pedicels 0–8 mm long; bracts and bracteoles obovate to triangular, glabrous or scarcely ciliate, caducous, bracts 1.5–4 mm long, bracteoles 1–2 mm long. Calyx limb 1.7–2 mm long, glabrous; lobes depressed obovate, 1.4–1.6 mm long glabrous. Petals broadly

obovate, mostly 4.5–7 mm long, 3.5–5 mm wide, white, glabrous. Stamens 80–100, 2–5 mm long. Disc glabrous. Style 4–5 mm long, glabrous. Fruit ovoid to ampulliform, 6–11 mm long, 4–8 mm wide, blue, purple or black.

***Additional selected specimens examined*: Queensland.** Port Curtis District: Isopod, Mt Parnassus, Oct 1976, *Hyland 4314RFK* (BRI); Bulburin S.F. 67, Apr 1980, *McDonald 3220 et al.* (BRI). Wide Bay District: The Missings, S.F. 915 Tuan, Dec 1994, *Forster PIF16046 et al.* (BRI); S.F. 639 Wrattens, Beauty Spot 50, end of Black Snake Road, Jan 2003, *Haskard & Smyrell s.n.* (BRI [AQ772885]); *c.* 2 miles [3.2 km] NE Maleny, May 1959, *Thorne 21263 et al.* (BRI); Mary Cairncross Park, Sep 2004, *Russell s.n.* (BRI [AQ613832]). Burnett District: Bunya Mountains, Oct 1919, *White s.n.* (BRI [AQ84418]). Moreton District: Brolga N.P., W of Woombye, Feb 1990, *Bean 1349* (BRI); Walking track between Lawnton Road & Joyners Ridge Road, *c.* 1 km from Lawton Road, Mt Glorious, Sep 2002, *Phillips 783* (BRI); Mt Glorious *c.* 50 km W of Brisbane, Sep 1978, *Jessup 147 & Reynolds* (BRI); Mt Mistake, May 1948, *Smith 3689 & Webb* (BRI); Cainbable Range, Oct 1952, *Lahey s.n.* (BRI [AQ478660]); Burleigh Heads N.P., Tallebudgera, Jul 1978, *McDonald 2165 et al.* (BRI). Darling Downs District: Mt Cordeaux, just below the summit, Dec 1981, *Guymer 1661 & Jessup* (BRI); The Head, Main Range N.P., Jan 2002, *Forster PIF28066 & Leiper* (BRI); Border of Lamington N.P., Sarabah Range, Oct 1969, *Schodde 5576* (BRI). **New South Wales.** Unumgar near base of Mt Lindsay, Nov 1944, *Jones s.n.* (BRI [AQ84429]); Booyong Reserve NE of Lismore, Nov 1982, *Floyd s.n.* (BRI [AQ393589]); *c.* 1 mile [1.6 km] S of Port Macquarie, Oct 1966, *Schodde 5152* (BRI, CANB, L); Robertson Nature Reserve, Jun 1994, *Kodela 315 et al.* (BRI). **Victoria.** Spur between two gullies entering Snowy River on W bank of Wood Point [13 km NW of Orbost], Mar 1976, *Cameron 6132a* (MEL).



Map 18. Distribution of *Symplocos thwaitesii*

***Distribution and habitat*:** Endemic to eastern Australia from central Queensland (Mt Parnassus near Rockhampton) south to the Snowy River in Victoria (**Map 18**). Grows mostly in notophyll vine forest on substrates derived primarily from basalts and granites.

***Phenology*:** Flowers are recorded from September to November; fruit in February.

***Conservation status*:** *Symplocos thwaitesii* is widely distributed and is not considered to be threatened.

19. Symplocos wooroonooran Jessup **nom. et stat. nov.**; *S. stawellii* var. *montana* C.T.White, *Proc. Roy. Soc. Queensland* 50:82 (1939); *S. cochinchinensis* var. *montana* (C.T.White) Noot., *Leiden Bot. Ser.* 1: 160 (1975). **Type:** Queensland. Cook District: Mt Bartle Frere, 7 October 1938, *H.Flecker 857* (holo: BRI).

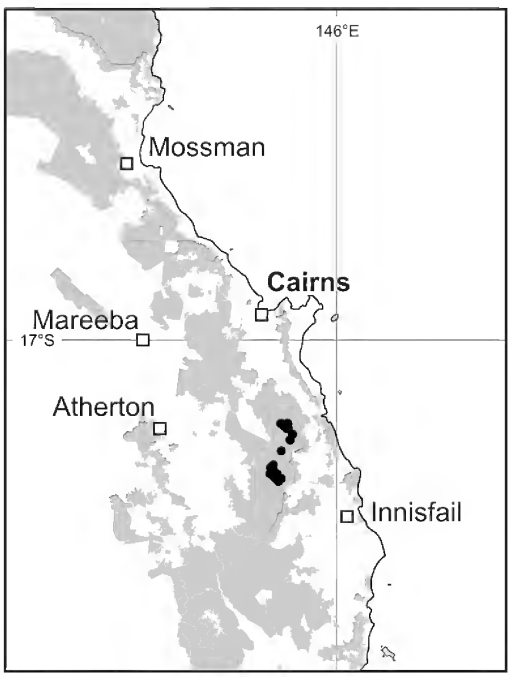
***Illustrations*:** Cooper & Cooper (2004: 539); Hyland *et al.* (2010), both under *Symplocos stawellii* var. *montana.*

Tree to 8 m. Shoots appressed pubescent, glabrescent; young branchlets glabrescent. Leaves chartaceous to thinly coriaceous; lamina oblanceolate to elliptic, 2–6.5 cm long, 0.9–2.4 cm wide, acuminate at apex, mostly attenuate at base, glabrous or nearly so; margins recurved, remotely denticulate or sometimes entire; secondary veins mostly 7–10 pairs; petiole 2.5–4.5 mm long, glabrescent or glabrous. Inflorescence axes 2 or 3, racemose, to 1.5 cm long, lightly appressed puberulous, branching at base, sometimes single; pedicels 0–1 mm long; bracts and bracteoles ovate, sparsely puberulous, ciliate, mostly persistent until after anthesis, bracts 1–2 mm long, bracteoles 0.6–1 mm long. Calyx limb 0.75–1 mm, glabrous; lobes depressed ovate, triangular or shortly oblong, rounded,

0.5–0.8 mm long, glabrous. Petals oblong or obovate, 4–5 mm long, white, glabrous. Stamens mostly 30–35. Disc pubescent. Style 3–3.5 mm long, pubescent near base. Fruit ampulliform, 5.8–6.3 mm long, 4–5.5 mm wide, black. **Fig. 3E–G.**

Additional selected specimens examined: Queensland. Cook District: S.F.R. 310, Upper Goldsborough L.A., Sep 1976, Dockrill 1278 (BRI); Bellenden Ker, s.dat., Johnson s.n. (BRI [AQ519814]; MEL46558, 46559, 46560, 46561, 46562); Summit of Mt Bellenden Ker, Aug 1971, Hyland 5304 & 5316 (BRI); N.P.R. 226, Bellenden Ker, Jan 1972, Hyland 5775 (BRI); Bellenden Ker Range, Oct 1974, Hyland 7769 (BRI); Centre Peak, near TV tower, summit of Bellenden Ker, Nov 1972, Webb & Tracey 10802 (BRI); Mt Bellenden Ker, Jun 1969, Smith 14630 (BRI); loc. cit., May 2001, Cooper 1525 & Cooper (BRI); Wooroonooran N.P., Mt Bellenden Ker summit area, Dec 2000, Forster PIF26516 et al. (BRI); Mt Bartle Frere, Oct 1935, Blake 9843 (BRI); loc. cit., Nov 1966, Gilmour 4076 (BRI); S.F.R. 755, Gosschalk L.A., Gray 702 (BRI); Summit area of Mt Bartle Frere, Sep 1977, Powell 833 et al. (BRI); Wooroonooran N.P., Bartle Frere, first heath to SE of South Peak, Oct 1997, Forster PIF21767 et al. (BRI).

***Distribution and habitat*:** This species is endemic to the Wet Tropics of Queensland where it occurs only on the upper slopes and summits of Mt Bartle Frere and Mt Bellenden Ker in Wooroonooran N.P. (**Map 19**). It grows in montane rainforest (simple microphyll vine-fern thicket and shrubland) on granite derived substrates.



Map 19. Distribution of *Symplocos wooroonooran*

***Phenology*:** Flowers are recorded in October and November; fruit from January to May.

***Notes*:** This species was treated as *Symplocos cochinchinensis* var. *montana* (C.T.White) Noot. (as *S. cochinchinensis* subsp. *thwaitesii* var. *montana*) in Nooteboom (1982).

***Conservation status*:** *Symplocos wooroonooran* (as *Symplocos stawellii* var. *montana*) is currently listed as Near Threatened under the *NCA*.

***Etymology*:** The species epithet commemorates the botanically diverse Wooroonooran N.P. and is also the aboriginal name for Mt Bellenden Ker (Bailey 1900a).

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A taxonomic revision of *Pseudoweinmannia* Engl. (Cunoniaceae: *Geissoieae*)

Andrew C. Rozefelds[1] & Belinda Pellow[2]

Summary

Rozefelds, A.C. & Pellow, B. (2011). A taxonomic revision of *Pseudoweinmannia* Engl. (Cunoniaceae: *Geissoieae*). ***Austrobaileya* 8(3): 252–266**. The vegetative and reproductive morphology of *Pseudoweinmannia* is described and illustrated. The genus is endemic to eastern Australia with two species, *Pseudoweinmannia apetala* (F.M.Bailey) Engl. and *P. lachnocarpa* (F.Muell.) Engl., that can be differentiated by their leaf serration, stipule morphology and flower and fruit characters. New interpretations of floral and fruit morphology in *Pseudoweinmania* are discussed, and their significance in better understanding the phylogenetic relationships within the tribe *Geissoieae* are examined.

Key Words: Cunoniaceae, *Geissoieae*, *Pseudoweinmannia*, *Pseudoweinmannia apetala*, *Pseudoweinmannia lachnocarpa*, Australia flora, Queensland flora, New South Wales flora, comparative morphology

[1]Andrew C. Rozefelds, Queensland Museum, GPO Box 3300, South Brisbane, Queensland 4101, Australia. Email: andrew.rozefelds@qm.qld.gov.au

[2]Belinda Pellow, Janet Cosh Herbarium, Department of Biological Sciences, University of Wollongong, Northfields Avenue, Wollongong, New South Wales 2522, Australia.

Introduction

The family Cunoniaceae includes 15 genera in Australia, which are all primarily rainforest trees and/or shrubs, and are currently being revised for the *Flora of Australia*. Recent revisions have been completed on the genera: *Anodopetalum* A.Cunn ex Endl. (Barnes & Rozefelds 2000), *Ceratopetalum* Sm. (Rozefelds & Barnes 2002), *Davidsonia* F.Muell. (Harden & Williams 2000), the Australian species of *Geissois* Labill. (Schimanski & Rozefelds 2002), *Vesselowskya* Pamp. (Rozefelds *et al.* 2001) and a new species of *Gillbeea* F.Muell. was described from north eastern Australia (Rozefelds & Pellow 2001). In this paper a revision of the Australian endemic genus *Pseudoweinmannia* Engl. is presented.

Pseudoweinmannia was proposed by Engler (1930) for two species, *Weinmannia lachnocarpa* F.Muell. and *W. apetala* F.M.Bailey from eastern Australia, which he referred to the tribe *Cunonieae* (R.Br.) Schrank & Mart. in Cunoniaceae. *Pseudoweinmannia* differs from *Weinmannia,* the major genus in this tribe, in lacking petals, having a polyandrous androecium and tardily-dehiscent fruits. Based upon an analysis of stipule morphology Dickison & Rutishauser (1990) concluded, that *Pseudoweinmannia* was more closely related to *Geissois* and *Lamanonia* Vell. in the Tribe *Belangerae* Lindl ex Pfeiff. (= Tribe *Geissoieae* Endl. ex Meisn.), than to the Tribe *Cunonieae*.

In a cladistic analysis using morphological characters, Hufford & Dickison (1992) showed that *Pseudoweinmannia* was sister to *Geissois* (including *Lamanonia*), as it shared with this genus, lateral stipules (Dickison & Rutishauser 1990), racemose inflorescences and a polyandrous androecium. Dickison (1984) and Hufford & Dickison (1992) also identified structures on the seeds as elaiosomes, which they interpreted as a putative autapomorphy for the genus.

Combined morphological and molecular data based upon analysis of *rbc*L, and intron and spacer regions in the combined *trnL*-G region, and chloroplast DNA data provide support for interpreting *Pseudoweinmannia* and *Geissois sens. lat.* as sister taxa (Bradford & Barnes 2001). These authors recircumscribed the

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Tribe *Geissoieae* (= Tribe *Belangerae sensu* Dickison & Rutishauser 1990) to include the Australian and New Caledonian species of *Geissois*, *Lamanonia* from South America, and *Pseudoweinmannia*.

Pseudoweinmannia is endemic to eastern Australia where it is restricted to rainforests. *Pseudoweinmannia lachnocarpa* (F.Muell.) Engl. (**Fig. 1**) occurs in north eastern New South Wales and south eastern Queensland (**Map 1**), and was described by Mueller (1874) from material collected from the Tweed District in north eastern New South Wales. A second species, *Pseudoweinmannia apetala* (F.M.Bailey) Engl. (**Fig. 2**), was described by Bailey (1893), from Kamerunga, near Cairns in north eastern Queensland (**Map 1**). Bailey (1893), in describing *Pseudoweinmannia apetala*, noted that it "approaches near to *lachnocarpa* but differs in its more lax slender inflorescence, more membranous leaves, which are not so prominently reticulate, its longer stamens, as well as probably the flower lobes to the calyx". Since their description there has not been a critical re-examination of the morphology of both species and as a result the status of *Pseudoweinmannia apetala* has become unclear. Recent reviews in flora and state censuses have either considered it a synonym of *Pseudoweinmannia lachnocarpa* (e.g. Henderson 1997; Hyland & Whiffin 1993; Jessup 2010), or a distinct species (e.g. Stanley & Ross 1983; Harden 1990; Bradford *et al*. 2004).

In this paper the vegetative and reproductive morphology of the two species is described using herbarium collections (both dried and in spirit) and consistent morphological differences are recognized between *Pseudoweinmannia lachnocarpa* and *P. apetala*. The vegetative and reproductive morphology of some key characters in *Pseudoweinmannia*, i.e. stipule morphology, inflorescence architecture and floral and fruit morphology, are also described and illustrated to permit comparisons with other genera in the Tribe.

Methods and materials

Herbarium collections examined include those from BRI, CANB, CNS (formerly in QRS), K, NSW and MEL. The principal collections used are cited herein and specimens examined with the scanning electron microscopy (SEM) are indicated by *. Common abbreviations used in specimen citation are N.P. (National Park), L.A. (Logging Area), S.F./S.F.R. (State Forest/State Forest Reserve).

Terminology follows Walsh & Entwisle (1999) for leaf morphology and Hickey (1979) for leaf architecture.

For SEM the material prepared included floral organs, pollen, seeds, and stipules. The specimens were either air-dried or critical point dried, and placed onto aluminium stubs with tape. They were then sputter coated with gold and examined with a Philips Electroscan Environmental Scanning Electron Microscope 2020, under high vacuum operated at 10–15 kV.

Results

Stipule morphology

The stipules in *Pseudoweinmannia* are keel-shaped, lanceolate structures. Developmental studies in *Pseudoweinmannia* and the Australian *Geissois* species by Dickison & Rutishauser (1990) showed that four stipular primordia arise laterally at each node. In *Pseudoweinmannia* the two stipular primordial, on either side of the node, coalesce to form a bifid laterally-positioned compound structure (**Fig. 3B**). The margins of the stipules have glandular trichomes and simple hairs in *Pseudoweinmannia apetala* while in *P. lachnocarpa* only glandular trichomes are present (**Fig. 3A–C**).

Inflorescence architecture

Schimanski & Rozefelds (2002) have described the inflorescence morphology in the Australian species of the related genus *Geissois*. Their terminology is applied here to describe the inflorescence morphology of *Pseudoweinmannia*.

The flowers of *Pseudoweinmannia* are arranged in indeterminate racemose units.

Fig. 1. Representative specimen of ***Pseudoweinmannia apetala*** (*Ford AF3202 & Jensen* [BRI])

Fig. 2. Representative specimen of ***Pseudoweinmannia lachnocarpa*** (*Forster 9353 & Machin* [BRI])

Following Bradford (1998), we use the term raceme to describe these elements, although occasionally the racemes are weakly branched (e.g. *Webb & Tracey 11246*). Bracts subtend each flower, but are quickly deciduous. The pedicels are shortly hirsute and have an abscission point about 1–2 mm above the point of attachment.

Variation in *Pseudoweinmannia*, as in the Australian species of *Geissois*, occurs at the following hierarchical levels: (1) in the varying development of the racemes and supporting axes and buds that form the inflorescence (Inflorescence Module *sensu* Bradford 1998); and (2) in the position that the inflorescences occupy in relation to the main stem axis. In both *Pseudoweinmannia apetala* and *P. lachnocarpa* the common condition, particularly in younger shoots, is for the raceme to occupy an axial position in the leaf axils and a terminal bud is present.

The pattern is more complicated in older branch units, where inflorescence units may develop in a number of leaf axils, and a compound inflorescence is formed; subtending leaves, may or may not, be present. The inflorescence could be described as a compound homothetic inflorescence (*sensu* Weberling 1989), and the arrangement of raceme-like units on the flowering stem is consistent with the decussate architecture of the shoot. In some specimens the terminal bud may also be replaced by a raceme (*Pseudoweinmannia lachnocarpa* (*Blake 22848*); *P. apetala* (*Whiffin 5978*, *Gray 5978*)). Heterothetic compound inflorescences (*sensu* Weberling 1989) therefore result if the terminal bud is replaced by a raceme-like unit and inflorescences are initiated in a number of leaf axils. In both *Pseudoweinmannia apetala* and *P. lachnocarpa*, heterothetic and homothetic compound inflorescences may occur on the same specimen, and no consistent inflorescence architectural differences have been identified between the two species. The racemes are somewhat variable in length, although those of *Pseudoweinmannia apetala* are usually longer than that in *P. lachnocarpa*.

Floral and fruit morphology

The flowers in both *Pseudoweinmannia* species are (5–)6(–7)-merous and polystemonous (Bradford & Barnes 2001; Bradford *et al.* 2004; Schimanski & Rozefelds 2002) (**Fig. 4B,E**). The sepals are valvate, ovate in shape and have a strigose indumentum over their inner and outer surfaces (**Fig. 4A,D**). Petals are lacking in both species (**Fig. 4B,E**). Anthers are introrse, dorsifixed at just below the midpoint of the anther and are weakly versatile and lack a sterile distal protrusion (**Fig. 4A,D,E**). A prominent, lobed annular nectary occurs at the base of the ovary (**Fig. 4B,F**). The ovary is bicarpellate, rarely tricarpellate, syncarpous, and is covered by a dense indumentum of strigose hairs (**Fig. 4A,B,C,F**). The styles are furrowed ventrally, are slightly coiled in bud and in young flowers (**Fig. 4A**) and straighten with flower development (**Fig. 4B**). The styles are exserted before the anthers and while studies on stigmatic receptivity have not been undertaken, the flowers are possibly proterogynous (**Fig. 4D**). The stigma is papillate at maturity (**Fig. 4C**). The fruit is a tardily dehiscent capsule. The ovary in *Pseudoweinmannia* is divided into two parts, rarely three, indicating origin from two carpels; the two carpels are adnate and free (**Fig. 5A,B**). The seeds are irregularly rounded pyramidal in shape (**Fig. 6A,C**), with weakly reticulate cell walls (**Fig. 6B,D**) and lack a wing-like extension.

Comparative morphology in the Tribe *Geissoieae*

The Tribe *Geissoieae* consists of *Pseudoweinmannia*, *Lamanonia* and *Geissois sens. lat.*, and includes species that occur in Australia, South America and New Caledonia (Bradford & Barnes 2001). The adult leaves in *Pseudoweinmannia* are trifoliolate and have two caducous stipels at the base of the lateral leaflets. Australian *Geissois* species also have stipels, or rarely reduced leaflets, that occupy the same position as those in *Pseudoweinmannia* (Schimanski & Rozefelds 2002). The New Caledonian *Geissois* taxa and *Lamanonia* are typically digitate or trifoliolate, the most basal leaflets being the smallest. Bradford & Barnes (2001)

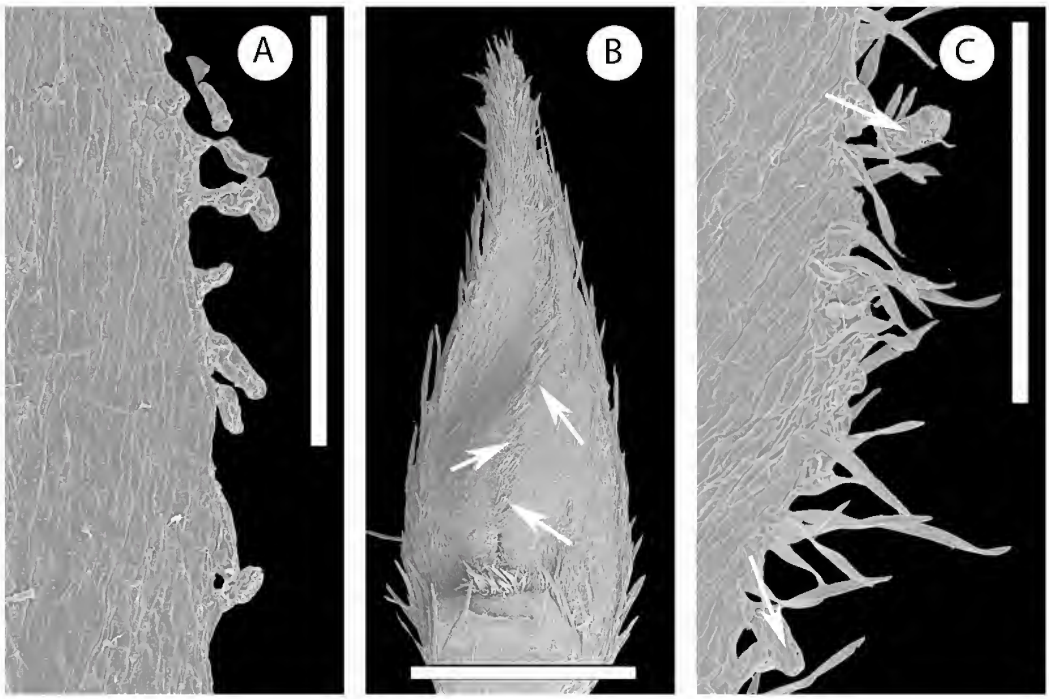


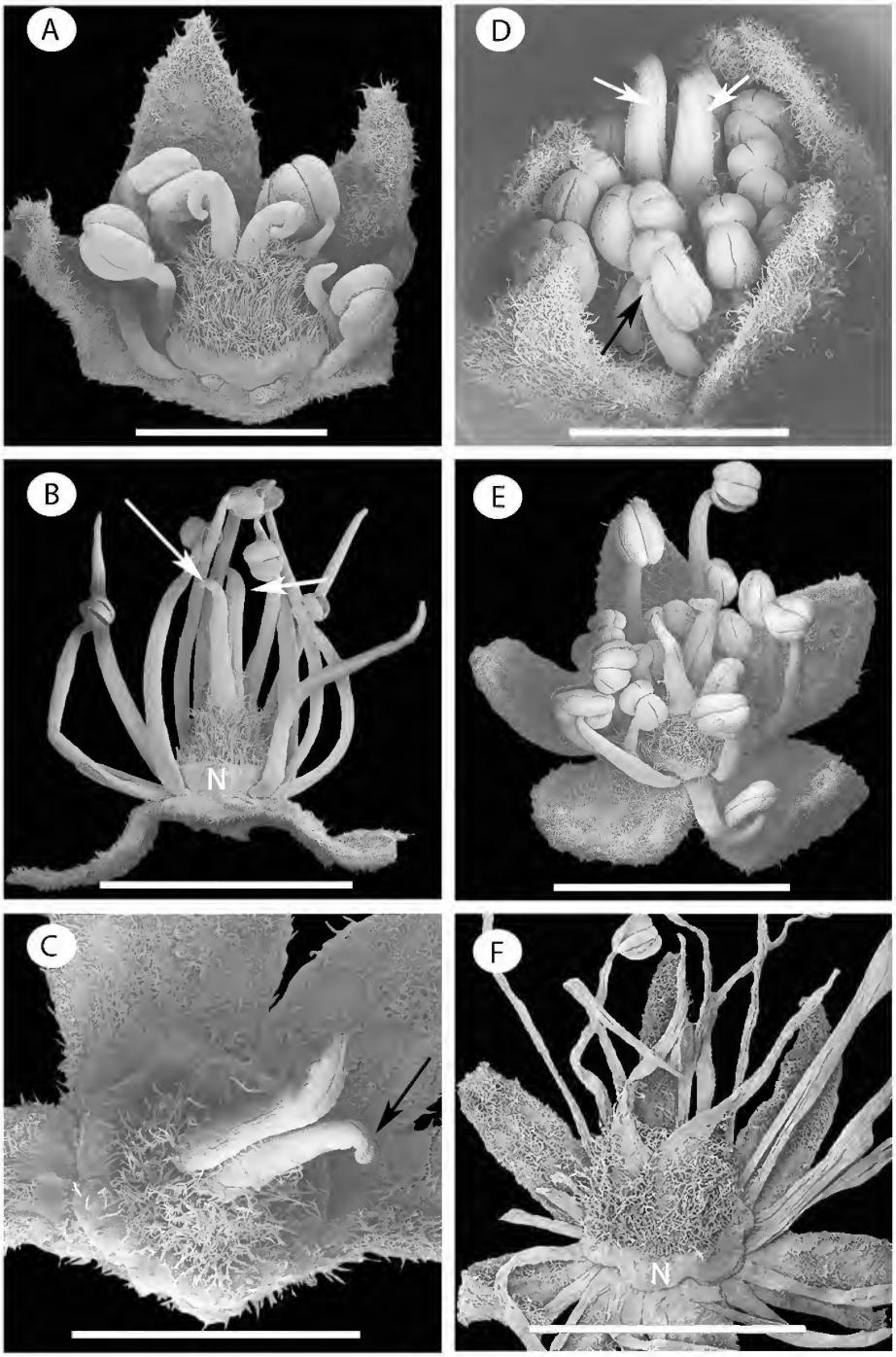
Fig. 3. Variation in stipule morphology in ***Pseudoweinmannia apetala*** and ***P. lachnocarpa***. A. ***P. lachnocarpa***, detail of stipule margin showing glandular trichomes. B. ***P. apetala***, the pair of stipules and the margins between the two stipules are arrowed. C. ***P. apetala*** stipule, detail of stipule margin showing unicellular and glandular trichomes (arrowed). Scale bars A,C = 300 µm; B = 1 mm. A from *Floyd s.n.* (CANB 289092); B–C from *Gray 1272* (CNS).

interpreted the common leaf condition in the tribe as being digitate (palmately compound), which is logical if the stipels in *Geissois* and *Pseudoweinmannia* are interpreted as homologues to lateral leaflets.

Dickison (1975) described the stomata in *Pseudoweinmannia* as anomocytic, although recent studies by Barnes in Bradford & Barnes (2001) interpreted the stomata as brachyparacytic, which is the common condition in the family and is present for all genera of the Tribe *Geissoieae*. The secondary leaf venation is semi-craspedodromous, which is the common condition in most of the Cunoniaceae and is typical of *Geissoieae* (Hufford & Dickison 1992; Barnes pers. comm. 2011).

The androecium is defined as polyandrous in the *Geissoieae* (Bradford & Barnes 2001). In the New Caledonian species of *Geissois*, developmental studies show that the stamens are grouped together in fascicles, occupy an episepalous position and development proceeds from a centre of the fascicle outwards in both directions (Matthews & Endress 2002). In developing flowers the inner stamens are typically larger than the outer ones in the fascicle. This arrangement of stamens is evident in older stages of flower development in the Australian species of *Pseudoweinmannia* (Rozefelds *pers. obs.*) and *Geissois* (Schimanski & Rozefelds 2002, figs 25, 27). The arrangement of stamens in *Pseudoweinmannia* and the Australian species of *Geissois* is considered to be weakly polyandrous.

The common fruit type in the Cunoniaceae is a bilocular, ventrally dehiscent capsule (Dickison 1984). *Geissois s.l.* and *Lamanonia* have ventrally dehiscent capsules, while those of *Pseudoweinmannia* were interpreted by Dickison (1984) as an 'indehiscent capsule' and Bradford *et al.* (2004) similarly referred to the fruits in *Pseudoweinmannia* as indehiscent


A
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fruits. Other researchers have indicated that the fruits are septicidally dehiscent (Harden 1990) and open into two valves (Floyd 1989). The semantic discontinuities imposed by terms, such as 'indehiscent' versus 'dehiscent', obscure the morphological similarities that link these genera together.

The fruits in *Pseudoweinmannia* are typically derived from two carpels, although they are obscured by the mass of fine hairs on the outside of the fruit (Dickison 1984, fig. 13). Sections through the fruit indicate that the walls of the carpels are adnate, but are not fused together (**Fig. 5A,B**). The placental proliferations that Dickison (1984, pl. 2, Fig. 21) illustrated were not evident in the specimens we sectioned. The thickened (sclerenchyma) walls of the capsules can be convoluted in appearance as the oblique section revealed (**Fig. 5B**), but near the mid-region of the fruit these walls are straight (**Fig. 5B**). It seems likely that Dickison's interpretations were based upon either a section through an immature fruit and/or an oblique section through the fruit that cut through the developing, convoluted walls of the capsule.

In *Pseudoweinmannia* the fruits are similar to those of the other genera as the walls of the two carpels are not fused together but stay conjoined for some time after fruit fall. The mid-section through the *Pseudoweinmannia* fruits indicates that sclerenchyma occupies a largely identical position to that seen in *Geissois stipularis* A.C.Sm (Dickison 1984, pl 2, fig. 22). All genera in the Tribe *Geissoieae* therefore have bi-locular fruits that are derived from capsules and are dehiscent or tardily dehiscent.

Pseudoweinmannia differs from the other genera in the Tribe by stipule morphology (Schimanski & Rozefelds 2002) and in seed and fruit morphology. The stipules in *Pseudoweinmannia* are keel-shaped, lanceolate structures (**Fig. 3B**), while those in *Geissois* from Australia (Schimanski & Rozefelds 2002) and *Lamanonia* from South America are large and often foliose (Leite 1983; Zickel & Leitao Filho 1993; Engler 1930).

Pseudoweinmannia has rounded, pyramidal seeds while the other genera in the tribe have winged seeds. Dickison (1984) described the seeds of *Geissois s. lat.* as having distal wings. *Lamanonia* also has a distal wing (Engler's (1930) illustration of *L. tomentosa* Camb. (= ?*L. ternata Vell.*); Zickel & Leitao Filho 1993; Leite 1983), and Dickison (1984) interpreted the seed in *Lamanonia ternata* as having a distal wing and lateral extensions. Dickison (1984) drew particular attention to an aril-like outgrowth on the seeds in *Pseudoweinmannia*, which he interpreted as an elaiosome. We observed a few, thin-walled parenchyma cells around the point of attachment of the seed, but we interpret these cells as being derived from the placental parenchyma (**Fig. 5B,C**). We are unaware of any ecological or field studies that support interpretation of these structures as an elaiosome.

The seeds of *Pseudoweinmannia* were described as having either a smooth (Dickison 1984) or papillate (Hufford & Dickison 1992) surface, although the material we examined of both species had a smooth, weakly reticulate appearance due to the cell walls (**Fig. 6A–D**). Dickison (1984) considered the epidermal cells of the Australian species of *Geissois* to be more ornamented and they could be identified apart by differences in the epidermal cell structures. The epidermal cells of the seed coats of *Lamanonia* and *Geissois stipularis* A.C.Sm. (New Caledonia) were described as having irregular outlines and moderately thick to thin lateral walls (Dickison 1984).

Fig. 4. (facing page) Floral morphology of ***Pseudoweinmannia apetala*** and ***P. lachnocarpa***. A–C. ***P. apetala***. A. Partially opened bud with some stamens removed to show dense covering of hairs on ovary, and curved styles. B. Mature flower with fully exserted stamens, and the two style branches are arrowed, note conspicuous disc (nectary = N) at base of ovary. C. Top view of flower and the papillate surface of the stigma is arrowed (white arrow). D–F. ***P. lachnocarpa***. D. partially opened bud, note that the style branches are exserted (white arrows) and the anthers are dorsifixed at just below anther midpoint (black arrow). E. Newly open flower, note the variation in length of the stamen filaments. F. Mature flower with stamen filaments extended and basal disc (N). Scale bars A,C,D = 1 mm; B,E,F = 2 mm. A from *Gray 5978* (CNS); D–E from *Rozefelds s.n.* (HO); F from *Forster PIF9353 & Machin*

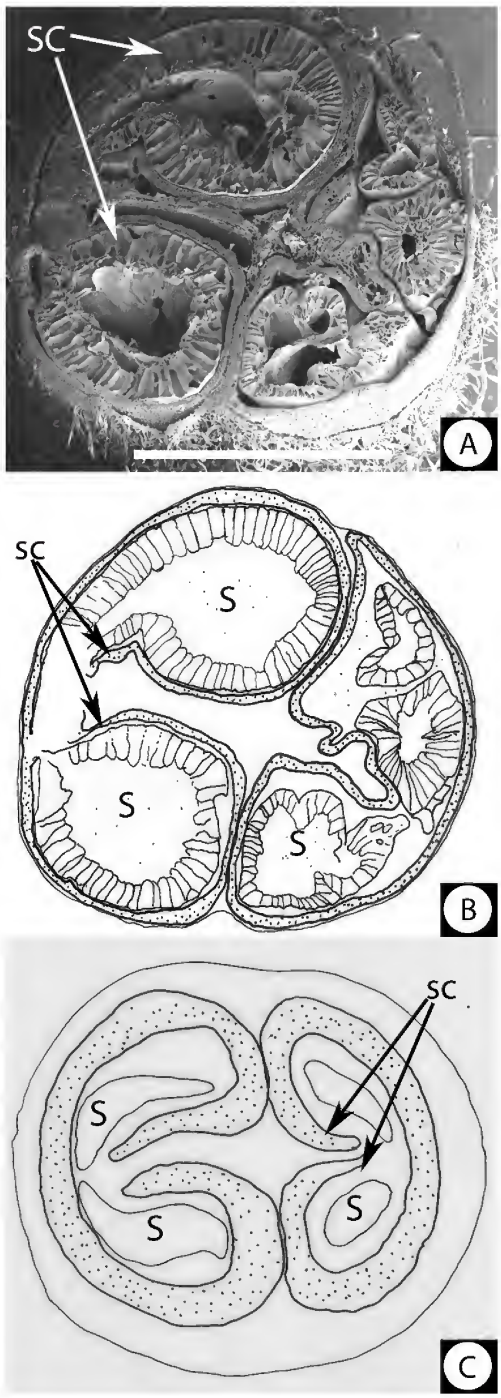

Fig. 5. A. ***Pseudoweinmannia lachnocarpa***, oblique transverse section through a mature fruit. Note the position of the seeds in the fruit and the thickened seed coat (SC). B. Drawing of A showing that the walls of the two carpels are adnate but free; the sclerenchyma wall (sc) of the right hand carpel are not continuous and remain free near the mid-section of the fruit. The more oblique section through the left hand carpel shows that the convoluted sclerenchyma (sc) wall of the carpel is continuous. C. Simplified transverse section of fruit of ***Geissois stipularis*** A.C.Sm., redrawn from Dickison (1984), note that the sclerenchyma walls (sc) of the capsule remain free. (S = seed; SC = seed coat; sc = sclerenchyna). Scale bar = 1 mm. A from *Williams s.n.* (MEL).

The tribe *Geissoieae* are a very cohesive group, with all species having a similar vegetative and reproductive morphology. The species share digitate (palmately compound) leaves, brachyparacytic stomates and semi-craspedodromous secondary venation. The floral plan in all genera consists of valvate sepals, no petals, polyandrous androecium, the anthers lack a distal connective protrusion, and the bicarpellate ovary is covered in a thick indumentum with a prominent disc (nectary) at the base. *Pseudoweinmannia* also shares with the other two genera dicolporate pollen, raceme-like inflorescences and capsular dehiscent fruits (Hufford & Dickison 1992; Bradford & Barnes 2001; Schimanski & Rozefelds 2002; herein).

Systematics

Family Cunoniaceae

Tribe *Geissoieae* Endl. ex Meisn.

Pseudoweinmannia Engl., *Nat. Pflanzenfam.* 2nd Ed., Vol. 18a: 249 (1930). **Type species:** *Pseudoweinmannia lachnocarpa* (F.Muell.) Engl. (= *Weinmannia lachnocarpa* F.Muell.)

Trees or shrubs. *Leaves* opposite, decussate, trifoliolate and with a pair of stipels at base of lateral leaflets (digitate); unifoliolate in coppice growth or seedlings; *leaflets* sessile or very shortly petiolulate, similar in size, central leaflet sometimes up to one-third larger, broadly lanceolate, elliptical to obovate, apices typically acute, less commonly obtuse, leaf bases are cuneate to attenuate, lateral leaflets base slightly asymmetrical, margin serrate to crenate, sinuses weakly to strongly

developed, *venation* semi-craspedodromous, midrib course straight in central leaflet and slightly curved in lateral leaflets, secondary venation thickness stout, alternate, uniformly divergent, tertiary venation percurrent, complete areolation is formed by higher-order venation, teeth dark, glandular with simple apical termination. *Stipules* 4 at each node, keel-shaped, lanceolate, apex acute. *Inflorescences* usually axillary, consisting of raceme-like units, which typically occur in the upper leaf axils, or occasionally terminate the main axis. *Flowers* bisexual; *sepals* (5–)6(–7) free; *petals* absent; *androecium* weakly polystemonous, stamens 12–25, *carpels* 2 (or 3) fused, styles subulate, 2 (or 3) distally free, ovary densely hairy, stigmas papillate, 2–4 ovules/carpel, disc (annular nectary) around base of ovary. *Fruit* a dry, tardily dehiscent capsule covered in a dense, woolly golden-brown indumentum, stamen filaments and styles persistent; carpels free; *seed* rounded-pyramidal, not winged, seed walls weakly reticulate.

***Etymology*:** Name from the Latin *pseudo* meaning (false), and *Weinmannia* a genus named in honour of Johann Wilhelm Weinmann, German pharmacist and botanist, (1683–1741).

Key to *Pseudoweinmannia* species

Leaf margins crenulate-crenate, sinuses weakly developed; stipules fringed with glandular and simple trichomes; stamens 12–20, disc < 2.5 mm high; fruit ovoid-globose. NE Qld . . . . . ***P. apetala***

Leaf margins serrulate-serrate (rarely crenate), sinuses well developed; stipules fringed with glandular trichomes; stamens (12–)20–24, disc >3 mm high; fruit globose. SE Qld, NE NSW . . . . . ***P. lachnocarpa***

Pseudoweinmannia apetala (F.M.Bailey) Engl. in Engl. & Prantl., *Nat. Pflanzenfam.* 2nd Ed., Vol. 18a: 249 (1930); *Weinmannia apetala* F.M.Bailey, *Dept. Agric. Brisbane, Bot. Bull.* 8: 76 (1893). **Type:** Queensland. Cook District: Kamerunga, January 1892, *E.Cowley 65,* 'the growing shoots from roots, flower' (holo: BRI [AQ341025]; iso: K *n.v.* [photo at HO!]).

Pseudoweinmannia lachnocarpa auct. non (F.Muell.) Engl.; Hyland & Whiffin (1993: 131); Cooper & Cooper (2004: 148).

***Illustrations*:** Christophel & Hyland (1993: pl. 25, fig. C); Cooper & Cooper (2004: 148); all as *P. lachnocarpa*.

Tree up to 30 m tall, often prominently buttressed in larger trees (Hyland & Whiffin 1993). *Outer bark* flaky (*Sanderson 1634*). *Branchlets* terete, bark grey with conspicuous lenticels. *Stipules* 2–5 mm long, base to 2 mm wide, margin entire with glandular trichomes (colleters) and non-glandular strigose trichomes, glabrous above, caducous. *Leaves* opposite, decussate, petiolate, trifoliolate with two caducous stipels; *petiole* 1.5–4.5 cm long, broadly elliptic in cross-section, glabrous to sparsely strigose; *leaflets* 5–12.5 cm long, 1.5–4.9 cm wide, sessile or occasionally with short petiolule, broadly lanceolate, elliptical to obovate, apex acute to acuminate, rarely obtuse, bases cuneate to attenuate, margins typically crenulate to crenate, sinuses weakly developed; *secondary veins* 10–16 pairs, 60–80° to midrib and branching well inside margin. *Inflorescence* usually axillary, consisting of a simple raceme, 4.5–12 cm long, occasionally with one or two racemose lateral branches, or with some of the lower flowers replaced by 3-flowered dichasia; *rachis* terete, shortly hirsute with crispate trichomes. *Flowers* bisexual; pedicels terete, 3–8 mm long, shortly hirsute with crispate trichomes, abscission point 0.3–0.9 mm above attachment; *sepals* valvate in bud, (5–)6(–7), ovate, elliptical to narrowly ovate, 1.5–2.5 mm long, 0.6–1 mm wide, apex acute, densely hirsute distally, trichomes more sparsely distributed below; *stamens* 12–20; filaments of unequal length, 2–4 mm long, glabrous, *anthers* introrse, 0.4–0.5 mm long; *disc*

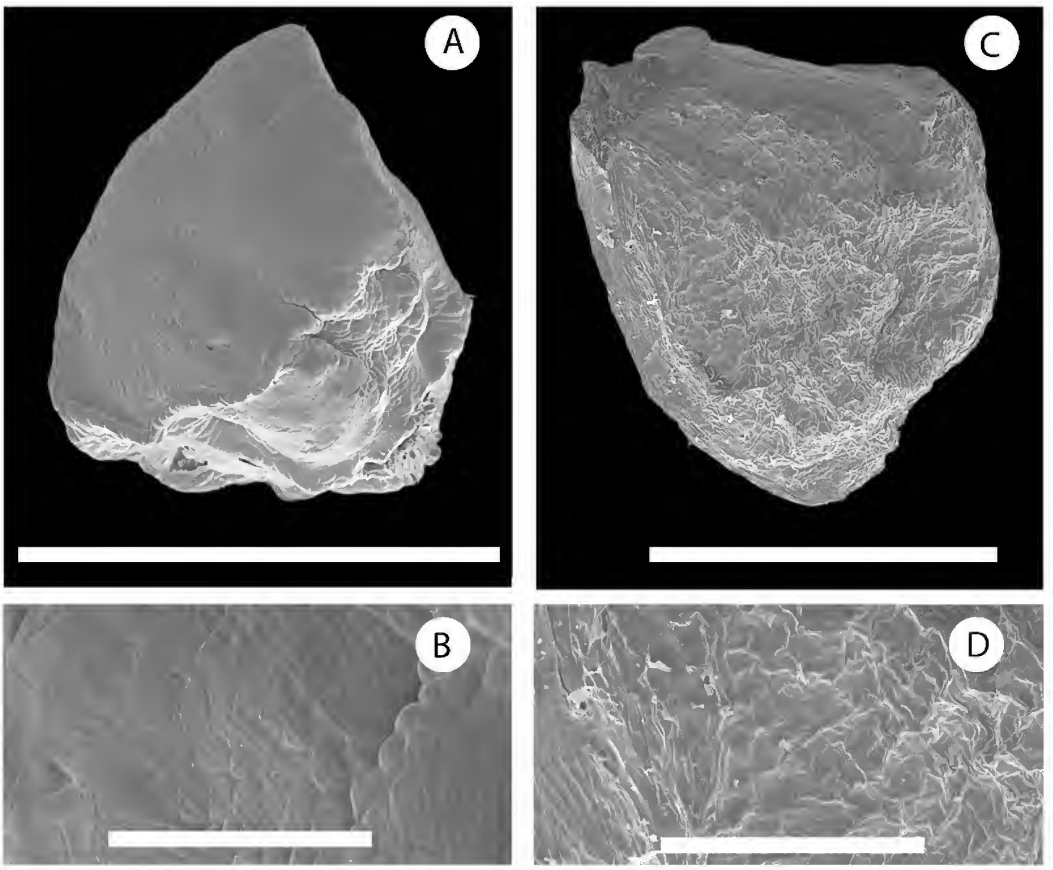

Fig. 6. Seed morphology in ***Pseudoweinmannia apetala*** and ***P. lachnocarpa***. A & B. *P. lachnocarpa*. A. Seed showing rounded, pyramidal shape and irregular surface and angular margins. B. Detail showing reticulate appearance of the cell walls. C & D. *P. apetala*. C. seed showing rounded, pyramidal shape and angular margins. D. Detail showing somewhat more wrinkled, reticulate appearance of the cell walls. Scale bars A = 1 mm; B,D = 200 µm; C = 0.5 mm. A & B from *Webb & Tracey 11246* (CANB); C & D from *Risley 35* (NSW).

colour not noted, *c.* 0.2 mm high, glabrous, slightly lobed; *ovary* subglobular-conical, 0.6–1 mm high, 0.9–1 mm wide, externally woolly hirsute, 2 (or 3) celled, each cell with two rows of 3 or 4 ovules, tapering into 2 (or 3) free styles; *styles* subulate, 1.8–2.8 mm long, *c.* 0.2 mm wide at base, glabrous except for a few trichomes near the base. *Fruit* ovoid-globose, 3–4.5 mm high, 4–5 mm wide; *seed* brown. **Fig. 1.**

***Additional selected specimens examined*: Queensland.** Cook District: T.R. 176, Monkhouse, Oct 1982, *Hyland 12175* (CNS); Shiptons Flat on Tin Mine Road, May 1969, *Smith 14341* (BRI); E.P. 40, S.F.R. 144, Jun 1979, *Sanderson 1634* (CNS); S.F.R. 144, Dagmar, Chowchilla L.A., Feb 1995, *Gray 5978** (CNS); S.F.R. 144 Chowchilla L.A., Windsor Tableland, Dec 2001, *Ford AF3202 & Jensen* (BRI, CNS, HD); S.F.R. 1073, Dulanban, Hartley L.A., Feb 1993, *Hyland 14641** (CNS); near Kuranda, Jan 1972, *Hyland 5795** (BRI, CNS); S.F.R. 933, Little Pine L.A., Feb 1979, *Gray 1272* (BRI, CNS); S.F.R. 185, Downfall L.A., Mar 1973, *Whiffin & Risley 586* (CNS); S.F.R. 185, Downfall L.A., Jan 1985, *Gray 3848** (CNS); Downfall L.A., S.F.R. 185, Feb 1972, *Risley 35** (BRI, CANB, CNS, NSW); Atherton District, *Dansie 2053* (BRI); Bellenden Ker Range near Babinda, Jan 1979, *Jago 270** (CNS); Downfall Creek Road, near Tinaroo Dam, *s.dat.*, *Webb & Tracey 7646* (BRI); Babinda, May 1997, *Jago 634* (CNS). North Kennedy District: Tully River, rafting access point no. 9, SE of Cardstone, Jun 2001, *Ford AF2892* (BRI, CNS).

***Distribution and habitat*:** Restricted to north eastern Queensland from near Cardstone in the south to Rossville near Cooktown in the north (**Map 1**). Hyland & Whiffin (1993)

noted that *Pseudoweinmannia apetala* (under the name *P. lachnocarpa*) occurs from sea level to 800 m, commonly in drier rain forest, but also occasionally in wetter rainforest communities. Cooper & Cooper (2004) extended the altitudinal range to 950 m.

***Phenology*:** *Pseudoweinmannia apetala* flowers from January through to April, rarely as late as June; with fruiting specimens collected from December through to March.

***Notes*:** The notes with the type specimen i.e. "the growing shoots from roots, flower" suggest that it may have been collected from coppice growth at the base of the tree.

***Etymology*:** The species name, *apetala*, comes from the Greek *a*, not, and Latin *petalum* for petals, which refers to the lack of petals in the flowers.

Although Cooper & Cooper (2004) list a common name as 'Marara', this application is derived from populations of *Pseudoweinmannia lachnopetala* and the adoption of this aboriginal name by people in southern Queensland and New South Wales (Bailey 1900, 1913; Maiden 1922). No common names were listed for this species by Bailey (1900, 1913).

Pseudoweinmannia lachnocarpa (F.Muell.) Engl. in Engl. & Prantl., *Nat. Pflanzenfam.* 2nd Ed., Vol. 18a: 249 (1930); *Weinmannia lachnocarpa* F.Muell., *Fragm.* 8: 7 (1874); *Windmannia lachnocarpa* (F.Muell.) Kuntze, *Revis. Gen. Pl.* 1: 228 (1891); *Geissois lachnocarpa* (F.Muell.) Maiden, *Forest Fl. New South Wales* 7: 6 (1922). **Type:** New South Wales. Tweed, *s.dat.,* [*W.*]*Guilfoyle s.n.* (lecto [here designated]: MEL104457; isolecto: K *n.v.*, photo at HO!; Tweed, *s.dat.*, *C.Moore s.n.* (lectopara: MEL104455, MEL104456).

Weinmannia lachnocarpa var. *parvifolia* F.M.Bailey, *Queensland Agric. J.* 28: 196 (1912). **Type:** Queensland. Moreton District: Macpherson Range, February 1912, *C.T.White s.n.* (holo: BRI [AQ321400]; iso: NSW104762).

***Illustrations*:** Maiden (1922, t. 229); Francis (1951: figs 11, 87, 88); Beadle (1976: fig. 150C); Stanley & Ross (1983: Fig. 36D1,D2); Harden (1990: 518).

Tree up to 40 m tall, often prominently buttressed in larger trees (Francis 1951; Beadle 1976). *Outer bark* grey or fawn pink usually rough with small scales and pustules (Floyd 1989). *Branchlets* terete, bark grey with conspicuous lenticels. *Stipules* 2–3.5 mm long, base to 1 mm wide, margin entire with glandular trichomes (colleters), glabrous above, caducous. *Leaves* opposite, decussate, petiolate, trifoliolate with two caducous stipels; *petiole* 1.5–3.5 cm long, broadly elliptic in cross-section, glabrescent, *leaflets* 2–13.3 cm long, 0.5–5.8 cm wide, sessile or occasionally with a short petiolule, broadly lanceolate, elliptical to obovate, apex acute to obtuse and ± acuminate, base cuneate to attenuate, margins serrulate to serrate, rarely crenate, sinuses typically strongly developed; *secondary veins* 11–16(–20) pairs, at 60–80° to midrib and branching well inside margin. *Inflorescence* typically consisting of a simple raceme, 3–10 cm long, occasionally with one or two racemose lateral branches, or with some of the lower flowers replaced by 3-flowered dichasia, *rachis* terete, shortly hirsute, with crispate trichomes. *Flowers* bisexual; *pedicels* terete, 3–8 mm long, with shortly hirsute crispate trichomes on rachis, abscission point 0.3–1 mm above attachment; *sepals* valvate in bud, (5–)6(–7), ovate-elliptical to narrowly ovate, 2–3 mm long, 0.9–1.2 mm wide, apex acute, densely hirsute distally and proximally, with sparse glands on margins; *stamens* (12–)20–24; *filaments* of unequal length 3–5 mm long, glabrous, *anthers* introrse, 0.5–0.8 mm long; *disc* red-brown in colour, *c.* 0.4 mm high, distinctly lobed; *ovary* globular, 0.8–1 mm high, 0.9–1 mm wide, externally woolly hirsute, 2(–3) celled, each cell with two rows of 2, 3 or 4 ovules, tapering into 2(–3) free styles, styles subulate, 2–3 mm long, *c.* 0.35 mm wide at base, glabrous except for a few trichomes near the base. *Fruit* globose, 3–5 mm high, 4–7 mm wide; *seed* light brown. **Fig. 2.**

***Additional selected specimens examined*: Queensland.** Wide Bay District: Tinana Creek, 7 km ENE of Tiaro, Jan 2005, *Forster PIF30579 et al.* (BRI); NW slopes of Mt Glastonbury, Dec 1991, *Forster PIF9273 & Sharpe* (BRI, CNS, MEL); S of Anderson Road, 10 km W of Cooroy, Nov 1993, *Bean 7065* (BRI, NSW; AD, DNA *n.v.*); Imbil, Dec 1943, *Clemens s.n.* (BRI [AQ321401]); near Imbil, Jun 1947, *Smith & Webb 31162* (BRI).

Moreton District: Scientific Area 2, S.F. 309, Enoggera, Jan 1992, *Forster PIF9353 & Machin** (BRI, CNS, MEL, NSW; A, B, K, L, NY, MO *n.v.*); Laceys Creek, Mt Glorious Road, Taylor Range, Feb 1972, *Webb & Tracey 11246* (BRI, CANB); The Rafting Ground, Kenmore, Dec 1981, *Dickison 294 & Jessup* (BRI); Pimpama River, 3.7 km along Ormeau Road from Pacific Highway, *c.* 11 km SE of Beenleigh, Jul 1986, *Beesley 8497 & Ollerenshaw* (CANB); *c.* 2 miles [3.2 km] SW of Canungra, Jan 1971, *Williams s.n.** (BRI [AQ310510], CANB, MEL); Mt Roberts, McPherson Range, Oct 1967, *Blake 22848** (BRI); Roberts Plateau, McPherson Range, Mar 1920, *White s.n.** (BRI [AQ321398]); O'Reilly's, Lamington N.P., Nov 1999, *Rozefelds s.n.** (HO); Morans Falls, Lamington N.P., Aug 1978, *Floyd s.n.** (CANB289092). **New South Wales.** Pacific Highway – Byron Bay Road, May 1964, *Williams s.n.* (NSW); Casino, Dec 1908, *Pope s.n.* (NSW).

***Distribution and habitat*:** *Pseudoweinmannia lachnocarpa* extends from near Tinana in south eastern Queensland to Casino in New South Wales (**Map 1**). It occurs in riverine, coastal or montane rainforest from near sea level to 1000 m.

***Phenology*:** *Pseudoweinmannia lachnocarpa* flowers from October through to January; with fruiting specimens collected between November through to March.

***Typification*:** Mueller's (1874) description of *Weinmannia lachnocarpa* cited collections by both *C.Moore* and *W.Guilfoyle* from the Tweed District of northern New South Wales. The *Guilfoyle* specimen was initially selected by Hoogland in 1984 as the lectotype, and is an appropriate choice as it is the only fruiting specimen. A specimen in K, which is also fruiting, was sent by Mueller and it matches the colouration and appearance of the lectotype and is interpreted as a putative isolectotype.

***Notes*:** The type of *Pseudoweinmannia lachnocarpa* var. *parvifolia* F.M.Bailey differs from the more typical form of the plant in having smaller leaves and fewer stamens. More comprehensive collections, particularly of flowering material, from throughout the range of the species are needed to fully assess this variation although there seems little justification, at present, to recognise a separate variety.

***Etymology*:** The species name, *lachnocarpa*, comes from the Greek *lachnos*, wool and *karpos*, fruit, alludes to the dense indumentum covering the fruits.

Common names applied to this species include 'Marara', 'Rose Marara', 'Mararie', 'Merrany', 'Scrub Rosewood', 'Red Carabeen' (Bailey 1900, 1913; Maiden 1922; Francis 1951; Floyd 1989).

Acknowledgments

This study has benefited from the detailed notes compiled by the late Ru Hoogland, although our conclusions regarding the number of species occurring in Australia differs from his. We are grateful to an anonymous referee and Paul Forster for their helpful advice and comments on an initial draft of this ms. We thank the Australian Botanical Liaison Officer, Ken Hill, for arranging cibachromes of material of both species in Kew. Andrew Ford and Bernie Hyland, and Robert Kooyman assisted with fieldwork in 1998 and 1999 respectively. We thank Phillip Brown, Department of Agriculture, University of Tasmania for access to a critical point drier and David Steele, Central Science Laboratory, University of Tasmania for assistance with SEM studies.

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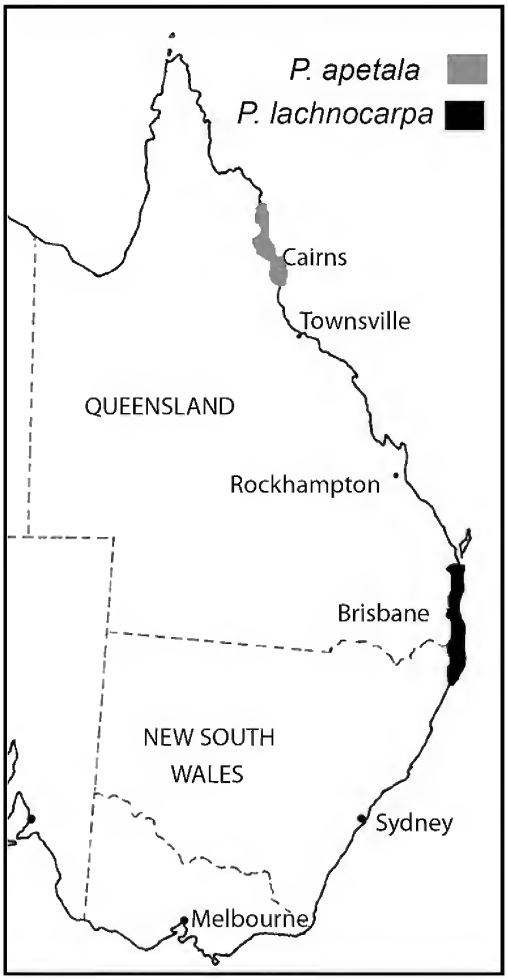

Map 1. Distribution of *Pseudoweinmannia lachnocarpa* and *P. apetala* in eastern Australia.

A taxonomic revision of *Nyssanthes* R.Br. (Amaranthaceae)

A.R.Bean[1] & C.H.Miller[2]

Summary

Bean, A.R. & Miller, C.H. (2011). A taxonomic revision of *Nyssanthes* R.Br. (Amaranthaceae). ***Austrobaileya* 8(3): 267–279.** The endemic Australian genus *Nyssanthes* is revised, with the recognition of four species, *N. erecta* R.Br., *N. diffusa* R.Br., *N. impervia* A.R.Bean sp. nov. and *N. longistyla* C.H.Mill. sp. nov. All species are illustrated, and distribution maps provided. Notes for each species are given on conservation status, distribution and habitat, and an identification key is presented.

Key Words: Amaranthaceae, *Nyssanthes*, *Nyssanthes impervia*, *Nyssanthes longistyla*, Australia flora, Queensland flora, taxonomy, identification key, new species

[1]A.R. Bean, Queensland Herbarium, Department of Environment and Resource Management, Brisbane Botanic Gardens, Mt Coot-tha Road, Toowong 4066, Queensland, Australia. E-mail: tony.bean@derm.qld.gov.au

[2]C.H. Miller, Australian National Herbarium, Centre for Australian National Biodiversity Research, G.P.O. Box 1600, Canberra 2601, Australian Capital Territory, Australia. E-mail: cathy.miller@csiro.au

Introduction

Nyssanthes R.Br. is a small genus endemic to eastern Australia. All species are perennial shrubs or subshrubs characterised by their opposite leaves, 2-locular anthers, 4-merous flowers, spreading spinose bracteoles, and tepals of unequal length. *Nyssanthes* belongs to Amaranthaceae Subfamily *Amaranthoideae*, but its closest affinities are unclear. It shows superficial similarities to *Achyranthes* L., but pollen morphology suggests an affinity with *Deeringia* R.Br. and *Celosia* L. (Borsch 1998).

Nyssanthes was named by Brown (1810), from specimens he collected while in Australia. Brown described three species, *Nyssanthes diffusa, N. erecta* and *N. media*. Moquin (1849) maintained all of these, but Bentham (1870) reduced *Nyssanthes media* to synonymy with *N. diffusa*. Little has been written about the taxonomy of *Nyssanthes* since the work of Bentham. Townsend (1993) included a description of *Nyssanthes* in his comprehensive synopsis of the Amaranthaceae, although this did not expand beyond that written by Bentham.

The two common species, *Nyssanthes diffusa* and *N. erecta*, have been treated in state or regional floras (Ross 1983; Jacobs & Lapinpuro 1990). They are not infrequent as a component of the understorey in woodlands and forests of eastern Queensland and New South Wales. Despite being indigenous, they are often termed "weeds", because they are prickly and may proliferate under optimal conditions. Two additional species have recently been recognised from western Queensland, and they are newly described here as *Nyssanthes impervia* A.R.Bean and *N. longistyla* C.H.Mill. They inhabit shallow or skeletal soils in areas that receive low annual rainfall (280–445 mm).

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Discussion of some morphological characters

Due to the lack of basic knowledge of *Nyssanthes* morphology, a number of misconceptions have been propagated in the literature. Townsend (1993) mentioned that all flowers are hermaphroditic in *Nyssanthes*. However, the basal flowers formed in the leaf axils of *Nyssanthes diffusa* are sterile. They usually comprise a bract, two bracteoles, and one tepal. All of the other tepals are rudimentary or absent, and no male or female parts can be observed. These sterile flowers seem to develop in all leaf axils and persist year-round. Subsequently (and perhaps at certain times of the year) fully fertile and bisexual flowers develop. As far as is known, sterile flowers do not occur in the other species.

The length of the bract, bracteoles and the longest tepal vary greatly within each species of this genus, as Bentham (1870) observed. However, the variation is not random. The sterile flowers of *Nyssanthes diffusa* have very long spinose bracts and bracteoles, and sometimes the longest tepal is also of similar length and is spinose. Subsequent flowers in an inflorescence display a gradual decrease in the lengths of the bracts and bracteoles, even though the change from sterile to fertile flowers is apparently rapid and without intermediate forms.

Jacobs & Lapinpuro (1990) stated that stamen number varies within species of this genus. We have not found this to be the case. All flowers of *Nyssanthes erecta* examined, have possessed four fertile stamens, and for *N. diffusa* consistently two. However, the anthers are very easily shed, and an erroneous stamen count can easily occur if the flower is not opened very carefully.

Materials and methods

This revision is based upon field examination of all species, and herbarium holdings at AD, BRI, CANB, CNS, HO, MEL, NSW and NT, and type specimens from BM and K. Measurements of leaves, bracts and bracteoles were made from dried herbarium specimens; measurements of tepals, stamens and styles were made from material preserved in spirit or reconstituted with boiling water.

Common abbreviations in the specimen citations are N.P. (National Park) and S.F. (State Forest).

Taxonomy

Nyssanthes R.Br., *Prodr.* 418 (1810). **Type species:** *N. diffusa* R.Br. (lecto: here designated).

Perennial herbs or shrubs. Leaves opposite, entire, exstipulate. Inflorescence spicate, in leaf axils. Rachis present or absent. Flowers sessile. Bract 1 per flower, bracteoles 2 per flower, spinose; basal parts cymbiform, more or less appressed. Sterile flowers sometimes present. Fertile flowers all bisexual, sessile. Perianth 4-merous, tepals cymbiform, heteromorphic, the outermost (posterior) tepal being the longest, the next (anterior) tepal being shorter; the two inner tepals shorter again, but about the same size and shape as each other. Stamens 2 or 4; anthers bilocular. Pseudostaminodes present, 4. Ovary 1-locular, 1-ovular. Style not lobed, capitate. Fruit an indehiscent utricle, dispersed as a unit with perianth and bracteoles. Seeds 1, ellipsoid to ovoid.

***Etymology*:** From the Greek *nyssa* (a prickle), and *anthos* (flower), in reference to the prickly bracteoles and bracts found in all species of the genus.

***Typification*:** In Brown's diary the description of *Nyssanthes diffusa* has been annotated with "nov: gen Amaranthor: Infs:". Additionally the name was written as "Nyssanthos axillaris" but this has been crossed out and replaced by "Nyssanthes diffusa" while the other species names had not been altered. This would indicate that Brown had determined the name of this taxon before he named the other two taxa (J.G.West *pers. comm.*). For these reasons *Nyssanthes diffusa* R.Br. has been selected as the lectotype species for the genus.

A genus of four species endemic to eastern Australia.

Key to the species of *Nyssanthes*

1 Leaf lamina 2.5–5.5 times longer than broad; leaf apical mucro absent or up to 0.7 mm long; longest tepal recurved; central Queensland, eastern New South Wales . . . . . **1. N. erecta**

1. Leaf lamina 1.5–2.5 times longer than broad; leaf apical mucro 0.5–2.1 mm long; longest tepal straight 2

2 Fully expanded leaves sparsely tomentose; inflorescence up to 22-flowered; stamens two; eastern New South Wales & Queensland . . . . . **2. N. diffusa**

2. Fully expanded leaves moderately to densely tomentose; inflorescence 2–5(-8) flowered; stamens four 3

3 Style 0.6–0.8 mm long; pseudostaminodes without dorsal appendage; bracts 0.8–1.2 mm wide; southwest Queensland . . . . . **3. N. impervia**

3. Style 2.7–3.5 mm long; pseudostaminodes with trifid dorsal appendage; bracts 1.4–2 mm wide; southwest Queensland . . . . . **4. N. longistyla**

1. Nyssanthes erecta R.Br., *Prodr.* 418 (1810). **Type citation:** "(J.) v.v." **Type:** New South Wales. Banks of the Nepean [River] on Badgery's farm, [December 1804 or January 1805], *R. Brown [Bennett No. 3070]* (lecto: BM000795238, here designated; isolecto: BM000795214).

Dichasially branched perennial forb or shrub to 0.8 m high. Stems striate, grooved, sparsely tomentose; hairs antrorse, appressed to spreading, 0.1–0.5 mm long. Petioles 1–5 mm long; lamina narrowly-elliptic to narrowly ovate, 14–26 mm long, 3.5–8 mm wide, 2.5–5.5 times longer than broad, sparsely tomentose when fully expanded; hairs unicellular, appressed to spreading, 0.15–0.5 mm long; base attenuate, apex acute or mucronate (mucro 0–0.7 mm long). Inflorescence up to 16-flowered. Rachis to 8 mm long, sparsely to densely tomentose. All flowers fertile. Bract 1.3–1.75 mm long, 1–1.3 mm wide; apex acuminate, spinulose, acumen 0.2–1.5 mm long; base broadly ovate, hyaline; remaining firmly attached to rachis upon disarticulation of flower. Bracteoles 2.5–4.5 mm long, 0.9–1.7 mm wide; basal part ovate to broadly ovate, moderately tomentose, with thick, yellowish-brown midrib, otherwise hyaline; acumen slender, patent, yellowish-brown, spinose; remaining attached to perianth upon disarticulation of flower. Perianth 1.4–2 mm wide. Longest tepal lanceolate-acuminate, 5.5–7.7 mm long, recurved, basal half very sparsely to densely tomentose; midrib prominent, with 1–2 pairs of lateral longitudinal ribs visible; apex spinose. Next longest (anterior) tepal slightly shorter but otherwise similar, 4.2–6.8 mm long. Inner 2 tepals narrowly-ovate, 2.8–3.8 mm long, glabrous; apex acuminate, spinulose. Fertile stamens 4, filaments slender, 0.4–0.7 mm long; anthers 0.35–0.5 mm long, white to yellow. Staminodes absent. Pseudostaminodes quadrate, glabrous, almost filling space between filaments, 0.3–0.8 mm high, translucent; distal margin entire or ciliate; dorsal appendage absent. Ovary oblate, *c.* 0.8 mm long, glabrous. Style simple, 0.4–0.6 mm long, stigma capitate. Utricle with membranous covering, irregularly fragmenting. Seed obloid, 0.75–1.6 mm long, 0.65–1.1 mm wide, brown. **Fig. 1.**

***Additional selected specimens examined*: Queensland.** South Kennedy District: 'Logan Downs', Clermont, Jun 1942, *Fairbairn s.n.* (BRI [AQ683973]). Mitchell District: Jericho, Apr 1946, *Clemens s.n.* (BRI [AQ683970]); 'Gartmore' on Alpha – Tambo road, *c.* 11 km NNE of Tambo, Apr 1961, *Johnson 2185* (BRI). Leichhardt District: 'Minerva', Mar 1935, *Blake 7946* (BRI, CANB); 'Cluden', south of Taroom, Oct 1954, *Johnson & Pedley 17* (BRI); 'Nirvana', *c.* 15 km WNW of Banana, Apr 2003, *Bean 20152* (BRI); SE of 'Redcliffe' via Baralaba, Mar 2005, *Bean 23609* (BRI). Port Curtis District: Charons Ferry Station near Styx, Jun 1942, *Blake 14606* (BRI); Rosedale, N.C. [North Coast] Line, Nov 1932, *Dovey 164* (BRI); Experimental Farm, Biloela, Oct 1947, *Smith 3550* (BRI). Burnett District: on property of H.J. Brunje, West Goomeri, Mar 1962, *Saint-Smith s.n.* (BRI [AQ178268]). Warrego District: 51 km N of Charleville along road to Augathella, W side of road, Mar 1976, *Purdie & Boyland 163* (BRI). Darling Downs District:

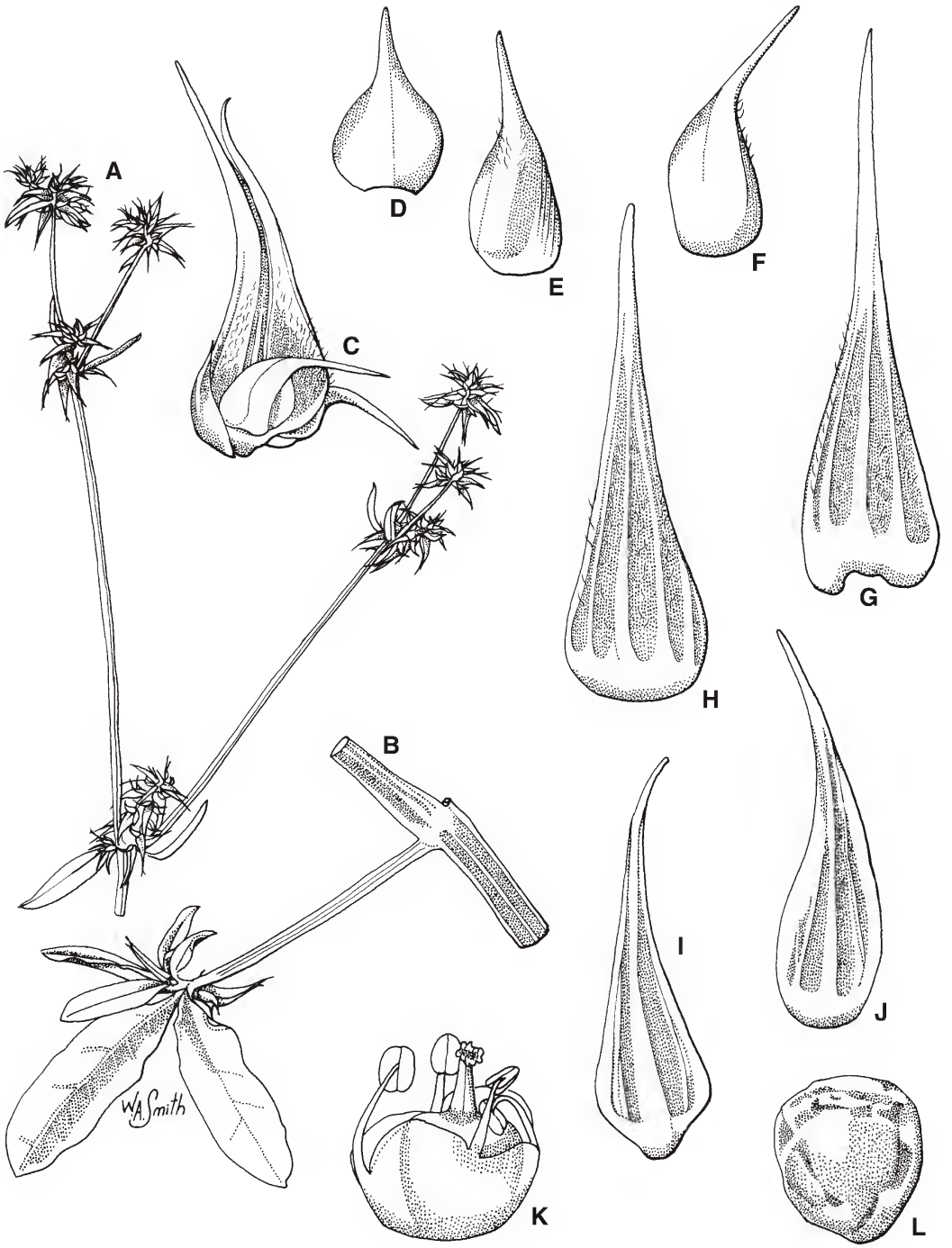

Fig. 1. ***Nyssanthes erecta***. A. upper part of flowering plant × 1. B. leafy branchlet × 1.5. C. complete flower × 8. D. bract × 12. E. bracteole × 12. F. bracteole × 12. G. outermost tepal × 12. H. second tepal × 12. I. third tepal × 12. J. innermost tepal × 12. K. ovary, style, stamens and pseudostaminodes × 16. L. seed × 16. A, C from *Bean 20152* (BRI); B from *Bean 23609* (BRI); L from *Clemens s.n.* (BRI [AQ683970]. Del. W.Smith.

Chinchilla, Portion 100, 'Mylo', Chinchilla Shire, Dec 1989, *Mann s.n.* (BRI [AQ467453]); Kindon Station, about 54 miles [90 km] NNE of Goondiwindi, Dec 1938, *Smith 610* (BRI); 'Woodside', Pratten, Oct 1962, *Walsh s.n.* (BRI [AQ169899]); Bybera, Jan 1934, *White 9700* (BRI); Wallumbilla, May 1916, *White 9984* (BRI); *c.* 0.5 km S of Pelican Hall on Chinchilla – Burra Burri Road, Apr 1981, *Wilson 3395* (BRI, NSW). MORETON DISTRICT: Crows Nest, Mar 1948, *Clydesdale 87* (BRI). **New South Wales.** 'Roma', near Moree, May 1977, *Bradbrook s.n.* (NSW); Stoney Creek Road at South Creek, south of 'Berkshire Park', Dec 1982, *Coveny et al. 11473* (NSW); Tenterfield, *s.dat.*, *s.coll.* (MEL 59864); Bank of Shoalhaven River, Nowra, Feb 1933, *Menaghan s.n.* (NSW); Bullen Buttress, Shoalhaven Gorge, *c.* 8 km upstream from the Tallowa Dam site, Feb 1974, *Pullen 8775* (AD, CANB, HO, NSW); New England, *s.dat., Stuart s.n.* (MEL59863).

***Distribution and habitat*:** *Nyssanthes erecta* is widespread from the Mt Coolon area (west of Mackay) in Queensland south to Nowra in New South Wales (**Map 1**). It grows on heavy clay soils, often in association with brigalow (*Acacia harpophylla* F.Muell. ex Benth.) or poplar box (*Eucalyptus populnea* F.Muell.), but also in a range of other eucalypt-dominated communities.

***Phenology*:** Flowers and fruits may be found throughout the year.

***Typification*:** Brown's diary does not specify any locality for *Nyssanthes erecta*. However, one of the sheets at BM (000795238) has the locality written in Brown's handwriting. Also written next to the name is "Prod. 418" indicating that Brown probably saw this specimen. This sheet has been designated as the lectotype. There is another sheet at BM (000795214) that matches the lectotype material but does not have a label in Brown's handwriting and with a general location of Port Jackson. This was probably from the same collection but has been separated as there is no Bennett number (J.G. West *pers. comm.*). This specimen is here designated as an isolectotype.

***Notes*:** The conspicuously recurved perianth exhibited by this species is not found in any other species of *Nyssanthes*. In all of the other species, the perianth is straight or slightly incurved.

***Conservation status*:** A widespread and relatively common species.

2. Nyssanthes diffusa R.Br., *Prodr.* 418 (1810). **Type:** [Queensland. PORT CURTIS DISTRICT:]. Pine Mountain, Shoalwater Bay, 3 September 1802, *R.Brown [Bennett No. 3069]* (holo: BM; iso: E *n.v.*, K000357277 & 000357276).

N. media R.Br., *Prodr.* 418 (1810). **Type citation:** "(J.) v.v." **Type:** New South Wales. Port Jackson, banks of the Hawkesbury, *R.Brown s.n.* (lecto: BM000795233, specimen on right hand side of sheet, here designated; isolecto: BM000795234 & 000795235).

Divaricately branched herb or shrub to 0.7 m high. Stems striate, grooved, sparsely tomentose, glabrescent; hairs antrorse, appressed to spreading, 0.2–0.4 mm long. Petioles 0.5–3 mm long; lamina broadly elliptical, 8–35 mm long, 4.5–18 mm wide, 1.5–2.5 times longer than broad, sparsely tomentose when fully expanded; hairs unicellular, appressed, 0.2–0.5 mm long; base cuneate, apex mucronate (mucro 0.5–1.7 mm long). Inflorescence up to 22-flowered. Rachis to 10 mm long, with simple non-ciliolate hairs. Up to 4 basal flowers sterile, subsequent flowers fertile. Sterile flowers: Bract subulate throughout and spinose, remaining attached to perianth upon disarticulation of the flower, 3.5–7 mm long; bracteoles subulate throughout and spinose, 5–9 mm long; longest tepal somewhat expanded at the base, 3–7mm long; all other tepals rudimentary or absent; stamens and ovary absent. Fertile flowers: Bract subulate, 1.3–4.5 mm long, 0.5–1.2 mm wide; basal part ovate to broadly ovate, hyaline, 0.6–1.5 mm long; acumen 1–3.5 mm long, spreading, spinose; remaining attached to rachis upon disarticulation of flower. Bracteoles 2.1–4.6 mm long, 0.6–1.2 mm wide; basal part ovate to broadly ovate, with thick, yellow-brown midrib, otherwise hyaline, sparsely tomentose; acumen slender, patent, 1–5 mm long, yellowish-brown, spinose; remaining attached to perianth upon disarticulation of flower. Perianth 0.9–1.4 mm wide. Longest (posterior) tepal lanceolate-acuminate, 5–8.7 mm long, straight, basal half tomentose on outer surface; midrib prominent, with 2 or 3 pairs of lateral longitudinal ribs; apex subulate, spinose. Next longest (anterior) tepal 2.6–4.9 mm long, straight, sparsely tomentose on outer surface; apex acute,

spinulose. Inner 2 tepals narrowly-ovate, 2.1–2.9 mm long, sparsely tomentose or glabrous on outer surface; apex acute, not spinose. Fertile stamens 2, filaments slender, 0.7–1.1 mm long, often differing in length in the same flower; anthers 0.25–0.4 mm long, white to yellow. Staminodes 0–2, 0.5–0.8 mm long, shorter and thinner than stamen filaments. Pseudostaminodes quadrate, translucent, 0.4–0.8 mm high, almost filling the space between filaments, glabrous, distal margin entire or denticulate, dorsal appendage absent. Ovary lenticular, 0.3–0.6 mm long, glabrous. Style simple, 0.3–0.5 mm long, stigma capitate. Utricle with membranous covering, irregularly fragmenting. Seed ovoid, 1–1.5 mm long, 0.9–1.1 mm wide, 0.7–0.8 mm deep, brown. **Fig. 2.**

***Additional selected specimens examined*: Queensland.** North Kennedy District: 3 km along Tumoulin Road from Kennedy Highway Junction, Jan 2004, *McDonald 1692* (BRI). South Kennedy District: Eungella Range, Sep 1938, *White 12979* (BRI). Leichhardt District: Crows Apple Scrub, 'Rookwood', Apr 1991, *Forster PIF7977 & McDonald* (BRI); Rosedale near Baralaba, Sep 1959, *Johnson 920* (BRI). Brigalow Research Station, 20 miles [33 km] NW of Theodore, Mar 1963, *Johnson 2632* (BRI); Auburn Range S.F., about 50 km S of Thangool, Jun 1996, *Bean 10363* (BRI); road to Sandstone Bore, S.F. 46, NW of Taroom, Jan 2003, *Bean 19921* (BRI). Port Curtis District: Bulburin S.F. 67, vicinity of Forest station, Apr 1980, *McDonald et al. 3228* (BRI, CANB). Burnett District: Bunya Mountains. Near Mowbullan guest house, Jun 1961, *Willis s.n.* (MEL). Wide Bay District: Stony Creek, 4 km E of Didcot, Biggenden Shire, Dec 1984, *Forster PIF1969* (BRI); Glastonbury district; *c.* 24 km WSW of Gympie, Apr 1978, *Henderson 2623* (BRI). Darling Downs District: Teviot Range, 35 km NE of Killarney (SW of Wilsons Peak), May 1971, *Briggs 4210* (NSW). Moreton District: 10 km E of Mt Nebo, Nov 1980, *Dillewaard & Olsen 241* (BRI, CANB); Table Top, Main Range, Toowoomba, May 1937, *Roe A27* (CANB); Lamington N.P., near turnoff to Moran's Falls from O'Reilly's guest house, May 1981, *Willis s.n.* (MEL). **New South Wales.** 0.5 km along Tucker Box Road, Breury S.F., 20 km NNW of Urbenville, Nov 1987, *Coveny et al. 12810* (CANB, NSW); 'The Native Vineyard' (near Cobbity Trig), 5.5 km N of Cobbity, Mar 1976, *Coveny et al. 7445* (NSW); Waa Gorge, Mt Kaputar N.P., 68 km NE of Narrabri by road, Nov 1976, *Coveny & Roy 9019* (NSW); Yellow-Rock Road, about 4 miles [6.6 km] SW of 'Albion Park', Feb 1967, *Evans 2584* (BRI, CANB, MEL, NSW); Berry, Jan 1929, *George s.n.* (NSW); Acacia Creek, Jan 1956, *Gray 3787* (CANB); 'Taroona', south of Bowling Alley Point, Mar 1995, *Hosking 1096* (CANB); Scone, May 1902, *Maiden & Boorman s.n.* (NSW); 'Bajoloma', Cowal Creek Road, Bellangry, Sep 1987, *Miller & Whaite 458* (CANB); Between Kiama and Jamberoo, South Coast, Mar 1964, *Pullen 4028* (CANB, NSW); *c.* 8 km SW of Beelbrook on Mackenzies Creek Road, Apr 1976, *Wilson 1564* (NSW); 5.8 km W of Bingara on Narrabri Road, May 1985, *Wilson 6232* (BRI, NSW).

***Distribution and habitat*:** *Nyssanthes diffusa* extends from the southern coast of New South Wales to Ravenshoe in north Queensland. While most occurrences are within 200 km of the coast, it does extend as far inland as Carnarvon Station, south-west of Springsure (**Map 2**). It inhabits sunny spots (e.g. along tracks) in rainforest (especially the Araucarian vine forests), and sometimes in eucalypt open forest. When it occurs in eucalypt communities, it is usually found in a shady microhabitat.

***Phenology*:** Flowers and fruits may be found at any time of the year.

***Typification*:** There are three sheets of *Nyssanthes media* located at BM. The sheet BM000795233 has a reference to Brown's *Prodromus* written on the label in Brown's handwriting attached to the specimen on the right hand side of the sheet and is here designated as the lectotype. The specimen on the left hand side of the sheet has a different location (Mount Hunter) and is a lusher specimen than normal and has been designated as a residual syntype. The other two BM sheets (000795234 and 000795235) do not have labels in Brown's handwriting but have other labels indicating Port Jackson and match the lectotype material (J.G. West *pers. comm.*). These are here designated as isolectotypes.

***Notes*:** The basal (first-formed) flowers of the inflorescence in this species are usually sterile. The bract and bracteoles and the posterior tepal are all long and rigid, and the latter has only a small hyaline swelling at its very base. The other tepals are much reduced, and there are no male or female parts. Bentham (1870) wrote "sometimes all three bracts are subulate almost from the base and 3 to 4 lines long". This is a reference to the sterile flowers, although he did not record them as such.

Nyssanthes media has been maintained in synonymy here following Bentham (1870) as there are not enough characters to distinguish it from *N. diffusa*. Brown (1810) separated

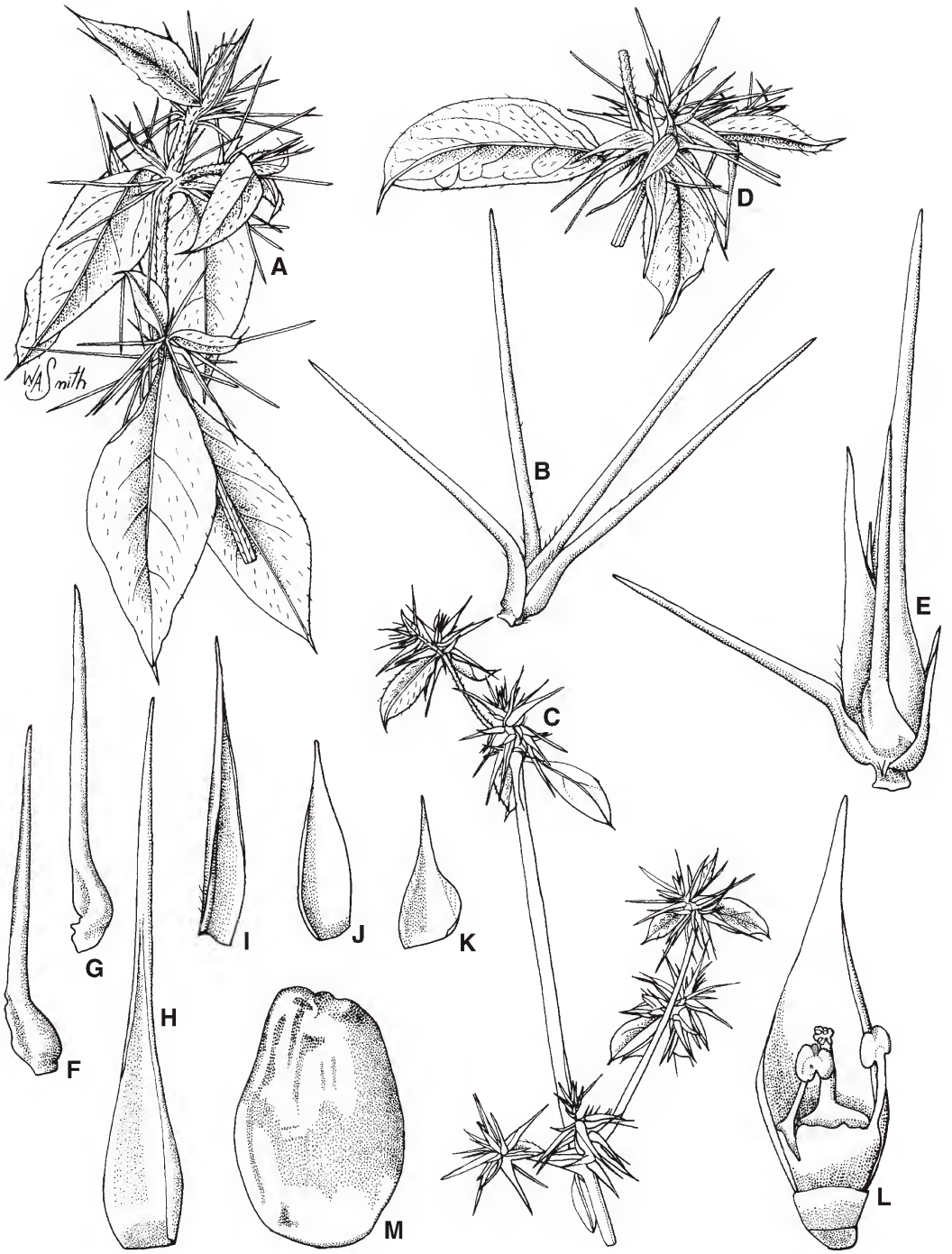

Fig. 2. ***Nyssanthes diffusa***. A. branchlet with sterile flowers × 2. B. sterile flower × 6. C. branchlet with fertile flowers × 1.5. D. inflorescence with fertile flowers × 3. E. fertile flower × 12. F. bract × 12. G. bracteole × 12. H. outermost tepal × 12. I. second tepal × 12. J. third tepal × 12. K. innermost tepal × 12. L. style, stamens and pseudostaminodes × 24. M. seed × 24. A, B from *Bean 19921* (BRI); C–L from *Bean 10363* (BRI); M from *Johnson 920* (BRI). Del. W.Smith.

the two taxa by the number of nerves on the tepals, the level of pubescence of the plant and the awn to leaflet ratio. Examination of the type specimens found that the first two characters varied considerably and could not be used to consistently separate the taxa. The third character is not useful as it is not clear from his descriptions as to his definition of an awn and several interpretations are possible. Bentham (1870) stated that "*N. media* appears to me to be rather a luxuriant state than a variety of *N. diffusa*".

***Conservation status*:** A widespread and relatively common species.

3. Nyssanthes impervia A.R.Bean **species nova** a finis *N. diffusae*, sed foliis hirsutioribus, inflorescentiis 3-floris, et staminibus fertilibus 4 antheris 0.2–0.3 mm longis, distinguenda. **Typus:** Queensland. Gregory South District: 4 km (direct) NNW of 'Trinidad' Homestead, E of Windorah, 1 September 2010, *A.R. Bean 30219* (holo: BRI; iso: CANB, K, MEL, NSW).

Divaricately branched, woody shrub up to 1 m high. Stems obscurely grooved or terete, young growth moderately to densely tomentose; hairs antrorse, appressed to spreading, 0.15–0.4 mm long. Petioles 0–2 mm long. Lamina broadly elliptical, 5–11 mm long, 2.5–6 mm wide, 1.8–2.2 times longer than broad, with dense hairs on both surfaces when fully expanded; hairs unicellular, appressed, 0.25–0.6 mm long; base cuneate, apex mucronate (mucro 0.7–2.1 mm long). Inflorescences 3-flowered; rachis absent. All flowers fertile, lateral flowers maturing before central flower. Bract 6–8.5 mm long, 0.8–1.2 mm wide, remaining attached to stem upon disarticulation of fruit; basal part ovate, hyaline, 1.2–1.6 mm long, sparsely tomentose; upper part subulate, 4.5–7 mm long. Bracteoles 5.2–7.8 mm long, 1.5–2 mm wide; basal part ovate, hyaline, 1.3–1.8 mm long, acumen 4.2–6.5 mm long, spreading, spinose. Perianth 1.2–1.8 mm wide. Longest tepal lanceolate-acuminate, 6.5–9.5 mm long, straight, glabrous, midrib prominent and 2 or 3 pairs of lateral ribs visible; apex spinose. Next longest tepal lanceolate-acuminate, 5–6.8 mm long, with dense, appressed to spreading tomentum on outer surface, apex acute, not spinose. Inner 2 tepals deltate, 3.5–6.2 mm long, with moderately dense, appressed to spreading tomentum on outer surface, apex acute, not spinose. Fertile stamens 4, filaments 0.2–0.45 mm long; anthers 0.2–0.3 mm long, white. Staminodes absent. Pseudostaminodes 4, quadrate, *c.* 0.3 mm long, distal margin irregular, dorsal appendage absent. Ovary oblate, *c.* 0.25 mm long, glabrous. Style simple, 0.6–0.8 mm long, stigma capitate. Fruits not seen. **Fig. 3.**

***Additional specimens examined*: Queensland.** Gregory South District: 4 km (direct) NNW of 'Trinidad' Homestead, E of Windorah, Sep 2010, *Bean 30228* (AD, BRI, US); Cheviot Range, *c.* two-thirds of the way between 'Budgerygar' Homestead and 'Trinidad' Homestead (towards Trinidad), Aug 1997, *Purdie 4598* (BRI, CANB).

***Distribution and habitat*:** *Nyssanthes impervia* is currently known only from the type location in south-western Queensland (**Map 3**). It inhabits shallow sandy soils at the base of rock outcrops or cliffs, in low open woodland dominated by *Acacia catenulata* C.T.White, *A. shirleyi* Maiden or *Eucalyptus thozetiana* F.Muell. ex R.T.Baker. Other associated shrubs include *Eremophila* spp., *Ptilotus obovatus* and *Sida* spp.

***Phenology*:** Flowers are recorded in August and September; fruits have not been collected.

***Notes*:** *Nyssanthes impervia* is similar to *N. diffusa*, but differs by the denser indumentum of the leaves, the 3-flowered inflorescences (up to 22-flowered for *N. diffusa*), the 4 fertile stamens in each flower (2 fertile stamens for *N. diffusa*), and the anthers 0.2–0.3 mm long (0.25–0.4 mm for *N. diffusa*). It is similar stature and appearance to *Nyssanthes longistyla*. However, *Nyssanthes impervia* differs by the much shorter style (0.6–0.8 mm long), and the pseudostaminodes that lack a dorsal appendage.

***Conservation status*:** There are 300–400 plants of this species currently known at the type locality. Feral goats are present in the area (J. Silcock *pers. comm.* Nov 2010) and the effects of their grazing were evident on most plants in September 2010. Under the

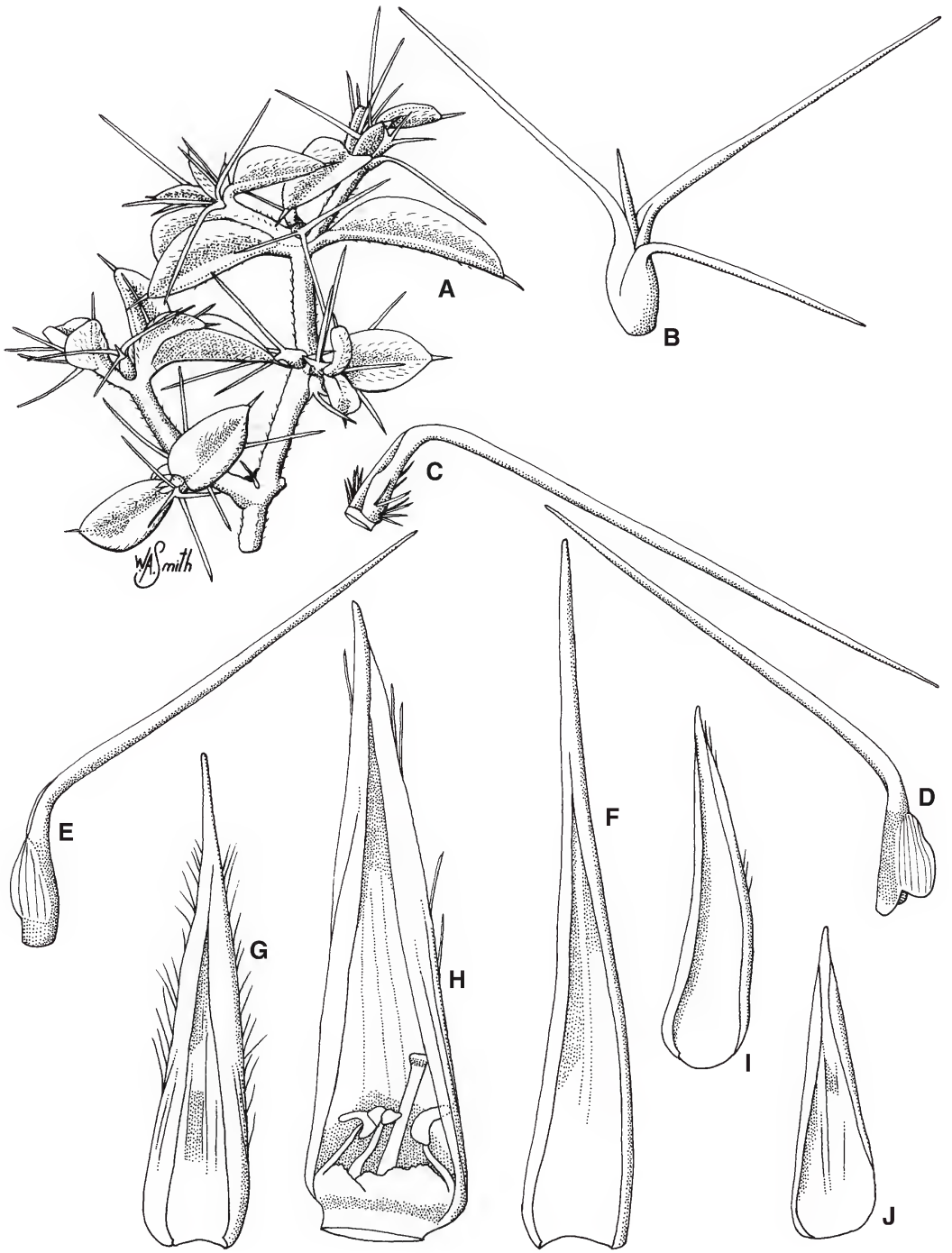

Fig. 3. ***Nyssanthes impervia***. A. flowering branchlet × 3. B. immature flower × 9. C. bract × 12. D. bracteole × 12. E. bracteole × 12. F. outermost tepal × 12. G. second tepal × 12. H. style, stamens, pseudostaminodes and innermost tepal × 24. I. third tepal × 12. J. innermost tepal × 12. A–E from *Purdie 4598* (BRI); F–J from *Bean 30219* (BRI). Del. W.Smith.

criteria of the IUCN Red List (IUCN 2001), a conservation status of Vulnerable is suggested [VU B1ab(v) + 2ab(v); C1+2a(i,ii); D1+2].

***Etymology*:** From the Latin *impervius* meaning impassable. This is in reference to the very spiny nature of the plant, making it impervious to human touch and impassable to human traffic.

4. Nyssanthes longistyla C.H.Miller **species nova** distinguenda a *N. erecta* habitu lignea; tepalis duobus exterioribus pilis extus dense obtectis; tepalis interioribus, filamentis staminalibus, antheris et stylo longioribus; pseudostaminodiis multo longioribus, laciniatis et fimbriatis, dorsaliter squama trifida praeditis; fructibus multo latioribus. **Typus:** Queensland. Gregory North District: Mt Booka Booka, Elderslie Station, *c.* 6 km E of Diamantina River, Boulia – Winton road, 10 June 1997, *L.A.Craven, C.L.Brubaker & J.P. Grace 9915* (holo: CANB; iso: AD, BRI, DNA, K, MEL, MO, NSW).

Dichasially branched woody shrub up to 1.2 m tall. Stems striate, grooved, on older stems, young growth densely tomentose; hairs antrorse, appressed to spreading, 0.3–0.6 mm long. Petioles 0.5–3.5 mm long. Lamina elliptical, 6–15 mm long, 3–8.5 mm wide, 2–2.5 times longer than broad, moderately tomentose on both surfaces when fully expanded; hairs unicellular, appressed to spreading, 0.5–1 mm long; base attenuate to cuneate, apex mucronate, (mucro 0.5–1.3 mm long). Inflorescence with (2–) 5–8 flowers; rachis to 1 mm long. All flowers fertile. Bract 3.2–6.5 mm long, 1.4–2 mm wide, remaining firmly attached to rachis upon disarticulation of fruit; basal part ovate to broadly ovate, hyaline, 1.2–2.5 mm long, becoming recurved with maturity, glabrous or with a few hairs on back near base; upper part subulate, 2.5–5.8 mm long. Bracteoles 4–7.2 mm long, 1.7–2.3 mm wide; base ovate to broadly ovate, hyaline, 1.5–2.8 mm long, acumen 2.5–6.5 mm long, spinose; moderately tomentose along edge of nerve, remaining attached to perianth upon disarticulation of flower. Perianth 1.5–2.2 mm wide. Longest (posterior) tepal lanceolate-acuminate, 6.5–9 mm long, straight, sparsely tomentose along edge of nerve of top half; midrib prominent and 3–5 pairs of lateral longitudinal ribs visible; apex spinose. Next longest (anterior) tepal similar, 5.5–7.5 mm long, densely tomentose. Inner 2 tepals narrowly–ovate, 5–6.5 mm long, glabrous; apex acuminate. Fertile stamens 4, filaments slender, 2.6–3.3 mm long; anthers 1.2–1.7 mm long, cream. Staminodes absent. Pseudostaminodes 4, quadrate, 1.5–2 mm high, distal margin laciniate, fimbriate translucent, dorsal appendage trifid with ciliate margins, 0.6–1.1 mm long. Ovary obconical, *c.* 0.8 mm long, glabrous. Style simple, 2.7–3.5 mm long, stigma capitate. Utricle with membranous covering, irregularly fragmenting. Seed ellipsoid, 1.8–2.1 mm long, 1.4–1.5 mm wide, brown. **Fig. 4.**

***Additional specimens examined*:** **Queensland:** Mitchell District: Mt Felix, *c.* 90 km N of Jundah on road to Winton, May 2010, *Bean 29779 & Emmott* (BRI, CANB, MEL, MO). Gregory North District: On upper slopes of Mt Booka Booka, 'Elderslie', Oct 1935, *Blake 10056* (BRI, NT); Mt Booka Booka, 'Elderslie', *c.* 70 km W of Winton, Aug 2009, *Silcock s.n.* (BRI [AQ785536]).

***Distribution and habitat*:** Endemic to Queensland, where it is known from two locations in the west of the state (**Map 3**). It grows on the upper slopes of mountains in gravelly shaly soil in association with other shrubby genera including *Senna* and *Abutilon*.

***Phenology*:** Flowers and fruits have been recorded in May, August and October.

***Notes*:** This species varies considerably from the other species of *Nyssanthes*. It differs from *Nyssanthes erecta* by being a woody shrub sometimes more than a metre tall, densely covered in hairs all over; leaves are small and elliptic; the tepals are usually densely covered with hairs on the outside; the fruits are much broader; style, staminal filaments, anthers and pseudostaminodes are much longer. It is the only *Nyssanthes* species to have a trifid appendage on the dorsal surface of the pseudostaminode. It and *Nyssanthes impervia* have a scattered distribution in inland Queensland, compared to the more extensive distribution of *N. erecta* and *N. diffusa* throughout large areas of eastern Queensland and New South Wales.

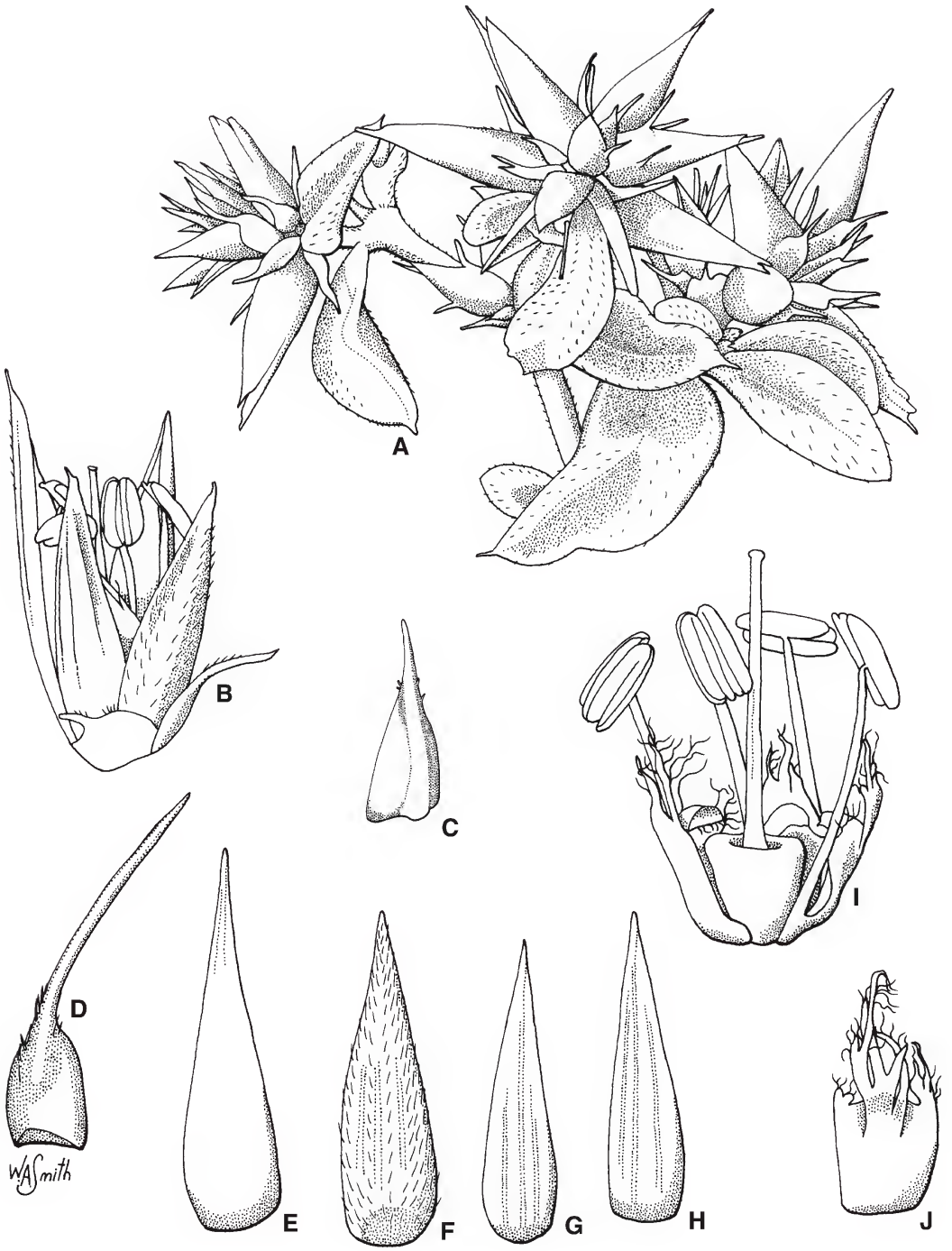

Fig. 4. ***Nyssanthes longistyla***. A. flowering branchlet × 4. B. flower at anthesis × 8. C. bracteole × 12. D. bract × 12. E. outermost tepal × 12. F. second tepal × 12. G. third tepal × 12. H. innermost tepal × 12. I. ovary, style, stamens and pseudostaminodes × 12. J. pseudostaminode × 16. A–C, E–J from *Bean 29779 & Emmott* (BRI); D from *Silcock s.n.* (BRI [AQ785536]). Del. W.Smith.

***Conservation status*:** There are between 100 and 200 plants present of this species on Mt Booka Booka (J.Silcock *pers. comm.* Aug 2009), and all plants are very heavily grazed by feral goats. At Mt Felix, there are more than 1000 plants; here all plants are in good condition and feral goats are not present. Applying the criteria of the IUCN Red List (IUCN 2001), a conservation status of Vulnerable is proposed. [VU B1ab(v) + 2ab(v); C1; D2].

***Etymology*:** From the Latin *longus* meaning long and *stylus* meaning style in reference to its long style. The other *Nyssanthes* taxa have styles that are 0.3–0.8 mm long, while in *N. longistyla* the style is 2.7–3.3 mm long.

Acknowledgements

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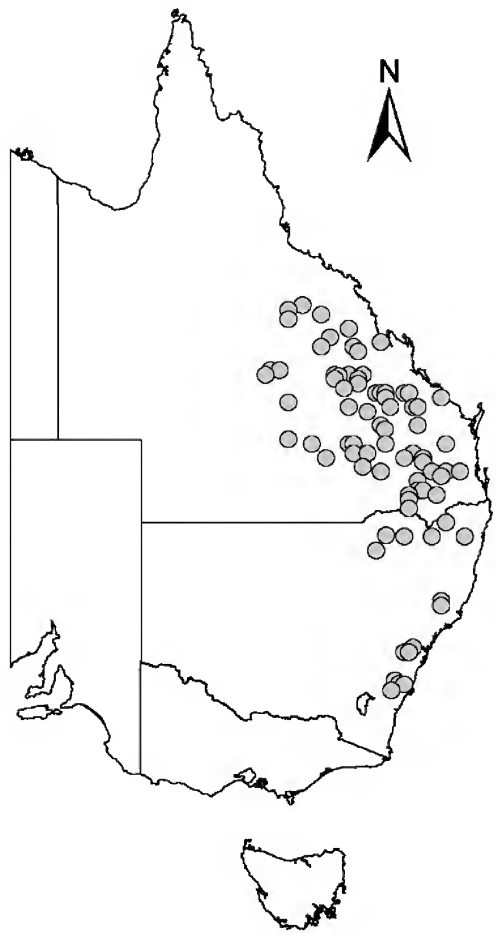
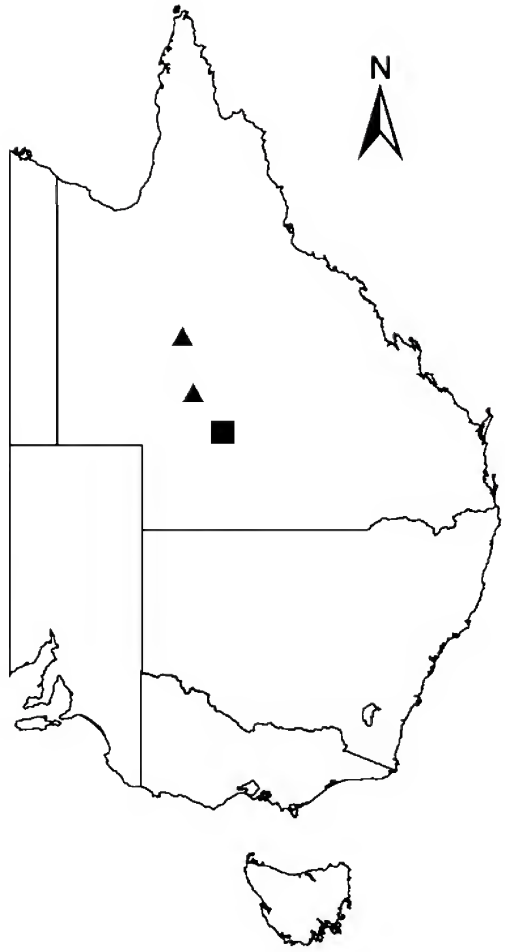


Map 1. Distribution of *Nyssanthes erecta*

Map 2. Distribution of *Nyssanthes diffusa*



Map 3. Distribution of *Nyssanthes impervia* ■ and *N. longistyla* ▲

A taxonomic revision of *Pterocaulon* section *Monenteles* (Labill.) Kuntze (Asteraceae: *Inuleae–Plucheinae*)

A.R. Bean

Summary

Bean, A.R. (2011). A taxonomic revision of *Pterocaulon* section *Monenteles* (Labill.) Kuntze (Asteraceae: *Inuleae–Plucheinae*). ***Austrobaileya* 8(3): 280–334.** *Pterocaulon* section *Monenteles*, comprising all species of the genus from Asia, Malesia, Australia and Melanesia, is revised. 14 species are recognised, including the six new species, *P. brachyanthum* A.R.Bean, *P. ciliosum* A.R.Bean, *P. discolor* A.R.Bean, *P. paradoxum* A.R.Bean, *P. tricholobum* A.R.Bean and *P. xenicum* A.R.Bean, and one new combination, *P. intermedium* (DC.) A.R.Bean. Descriptions, illustrations, and distribution maps are provided for all taxa. *Monenteles sphacelatus* and *M. spicatus* are lectotypified. The ecology, chemistry and diagnostic morphological characters of members of the section are discussed, and an identification key to species is provided.

Key Words: Asteraceae, *Pterocaulon*, *Pterocaulon brachyanthum*, *Pterocaulon ciliosum*, *Pterocaulon discolor*, *Pterocaulon intermedium*, *Pterocaulon paradoxum*, *Pterocaulon tricholobum*, *Pterocaulon xenicum*, taxonomy, Australia flora, New Caledonia flora, Malesia flora, coumarins, identification key, taxonomy, new species

A.R.Bean, Queensland Herbarium, Department of Environment and Resource Management, Brisbane Botanic Gardens, Mt Coot-tha Road, Toowong, Queensland 4066, Australia. E-mail: tony.bean@derm.qld.gov.au

Introduction

Pterocaulon Elliott comprises 26 species distributed in North America, South America, south-east Asia, Malesia, Melanesia and Australia. In a revision of the genus by Cabrera & Ragonese (1978), four taxonomic sections were recognised. Three of these sections consist wholly of American species while the fourth, *Pterocaulon* section *Monenteles* (Labill.) Kuntze, comprises all of the Old World taxa.

Monenteles Labill. was described at generic rank by Labillardière (1825), with two species, *M. sphacelatus* Labill. and *M. spicatus* Labill., both named from specimens collected in New Caledonia. De Candolle (1836) and Bentham (1867) maintained *Monenteles* at generic rank, but the latter commented, "From the American genus *Pterocaulon* it scarcely differs in the hermaphrodite flowers usually reduced to a single one".

The reduction of *Monenteles* to synonymy with *Pterocaulon* was effected by Bentham (1873), and species combinations were made by Mueller (1882). *Monenteles* was reinstated as a section of *Pterocaulon* by Kuntze (1903). Anderberg (1989) suggested that the genus *Monenteles* could be resurrected, but later (Anderberg 1991) he abandoned the idea.

The differences between *Pterocaulon* section *Pterocaulon* and *P.* section *Monenteles* are minimal. Nesom (2006) stated that species in *Pterocaulon* section *Pterocaulon* have 1–17 functionally staminate florets per capitulum, a 1 or 2-seriate pappus, and the hairs have a relatively long aseptate portion arising from a cluster of basal cells; while species in *P.* section *Monenteles* have a single staminate floret per capitulum, a uniseriate pappus, and the hairs are more-or-less uniformly septate throughout.

Pterocaulon has been consistently placed in the *Pluchea*-group of genera. The rank of this group was originally a Subtribe (Subtribe *Plucheinae* Benth. & Hook.f. of the Tribe *Inuleae* Cass.; Bentham 1873); then it was deemed a Tribe (Tribe *Plucheeae* A.Anderb.; Anderberg 1991, 1994). Evidence from molecular data now favours subtribal rank (Anderberg *et al.* 2005). Within the subtribe, Anderberg (1991) grouped *Pterocaulon* alongside *Neojeffreya* Cabrera and *Stenachaenium* Benth. in the "Pterocaulon clade".

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Pterocaulon species are readily identified by the winged stems formed by decurrent leaf bases, the sessile capitula grouped into spiciform, cylindrical or spherical secondary heads (capitulescences), and the pappus of capillary bristles. In *Pterocaulon* section *Monenteles*, the secondary heads are usually aggregated to form a globose or ellipsoidal capitulescence, and only two or three species have a spicate or cylindrical capitulescence. *Pterocaulon* is sometimes confused with the related genus *Sphaeranthus* L., as the latter also has globose capitulescences and winged stems. However, *Sphaeranthus* differs by the much-reduced capitula and the florets that lack a pappus.

Cabrera & Ragonese (1978) recognised six species in *Pterocaulon* section *Monenteles*, including one species newly described therein. Wilson (1992) reinstated *Pterocaulon globuliflorum* W.Fitzg., so that there were seven accepted species prior to this study, *viz. P. globuliflorum*, *P. niveum* Cabrera & A.M.Ragonese, *P. redolens* (Willd.) Fern.-Vill., *P. serrulatum* (Montrouz.) Guillaumin, *P. sphacelatum* (Labill.) F.Muell., *P. sphaeranthoides* (DC.) F.Muell. and *P. verbascifolium* (Benth.) F.Muell.

Fourteen species are recognised in this paper. The following species are described as new; *Pterocaulon brachyanthum* A.R.Bean, *P. ciliosum* A.R.Bean, *P. discolor* A.R.Bean, *P. paradoxum* A.R.Bean, *P. tricholobum* A.R.Bean and *P. xenicum* A.R.Bean. *Monenteles intermedius* DC. is reinstated and transferred to *Pterocaulon*. *Pterocaulon serrulatum* is maintained with two varieties.

Materials and methods

This revision is based on morphological examination of herbarium specimens from A, AMES, BRI, CANB, CNS, DNA, GH, K, L, MEL, NOU and PERTH, and images of type specimens from B, FI, G, K and P. Specimens from NSW and P were not available for loan when this paper was being prepared.

All measurements were made from dried material. Leaf measurements are of cauline leaves only, and do not include leaves from the basal rosette (if present). Leaf length is the distance from the apex to where the midrib joins the stem. The width of the stem wings was measured on the main stem at 20–25 cm from the apex of the specimen.

Measurements of the dimensions of capitulescences (secondary heads) reported in this paper were made at or near anthesis, on capitulescences where the corolla lobes of the hermaphrodite floret were open, and where the inner involucral bracts and the florets were still attached to the receptacle. After anthesis, and especially in fruiting plants, the inner bracts and florets become detached from the receptacle and form expanded "fluffy" heads, often two or more times the diameter of the intact heads. Pappus length was measured on female florets.

Notes on conservation status have not been given. Most species are common and widespread; for the species that may perhaps be threatened (*Pterocaulon discolor*, *P. globuliflorum*, *P. xenicum*), I have no knowledge of their extent or population sizes.

The catalogue of Malesian plant collectors (van Steenis-Kruseman 2006-onwards) was used for checking the interpretation of label data of Malesian specimens.

Species treatments are arranged in alphabetical order. Common abbreviations used in the specimen citations are N.P. (National Park) and S.F. (State Forest).

Chemistry

Species in the genus *Pterocaulon* are rich in chemical compounds, particularly coumarins and flavonoids. These are thought to have a biocidal effect against bacteria and fungi, and to protect against herbivory (Daniel *et al.* 1999).

Johns *et al.* (1968) identified 6,7-dimethoxycoumarin as a major alkaloid constituent of a *Pterocaulon* from Inkerman, Queensland, which they identified as *P. sphacelatum*. I have located the specimen on which this is based. It is held at CANB (Inkerman, 8 June 1960, *W.T.Jones 1531*), and it bears a stamp saying "Voucher for identity of Bulk Sample No. 6489, Aust. Phytochemical Survey". The specimen is *Pterocaulon intermedium*.

MacLeod & Rasmussen (1999) reported the identification of a new caryophyllene from *Pterocaulon serrulatum*, as well as three coumarins and a flavanone. Semple *et al.* (1998) found that a flavonoid (chrysosplenol C) they extracted from the leaves of *Pterocaulon sphacelatum* has an antiviral effect, by inhibiting the replication of rhinoviruses, the most frequent causative agent of the Common Cold. *Pterocaulon* species, especially *P. sphacelatum* and *P. serrulatum* have traditionally been used by Aboriginal peoples as a medicine, helpful in the treatment of respiratory infections, colds and fevers (Barr *et al.* 1993; Latz 1995).

In Asteraceae Subtribe *Plucheinae, Pterocaulon* is the only genus known to contain coumarins, and around 40 different coumarins have been found in the 15 investigated species (Stein *et al.* 2007). These authors stated that although the species of *Pterocaulon* exhibit other classes of compounds, coumarins are characteristic of the genus and they postulated that they could be considered chemotaxonomic markers for the genus.

Ecology and distribution

Taxa belonging to *Pterocaulon* section *Monenteles* are forbs and shrubs. They do not occur in rainforest or other densely shaded areas and are primarily found in sunny shrublands, woodlands and open forests. Most species are confined to areas where the climate is frost-free and the rainfall exceeds *c.* 600 mm per year. All species show a preference for coarse-grained soils, probably because of the associated good drainage, but can sometimes be found on finer grained clay-loams. None however, occurs on cracking clays.

Many species of *Pterocaulon* clearly tolerate salt-bearing wind, as a few species are found in littoral habitats, not only in Australia, but also in Indonesia and New Caledonia. In coastal areas, they can be found close to salt marsh or mangrove communities, and in the arid areas close to salt lakes. The label for *Henry 952* (NT), collected from the Simpson Desert, says that *Pterocaulon sphacelatum* is "common in saline soil on surrounding edges of salt lake".

It is presumed that Pterocaulons do not have strict requirements with regard to soil acidity or soil chemistry. While they frequently occur on soils derived from sandstone, where the pH would be quite low, some species (e.g. *Pterocaulon globuliflorum*, *P. niveum*) occur on alkaline limestone substrates. In New Caledonia and near Rockhampton in Queensland, *Pterocaulon* spp. occur on serpentinite, and the soils that develop there are toxic to most plant species.

As with numerous other species in the Asteraceae, *Pterocaulon* species are pioneer plants. Accordingly, they favour places that have been disturbed by fire or machinery, and may occur in large numbers at such sites. For this reason, they are sometimes regarded as weeds, but they are readily displaced by alien species that have a similar ecological preference.

The life cycle is not known in detail for any species of *Pterocaulon* section *Monenteles*. All species appear to develop a rootstock of some kind, and in some species (e.g. *P. intermedium*) it is distinctly woody. Some species are clearly perennial, living for three or four years at least; while others are probably annual resprouters (above-ground parts dying each year, but resprouting for one or more years).

Pterocaulon section *Monenteles* is distributed in southern China, Burma, Thailand, Indochina, Malesia, much of Australia (north of about 30°S), New Caledonia and Vanuatu. The greatest diversity of species is in the Kimberley region of Western Australia and the 'Top End' of the Northern Territory. Only one species (*Pterocaulon brachyanthum*) does not occur in Australia.

Discussion of characters

1. Winged stems

Winged stems formed from the decurrent leaf bases are a constant feature of all species in the genus, and the generic name is derived from this attribute. The width of the stem wings is useful in distinguishing some species in *Pterocaulon* section *Monenteles*. For example, the stem wings of *Pterocaulon niveum* are invariably narrow (usually 0.5–

1.5 mm wide), while the stem wings of the vegetatively similar *P. verbascifolium* are broad (usually 2.5–6 mm wide). In *Pterocaulon serrulatum* and *P. sphaeranthoides* the stem wings are serrated; in other species they are nearly always entire (*P. sphacelatum* and *P. brachyanthum* sometimes have sparsely toothed stem wings).

2. Leaves

Some species, and perhaps all species, begin as a rosette of leaves at ground level. Knowledge about this stage of the plant's life cycle is poor, as these leaves are rarely represented on herbarium specimens. In some species, the cauline leaves are obovate or oblanceolate, i.e. broadest above the middle, while in others, they are elliptical, i.e. broadest at around the midpoint. The upper leaf surface of most species is bullate to a greater or lesser extent. The leaf margins are always dentate to denticulate, though sometimes appearing entire as the teeth can be obscured by dense indumentum or by recurved margins.

3. Leaf indumentum

Lanate hairs (uniseriate, multicellular) (**Fig. 1A**) are found in all species, but their density varies greatly, with some taxonomic correlation. In *Pterocaulon verbascifolium* and *P. niveum*, the lanate hairs are dense enough to obscure the lamina surface even under magnification; in *P. sphaeranthoides* and *P. serrulatum* var. *serrulatum*, the lanate hairs may be very sparse. The upper leaf surface often has a sparser indumentum than the lower, and this is particularly the case in *Pterocaulon discolor*. In *Pterocaulon intermedium*, the lanate hairs on the upper surface are as dense as or denser than those on the lower surface.

Two taxa have broad-based stalked glandular hairs on the leaves and stem wings (**Fig. 1B**). Globose sessile glands (often shining-yellow) are found on the lower leaf surface of all species, and their density can be diagnostic for some species (**Fig. 1A**).

4. Capitulescence (secondary head) shape and diameter

The capitulescences of *Pterocaulon globuliflorum* and *P. brachyanthum* are consistently narrower in diameter than other species in the section.

While head shape varies within species, it is still quite diagnostic. Three species (*Pterocaulon serrulatum, P. redolens* and *P. verbascifolium*) have heads usually described as cylindrical or spicate. In *Pterocaulon paradoxum*, capitulescences are usually markedly ellipsoidal, though sometimes approaching globose. Similarly, the heads of *Pterocaulon serrulatum* are sometimes almost globose.

For the remainder, heads are globose or ellipsoidal; in some species (e.g. *Pterocaulon intermedium*) the capitulescences are always close to globose while in others (e.g. *P. sphaeranthoides*, *P. sphacelatum*) they may vary from globose to broadly-ellipsoidal, sometimes on the same plant.

5. Branching patterns and peduncles

Capitulescences are in some species predominantly sessile, while in others consistently pedunculate. Peduncle length can be reliably determined only for overtopped capitulescences, i.e. those where a side branch has arisen below it, exceeding it and producing a further (younger) capitulescence. The peduncle length is the distance between the base of the overtopped capitulescence and the insertion of the lateral branchlet. *Pterocaulon intermedium* is notable for its consistently pedunculate heads. The lateral branchlets usually protrude at 30–60° and sometimes at right angles to the subtending branch. In a few species with sessile capitulescences, e.g. *Pterocaulon tricholobum*, they may continue in more-or-less the same direction (0–30°), here termed 'continuous' branchlets (e.g. **Fig. 19**). Where this happens, the sessile capitulescence appears to be borne laterally and its shape can be globose-truncate.

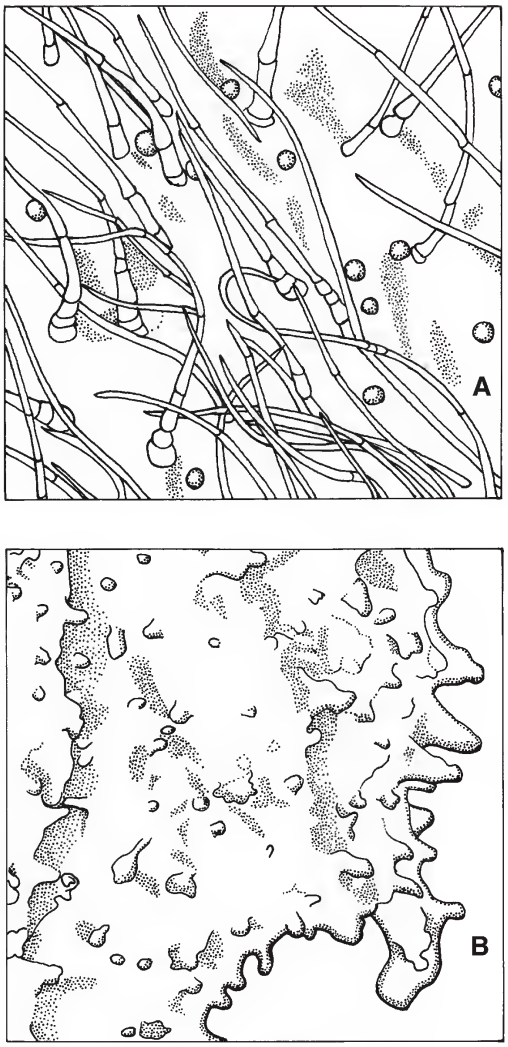

Fig. 1. Leaf hairs in ***Pterocaulon***. A. ***P. serrulatum*** var. ***velutinum***, showing lanate hairs and sessile glands × 40. B. ***P. serrulatum*** var. ***serrulatum***, showing broad-based glandular trichomes and sessile glands × 40. A from *Bean 22246* (BRI); B from *Fox 25 & Bean* (BRI). Del. W.Smith.

6. Inner involucral bracts

The inner involucral bracts offer some diagnostic characters. Firstly, the bract length (only the longest (innermost) bracts are documented in this paper) may be diagnostic for some species. Their colour may be white, straw-coloured or pink, or pink with violet speckles. The colour is not totally fixed for each species, but some species have predominantly pink bracts, some have predominantly white, and in others the bracts are straw-coloured.

The upper margins of the inner bracts may be entire, slightly toothed, strongly toothed or lacerate, and this is strongly correlated to the species. For example, in *Pterocaulon redolens* the upper margins are entire, tapering to an attenuate apex; in *P. sphacelatum*, the upper margins are often lacerate, and there is no single bract apex.

7. Cilia

The margins of the inner bracts of every species have ± straight, hyaline, antrorse cilia, up to 75% of the bract length. The cilia of different species may vary in number, position and length.

This character may be usefully employed on intact or in-situ heads, i.e. where the capitula are still attached to the receptacle. The cilia protrude beyond the outer bracts and may be seen alongside the inner bracts and the pappus. The cilia of the bracts are distinguishable from the bristles of the pappus because the cilia are not barbellate. The prominence of cilia varies greatly between species. In some species e.g. *Pterocaulon tricholobum*, *P. ciliosum*, numerous cilia are clearly visible on the protruding part of inner bracts, and in *P. ciliosum* only, these cilia can exceed the bract apices; in other species e.g. *P. intermedium*, *P. sphacelatum*, *P. brachyanthum*, very few if any cilia can be seen on the protruding part of inner bracts (**Fig. 2**).

8. Number of female florets per capitulum

The number of female florets is difficult to determine by casual observation of the capitulum, and an accurate count is rather tedious, involving removal of an intact capitulum and spreading out the contents so that each element is clearly visible. However, it can be very useful in distinguishing between some species in the section. Three groups of species can be distinguished using this character; *Pterocaulon redolens*, *P.serrulatum*, *P. verbascifolium* and *P. xenicum* with 26–58 florets; *P. ciliosum*, *P. globuliflorum*, *P. paradoxum*, *P. sphacelatum*, *P. sphaeranthoides* and *P. tricholobum* with

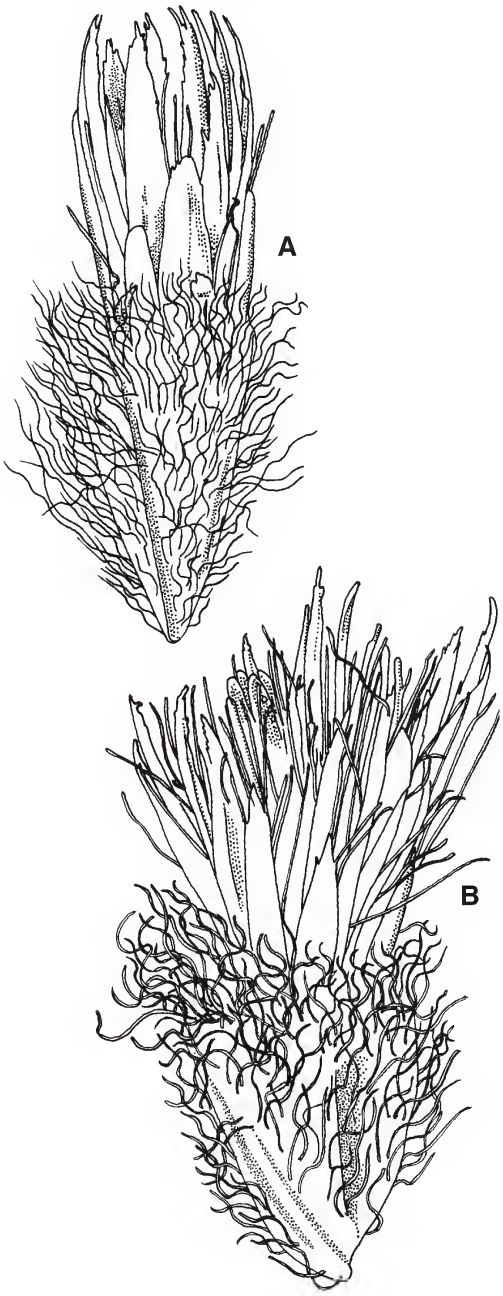

Fig. 2. Single capitula in ***Pterocaulon***. A. ***P. sphacelatum*** × 16. B. ***P. ciliosum*** × 12. A from *Piercey 51* (DNA); B from *Bean 19221* (BRI). Del. W.Smith.

14–29 florets; *P. brachyanthum*, *P. discolor*, *P. intermedium* and *P. niveum* with 7–17 florets.

9. Florets

There is a single hermaphrodite floret in each capitulum of every species, except *Pterocaulon verbascifolium* and *P. sphaeranthoides*, which can sometimes have two.

On this floret, a cluster of globose sessile glands is consistently present on the outer surface of each corolla lobe, for all species except *Pterocaulon verbascifolium*, in which these glands are lacking. In some species (e.g. *Pterocaulon tricholobum*) the corolla lobes of the hermaphrodite floret consistently bear numerous conspicuous eglandular unicellular trichomes on their outer surface. In other species (e.g. *Pterocaulon intermedium*) the lobes are always glabrous. In some species (e.g. *Pterocaulon ciliosum*) the trichomes are absent on some collections, but present on others.

The length of the corolla lobes of the hermaphrodite floret is taxonomically informative. In one group of species, the corolla lobes are 0.7–1.2 mm long; in another group, they are 0.3–0.6 mm long. In only two species (*Pterocaulon intermedium* and *P. paradoxum*) are the lobes of intermediate length.

The female florets are very slender, with an inconspicuously lobed corolla and a 2-fid style (**Fig. 20L**). The female corolla length can be diagnostic for species determination.

10. Achenes and pappus

The length of achenes varies from 0.5–1.2 mm within the section, with each species showing a small range of lengths. Twin hairs are found on the achenes of all species, but the number of hairs varies between species, and is hence taxonomically useful.

In a few species, it is possible to find a ring of transparent globose glands at the junction of the achene and the pappus (**Fig. 11L**). These glands are not consistently present in any species, but can most frequently be seen in *Pterocaulon redolens*. The pappus length varies between species and is often diagnostic,

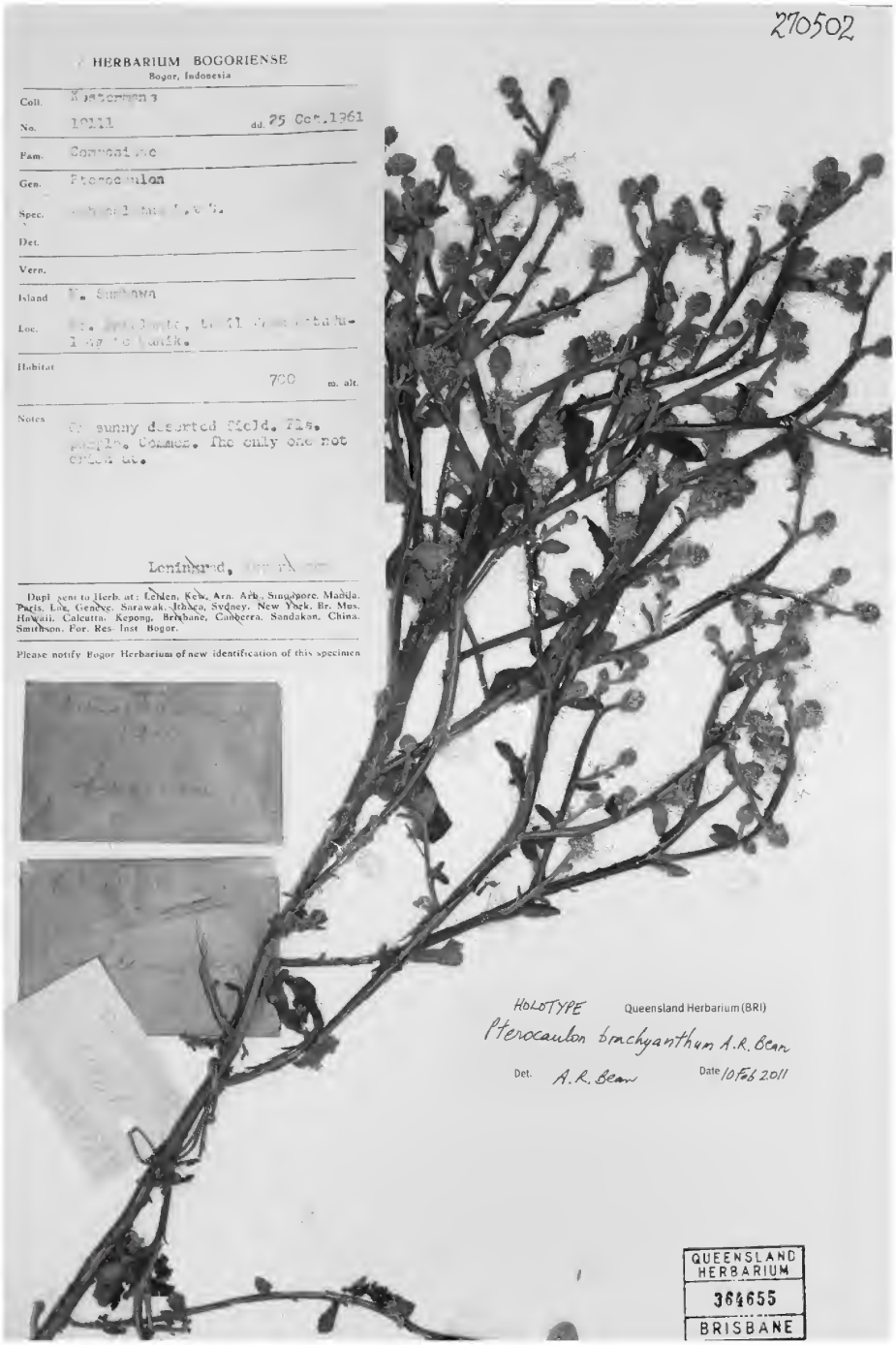

Fig. 3. Holotype of ***Pterocaulon brachyanthum*** (*Kostermans 19111* [BRI]).

but no other pappus characteristics appear to be of taxonomic utility.

Taxonomy

Pterocaulon section **Monenteles** (Labill.) Kuntze, *Lex. Gen. Phan.* 468 (1903); *Monenteles* Labill., *Sert. Austro-Caledon.* 42, t. 43, 44 (1825). **Type species:** *Monenteles spicatus* Labill. (= *Pterocaulon redolens* (Willd.) Fern.-Vill., *fide* Cabrera & Ragonese [1978: 202]).

Annually resprouting or perennial forbs or shrubs, often aromatic. Basal rosette present in some species. Stems conspicuously winged due to decurrent leaf margins, wings extending for 1 and 2 nodes. Leaves alternate, sessile, decurrent; indumentum of uniseriate, multicellular hairs; hairs of the upper surface with short basal cells and relatively long upper cells; hairs of the lower surface with cell length relatively uniform throughout; broad-based glandular hairs sometimes present; lower surface with yellow, shining, globose sessile glands. Capitulescences terminal, monochasially cymose; globose, ellipsoidal, cylindrical or spiciform; partial clusters subtended by a bract. Capitula cylindrical, with involucral bracts in two series; the outer bracts persistent, lanate-hairy and sometimes glandular-hairy, all similar in size; the inner bracts caducous, margins with ± straight, spreading to antrorse cilia, dorsal surface glabrous or with tiny translucent sessile glands, inner whorls slender, outer whorls shorter and broader. Receptacle epaleate, glabrous. Outer florets numerous, filiform, female; corolla three-lobed, style bifid. Disc floret hermaphrodite, solitary (rarely 2), tubular, functionally male; corolla broad, 5-lobed; anthers tailed; style bifid; style branches with acute sweeping-hairs reaching beyond the furcation. Achenes narrowly-ellipsoid to obovoid, with a conspicuous white ring-shaped carpopodium; twin hairs antrorse, appressed. Pappus comprising a single row of barbellate capillary bristles, united at the base, persistent.

Cytology

The only published cytological record for *Pterocaulon* section *Monenteles* is $n = 10$ for *Pterocaulon sphacelatum* (Watanabe *et al.* 1999).

Etymology

Monenteles is derived from the Greek *monos* meaning 'single' and *enteles* meaning 'complete, entire or perfect'. This refers to the single hermaphrodite floret in each capitulum, surrounded by numerous female florets.

Fourteen species; distributed in Australia, Melanesia, Malesia and South-east Asia.

Key to the species of *Pterocaulon* section *Monenteles*

1 Capitulescences globose-ovoid, spherical to ellipsoidal, 0.7–2.1 times longer than wide **2**
1. Capitulescences cylindrical or spicate, 2.2–5.8 times longer than wide **13**

2 Some capitulescences on each plant laterally placed on continuous branchlets, side branches erect or diverging at less than 30 degrees (**Fig.7**) **3**
2. All capitulescences terminal, side branchlets diverging at 30–90 degrees (**Fig. 5**) **6**

3 Stem wings broad, 2.8–5.5 mm wide . . . . . **12. P. tricholobum**
3. Stem wings narrow, 0.3–2.5 mm wide **4**

4 Upper side of leaves with dense to very dense lanate indumentum; inner involucral bracts pink to violet in dried specimens . . . . . **6. P. niveum**

4. Upper side of leaves with sparse lanate indumentum; inner involucral bracts greenish-white to white in dried specimens **5**

5 Capitulescences 8.5–10 mm wide; pappus 1.3–1.8 mm long . . . . . **4. P. globuliflorum**
5. Capitulescences 11–13 mm wide; pappus 2.6–3.4 mm long . . . . . **3. P. discolor**

6 Stem wings serrate or dentate **7**
6. Stem wings entire or sparsely toothed **8**

7 Leaf upper surface conspicuously bullate; few or no cilia visible on protruding part of inner bracts (**Fig. 2A**); inner bracts pink, violet or white . . . . . **11. P. sphaeranthoides**

7. Leaf upper surface not or slightly bullate; many cilia visible on protruding part of inner bracts (**Fig. 2B**); inner bracts white or greenish-white . . **9. P. serrulatum**

8 Capitulescences 8.5–10 mm wide at anthesis; longest inner bracts 2.8–3.5 mm long; sessile glands on lower leaf surface very sparse . . . . . **1. P. brachyanthum**
8. Capitulescences 10–15 mm wide at anthesis; longest inner bracts 3.4–5.6 mm long; sessile glands on lower leaf surface sparse to dense **9**

9 Female florets 8–17 per capitulum; achenes hairs 0–25; leaves elliptic to lanceolate, broadest near the middle . . . . . **5. P. intermedium**
9. Female florets 16–44 per capitulum; achenes hairs 25–50 or more than 50; leaves oblanceolate to obovate, broadest towards apex **10**

10 Corolla lobes of hermaphrodite floret 0.5–0.8 mm long; numerous cilia visible on protruding part of inner bracts, but none exceeding apices . **7. P. paradoxum**

10. Corolla lobes of hermaphrodite floret 0.35–0.6 mm long; cilia on protruding part of inner bracts either few or absent, or cilia abundant with some exceeding bract apices **11**

11 Stem wings 0.3–0.5 mm wide; longest inner bracts 4.8–5.6 mm long . . . . **14. P. xenicum**
11. Stem wings 0.7–3 mm wide; longest inner bracts 3.4–4.6 mm long **12**

12 Protruding part of inner bracts with abundant cilia (**Fig. 2A**), some exceeding bract apices (**Fig. 2B**); inner involucral bracts straw to white coloured; leaves 2.1–3.5 times longer than wide . . . . . **2. P. ciliosum**
12. Protruding part of inner bracts with few or no cilia; inner involucral bracts, white or pink to violet; leaves 3.3–5.8 times longer than wide **10. P. sphacelatum**

13 Stem wings serrate; achenes 0.7–1 mm long; outer involucral bracts with broad-based glandular hairs and lanate trichomes outside . . . . . **9. P. serrulatum**
13. Stem wings entire; achenes 0.5–0.7 mm or 1.1–1.3 mm long; outer involucral bracts with lanate hairs only outside **14**

14 Capitulescence 17–30 mm wide at anthesis; hermaphrodite corolla 4–6.5 mm long; achenes 1.1–1.3 mm long . . . . . **13. P. verbascifolium**
14. Capitulescence 8–14 mm wide at anthesis; hermaphrodite corolla 2.5–3 mm long; achenes 0.5–0.7 mm long . . . . . **8. P. redolens**

1. Pterocaulon brachyanthum A.R.Bean **species nova** affinis P. sphacelato sed capitulescentiis minoribus, bracteis interioribus brevioribus, dentibus minoribus in margine superiore illarum et flosculis femineis paucioribus in quoque capitulo differens. **Typus:** Indonesia. West Nusa Tenggara Province: Trail from Batudulang to Punik, Mt. Batulante, west Sumbawa, 25 October 1961, *A.J.G.Kostermans 19111* (holo: BRI; iso: CANB, L).

Shrub 40–70 cm high; stems densely to very densely lanate; stem wings entire or with scattered teeth, 0.9–3 mm wide. Leaves narrowly-elliptic to oblanceolate, 36–55 × 10–22 mm, 2.5–3.6 times longer than wide, apex acute; margins recurved, denticulate, with 2–14 pairs of blunt teeth, sometimes obscure. Indumentum comprising lanate multi-cellular hairs, glandular hairs absent. Upper surface with hairs erect to spreading, sparse to moderately dense, basal cells short; globose sessile glands absent. Lower surface with lanate hairs spreading, dense to very dense, extending 0.4–0.7 mm from the surface, basal cells not very short; sessile glands globose, yellow and shining, very sparse, 8–30 diameters apart. Capitulescence globose to ellipsoidal, 9–14 mm long and 8.5–10 mm wide at anthesis, 1–1.5 times longer than wide; side branchlets never continuous, at 20–60°; peduncles 2–17 mm long. Outer involucral bracts 1.5–1.8 mm long, oblong to oblong-spathulate, with dense spreading lanate hairs on outer surfaces, inner surface glabrous or with hairs on the distal end of inner surface; glands absent; apex obtuse, erose or truncate. Inner bracts straw-coloured or white on dorsal surface; longest ones linear, 2.8–3.5 × 0.25–0.5 mm, apex acute, upper margins with numerous small teeth; cilia 3–9, up to 1.7 mm long, attached along the proximal half, few extending to the distal one third, none exceeding the bract apex. Filiform (female) florets 7–17, colour unknown, corolla 2–2.4 mm long, styles extending 0.3–0.5 mm beyond corolla. Hermaphrodite floret solitary, corolla colour unknown, 2.4–2.8 mm long; corolla lobes 0.3–0.5 mm long, globose sessile glands present, eglandular trichomes absent. Achenes narrowly ellipsoidal, 0.5–0.8 mm long, dark brown, with 0–25 or 25–50 twin hairs each *c.* 0.05 mm long; globose sessile glands at junction between achene and pappus sometimes present; pappus 2.1–2.5 mm long. **Figs. 3, 4A–D.**

***Additional specimens examined*: Indonesia.** Likoeatang – Taramana, Alor Island, May 1938, *Jaag 853* (L); Saseël Island, Kangean Archipelago, Apr 1919, *Backer 288635* (L); Karimunjawa Island, north-central Java, Nov 1955, *Hoogerwerf 172* (L); Flores, Lesser Sunda Islands, Sep 1966, *Schmutz 355* (L); Soembawa, Nov 1879, *Colfs 129* (L); Kambaniroe, Soemba [Sumba] Island, *s.dat.* [Sep 1873], *Teysmann 8824* (A, L); Soemba [Sumba Island], Lesser Sunda Islands, Nov 1932, *Posthumus 3026* (L); Sumba, Lesser Sunda Islands, Jul 1974, *Verheijen 4147* (L); Banyupoh, Bali, Oct 1929, *Demandt & Van Dillewijn s.n.* (L); Timor, *s.dat.*, *Spanoghe s.n.* (L); Timor, *s.dat.*, *Zippelius s.n.* (L); Buton Island, south-east Celebes, Sep 1909, *Elbert 2598* (L); Timor, Aug 1973, *Kooy 957* (K, L). **Timor-Leste.** *s.loc.*, 1962–63, *Cinatti 210* (L); in Tasitolu area, just west of Dili, Oct 2006, *Cowie 11213* (DNA, L).

***Distribution and habitat*:** *Pterocaulon brachyanthum* is endemic to Indonesia and Timor-Leste. Most collections are from the Lesser Sunda Islands, east of Java, and from Timor, but there are two records from islands north of Java, and one from the south-eastern end of Sulawesi (**Map 1**). It inhabits grassy areas near the coast. One specimen label states "from the upper margin of mangroves and salt flat, at the base of a steep shale hill". The collections seen were made between altitudes of 0–200 metres, except the type, which was from 700 metres.

***Phenology*:** Flowers and fruits are recorded from April to November.

***Affinities*:** *Pterocaulon brachyanthum* is similar to *P. sphacelatum*, but differs by the 8.5–10 mm wide capitulescences (10–14 mm wide for *P. sphacelatum*); longest inner bracts 2.8–3.5 mm long (3.5–4.5 mm long for *P. sphacelatum*); upper margins of inner bracts with small teeth (lacerate or conspicuously toothed for *P. sphacelatum*); female florets 7–17 (17–29 for *P. sphacelatum*); and globose sessile glands very sparse on the lower leaf surface (dense for *P. sphacelatum*).

***Notes*:** Cabrera & Ragonese (1978) cited specimens of the type (*Kostermans 19111*) from P and NY.

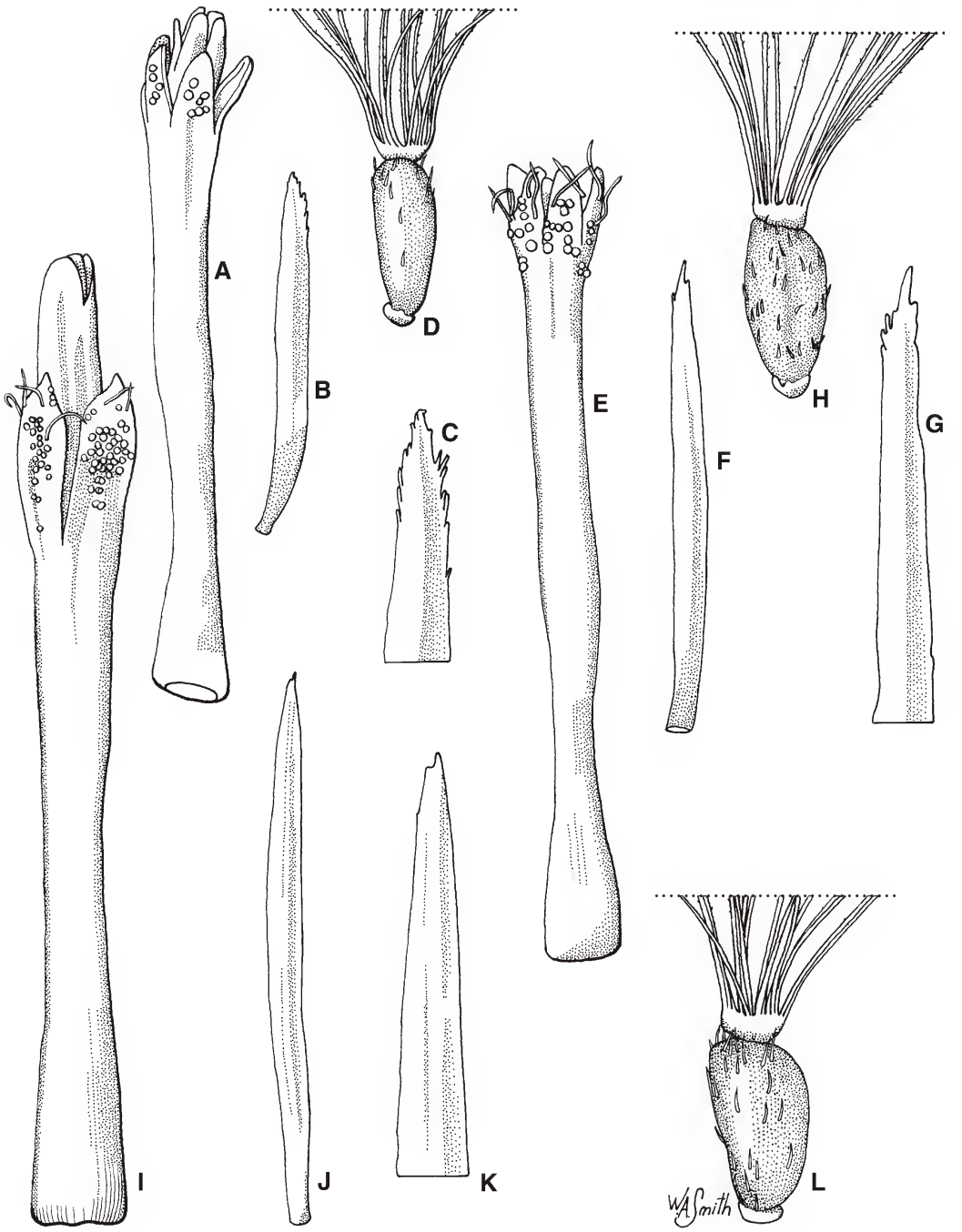

Fig. 4. ***Pterocaulon brachyanthum***. A. hermaphrodite floret × 32. B. inner involucral bract (cilia not shown) × 16. C. upper portion of inner involucral bract × 32. D. mature achene and basal portion of pappus × 32. ***P. ciliosum***. E. hermaphrodite floret × 32. F. inner involucral bract (cilia not shown) × 16. G. upper portion of inner involucral bract × 32. H. mature achene and basal portion of pappus × 32. ***P. discolor***. I. hermaphrodite floret × 32. J. inner involucral bract (cilia not shown) × 16. K. upper portion of inner involucral bract × 32. L. mature achene and basal portion of pappus × 32. A–D from *Cowie 11213* (DNA); E,H from *Bean 12069* (BRI); F,G from *Bean 27963* (BRI); I–L from *Kerrigan 579* (DNA).

Distinctive features of this species are the capitulescences 8.5–10 mm wide; stem wings often toothed; glands very sparse on lower leaf surface; female florets few in each capitulum.

***Etymology*:** From the Greek *brachys* meaning short and *anthos* meaning flower. This is in reference to both the hermaphrodite and female florets, which are shorter than in most other species of the section.

2. Pterocaulon ciliosum A.R.Bean **species nova** affinis *P. sphacelato* sed foliis latioribus, bracteis interioribus stramineis, ciliis abundantibus in capitulis in situ visibilibus, dentibus minoribus in margine superiore in bracteis interioribus et pedunculis brevioribus differens. **Typus:** Australia: Queensland. Port Curtis District: 7.1 km by road NNW of Kalpowar Railway Station towards Many Peaks, 30 August 1975, *R.Coveny 6847 & P.Hind* (holo: BRI; iso: L, NSW).

***Illustration*:** Stanley & Ross (1986: 532), as *P. sphacelatum*

Aromatic shrub 40–100 cm high; stems one to several from non-woody rootstock, sparsely to densely lanate and sometimes with a few globose sessile glands; stem wings entire, 1.2–3 mm wide. Leaves oblanceolate to obovate, 32–56 × 11–21 mm, 2.1–3.5 times longer than wide, apex acute; margins recurved, denticulate, with 8–18 pairs of blunt teeth. Indumentum comprising lanate multi-cellular hairs, glandular hairs absent. Upper surface somewhat bullate; hairs erect to spreading, sparse to moderately dense, basal cells short; globose sessile glands absent. Lower surface with lanate hairs erect to spreading, moderately dense to dense, extending 0.5–1 mm from the surface, basal cells not very short; globose sessile glands yellow and shining, dense, touching or up to 3 diameters apart. Capitulescence globose, 10–16 mm long and 10–13 mm wide at anthesis, 0.9–1.2 times longer than wide; side branchlets never continuous, at 30–90º; peduncles to 7 mm long. Outer involucral bracts 1.8–2.4 mm long, oblong to oblong-spathulate, with dense spreading lanate hairs on outer surface, glabrous or with hairs on the distal end of inner surface; glands absent; apex obtuse. Inner bracts white to straw coloured (sometimes tinged pink) on dorsal surface; longest ones linear, 3.4–4.3 × 0.2–0.4 mm, apex acute, upper margins with some small teeth; cilia 7–15, up to 2.9 mm long, attached along the proximal half and consistently extending to the distal one third, and some exceeding the bract apex. Filiform (female) florets 16–23, pink or straw-coloured, corolla 2.2–3 mm long, styles extending 0.2–0.5 mm beyond corolla. Hermaphrodite floret solitary, corolla pink, 2.9–3.5 mm long; corolla lobes 0.35–0.5 mm long, globose sessile glands present, eglandular trichomes absent or present. Achenes narrowly ellipsoidal, 0.7–0.9 mm long, obscurely quadrangular, dark brown, with 25–50 twin hairs each <0.1 mm long, evenly distributed; globose sessile glands at junction between achene and pappus absent; pappus 2.3–3.1 mm long. **Figs. 2B, 4E–H, 5.**

***Additional selected specimens examined*: Indonesia.** Flores, May 1967, *Schmutz 1545* (L); Manggarai, Flores, Jul 1983, *Schmutz 5996* (L). **Australia: Northern Territory.** Blue Mud Bay, 10 km N of Harris Creek crossing, Sep 1987, *Russell-Smith 3117 & Lucas* (DNA); Tanumbirini Station, Apr 1991, *Wilson 522* (BRI, DNA); 50 miles [80 km] S of Borroloola Road – Anthonys Lagoon Road junction, Jun 1971, *Latz 1539* (DNA); *c.* 21 km W of 'Wollogorang' on the Calvert Hills Road, May 1974, *Pullen 9214* (CANB, DNA); 8.7 miles [14.0 km] S of 'Dunmurra', Sep 1957, *Chippendale 3751* (BRI, CANB, DNA); Goulburn Island, Anyiminali Point, May 1992, *Coleman 280* (DNA); Caledon Bay, Jun 1972, *Latz 2691* (DNA). **Queensland.** Burke District: 38.5 km NW of 'Bowthorn' Homestead on Bowthorn Station, Jun 2006, *Thompson WES745 & Hogan* (BRI). Cook District: 4.4 km S of 'Fairlight' on the Palmerville Road, Jun 1992, *Clarkson 9607 & Neldner* (BRI, CNS, K, MEL); Palm Cove, Cairns, Jul 1995, *Jago 3526* (BRI, DNA); Spear Creek, *c.* 1 mile [1.6 km] north of Mt Molloy, Aug 1963, *Schodde 3355* (A, AD, B, BRI, E, L). North Kennedy District: Hook Island, Whitsunday Group, Jul 1985, *Warrian CW712* (BRI); Mt Abbot, 50 km W of Bowen, Aug 1992, *Bean 4893* (BRI); May's firebreak, W of Ravenshoe, Aug 2010, *Bean 29858 & McDonald* (AD, BRI, L). South Kennedy District: Brampton Island, Sep 1988, *Batianoff 5114* (BRI); 5.4 km from 'Redcliffe Vale' Homestead on road to Turrawallah, May 1997, *Thompson 266* (BRI). Leichhardt District: Grey Rock, Glenlea Road, WNW of Springsure, Jul 1989, *O'Keeffe 894* (BRI); 10 km S of Isla Gorge lookout, 37 km S of Theodore, Jun 1971, *Johnson 7169 & Briggs* (BRI, NSW). Port Curtis District: Hill W of Mt Couti-Outi, Stanage Bay area, N of Rockhampton, Jul 1997, *Bean 12069* (BRI); 4 km SW of Mt Castletower, *c.* 40 km SW of Gladstone, Jun 1977, *Crisp 2739* (BRI, CANB). Burnett District: Near junction of Delubra and Cadarga Creeks, 35 km SW of Mundubbera, Sep 2008, *Bean 27963* (BRI).

Fig. 5. Holotype of ***Pterocaulon ciliosum*** (*Coveny 6847 & Hind* [BRI]).

WIDE BAY DISTRICT: Fairlies Knob, Seaview Range, May 2000, *Phillips 389 & Phillips* (BRI); Western edge of Mt Walsh N.P., near Biggenden, Sep 2002, *Bean 19221* (BRI). MORETON DISTRICT: Upper Ithaca Creek, Aug 1887, *Simmonds s.n.* (BRI); Mermaid Mt, NW of Brookfield, May 1970, *Telford 1590* (CANB).

***Distribution and habitat*:** *Pterocaulon ciliosum* is a widely distributed species. It has been collected on the island of Flores in Indonesia; it occurs in the north-east of Northern Territory (extending to far north-west Queensland), and is widespread in eastern Queensland from Murray Island in the Torres Strait to Brisbane (**Map 2**). It is found in eucalypt woodland, mainly on well-drained sandy to loamy soils, including sites near the ocean.

***Phenology*:** Flowers and fruits have been recorded from April to October.

***Affinities*:** *Pterocaulon ciliosum* is similar to *P. sphacelatum*, but differs by the leaves 2.1–3.4 times longer than wide (3.3–5 times for *P. sphacelatum*); the straw-coloured inner bracts on dried material (white or pink for *P. sphacelatum*); abundant cilia visible on the protruding part of inner bracts (few or no visible cilia for *P. sphacelatum*); the upper margins of the inner bracts with small teeth (strongly toothed or lacerate for *P. sphacelatum*); and the peduncles to 7 mm long (to 22 mm long for *P. sphacelatum*).

***Notes*:** Distinctive features for this species are the abundant cilia visible on the protruding part of inner bracts, straw-coloured inner bracts on dried material and the short corolla lobes of the hermaphrodite floret.

***Etymology*:** The specific epithet is from the Latin *cilia* meaning 'full of cilia' and refers to the numerous cilia on the margins of the inner bracts.

3. Pterocaulon discolor A.R.Bean **species nova** affinis *P. tricholobae* sed alis caulinis angustioribus, foliis valde discoloribus, foliorum dentibus paucioribus, flosculis femineis paucioribus in capitulo quoque numeris majoribus pilorum in achenis differens. **Typus:** Australia: Northern Territory. 3 km N of Adelaide River bridge on Stuart Highway, 3 May 1983, *J.D.Briggs 819* (holo: CANB; iso: MEL).

Forb 50–80 cm high, aromatic properties unknown; stems one to several from woody rootstock, densely lanate but without globose sessile glands; stem wings entire, 1–2.5 mm wide. Leaves elliptical, 35–68 × 13–31 mm, 2–2.7 times longer than wide, apex obtuse or mucronate; margins not recurved, denticulate to crenulate, with 10–16 pairs of small teeth. Indumentum comprising lanate multi-cellular hairs, glandular hairs absent. Upper surface not or slightly bullate; hairs erect to spreading, sparse, basal cell short; globose sessile glands absent. Lower surface with lanate hairs erect to spreading, very dense, obscuring surface, extending 0.2–0.3 mm from the surface, basal cells not very short; globose sessile glands not visible. Capitulescence globose to ellipsoidal, 12–15(–19) mm long and 11–13 mm wide at anthesis, 1–1.2(–1.5) times longer than wide; side branchlets sometimes continuous, at 0–60°; peduncles absent or up to 12 mm long. Outer involucral bracts oblong-spathulate, 2.1–2.4 mm long, with dense spreading lanate hairs on outer surface, sparse to moderately dense hairs on the distal end of inner surface, glands few, apex obtuse. Inner bracts white or greenish-white on dorsal surface; longest ones linear, 4.5–5 × 0.3–0.4 mm, apex acute, upper margins entire or with some small teeth; cilia 8–12, up to 3.3 mm long, attached along the proximal half and consistently extending to the distal one third, not exceeding the bract apex. Filiform (female) florets 7–14, white or straw-coloured, corolla 2.7–3.2 mm long, styles extending 0.3–0.7 mm beyond corolla. Hermaphrodite floret solitary, corolla pink, 3.3–4 mm long; corolla lobes 0.7–1.1 mm long, globose sessile glands present, eglandular trichomes 1–5 per lobe. Achenes narrowly ellipsoidal, 0.8–0.9 mm long, faintly ribbed, dark brown, with 25–50 twin hairs each 0.1–0.2 mm long, evenly distributed; globose sessile glands at junction between achene and pappus absent; pappus 2.6–3.4 mm long. **Figs. 4I–L, 6.**

***Additional specimens examined*: Australia: Northern Territory.** Tipperary, May 1963, *Muspratt 575* (DNA); 0.5 miles [0.8 km] E of Stuart Highway, 60 miles [98 km] [from Darwin?], Apr 1964, *Robinson R343* (DNA); Nitmiluk N.P., eastern boundary, May 2002, *Michell 3875* (DNA); Nitmiluk N.P., Apr 2001, *Michell 3329* (DNA); Nitmiluk N.P., Edith Falls, May 2002, *Kerrigan*

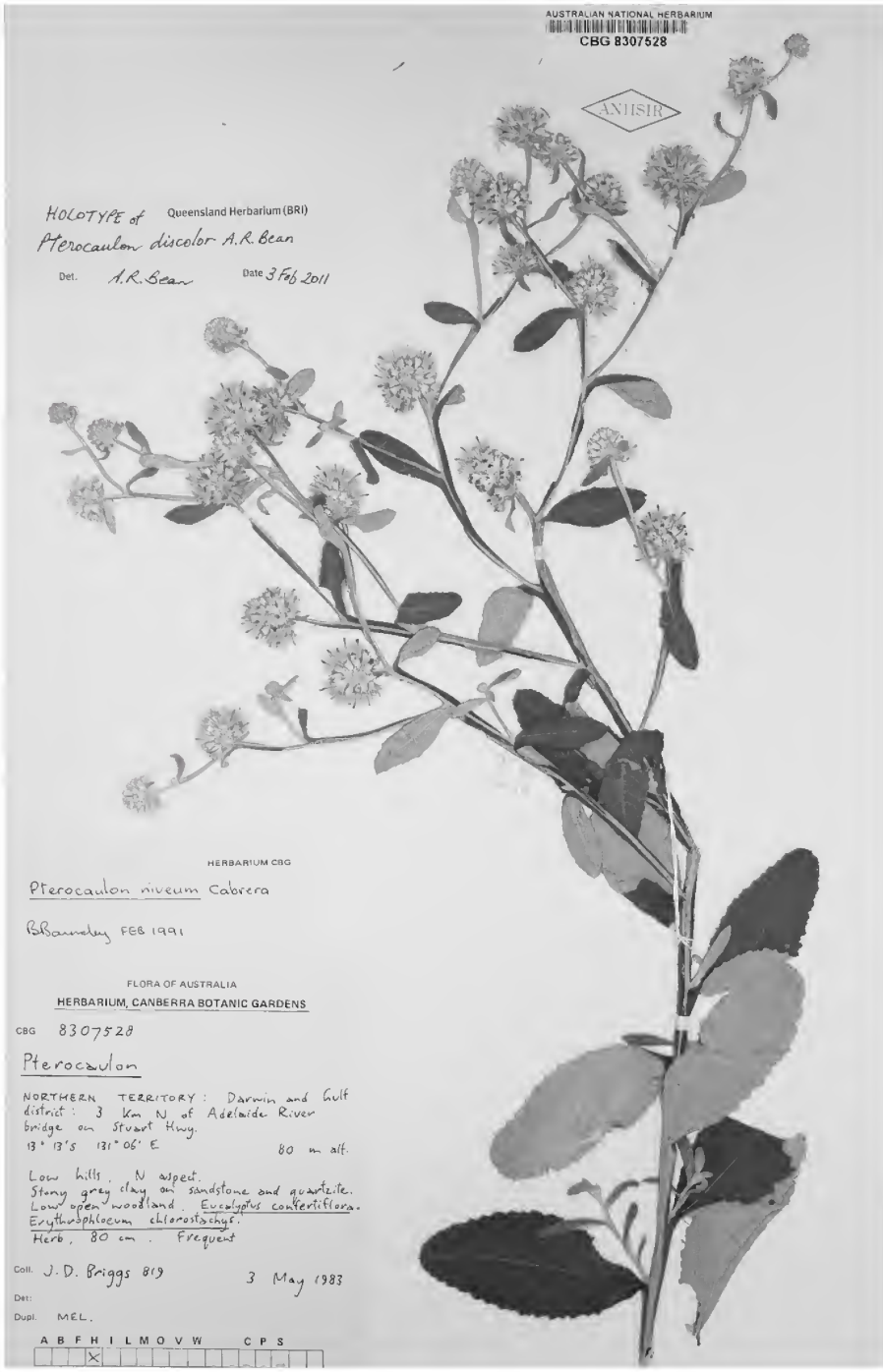

Fig. 6. Holotype of ***Pterocaulon discolor*** (*Briggs 819* [CANB]).

579 (DNA); Tin Camp Creek, *c.* 20 miles [32 km] S of Nabarlek mining camp, May 1973, *Hartley 13824* (CANB [2nd sheet only], DNA, L); 11 km E of Katherine Gorge ranger station, May 2009, *Latz 24367 & Quarmby* (DNA, K, NT).

***Distribution and habitat*:** *Pterocaulon discolor* is known from a few scattered locations in the 'Top End' of the Northern Territory, including Nitmiluk N.P. (**Map 3**). It grows on sandstone and quartzite hills and ridges in mixed open forest or open woodland, in sandy soil.

***Phenology*:** Flowers and fruits have been collected in April and May.

***Affinities*:** *Pterocaulon discolor* is similar to *P. tricholobum*, but differs by the stem wings 1–2.5 mm wide (2.8–5.5 mm for *P. tricholobum*); the lanate indumentum of the lower leaf surface 0.2–0.3 mm high (0.4–0.8 mm high for *P. tricholobum*); the 10–16 pairs of readily observed leaf teeth (15–30 pairs of obscure leaf teeth for *P. tricholobum*); the 7–14 female florets per capitulum (15–21 for *P. tricholobum*); and the 25–50 hairs on the achene (0–25 hairs for *P. tricholobum*).

***Notes*:** This species is distinctive in the strongly discolorous leaves, few female florets per capitulum, conspicuous leaf teeth, white or greenish-white inner bracts and the trichomes on the corolla lobes of hermaphrodite floret.

***Etymology*:** From the Latin *discolor*, meaning 'of different colours'. This refers to the leaves, which in this species are strikingly green on the upper surface and snowy white on the lower surface.

4. Pterocaulon globuliflorum W.Fitzg., *J. & Proc. Roy. Soc. Western Australia* 3: 223 (1918), (as "*globuliflorus*"). **Type:** Australia: Western Australia. Devil's Pass, Napier Range, May 1905, *W.V.Fitzgerald 607* (holo: PERTH; iso: K373285; NSW *n.v.*).

Shrub to 60 cm high; aromatic properties unknown; stems sparsely to densely lanate and with a few globose sessile glands; stem wings entire, 0.3–1.5 mm wide. Leaves elliptical, 18–51 × 7–24 mm, 2–2.6 times longer than wide, apex acute or obtuse; margins not recurved, denticulate, with 7–15 pairs of blunt teeth. Indumentum comprising lanate multicellular hairs, glandular hairs absent. Upper surface not or slightly bullate, hairs sparse, flexuose, basal cells not short; globose sessile glands absent. Lower surface with lanate hairs flexuose, dense to very dense, extending 0.15–0.25 mm from the surface, basal cells not very short; globose sessile glands yellow and shining, dense, touching or up to 3 diameters apart, but usually obscured by indumentum. Capitulescence globose or globose–truncate, 6–10 mm long, 8.5–10 mm wide at anthesis, 0.7–1.1 times longer than broad; side branchlets 0–50°, often continuous, peduncles 0–4 mm long. Outer involucral bracts oblong, 0.8–1.9 mm long, with dense spreading lanate hairs on the distal one-half of outer surface, and glabrous on the inner surface; apex obtuse or truncate. Inner bracts white on dorsal surface, sessile glands absent; longest ones linear, 3.1–3.5 × 0.2–0.25 mm, apex acute, upper margins with small teeth; cilia 5–8, up to 1.6 mm long, mostly attached proximally and extending to the distal one third. Filiform (female) florets 16–20, colour unknown, corolla 1.7–2 mm long, styles extending 0.3–0.5 mm beyond corolla. Hermaphrodite floret solitary, corolla pink, 2.5–2.8 mm long; corolla lobes 0.7–1.2 mm long, globose sessile glands present, eglandular trichomes absent or with 1 or 2 per lobe. Achenes narrowly ellipsoidal, 0.7–0.8 mm long, slightly longitudinally ribbed, dark brown, with 25–50 twin hairs each *c.* 0.05 mm long, evenly distributed; globose sessile glands at junction between achene and pappus absent; pappus 1.3–1.8 mm long. **Figs. 7, 8A–D.**

***Additional specimens examined*: Australia: Western Australia.** Windjana Gorge, Napier Range, Jul 1974, *Carr 3882 & Beauglehole 47660* (PERTH); Windjana Gorge, Napier Range, Jul 1974, *Carr 4036 & Beauglehole 47814* (PERTH); Yammera Gap, Napier Range, 9 km NE of Lennard River crossing on Gibb River Road, May 1988, *Streimann 8269* (A, B, CANB, L); Old Fossil Downs Station, May 1970, *Wolfe & Martin 72* (CANB).

***Distribution and habitat*:** Endemic to the Napier and Geikie Ranges, Kimberley region, Western Australia (**Map 3**). It is confined to limestone ranges and hills, growing in grassland or low open woodland.

***Phenology*:** Flowers and fruits have been recorded in May and July.

Fig. 7. Representative specimen of ***Pterocaulon globuliflorum*** (*Streimann 8269* [CANB]).

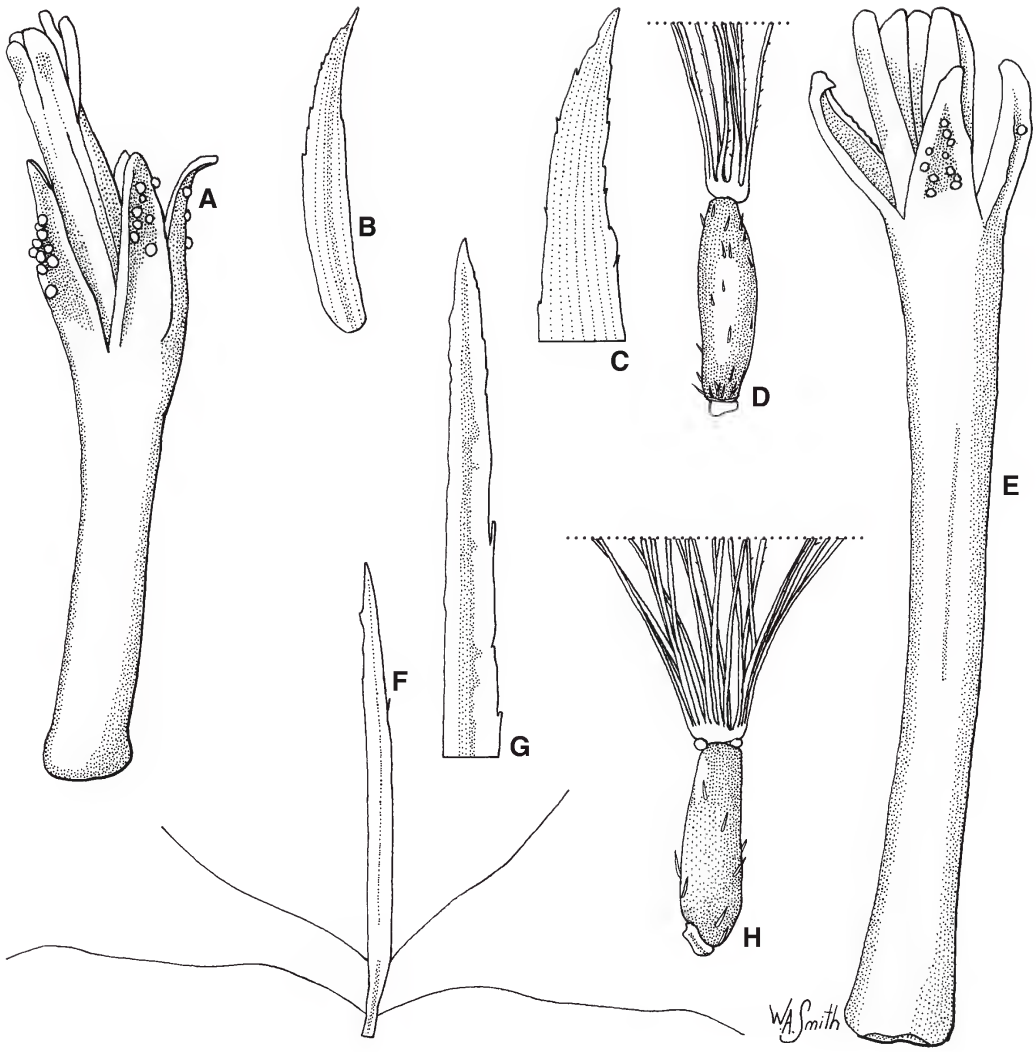

Fig. 8. ***Pterocaulon globuliflorum.*** A. hermaphrodite floret × 32. B. inner involucral bract (cilia not shown) × 16. C. upper portion of inner involucral bract × 32. D. mature achene and basal portion of pappus × 32. ***P. intermedium.*** E. hermaphrodite floret × 32. F. inner involucral bract (cilia shown) × 16. G. upper portion of inner involucral bract × 32. H. mature achene and basal portion of pappus × 32. A–D from *Carr 4036 & Beauglehole 47814* (PERTH); E–G from *Bean 12186* (BRI); H from *Clarkson 4854* (BRI).

***Affinities*:** *Pterocaulon globuliflorum* appears to be allied to *P. tricholobum* and *P. niveum*, on the basis of the long corolla lobes of the hermaphrodite floret, and the often 'continuous' branchlets giving rise to lateral capitulescences.

***Typification*:** Fitzgerald wrote the location 'Devil's Pass' on the label of his specimen. In the protologue, he used the locality 'Wingrah Pass'. According to an annotation by Annette Wilson on the holotype, both of these terms are equivalent to Windjana Pass or Windjana Gorge.

***Notes*:** Distinctive features for this species include the small capitulescences (8.5–10 mm diameter) that are often lateral; leaves short and broad, 2–2.6 times longer than wide, strongly discolorous; stem wings very narrow and the very short pappus.

5. Pterocaulon intermedium (DC.) A.R.Bean **comb. nov.;** *Monenteles intermedius* DC., *Prodr.* 5: 456 (1836). **Type:** [Australia: Queensland. North Kennedy:] Sandy shores of Cape Cleveland, 14 June 1819, *A.Cunningham 52* (holo: G-DC [G214737]; iso: K373284).

Monenteles globiferus DC., *Prodr.* 5: 455 (1836). **Type:** [Australia: Queensland. Moreton District:] Lockyer's Creek, Brisbane River, Moreton Bay, July 1829, *A.Cunningham 51* (holo: G-DC [G214749]; iso: K373282).

Pterocaulon sp. A; Wilson (1992: 954).

Pterocaulon sp. A Kimberley Flora (B.J.Carter 599); Paczkowska & Chapman (2000: 172).

Pterocaulon sp. (Yarrowmere Station E.J. Thompson+ BUC340); Bostock & Holland (2007: 30); Bostock & Holland (2010: 25).

***Illustration*:** Kenneally *et al.* (1996: 67), as '*Pterocaulon* sp. A, Kimb. Flora'

Aromatic perennial shrub 20–60 cm high; stems sprouting from a woody rootstock, sparsely to densely lanate and sometimes with a few globose sessile glands; stem wings entire, 0.2–1.4 mm wide. Leaves lanceolate, narrowly–elliptic or elliptic, 12–52 × 3.5–18 mm, 2.6–4.6 times longer than wide, apex acute; margins not recurved, entire or denticulate, with 2–20 pairs of blunt teeth. Indumentum comprising lanate multi-cellular hairs, glandular hairs absent. Upper surface not bullate, hairs moderately dense to very dense, erect near base then antrorse, basal cells short; globose sessile glands absent. Lower surface with lanate hairs erect to spreading, moderately dense to dense, extending 0.5–1 mm from the surface, basal cells not very short; globose sessile glands yellow and shining, dense, touching or up to 3 diameters apart. Capitulescence globose or almost so, 10–15 mm long, 10–14 mm wide at anthesis, 1–1.2 times longer than broad; side branchlets never continuous, at 30–90°; peduncles (5–)7–25 mm long. Outer involucral bracts oblong to spathulate, 1.7–2.4 mm long, with dense spreading lanate hairs on the distal one-third of outer surface, and glabrous or with a few hairs distally on the inner surface, glands absent; apex acute, obtuse or truncate. Inner bracts pink to violet on dorsal surface; longest ones linear, 4–4.8 × 0.2–0.4 mm, apex acute, upper margins with small teeth; cilia 1–7, up to 2.8 mm long, mostly attached proximally and not extending to the distal one third. Filiform (female) florets 8–17, pink, corolla 2.7–3.6 mm long, styles extending 0.3–0.8 mm beyond corolla. Hermaphrodite floret solitary, corolla pink, 3.1–3.8 mm long; corolla lobes 0.6–0.9 mm long, globose sessile glands present, eglandular trichomes absent. Achenes narrowly ellipsoidal, 0.6–0.75 mm long, longitudinally ribbed, dark brown, glabrous or with 1–25 twin hairs each <0.1 mm long, evenly distributed; globose sessile glands at junction between achene and pappus absent; pappus 2.5–3.1 mm long. **Figs. 8E–H, 9.**

***Additional selected specimens examined*: Indonesia.** Kisar Island [just N of Timor], Apr 1939, *Bloembergen 3852* (A, L). **Papua New Guinea.** Morobe Province: Sialum Station, May 1975, *Henty & Katik NGF49770* (BRI, CANB, L). **Australia: Western Australia.** Fence line at junction of Pindan, Calanjadie and Cardingy paddocks, Anna Plains Homestead, Sep 2004, *Byrne 1266* (PERTH); Sir Graham Moore Island, Jul 1973, *Wilson 11263* (PERTH); adjacent to Telecom tower, *c.* 5 km E of Broome, Oct 1993, *Dureau DD150* (BRI, PERTH); 4 km SSE of Cape Bertholet, Dampier Peninsula, Aug 1992, *Carter BJC599* (PERTH); Pender Bay at Weedong Lake, Dampier Peninsula, Jun 1984, *Forbes 2435 & Kenneally* (L, MEL). **Northern Territory.** Elcho Island, Warangaya, Sep 1987, *Russell-Smith 3282 & Lucas* (BRI, DNA); Elcho Island, Refuge Bay, Aug 1995, *Cowie 6002* (BRI, CANB, DNA, MEL); Howard Island, Jun 1996, *Booth 1789* (DNA); Maria Island, Gulf of Carpentaria, Jul 1972, *Dunlop 2803* (BRI, DNA); Homestead Creek, Bing Bong Station, Jun 1971, *Dunlop 2245* (DNA). **Queensland.** Burke District: Karumba, Jun 1901, *Bailey s.n.* (BRI [AQ270420]); Pandanus Ridge, 20 km NE of Burketown, May 2005, *Booth 4281 & Thompson* (BRI); Settlement Creek, 2 miles [3 km] from coast, Gulf of Carpentaria, Jun 1948, *Perry 1217* (BRI, CANB, DNA); Sweers Island, South Wellesley group, Gulf of Carpentaria, Nov 2002, *Thomas SWI111* (BRI). Cook District: Lakefield N.P., Jane Table Hill, Jun 1983, *Clarkson 4854* (BRI); near California Creek, NW of Mt Garnet, Aug 1997, *Bean 12186* (BRI); 1.5 km N of the North Kennedy River on the Laura – Musgrave Road, May 1989, *Clarkson 7996 & Neldner* (BRI, DNA, K, L); on southern bank of Nassau River 0.5 km upstream from junction with Rocky Creek, Jun 1990, *Neldner 3001* (BRI, L). North Kennedy District: 15 miles [25 km] NW of Bowen towards Townsville, May 1970, *Fagg 698* (CANB, L). South Kennedy District: 22.5 km S of 'Yarrowmere' Homestead, Apr 1992, *Thompson BUC340 & Simon* (AD, BRI). Port Curtis District: 'Galloway Plains', *c.* 28 km SW of Calliope, Mar 1989, *Anderson 4623* (BRI); S.F.60 Rundle Range, 37 km NW of Gladstone, Aug 1989, *Gibson TOI683* (BRI). Burnett

Fig. 9. Representative specimen of ***Pterocaulon intermedium*** (*Booth 4281 & Thompson* [BRI]).

DISTRICT: Brian Pastures near Gayndah, Mar 1952, *Blake 18894* (BRI); Wetheron, Apr 1980, *Forster PIF739* (BRI). DARLING DOWNS DISTRICT: 'Rockwood', 60 miles [98 km] W of Dalby, Apr 1969, *Dunlop 337* (CANB). MORETON DISTRICT: Ipswich, 1909, *Hall s.n.* (BRI [AQ270443]).

***Distribution and habitat*:** *Pterocaulon intermedium* is widely distributed in northern Australia from Port Hedland (Western Australia) to Ipswich (Queensland). It is often found close to the coast, but it may occur up to 250 km inland. Outside Australia, it is known from the island of Kisar in Indonesia, and from one location in Papua New Guinea (**Map 4**). In coastal areas it favours sandy swales or dunes, in shrubland or low woodland, and is sometimes adjacent to saline tidal areas. In the more inland areas, it grows in eucalypt woodland with sandy soil.

***Phenology*:** Flowers and fruits are recorded from April to October.

***Affinities*:** *Pterocaulon intermedium* is perhaps closest to *P. paradoxum*, but differs by the leaves being broadest near the midpoint, the upper surface not bullate, the indumentum of the upper surface as dense as or denser than the lower, the shorter achenes and the fewer female florets per capitulum.

***Typification*:** The original label of the holotype of *Monenteles intermedius* gives the date of collection as "June 14 1829". This is incorrect. The isotype at K bears the correct date of 14 June 1819, as confirmed by Curry & Maslin (1990).

***Notes*:** Distinctive features for *Pterocaulon intermedium* are the narrow stem-wings; consistently long peduncles; a consistently ± globose capitulescence, inner bracts pink or violet; relatively few female florets per capitulum; elliptical leaves; upper leaf surface indumentum as dense as or denser than lower surface; and few hairs on the achene.

One specimen label reports that *Pterocaulon intermedium* has an "apple juice smell".

6. Pterocaulon niveum Cabrera & A.M.Ragonese, *Darwiniana* 21: 249 (1978). **Type:** Australia: Western Australia. Mt Amherst, 13 May 1951, *C.A.Gardner 10206* (holo: PERTH; iso: SI).

***Illustration*:** Cabrera & Ragonese (1978: 248).

Spreading shrub 40–100 cm high; stems very densely lanate; stem wings entire, 0.5–1.5 (–2.5) mm wide. Leaves elliptical or obovate, 39–70 × 21–38 mm, 2.1–2.6 times longer than wide, apex acute or obtuse; margins not recurved, denticulate, with 9–20 pairs of blunt teeth. Indumentum comprising lanate multicellular hairs, glandular hairs absent. Upper surface with hairs erect to spreading, very dense; globose sessile glands absent. Lower surface with lanate hairs erect to spreading, very dense, extending 0.5–1 mm from the surface; globose sessile glands sparsely present, but hidden by hairs. Capitulescence globose to globose-truncate, 10–15 mm long and 10–15 mm wide at anthesis, 0.7–1.1 times longer than wide; side branchlets sometimes continuous, at 0–70°; peduncles 0–8 mm long. Outer involucral bracts 2.2–3.2 mm long, oblong to oblong-spathulate, with dense spreading lanate hairs on outer surface, inner surface glabrous; glands absent; apex acute or obtuse. Inner bracts pink to violet on dorsal surface; longest ones linear, 4.5–5.4 × 0.2–0.35 mm, apex acute; upper margins entire or with a few small teeth; cilia 8–14, up to 3 mm long, attached mainly along the proximal half and consistently extending to the distal one third, not exceeding the bract apex. Filiform (female) florets 11–17, pink, corolla 3–3.7 mm long, styles extending 0.4–1.2 mm beyond corolla. Hermaphrodite floret solitary, corolla pink, 3.3–4 mm long; corolla lobes 0.7–1.1 mm long, globose sessile glands present, eglandular trichomes present, 2–8 per lobe. Achenes narrowly ellipsoidal, 0.9–1 mm long, terete or slightly angular, dark brown, with 25–50 or >50 twin hairs each *c.* 0.1 mm long, evenly distributed; globose sessile glands at junction between achene and pappus absent; pappus 2–3.1 mm long. **Figs. 10, 11A–D.**

***Additional specimens examined*: Australia: Western Australia.** 19 miles [31 km] NW of Turner River Station, Jul 1949, *Perry & Lazarides 2410* (CANB, DNA); China Wall, Jun 1983, *MacDonald 234* (BRI); Mt Amherst Range, 1 mile [1.6 km] E of Mt Amherst Station, July 1959, *Lazarides 6341* (BRI); 9 km SSW of Bungle Bungle outcamp, East Kimberley, Jul 1984, *Kenneally 9264* (BRI, CANB, PERTH); S slopes of Mt North, May 1988, *Goble-Garratt 525* (BRI, PERTH); Mt House

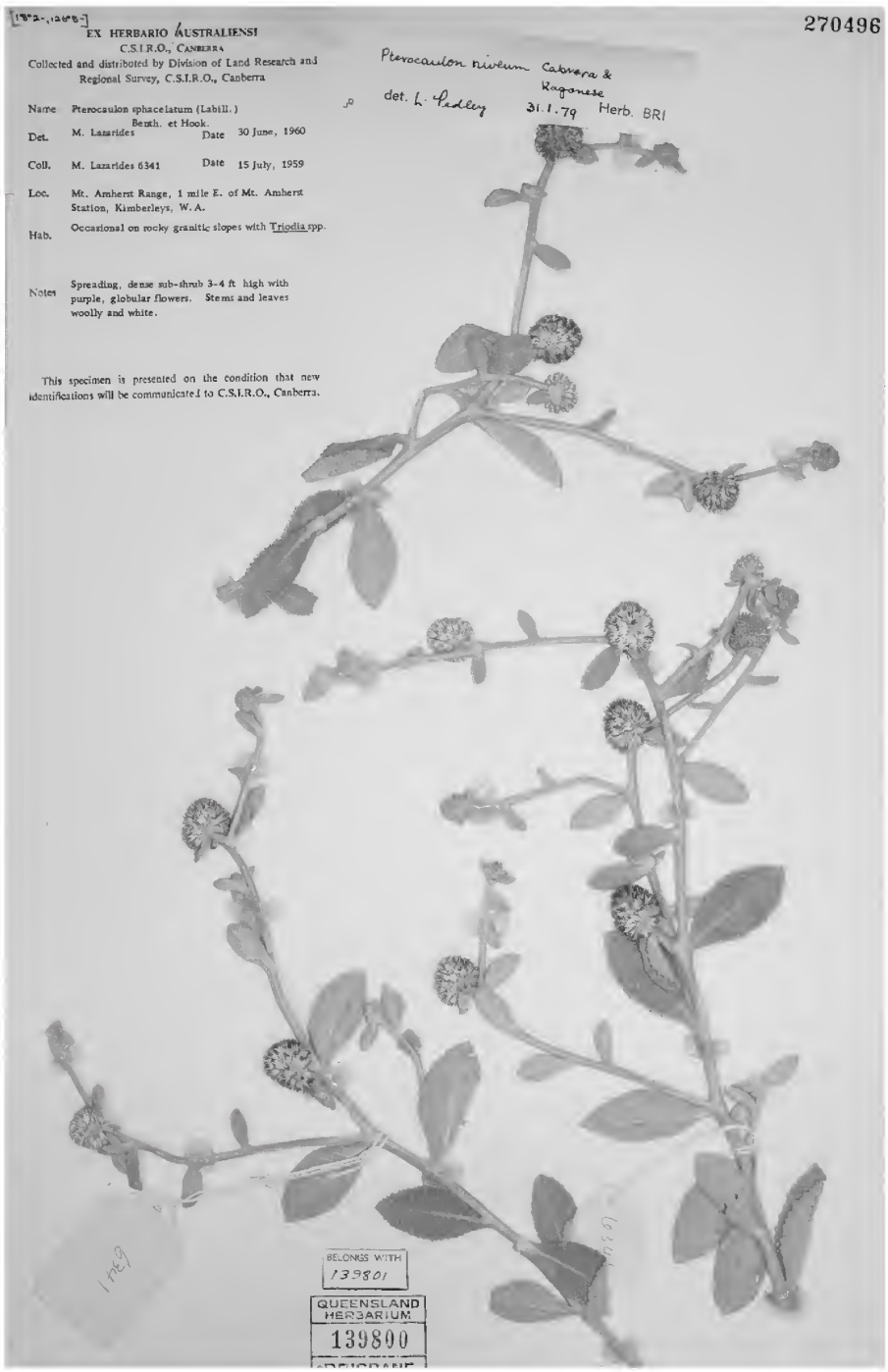

Fig. 10. Representative specimen of ***Pterocaulon niveum*** (*Lazarides 6341* [BRI]).

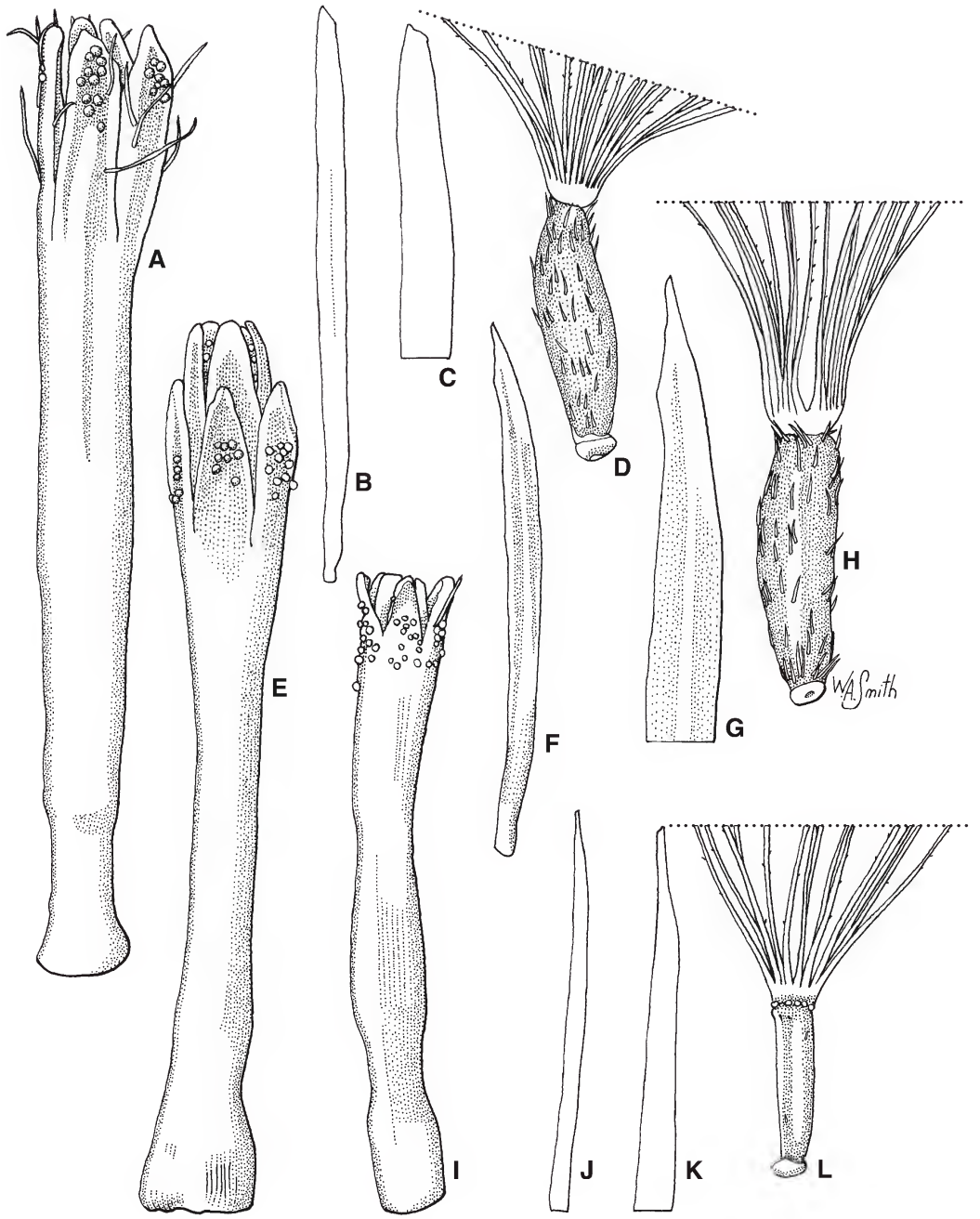

Fig. 11. ***Pterocaulon niveum***. A. hermaphrodite floret × 32. B. inner involucral bract (cilia not shown) × 16. C. upper portion of inner involucral bract × 32. D. mature achene and basal portion of pappus × 32. ***P. paradoxum***. E. hermaphrodite floret × 32. F. inner involucral bract (cilia not shown) × 16. G. upper portion of inner involucral bract × 32. H. mature achene and basal portion of pappus × 32. ***P. redolens***. I. hermaphrodite floret × 32. J. inner involucral bract (cilia not shown) × 16. K. upper portion of inner involucral bract × 32. L. mature achene and basal portion of pappus × 32. A–D from *Brocklehurst 372* (DNA); E–G from *Keighery 9018* (PERTH); H from *George 13582* (PERTH); I–K from *Rodd & Hardie 4378* (BRI); L from *McKee 10198* (CANB).

Station, Aug 1950, *Royce 3304* (PERTH); Caroline Pool, 8 km E of Halls Creek, Jun 1976, *Beauglehole ACB53312* (PERTH); 48.5 km N of 'Springvale' Homestead, 86 km N of Halls Creek, Jun 1976, *Beauglehole ACB53527* (BRI, PERTH); Palm Springs, S of Halls Creek, Aug 2000, *Handasyde & Start TH00287* (PERTH); McSpeery Gap, Napier Range, Jun 1971, *Maconochie 1298* (BRI, DNA); between Njitparriya and Djimbitjba, 3 km SE of Bungle Bungle Outcamp, Jul 1984, *Forbes 2597* (BRI, CANB, DNA, MEL, PERTH); Mt Broome, May 1971, *Byrnes 2253* (K). **Northern Territory.** Calcite flow stop, Limestone Gorge, Gregory N.P., Jun 2000, *Kerrigan & Risler 171* (DNA); Mt Napier area, May 1974, *Dunlop 4066* (DNA); Gregory N.P., Fire plot 41, May 1999, *Michell & Johnson 2449* (DNA, NT); Gregory N.P., 28 km SW of Bullita outstation, Apr 1996, *Coles 28 & Barritt* (DNA, MEL); Gregory N.P., Humbert River road, Aug 1991, *Brocklehurst 372* (DNA).

***Distribution and habitat*:** *Pterocaulon niveum* is widespread in the Kimberley region of Western Australia, occurring in the Napier Range (western Kimberley) and from Mt Amherst (south-eastern Kimberley) eastwards to the Gregory N.P. in the Northern Territory (**Map 2**). It grows in *Triodia* grassland or low open eucalypt woodland, on rocky slopes or in gullies with shallow sandy soils. The geological substrate may be sandstone, quartzite or limestone.

***Phenology*:** Flowers and fruits have been collected from April to August.

***Affinities*:** *Pterocaulon niveum, P. tricholobum, P. discolor* and *P. globuliflorum* appear to be related, based on similarity in morphology of the hermaphrodite floret, i.e. corolla lobes long (0.7–1.2 mm long) with eglandular trichomes present, and the presence of lateral capitulescences.

Sterile specimens of *Pterocaulon niveum* and *P. verbascifolium* may be confused, as they have leaves of similar size, shape and toothing, and the indumentum is extremely dense for both. However, the much broader stem wings of *Pterocaulon verbascifolium* allow them to be easily distinguished.

***Notes*:** Distinctive features of *Pterocaulon niveum* are the indumentum of the lower leaf surface being extremely dense and obscuring the surface, the continuous branchlets with lateral capitulescences present, narrow stem wings and long corolla lobes on the hermaphrodite floret.

7. Pterocaulon paradoxum A.R.Bean **species nova** affinis *P. sphacelato* sed alis caulinis latioribus, glandibus sparsius in pagina inferiore folii distributis, dentibus parvis in marginibus superioribus bractearum interiorum, capitulescentiarum plus elongatarum et lobis longioribus corollae flosculi hermaphroditi differens. **Typus:** Australia: Western Australia. 15 km ESE of Winnama yards by Samin mining exploration track, *c.* 8 km E of Palms yard, SE Kimberley, 15 May 1984, *S.J.Forbes 2017* (holo: DNA; iso: CANB, MEL).

***Illustration*:** Kenneally *et al.* (1996), as *P. sphacelatum*.

Shrub 60–120 cm high, aromatic properties unknown; stems one or more from non-woody rootstock, sparsely to densely lanate but without globose sessile glands; stem wings entire, 1.5–4.5 mm wide. Leaves elliptical to oblanceolate, 30–65 × 10–20 mm, 2.6–4.6 times longer than wide, apex obtuse; margins recurved, denticulate, with 13–23 pairs of very small teeth. Indumentum comprising lanate multi-cellular hairs, glandular hairs absent. Upper surface slightly bullate; hairs erect to spreading, moderate to very dense, basal cell short; globose sessile glands absent. Lower surface with lanate hairs erect to spreading, dense to very dense, extending 0.4–0.7 mm from the surface, basal cells not very short; globose sessile glands yellow and shining, moderately dense, 3–6 diameters apart. Capitulescence ovoid to ellipsoidal, 14–28 mm long and 12–15 mm wide at anthesis, 1.2–2.1 times longer than wide; side branchlets never continuous, at 20–50°; peduncles 0–20 mm long. Outer involucral bracts spathulate, 2.4–2.7 mm long, with dense spreading lanate hairs on outer surface, sparse hairs on the distal end of inner surface; glands absent; apex obtuse or truncate. Inner bracts white to greenish (occasionally tinged pink) on dorsal surface; longest ones linear, 3.5–4.8 mm long and 0.2–0.4 mm wide, apex acute, upper margins entire or with some small teeth; cilia 6–12, up to 3.1 mm long, attached along the proximal half and consistently extending to the distal one third, not exceeding the bract apex. Filiform (female) florets 18–24, pink,

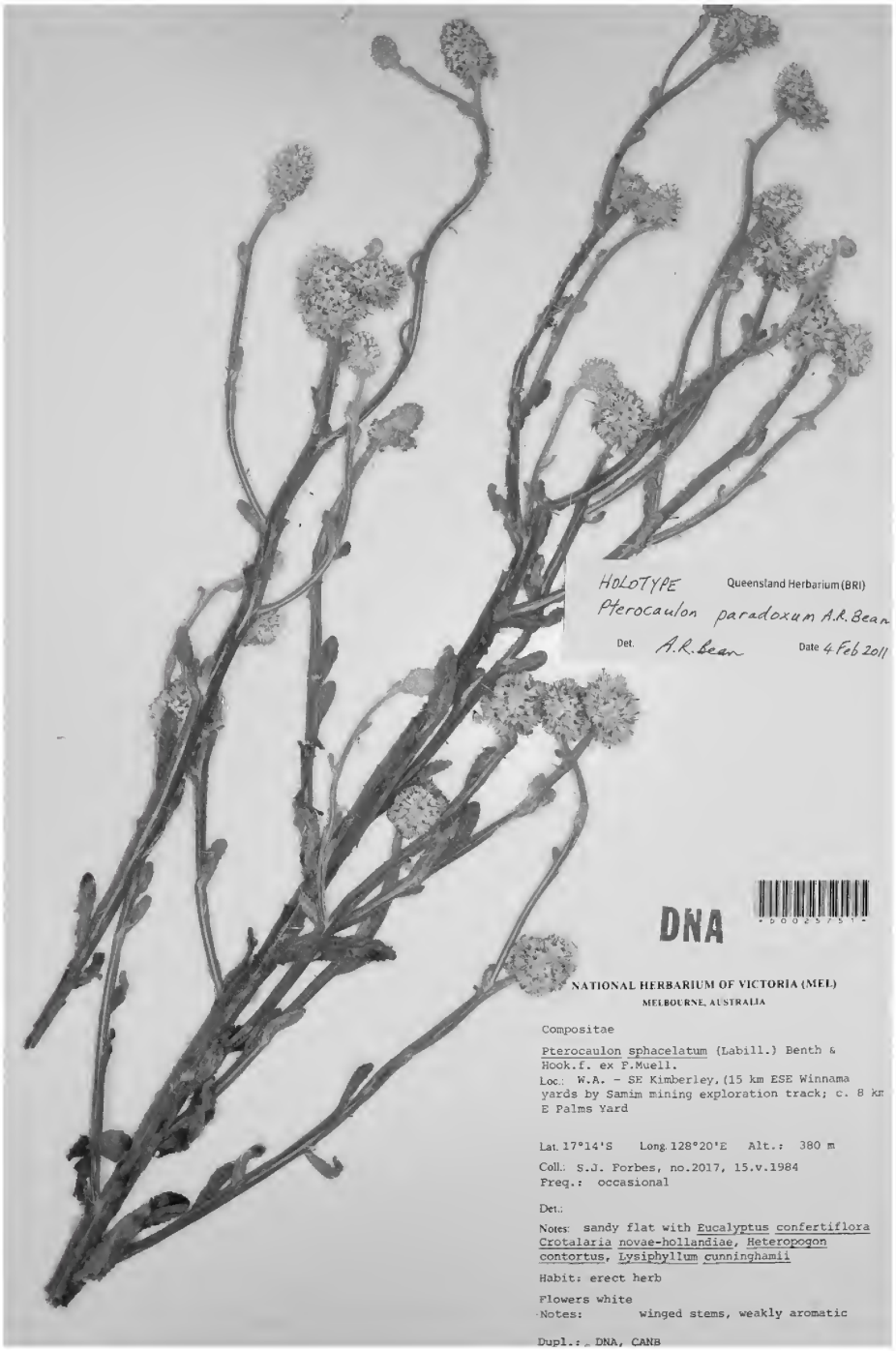

Fig. 12. Holotype of ***Pterocaulon paradoxum*** (*Forbes 2017* [DNA]).

corolla 2.5–3.4 mm long, styles extending 0.3–0.7 mm beyond corolla. Hermaphrodite floret solitary, corolla pink, 2.9–3.7 mm long; corolla lobes 0.5–0.8 mm long, globose sessile glands present, eglandular trichomes absent. Achenes narrowly ellipsoidal, 0.9–1.2 mm long, obscurely quadrangular, dark brown, with 25–50 or >50 twin hairs each *c.* 0.1 mm long, evenly distributed; globose sessile glands at junction between achene and pappus occasionally present; pappus 2.5–3.5 mm long. **Figs. 11E–H, 12.**

***Additional selected specimens examined*: Papua New Guinea.** Central Province: Rogers Airstrip, *c.* 8 miles [13 km] W of Kanosia Plantation, Kairuku subdistrict, July 1962, *Darbyshire 647* (A, BRI, CANB, L). **Australia: Western Australia**. Adjacent to King Edward River, 8.7 km NW of Gibb River – Kalumburu road intersection, along old Mitchell River Station Road, Jun 1987, *Koch 506* (PERTH); S side of Cockburn Range, *c.* 13 km W of King River, Jul 1974, *Carr 3338 & Beauglehole 47116* (CANB); King Edward River, 100 km S of Kalumburu, Jun 1987, *Keighery 9018* (PERTH); King Edward River, Mitchell Plateau road, *c.* 200 km W of Wyndham, Jun 1976, *Beauglehole ACB51933* (PERTH); 'Beverley Springs' Homestead, May 1979, *Muir et al. 757* (PERTH); near Dromaius Creek, near southern end of Ashton Range, Drysdale River N.P., Aug 1975, *George 13191* (PERTH); Mogurnda Creek, near Drysdale River, Drysdale River N.P., Aug 1975, *George 13582* (PERTH); upper reaches of Barker River, 2 km N of 'Mount Hart' Homestead, Jun 1987, *Edinger 423* (BRI, PERTH); Oobraguma Road, 5 km E of Stuart River, 74 km NNE of Derby, Jun 1976, *Beauglehole ACB52918* (PERTH); *c.* 100 m W of Taylor's Lagoon, Sep 2005, *Byrne 1639* (PERTH); One Arm Point, Dampier Peninsula, Jul 1989, *Carter 410* (PERTH); Mornington Station, Trapline 1, May 2004, *Handasyde 2099* (PERTH). **Northern Territory.** Middle Beach swamp, West Alligator Head, Jul 1990, *Brennan Bre646* (DNA); Near Maningrida, Anamayirra Creek, Aug 1995, *Cowie 5909* (CANB, DNA, MEL); Danger Point, Coburg Peninsula, Jul 1961, *Chippendale 8244* (BRI, CANB, DNA); Grant Island, north side, May 1987, *Clark s.n.* (DNA); Ramingining area, W of Dhabla Road, Aug 1998, *Cowie & Dunlop 7922* (DNA); Wunyu Beach in Aurari Bay, *c.* 30 km SE of Murgenella, Jun 1988, *Weber 10102* (AD, DNA).

***Distribution and habitat*:** *Pterocaulon paradoxum* is relatively widespread in the Kimberley region of Western Australia, is scattered along the north coast of Northern Territory, and there is one record from Papua New Guinea (**Map 5**). It inhabits eucalypt woodland on alluvial flats (species including *Eucalyptus miniata* A.Cunn. ex Schauer, *E. tetrodonta* F.Muell., *Corymbia confertiflora* (F.Muell.) K.D.Hill & L.A.S.Johnson), on sheltered sandstone scree slopes, or on coastal dunes. Soils include red-brown clayey sand, red loam, and grey sand.

***Phenology*:** Flowers and fruits are recorded from April to September.

***Affinities*:** *Pterocaulon paradoxum* appears to be most closely allied to *P. sphacelatum*. It differs by the stem wings 1.5–4.5 mm wide (0.7–2 mm wide for *P. sphacelatum*); the corolla lobes of the hermaphrodite floret (0.5–)0.6–0.8 mm long (0.4–0.6 mm long for *P. sphacelatum*); the globose sessile glands on the lower leaf surface moderately dense, 3–8 diameters apart (dense, 0–3 diameters apart for *P. sphacelatum*); the upper margins of the inner bracts with small teeth (strongly toothed or lacerate for *P. sphacelatum*); and the capitulescences usually more elongated.

The capitulescences of this species provide a link between the 'spicate' group (*Pterocaulon redolens*, *P. verbascifolium*, *P. serrulatum*) and the 'globose to ovoid' group (*P. sphacelatum*, *P. ciliosum*, *P. sphaeranthoides*, *P. intermedium*). The capitulescences are more elongated that other species in the 'globose to ovoid' group, but not clearly cylindrical as in the 'spicate' group. One or more separate clusters of capitula can usually been seen at the base of the capitulescence, as in the spicate species *Pterocaulon redolens*. In some areas, particularly the Dampier Peninsula (Western Australia), the capitulescences appear consistently almost globose, although the floret dimensions and other features appear to be the same as in the type.

***Notes*:** Distinctive features of *Pterocaulon paradoxum* are the capitulescences often markedly ellipsoidal, the medium length corolla lobes on the hermaphrodite floret and the long achenes.

Two forms of this species exist. The typical form is endemic to the Kimberley, mainly away from the coast, and is a densely hairy plant with corolla lobes on the hermaphrodite floret 0.6–0.8 mm long. The second form (e.g. *Cowie 5909*) is found along the northern coast of the Northern Territory, often in littoral areas, and one specimen from Papua New

Guinea is rather doubtfully included here. The indumentum on vegetative parts is much sparser in this form than the typical one, there are few cilia visible on protruding part of inner bracts, the corolla lobes on the hermaphrodite floret are shorter (0.5–0.6 mm long) and the capitulescences are narrower. Both forms can have ellipsoidal capitulescences, where separate clusters of capitula are discernable.

***Etymology*:** From the Latin *paradoxus*, meaning 'contrary to expectations, puzzling'. This species is puzzling because of its sometimes ± globular and sometimes markedly ellipsoidal capitulescences, and the different forms within the species.

8. Pterocaulon redolens (Willd.) Fern.-Vill., *Nov. App.* ed. 3, 4(3): 116 (1880); *Conyza redolens* Willd., *Sp. Pl.* ed. 3(3), 1951 (1804); *Tessaria redolens* (Willd.) Less., *Linnaea* 6: 151 (1831); *Monenteles forsteri* Endl., *Ann. Wiener Mus. Naturgesch.* 1: 168 (1836), *nom. illeg.*; *Monenteles redolens* (Willd.) DC., *Prodr.* 5: 455 (1836). **Type:** New Caledonia. in 1774, *J.R.Forster & J.G.A.Forster* (holo: B-W No. 15639; iso: K373288, 1st, 2nd and 4th pieces from the left).

Monenteles spicatus Labill., *Sert. Austro-Caledon.* 43 (1825); *Pterocaulon billardierei* F.Muell., *Descr. Notes Papuan Pl.* 8: 43 (1886), *nom. nov.*; *Pterocaulon spicatum* (Labill.) Domin, *Biblioth. Bot.* 89: 664 (1930), *nom. illeg. non* DC. (1836). **Type:** New Caledonia. [June 1792], *J.J.H. Labillardière* (lecto: FI [FI-W92604], here designated; isolecto: FI [FI-W92605], right hand specimen only, FI [FI-W92611], P537803).

Sphaeranthus elongatus Blanco, *Fl. Filip.* 636 (1837), *fide* Merrill (1918: 379).

Pterocaulon cylindrostachyum C.B.Clarke, *Compos. Ind.* 98 (1878), *nom. illeg.* (*Monenteles spicatus* is listed as a synonym).

Gnaphalium cylindrostachyum Wallich, *Num. List* [Wallich] 2931 (1831), *nomen nudum.*

***Illustrations*:** Cabrera & Ragonese (1978: 240); Porteners (1992: 204); Stanley & Ross (1986: 532).

Weakly aromatic shrub 40–100 cm high; stems one to several from non-woody rootstock, sparsely to densely lanate and sometimes with a few globose sessile glands; stem wings entire, 1.4–3.3 mm wide. Leaves oblanceolate to obovate, 16–45 × 6.5–16 mm, 2.1–3.4 times longer than wide, apex acute or obtuse; margins recurved, denticulate, with 7–16 pairs of blunt teeth. Indumentum comprising lanate multi-cellular hairs, glandular hairs absent. Upper surface somewhat bullate; hairs erect to spreading, sparse to moderately dense, basal cells short; globose sessile glands absent. Lower surface with lanate hairs erect to spreading, moderately dense to dense, extending 0.5–1 mm from the surface, basal cells not very short; globose sessile glands yellow and shining, dense, touching or up to 3 diameters apart. Capitulescence spiciform, 33–75 mm long and 8–14 mm wide at anthesis, 2.8–5.8 times longer than wide; side branchlets never continuous, at 20–45°; peduncles 5–25 mm long. Outer involucral bracts 1.6–2 mm long, oblong to oblong-spathulate, with dense spreading lanate hairs on outer surface, glabrous on inner surface; glands absent; apex obtuse. Inner bracts white to straw coloured (sometimes tinged pink) on dorsal surface; longest ones linear, 3–3.6 × 0.1–0.25 mm wide, apex attenuate, upper margins entire or with an occasional small tooth; cilia 5–9, up to 2.5 mm long, attached along the proximal half and consistently extending to the distal one third, not exceeding the bract apex. Filiform (female) florets 27–45, white or straw-coloured, corolla 2.3–2.8 mm long, styles extending 0.1–0.7 mm beyond corolla. Hermaphrodite floret solitary, corolla pink, 2.5–3 mm long; corolla lobes 0.25–0.5 mm long, globose sessile glands always present, eglandular trichomes absent. Achenes narrowly ellipsoidal, 0.5–0.7 mm long, terete or slightly angular, dark brown, with 0–25 or 25–50 twin hairs each *c.* 0.05 mm long, evenly distributed; globose sessile glands at junction between achene and pappus usually present; pappus 2.2–3 mm long. **Figs. 11I–L, 13.**

***Additional selected specimens examined*: China.** Ch'ang-kiang District, Hainan Island, Feb 1934, *Lau 3261* (GH); Taichow, Hainan Island, Jan 1938, *How & Chun 70001* (GH). **India.** Ghariajhor, 11 miles [18 km] from Sundargarh, Orissa, Mar 1950, *Mooney 3748* (K). **Myanmar.** Pegu, *s.dat.*, *Kurz 2263* (K); Prome, Ava,

Fig. 13. Representative specimen of ***Pterocaulon redolens*** (*Eddie CPE1064* [BRI]).

s.dat., *Hance 17401* (K). **Thailand.** Ban Huay Nam Kow, Chiang Mai Province, Feb 1993, *Radanachalesa 1* (A). **Indonesia.** near Palu, Celebes, Apr 1975, *Meijer 9173* (A, L). **Philippines.** Bataan Province: Luzon, Jul 1913, *Merrill 341* (AMES, L). **Papua New Guinea.** Morobe Province: Erap, Jan 1958, *Henty NGF9481* (BRI, CANB, K). Central Province: Tupuseleia, Port Moresby subdistrict, Aug 1967, *Kairo & Streimann NGF30803* (BRI, CANB, L). **New Caledonia.** Ilé Pott, Mouane, Aug 1968, *McKee 19366* (NOU); Plateau central, Ilé des Pins, Jul 1970, *McKee 22304* (NOU); Noumea, 1868–1870, *Balansa* (A). **Vanuatu.** Tableland, Eromanga, Jul 1896, *Morrison s.n.* (K). **Australia: Queensland.** Cook District: Dimbulah, Apr 1935, *Flecker 398* (CNS); Ravenshoe – Hughenden Road, *c.* 150 km N of Hughenden, Apr 1975, *Halliday 418* (BRI); Bulleringa N.P., 80 km NW of Mt Surprise, Apr 1998, *Forster PIF22541 & Booth* (BRI, DNA, MEL). North Kennedy District: Barrabas Scrub, May 1972, *Hyland 6085* (CNS); 13.5 km W of the Dry Swamp, May 1991, *Neldner 3268 & Thompson* (BRI, K); 6 miles [10 km] N of Craigie Station, Jul 1953, *Lazarides 3718* (BRI, CANB); Townsville, Aug 1916, *White s.n.* (BRI [AQ270344]). Leichhardt District: Springsure, Apr 1961, *Jones 1870* (BRI, CANB); Twenty Mile Yards, 'Rookwood', Apr 1991, *Forster PIF7881 & McDonald* (BRI, MEL). Port Curtis District: Rundle Range, S.F. 60, 37 km NW of Gladstone, Aug 1989, *Gibson TOI698* (BRI). Burnett District: 9 km SE of Mt Perry (town), Apr 1985, *Rodd & Hardie 4378* (BRI, CANB, NSW); Windera, Apr 1963, *McKee 10198* (BRI, CANB). Maranoa District: Boatman Station, Mar 1947, *Everist 2813* (BRI); 'Six Mile', Bulloak Paddock, NNW of Roma, Mar 2007, *Eddie CPE1064* (BRI). Warrego District: Yanna Siding, via Charleville, May 1949, *Heinemann s.n.* (BRI [AQ270369]). Moreton District: Rifle Range Reserve, Goodna, E of Ipswich, Apr 1990, *Bean 1512* (BRI).

***Distribution and habitat*:** *Pterocaulon redolens* is widespread, with occurrences in China (Hainan), India, Myanmar, Thailand, Philippines, Indonesia, Papua New Guinea, Australia, New Caledonia and Vanuatu. Cabrera & Ragonese (1978) reported seeing specimens also from Laos, Cambodia and Vietnam. In Australia, it is widely distributed in eastern Queensland, south from Lakefield National Park (**Map 6**), and was reported by Porteners (1992) to occur in the far north-east of New South Wales. It inhabits grassy areas at low altitudes in hilly or flat terrain, with sandy to clay-loam soil. In Australia, it is found in various eucalypt woodlands or on the edge of vine thickets in shallow or deep soils, sometimes behind coastal dunes. The geological substrate may be granite, sandstone, basalt or serpentinite.

***Phenology*:** Flowers and fruits are recorded for every month of the year, with most records between April and September.

***Affinities*:** *Pterocaulon redolens* is not obviously allied to any other species. However, sterile specimens of *Pterocaulon redolens* are indistinguishable from the sympatric *P. ciliosum*.

***Typification*:** The isotype of *Conyza redolens* at K [K000373288] has a blue hand-written label stating "Gnaphalium redolens (Forster)/ Habitat in New Caladonia", and next to that, a printed label saying "The Forster Herbarium. Presented by the Corporation of Liverpool, August 1885". There are five separate branches mounted on the sheet; three are *Pterocaulon redolens* and two are *P. sphacelatum*.

***Notes*:** This species is distinctive in the spicate, interrupted capitulescence; ring of glands often present at apex of achene; upper margins of inner bracts entire and many female florets (27–45) per capitulum.

The author has seen a single specimen of this species from India, as cited above. *Pterocaulon redolens* must be a relatively recent arrival in India, as Hooker (1882) recorded it only from "Burma and the Eastern Peninsula". It was not recorded by Haines (1961) as present in Bihar or Orissa. Rath & Priyadarshini (2005) reported *Pterocaulon redolens* from an abandoned manganese quarry, a highly modified habitat. I conclude that this species is very likely not native to India, but naturalised.

9. Pterocaulon serrulatum (Montrouz.) Guillaumin, *Bull. Soc. Bot. France* 84: 56 (1937); *Monenteles serrulatus* Montrouz., *Mém. Acad. Roy. Sci. Lyon, Sect. Sci.* 10: 225 (1860). **Type:** New Caledonia. Art Island, *s.dat.*, *J.X.Montrouzier 125* (holo: LY, destroyed).

Monenteles glandulosus Benth., *Fl. Austral.* 3: 523 (1867); *Pterocaulon glandulosum* (Benth.) F.Muell., *Syst. Census Austral. Pl.* 79 (1883); *P. glandulosum* var. *glandulosum*, Ewart & Davies, *Fl. N. Territory* 277 (1917). **Type:** Australia: Queensland. Cook District: Gilbert River, October 1856, *F. Mueller s.n.* (lecto: K373279, *fide* Cabrera & Ragonese [1978: 254]).

Strongly aromatic perennial shrub 35–150 cm high; stems one to several from woody rootstock, with sparse to dense lanate eglandular hairs, globose sessile glands and sometimes stalked glandular hairs; stem wings serrate, 2.5–8 mm wide. Leaves elliptical, ovate or broadly-lanceolate, 20–82 × 8–28 mm, 2.1–4.3 times longer than wide, apex acute; margins flat or recurved, serrulate, with 13–45 pairs of teeth. Indumentum comprising lanate multi-cellular hairs, glandular hairs present or absent. Upper surface smooth or slightly bullate; hairs erect to spreading, sparse to dense, basal cells short; globose sessile glands present. Lower surface with lanate hairs erect to spreading, sparse to very dense, extending 1–1.5 mm from the surface, basal cells not very short; globose sessile glands yellow and shining or pale yellow and opaque, dense, touching or up to 3 diameters apart. Capitulescence ellipsoid or cylindrical, sometimes 'interrupted', rarely almost globose, 14–52 mm long and 13–17 mm wide at anthesis, 1.1–3.5 times longer than wide; side branchlets never continuous, at 20–45°; peduncles 0–15 mm long. Outer involucral bracts 2.3–3.7 mm long, oblong, with sparse to moderately dense spreading lanate hairs on margins, glandular-hairy on both surfaces; apex obtuse. Inner bracts white to greenish-white on dorsal surface; longest ones linear, 3.9–6.3 × 0.3–0.5 mm, apex acute, upper margins with small or large teeth; cilia 6–14, up to 2.4 mm long, attached along the proximal half and consistently extending to the distal one third, not exceeding the bract apex. Filiform (female) florets 29–52, white to straw coloured, corolla 2.8–4.2 mm long, styles extending 0.3–0.5 mm beyond corolla. Hermaphrodite floret solitary, corolla pink, 3.6–4.7 mm long; corolla lobes 0.4–0.6 mm long, globose sessile glands present, eglandular trichomes absent. Achenes narrowly ellipsoidal, 0.7–1 mm long, terete or almost so, dark brown, with 25–50 twin hairs each *c.* 0.1 mm long, evenly distributed; globose sessile glands at junction between achene and pappus absent; pappus 2.8–4.5 mm long.

***Affinities*:** *Pterocaulon serrulatum* is a distinctive species, but is sometimes confusable with *P. sphacelatum* and *P. ciliosum*. These are perhaps its closest relatives, and postulated hybrid specimens are reported in this paper.

***Typification*:** Vegter (1976) reported that Montrouzier's types are at LY, and Guillaumin & Beauvisage (1914) reported seeing the type of *Monenteles serrulatus* there. However, it appears that Montrouzier's collection at LY was destroyed or lost in the 1950's (P. Morat, *pers. comm*. June 2010), and the curator at LY has confirmed that the type of *Monenteles serrulatus* is not present there now. Duplicates of some of Montrouzier's collections are held at MPU, but no type material of *Monenteles serrulatus* can be found there (P. Schafer, *pers. comm*. June 2010), nor is there an isotype at P (P. Morat, *pers. comm*. June 2010). This is in accord with the information provided by Guillaumin & Beauvisage (1914), i.e. that there was only a single type specimen for this name, the specimen at LY.

There seems little doubt about the application of the name *Pterocaulon serrulatum*. The protologue is fairly detailed and the description matches the plant currently called *Pterocaulon serrulatum* var. *serrulatum* in Australia. Guillaumin & Beauvisage (1914) reported that the type was very similar to *Pterocaulon glandulosum* F.Muell., but that it differed by being totally glabrous.

***Notes*:** *Pterocaulon serrulatum* is distinctive in the cylindrical to ovoid capitulescence; broad serrated stem wings; many female florets per capitulum; outer involucral bracts glandular hairy on both surfaces and the sessile glands on upper leaf surface.

Varietal rank is appropriate for the taxa included within *Pterocaulon serrulatum*. The two varieties differ only in their indumentum, but these characters do not vary continuously in Australian material, and a useful geographical separation is achieved through their use. All eastern Queensland material can be readily assigned to var. *serrulatum*, and all Northern Territory material is referrable to a more broadly circumscribed var. *velutinum*, as outlined in the key. Some specimens from the Kimberley region are assigned here to var. *serrulatum*. Some specimens from the Jericho and Hughenden districts of Queensland are difficult to assign to either variety; for example,

Fig. 14. Representative specimen of ***Pterocaulon serrulatum*** var. ***serrulatum*** (*Bean 22120* [BRI]).

Smyrell GS69 has broad based glandular hairs (a feature of var. *serrulatum*) and also has lanate hairs on the upper leaf surface (a feature of var. *velutinum*). Similarly, in the Pilbara region of Western Australia, there are specimens referred to here as var. *velutinum*, but which closely approach var. *serrulatum* e.g. *Byrne 2807.*

Key to varieties

Lanate hairs absent from upper leaf surface; broad based glandular hairs common on leaves, stems and stem wings . . . . . **9a. P. serrulatum** var. **serrulatum**

Lanate hairs present on upper leaf surface; broad based glandular trichomes absent, but globose sessile hairs common on leaves, stems and stem wings . . . . . **9b. P. serrulatum** var. **velutinum**

9a. Pterocaulon serrulatum var. serrulatum

Winged stems and leaf surfaces with many broad-based glandular hairs 0.1–0.2 mm long; erect or spreading eglandular multicellular lanate absent from upper leaf surface, sparse or absent on lower leaf surface, stem wings and stems. **Figs. 1B, 14, 16A–D.**

***Illustration*:** Stanley & Ross (1986: 532).

***Additional selected specimens examined*: Australia: Western Australia.** Bell Gorge parking area, Aug 2005, *Byrne 1619* (PERTH); western base of Mt Hamilton, Jul 1905, *Fitzgerald 1209* (PERTH); Little Island, off Long Island, Buccaneer Archipelago, Jun 1982, *Hopkins BA0115* (PERTH); Around 'Beverley Springs' Homestead buildings, Jun 1992, *Mitchell 2556* (PERTH). **Queensland.** Cook District: Fossilbrook Creek, 'Burlington', N of Mount Surprise, Aug 1997, *Bean 12229* (BRI); along Kuranda Highway, *c.* 10 miles [16 km] E of Mareeba, Jun 1962, *Hoogland 8486* (BRI, CANB). North Kennedy District: 22.5 km (by road) SW of Herberton, on the Silver Valley road, May 1983, *Conn & Clarkson 1178* (AD, BRI, CANB, CNS, DNA, HO, NSW, PERTH); Road from Camel Creek to Greenvale, Aug 1998, *Fox 25 & Bean* (BRI); base of Frederick Peak, 25 km SW of Townsville, May 1991, *Bean 3215* (BRI); Lookout, on eastern slopes of Mt Kelly, *c.* 14 km south-west of Ayr, May 2009, *Bean 28848* (BRI); Bowen, reserve near reservoir, Nov 1978, *Ross s.n.* (BRI [AQ297444]). Mitchell District: 'Grant', *c.* 70 km ENE of Barcaldine, Jul 1994, *Smyrell GS89* (BRI). South Kennedy District: Redcliff Island, Seaforth, Aug 1992, *Batianoff 9208129* (BRI); 19 km E of 'Doongmabulla', N of Jericho, Apr 2002, *Bean 18984* (BRI, MEL). Leichhardt District: 60 miles [97 km] N of Comet township, Jul 1962, *Story & Yapp 185* (BRI, CANB); 118 km from Springsure, on road to Tambo, May 2004, *Bean 22120* (BRI); Ka Ka Mundi section, Carnarvon N.P., on fire trail from Salvator Rosa, Aug 2008, *Thomas MBT3780 & Leggett* (BRI). Port Curtis District: 'Corisande Hills', Stanage Bay road, N of Rockhampton, Jul 1997, *Bean 12063* (BRI, MEL); 32 km N of Miriam Vale, Jul 1996, *Thompson MIR136A & Turpin* (BRI). Burnett District: Gayndah, May 1917, *White s.n.* (BRI [AQ2703920]); 'Dykehead', 70 km W of Mundubbera, Jun 1998, *Robinson JR-1* (BRI). Wide Bay District: Degilbo Creek, near Biggenden, Aug 1980, *Johnson s.n.* (BRI [AQ343756]); Rossmore Road, 10 km SE of Kilkivan, May 2006, *Webb s.n.* (BRI [AQ619054]).

***Distribution and habitat*:** Found on Art Island, New Caledonia, and throughout the eastern half of Queensland in Australia, from Cooktown to Kilkivan. It also occurs in the western Kimberley region of Western Australia (**Map 7**). It grows on a wide range of sites (include coastal headlands) where drainage is good, usually in eucalypt woodland or grassland. Soils range from sands to clay-loams.

***Phenology*:** Flowers and fruits are borne between April and November.

9b. Pterocaulon serrulatum var. **velutinum** (Ewart & O.B.Davies) Guillaumin, *Bull. Soc. Bot. France* 84: 57 (1937); *Monenteles glandulosum* var. *velutinum* Ewart & O.B.Davies, *Fl. N. Territory* 277 (1917). **Type:** Australia: Northern Territory. Haast's Bluff, 17 May 1911, *G.F.Hill 184* (holo: MEL).

P. serratum O.Schwarz, *Repert. Spec. Nov. Regni Veg.* 24: 108 (1927). **Type:** Australia: Northern Territory. Port Darwin, 10 miles NE, *s.dat.*, *F.A.K.Bleeser 712* (holo: B, destroyed).

***Illustrations*:** Cabrera & Ragonese (1978: 253); Wheaton (1994: 112); Barrs (1999: 118) as *P. serrulatum* var. *serrulatum*.

Fig. 15. Representative specimen of ***Pterocaulon serrulatum*** var. ***velutinum*** (*Booth LH28-5 & Kelman* [BRI]).

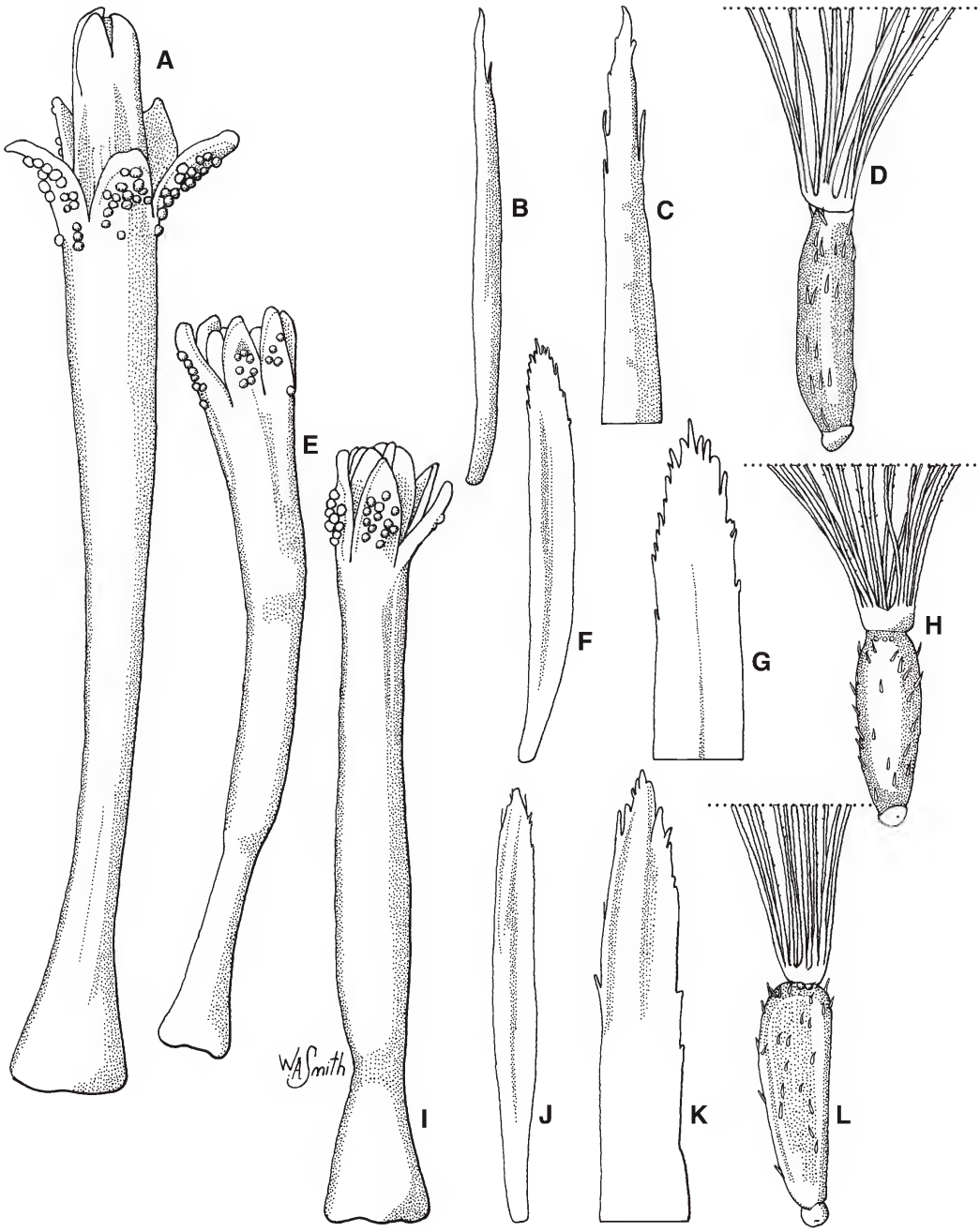

Fig. 16. ***Pterocaulon serrulatum*** var. ***serrulatum***. A. hermaphrodite floret × 32. B. inner involucral bract (cilia not shown) × 16. C. upper portion of inner involucral bract × 32. D. mature achene and basal portion of pappus × 32. ***Pterocaulon sphacelatum***. E. hermaphrodite floret × 32. F. inner involucral bract (cilia not shown) × 16. G. upper portion of inner involucral bract × 32. H. mature achene and basal portion of pappus × 32. ***Pterocaulon sphaeranthoides***. I. hermaphrodite floret × 32. J. inner involucral bract (cilia not shown) × 16. K. upper portion of inner involucral bract × 32. L. mature achene and basal portion of pappus × 32. A–C from *Bean 28848* (BRI); D from *Ross s.n.* (BRI [AQ297444]); E, H from *Piercey 51* (DNA); F–G from *Halford Q2626* (BRI); I–K from *van Leeuwen 0099* (PERTH); L from *van Leeuwen 0092* (PERTH).

Winged stems and leaf surfaces without broad-based glandular hairs; globose sessile glands *c.* 0.05 mm long, abundant; erect to tangled eglandular multicellular lanate hairs sparse to very dense on leaves, wings and stems. **Figs. 1A, 15.**

***Additional selected specimens examined*: New Caledonia.** Voh, presqu'île de Gatope, Aug 1970, *McKee 22393* (NOU); Mt Yallein, Jul 1968, *Jaffré 57* (NOU); Presqu'ile d'Arama, Aug 1965, *Schmid 619* (NOU); West face of Massif de Koniambo, Oct 1963, *Green 1288* (A, K, NOU). **Australia: Western Australia.** Gibb River Road, 117 km E of Derby, Aug 2001, *Courtney 40* (PERTH); Honeymoon Beach, 25 km N of Kalumburu, Jun 1990, *Edinger 713* (PERTH); 37.6 km NW of 'Bonney Downs' Homestead on road to Hillside, Oct 1995, *Mitchell PRP971* (DNA, PERTH); McLarty Hills, Great Sandy Desert, Aug 1977, *George 14625* (CANB, PERTH); 12 km SSW of Two Sisters, *c.* 150 km SE of Shay Gap, Jul 1984, *Newbey 10407* (PERTH); E of junction of Kununurra – Wyndham –Halls Creek roads, Jul 1974, *Carr 3203 & Beauglehole 46981* (BRI, CANB, PERTH); Roy Hill, Aug 2007, *Byrne 2807* (PERTH); Meentheena Conservation Reserve, 6.5 km SSE of 'Meentheena' Homestead, May 2001, *van Leeuwen 4797* (PERTH). **Northern Territory.** 4.5 km from Stuart Highway on Edith Falls Road, Jul 2003, *Elick 222* (CANB, CNS); 23 miles [37 km] NW of Rabbit Flat, Tanami, Apr 1971, *Dunlop 2131* (BRI, DNA); base of Meyers Hill, Alice Springs, Aug 1957, *Chippendale 3587* (BRI, CANB, DNA); Mt Bundy, Oct 1968, *Harpley NB982* (BRI, DNA); 269 km N of 'Barkly' Homestead towards Borroloola, Jun 1999, *Bean 15047* (BRI, DNA); Channel Island, Darwin Harbour, Jul 1995, *Cowie 5880* (DNA, MEL). **Queensland.** Burke District: 3 miles [5 km] from Mount Isa towards Lake Moondarra, Jul 1974, *Ollerenshaw 1142 & Kratzing* (BRI, CANB, L); Gregory Downs Station, E of Riversleigh, Jul 2009, *Booth LH28-5 & Kelman* (BRI). Cook District: Ortona Station, 102 km by road S of Forsayth, Aug 2010, *Bean 29878 & McDonald* (BRI, MEL, NSW). Mitchell District: Bessie's Castle, Silsoe Road, *c.* 100 km W of Longreach, May 2004, *Bean 22246* (BRI); 19.7 km E of Jericho, Jul 1975, *Chapman 1281* (AD, BRI, CANB, K, L). Gregory North District: Winton – Jundah Road, 23.9 km N of 'Elvo' Homestead, May 2004, *Bean 22561* (BRI).

***Distribution and habitat*:** A widespread taxon, occurring in New Caledonia, Australia in central and north-western Queensland, throughout the Northern Territory, and the northern half of Western Australia as far west as the Hamersley Range (**Map 7**). It is also recorded for a few locations in northern South Australia (Anon. 2011). It inhabits a wide range of habitats; the vegetation can be *Acacia* woodland, mallee shrubland, eucalypt open woodland or *Triodia* grassland. Soils can vary greatly, including beach sand, red sandy loam, or basaltic clay-loams, and it may grow on sandstone, limestone or quartzite hills, or on flats.

***Phenology*:** Flowers and fruits have been recorded from April to October.

***Notes*:** Cabrera & Ragonese (1978) stated that *Pterocaulon glandulosum* var. *velutinum* Ewart & O.B.Davies is a *nomen nudum*, but that is incorrect. Ewart and Davies provided an adequate description and the name is validly published.

The type of *Pterocaulon serrulatum* var. *velutinum* has a very dense cover of lanate eglandular hairs, and the two varieties have in the past been distinguished on the density of these hairs (based on herbarium specimen determinations). In this paper, I have placed more emphasis on the presence or absence of stalked glandular hairs in dividing the varieties. This provides a useful geographic separation between the varieties, but it means that a wide range of lanate hair densities is included within var. *velutinum*. The density of lanate hairs can vary at a single location, e.g. *Latz 7950* comprises pieces collected from two plants growing at the same place; on one the lanate hairs are sparse, and on the other they are very dense.

No type material of *Pterocaulon serratum* O.Schwarz has been seen, but from the description given in the protologue, there seems little doubt that it is this variety.

10. Pterocaulon sphacelatum (Labill.) F.Muell., *Syst. Census Austral. Pl.* 79 (1882); *Monenteles sphacelatus* Labill., *Sert. Austro-Caledon.* 43 (1825). **Type:** [New Caledonia] Nova Caledonia. [June 1792], *J.J.H.Labillardière s.n.* (lecto: FI [FI-W 92608], here designated, image!; isolecto: FI [FI-W 92605, left hand specimen only], P537804, image!).

***Illustrations*:** Cabrera & Ragonese (1978: 246); Porteners (1992: 204); Milson (2000: 21); Moore (2005: 126).

Strongly aromatic shrub 40–100 cm high, often almost as wide; stems single or numerous, densely lanate and sometimes with a few globose sessile glands; stem wings entire or sparsely toothed, 0.7–2 mm wide.

Leaves oblanceolate or spathulate, 20–66 × 4–15 mm, 3.3–5.8 times longer than wide, apex obtuse or acute; margins recurved, denticulate, with 6–14 pairs of blunt teeth. Indumentum comprising lanate multi-cellular hairs, glandular hairs absent. Upper surface moderately to strikingly bullate; hairs erect to spreading, sparse to moderately dense, basal cells short; globose sessile glands absent. Lower surface with lanate hairs erect to spreading, moderate to dense, extending 0.4–0.7 mm from the surface, basal cells not very short; globose sessile glands yellow and shining, dense, touching or up to 3 diameters apart. Capitulescence globose or ellipsoidal, 10–15 mm long, 10–14 mm wide at anthesis, 1–1.4 times longer than wide; side branchlets never continuous, at 30–60°; peduncles 0–22 mm long. Outer involucral bracts 2.2–3.7 mm long, spathulate, with dense spreading lanate hairs throughout on the outer surface, sparse hairs at distal end of the inner surface; glands absent; apex acute. Inner bracts violet, pink or white on dorsal surface; longest ones linear, 3.5–4.6 × 0.3–0.5 mm; apex acute, upper margins conspicuously toothed, or upper margins lacerate with no single distinct apex; cilia 6–18, up to 1.7 mm long, mostly attached in proximal half and few extending to the distal one third. Filiform (female) florets 17–29, pink, corolla 2.4–3.2 mm long, styles extending 0.4–0.6 mm beyond corolla. Hermaphrodite floret solitary, corolla pink, 2.5–3.7 mm long; corolla lobes 0.4–0.6 mm long, globose sessile glands present, eglandular hairs absent. Achenes narrowly ellipsoid, 0.7–1 mm long, terete or slightly quadrangular, dark brown, with 25–50 twin hairs each *c.* 0.05 mm long, evenly distributed; globose sessile glands at junction between achene and pappus rarely present; pappus 2.3–3.3 mm long. *Fruit salad plant, Apple bush.* **Figs. 2A, 16E–H, 17.**

***Additional selected specimens examined*: Timor-Leste.** Plateau of Baucau, Dec 1953, *Van Steenis 18030a* (L). **New Caledonia.** Baie Maa, Oct 1982, *Suprin 2059* (NOU); *s.loc.*, Oct 1965, *MacKee 13525* (K, L). **Australia: Western Australia.** Eagle Bore Study site, Plot 9, Gibson Desert Nature Reserve, Aug 2002, *Bragg 118* (MEL, PERTH); Rocky Pool, Gascoyne River, *c.* 850 km N of Perth, Oct 1975, *Kenneally 4641* (PERTH); Northern end of Windjana Gorge, Jul 1974, *Carr 4281 & Beauglehole 48059* (PERTH); Elder Creek, 2 km W of Warburton, Aug 1962, *George 3828* (PERTH); Anna Plains Station, Jul 1941, *Burbidge 1462* (PERTH); Lacrosse Island, at head of Cambridge Gulf, Jun 1992, *Kenneally 11328* (DNA, CANB, PERTH). **Northern Territory.** Auvergne Station, 35 km NW of Timber Creek, Jul 1977, *Must 1620* (CANB, DNA, SI); *c.* 4.5 km by road N of Gilbert Creek crossing by Stuart Highway, between Wauchope and Tennant Creek, Aug 1978, *Donner 6232* (AD, CANB, NT); Junction Reserve, Jul 1982, *Piercey 51* (DNA); Oenpelli, Sep 1948, *Specht 1083* (BRI, L); Burt Creek, 4 miles [6 km] S of Yambah Station, Mar 1953, *Perry 3372* (BRI, CANB); 3.2 miles [5.1 km] N of Alice Springs, Dec 1962, *Nelson 559* (CANB, DNA); Andado Station, Mac Clarke Reserve, Sep 1992, *Latz 12706* (DNA, MEL); Horse paddock, 'Tobermorey', Oct 1954, *Chippendale 418* (DNA); Barkly Tablelands, N of Telegraph bore, Mittibah Station, Jul 2001, *Mangion 1534 & Risler* (DNA). **Queensland.** Burke District: East bank of Leichhardt River, 72 km SE of Burketown, Burke Development Road, Jul 1991, *Jobson 1490* (BRI, HO, MEL). Cook District: Topsy Creek, Kowanyama Aboriginal Reserve, Aug 1980, *Clarkson 3392* (BRI, CNS). Gregory North District: 32 km N of Bedourie along road to Boulia, Jul 1995, *Halford Q2626* (BRI). Mitchell District: Silsoe Road, 4.1 km W of 'Morella' turnoff, W of Longreach, May 2004, *Bean 22250* (BRI). Warrego District: 99.3 km from Blackall towards Adavale, near Listowel Downs Station, Oct 1983, *Canning 6192 & Rimes* (CANB, BRI, DNA, MEL, NSW). Gregory South District: 20.2 km WSW of Eromanga, on Cooper Developmental Road, Aug 2010, *Bean 30023* (A, BRI, BRIT, MO). **New South Wales.** 113 km W of Wanaaring on Milparinka Road, Nov 1971, *Blaxell 613* (BRI, NSW); Lake Pinaroo near Fort Grey camping area, NW of Tibooburra, Sep 1989, *Coveny 13477 et al.* (AD, BRI, CANB, NSW, MEL, PERTH); Homestead Gorge, Mootwingee N.P., 112 km NE of Broken Hill, Oct 1988, *Crawford 1028* (AD, CANB, NSW). **South Australia.** around Nent Oura Research unit, Mount Freeling Station, Oct 1987, *Foster 227* (AD, DNA); Stuart Creek, 18 km WSW of 'Stuart Creek' Homestead, Dec 1984, *Badman 1597* (AD, DNA); Bunyeroo Gorge, Flinders Ranges N.P., Nov 1982, *Symon 13040* (AD, CANB, MO).

***Distribution and habitat*:** *Pterocaulon sphacelatum* is the most widespread Australian *Pterocaulon* species, occurring in all mainland states except Victoria, and extending from the west coast of Western Australia to within 150 km of the Queensland east coast. It occurs throughout much of Northern Territory and South Australia, and in the north-west of New South Wales. It also occurs in Timor and New Caledonia (**Map 8**). In grows on a range of sandy to clay-loam soils, on stony hillsides (higher rainfall areas) or creek-beds (arid areas), in grassland (often dominated by *Triodia* spp.), eucalypt woodland or low open woodland with *Acacia aneura* or other *Acacia* spp.

Fig. 17. Representative specimen of ***Pterocaulon sphacelatum*** (*Mangion & Risler 1534* [DNA]).

***Phenology*:** Flowers and fruits occur from June to October in northern parts of its range, and from August to December in southern parts.

***Affinities*:** *Pterocaulon sphacelatum* is closely related to *P. ciliosum*, but differs by the narrower leaves, and the bright pink inner bracts with few visible cilia on protruding parts, and strongly toothed to lacerate upper margins.

***Typification*:** There are two sheets at FI bearing material that matches the protologue of *Monenteles sphacelatus*. On one sheet (FI-W 92605), specimens of both *Pterocaulon sphacelatum* and *P. redolens* are present, but neither specimen is named; on the other sheet (FI-W 92608), there is a single specimen of *P. sphacelatum* accompanied by a detailed description written by Labillardière and headed *Monenteles sphacelatus*; this description agrees perfectly with the protologue. This latter sheet is selected as the lectotype.

***Notes*:** This species is distinctive in the upper margins of the inner bracts often lacerate; capitulescences often ellipsoidal, up to 1.4 times longer than wide; the inner bracts always partly pink to violet, often predominantly so; leaves oblanceolate in shape, 3.5–5.8 times longer than wide; leaf upper surface bullate; corolla lobes of hermaphrodite floret short and none or few cilia visible on protruding part of inner bracts.

11. Pterocaulon sphaeranthoides (DC.) F.Muell., *Syst. Census Austral. Pl.* 79 (1882); *Monenteles sphaeranthoides* DC., *Prodr.* 5: 456(1836). **Type:** Australia: Western Australia. Enderby Island, Dampier Archipelago, 25 February 1818, *A.Cunningham s.n.* (holo: G-DC; iso: PERTH; BM, K *n.v.*).

***Illustration*:** Cabrera & Ragonese (1978: 250).

Strongly aromatic shrub 30–120 cm high; stems numerous, densely glandular-hairy and sometimes with sparse lanate eglandular hairs; stem wings prominently toothed, 0.5–3(–4) mm wide. Leaves narrowly oblanceolate to linear, 12–48 × 2–10 mm, 3.5–13 times longer than wide, apex acute; margins recurved to revolute, serrate with 10–16 pairs of teeth. Indumentum comprising broad-based glandular hairs, globose sessile glands and sometimes lanate eglandular hairs. Upper surface strikingly bullate; glandular hairs erect, sparse to moderately dense, 0.1–0.2(–0.4) mm long, broad-based; lanate hairs absent or sparse; globose sessile glands present. Lower surface glabrous or with sparse, erect to spreading lanate hairs, basal cells not very short; globose sessile glands yellow and shining, dense, touching or up to 3 diameters apart. Capitulescence ± globose, 11–16 mm long, 11–14 mm wide at anthesis, 1–1.2 times longer than wide; side branchlets never continuous, at 30–60°; peduncles 1–20 mm long. Outer involucral bracts 2.2–2.7 mm long, linear-spathulate to oblong, with dense spreading lanate hairs throughout on the outer surface, glabrous on inner surface; glands present; apex acute or obtuse. Inner bracts violet, pink or white on dorsal surface; longest ones linear, 3.5–4 × 0.2–0.5 mm, upper margins with large teeth, or lacerate with no distinct single apex; cilia 5–12, up to 1.5 mm long, mostly attached in proximal half and few extending to the distal one third. Filiform (female) florets 14–20, pink, corolla 2.3–2.8 mm long, styles extending 0.2–0.9 mm beyond corolla. Hermaphrodite floret solitary or very rarely two, corolla pink, 2.7–3.4 mm long; corolla lobes 0.4–0.5 mm long, globose sessile glands present, eglandular trichomes absent. Achenes narrowly ellipsoid, 0.8–0.95 mm long, slightly quadrangular, dark brown, with 25–50 twin hairs each 0.05–0.1 mm long, evenly distributed; globose sessile glands at junction between achene and pappus occasionally present; pappus 2.2–2.9 mm long. **Figs. 16I–L, 18.**

***Additional specimens examined*: Australia: Western Australia.** Hermite Island, Montebello Islands, Oct 2000, *Kenneally 11558* (PERTH); Depuch Island, NE of Roebourne, May 1962, *Royce 7131* (PERTH); Charles Knife Road, between picnic area and Cape Range N.P., Aug 1978, *Perry 845* (BRI, PERTH); Legendre Island, Dampier Archipelago, Jun 1962, *Royce 7264* (PERTH); Barrow Island, Aug 1973, *Butler 47* (PERTH); Rosemary Island, Dampier Archipelago, Jun 1962, *Royce 7451* (PERTH); Barrow Island Nature Reserve, 11.3 km WNW of Town Point, Nov 1991, *van Leeuwen 1086* (PERTH); 48.6 km NW of 'Bonney Downs' Homestead on road to Hillside, Nov 1995, *Mitchell PRP977* (DNA, PERTH); Lower end of Upper Bee Gorge, Hamersley Range N.P., Aug 1973, *Weston 8443* (PERTH); Python

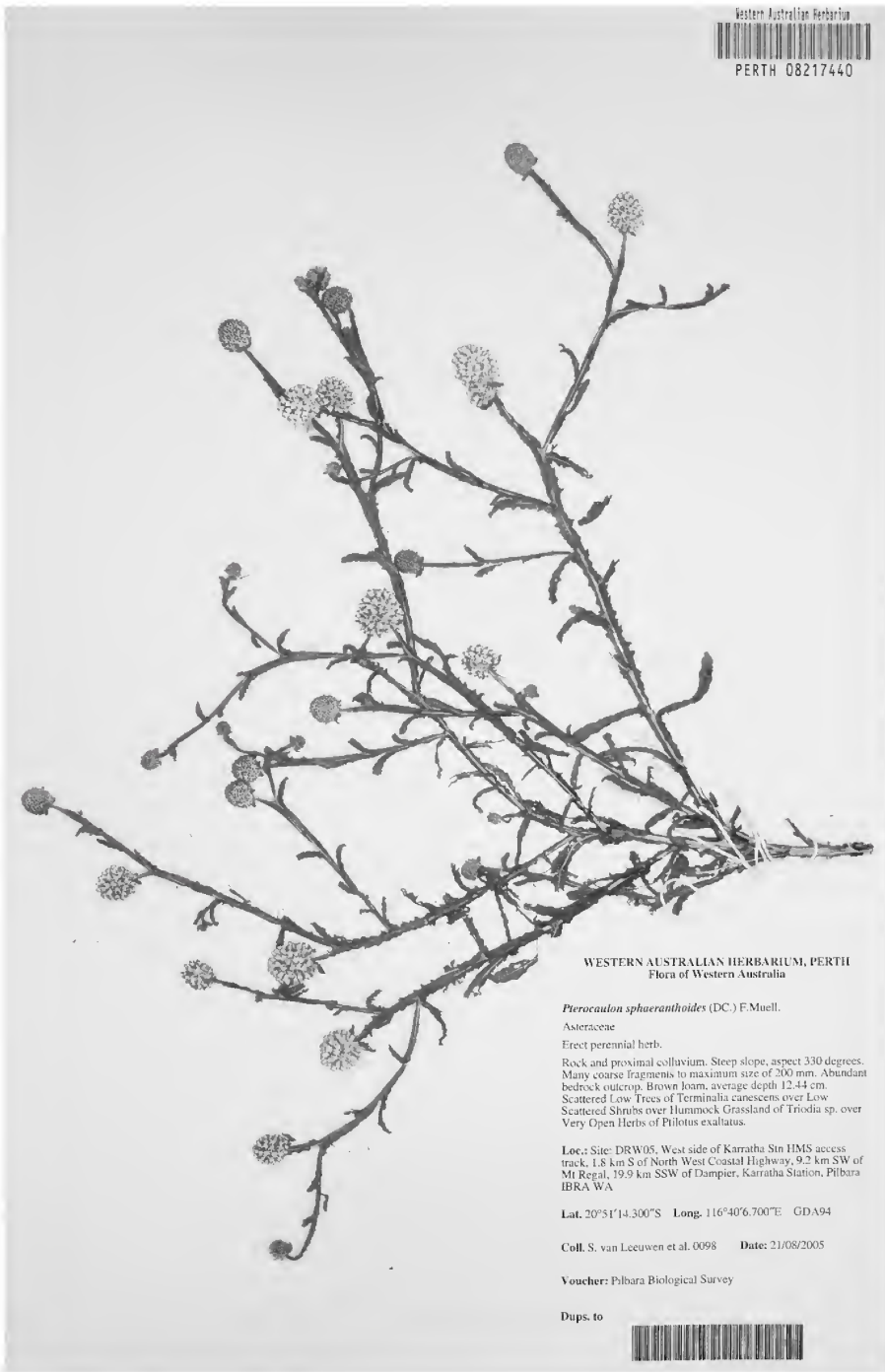

Fig. 18. Representative specimen of ***Pterocaulon sphaeranthoides*** (*van Leeuwen et al. 0098* [PERTH]).

Pool, Chichester-Millstream N.P., Oct 1989, *Nordenstam & Anderberg 302* (PERTH); Yardie Creek, Cape Range N.P., Dec 1986, *Alford 816* (PERTH); Cleaverville Creek, Roebourne, Jul 2004, *Byrne 1075* (PERTH); W of Mt Leal, on Roebourne to Wittenoon Highway, Sep 1981, *Lander 1132* (PERTH); Karrawingina Pool, Harding River, Sep 1981, *Weston 12772* (PERTH); Site OYE04, 3.4 km E of Pannawonica – Cape Lambert railway crossing on Pannawonica – Millstream Road, Aug 2006, *van Leeuwen et al. 0102* (PERTH); Site PW17, 13.4 km N of 'Mt Flora', 71.1 km E of Pannawonica, Sep 2006, *van Leeuwen et al. 0092* (BRI, PERTH); Durba Hills, Keartland district, Jun 1984, *Morse 180* (CANB); 3.1 km SSE of Pulgorah Cone, Warrawagine Station, Pilbara, Aug 2004, *van Leeuwen 0090* (PERTH); West side of Karratha Station Homestead access track, 1.8 km S of North West Coastal Highway, Aug 2005, *van Leeuwen 0098* (PERTH); North side of Fortescue River Mouth access track, 6.8 km W of North West Coastal Highway, Aug 2005, *van Leeuwen 0099* (PERTH).

***Distribution and habitat*:** This species is endemic to Western Australia. It is common along coastal parts of the Pilbara region, including offshore islands, from the Cape Range to Depuch Island, east of Roebourne. It also occurs away from the coast, to the south and south-east of Port Hedland, as far east as the Durba Hills (**Map 3**). It grows in *Triodia* grassland, or in *Acacia* shrubland with *Triodia* understorey, on coastal sand dunes, rocky hillsides or rocky watercourses. Soils are often red sandy-loams. The substrate may be limestone, sandstone or granite.

***Phenology*:** Flowers and fruits have been recorded from June to December.

***Affinities*:** This species has affinities with *Pterocaulon sphacelatum*; however, that species has stem wings that are entire or sparsely toothed, lanate hairs frequent and glandular hairs absent from the upper leaf surface.

***Notes*:** This species is distinctive in the blistered bright green narrow leaves; serrated stem wings; lanate hairs absent or sparse and the short broad-based glandular hairs present on upper leaf surfaces.

Pterocaulon sphaeranthoides and *P. sphacelatum* are very closely related and some specimens are hard to identify, suggesting that they do intergrade in some areas. For example, *Trudgen & Parnell 11608* (PERTH), *Backhouse et al. BEM50* (PERTH), and *Lander 1132* (PERTH), all from the Hamersley Ranges, while assigned here to *Pterocaulon sphaeranthoides*, are also close to *P. sphacelatum*. In other areas, they are apparently sympatric; typical specimens of both species have been seen from Barrow Island, for example.

I have been unable to confirm the observation made first by Bentham (1867) that the involucres of *Pterocaulon sphaeranthoides* have "Usually 2, very rarely 1 or 3" disc (hermaphrodite) florets. Cabrera & Ragonese (1978) stated "male florets 1–3", as did Wilson (1992), both presumably paraphrasing Bentham. Of the hundreds of capitula examined by the present author, all except one had a solitary hermaphrodite floret. The exceptional capitulum had two hermaphrodite florets.

12. Pterocaulon tricholobum A.R.Bean **species nova** affinis *P. globulifloro* sed alis caulinis multo latioribus, bracteis interioribus longioribus, pilis numerosis in lobis corollarum flosculorum hermaphroditorum, achenarum pilis paucioribus et pappis longioribus differens. **Typus:** Australia: Northern Territory. East Alligator, 10 June 1971, *G.C.Taylor 75* (holo: BRI; iso: CANB, DNA).

Aromatic shrub 50–120 cm high; stems one to several from woody rootstock, densely lanate but without globose sessile glands; stem wings entire, 2.8–5.5 mm wide. Leaves elliptical to obovate, 25–92 × 8–30 mm, 2.1–3.7 times longer than wide, apex obtuse or rarely acute; margins recurved, denticulate, with 15–30 pairs of very small teeth. Indumentum comprising lanate multi-cellular hairs, glandular hairs absent. Upper surface not or slightly bullate; hairs erect to spreading, sparse to moderately dense, basal cell short; globose sessile glands absent. Lower surface with lanate hairs erect to spreading, dense to very dense, extending 0.4–0.8 mm from the surface, basal cells not very short; globose sessile glands yellow and shining, moderately dense, 3–6 diameters apart. Capitulescence globose to broadly ellipsoidal, rarely truncate-globose, (8–)10–16 mm long and 10–14 mm wide at anthesis, (0.7–)0.9–1.3 times longer than wide; side branchlets very often

Fig. 19. Holotype of ***Pterocaulon tricholobum*** (*Taylor 75* [BRI])

continuous, at 0–80°; peduncles often absent, but sometimes up to 11 mm long. Outer involucral bracts oblong-spathulate, 2.5–3 mm long, with dense spreading lanate hairs on outer surface, sparse to moderately dense hairs on the distal end of inner surface; glands absent; apex obtuse. Inner bracts white, rarely tinged pink on dorsal surface; longest ones linear, 4–4.8 × 0.2–0.35 mm, apex acute, upper margins with some small or large teeth; cilia 11–22, up to 2.5 mm long, attached along the proximal half and consistently extending to the distal one third, not exceeding the bract apex. Filiform (female) florets 15–21, white or straw-coloured, corolla 2.3–2.9 mm long, styles extending 0.6–1 mm beyond corolla. Hermaphrodite floret solitary, corolla pink, 2.9–3.6 mm long; corolla lobes 0.8–1.2 mm long, globose sessile glands present, eglandular trichomes 2–8 per lobe. Achenes narrowly ellipsoidal, 0.8–0.9 mm long, faintly ribbed, dark brown, with 0–25 twin hairs each <0.1 mm long, evenly distributed or mostly in distal half; globose sessile glands at junction between achene and pappus absent; pappus 2.1–3 mm long. **Figs. 19, 20A–D.**

***Additional selected specimens examined*: Australia: Western Australia.** S side of Cockburn Range, *c.* 13 km W of King River, Jul 1974, *Carr 3338 & Beauglehole 47116* (PERTH); Langi, 4 km S of Prior Point and 33 km SSW of Kuri Bay, Jul 1990, *Kenneally 11055* (PERTH); Python Cliffs, Marigui Promontory, Prince Regent River Reserve, Aug 1974, *Kenneally 2138* (CANB, PERTH); The Grotto, Deception Ranges, near Kimberley Research Station, Jul 1952, *Lazarides 3071* (BRI, CANB, DNA); Mt Trafalgar, Prince Regent River Reserve, Aug 1974, *George 12698* (CANB, PERTH); Inglis Gap, Gibb River Road, west Kimberley, Jun 1988, *Wilson 12959* (PERTH); Mirima [Hidden Valley] N.P., Jun 1989, *Kenneally 10947* (DNA, PERTH); Sunday Island, Buccaneer Archipelago, Jun 1982, *Kenneally 8250* (DNA, MEL, PERTH); Bungle Bungle N.P., Bull Creek, Jun 1989, *Cowie 874* (DNA, MEL, PERTH); Gibb River Road, Home Valley Station, East Kimberley, Jun 1992, *Menkhorst 1067* (DNA, MEL, PERTH). **Northern Territory.** South Bay, Bickerton Island, Gulf of Carpentaria, Jun 1948, *Specht 617* (A, BRI, CANB, PERTH); Victoria River Gorge, May 2001, *Leach & Cowie 4659* (DNA); Gregory N.P., S of Victoria River pub, May 2001, *Risler & Smith 687* (DNA); Spirit Hills Conservation Area; Nancy's Gorge, Aug 1996, *Cowie 7136* (DNA); 2 km S of Myra Falls, Jun 1993, *Brennan 2355* (DNA); Fitzmaurice River, May 1994, *Barritt 1270* (DNA, MEL); Keep River Gorge, Jun 1995, *Egan 5004* (DNA); Bartelumba Bay, Groote Eylandt, Aug 1975, *Levitt 437* (CANB, DNA, NE, NT); Mt Brockman near Koongarra Saddle, 2 km N of Koongarra, May 1980, *Lazarides 8905* (CANB, DNA); Nitmiluk N.P., eastern boundary, May 2002, *Michell 3877* (DNA); Gregory N.P., *c.* 29 km NW of Bullita Outstation, Apr 1996, *Coles 103 & Duretto* (DNA, MEL); Keep River N.P., Apr 1982, *King 65* (DNA); Bauhinia Downs Station, Alligator Stockyards, May 1985, *Wightman 1835 & Leach* (CANB, DNA, NT); Limmen Bight, May 1996, *Egan 5396 & Michell* (DNA). **Queensland.** BURKE DISTRICT: 'Westmoreland', Big Amphitheatre, May 1997, *Forster PIF21039 & Booth* (BRI, DNA).

***Distribution and habitat*:** A widespread species distributed in the northern Kimberley of Western Australia, the 'Top End' of the Northern Territory, and extending to the north-west of Queensland (**Map 9**). The occurrences of *Pterocaulon tricholobum* are strongly associated with sandstone hills, escarpments, scree slopes and gorges. The vegetation type is variously recorded as *Triodia* grassland, open savannah or shrubby woodland. Soils are sandy.

***Phenology*:** Flowers and fruits have been recorded from May to September.

***Affinities*:** *Pterocaulon tricholobum* is most closely allied to *P. globuliflorum*, but differs by the stem wings 2.8–5.5 mm wide (0.4–1.5 mm wide for *P. globuliflorum*); the longest inner bracts 4–4.8 mm long (3.2–3.5 mm long for *P. globuliflorum*); trichomes always present on corolla lobes of hermaphrodite floret (usually absent for *P. globuliflorum*); achene hairs 0–25 (achene hairs 25–50 for *P. globuliflorum*); and pappus 2.1–3 mm long (1.3–1.7 mm long *for P. globuliflorum*).

***Notes*:** This species is distinctive in the broad stem wings, rather small white globose capitulescences that are often laterally and the obvious trichomes on corolla lobes of hermaphrodite floret.

The label of *Coles 103 & Duretto* records that the plant "smells like Granny Smith apples".

Carr 3338 & Beauglehole 47116 is a mixed gathering. All pieces on the CANB sheet are *Pterocaulon paradoxum*; both pieces on the PERTH sheet are *P. tricholobum*.

***Etymology*:** From the Greek *trichos* meaning hair or thread, and *lobus* meaning lobes. This is in reference to the conspicuous unicellular hairs consistently borne on the corolla lobes of

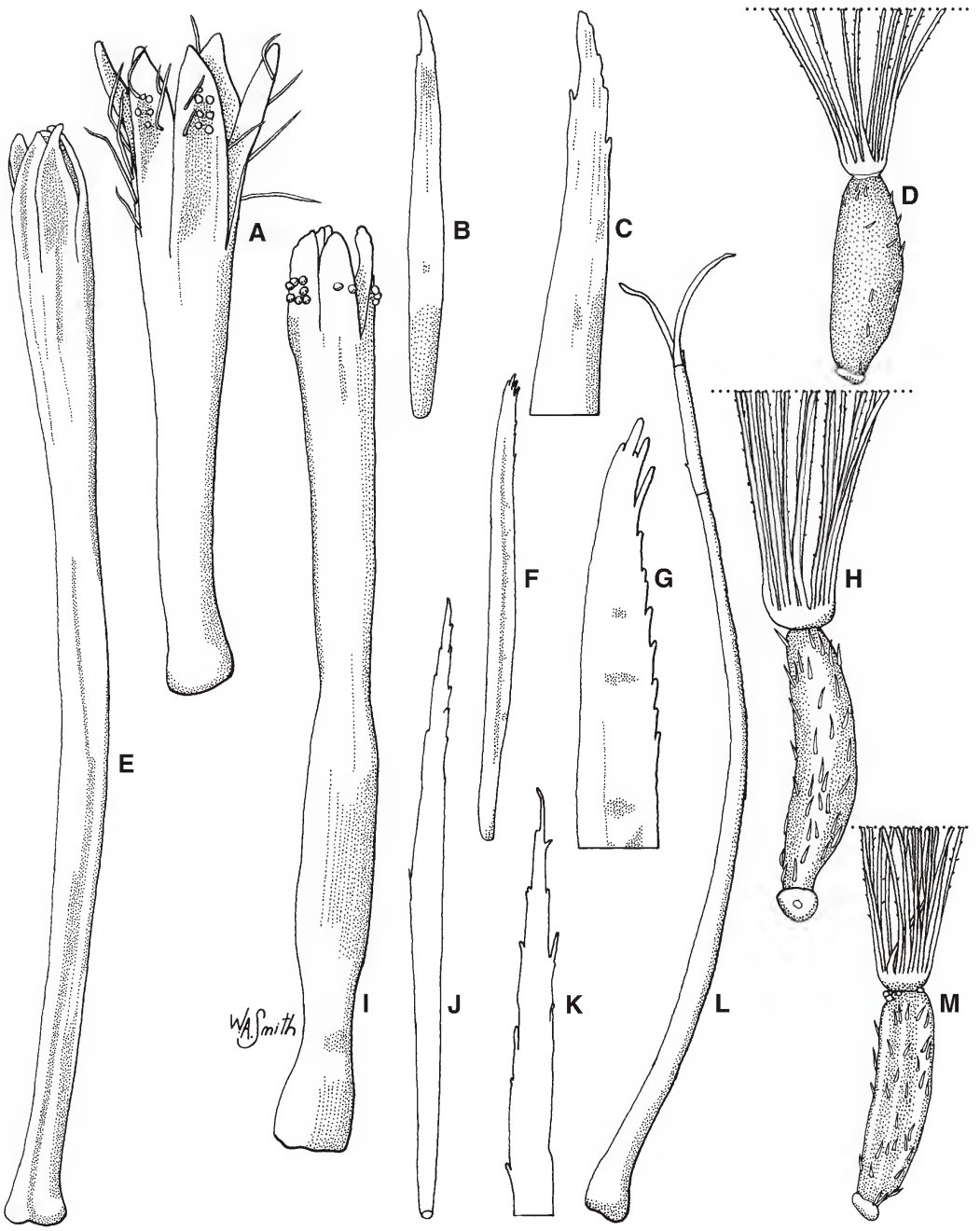

Fig. 20. ***Pterocaulon tricholobum***. A. hermaphrodite floret × 32. B. inner involucral bract (cilia not shown) × 16. C. upper portion of inner involucral bract × 32. D. mature achene and basal portion of pappus × 32. ***Pterocaulon verbascifolium***. E. hermaphrodite floret × 32. F. inner involucral bract (cilia not shown) × 16. G. upper portion of inner involucral bract × 32. H. mature achene and basal portion of pappus × 32. ***Pterocaulon xenicum***. I. hermaphrodite floret × 32. J. inner involucral bract (cilia not shown) × 16. K. upper portion of inner involucral bract × 32. L. female floret × 32. M. mature achene and basal portion of pappus × 32. A–C from *Egan 5004* (DNA); D from *Cowie 7136* (DNA); E–H from *von Oertzen 116* (DNA); I–L from *Dunlop 1830* (DNA); M from *George 14628* (PERTH).

the hermaphrodite floret. Other species have this feature, but in this species the trichomes are consistently present and obvious.

13. Pterocaulon verbascifolium (Benth.) F.Muell., *Syst. Census Austral. Pl.* 79 (1882); *Monenteles verbascifolius* Benth., *Fl. Austral.* 3: 523 (1867). **Type:** Australia: Northern Territory. Fitzmaurice River, *s.dat.*, *F.Mueller s.n.* (lecto: K373286), *fide* Cabrera & Ragonese (1978: 245).

***Illustration*:** Cabrera & Ragonese (1978: 243).

Non-aromatic shrub 50–130 cm high; stems very densely lanate; stem wings entire, 2.5–6(–8) mm wide. Leaves elliptical, ovate or obovate, 37–70 × 20–43 mm, 1.6–2.3 times longer than wide, apex acute; margins recurved, denticulate, with 5–24 pairs of blunt teeth, sometimes obscure. Indumentum comprising lanate multi-cellular hairs, glandular hairs absent. Upper surface with hairs erect to spreading, very dense, basal cells short; globose sessile glands absent. Lower surface with lanate hairs adpressed to spreading, very dense, extending 0.5–0.9 mm from the surface, basal cells not very short; globose sessile glands sparsely present, but hidden by hairs. Capitulescence spiciform or cylindrical, 35–105 mm long and 17–30 mm wide at anthesis, 1.8–4.3 times longer than wide; side branchlets never continuous, at 30–90°; peduncles 3–40 mm long. Outer involucral bracts 3.3–5.5 mm long, oblong to oblong-spathulate, with dense spreading lanate hairs on outer surfaces, inner surface glabrous or lanate; glands absent; apex acute. Inner bracts white on dorsal surface; longest ones linear, 5.3–9.2 × 0.3–0.6 mm, apex acute, upper margins with numerous small teeth; cilia 12–30, up to 5.5 mm long, attached along the proximal half and consistently extending to the distal one third, not exceeding the bract apex. Filiform (female) florets 25–58, straw-coloured, corolla 3.7–7.5 mm long, styles extending 0.4–0.9 mm beyond corolla. Hermaphrodite floret 1(–2), corolla pink, 4–6.5 mm long; corolla lobes 0.6–1 mm long, globose sessile glands absent, eglandular trichomes absent. Achenes narrowly ellipsoidal, 1.1–1.3 mm long, terete or slightly angular, dark brown, with 25–50 or more than 50 twin hairs each *c.* 0.1 mm long; globose sessile glands at junction between achene and pappus absent; pappus 3.5–6.9 mm long. **Figs. 20E–H, 21.**

***Additional specimens examined*: Indonesia.** Sumbawa, *s.dat.*, *Zollinger 3421* (GH, L). **Australia: Western Australia**. Dillie Gorge, Charnley River Station, Jul 2005, *Byrne 1584* (PERTH); Carlton Hill Station, close to Ningbing Site 3, Jun 2001, *Handasyde & Start TH01137* (DNA, PERTH); Sir Graham Moore Island, Jul 1973, *Wilson 11317* (PERTH); SW from Mt Trafalgar, margin of Saint George Basin, Jul 1990, *Willing 212* (PERTH); Fenelon Island, off Admiralty Gulf, Jul 1977, *Kenneally 6412* (PERTH); Inglis Gap, King Leopold Range, May 1905, *Fitzgerald 752* (PERTH); Bushfire Hill, Prince Regent River Reserve, Aug 1974, *George 12261* (PERTH); around 'Beverley Hills' Homestead buildings, Jun 1992, *Mitchell 2557* (PERTH); Euro Gorge, Drysdale River N.P., Aug 1975, *Kenneally 4349* (PERTH). **Northern Territory.** Aerodrome paddock, Manbulloo Station, Apr 1971, *Kruizinga s.n.* (BRI, CANB); 7 miles NE of Wilton River – Bulman Crossing, Jun 1972, *Maconochie 1437* (BRI); 'Bupa', 4 km S Jarrong Yards, May 1994, *Leach 4269 & Walsh* (BRI, DNA, MEL); Kakadu N.P., Coronation Hill, Jul 1988, *von Oertzen 116* (DNA); Cave Creek Station, Snake Track, Jul 2002, *Risler 1908* (DNA). **Queensland.** [unlocalised], *s.dat.*, *Bowman s.n.* (K373287). Burke District: Gorge Creek gorge, Bowthorn Station, 100 km W of Doomadgee, Aug 2001, *Addicott EPA1034* (BRI, CNS). Cook District: 21.1 km S of Georgetown, Aug 2010, *Bean 29874 & McDonald* (BRI, CANB); 100 m from Georgetown – Forsayth Road, 13 km S of Georgetown, Aug 2010, *Bean 29861 & McDonald* (AD, BRI, NSW); 5.7 km E of Chillagoe, Ramparts section, Chillagoe–Mungana Caves N.P., Jun 2011, *McDonald 11687 & McDonald* (BRI).

***Distribution and habitat*:** *Pterocaulon verbascifolium* is found commonly in the northern Kimberley, including offshore islands, and occasionally well inland. It is widespread though sporadic in sub-coastal (but not coastal) areas of the Northern Territory, extending into northern Queensland, as far east as Petford. Outside Australia, it is known only from the island of Sumbawa in Indonesia (**Map 10**). It inhabits lateritic plateaux or rocky hill-slopes in eucalypt or *Terminalia* dominated open woodland. Soil type varies, and the geological substrate may be basalt or sandstone.

***Phenology*:** Flowers and fruits are recorded between May and August.

***Affinities*:** The species is not obviously allied to any other.

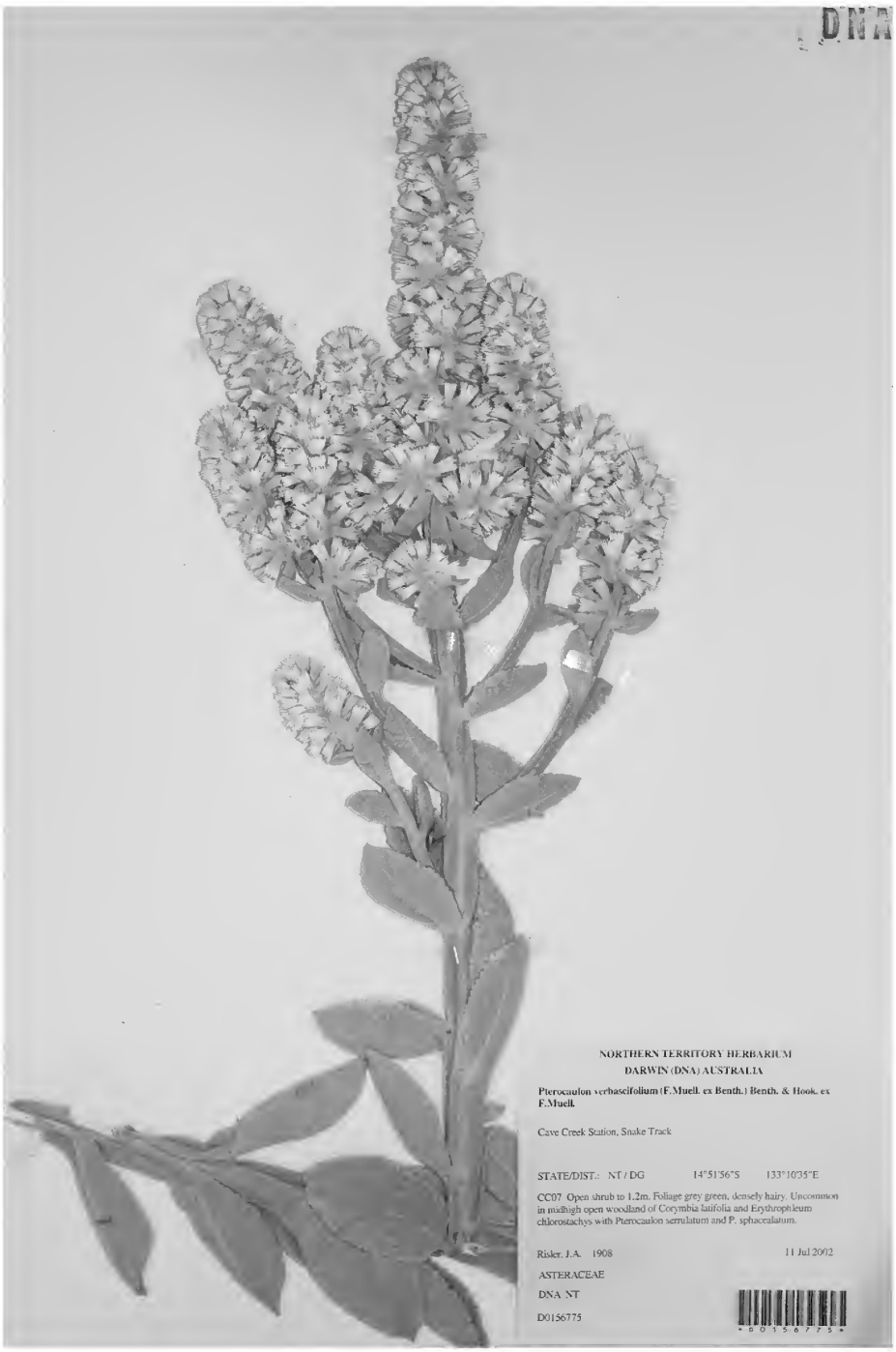

Fig. 21. Representative specimen of ***Pterocaulon verbascifolium*** (*Risler 1908* [DNA])

***Notes*:** This species is distinctive in the dense cylindrical capitulescences; corollas, achenes and pappus longer than in other species; no globose sessile glands on corolla lobes of hermaphrodite floret; indumentum of leaves extremely dense, obscuring surfaces; stem wings broad and the foliage not aromatic.

Pterocaulon verbascifolium is remarkable for the large variation between collections in the sizes of the floral parts. In some collections, the female florets (for instance) are only 3.7 mm long, and in other collections they are up to 7.5 mm long. There are correlated differences in other floral parts; however, there does not appear to be any geographical or ecological pattern to this variation.

There is a specimen of *Pterocaulon verbascifolium* at K collected by E.M. Bowman, with the locality given merely as "Queensland". It is of interest because Bowman did not travel any further north or west than the upper reaches of the Flinders River, near present-day Hughenden (Blake 1955). Hughenden is more than 200 km beyond the currently known extent of the species.

14. Pterocaulon xenicum A.R.Bean **species nova** affinis *P. niveo* aliscaulinis angustioribus, numero majore flosculorum femineorum in quoque capitulo, lobis brevioribus corollae flosculorum hermaphroditorum et pappis longioribus differens. **Typus:** Australia: Western Australia. McLarty Hills, Great Sandy Desert, 5 August 1977, *A.S. George 14628* (holo: PERTH; iso: CANB).

Shrub 25–40 cm high; stems numerous, densely lanate and sometimes with a few globose sessile glands; stem wings entire, 0.3–0.5 mm wide. Leaves oblanceolate or obovate, 18–52 × 7–17 mm, 2.6–4.7 times longer than wide, apex obtuse or acute; margins recurved, denticulate, with 10–21 pairs of blunt teeth. Indumentum comprising lanate multi-cellular hairs, glandular hairs absent. Upper surface moderately bullate; hairs erect to spreading, sparse to dense, basal cells short; globose sessile glands absent. Lower surface with lanate hairs erect to spreading, very dense, extending 0.4–0.7 mm from the surface, basal cells not very short; globose sessile glands yellow and shining, moderately dense, 3–8 diameters apart, but usually obscured by indumentum. Capitulescence globose to ellipsoidal, 13–18 mm long, 13–16 mm wide at anthesis, 1–1.3 times longer than wide; side branchlets never continuous, at 30–80°; peduncles 0–14 mm long. Outer involucral bracts 2.5–2.9 mm long, spathulate, with dense spreading lanate hairs throughout on the outer surface, glabrous on the inner surface or with sparse hairs at distal end; glands absent; apex lacerate to fimbriate (fimbriae 0.1–0.35 mm long). Inner bracts pink or white on dorsal surface; longest ones linear, 4.8–5.6 × 0.25–0.4 mm; apex acute, upper margins conspicuously toothed or with small teeth; cilia 6–9, up to 3.8 mm long, mostly attached in proximal half and few extending to the distal one third. Filiform (female) florets 26–44, pink, corolla 3.2–4.1 mm long, styles extending 0.2–0.4 mm beyond corolla. Hermaphrodite floret solitary, corolla pink, 3.5–4.3 mm long; corolla lobes 0.3–0.5 mm long, globose sessile glands present, eglandular hairs absent or present. Achenes narrowly ellipsoidal, 0.8–0.9 mm long, terete or slightly angular, dark brown, with 25–50 or >50 twin hairs each *c.* 0.05 mm long, evenly distributed; globose sessile glands at junction between achene and pappus sparsely present; pappus 3.3–4.2 mm long. **Figs. 20I-M, 22.**

***Additional specimens examined*: Australia: Northern Territory.** 46 miles [74 km] WSW of The Granites, Aug 1970, *Dunlop 1830* (DNA). **Western Australia.** just N of Dragon Tree Soak, Great Sandy Desert, Aug 1977, *George 14748* (PERTH); 21.1 km ESE of Warrawagine Station Homestead, Pilbara IBRA (Site PHYE07), Aug 2006, *van Leeuwen et al. 0028* (BRI, PERTH); 13.3 km W of Warrawagine Station Homestead, Pilbara IBRA (Site PHYE06), Aug 2006, *van Leeuwen et al. 0027* (BRI, PERTH); E of Cherrabun Station, Oct 1952, *s.coll.* (PERTH536415).

***Distribution and habitat*:** Known from a few localities in northern Western Australia, extending from Warrawagine Station to the Tanami Desert in Northern Territory (**Map 4**). At the type locality it occurs on open plains in association with shrubs including *Acacia* spp., *Senna* spp., *Solanum lasiophyllum* Dunal ex Poir. and *Grevillea juncifolia* Hook. The understorey is dominated by spinifex (*Triodia* spp.)

Fig. 22. Holotype of ***Pterocaulon xenicum*** (*George 14628* [PERTH]).

***Phenology*:** Flowers and fruits are recorded for August and October.

***Affinities*:** The species shows affinity with *Pterocaulon sphacelatum* and *P. niveum*. *Pterocaulon xenicum* differs from *P. niveum* by the stem wings 0.3–0.5 mm wide (0.5–1.5 mm for *P. niveum*); the 26–44 female florets (11–17 for *P. niveum*); the corolla lobes of the hermaphrodite floret 0.3–0.5 mm long (0.7–1.1 for *P. niveum*); and the pappus 3.3–4.2 mm long (2–3.1 mm for *P. niveum*).

Pterocaulon xenicum differs from *P. sphacelatum* by the stem wings 0.3–0.5 mm wide (0.7–2.0 mm for *P. sphacelatum*); the longest inner bracts 4.8–5.6 mm long (3.5–4.6 mm for *P. sphacelatum*); the female florets 3.2–4.1 mm long (2.4–3.2 mm for *P. sphacelatum*); the hermaphrodite florets 3.5–4.3 mm long (2.5–3.7 mm long for *P. sphacelatum*); the pappus 3.3–4.2 mm long (2.3–3.3 mm for *P. sphacelatum*); and the *outer* bracts with lacerate or fimbriate apices (acute apices for *P. sphacelatum*).

***Notes*:** This species is distinctive for the stem wings being very narrow and almost redundant; leaf indumentum very dense on lower surface; corolla lobes of hermaphrodite floret short; none or few cilia visible on protruding part of inner bracts; apices of outer bracts lacerate to fimbriate and the relatively long hermaphrodite florets.

***Etymology*:** Derived from the Greek word *xenos* meaning 'stranger, foreigner' and the suffix *–icus* 'belonging to'. This alludes to the specimens of this species found in amongst collections of *Pterocaulon sphacelatum*, and looking like 'strangers'.

Postulated hybrids

Pterocaulon intermedium × *P. paradoxum*.

***Specimens examined*: Australia: Western Australia.** 9 km N of Bunda Bunda Mill on Baldwin Creek track, Dampier Peninsula, Jun 1984, *Kenneally 9078* (PERTH).

This specimen has broad stem wings, somewhat ellipsoidal capitulescences, achenes *c.* 0.8 mm long and scarcely acute leaves. These features do not fit *Pterocaulon intermedium*, nor do they quite fit *P. paradoxum*, although the specimen has similarities to both. This specimen is probably a hybrid between these two species, both of which occur on the Dampier Peninsula.

Pterocaulon serrulatum var. *velutinum* × *P. sphacelatum*.

***Specimens examined*: Australia: Western Australia.** 4.8 km E of Donkey Creek, on the Gibb River Road, Sep 2006, *Sweedman 6984* (PERTH); 6.5 km NE of Mary River Crossing, Great Northern Highway, 92 km SW of Halls Creek, Jun 1976, *Beauglehole ACB53238* (PERTH); Site PHYE09, 10.3 km SW of Warrawagine Station Homestead, Pilbara, Aug 2006, *van Leeuwen et al. 0035* (PERTH).

These specimens have glandular outer involucral bracts as in *Pterocaulon serrulatum*, but the leaves are smaller and rather more bullate than is usual for that species. Furthermore, the stem wings are almost entire, with just the occasional tooth.

Pterocaulon ciliosum × *P. serrulatum* var. *serrulatum*.

***Specimens examined*: Australia: Queensland.** NORTH KENNEDY DISTRICT: 22.5 km (by road) SW of Herberton, on the Silver Valley road, May 1983, *Conn & Clarkson 1177* (BRI, CANB, DNA, NSW).

This specimen has narrower stem wings than *Pterocaulon serrulatum*, and the toothing is less than usual for that species. The capitulescences are almost globose and the protruding part of inner bracts has many long cilia, both features of *Pterocaulon ciliosum*.

Excluded names

Pterocaulon tomentosus Boerl., *Handl. Fl. Ned. Ind. (Boerlage)* 2(1): 240 (1891).

This is a *nomen nudum*.

Monenteles tomentosus Sch. Bip., *Syst. Verz. (Zollinger)* 122 (1854).

This is a *nomen nudum*.

Gnaphalium redolens G.Forst., *Fl. Ins. Austr.* 91 (1786).

This is a *nomen nudum*.

Acknowledgements

The Directors of several Herbaria have kindly sent specimens on loan from their institutions. I gratefully acknowledge G.Rouhan (P), M.Pignal (P), P.Morat (P)

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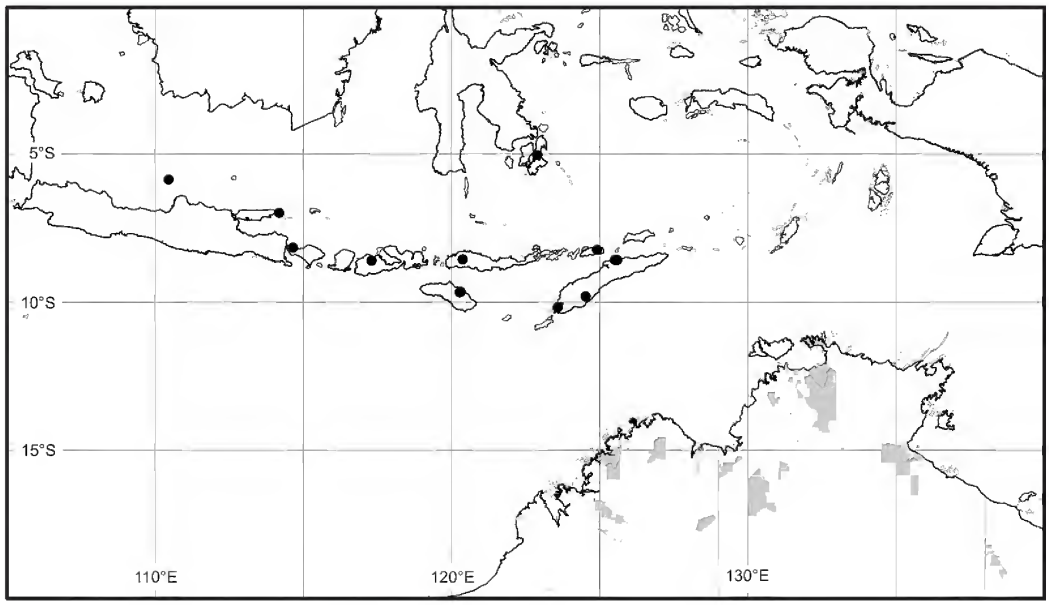
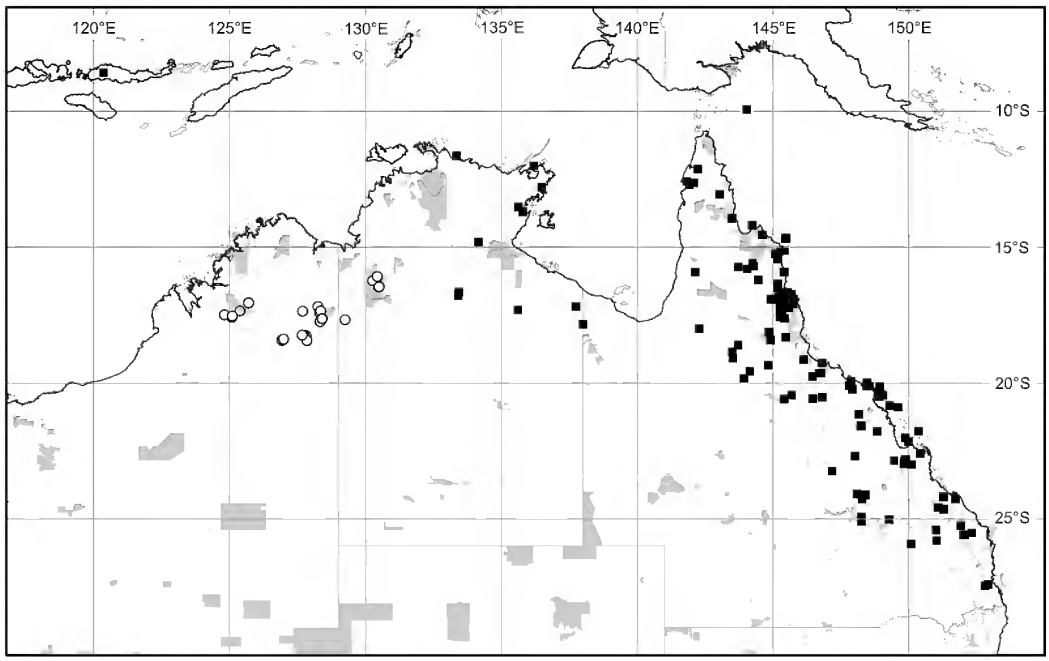
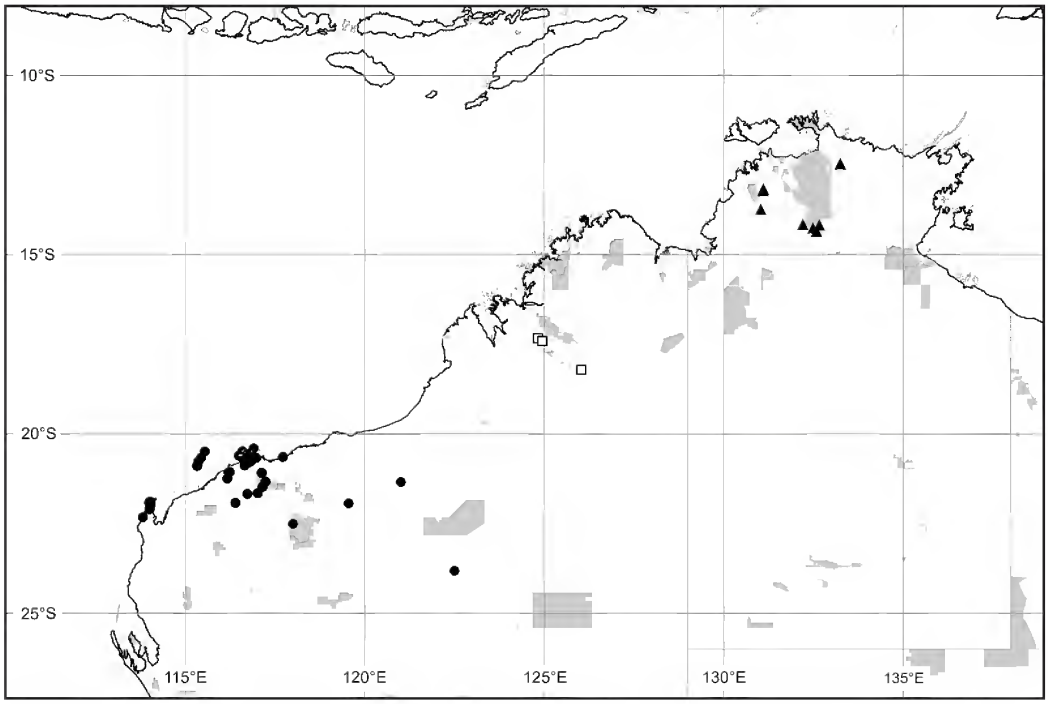


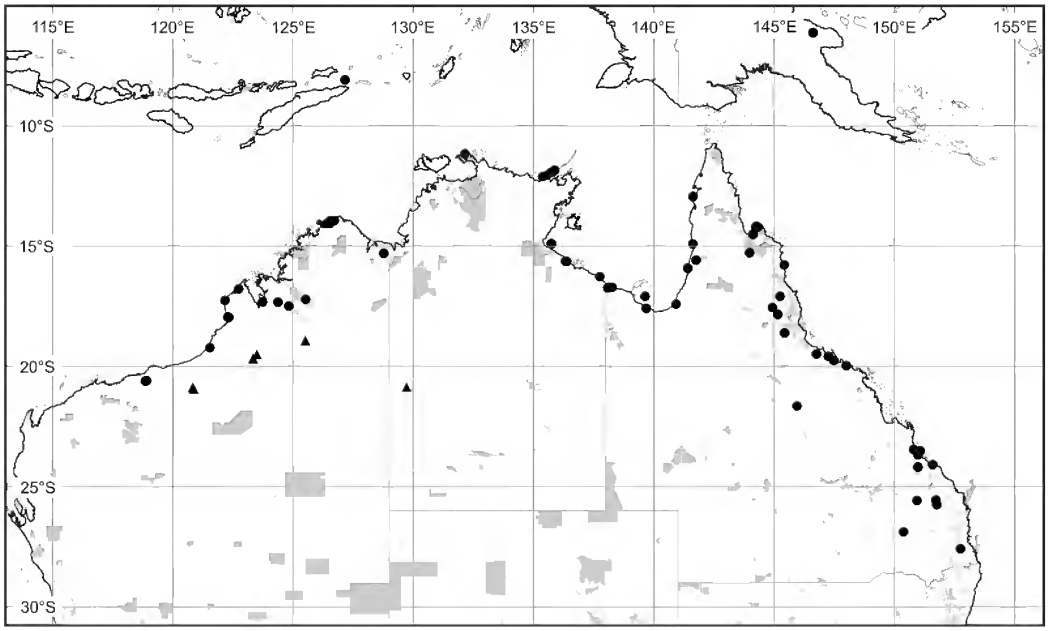
Map 1. Distribution of *Pterocaulon brachyanthum*



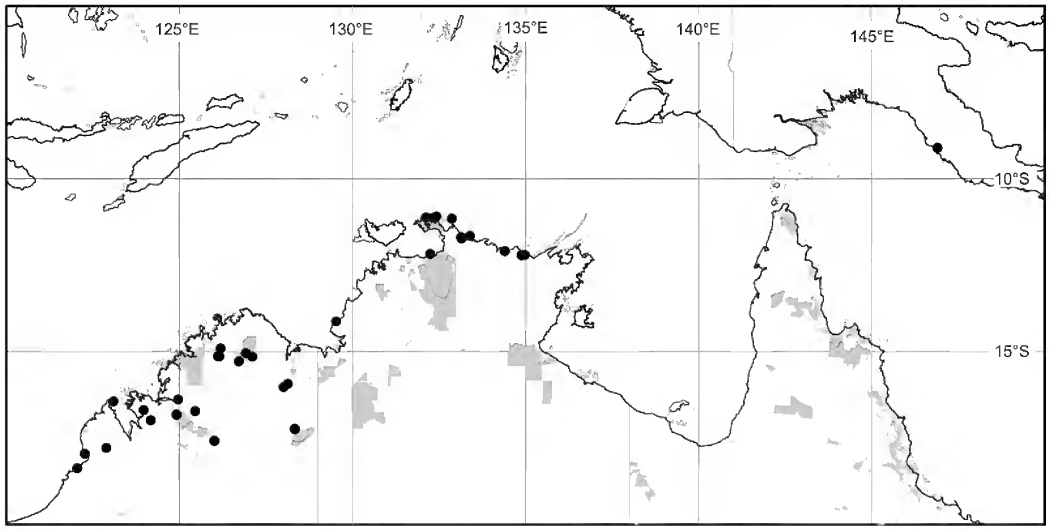
Map 2. Distribution of *Pterocaulon ciliosum* ■, *P. niveum* ○



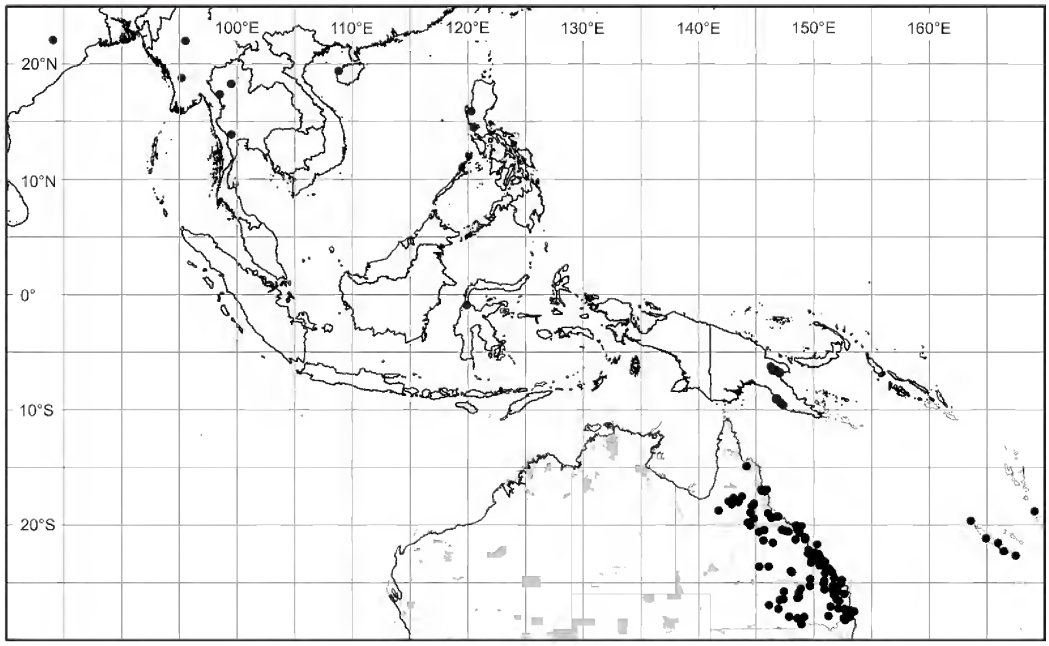
Map 3. Distribution of *Pterocaulon discolor* ▲, *P. globuliflorum* □, *P. sphaeranthoides* ●



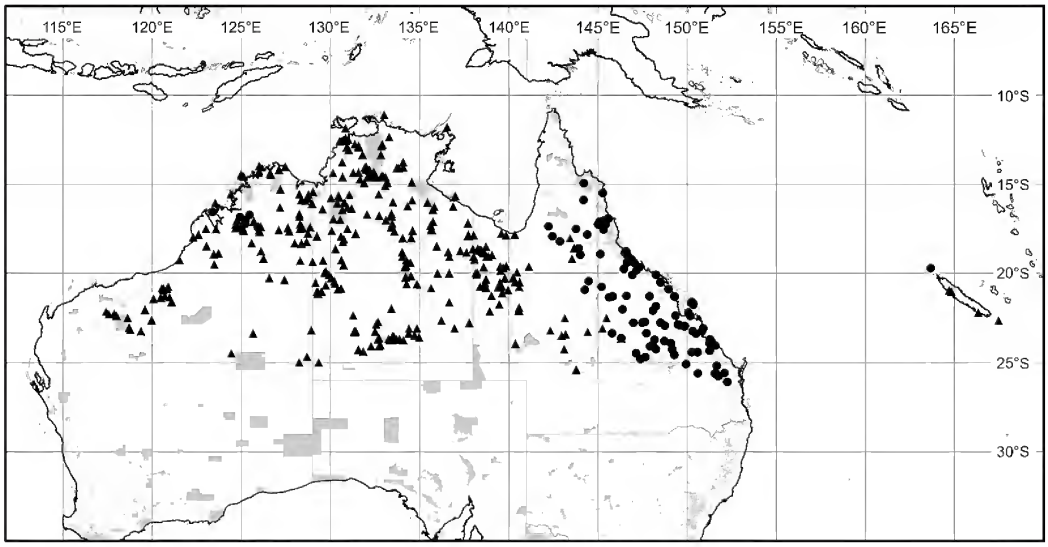
Map 4. Distribution of *Pterocaulon intermedium* ●, *P. xenicum* ▲



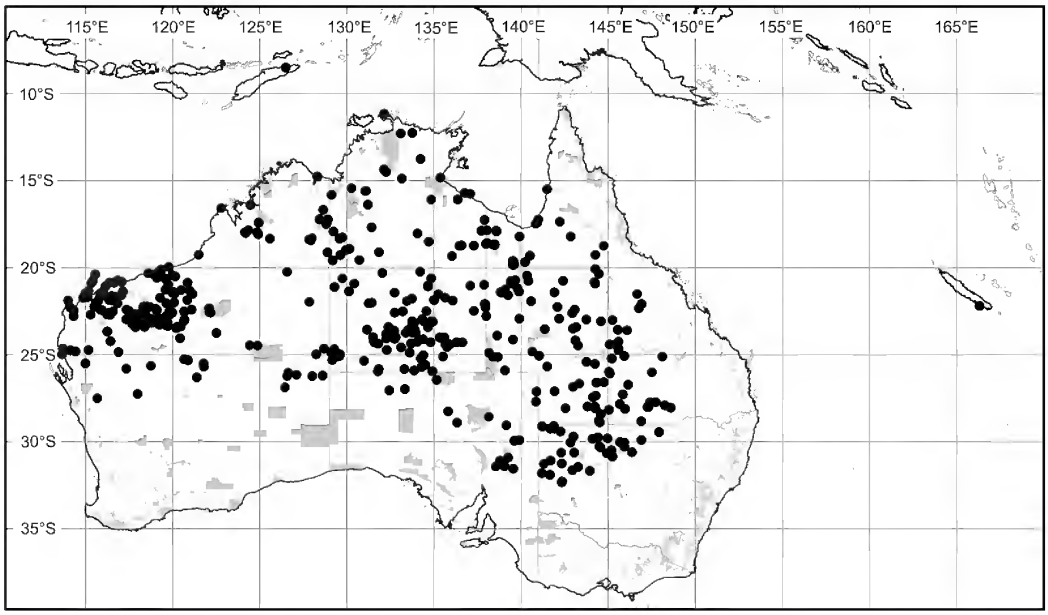
Map 5. Distribution of *Pterocaulon paradoxum*



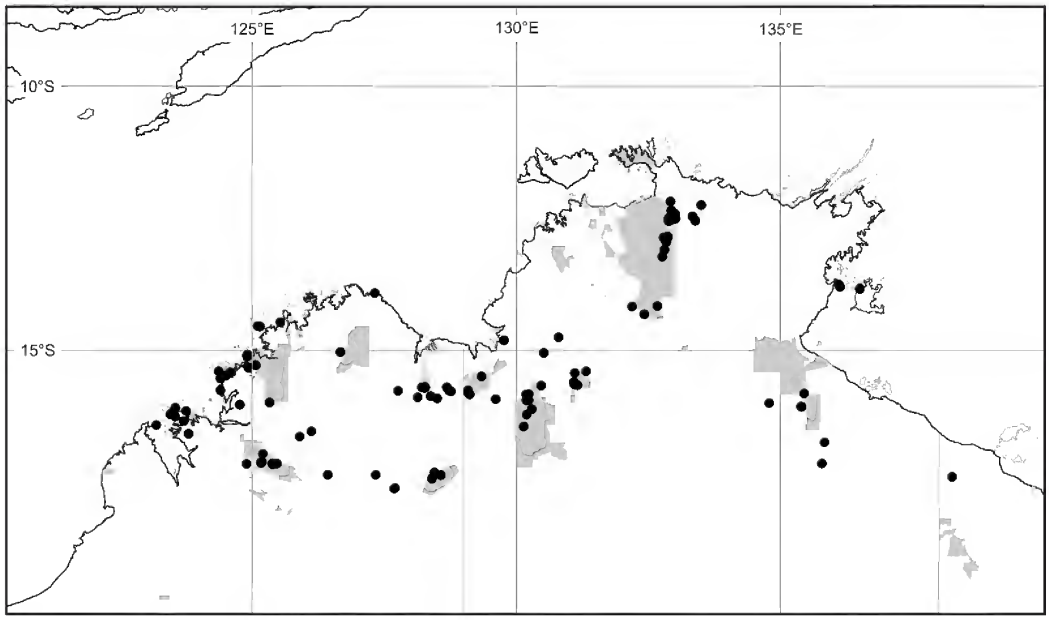
Map 6. Distribution of *Pterocaulon redolens*



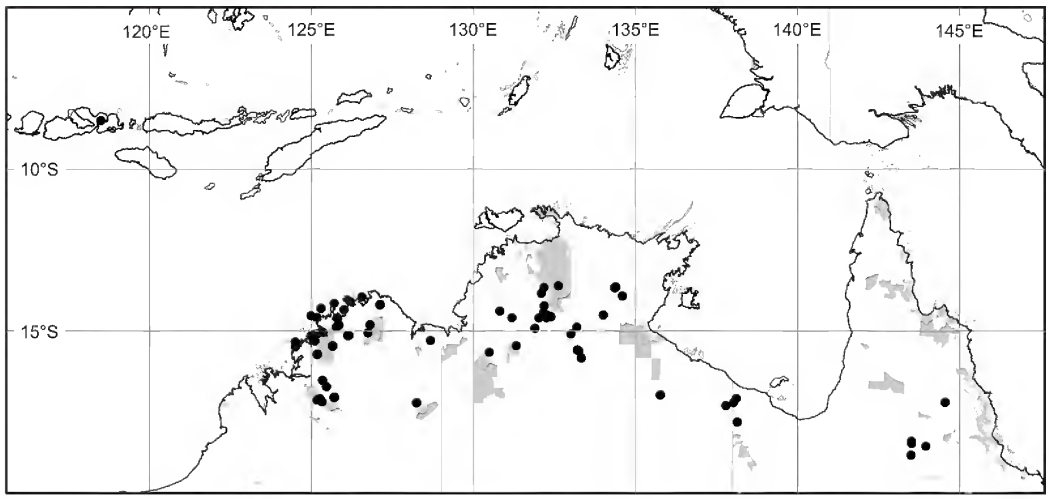
Map 7. Distribution of *Pterocaulon serrulatum* var. *serrulatum* ●, *P. serrulatum* var. *velutinum* ▲



Map 8. Distribution of *Pterocaulon sphacelatum*



Map 9. Distribution of *Pterocaulon tricholobum*



Map 10. Distribution of *Pterocaulon verbascifolium*

Heliotropium microspermum E.J.Thomps. (Boraginaceae), a new species from Queensland

E.J. Thompson

Summary

Thompson, E.J. (2011). *Heliotropium microspermum* E.J.Thomps. (Boraginaceae), a new species from Queensland. ***Austrobaileya* 8(3): 335–339.** The new species *Heliotropium microspermum* E.J.Thomps., endemic to Cape York Peninsula, Queensland, is described and illustrated.

Key Words: Boraginaceae, *Heliotropium*, *Heliotropium microspermum*, Queensland flora, taxonomy, new species

E.J. Thompson, Queensland Herbarium, Department of Environment & Resource Management, Brisbane Botanic Gardens, Mt Coot-tha Road, Toowong, Queensland 4066, Australia. Email: john.thompson@derm.qld.gov.au

Introduction

The genus *Heliotropium* L. comprises 84 species in Australia (Craven 1996, 2005a,b) with 43 (38 native, five naturalised) occurring in Queensland (Thompson 2010). A critical review of *Heliotropium* specimens at the Queensland Herbarium has revealed a new species for Cape York Peninsula.

Materials and methods

Morphological data were collected from dried herbarium material at BRI. Description of the new species largely follows Craven's (1996) format.

Indumentum is a useful character in Australian *Heliotropium* and is usually "composed of unicellular, simple, non-glandular hairs (the 'standard' hairs) with multicellular, simple, glandular hairs also occurring in some species. The walls of standard hairs may be smooth or ornamented" (Craven 1996). Craven (1996) refers to indumentum as having more than one class of hair when hairs can be differentiated, such as long coarse hairs and shorter fine hairs.

Mericarps are essential for identifying *Heliotropium* species and the mericarp characters used were length, commissure (side faces) pit shape and size; presence or absence of a food body in the pits; size, distribution and type of the hairs on the back; and shape of the apex. Although Craven (1996) provided images of some mericarp indumentum types he did not present illustrations of mericarps for each species. Illustrations of mericarps are provided here for the new species and its putative allies. Other significant characters included leaf width and hair type, inflorescence characters, and plant growth form.

Accepted for publication 23 August 2011

Taxonomy

Heliotropium microspermum E.J.Thomps. **species nova** affinis *H. rhadinostachyum* Craven sed pilis applanatis fortuito dispositis, fovea circulari minore in mericarpiis minoribus et corolla breviore differens. **Typus:** Queensland. Cook District: 12.3 km along Pormpuraaw Road from Gulf Development Road near Musgrave, 15 November 2010, *K.R.McDonald KRM10095* (holo: BRI).

Prostrate to ascending perennial herbs, 5–15 cm tall and to 15 cm broad. Branches moderately hairy with ascending standard hairs of one class. Adult leaves ascending, linear to narrowly elliptic, 5–13 mm long, 2–3 mm wide, base attenuate, apex acute; petiole short; abaxial surface moderately densely hairy with appressed to ascending hairs; adaxial surface with ornamented hairs, 0.7–1.2 mm long, similar to the abaxial surface only hairs tending towards more numerous along the midrib. Cyme on mature plants at anthesis straight, simple or branched, bracteate; bracts conspicuous, linear to narrowly elliptic, 2.5–4.5 mm long, touching to separated up to one length along the cymes, with ornamented hairs on adaxial surface appressed on lamina

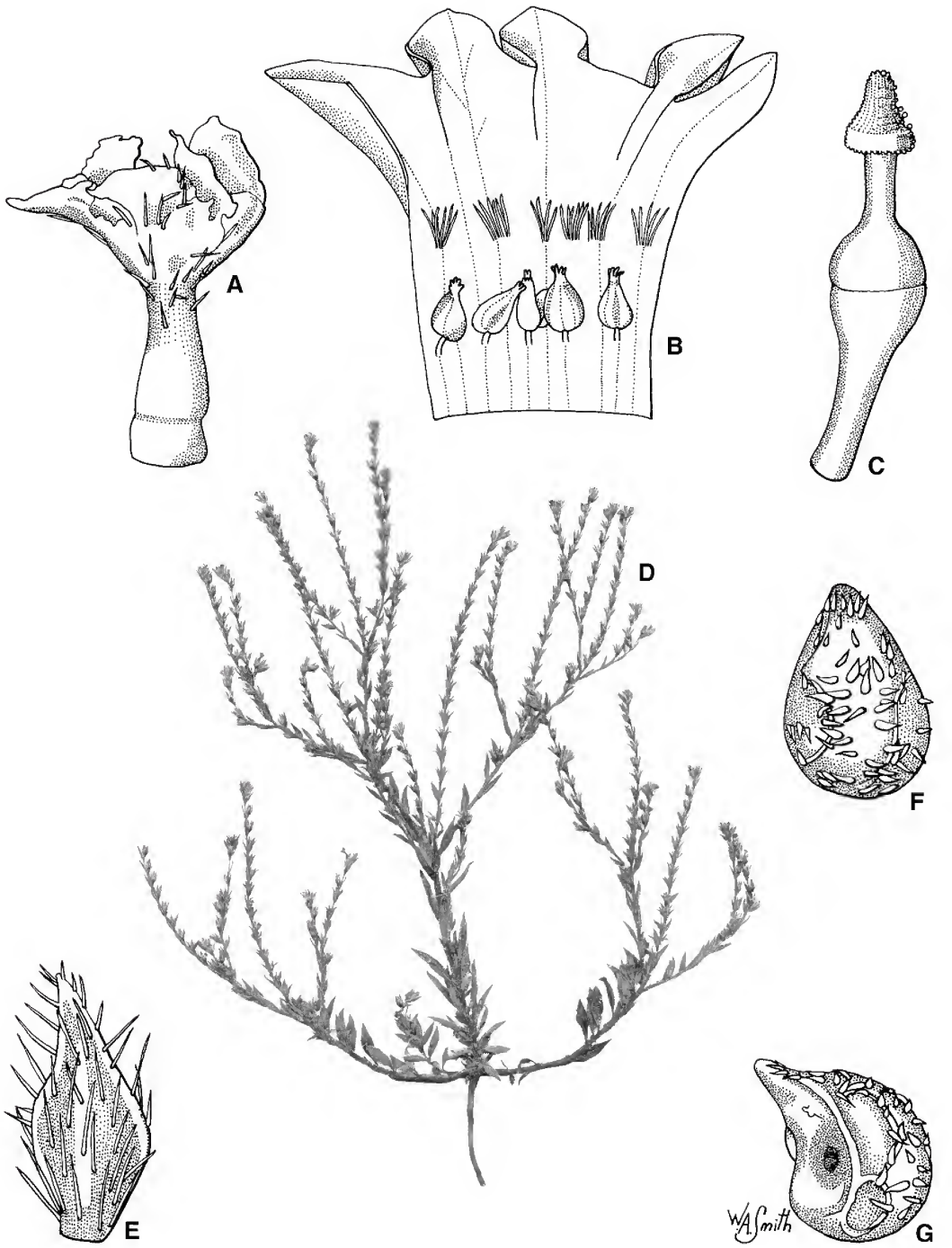


Fig. 1. ***Heliotropium microspermum***. A. corolla ×16. B. corolla expanded demonstrating anthers and appressed hairs in throat × 16. C. pistil × 32. D. plant × 0.6. E. calyx × 16. F. mericarp back view × 40. G. mericarp side face × 40. All from *McDonald KRM10095* (BRI). Del. W.Smith.

and ascending on margin, abaxial surface glabrous; varying from clearly different to similar in shape and size to the leaves. Calyx lobes with ornamented hairs 0.5–0.8 mm long on the abaxial surface, appressed on the lamina and ascending on the margin, adaxial surface glabrous; outermost calyx lobe narrowly ovate, 2–2.6 mm long, acute. Corolla 2.5–3 mm long, white, tube cylindrical, not swollen around anthers at anthesis, 1.5–3 mm long, the outer surface sparsely hairy with appressed hairs, the inner surface glabrous in the throat; lobes broadly triangular, 0.7–1 mm long, apex acute. Anthers ovate, 0.3–0.5 mm long, apex acuminate, papillate. Gynoecium *c.* 1.6 mm long; ovary *c.* 0.5 mm long; style 0.5–0.7 mm long; stigma 0.3–0.4 mm long. Mericarps ovate to broadly ovate, 0.6–0.7 mm long, 0.4–0.5 mm wide, 1.4 times as long as wide; apex acute; outer surface with mostly appressed to slightly ascending microhairs, 0.04–0.1 mm long, flattened, mostly distributed along minute ridges over most of surface and somewhat randomly orientated; commissures with pit to about ⅓ width of commissure, the pit elliptic, without a food body. **Fig. 1.**

***Additional specimens examined*: Queensland.** Cook District: 36.3 km from Dixie Station on track to Killarney, Jun 1989, *Clarkson 8154B & Neldner* (BRI); 13.9 km along Pormpuraaw Road from Gulf Development Road, Nov 2010, *McDonald KRM10093* (BRI); 6 km N of 'Fairview' on the Peninsula Road, Apr 1980, *Clarkson 3090* (BRI); 12.2 km along Pormpuraaw Road from Cape York Development Road junction, Dec 2010, *McDonald KRM10303* (BRI).

***Distribution and habitat*:** *Heliotropium microspermum* is only known from near Musgrave on Cape York Peninsula (**Map 1**). It has been found in woodland of *Melaleuca viridiflora* Sol. ex Gaertn. on flat terrain, and eucalypt woodland dominated by *Eucalyptus tetrodonta* F.Muell. or *Corymbia stockeri* subsp. *peninsularis* (K.D.Hill & L.A.S.Johnson) A.R.Bean or *C. nesophila* (Blakely) K.D.Hill & L.A.S.Johnson on granite hills with sandy soil.

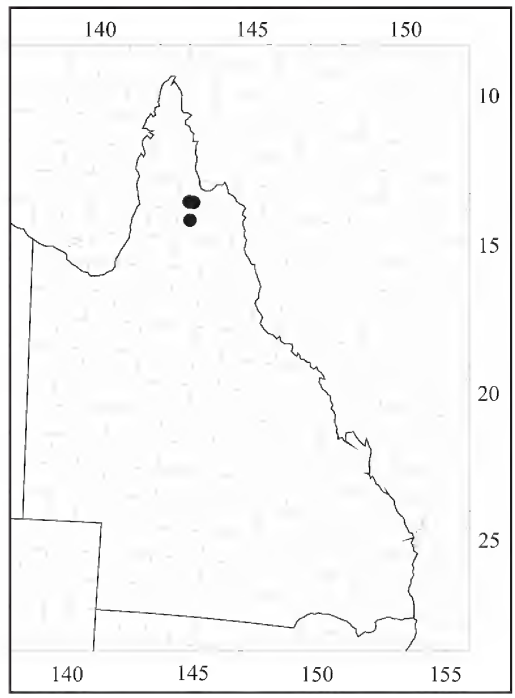
***Phenology*:** Flowers and fruits have been recorded in June and November.

***Affinities*:** *Heliotropium microspermum* is similar to *H. rhadinostachyum* with respect to growth habit, appearance of the cymose inflorescences, and leaf and bract shape, size, and distribution along the branches. *Heliotropium microspermum* differs most notably from *H. rhadinostachyum* and *H. cunninghamii* Benth. by the size and shape of the corollas and mericarps, as well as indumentum type and cover (**Table 1**).

***Notes*:** Juvenile leaves of *Heliotropium microspermum* can be larger than adult leaves and therefore more clearly different from the bracts. Juvenile plants of this species may have very short cymes. The corolla of *Heliotropium microspermum* can be a little swollen around the anthers at fruiting.

***Conservation status*:** *Heliotropium microspermum* is only known from near Musgrave. Inappropriate burning regimes present the most significant potential threat to this species. Further field observation is required to determine the species population size and area of extent.

***Etymology*:** The specific epithet is derived from the Greek *micro* (small) and *spermum* (seed) alluding to the relatively small mericarps for this species.



Map 1. Distribution of *Heliotropium microspermum* in Queensland

Table 1. Comparison of morphological characters for *Heliotropium microspermum*, *H. rhadinostachyum* and *H. cunninghamii*

Character State	*H. microspermum*	*H. rhadinostachyum*	*H. cunninghamii*
mericarp length (mm)	0.6–0.7	0.9–1.2	0.6–1.2
mericarp apex shape	acute	rounded	acute
mericarp microhair length (mm)	0.04–0.1	to *c.* 0.05 or occasionally absent	0.05–0.1
mericarp microhair type	flattened	papillate	circular in cross-section
mericarp microhair distribution	most of surface	upper ⅓	upper ⅓–½
mericarp pit size	small, up to ⅓ width of commissure	large, c. ½ the width of the commissure	small, up ⅓ width of commissure
mericarp pit shape	elliptic	elliptic	circular
mericarp outer surface	minutely ridged over most of surface	mostly smooth, occasionally minutely ridged in upper ½	smooth
corolla length (mm)	2.5–3	3–4	5–6
corolla tube shape at anthesis	cylindrical	swollen around anthers	swollen around anthers
calyx lobe trichome length (mm)	0.5–0.8	0.5–0.8	0.3–0.4
bract length (mm)	2.5–4.5	2–4.5	1–2.5
bract	conspicuous; leaves distinctly different to similar	conspicuous; leaves distinctly different to similar	inconspicuous; leaves distinctly different
bract imbrication	touching to separated by about 1 length	overlapping by ½ a length to separated by up to 2 lengths	widely separated

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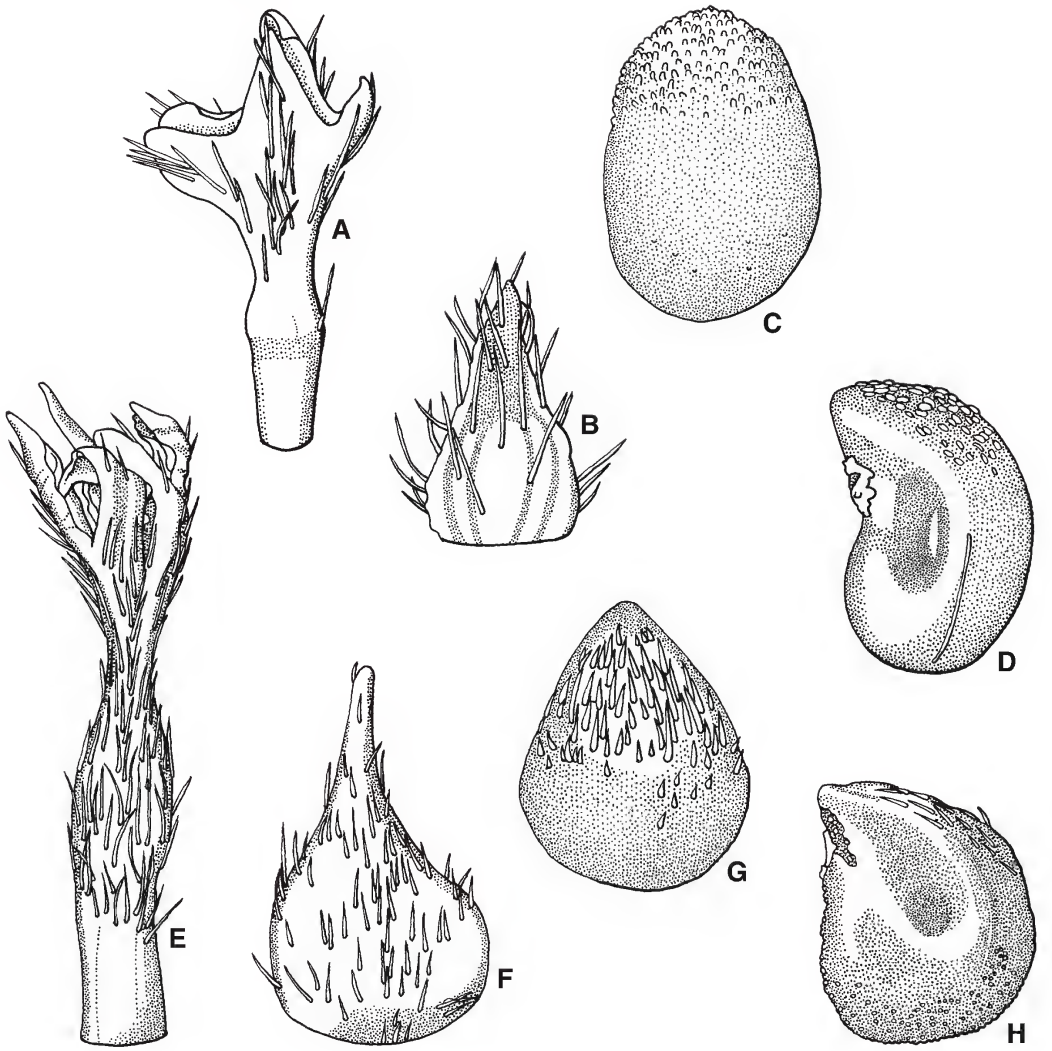

Fig. 2. A–D: ***Heliotropium rhadinostachyum***. A. corolla × 16. B. outer calyx lobe × 16. C. mericarp backview × 40. D. mericarp side view × 40. E–H: ***Heliotropium cunninghamii***. E. corolla × 16. F. outer calyx lobe × 16. G. mericarp back view × 40. H. mericarp side face × 40. A–D from *Clarkson & Neldner 8146* (BRI); E–H from *Thompson & Booth TAN239* (BRI). Del. W.Smith.

Two new species of *Pluchea* Cass. (Asteraceae: *Plucheinae*) from Queensland, Australia

A.R.Bean

Summary

Bean, A.R. (2011). Two new species of *Pluchea* Cass. (Asteraceae: *Plucheinae*) from Queensland, Australia. ***Austrobaileya* 8(3): 340–346.** The new species *Pluchea punctata* A.R.Bean and *P. xanthina* A.R.Bean are described from Queensland, with the latter replacing the misapplied name *P. dioscoridis* (L.) DC. Illustrations, a distribution map, and notes on the habitat and conservation status are provided for each new species. A note is given regarding the apparent sexual dimorphism of *Pluchea baccharoides*. A key to the identification of Queensland species of *Pluchea* is included.

Key Words: Asteraceae, *Pluchea*, *Pluchea baccharoides*, *Pluchea punctata*, *Pluchea xanthina*, Australia flora, Queensland flora, taxonomy, new species, identification key

A.R.Bean, Queensland Herbarium, Department of Environment & Resource Management, Brisbane Botanic Gardens, Mt Coot-tha Road, Toowong 4066, Queensland, Australia. E-mail: tony.bean@derm.qld.gov.au

Introduction

Pluchea Cass. is a genus of about 50 species, with representatives throughout the tropics and subtropics of the world, but especially in eastern Africa, the Arabian Peninsula and north-western Australia (King-Jones 2001; Thulin 2004). The Australian members of the genus are perennial shrubs or subshrubs, often woody, with alternate toothed leaves, and pink tubular florets. The involucral bracts are acute, and borne in several rows. The achenes are cylindrical to ellipsoidal, and the pappus comprises many barbellate capillary bristles.

Hunger (1996) described the new species *Pluchea dunlopii* from Australian material, and soon after provided a revision of the genus for Australia wherein six species were enumerated (Hunger 1997).

Two new species are described here, both endemic to Queensland. *Pluchea xanthina* A.R.Bean is a moderately widespread species for which the name *P. dioscoridis* (L.) DC. has been misapplied. *Pluchea punctata* A.R.Bean is a newly discovered species with a very restricted distribution. Both species are illustrated and compared with related taxa. A distribution map is provided, as is an identification key for the Queensland species of *Pluchea*.

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Materials and methods

This paper is based on a study of herbarium specimens at BRI, an image of the type specimen of *Blumea dioscoridis* at LINN and examination of *Pluchea* populations and plants in the field. Measurements of florets were made from material preserved in spirit or reconstituted in boiling water, while leaves, bracts and achenes were measured from dried specimens.

Abbreviations used in the text include N.P. (National Park) and S.F. (State Forest).

Taxonomy

Pluchea xanthina A.R.Bean **species nova** affinis *P. wallichianae*, sed foliis petiolatis angustioribus, bracteis involucralibus exterioribus longioribus, marginibus superioribus integris in bracteis involucralibus omnibus et corollae lobis longioribus flosculorum discoideorum differens. **Typus:** Queensland. South Kennedy District: Llanarth Back Range Road, 9.4 km S of junction with Scartwater Road, 15 May 1991, *V.J.Neldner 3479 & E.J.Thompson* (holo: BRI; iso: AD, K).

Pluchea dioscoridis auct. non (L.) DC.; Mueller (1889); Bailey (1900); Hnatiuk (1990); Henderson (1997); Holland (2007, 2010).

Woody shrub to 150 cm high, rarely higher. Stems green to brown, terete, erect to spreading, well-branched, with sessile yellow glands and multicellular eglandular hairs to 0.3 mm long, dense on young stems, glabrescent on older stems. Leaves petiolate, narrowly-elliptic to oblanceolate, spreading, not decurrent, 24–68 × 4–17 mm, 3.8–6.4 times longer than broad, margins denticulate or occasionally dentate, apex acute; both surfaces with many sessile yellow glands and multicellular eglandular hairs; petioles 5–15 mm long. Capitula in small terminal clusters, campanulate, 7–8 × 6–7 mm; peduncles 1–6(–16) mm long, with 1–3 lanceolate bracts near the apex, each 1–3(–9) mm long. Involucral bracts in several rows; outer bracts ovate, 3.2–4.2 × 1.3–1.7 mm, with apex acute, outer surface with sessile yellow glands and dense eglandular hairs, margins entire distally; median bracts elliptic, 4.7–5 × 1.2–1.6 mm, apex acute, distal half of outer surface with sessile yellow glands and dense eglandular hairs, upper margins entire; inner bracts linear, 6–6.7 × 0.4–0.8 mm, apex acute, outer surface glabrous, upper margins entire. Receptacle epaleate, verrucose, flat, 1.6–2.8 mm diameter. Outer florets 75–100, female; corolla very slender, 4.3–6 mm long, pink; lobes 3, triangular, 0.2–0.3 mm long, glabrous; style bifid, exserted, glabrous; pappus 4.5–5.1 mm long, pappus bristles 9–13, all of similar length, barbellate. Disc florets 4–8, each with an ovary and divided style but functionally male; corolla cylindrical, 4.5–6 mm long, purple; lobes 5, triangular, 0.7–1 mm long, glandular; anthers *c.* 2 mm long, including tail *c.* 0.2 mm long; style bifid, exserted by 0.5–1 mm, with acute sweeping hairs; pappus 5.2–6 mm long, pappus bristles *c.* 20, barbellate, all of similar length. Achenes cylindrical, 0.9–1.2 mm long, with scattered appressed twin hairs; carpopodium prominent, white. **Fig. 1.**

***Additional selected specimens examined*: Queensland**. Burke District: Micky Spring, 'Clyde Park', N of Hughenden, Aug 1984, *Godwin C2715* (BRI). North Kennedy District: Lynd Scrub, *c.* 64 km SW to SSW of Mt Garnet, Aug 1948, *Smith 3857* (BRI); 15 km S of 'Mt McConnell' Homestead, Jun 1992, *Thompson CHA60 & Sharpe* (BRI). South Kennedy District: 6 km NE of 'Moonoomoo' Homestead in Darkies Range, Apr 1992, *Thompson BUC354 & Simon* (BRI); Cudmore N.P., Sep 2001, *Augustyn JA5* (BRI). Leichhardt District: Gogango Range, near Edungalba, Sep 1943, *Blake 15354* (BRI); Southern end of S.F. 236, SW of Blackwater, Nov 2002, *Bean 19528* (BRI); *c.* 30 miles [48 km] WSW of Springsure, Sep 1966, *Everist 7939* (BRI); Goodliffe section, Carnarvon N.P., 12 km W of eastern boundary of park, along road from Springsure, Sep 2009, *Halford Q9690* (BRI); 17 miles [28 km] E of Duaringa, Aug 1963, *Speck 1667* (BRI, CANB, NSW); 'Early Storms', Carnarvon Creek, Sep 1974, *Gittins 2764* (BRI, NSW). Port Curtis District: 12.9 km by road SE of Maryborough towards Rockhampton, Sep 1975, *Coveny 6908 & Hind* (BRI); 'Maryvale', between Byfield and Yeppoon, Sep 1931, *White 8036* (BRI); N of The Caves, near Yaamba, Rockhampton, Aug 1992, *Barton 4* (BRI). Burnett District: Cole's Lookout, Coominglah S.F., W of Monto, Aug 1995, *Bean 8856* (BRI, MEL).

***Distribution and habitat*:** *Pluchea xanthina* is endemic to Queensland. It occurs from Forty Mile Scrub N.P. in northern Queensland south to the Carnarvon Ranges and Monto, with several collections from the Rockhampton area (**Map 1**). The species grows on hilly terrain in eucalypt woodland, often with *Corymbia citriodora* (Hook.) K.D.Hill & L.A.S.Johnson or *Eucalyptus crebra* F.Muell., on sandy-loam to clay-loam soils. It sometimes grows on the margins of brigalow forest, and near Rockhampton it has also been recorded growing on serpentinite.

***Phenology*:** Flowers and fruits have been recorded from May to November.

***Notes*:** Mueller (1889) was the first to apply the name *Pluchea dioscoridis* to Australian material. This name was then employed by Bailey (1900), and subsequent authors have followed that usage. A high quality image of the type of *Blumea dioscoridis* L. (LINN 992.6) has been viewed on the Linnean Society website (Anon. 2010). It shows a rather broad-leaved plant with sessile auriculate-based leaves, clearly different to the taxon found in Queensland. According to Boulos (2002), the type was collected in Egypt by F. Hasselquist. King-Jones (2001) recorded *Pluchea dioscoridis* from central and northern Africa and the Arabian Peninsula.

Pluchea xanthina differs from *P. dioscoridis* in several characters based on the description of the latter by King-Jones (2001): leaf base attenuate (auriculate in *P. dioscoridis*); capitula 7–8 mm long (4.5–(5–7)–9) mm in *P. dioscoridis*); involucral bracts with margins entire distally

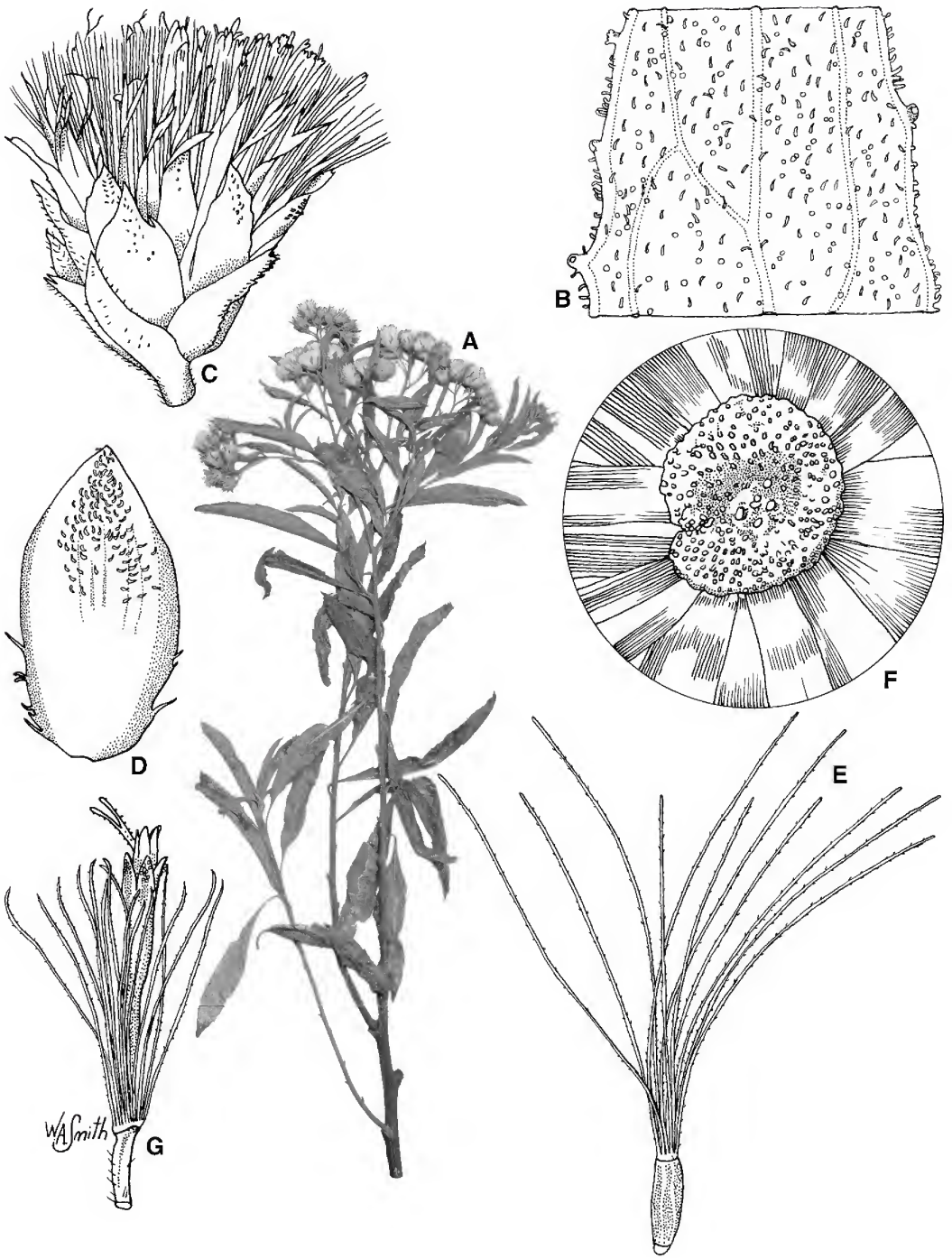

Fig. 1. ***Pluchea xanthina***. A. flowering branchlet × 0.5. B. portion of leaf surface showing eglandular hairs and sessile glands × 12. C. capitulum × 6. D. median involucral bract × 12. E. mature achene and pappus × 12. F. receptacle of spent capitulum and bract-bases × 12. G. disc floret × 8. A, B from *Neldner 3479 & Thompson* (BRI); C, D from *Halford Q9690* (BRI); E–G from *Bean 20718* (BRI).

(fimbriate in *P. dioscoridis*); inner involucral bracts 6–6.7 mm long (4.2–5.2 mm long in *P. dioscoridis*); outer florets 4.3–6 mm long (2.7–4 mm in *P. dioscoridis*); and pappus bristles all the same length (of varying length in *P. dioscoridis*).

Pluchea xanthina is perhaps most closely allied to *P. wallichiana* DC., a species from India and Pakistan. *Pluchea xanthina* differs by the leaves 0.4–1.7 cm wide (1.5–2.5(–3) cm in *P. wallichiana*); leaves consistently petiolate (consistently sessile and sometimes auriculate in *P. wallichiana*); outer involucral bracts 3.2–4.2 mm long (2–2.5(–2.8) in *P. wallichiana*); involucral bract margins entire (fimbriate in *P. wallichiana*); and corolla-lobes of the disc florets 0.7–1 mm long (0.4–0.6 mm long in *P. wallichiana*).

***Conservation status*:** A widespread species, that it is not currently under threat.

***Etymology*:** The epithet is from the Greek *xanthos* meaning yellow and *inos*, of the nature of. It refers to the shining yellow glands that are found commonly on many parts of the plant.

Pluchea punctata A.R.Bean **species nova** affinis *P. baccharoidi* sed capitulo longiore, marginibus glandularibus bractearum involucralium, flosculis discoideis corollae lobis quattuor, pappo longiore et acheniis ellipsoidalibus brevioribus differens. **Typus:** Queensland. Cook District: Gilbert River Holding, 78 km by road S of Forsayth, 13 August 2010, *A.R.Bean 29877 & K.R.McDonald* (holo: BRI [1 sheet + spirit]; iso: AD, B, CNS, MEL, NSW, US).

Woody shrub to 80 cm high. Stems green to brown, terete, erect to spreading, well-branched, glabrous, viscid. Leaves sessile, linear to very narrowly oblanceolate, spreading, not decurrent, 18–54 × 1–2.5 mm, 13–23 times longer than broad, viscid or resinous, margins entire, apex acute; both surfaces punctate with conspicuous embedded glands. Capitula in small terminal clusters, narrowly ovoid to campanulate, 7–10 × 4–5 mm; peduncles 1–10 mm long, with 1–3 lanceolate bracts near the apex, each 1.5–2.5 mm long. Involucral bracts in several rows; outer bracts ovate, 2.5–3.5 × 1.5–1.7 mm, apex acuminate, outer surface and margins with stipitate glandular hairs; median bracts elliptic, 3.5–4.7 × 1.2–1.8 mm, apex obtuse to acuminate, outer surface and distal margins with stipitate glandular hairs; inner bracts linear, 5–6.3 × 0.4–0.6 mm, apex acute, glabrous or with a few stipitate glands near apex. Receptacle epaleate, verrucose, flat, *c.* 2 mm diameter. Outer florets 80–120, female; corolla very slender, 4.2–5.5 mm long, pink; lobes 3, triangular, 0.15–0.25 mm long, glabrous; style bifid, exserted, glabrous; pappus 3.7–5 mm long, pappus bristles 13–17, all of similar length, barbellate. Disc florets 8–12, each with an ovary and divided style and appearing bisexual but functionally male; corolla cylindrical, 5.2–6.5 mm long, purple; lobes 4, triangular, each 0.6–0.7 mm long, glandular; anthers *c.* 2 mm long, including a tail *c.* 0.3 mm long; style bifid, exserted by 1.5–2 mm, with acute sweeping hairs; pappus 4.3–5.5 mm long, pappus bristles *c.* 15, all of similar length, barbellate. Achenes narrowly ellipsoid, 0.8–1.0 mm long, with scattered appressed twin hairs; carpopodium prominent, white. **Fig. 2**.

***Additional specimen examined*: Queensland**. Cook District: Gilbert River holding, 40 km by road from Cobbold Gorge turnoff, Oct 2007, *McDonald KRM6961* (BRI, CANB).

***Distribution and habitat*:** *Pluchea punctata* is known only from the type locality (**Map 1**). It occurs on the lower slope of a steep hill amongst *Triodia* sp., in an exposed area with scattered trees of *Eucalyptus microneura* Maiden & Blakely and *Grevillea striata* R.Br. Soil is a reddish-brown sandy-loam.

***Phenology*:** Flowers and fruits have been recorded in August and October.

***Affinities*:** *Pluchea punctata* is superficially very similar to *P. baccharoides* (F.Muell.) Benth. as both are small woody shrubs with viscid gland-dotted, linear leaves. However, *Pluchea punctata* can be distinguished by the longer leaves 18–54 mm long (6.5–19 mm long for *P. baccharoides*); capitula 7–10 mm long (6–7 mm long for *P. baccharo*ides); involucral bracts with stipitate glandular hairs on margins (eglandular fimbriate margins for *P. baccharoides*); disc florets 8–12 (1–2 or 13–18 for *P. baccharoides*); disc florets

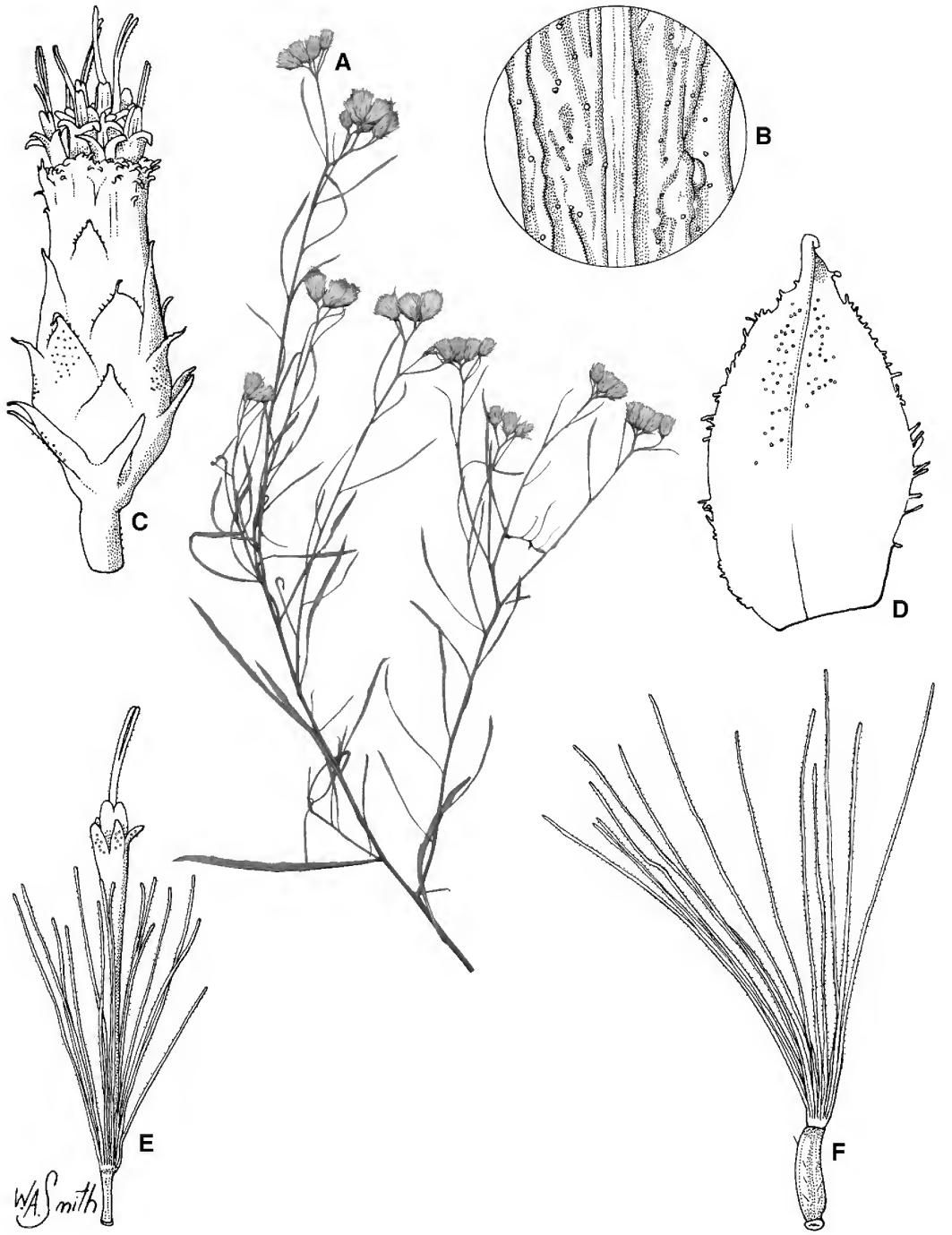

Fig. 2. ***Pluchea punctata***. A. flowering branchlet × 0.5. B. portion of leaf surface showing embedded glands × 16. C. capitulum × 6. D. median involucral bract × 16. E. disc floret × 8. F. mature achene and pappus × 16. A–E from *Bean 29877 & McDonald* (BRI); F from *McDonald KRM6961* (BRI).

with 4 glandular corolla lobes (5 eglandular lobes for *P. baccharoides*); female florets with pappus 3.7–5 mm long (2.5–3 mm for *P. baccharoides*); and achenes narrowly ellipsoid, 0.8–1 mm long (linear, 1.4–1.7 mm long for *P. baccharoides*). The hillside habitat of *Pluchea punctata* is quite different to the strictly riparian habitat of *P. baccharoides*.

***Conservation status*:** There are between 40 and 50 plants at the type locality. Similar habitats along the roadside north and south of the type locality were searched without locating any additional plants. A conservation status of Critically Endangered is recommended, based on criterion D of the IUCN Red List (IUCN 2001).

***Etymology*:** The epithet is from the Latin *punctatus*, dotted, which derives from the Latin *punctum* 'a spot, dot, or point', and refers to the dot-like glands embedded in the leaves of this species. Such glands are found in only a few species of *Pluchea*.

A note on *Pluchea baccharoides*

Hunger (1997) noted that *Pluchea baccharoides* produces both homogamous and heterogamous capitula; however, she gave no indication as to whether homogamous and heterogamous capitula appear on the one plant or on different plants. Hunger (1997) recorded 2–30 disc florets and 0–60 female florets for *P. baccharoides*; these observations are correct but rather misleading, as they imply a continuum of floret numbers.

There are currently 17 flowering specimens of *Pluchea baccharoides* at BRI. Of these, 11 were found to have only heterogamous capitula with 40–90 female florets and 1 or 2 functionally-male disc florets (not "hermaphroditic", as stated by Hunger). The other six specimens bear only homogamous capitula in which all 13–18 disc florets are functionally male, and female florets are lacking. The absence, in this sample, of any individual specimen with both homogamous and heterogamous capitula suggests that the species is subdioecious.

Key to Queensland species of *Pluchea*

1 Leaves and stems resinous or viscid **2**
1. Leaves and stems neither resinous nor viscid. **4**

2 Leaves broadly obovate, toothed; hairs (0.1–0.25 mm long) frequent on stems and leaves . . . . . **P. dunlopii**
2. Leaves linear, entire; hairs absent on stems and leaves **3**

3 Margins of involucral bracts fimbriate, eglandular; disc florets with five corolla lobes; achenes 1.4–1.7 mm long . . . . . **P. baccharoides**
3. Margins of involucral bracts with stalked glandular hairs; disc florets with four corolla lobes; achenes 0.8–1 mm long . . . . . **P. punctata**

4 Leaves and stems with surfaces obscured by a very dense indumentum . . . . . **P. ferdinandi-muelleri**
4. Leaves and stems glabrous or hairy but surfaces readily visible

5 Leaves and stems with eglandular septate hairs **6**
5. Leaves glabrous or with stalked glandular hairs, but eglandular septate hairs absent. . . . **7**

6 Leaves and stems with many yellow sessile glands . . . . . **P. xanthina**
6. Leaves and stems without sessile glands . . . . . **P. indica**

7 Leaf-bases not decurrent; stems and leaves with many stalked glandular hairs; inner involucral bracts 6–8 mm long . . . . . **P. dentex**
7. Leaf-bases decurrent on stems; stems and leaves glabrous; inner involucral bracts 3.5–5 mm long . . . . . **P. rubelliflora**

Acknowledgements

I am grateful to Keith McDonald for taking me to the population of *Pluchea punctata* that he discovered. My thanks are also due to Will Smith for the illustrations and Peter Bostock for the Latin diagnoses.

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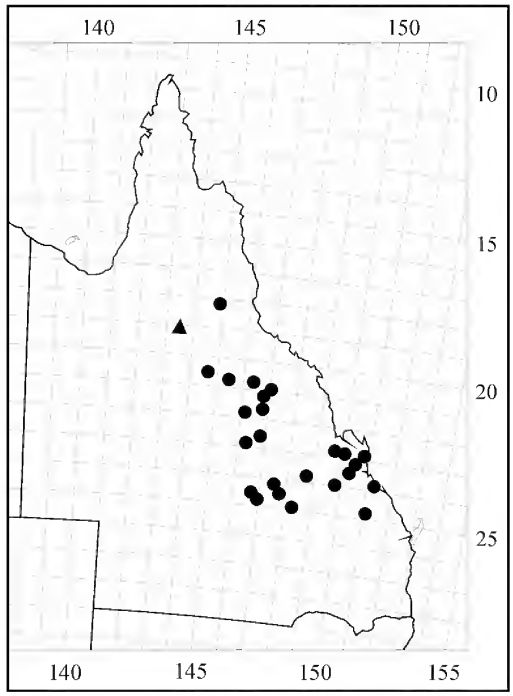

Map 1. Distribution of *Pluchea xanthina* ● and *P. punctata* ▲

Eucalyptus melanophloia subsp. *nana* D.Nicolle & Kleinig, a new mallee ironbark (*E.* series *Siderophloiae* Blakely; Myrtaceae) from central Australia and north western Queensland

D.Nicolle[1]* & D.A.Kleinig[2]

Summary

Nicolle, D. & Kleinig, D. (2011). *Eucalyptus melanophloia* subsp. *nana* D.Nicolle & Kleinig, a new mallee ironbark (*E.* series *Siderophloiae* Blakely; Myrtaceae) from central Australia and north western Queensland. **Austrobaileya 8(3): 347–355.** The new subspecies *Eucalyptus melanophloia* subsp. *nana* is described. The subspecies is of widespread but very scattered distribution in arid regions on rocky sites from the Yaripilangu Range in the Northern Territory in the west (about 250 km WNW of Alice Springs), eastwards to the Mount Isa area in north western Queensland. It is distinguished from subsp. *melanophloia* by its consistently multi-stemmed, bushy mallee habit and this is unique among the ironbark eucalypts (*Eucalyptus* series *Siderophloiae* and *E.* series *Rhodoxylon*). Illustrations of the new subspecies (including the holotype), a key to the subspecies of *Eucalyptus melanophloia* and a distribution map are provided.

Key Words: Myrtaceae, *Eucalyptus, Eucalyptus melanophloia*, *Eucalyptus melanophloia* subsp. *nana*, Australia flora, Northern Territory flora, Queensland flora, taxonomy, new subspecies, ironbark, mallee

[1]D.Nicolle, Currency Creek Arboretum, P.O. Box 808, Melrose Park, South Australia 5039, Australia. Email: dn@dn.com.au *author for correspondence

[2]D.A.Kleinig, P.O. Box 395, Clare, South Australia 5453, Australia. Email: dendros@bigpond.com

Introduction

Eucalyptus melanophloia F.Muell. belongs to *E.* series *Siderophloiae* Blakely (which includes all the ironbark taxa in which all the stamens are fertile – about 22 species) subseries *Jugatae* Blakely (only *E. melanophloia* and *E. shirleyi* Maiden). The subseries is distinguished within the genus by the combination of the following characteristics (amended from Brooker 2000):

Eucalyptus subgenus *Symphyomyrtus* (Schauer) Brooker–Cotyledons folded in seeds; buds bi-operculate; seeds with ventral or terminal hilum; seed coat formed from both integuments.

Eucalyptus section *Adnataria* L.D.Pryor & L.A.S.Johnson ex Brooker–Cotyledons reniform; seeds with a ventral hilum; leaf venation usually densely reticulate; anthers not versatile.

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Eucalyptus subsection *Apicales* Brooker – Anthers erect at tip of filament; inflorescences commonly terminal.

Eucalyptus series *Siderophloiae* – Ironbarks; outer operculum shed early; all stamens fertile, irregularly flexed.

Eucalyptus subseries *Jugatae*–Juvenile leaves sessile; mature crown of juvenile leaves.

Eucalyptus subseries *Jugatae* (with the two species *E. melanophloia* and *E. shirleyi*) was recognised by Brooker (2000) on the basis of the sessile juvenile leaves forming the mature crown, which distinguish the subseries from *E.* subseries *Subglaucae* Blakely (the remaining 20 species of *E.* series *Siderophloiae*), which have petiolate juvenile leaves and a crown of adult leaves. However, the distinction between these subseries is weak and perhaps not representative of the phylogeny of the group; indeed *Eucalyptus whitei* Maiden & Blakely of *E.* subser. *Subglaucae* forms substantial intergrading populations with *E. melanophloia* of *E.* subseries *Jugatae* (Holman *et al.* 2011).

Nevertheless, within *Eucalyptus* subseries *Jugatae*, *E. melanophloia* is distinguished from *E. shirleyi* in its less straggly habit, smaller juvenile leaves, the occasional development of intermediate or adult leaves in some individuals (*E. shirleyi* is not known to develop intermediate or adult leaves) and the much smaller flower buds and fruits. Interestingly, *Eucalyptus shirleyi* is quite variable and may be composed of more than one taxon. The distribution of *Eucalyptus* subseries *Jugatae* can be roughly defined by the distribution of *E. melanophloia*, with the distribution of *E. shirleyi* (inland of Mackay north to the Atherton Tableland region) occurring largely within the northern part of the distribution of *E. melanophloia.*

The new taxon described here was first collected south of Mt Isa in Queensland as early as 1951 and has subsequently been collected numerous times south of Mt Isa on the Mt Isa to Dajarra road, as well as occasionally from elsewhere on the hills around Mt Isa. The population on the Mt Isa to Dajarra road has become well known because it is atypical compared to *Eucalyptus melanophloia* elsewhere in Queensland. Brooker & Kleinig (1994: 347) mentioned the population in the text "*…occurring as a small mallee south of Mt Isa*". Brooker & Kleinig (1994) included an image of both the tree variant (subsp. *melanophloia*) and the mallee variant (subsp. *nana*) of *E. melanophloia.* Field and herbarium studies in conjunction with cultivation trials in a common garden indicate that the Mt Isa populations are sufficiently distinct to warrant taxonomic recognition.

The new subspecies was not collected in central Australia (Northern Territory) until the 1990s, when Peter Latz collected specimens from two widely separated localities (Ennugan Mountains and Yaripilangu Range). A number of other central Australian collections have since been made in localities in between, including at the type locality at Mt Leichhardt.

Taxonomic recognition of the two variants of *Eucalyptus melanophloia* is considered appropriate due to the conspicuous distinction in habit between the two geographically disjunct variants. This is consistent with the taxonomic recognition of other tree versus mallee variants (genetically and not environmentally determined) within the eucalypts, such as *Eucalyptus loxophleba* Benth. subsp. *supralaevis* L.A.S.Johnson & K.D.Hill (tree) and subsp. *lissophloia* L.A.S.Johnson & K.D.Hill (mallee).

The new subspecies (*Eucalyptus melanophloia* subsp. *nana*) has great horticultural potential in arid regions, because of its depauperate habit (for a eucalypt), crown of silvery leaves, and habitat of rocky sites (i.e. confined soil pockets) in a hot and dry region.

The relatively recent discovery of this new subspecies in Central Australia must be associated with the remoteness and relative paucity of botanical collections in the area in which it occurs. The subspecies is not rare (it can locally dominate some vegetation communities) and it is conspicuous in the field.

Material and methods

This paper is based on examination of herbarium collection at the herbaria AD, BRI, CANB and NSW, together with visits to populations in the Northern Territory and Queensland.

Taxonomy

Eucalyptus melanophloia F.Muell., *J. Proc. Linn. Soc., Bot.* 3: 93 (1859). **Type citation:** 'A tractu montano Newcastle Range usque ad sinum Morton Bay Eucalypto crebra abunde adsociata, solum sterilibus indicans'. **Type:** Queensland: Dawson River, *s.dat.*[1856], *F.Mueller s.n.* (lecto: K, material on upper half of sheet, *fide* Bean [2010: 472]).

Bark rough throughout (to branches less than 25 mm in diameter), moderately to deeply fissured and hard (ironbark), dark grey to black. Branchlets terete, waxy on current season's growth (wax eroded and not apparent on old branchlets), lacking pith glands. Seedling leaves opposite, sessile or on petiole to 2 mm long, elliptical to ovate, concolorous to slightly discolorous, dull, greyish, usually waxy, 35–60 mm long,

16–35 mm wide. Juvenile leaves opposite, sessile, (cordate at base) broadly elliptical to ovate (rounded to slightly pointed at tip), concolorous, dull, greyish, waxy on current season's growth, persisting on reproductively mature plants. Inflorescences held erect, terminal or sometimes sub-terminal (growing tip continuing). Peduncles terete or nearly so. Pedicels terete. Flower buds with operculum scar (but outer operculum sometimes still present at tip at anthesis), diamond-shaped to broadly fusiform, broadest below or at hypanthium-operculum join, 6–9 × 2.8–3.2 mm, waxy; operculum bluntly conical to conical, 3–5 mm long. Flower stamens cream, all anthers fertile. Fruits waxy when young (wax eroded and not apparent on old fruits). Seeds compressed ovoid, 1–2 mm long, dark grey-brown to black, finely reticulate; chaff smaller, linear, orange brown.

Two geographically disjunct subspecies are recognised in *Eucalyptus melanophloia*, differing most conspicuously and consistently in habit but also generally differing (with some degree of overlap) in leaf spacing and size, and in fruit size.

Key to subspecies of *Eucalyptus melanophloia*

Tree, usually single-stemmed, 7 to 18 m tall; most internodes 20 to 50 mm long (central and eastern Queensland and northern New South Wales) . . . . . subsp. **melanophloia**

Mallee, multi-stemmed, 2 to 6 m tall; most internodes 10 to 30 mm long (Northern Territory and north western Queensland) . . . . . subsp. **nana**

Eucalyptus melanophloia subsp. **melanophloia**

Tree, usually single-stemmed at ground level, 7–18 metres tall; forming an inconspicuous lignotuber. Juvenile leaves well-spaced (internodes usually 20–50 mm). Juvenile leaves 35–70 mm long, 22–48 mm wide. Intermediate and adult leaves sometimes produced in crown, 75–110 mm long, 13–30 mm wide. Inflorescences 7 or 9-flowered.; peduncles 5–14 mm long; pedicels 1–5 mm long. Fruits cupular to truncate-globose to pyriform, 5–6 mm long, 5–6.5 mm wide, disc descending then level to slightly ascending, valves 3, 4 or 5, enclosed to slightly exserted.

***Distribution and habitat*:** Widespread and relatively common in north-eastern Australia, from Narromine in New South Wales northwards to west of Musgrave on central Cape York Peninsula in Queensland (Clarkson 2009), and inland in Queensland to near Adavale and Croydon. A common component of open woodland vegetation, where it occurs on level to undulating topography as well as on hills and ridges, in skeletal or sandy soils (occasionally including deep red sands) to well-drained loams. Numerous woodland eucalypt species have been recorded as associates, and although the subspecies sometimes forms pure stands, it is more commonly co-dominant with one of a number of *Eucalyptus* section *Adnataria* (ironbark or box) species, especially *E. crebra* F.Muell.

***Notes*:** Putative sporadic hybrids are known with a number of other species, including intra-serial hybrids with *Eucalyptus crebra* (e.g. *Forster 16089, 16229, 13104, 16281*; see Brophy *et al.* 2009), *E. cullenii* Cambage, *E. decorticans* (F.M.Bailey) Maiden and *E. drepanophylla* F.Muell. ex Benth. (in the broad sense when including *E. xanthoclada* Brooker & A.R.Bean) and inter-serial hybrids with *E. coolabah* Blakely & Jacobs and *E. leptophleba* F. Muell. (both *E.* series *Aquilonares* Brooker) and *E. populnea* F.Muell. and *E. orgadophila* Maiden & Blakely (both *E.* series *Buxeales* Blakely). Extensive intergrading populations between *Eucalyptus melanophloia* subsp. *melanophloia* and *E.whitei* are known where their distributions adjoin in the Pentland to Jericho area of Queensland (Holman *et al.* 2011).

Eucalyptus melanophloia subsp. **nana** D.Nicolle & Kleinig **subspecies nova** a subspecie typica habitu minore et pluricauli "mallee", foliis juvenilibus minoribus et internodis brevioribus differt. **Typus:** Northern Territory. Western slope of Mt Leichhardt, 1 July 2008, *D.Nicolle 5205 & M.E.French* (holo: AD; iso: CANB, DNA, PERTH).

Eucalyptus melanophloia subsp. (Dajarra V.J. Neldner 1523); Bean *et al.* (2010: 119).

Mallee, several-stemmed from ground level, 2–6 metres tall; forming a lignotuber. Juvenile leaves crowded (internodes mostly 10–30 mm). Juvenile leaves 18–55 mm long, 12–40 mm wide. Reproductively mature in juvenile leaf phase, intermediate and adult leaves rarely produced. Intermediate leaves rarely produced. Adult leaves not known. Inflorescences 7–11-flowered. Peduncles 5–10 mm long. Pedicels 1–2 mm long. Fruits cupular, truncate-globose, barrel-shaped or slightly pyriform, 5–6 mm long, 4.5–5 mm wide, disc descending, valves 3 or 4, enclosed. **Fig. 1–3.**

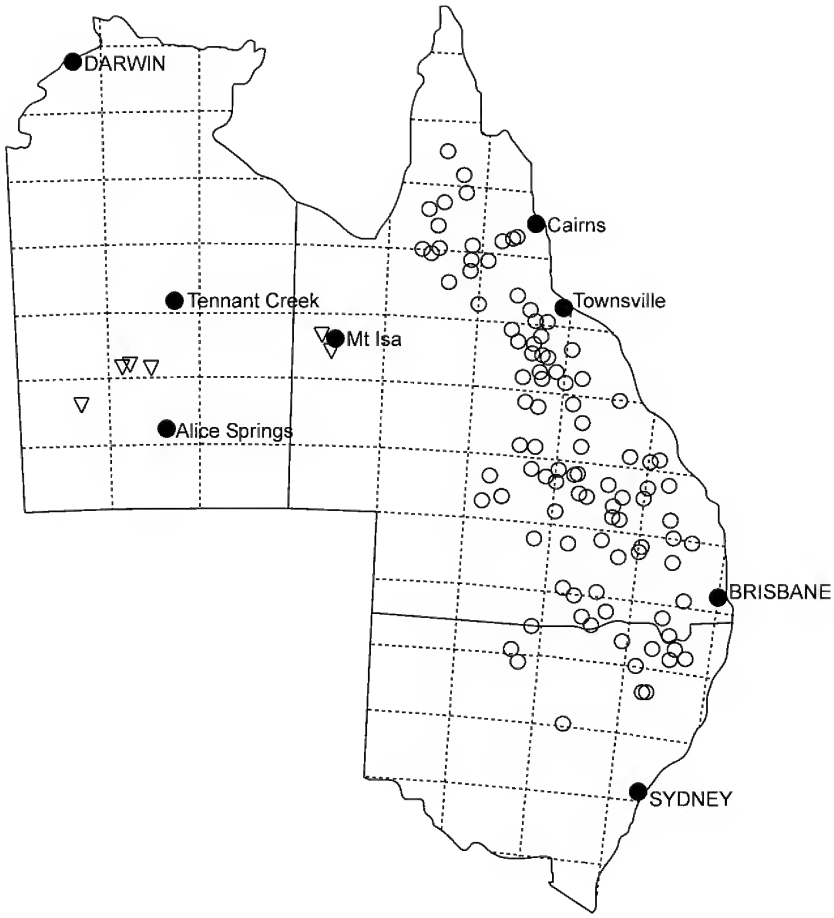
***Additional selected specimens examined*: Northern Territory.** 4 km NE of Mt Leichhardt, 30 km NNE of 'Coniston' Homestead, Sep 2006, *Duguid 22376 & Latz* (CANB, NT); Mt Leichhardt, 29 km NNE of 'Coniston' Homestead, Sep 2006, *Duguid 22380 & Latz* (CANB, NT); Mt Leichhardt summit, Jul 2008, *Nicolle 5207 & French* (AD); Mt Leichhardt, upper S slope, Aug 2005, *Albrecht 11677 & Latz* (BRI, NT); Mt Leichhardt, lower S-slope, Aug 2005, *Albrecht 11660 & Latz* (BRI, DNA, NSW, NT); Mt Denison, 23 km NNW of 'Coniston' Homestead, Sep 2005, *Latz 21028* (BRI, NT); SE end of Yindjirbi Range, Coniston Station, Jul 2008, *Nicolle 5203 & French* (AD, CANB, DNA); Ti Tree Station, Ennugan Mountains, Jul 1992, *Latz 12366* (AD, DNA, NT); 13 km ENE 'Newhaven' Homestead, Jul 2002, *Harris 4* (NSW, NT); 13 km ENE 'Newhaven' Homestead, Jul 2002, *Latz 18773 & Harris* (NT); Yaripilangu Range, 12 km ENE 'Newhaven' Homestead, Mar 1997, *Latz 15097* (CANB, DNA, NT). **Queensland.** Burke District: 53 km ENE of Mt Isa, N of Breakfast Creek, Jul 1988, *Harris 246* (BRI); W of Mt Isa on May Downs Station, Sep 2008, *Kleinig 6768* (AD); May Downs Station, W of Mt Isa, Jul 2004, *Booth 3563 & Kelman* (BRI, CANB); 11 km SSW of Mt Isa, Aug 1988, *Harris 250* (BRI); S of Mt Isa on the road to Dajarra, Apr 1995, *Nicolle 1330* (AD); 16 km S of Mt Isa, Sybella Creek, Apr 1988, *Harris 239* (BRI); South of Mt Isa on the road to Dajarra, Nov 2001, *Nicolle 4183* (AD, BRI, CANB); *c.* 20 km S of Mt Isa on Dajarra Road, Sep 2008, *Kleinig 6767* (AD); 20.9 km S of Mt Isa on Dajarra road, Mar 1990, *Brooker 10434* (BRI, CANB, MEL, NSW); 21 km S of Mt Isa on Dajarra road, May 1994, *Brooker 11888* (BRI, CANB, DNA, NSW); 22.5 km S of Mt Isa, Aug 1973, *Williams 138 & Trapnell* (BRI); 29 km S of Mt Isa on stony ridge, Sep 1951, *Everist 4455* (BRI).

***Distribution and habitat*:** The new subspecies is of widespread but has a very scattered distribution on arid rocky sites from the Yaripilangu Range in the west (about 250 km WNW of Alice Springs in the Northern Territory), eastwards to the Mount Isa area in north western Queensland (**Map 1**). Although the Northern Territory and Queensland populations are widely separated geographically, it is likely that further populations occur in the intervening area, which is remote and botanically poorly sampled.

In central Australia (Northern Territory), the subspecies occurs as very scattered populations from the Yaripilangu Range to the Ennugan Mountains but can be locally common or dominant, such as on the slopes of Mt Leichhardt. It occurs on granite hills and ranges, in open mallee vegetation. Associated eucalypts in Central Australia include *Corymbia aparrerinja* K.D.Hill & L.A.S.Johnson, *C. deserticola* subsp. *mesogeotica* K.D.Hill & L.A.S.Johnson, *C. eremaea* (D.J.Carr & S.G.M.Carr) K.D.Hill & L.A.S.Johnson, *E. gillenii* Ewart & L.Kerr, *E. normantonensis* Maiden & Cambage and *E. pachyphylla* F.Muell., with scattered shrubs including *Grevillea wickhamii* Meisn. and *Hakea grammatophylla* (F.Muell.) F.Muell. and a groundstorey dominated by *Triodia* R.Br.

In north western Queensland, the subspecies is locally common in a small area on the Mt Isa to Dajarra road, where it occurs on rocky outcrops and the intervening valleys in hilly, quite rugged topography in gravelly red sand derived from Sybella granite. The subspecies also occurs as very scattered populations elsewhere on the Mt Isa Mines Lease, where Barrs (1999) describes the vegetation unit as '*Eucalyptus melanophloia* dwarf open forest'. Associated eucalypts in the Mt Isa area include *Corymbia terminalis* (F.Muell.) K.D.Hill &

Fig. 1. Holotype of ***Eucalyptus melanophloia*** subsp. ***nana*** (Nicolle 5205 & French [AD]).



Map 1. Distribution of *Eucalyptus melanophloia* subsp. *melanophloia* (○) and subsp. *nana* (▽).

L.A.S.Johnson, *E. leucophloia* subsp. *euroa* L.A.S.Johnson & K.D.Hill, *E. leucophylla* Domin and *E. normantonensis*. Scattered *Acacia* shrubs are present as an understorey (including *A. hilliana* Maiden and *A. monticola* J.M.Black) and *Triodia* dominates the groundstorey. It categorises a distinct regional ecosystem (RE1.12.2) in Queensland that has an 'Of Concern' status and an estimated area of <10,000 ha (Accad *et al.* 2008; http://www.derm.qld.gov.au/wildlife-ecosystems/biodiversity/regional_ecosystems/details.php?reid=1.12.2.

***Notes*:** *Eucalyptus melanophloia* subsp. *nana* is distinguished from *E. melanophloia* subsp. *melanophloia* by the consistently bushy, multi-stemmed mallee habit and also in the generally smaller and more crowded juvenile leaves. The fruits also tend to be smaller and the new subspecies more rarely produces intermediate (and adult) leaves than the typical subspecies.

This new subspecies is disjunct from the nearest known locality of subsp. *melanophloia* to the north-east (west of Croydon) by about 350 km. No intergrading populations are known.

Cultivation trials of Mt Isa populations of the new subspecies and three Queensland provenances of subsp. *melanophloia* have been undertaken since 1994 at Currency Creek Arboretum in South Australia (Nicolle 2000). The aim of these trials was to determine if habit differences apparent between the Mt Isa populations (subsp.

Fig. 2. ***Eucalyptus melanophloia*** subsp. ***nana*** at Yindjirbi Range, Northern Territory (population voucher: *Nicolle 5203 & French* [AD, CANB, DNA]). Photo: D. Nicolle

nana) and *E. melanophloia* elsewhere in Queensland (subsp. *melanophloia*) are caused by environmental factors (subsp. *nana* occurring in a more arid environment) or due to genetic differentiation. These trials indicate that subsp. *nana* retains both its low, bushy, mallee habit and the generally smaller adult leaves compared to subsp. *melanophloia* (Queensland populations grown from the Mt Moffatt, Jericho and Miles areas), which consistently developed into taller, single-stemmed trees with a crown composed of larger juvenile leaves.

Although there are no known intermediate ('intergrading') populations between the two subspecies, and although the new subspecies is consistently distinct in habit, subspecific rather than specific status has been applied to the new taxon due to the allopatric distribution of the two taxa and the overlapping distinctions of leaf and fruit morphology. It is likely that the two taxa would readily interbreed if brought into geographical contact, and the discovery of intermediate populations remains a possibility.

Sporadic hybrids are known with *Eucalyptus normantonensis* Maiden & Cambage, of *E.* series *Buxeales* (see below). This inter-series hybrid is conspicuous in the field, having a crown of leaves intermediate in morphology between the dull greyish, sessile, broad leaves of *Eucalyptus melanophloia* subsp. *nana* and the glossy green, petiolate, narrow leaves of *E. normantonensis* (**Fig. 4**).

***Conservation status*:** Although populations are widely scattered, the subspecies is locally common or dominant where it has been recorded, and it is not considered to be at risk. At Mt Leichhardt in Central Australia, the subspecies is dominant or co-dominant on the ridges, summit and western slopes, with the population size likely to exceed 10,000 individuals (**Fig. 3**).

Fig. 3. ***Eucalyptus melanophloia*** subsp. ***nana*** at Mt Leichhardt, Northern Territory (type locality). Photo: D. Nicolle

***Etymology*:** From the Latin *nanus* (a dwarf) referring to the consistently low bushy habit and also in reference to the generally smaller leaves of the new subspecies in comparison to *E. melanophloia* subsp. *melanophloia*.

Eucalyptus melanophloia subsp. nana × E. normantonensis hybrids

***Specimens examined*: Northern Territory.** 4 km NE of Mt Leichhardt, 30 km NNE of 'Coniston' Homestead, Sep 2006, *Duguid 22375 & Latz* (CANB, NT); SE end of Yindjirbi Range, Coniston Station, Jul 2008, *Nicolle 5204 & French* (AD, CANB, DNA).

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Fig. 4. ***Eucalyptus melanophloia*** subsp. ***nana*** × ***E. normantonensis*** hybrid (*Nicolle 5204 & French* [AD, CANB, DNA]). Photo: D. Nicolle

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Cycas terryana P.I.Forst. (Cycadaceae), a new species from central Queensland

Paul I. Forster

Summary

Forster, P.I. (2011). *Cycas terryana* P.I.Forst. (Cycadaceae), a new species from central Queensland. ***Austrobaileya* 8(3): 356–363.** A new species of *Cycas* from the Broadsound and Connors Ranges in central Queensland is described, illustrated and diagnosed as *C. terryana* P.I.Forst. It is known from five populations in an area of occurrence of approximately 800 km² and does not occur in any conservation reserves. A conservation status of Vulnerable based on the IUCN criterion of D2 is recommended for the species.

Key Words: Cycadaceae, *Cycas*, *Cycas terryana*, Australia flora, Queensland flora, new species, taxonomy, identification key, conservation status

P.I.Forster, Queensland Herbarium, Department of Environment & Resource Management, Brisbane Botanic Gardens, Mt Coot-tha Road, Toowong, Queensland 4066, Australia. Email: paul.forster@derm.qld.gov.au

Introduction

The genus *Cycas* L. is speciose in Australia with 28 species recognised (Hill 1998, 2004). The species generally occur in well defined, geographically discrete areas in few (in several instances one) to many populations. Botanical exploration in Queensland continues to reveal previously undocumented populations of *Cycas*; such a case pertains to several populations of plants in the area southwest of St Lawrence and northwest of Marlborough in the Broadsound and Connors Ranges.

Hill (1992) was of the opinion, albeit without supporting evidence, that this material represented a zone of hybridism ("intergrading populations") between *Cycas media* R.Br. and *C. ophiolitica* K.D.Hill. This hypothesis was developed further (Hill 1996: 3), *viz.* "these [populations] are morphologically intermediate between the putative parent species and also show the high degree of variability to be expected from Mendelian segregation in second and later generations". Such introgressed populations were considered to occur throughout the range of the genus in Australia (Hill 1996) and elsewhere (e.g. Hill 1994, 2008; Hill *et al.* 2004), in some instances between species that he classified in different series. This 'multiple hybridism' hypothesis remains to be tested using molecular markers (e.g. haplotype networks [Schaal & Olsen 2000]) and remains merely as a plausible supposition in some cases. Alternative hypotheses are that these populations are merely variations of more broadly defined species or in some instances represent discrete taxa.

Hill's propensity for designating a large number of *Cycas* populations as hybrids or examples of introgression was probably influenced by his work on eucalypts (where this is widespread and by comparison well documented with genetic studies) and his mentoring by L.A.S.Johnson who together with Lindsay Pryor was a keen supporter of the 'phantom' hybrid population concept (Pryor 1951; Pryor & Johnson 1971; Parsons & Kirkpatrick 1972; Johnson 1976; Kirkpatrick & Potts 1987). Eucalypts are bisexual, often promiscuous outbreeders with non specialist pollinators and appear to be readily dispersed; hence, the potential for hybrids where different taxa adjoin is high, although recorded instances are relatively low (Griffin *et al.* 1988). Populations of hybrid individuals may lead to extinction of the parental species via genetic pollution, although in many cases the progeny are sterile or with reduced viability (Levin 2000). Alternatively, these populations may in time lead to separate speciation events once fertility is restored

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(e.g. via allotetraploidy) and genetic change via selection or genetic drift occurs (Levin 2000).

The situation in *Cycas* is quite dissimilar, insomuch as the plants are dioecious, require pollination by insects (in variations of a mutualistic relationship) and perhaps wind in combination (Kono & Tobe 2007), polyploidy is unknown (Gorelick & Krystle 2011), and distribution of the populations are limited by dispersal (Forster 2007). As noted by Hill (1992) it is perhaps unlikely that strong genetic barriers to cross pollination between different taxa exist and so the only real barrier to hybridism/introgression is isolation in geographic space. Populations of *Cycas* and other Australian cycads are rare in the landscape for the above reasons, quite unlike the situation with most eucalypts. Johnson (1959, 1961) actively promoted the concept of widespread hybridism in cycads, especially for Zamiaceae (*Macrozamia*) species, although some of his examples are merely juveniles of much larger adults (e.g. *M. lucida* × *M. moorei*; juveniles of what is now known as *M. johnsonii* D.L.Jones & K.D.Hill) or represented discrete taxa that he was not aware of. Speciation in *Cycas* and *Macrozamia* is perhaps most likely to occur via genetic drift in isolated populations, rather than genetic selection *per se* (Gorelick 2009). This is reflected in the occurrence of similar appearing taxa, often in a geographic replacement series of allopatric populations. This can be interpreted as an indication of both continuous and incomplete speciation in a non-adaptive radiation where the inter-relationship between environment and morphology is unclear (Savolainen & Forest 2005) and in cycads is probably driven mainly by fragmentation, rather than radical differences in habitat specialisation (*cf.* Linder 2003). Either way, the tempo of speciation is likely to be slow given the long time period between germination and individuals reaching maturity, together with slow turnover of individuals within populations.

With regard to the so called *Cycas media* – *C. ophiolitica* intermediates south of St Lawrence, Hill (1992) was probably only aware of two populations based on his collection (*Hill 3788 & Stanberg*) and that of *Hind 2878*, or others that he examined and determined as such. There are now five populations of these plants known and perhaps more in what is largely a botanically unexplored part of central Queensland.

Neither of the putative parental species have populations that are particularly geographically close to the Broadsound and Connors Ranges plants. Hill (1996) vaguely stated that the hybrid populations were "wherever different species grow in relatively close proximity". The closest population of *Cycas media* is *c.* 9 km to the northeast (in different habitat and geology) and the closest population of *C. ophiolitica* some *c.* 45 km to the east of the overall area of occupancy for the five populations. The southern populations of *Cycas media* are predominantly coastal and occur on substrates derived from basalts, finer grained granites or stabilised sand masses. The northern populations of *Cycas ophiolitica* are restricted to serpentinite substrates. By comparison the Broadsound and Connors Ranges plants occur well inland in the ranges on substrates derived from heavily weathered porphyritic granites.

These populations of *Cycas* may well have originated from mixing of the ancestral lineages of both *C. media* and *C. ophiolitica* as postulated by Hill, with speciation following the initial hybridism and subsequent geographic isolation. However, the situation could well be much more complex than this and reflect multiple instances of fragmentation and integration of populations driven by climatic changes since the glacial cycles of the Pleistocene. This hypothetical pattern of change has been actively promoted as one of the main drivers of speciation in Mexican cycads (Vovides *et al.* 2003) and similar reproductive and dispersal biology of the Australian cycads may infer similar patterns of allopatry (Forster 2004).

Given that the recorded populations of these *Cycas* are disjunct over an area of occurrence of at least 800 km², it is likely that the hypothesised speciation event is well advanced with subsequent fragmentation following an initial introgression. It is unlikely that these populations are any less fit

than the core *Cycas media* or *C. ophiolitica* populations and to all extents they appear to exist and operate much like any other healthy cycad populations. If of hybrid origin, then they probably commenced as a neutral hybrid zone with genetic compatibility and superficially similar habitats, although such zones are usually in close proximity to the putative parental species (Levin 2000) which is no longer the case here. Whatever the origin, these populations possess character states that enable them to be distinguished from both *Cycas media* and *C. ophiolitica*; hence, they are described below as a new species. The hypothesised species origin is also relevant for speciation elsewhere in *Cycas* and other genera of cycads, particularly *Macrozamia* Miq. from Australia (Forster 2004), *Encephalartos* Lehm. in Africa (Vorster *et al.* 2004) and *Ceratozamia* Brongn. and *Zamia* L. in the New World (Vovides *et al.* 2003, 2004).

Materials and methods

The species description is based on examination of both live plants in habitat and herbarium collections at the Queensland Herbarium.

Taxonomy

Cycas terryana P.I.Forst. species nova a *C. ophiolitica* differt praecipue foliis valde fragilibus (adversum non), multo parcius carinatis et juvenilibus non glaucis, extra colore indumenti; quum a *C. media* subsp. *media* differentiae principales sunt folia valde (non infirme) fragilia, maturitate indumentum gerentia (adversum indumentum deficiens) et valde carinata (adversum plus minusve non vel infirme carinata), cum colore indumenti in cataphyllis. **Typus:** Queensland. Port Curtis District: Broadsound Range, 9 March 2005, *P.I.Forster PIF30618 & P.J.Machin* (holo: BRI [4 sheets, ♀ carpological and spirit samples]).

Arborescent cycad with stems to 3 m high (rarely multiheaded), 12–22 cm thick. Leaves 80–190 cm long, straight and becoming wavy towards the apex, weakly to strongly keeled in cross-section, pale green to somewhat glaucous green-grey above; opposing leaflets inserted at 20–50° to the rhachis, the rhachis usually terminated by paired leaflets, tomentose; petiole 17–30 cm long, 7–15 mm diameter, dull olive grey-green, with 4–40 short teeth (pinnacanths) 1.5–2 mm long and spaced 8–17 mm apart, sometimes spineless. Leaflets 184–320 per leaf, 7–10 mm apart, being evenly spaced in lower half of leaf, then becoming more interleaved and more strongly keeled in upper half of leaf, brittle, margins recurved; median leaflets at 25–45° to the rhachis, 105–230 mm long, 5–7 mm wide, green-grey with fawn-tan bloom when young; weakly convex in cross section, decurrent for 5–7 mm, up to 13 mm at base of leaf. New growth densely tomentose with pale cream-fawn indumentum, glabrescent. Cataphylls pungent, linear, 8–12 cm long, densely tomentose for entire length with pale fawn indumentum. Microsporangiate cones elongate-ovoid, 21–28 cm long, 6.5–8 cm diameter, with dense ferruginous-brown indumentum; microsporophylls 28–40 mm long, fertile zone 17–28 mm long, 4–12 mm wide; apical spine antrorsely recurved, 4–10 mm long. Megasporophylls 20–33 cm long, when young with dense fawn-tan indumentum, aging grey, eventually glabrescent and olive-green; ovules 4 to 6; lamina broadly triangular 50–70 mm long, 30–38 mm wide, strongly dentate with well developed antrorse teeth 4–7 mm long, apical spine 17–33 mm long. Seeds ovoid, 37–40 mm long, 30–35 mm diameter, sarcotesta *c.* 5 mm thick, weakly grey pruinose, olive green beneath wax covering, becoming orange when ripe. **Figs. 1–5.**

***Additional specimens examined*: Queensland.** Leichhardt District: Broadsound Range, Mar 1964, *Everist 7624* (BRI); *ditto loc.*, Nov 2003, *Forster PIF29714 & Halford* (BRI); *ditto loc.*, Nov 2003, *Forster PIF29715 & Halford* (BRI); *ditto loc.*, Mar 2005, *Forster PIF30617 & Machin* (BRI); *ditto loc.*, Dec 2010, *Mathieson MTM965 & 966* (BRI); *ditto loc.*, Jun 2011, *Forster PIF38217 & Machin* (BRI). Port Curtis District: St Lawrence towards Croydon, Aug 1990, *Hill 3788 & Stanberg* (BRI, NSW); Croydon Station – St Lawrence Road, Jun 2011, *Forster PIF38218 & Machin* (BRI); 5 km W of Prospect Hill, Nov 1992, *Forster PIF12276 & Machin* (BRI); near Burwood [as 'Barwood'], Broadsound, Jun 1981, *Maconochie 2757* (BRI; CANB, DNA, NY *n.v.*).

Fig. 1. ***Cycas terryana***. Plants in habitat (population voucher: *Forster PIF29714 & Halford* [BRI]). Photo: P.I.Forster

***Distribution and habitat*:** *Cycas terryana* is restricted to the Broadsound and Connors Ranges northwest of Marlborough and southwest of St Lawrence. Populations occur on undulating low hills on stony soil derived from porphyritic granite in woodland dominated in various combinations by *Corymbia clarksoniana* (D.J.Carr & S.G.M.Carr) K.D.Hill & L.A.S.Johnson, *C. dallachiana* (Benth.) K.D.Hill & L.A.S.Johnson, *Eucalyptus crebra* F.Muell., *E. drepanophylla* F.Muell. ex Benth. and *Petalostigma pubescens* Domin.

***Notes*:** *Cycas terryana* appears to have first been collected by Selwyn Everist in 1964; however, this herbarium specimen has been variously identified as *C. media* or an intergrade between *C. media* and *C. ophiolitica* (determination of K.D.Hill).

The primary morphological differences between *Cycas terryana*, *C. media* and *C. ophiolitica* are summarised in **Table 1**. The leaflets and rhachis of *C. terryana* are very brittle and easily snapped, as opposed to the situation in *C. media* and *C. ophiolitica* where they are less brittle in the former and robustly flexible in the latter. The megasporophylls in *Cycas terryana* are generally broader than in the other species being compared here and indumentum on the new growth, cataphylls and megasporophylls is pale grey-fawn to fawn-tan whereas in the others it is usually orange-brown, only becoming greyish if particularly weather beaten. *Cycas terryana* differs from *C. ophiolitica* mainly in the leaves being markedly brittle (versus not), much less strongly keeled and not glaucous when young, as well as the indumentum colour; whereas from *C. media* subsp. *media* the main differences are the leaves being markedly brittle (versus weakly brittle), with indumentum at maturity (versus none) and strong keeling (versus ± flat to weakly keeled), together with the indumentum colour on the cataphylls.

Fig. 2. ***Cycas terryana***. Apex of mature plant showing cataphylls (population voucher: *Forster PIF30617 & Machin* [BRI]). Photo: P.I.Forster

Cycas media and *C. ophiolitica* were classified in different series by Hill (1996, 1998) on the basis of anatomy and morphology. Given that species such as *C. terryana* exist, there seems little point in the continued recognition of such artificial supraspecific taxa.

***Etymology*:** This species is named for Dr L. Irene Terry of the University of Utah, U.S.A., in recognition of her ground breaking work on cycad pollination, both in Australia and on Guam (e.g. Terry 2001; Terry *et al.* 2004, 2005, 2007, 2009).

***Conservation status*:** The species is known from five populations with an area of occurrence of *c.* 800 km and an area of occupancy that is much less. An appropriate status is Vulnerable based on the D2 criterion (IUCN 2001). None of the populations occur in conservation reserves and at least one has been reduced to non viable numbers of plants.

Acknowledgements

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Table 1. Comparison of character states for *Cycas media, C. ophiolitica and C. terryana*

Character State	*C. media*	*C. ophiolitica*	*C. terryana*
Mature leaf indumentum	glabrous	tomentose below and on rhachis	tomentose below and on rhachis
Leaflet insertion	± flat to weakly keeled	strongly keeled	keeled
Leaflet number	160–300	170–220	184–320
Leaflet colour mature leaves	glossy green	glaucous grey-blue	glossy green to glaucous green-grey
Leaflet texture	flexible to weakly brittle	flexible	strongly brittle
New growth indumentum colour	pale orange-brown	mixture of grey-white and pale orange-brown	pale grey-fawn
Cataphyll indumentum colour	orange-brown	orange-brown	pale grey-fawn
Megasporophyll indumentum	ferruginous or grey	brown	fawn-tan
Megasporophyll width (mm)	17–30	12–30	30–38
Seed sarcotesta colour	green becoming orange-yellow, not pruinose	green becoming yellowish, pruinose	green becoming orange, not or only weakly pruinose
Seed size: length × wide (mm)	31–38 × 26–32	29–33 × 28–32	37–40 × 30–35

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Fig. 3. ***Cycas terryana***. Detail of megasporophylls with near mature seeds (population voucher: *Forster PIF30618 & Machin* [BRI]). Photo: P.I.Forster

Fig. 4. ***Cycas terryana***. Detail of megasporophyll teeth (population voucher *Forster PIF30618 & Machin* [BRI]). Photo: P.I.Forster

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Fig. 5. ***Cycas terryana***. Male plant with microsporangiate cone (population voucher: *Mathieson MTM965* [BRI]). Photo: M.T.Mathieson.

A taxonomic revision of *Trichosanthes* L. (Cucurbitaceae) in Australia, including one new species from the Northern Territory

W.E. Cooper[1] & H.J. de Boer[2]

Summary

Cooper, W.E. & de Boer, H.J. (2011). A taxonomic revision of *Trichosanthes* L. (Cucurbitaceae) in Australia, including one new species from the Northern Territory. ***Austrobaileya* 8(3): 364–386.** *Trichosanthes* is represented by six species in Australia: *T. cucumerina* L. var. *cucumerina*, *T. morrisii* W.E.Cooper sp. nov., *T. odontosperma* W.E.Cooper & A.J.Ford, *T. pentaphylla* F.Muell. ex Benth., *T. pilosa* Lour. and *T. subvelutina* F.Muell. ex Cogn. *Trichosanthes ovigera* Blume has recently been synonymised with *T. pilosa* and we now include *T. holtzei* F.Muell. within this synonymy. All taxa are illustrated (with the exception of *T. odontosperma* previously illustrated in 2010), and distinguished from other Australian species. Notes on habitat and distribution are included together with distribution maps. Three identification keys are presented, two to the sections of *Trichosanthes* and one to the species of *Trichosanthes* in Australia.

Key Words: Cucurbitaceae, *Trichosanthes*, *Trichosanthes cucumerina*, *Trichosanthes ovigera*, *Trichosanthes pilosa*, *Trichosanthes odontosperma*, *Trichosanthes subvelutina*, *Trichosanthes pentaphylla*, *Trichosanthes morrisii*, Australia flora, Northern Territory flora, Queensland flora, taxonomy, identification keys, new species, new combination, probracts

[1] W.E. Cooper, Australian Tropical Herbarium, James Cook University, Cairns Campus, McGregor Road, Smithfield, Queensland, 4878, Australia.

[2] H.J. de Boer, Department of Systematic Biology, Uppsala University, Norbyvägen 18 D, 752 36 Uppsala, Sweden. Email: hugo.deboer@ebc.uu.se

Introduction

Trichosanthes L. is a genus of approximately 100 species distributed from India, Sri Lanka, China, Japan, SE Asia to Malesia (including New Guinea), Australia, and the eastern Pacific (Rugayah & de Wilde 1999). *Trichosanthes* is broadly represented in Australia with one or two species from five of the six sections: *Trichosanthes* L., *Cucumeroides* (Gaertn.) Kitam., *Edulis* Rugayah, *Asterosperma* W.J.de Wilde & Duyfjes (not in Australia), *Foliobracteola* C.Y.Cheng & C.H.Yueh and *Involucraria* (Ser.) Wight. Sections are distinguished using (1) seed shape and structure, (2) colour of fruit pulp, (3) presence or absence of probracts, (4) size of male bracts. However, leaf shape is variable within all species, and shape of male bracts can vary greatly in *Trichosanthes cucumerina* L., *T. pentaphylla* F.Muell. ex Benth. and *T. subvelutina* F.Muell. ex Cogn.

The last comprehensive treatment of *Trichosanthes* in Australia (Telford 1982) described six species in which *T. holtzei* F.Muell. was thought to be closely allied to *T. ovigera* Blume; however, *T. holtzei* is no longer maintained here with the present authors synonymising it with the widespread and variable *T. pilosa* Lour. Examination of a greater number of herbarium specimens collected in Australia during recent years, as well as molecular analysis (de Boer & Cooper unpublished), have confirmed this finding. *Trichosanthes ovigera* has been previously referred to this synonymy through priority of *T. pilosa* (de Wilde & Duyfjes 2008).

Telford (1982) suggested that *Trichosanthes pentaphylla* (**Fig. 1, 6**) is probably conspecific with *T. trifolia* (L.) Merr. and the latter has now been synonymized with *T. wawrae* Cogn. (Rugayah & de Wilde 1997). However, the two species differ sufficiently to maintain *Trichosanthes pentaphylla* as distinct from *T. wawrae*.

Taxa in the genus *Trichosanthes* can be extremely variable throughout their distribution with regard to leaf (**Fig. 3,4**),

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Fig. 1. ***Trichosanthes pentaphylla*** from the Mowbray River, showing silvery leaves with dark green veins, typical juvenile growth of plants in the section *Involucraria*. Photograph: W.T. Cooper

Fig. 2. ***Trichosanthes subvelutina***. male flowers, Terania Creek NSW. Photograph: H. Nicholson

bract and fruit morphology, as well as seed surface in *T. pilosa*. The extremes of habitat preferences within one species can often be associated with morphological variation. *Trichosanthes* sp. Fine Leaf (L.A. Craven 7930) had been recognised as a different taxon by the Northern Territory Herbarium (DNA); however, the present authors see it as part of the widespread and variable *T. cucumerina* L. var. *cucumerina*.

In this revision, six species of *Trichosanthes* are recognised for Australia and of those, *T. odontosperma* W.E.Cooper & A.J.Ford, *T. pentaphylla*, *T. subvelutina* and *T. morrisii* W.E.Cooper are endemic. Five species are mostly tropical with one species (*Trichosanthes subvelutina*) mainly subtropical.

Materials and methods

We examined 363 specimens from BR, BRI, CANB, CNS, DNA, K, L, MEL, P, PERTH and NSW. All species were observed in the field by the first author.

Flowers of *Trichosanthes* are fragile and difficult to preserve as good quality dried specimens. They are therefore not easy to analyze (Duyfjes & Pruespan 2004), and have not been used as key species characters. Even with fresh flowers, plants are mostly not identifiable to species; however, plants having flowers with fimbriate petal margins belong to sections *Trichosanthes* or *Cucumeroides*, and those having petals with fimbriate apices belong to sections *Foliobracteola*, *Involucraria* or *Edulis*. Leaf, probract and seed features provide good characters (Duyfjes & Pruespan 2004) and along with male bract size and sepals, have been predominantly used here as key features for dichotomous determination keys.

Measurements of all parts were done on dried material and specimens preserved in 70% ethanol, as well as on fresh material in the field. Common abbreviations in the text include N.P. (National Park) and S.F./S.F.R. (State Forest/State Forest Reserve).

The extensive bibliographic taxonomic history of *Trichosanthes* sections and the species that also occur outside of Australia has been repeated several times in recent years (e.g. Rugayah & de Wilde 1997, 1999; Duyfjes & Pruespan 2004; de Wilde & Duyfjes 2010) and is largely omitted from this account.

Taxonomy

Trichosanthes L., *Sp. Pl.* 2: 1008 (1753). **Type species:** *Trichosanthes anguina* L., *fide* M.L.Green, *Prop. Brit. Bot.* 190 (1929) [= *T. cucumerina* subsp. *anguina* (L.) Greb.]

Cucumeroides Gaertn., *Fruct. Sem. Pl.* 2: 485, t. 4 (1791). **Type species:** not designated.

Involucraria Ser., *Mém. Soc. Phys. Genèv.* 3(1): 25, t. 5. (1825). **Type species:** *Involucraria wallichiana* Ser.

Trichosanthes in Australia: Monoecious or mostly dioecious, trailing or climbing **vines or lianas**, annual or mostly perennial, partially or completely seasonally senescent; bark corky, warty, flaky, fissured or lenticellate; stems either weak and slender or robust and somewhat woody; glabrous, pubescent or scabrous; roots tuberous. **Indumentum** of translucent multicellular trichomes, glandular or eglandular; cystoliths often present, discoid or rosette-shaped, drying to white or black in herbarium specimens. **Probracts** present at the nodes in many species, caducous or persistent, may be pubescent, glands often present. **Tendrils** unbranched or 2-, 3- or 4-branched (up to 9-branched in Asia), positioned at the node (not truly axillary). **Leaves** simple or compound (digitate), alternate, petiolate, unlobed or 3–7 (rarely 10)-lobed, margin entire or toothed with a soft mucro or callus terminating main veins, membranous or leathery, scabrous, velvety or glabrous, glands often present on the underside, pedately veined with 3–5 main veins, intralateral veins reticulate. **Inflorescence** beside petiole at the node (not truly axillary). **Flowers** unisexual, mostly nocturnal excepting *T. cucumerina,* epigynous, petals 5 (rarely 4); corolla white, cream or yellowish, actinomorphic; sepals 5 (rarely 4), free, subulate or triangular; petals hairy, margin fimbriate; receptacle tube elongate. **Male flowers** either solitary, paired, or in racemose or rarely paniculate inflorescences; bracts present on racemes at pedicel base and sometimes at peduncle

base, persistent or caducous, glands may be present; stamens 3, inserted near receptacle tube orifice, included, free until anthesis then becoming fused; filaments free; anthers oblong, s-shaped, two are 2-thecous, one is 1-thecous, basifixed. **Female flowers** mostly solitary or paired (one is usually much older), sometimes in a racemose inflorescence in *T. pilosa*, solitary and usually co-axillary with male raceme in *T. cucumerina*; perianth similar to males; style long, narrow; stigma 3–5-lobed; staminodes absent; ovary inferior, pubescent or glabrous, elliptic, ovoid, globose or fusiform; ovules numerous, horizontal. **Fruit** a pepo or berry, ellipsoid, ovoid, globose or fusiform, beaked at apex, 30–140 mm long, mostly solitary; epicarp green with or without longitudinal white stripes, orange or red, glabrous or pubescent; epicarp leathery, chartaceous or woody; mesocarp fleshy or firm, orange, yellow or whitish, smooth or fibrous; pulp white, yellow, orange, red or dark green; seeds few–numerous, horizontal, 1-locular or 3-locular with the two lateral locules empty, compressed or turgid, smooth or sculptured, brown, cream, grey or black. Germination is hypogeal, semi-hypogeal or epigeal.

***Etymology*:** The generic epithet *Trichosanthes* is derived from the Greek *tricho-* (hairy) and *-anthus* (flowered); referring to the petals, which have fimbriate margins.

Key to sections of *Trichosanthes* in Australia using mostly seed and fruit features

1 Seeds 3-locular . . . . . Section **Cucumeroides**
1. Seeds 1-locular **2**

2 Seeds surrounded by dark green pulp, adult leaves compound or simple; juvenile leaves silvery with dark green veins . . . . . Section **Involucraria**
2. Seeds surrounded by white, greenish-white, yellow, orange or red pulp, all leaves simple; juvenile leaves green only. **3**

3 Seeds surrounded by white or greenish-white pulp . . . . . Section **Foliobracteola**
3. Seeds surrounded by yellow, orange or red pulp **4**

4 Seeds toothed; probract present on new growth; plants dioecious . . . . . Section **Edulis**
4. Seeds with an undulate margin; probract absent; plants monoecious . . . . . Section **Trichosanthes**

Key to sections of *Trichosanthes* in Australia using leaf, probract and male bract

1 Leaves compound . . . . . Section **Involucraria**
1. Leaves simple **2**

2 Probracts present (at least on new growth) **3**
2. Probracts absent **5**

3 Probracts caducous . . . . . Section **Edulis**
3. Probracts persistent **4**

4 Leaf upperside with numerous cystoliths. . . . . Section **Involucraria**
4. Leaf upperside without cystoliths. . . . . Section **Foliobracteola**

5 Plants monecious; male inflorescence bracts up to 3 mm long. . . . Section **Trichosanthes**
5. Plants dioecious; male inflorescence bracts 4–8 mm long . . . . . Section **Cucumeroides**

Key to species of *Trichosanthes* in Australia

1 Leaves compound (Qld only) . . . . . **T. pentaphylla**
1. Leaves simple **2**

2 Leaf upperside glabrous or glabrescent **3**
2. Leaf upperside hairy **4**

3 Probract linear or narrowly ovate, caducous; seeds toothed, surrounded in orange or red pulp (Qld only) . . . . . **T. odontosperma**
3. Probract obovate, elliptical or oblong, persistent; seeds entire, surrounded in dark green pulp, (NT only). . . . . **T. morrisii**

4 Plants monoecious; male inflorescence bracts up to 3 mm long; seeds with an undulate margin (NT, Qld, WA) . . . . . **T. cucumerina** var. **cucumerina**
4. Plants dioecious; male inflorescence bracts 4–33 mm long; seed margin not undulate **5**

5 Male inflorescence bracts 4–8 × 0.5–3 mm; seeds tumid, t-shaped, surrounded by yellow-orange pulp (NT, Qld, WA). . . . . **T. pilosa**
5. Male inflorescence bracts 15–33 × 7–23 mm; seeds flat, round and entire, surrounded by greenish-white pulp (NSW, Qld) . . . . . **T. subvelutina**

Trichosanthes L. section **Trichosanthes**

Type species: *Trichosanthes anguina* L. [= *T. cucumerina* var. *anguina* (L.) Haines]

Monoecious trailing vines. Probracts absent. Male bracts persistent (caducous in Asia). Flowers diurnal, petals fimbriate with thread-like extensions along the margins. Fruit yellow or orange; seeds 1-locular, flat, margins broad and undulate.

***Distribution*:** One species (two varieties) occurring in China, India, Sri Lanka, SE Asia, Malesia and Australia (one variety).

1. Trichosanthes cucumerina L., *Sp. Pl.* 2: 1008 (1753). **Type:** habitat in India, "*Padavalam*" in Rheede, *Hort. Malab.* 8: 39, t. 15 (1688) (lecto: *fide* Keraudren-Aymonin [1975: 91]).

The species comprises two varieties as accepted here with *T. cucumerina* var. *cucumerina* occurring in Australia. The second variety (*T. cucumerina* var. *anguina* (L.) Haines) is the common snake gourd of horticulture. Data from molecular sequencing support the placement of the cultivated snake gourd as a cultivated variant of *T. cucumerina* (Ali & Al-Hermaid 2010).

Trichosanthes cucumerina var. **cucumerina**; Haines, *Bot. Bihar Orissa* 3: 388 (1922).

Trichosanthes pedatifolia Miq., *Fl. Ind. Bat.* 1: 677 (1856). **Type:** Indonesia: Java, *s.dat.*, *T.Horsfield s.n.* (holo: BM28187; iso: U).

Trichosanthes reniformis Miq., *Fl. Ind. Bat.* 1: 675 (1856). **Type:** Indonesia: Java, *s.dat.*, *T.Horsfield s.n.* (holo: BM28189, 28188).

Trichosanthes ambrozii Domin, *Biblioth. Bot.* 89: 631 (1929). **Type:** Australia: Western Australia. between Ashburton and De Gray Rivers, *s.dat.*, *E.Clement s.n.* (syn: B, K, PR *n.v.*).

Trichosanthes brevibracteata Kundu, *J. Bot.* 77: 10 (1939). **Type:** India. Punjab, Karnal, in 1885–1888, *J.R.Drummond 25031* (syn: K); India. Ahmedabad, July 1920, *L.J.Sedgwick s.n.* (syn: K).

Trichosanthes pachyrrhachis Kundu, *J. Bot.* 77: 9 (1939). **Type:** Northwest India, in 1844, *M.P.Edgeworth 63* (holo: K).

Trichosanthes sp. Nitmiluk. (C.R.Mitchell 3293); Australian Plant Census (CHAH 2005); Australian Plant Name Index, http://www.anbg.gov.au/cgi-bin/apni. Accessed February 2010.

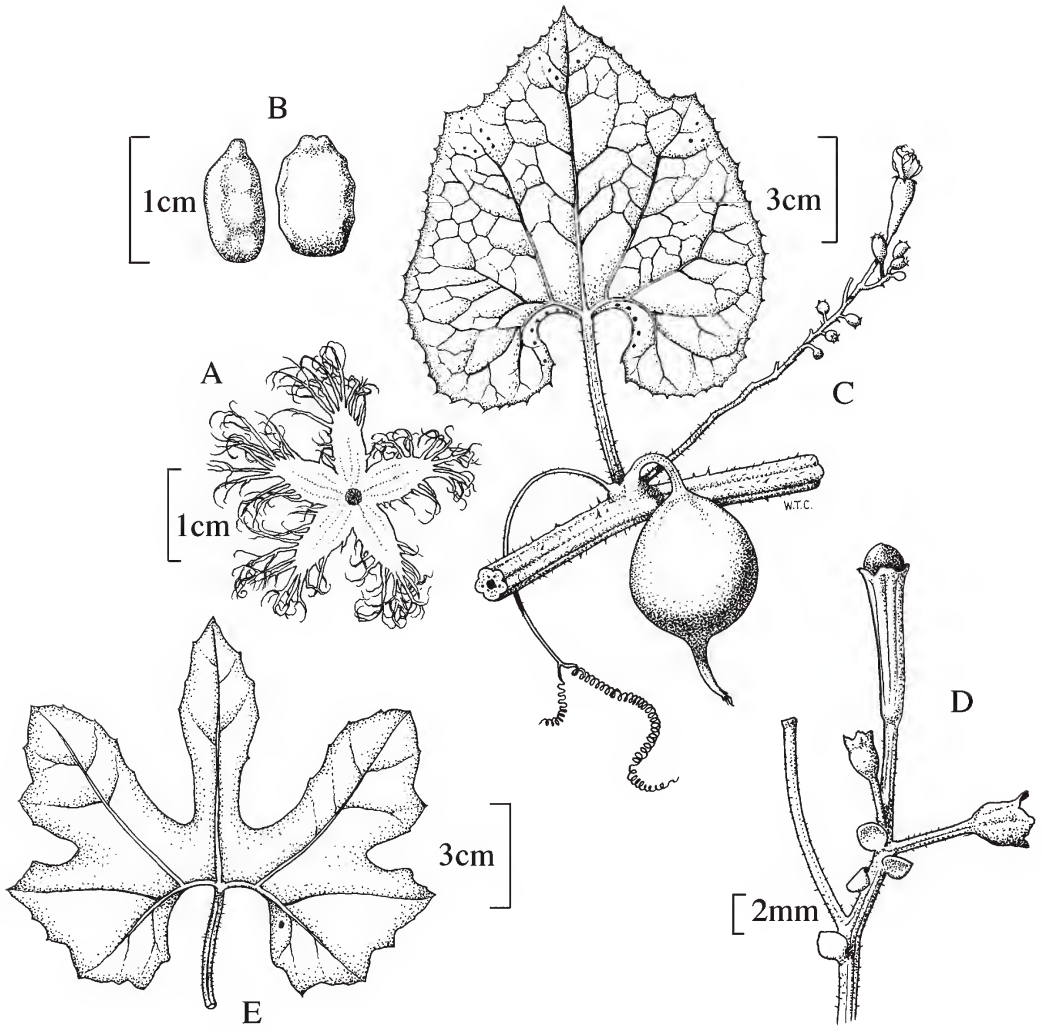

Fig. 3. ***Trichosanthes cucumerina*** var. ***cucumerina***. A. male flower. B. seeds. C. unlobed leaf underside showing glands, male inflorescence with bracts, fruit and tendril. D. male inflorescence, buds and broadly ovate and orbicular cupular bracts. E. leaf underside with deeply lobed margin and solitary gland. A–C from *Cooper 2119* (CNS); D–E from *Fox 2513* (DNA) (scales as indicated). Del. W.T. Cooper.

Trichosanthes sp. Fine Leaf (L.A.Craven 7930), Australian Plant Census (CHAH 2005); Kerrigan & Albrecht (2007); Australian Plant Name Index, http://www.anbg.gov.au/cgi-bin/apni. Accessed February 2010.

***Illustrations*:** Yueh & Cheng (1974: pl.82); Telford (1982: 197); Wheeler (1992: 254); Rugayah & de Wilde (1999: 231); Hyland *et al.* (2003); Duyfjes & Pruesapan (2004: 81).

Monoecious slender trailing vine to 2 m. **Stem** diameter 1–2 mm, 5-ribbed, pubescent (trichomes may be sparse); trichomes short glandular and eglandular and mostly interspersed with scattered long eglandular trichomes, denser at nodes or sometimes only at nodes; cystoliths rarely present. **Probracts** absent. **Tendrils** 2 or 3-branched, sparse glandular or eglandular trichomes towards base. **Leaves** simple, discolorous, membranous; petioles 8–57 mm long, sparse to dense short glandular and eglandular trichomes, mostly with scattered longer trichomes, rarely with a few discoid cystoliths; lamina cordate, ovate,

broad-ovate or reniform, 23–145 mm long, 25–135 mm wide; unlobed, or shallowly to deeply 3–7-lobed, rarely 10-lobed, lobe divisions up to *c.* 95% of lamina length; central lobes oblong, elliptical, obovate or spathulate; lateral lobes ovate, triangular, oblong, asymmetrical, spathulate; base cordate and shortly cuneate or truncate, sinus often shallow and wide; apex acute, acuminate or obtuse, with a soft mucro; margin undulate, denticulate, dentate or serrate, 4–40 teeth or soft mucros along each side; membranous; upperside pubescent, hirsute or scabrous, trichomes short eglandular and/or glandular, sometimes restricted to main veins, and mostly with scattered long eglandular trichomes often restricted to near the margin, rarely with a few scattered discoid cystoliths; underside pubescent, hirsute or scabrous, trichomes short glandular and/or eglandular, often with longer scattered eglandular trichomes usually on veins or close to margin; glands at leaf base 1–8 per side, some scattered glands may be present, gland diameter 0.2–0.3 mm; rarely with a few scattered discoid cystoliths. **Male inflorescences** racemose or solitary (rarely a panicle), usually arising well after co-axillary female; raceme 70–240 mm long, 4–21-flowered, rachis with sparse to dense, short glandular and eglandular trichomes as well as long eglandular trichomes, peduncle 25–180 mm long; bracts persistent at base of pedicels and often at base of peduncle, ovate, broadly ovate, orbicular, triangular, narrowly triangular, reniform, obovate, oblong, elliptical, rhombic or linear, often cupular, 0.25–3 mm long, 0.25–2.5 mm wide, base truncate or cuneate, apex obtuse, acute or rarely obcordate, entire, crenate, unlobed or with 3–5 shallow lobes, mostly orange-brown or pinkish-brown in herbarium specimens (linear bracts remain green), glabrous or trichomes sparse to dense and usually much sparser than those on the adjoining rachis, glands absent; venation absent, obscure or 3-veined with a midrib and intramarginal veins. **Male flowers:** pedicels 5–45 mm long; receptacle tube slender-funnelform, 7–35 mm long; trichomes glandular and eglandular, sparse to moderately dense; sepals triangular, entire, 0.5–2.5 mm long, 0.25–1 mm wide, green, trichomes sparse to dense; corolla diameter 8–20 mm (not including fimbrillae); petals elliptic-ovate, 9–10 mm long (not including numerous fimbrillae), *c.* 4 mm wide, white, pubescent abaxially and adaxially; anthers *c.* 2 mm long; filaments *c.* 0.8 mm long. **Female flowers:** solitary or paired, co-axillary with male racemes (usually emerging before male inflorescence is fully expanded); pedicels 3–50 mm long, trichomes glandular; receptacle tube, slender-funnelform, 12–50 mm long, trichomes glandular and eglandular, pubescent; sepals triangular or subulate, entire, 1–3 mm long, 0.5–1.5 mm wide, green, pubescent abaxially and adaxially; corolla diameter 9–25 mm (not including fimbrillae), petals ovate, 5–10 mm long, 2–3 mm wide, white, trichomes glandular and sparse; ovary 4–25 mm long, glabrous or trichomes sparse. **Fruit** elongated-globular, fusiform or globose with a beaked apex, 21–50 mm long, 18–25 mm wide, orange or red (unripe fruit is longitudinally streaked dark and pale green), glabrous or glabrescent; pulp meagre, translucent orange or reddish; mesocarp 2–2.5 mm wide; pedicel 3–9 mm long, trichomes sparse, bract from base of male raceme usually persistent at base; exocarp *c.* 0.3 mm wide; seeds 3–12, elliptical or obovoid, 1-locular, margin undulate with 3–5 shallow lobes on each side, 6–10 mm long, 4–7 wide, 3–5 mm thick, testa brown or grey. Germination type unknown. **Fig. 3.**

***Additional selected specimens* (*from 166 examined*): Australia: Western Australia.** Edge of small bay W of Cape Ruthiers, Mar 1993, *Mitchell 2989* (DNA); *c.* 2 km E of Mitchell Falls, Mar 1994, *Mitchell 3368* (CANB); Lacrosse Island at head of Cambridge Gulf, NE Kimberley, Jun 1992, *Kenneally 11327* (CANB); The Dag, Mornington Wildlife Sanctuary, Apr 2005, *Legge 521 et al.* (BRI); West Kimberley, Oscar Range, Brooking Gorge, May 1988, *Sands 4732* (CANB); Dampier Archipelago, Enderby Island, Jul 1980, *Wilson 7268* (CANB); *c.* 135 km S of Port Hedland on Great Northern Highway, Apr 1995, *Mitchell PRP280* (CANB). **Northern Territory.** *c.* 30 km NNE of Jabiru, Mar 1981, *Craven 7930 & Whitebread* (CANB); Kakadu N.P., Mt Brockman, Mar 1995, *Egan 4575* (DNA); 6 km S Mt Gilruth, Arnhem Land, March 1984, *Wightman 1345* (DNA); Deaf Adder Gorge, Feb 1977, *Fox 2513* (DNA); Nitmiluk gully of Nitmiluk Gorge, Apr 2004, *Crase 1311 & Dixon* (DNA); Katherine Gorge, Apr 1972, *Must 973* (DNA); 6 km NE Cape Crawford Hotel, Abner Range, Jan 1989, *Brock 484* (DNA). **Queensland.** Cook District: Lankelly Creek, McIlwraith Range, May 1995, *Hyland 15339* (CNS); Mt White, Coen, Apr 1993, *Hyland 14776* (CNS); Jane Table Hill, Lakefield N.P., Mar 1993,

Fell 2903 & Stanton (BRI); Metal Hills, 4 km NNE of Chillagoe, May 2006, *Wannan 4372* (NSW); Royal Arch N.P., Chillagoe, Feb 1996, *Forster PIF18614 & Ryan* (BRI); Royal Arch Tower, Chillagoe N.P., Apr 2010, *Cooper 2119 & Ford* (CNS).

***Distribution and habitat*:** *Trichosanthes cucumerina* var. *cucumerina* is widely distributed from India, Southern China and Southeast Asia through Malesia to Australia. Within Australia it is widespread in Western Australia from the northern Kimberley south to the Port Hedland area, also in the Northern Territory from Arnhem Land to the Abner Range near McArthur, and in Queensland from Cape York to Chillagoe (**Map 1**). In Queensland it is more restricted with a few isolated collections from Cape York Peninsula and Chillagoe-Mungana Caves N.P., and one collection from Black Mountain near Cooktown within the Wet Tropics bioregion. It has a strong association with sandstone habitats but it also occurs in areas of granite and limestone. It is a climber on rocks, shrubs and trees in open forest, woodland, shrubland (often on sandstone escarpments), monsoon forest, vine thickets, *Allosyncarpia* forest, herblands and grasslands.

***Phenology*:** Flowers have been recorded in January, February, March, April, May, June, July and October; fruit has been recorded in January, February, March, April, May, June, August and October.

***Notes*:** *Trichosanthes cucumerina* var. *cucumerina* is a highly variable species with leaves varying from unlobed to deeply lobed. However, all plants have male bracts up to 3 mm long, flowers that are open during the day, and seeds with undulate margins. It differs from all other Australian *Trichosanthes* by having flowers that open during daylight, and very small male bracts. Male inflorescence bracts are usually persistent through to ripe fruit in Australian populations, whereas in Malesia and China the bracts are absent, subpersistent or caducous (Backer & Bakhuizen van den Brink 1963; Rugayah & de Wilde 1997; de Wilde & Duyfjes 2004, 2010; Duyfjes & Pruesapan 2004; Lu *et al.* 2011). Leaf glands are usually present in Australian populations whereas in Malesia leaf glands are absent or few (de Wilde & Duyfjes 2010). The leaves have a pungent smell like those of *Momordica charantia* L. mixed with peanut butter.

***Etymology*:** After its similarity to the related genus *Cucumis*.

Trichosanthes section **Cucumeroides** (Gaertn.) Kitam., *J. Jap. Bot.* 19: 35 (1943); *Cucumeroides* Gaertn., *Fruct. Sem. Pl.* 2: 485, t. 4, f. 4. (1791). **Type species:** *T. cucumeroides* (Ser.) Maxim. [= *T. pilosa* Lour.]

Dioecious (sometimes monoecious) vines; probract absent; male bracts persistent (caducous or persistent in Thailand, Duyfjes & Pruesapan 2004), relatively short and mostly narrow; flowers nocturnal, petals fimbriate with thread-like margins; fruit pulp yellow or orange (also whitish or pinkish in Asia, de Wilde & Duyfjes 2004); seeds 3-locular, t-shaped, quadrangular and tumid.

***Distribution*:** Approximately 14 species in China, India, SE Asia, Malesia and Australia (one species).

2. Trichosanthes pilosa Lour., *Fl. Cochinch.* 1: 588 (1790). **Type:** Vietnam (holo: lost); Vietnam. Tu Phap, *s.dat.*, *Bon 4019* (neo: P, *fide* de Wilde & Duyfjes [2008: 270]).

Trichosanthes ovigera Blume, *Bijdr. Fl. Ned. Ind.* 15: 934 (1826). **Type:** Indonesia: Java. Mt Salak, *s.dat.*, *C. Blume s.n.* (holo: L130442; iso: L130439).

Trichosanthes chinensis Ser. in DC., *Prodr.* 3: 308 (1828). **Type:** tab. 13 in Cattley, *Ic. Pl. Chinâ* (1821).

Bryonia cucumeroides Ser. in DC., *Prodr.* 3: 308 (1828); *Trichosanthes cucumeroides* (Ser.) Maxim. in Franch. & Sav., *Enum. Pl. Jap.* 1: 172 (1873). **Type:** Japan, *Cucumeroides* Thunb. ex. Gaertn., *Fruct.* 2: 485 (1791).

Trichosanthes horsfieldii Miq., *Fl. Ned. Ind.* 1: 677 (1856). **Type:** Indonesia: Java. Priangan, *s.dat.*, *T.Horsfield s.n.* (holo: BM; iso: K, U).

Trichosanthes hearnii F.Muell. ex Benth., *Fl. Austral.* 3: 315 (1867). **Type:** Australia: Queensland. Rockingham Bay, *s.dat.*, *J.Dallachy s.n.* (syn: K; isosyn: MEL100085).

Trichosanthes himalensis C.B.Clarke in Hook.f., *Fl. Brit. India* 2: 608. (1879). **Type:**

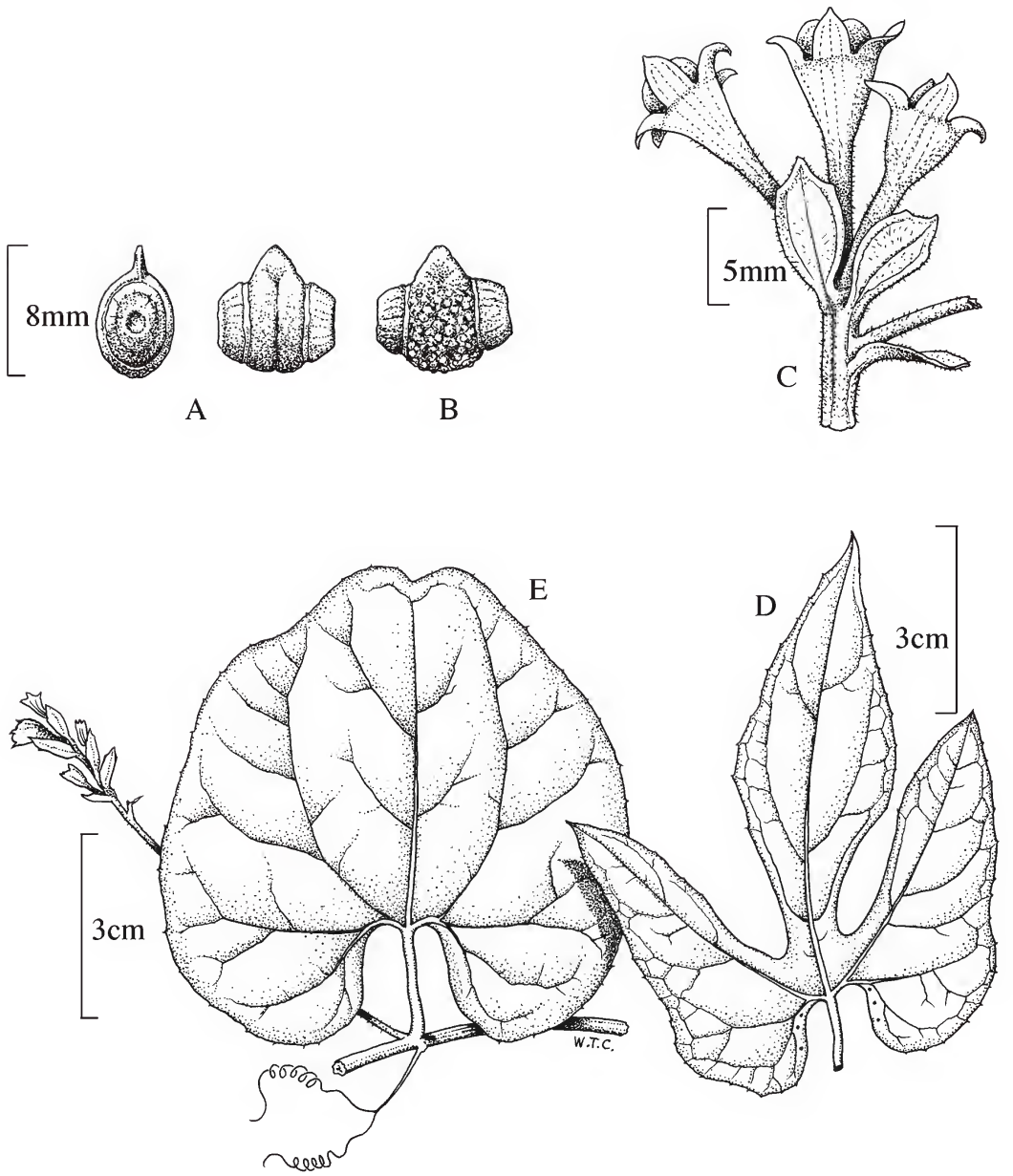

Fig. 4. ***Trichosanthes pilosa***. A. seed: lateral and adaxial view. B. seed: adaxial view. C. male inflorescence with bracts and buds. D. lobed leaf underside showing glands near base. E. unlobed leaf upperside, male inflorescence and tendril. A & E from *Gray 7477* (CNS); B from *Cooper 2120* (CNS); C from *McDonald 8839 & Dennis* (CNS); D from *Cooper 2064* (CNS) (scales as indicated). Del. W.T. Cooper.

India: Sikkim. Yoksun to the plains, *ann. coll. ign.*, *J.D. Hooker s.n.* (syn: K); India. Sikkim, *s.dat.*, *Clarke s.n.* (syn: K).

Trichosanthes dicoelospermum C.B.Clarke in Hook.f., *Fl. Brit. Ind.* 2: 609 (1879); *T. cucumeroides* var. *dicoelosperma* (C.B.Clarke) S.K.Chen, *Bull. Bot. Res.* 5: 118 (1985). **Type:** India: Sikkim. Khasia, *s.dat.*, *J.D.Hooker s.n.* (syn: K); *loc. cit.*, *s.dat.*, *J.D.Hooker & T. Thomson s.n.* (syn: K, UPS).

Trichosanthes holtzei F.Muell. *Aust. J. Pharm.* 1: 447 (1886). **Type:** Australia: Northern Territory. near Port Darwin, *s.dat.*, *M.Holtze 432* (holo: MEL100084), **syn. nov.**

Trichosanthes cavaleriei Lév., *Fl. Kouy-Tcheou* 123 (1914). **Type:** China: Guizhou Province: near Guiyang, *Bodinier 2306*, *Cavalerie 1032*, *1816* (syn: all E).

Trichosanthes vanoverberghii Merr., *Philipp. J. Sci.*, C 9: 458 (1915). **Type:** Philippines. Luzon Province: Bontoc subprovince, Bauco, *s.dat.*, *M.Vanoverbergh 3662 bis* (iso: K).

Trichosanthes baviensis Gagnep., *Bull. Mus. Hist. Nat. Paris* 24: 379 (1918). **Type:** Vietnam. Tu Phap, *s.dat.*, *Bon* [as *Balansa*] *4016* (holo: P).

Trichosanthes pierrei Gagnep., *Bull. Mus. Hist. Nat. Paris* 28: 380 (1918). **Type:** Vietnam. Baria, Mt Lu Dinh, *s.dat.*, *Pierre 4491* (holo: P).

Trichosanthes hainanensis Hayata, *Icon. Pl. Formosan.* 10: 8 (1921); *T. cucumeroides* var. *hainanensis* (Hayata) S.K.Chen, *Bull. Bot. Res.* 5: 117 (1985). **Type:** China. Hainan Province: *s.loc.*, *s.dat.*, *Katsumada s.n.* (holo: TI).

Trichosanthes formosana Hayata, *Icon. Pl. Formosan.* 10: 7 (1921). **Type:** Taiwan. Taipei, Urai, *s.dat.*, *Matsuda 267* (holo: TI).

Trichosanthes matsudai Hayata, *Icon. Pl. Formosan.* 10: 10 (1921). **Type:** Taiwan. Qishan, Kosenpo, *s.dat.*, *Matsuda s.n.* (holo: TI).

Trichosanthes boninensis Nakai ex Tuyama, *Bot. Mag. Tokyo* 50: 133 (1930). **Type:** Japan. Bonin Island, Titizima, *s.dat.*, *Nakai s.n.* (holo: TI).

Trichosanthes chingiana Hand.-Mazz., *Sinensia* 7: 621 (1936). **Type:** China: Guangxi Province: Yema Shan, *s.dat.*, *R.C.Ching 7113* (holo: W).

Trichosanthes rostrata Kitam., *Acta Phytotax. Geobot.* 5: 210 (1936). **Type:** Japan. Ryukyu Islands. Miyagi Island, *s.dat.*, *Koidzumi s.n.* (holo: KYO *n.v.*; iso: US36699).

Trichosanthes cucumeroides var. *stenocarpa* Honda, *Bot. Mag. Tokyo* 54: 223 (1941). **Type:** Japan. Musasi, Urawa, *s.dat.*, *K.Emori s.n.* (holo: TI).

Trichosanthes okamotoi Kitam., *J. Jap. Bot.* 19: 40 (1943). **Type:** Taiwan. Gaoxiong, 'Benchi, Chushinron', *s.dat.*, *Okamoto s.n.* (holo: KYO).

Trichosanthes mafuluensis Merr. & L.M.Perry, *J. Arnold Arbor.* 30: 58 (1949). **Type:** Papua New Guinea: Central Province. Mafulu, 1933, *L.J.Brass 5257* (holo: A; iso: BO, BRI).

Trichosanthes ascendens C.Y.Cheng & C.H.Yueh, *Act. Phytotax. Sin.* 18: 340 (1980). **Type:** China: Guangxi Province: He Xian, *s.dat.*, *C.T. Li 604120* (holo: IBX).

Trichosanthes trichocarpa C.Y.Wu ex C.Y.Cheng & C.H.Yueh, *Acta Phytotax. Sin.* 18: 340 (1980). **Type:** China. Yunnan Province: Baoshan Xian, *s.dat.*, *T.T. Yu 17861* (holo: KUN; iso: A).

***Illustrations*:** Keraudren-Aymonin (1975: 87) as *T. ovigera*; Telford (1982: 197) as *T. ovigera*; Brennan (1986: 26) as *T. cucumerina*; Jones & Gray (1988: 354) as *T. holtzei*; Wheeler (1992: 254) as *T. ovigera*; Rugayah & De Wilde (1999: 231) as *T. ovigera*; Hyland *et al.* (2003) as *T. ovigera*; Duyfjes & Pruesapan (2004: 81) as *T. ovigera*; Cooper & Cooper (2004: 144) as *T. ovigera*; Cooper & Cooper (2004: 144) as *T. holtzei*.

Dioecious or monoecious trailing vine to 6 m, perennial, partly or completely seasonally senescent. **Stem** diameter 1–3 mm, 5-ribbed, glabrous or glabrescent, trichomes glandular and/or eglandular, scattered longer eglandular trichomes may be present; nodes usually slightly swollen, discoid cystoliths may be present at nodes. **Probracts** absent. **Tendrils** unbranched or 2- or 3-branched. **Leaves** simple, discolorous, membranous or chartaceous; petioles 17–85 mm long, eglandular trichomes present, interspersed with sparse glandular trichomes, rarely with a few longer trichomes, discoid cystoliths may be present; lamina cordate, unlobed or shallowly to deeply 3-lobed, 70–200 mm long, 50–155 mm wide, base cordate, usually shortly cuneate, sinus deep and narrow (rarely wide),

apex acute, acuminate, obtuse or retuse, with a soft mucro, margin remotely denticulate, undulate or crenate (mostly almost entire except for a small mucro terminating each vein), 16–28 mucros on each side; upperside pubescent, hirsute or scabrous, sparsely to densely clothed in short eglandular trichomes, rarely with some glandular trichomes near base, sometimes interspersed with longer trichomes which are often only present near margin; underside pubescent, hirsute or scabrous, sparsely to densely covered in short eglandular or glandular trichomes (usually denser on underside), often with a few longer trichomes on main veins especially towards margin; 1–5 glands at leaf base on each side, rarely with scattered glands, gland diameter 0.2–0.9 mm; discoid cystoliths may be present on main veins. **Male inflorescence** racemose or sometimes co-axillary with a solitary flower; raceme up to 200 mm long and up to 11-flowered, rachis densely covered in glandular trichomes, peduncle 15–75 mm long; bracts persistent, lanceolate, ovate, rhomboid, linear, elliptical or obovate, 4–8 mm long, 0.5–3 mm wide, base truncate or cuneate, apex acute or rarely obtuse, margin entire or 3–7-toothed, glabrous or glabrescent, trichomes glandular and eglandular, glands absent, discoid cystoliths may be present, venation pinnate and reticulate. **Male flower:** pedicels 5–35 mm long; receptacle tube salverform or slender-funnelform, 23–24 mm long, clothed in glandular and eglandular trichomes; sepals triangular, subulate or lanceolate, entire or 3-toothed, 4–7 mm long, 1–2 mm wide, green, clothed in glandular and eglandular trichomes; corolla diameter 12–20 mm; petals ovate, 6–8 mm long (not including fimbrillae), white, cream, yellow or greenish-yellow, pubescent. **Female flowers** in racemose inflorescence or solitary (rarely intermixed on a male raceme) on a pedicel 10–30 mm long; racemes 30–70 mm long, 5–10 flowered; bracts present on racemes and similar to those on male inflorescences, trichomes glandular and eglandular. **Female flower:** pedicels 12–16 mm long for solitary flowers, *c.* 5 mm long for flowers in racemose inflorescence, trichomes glandular and eglandular; receptacle tube salverform or slender-funnelform, 18–50 mm long (including ovary), trichomes glandular and eglandular; sepals triangular or subulate, often recurved, 2–9 mm long, 0.5–3.5 mm wide, green, trichomes glandular and eglandular; corolla diameter (not including fimbrillae) 15–17 mm; petals ovate, 8–18 mm long, 4–9 mm wide (not including fimbrillae), white or cream, clothed in glandular and eglandular trichomes; fimbrillae white, yellow or greenish-yellow; ovary 10–16 mm long, trichomes glandular and eglandular. **Fruit** obovoid or oblong-globose, apex acute or obtuse with a short beak, 10-ribbed (ribs sometimes subtle), 31–62 mm long, 31–35 mm wide, orange or red, glabrous or a few glandular trichomes near base; mesocarp 2–2.5 mm wide, orange; pedicel 7–10 mm long; seeds 10–21, t-shaped, subquadrangular, tumid, 3-locular, central cell warty to smooth and containing the embryo, lateral cells cone-shaped and empty, 5–10 mm long, testa brown or blackish, suspended in yellow-orange pulp. Germination is hypogeal or semi-hypogeal, cotyledons straight. **Fig. 4.**

***Additional selected specimens (from 85 examined)*: Western Australia.** Mitchell Plateau, N Kimberley, Feb 1979, *Beard 8436* (PERTH). **Northern Territory.** Gurig N.P., Apr 2006, *Brennan 6919* (DNA); Murgenella, Wunyu Beach, Mar 1987, *Russell-Smith 1967 & Lucas* (DNA); 5 km E mouth of Peter John River, NE Arnhem Land, Feb 1988, *Russell-Smith 4768 & Lucas* (DNA); Rocky Bay, Yirrkala, Mar 1988, *Russell-Smith 5168 & Lucas* (BRI); 1 km SE of Angurugu, Groote Eylandt, Mar 1988, *Russell-Smith 5135 & Lucas* (CANB); 5 km SW Cutta Cutta Caves, Feb 1989, *Russell-Smith 7157 & Lucas* (DNA); Van Dieman Gulf at base of Cape Hotham Peninsula, Mar 1993, *Cowie 3291* (DNA); Gunn Point, Apr 1984, *Dunlop & Wightman 6678* (DNA); Wangi Falls, Litchfield N.P., Dec 2009, *Cooper 2100 & Morris* (CNS). **Queensland.** Cook District: Old Mapoon Road, Jun 2000, *Hyland 16381* (CNS); Iron Range N.P., Mar 1994, *Fell 4118 & Stanton* (BRI); Lake Patricia, Weipa, Mar 1989, *O'Reilly 262* (BRI); Turrell Hill, Macrossan Range, Silver Plains, Jun 1998, *Forster PIF23085 et al.* (BRI); Brooklyn, May 2010, *Cooper 2120 & Russell* (CNS); Barron Gorge, Aug 2001, *Cooper 1569 & Cooper* (CNS); Eight Mile Mt, Mar 1999, *Gray 7477* (CNS); Burke Developmental Road, Royal Arch Tower, Chillagoe N.P., Feb 2010, *Cooper 2102 & Ford* (CNS); Barron Gorge N.P., Apr 2009, *Cooper 2064* (CNS); Kennedy Highway, 300 m N of Herberton turnoff, May 2004, *Cooper 1840 & Cooper* (BRI); N.P.R. 16, Forty Mile Scrub, old road, Mar 1999, *Ford 2193* (CNS); Wind Tunnel Lava Tubes, Undara N.P., Mar 2010, *McDonald 8839 & Dennis* (CNS). South Kennedy District: Carlisle Island, Sep 1986, *Batianoff 5038* (BRI).

***Distribution and habitat*:** *Trichosanthes pilosa* is widely distributed from India through Southern China to Japan, Southeast Asia through Malesia to Australia and the eastern Pacific. Within Australia it is widespread in the Northern Territory and in Queensland it occurs from Cape York south to Carlisle Island (northeast of Mackay) and west to Chillagoe (**Map 2**). There is one specimen from the Mitchell Plateau in the northern Kimberly area of Western Australia. It occurs in a variety of habitats from wet tropical rainforest, monsoon forest and littoral rainforest to deciduous vine thickets at an altitudinal range from near sea level to 1000 m.

***Phenology*:** Flowers have been recorded in February, March, April and June; fruit has been recorded in February, March, April, May, June and August.

***Notes*:** *Trichosanthes holtzei* F.Muell. was described as being reminiscent of *T. anguina* (synonym of *T. cucumerina* var. *anguina*) by Mueller (1886). His description is of a specimen with staminate and pistillate flowers. However, pistillate flowers are not evident on the type specimen today, and even though pistillate flowers may have been present, this feature is not sufficient to distinguish it, as *Trichosanthes pilosa* can at times be monoecious. The inflorescence bracts and leaves on the type specimen are a good match for *Trichosanthes pilosa*, and *T. holtzei* is here synonymised with *T. pilosa*.

A second variety of *Trichosanthes pilosa* was described by de Wilde & Duyfjes (2008) restricted to Thailand. Molecular analyses to date do not support the recognition of varieties in this species (de Boer, unpublished). Only the nominative variety occurs in Australia.

***Etymology*:** The specific epithet *pilosa* is derived from the Greek *pilos* (anything made of felt), presumably referring to the indumentum.

Trichosanthes section **Edulis** Rugayah, *Reinwardtia* 11: 232 (1999). **Type species:** *T. edulis* Rugayah

Dioecious trailing vines or lianas; probract present, caducous; flowers nocturnal, petal margin fimbriate in upper half; fruit pulp red; seeds numerous, 1-locular, flat or quadrangular, toothed or notched.

***Distribution*:** Nine species (New Guinea eight endemic, Australia one endemic).

3. Trichosanthes odontosperma W.E.Cooper & A.J.Ford, *Austrobaileya* 8: 126 (2010). **Type:** Australia: Queensland. Cook District: Topaz, Westcott Road, 15 April 2009, *W.Cooper 2065* (holo: CNS; iso: BRI, CANB, DNA, L, MO, NSW, UPS).

***Illustrations*:** Cooper & Cooper (1994: 291), as *Trichosanthes* sp. (Mt Lewis); Cooper & Cooper (2004: 145), as *Trichosanthes* sp. (Mt Lewis); Hyland *et al.* (2003), as *Trichosanthes* sp. (Mt Lewis BG 167); Jones & Gray (1988: 354 & back cover), as *Trichosanthes* sp.; Williams (1987: 307), as *Trichosanthes* sp.; Cooper & Ford (2010: 128–129).

Dioecious trailing vine or liana to mid-canopy, perennial, partly or completely seasonally senescent. **Stem** diameter to 3 cm, young branchlets 5-angular, glabrescent with minute trichomes clustered at nodes; bark fissured and corky on older growth; nodes often markedly swollen. **Probracts** caducous, linear or narrowly ovate, minutely lobed or with a few teeth, 3–13 mm long, 1–3 mm wide, glandular, glabrous or glabrescent. **Tendrils** unbranched or 2- or 3-branched. **Leaves** simple, discolorous, coriaceous; petioles 20–95 mm long; lamina ovate, cordate or triangular, unlobed or rarely 3-lobed, 50–190 mm long, 41–160 mm wide, base cordate or rarely hastate, sinus mostly narrow and deep, apex acuminate to acute, with or without a soft mucro; margin denticulate with 13–27 teeth per side; upperside smooth, glabrous or with sparse minute translucent trichomes on main veins; numerous small translucent and sunken multicellular (rosette-shaped) cystoliths, which in most dried specimens become black; underside with sparse translucent minute trichomes on main veins, 1–16 circular and flat glands on each side of the leaf base. **Male inflorescences** with flowers mostly solitary, rarely in a fascicle of two flowers or a raceme beside a solitary flower, peduncle 35–110 mm long; bracts at the base of racemose flowers narrowly ovate, glabrous, 5–17 mm long, 1–3 mm wide. **Male flowers:** 45–90 mm

diameter, pedicel 43–83 mm long; receptacle tube salverform, 45–90 mm long, green or creamy-green with a narrow bright yellow centre, glabrous or glabrescent abaxially; sepals usually 5 (rarely 4), triangular, entire or with 1–3 teeth, 8–20 mm long, 2–4 mm wide, green, glabrous or glabrescent; petals 5 (rarely 4), obdeltoid, length including fimbrillae 27–40 mm, 24–40 mm wide, white, both surfaces villous becoming glabrescent towards apex. **Female inflorescences** a solitary flower on pedicels 31–50 mm long, bracts absent. **Female flowers:** 60–73 mm long, 55–65 mm diameter; receptacle tube salverform, 39–55 mm long, green or creamy-green with a narrow bright yellow centre, adaxial surface of tube yellow, glabrous or glabrescent abaxially; sepals 5, triangular, entire, glabrous or glabrescent, 5–12 mm long, 1–2 mm wide, green; petals 5, obdeltoid, 28–31 mm long, white, both surfaces villous; ovary 14–24 mm long, glabrous and 10-ribbed externally. **Fruit** ovoid or ellipsoid, apex beaked, 90–140 mm long, 60–90 mm diameter, glabrous, longitudinally 10-ribbed, orange to red; mesocarp firm, 10–13 mm thick, yellow-orange; pedicel 25–40 mm long (or more, based upon flowering specimens), 4–10 mm wide; seeds numerous, quadrangular, 1-celled, 2-horned at one end, 4-lobed at the other end, both sides with 2 rows of 2–10 teeth, 12–18 mm long, 6.3–7.7 mm wide, 3–4 mm thick, testa brown to blackish, suspended in orange or red pulp. Germination epigeal.

***Distribution and habitat*:** *Trichosanthes odontosperma* is endemic to the rainforests of the Wet Tropics bioregion in north-east Queensland. It occurs from the Windsor Tableland area, west of Cape Tribulation, to the Cardwell Range, west of Tully (detailed notes were given previously in Cooper & Ford [2010]).

***Phenology*:** Flowers have been recorded in all months; fruits have been recorded in January, March, April, June, July, August, October and November.

***Etymology*:** The specific epithet is derived from the Greek, *odonto* (tooth) and *-sperma* (seed) and refers to the toothed seeds, distinguishing it from all other Australian *Trichosanthes*.

Trichosanthes section **Foliobracteola** C.H.Yueh & C.Y.Cheng, *Act. Phytotax. Sin.* 12: 427 (1974). **Type species:** *T. kirilowii* Maxim.

Dioecious vines or lianas; probracts present; male bracts large; flowers nocturnal, petal margin fimbriate in upper half; fruit pulp whitish, cream or greenish-white; seeds 1-locular, flat, margined.

***Distribution*:** 12 species in China, India, SE Asia, Malesia and Australia (one species).

4. Trichosanthes subvelutina F.Muell. ex Cogn., *Monogr. Phan. [A.DC. & C.DC.]* 3: 366 (1881). **Type:** Australia: Queensland. Moreton District: Moreton Bay, Archers Brush, [November 1843], *L.Leichhardt 4* (lecto [here designated]: P731577, photo!); isolecto: P731576, photo!; MEL100124, photo!; MEL100125, photo!).

***Illustrations*:** Telford (1982: 197); Harden (1990: 448); Nicholson & Nicholson (2004: 65); Harden *et al.* (2007: cover, 95, 96).

Dioecious trailing vines or lianas to 8 m, sometimes extending into the canopy, perennial, seasonally senescent. **Stem** diameter to 15 mm, ribbed with vertical lenticels, bark shallowly corky on older stems; young stems glabrous and 5-angular, diameter *c.* 3 mm, clothed in rusty trichomes, discoid cystoliths may be present, nodes swollen. **Probracts** persistent, ovate, quadrate or triangular, entire or apex 3-toothed, 1–5 mm long, 1–4 mm wide, sparsely to densely pubescent, often glandular. **Tendrils** 2–7-branched. **Leaves** simple, discolorous, membranous; petioles 22–110 mm long; trichomes translucent white, fawn or pale rusty eglandular; discoid cystoliths may be present; lamina cordate or broadly ovate, 3–5-lobed (rarely 7-lobed), lobes shallow to deep, 85–260 mm long, 60–220 mm wide; base cordate, shortly cuneate or truncate, sinus deep and narrow or wide and shallow; apex acute, acuminate or obtuse, usually with a soft mucro; margin denticulate, undulate or almost entire except for a short soft mucro terminating each vein, 22–37 mucros per side; upperside pubescent (sometimes scabrous) with translucent white or fawn eglandular trichomes, may be interspersed

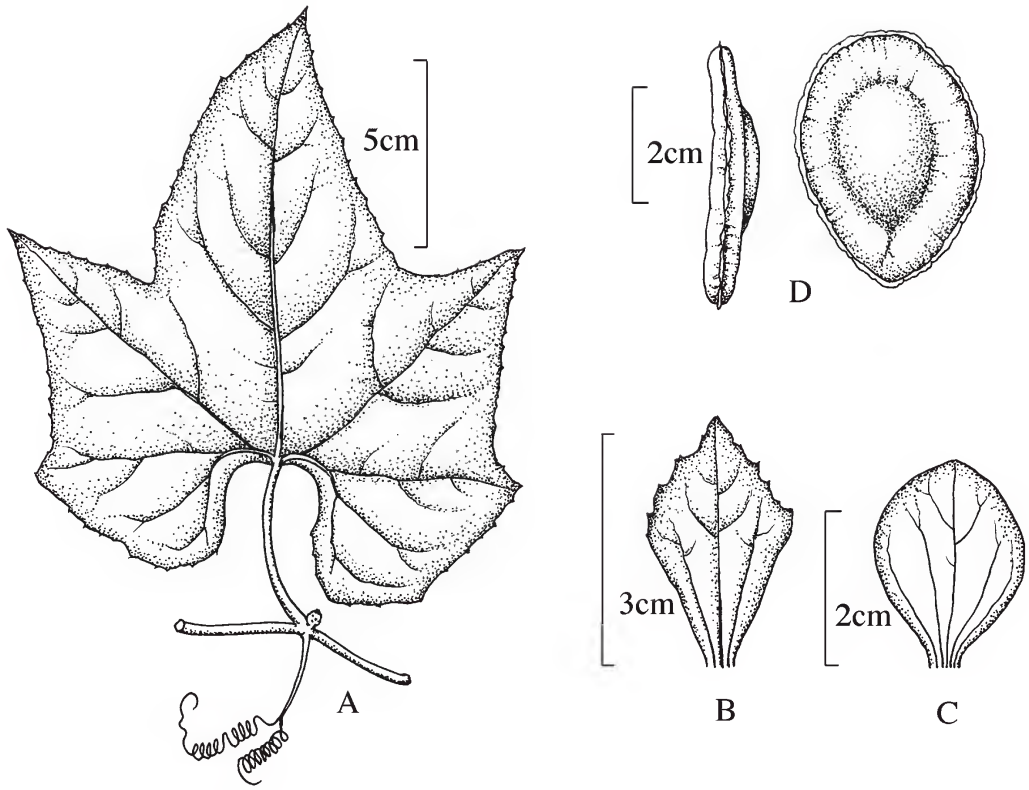

Fig. 5. . ***Trichosanthes subvelutina***. A. leaf, probract and tendril. B. rhomboid bract. C. broad-elliptic bract. D. seeds: left, lateral view; right, adaxial view. A & D from *Nicholson 3110* (BRI); B from *Boorman s.n.* (NSW146961); C from *Telford 9723* (CANB) (scales as indicated). Del. W.T. Cooper.

with longer trichomes; underside pubescent with translucent white or fawn glandular and eglandular trichomes, glands at leaf base up to 4 per side or absent, gland diameter 0.4–0.5 mm; cystoliths absent. **Male inflorescences** racemose, paired, solitary or a solitary flower co-axillary with a raceme, racemes *c.* 250 mm long with up to 12 flowers; peduncle 75–165 mm long, pubescent; bracts persistent, broad-elliptic, rhomboid or obovate, 15–33 mm long, 7–23 mm wide, apex acute or obtuse, base truncate or cuneate, densely pubescent, some trichomes glandular, margin denticulate or almost entire except for soft mucros, palmately veined, reticulate, glands sparse or absent, gland diameter 0.3–0.5 mm. **Male flowers:** pedicels 35–155 mm long; receptacle tube funnelform or slightly urceolate, 31–45 mm long, green with fawn pubescence abaxially; sepals triangular, entire, 8–11 mm long, 2–3 mm wide, green, pubescent; corolla diameter 30–70 mm; petals obovate or obdeltoid, 18–21 mm long (not including fimbrillae), white, pubescent on both sides. **Female inflorescences** with flowers solitary or paired (one usually much older) on pedicels 18–50 mm long, pubescent. **Female flowers:** receptacle tube tubular, 22–51 mm long, pubescent, trichomes fawn or rusty; sepals triangular, entire, 5–11 mm long, 1–3 mm wide, green, pubescent; corolla diameter (not including fimbrillae) 40–67 mm; petals obovate, *c.* 22 mm long, white, trichomes mostly on veins adaxially, glabrous abaxially; ovary 18–20 mm long, pubescent. **Fruit** ellipsoid, apex beaked, 75–160 mm long, 60–100 mm wide, green with paler irregular stripes, sparsely pubescent; mesocarp firm, *c.* 5 mm wide, whitish; pedicel 40–92 mm long, diameter 3.5–6 mm; seeds numerous

(about 100), broad-ovate or broad-elliptical, 9–12 mm long, 6–9 mm wide, testa cream-coloured, marginate, flesh around seeds white or greenish-white. Germination type unknown. *Silky Cucumber*. **Figs. 2 & 5.**

***Additional selected specimens (from 35 examined)*: Queensland.** North Kennedy District: Gloucester Island, Apr 1994, *Batianoff 9404129 & Figg* (BRI). Wide Bay District: Veteran S.F. [now Gympie N.P.], *c.* 9 km NNE of Gympie, May 1999, *Bean 14829* (BRI); Booloumba Creek area, Feb 2001, *Wright s.n.* (BRI [AQ552068]); Upper Kadanga S.F., 9 km NE of Gallangowan, Oct 2008, *Forster PIF34404 et al.* (BRI); Western Road, Montville, Apr 1959, *Gowlett s.n.* (BRI [AQ310073]). Moreton District: Dunumbar Reserve, London Creek, off McDonalds Road, 2 km NNE of Peachester, Jul 2006, *Forster PIF31757 & Smyrell* (BRI); Geebung, Brisbane, Jan 1977, *Gray s.n.* (BRI [AQ310082]); Daisy Hill S.F., Logan City, Dec 1992, *Thompson LOG75* (BRI); O'Possum Creek, Springfield near Ipswich, Apr 1994, *Bird s.n.* (BRI [AQ627235]); Springbrook Plateau, Purlingbrook Falls, Apr 1984, *Telford 9723* (CANB); Currumbin Creek Road to Tomewin Gap, Jan 1984, *Telford 9103* (CANB); Mt Nathan, Mudgeeraba, May 1963, *Morgan s.n.* (BRI [AQ310080]); Lyrebird Ridge Road, Springbrook, Feb 2004, *Edginton & Halford s.n.* (BRI [AQ763103]); Binna Burra, Feb 2004, *Fechner et al. s.n.* (BRI [AQ578156]). **New South Wales.** Billynudgel, Feb 1913, *Boorman s.n.* (NSW146961); Whian Whian S.F., N of Lismore, Apr 1939, *Joubert s.n.* (NSW146959); 10.2 km along Terania Creek Road from The Channon, Apr 2009, *Nicholson 3110* (BRI); Victoria Park near Rous, S of Alstonville, Nov 1964, *Williams K22* (NSW).

***Distribution and habitat*:** *Trichosanthes subvelutina* is endemic to eastern Australia. Apart from a highly disjunct population on Gloucester Island east of Bowen, it is restricted to southeast Queensland (extant northern limit at Gympie N.P.) south to Rous near Alstonville in northern New South Wales (**Map 2**). It inhabits open or closed canopy *Eucalyptus* forest, disturbed rainforest, rainforest margins and Araucarian vineforest at altitudes from near sea level to 600 m.

***Phenology*:** Flowers have been recorded in January, February, March, April, June, October and November; fruit has been recorded in January, February, March, April and May.

***Typification*:** A diverse range of specimens were cited in the original description of this species. These were widely distributed by Mueller to herbaria in Europe with some (but not all) having what are presumably duplicates retained at MEL. We have selected as lectotype of this name, a fertile collection that is labelled as being from "Archers Brush" and collected by Leichhardt.

Other residual syntypes are as follows – Australia: Queensland. Moreton District: Three Mile Scrub [Ashgrove Avenue, Ashgrove], Burrgan, Moreton Bay, July 1843, *F. Mueller s.n.* (BR6606213, photo!; MEL100126, photo!); Moreton Bay, *s.dat.*, *L.Leichhardt 8* (P731578, photo!); Moreton Bay, Archers Brush, November [?1843], *L.Leichhardt 26* (P731579, photo!); Moreton Bay, Archers Brush, November–December [?1843], *L. Leichhardt s.n.* (P731580, photo!); Moreton Bay, *s.dat.*, *F. Mueller s.n.* (P731573, photo!); Brisbane River, Moreton Bay, *s.dat.*, *F. Mueller s.n.* (P731575, photo!; MEL100128, photo!); New South Wales. Clarence River, 1861, *C.Moore s.n.*, (P731574, photo!).

***Etymology*:** The specific epithet is derived from the Latin *sub-* (almost or somewhat) and *velutinus* (velvety), probably referring to the indumentum.

Trichosanthes section **Involucraria** (Ser.) Wight, *Madras J. Lit. Sci.* 12: 52 (1840); *Involucraria* Ser., *Mém. Soc. Phys. Genève* 3: 27, t. 5 (1827). **Type species:** *Involucraria wallichiana* Ser. [= *Trichosanthes wallichiana* (Ser.) Wight]

Dioecious vines or lianas; probracts persistent; leaves simple or compound; juvenile leaves silvery with dark green veins; male bracts medium or large, glandular; petal margin fimbriate in upper half; fruit red, pulp dark green; seeds 1-locular, flat or slightly swollen, with a narrow margin or not margined.

***Distribution*:** Approximately 50 species in China, India, SE Asia, Malesia (including New Guinea) and Australia (two species).

5. Trichosanthes pentaphylla F.Muell. ex Benth., *Fl. Austral.* 3: 314 (1867). **Type:** Australia: Queensland. North Kennedy District: "Mt Grame" [Mt Graham, west of Rockingham Bay], June 1864, [probably *J.Dallachy s.n.* for F.Mueller] (lecto [here designated]: MEL100120, photo!).

***Illustrations*:** McCubbin (1971: cover, 58–59); Jones & Gray (1988: 354); Cooper & Cooper (1994: cover, 290); Hyland *et al.* (2003); Cooper & Cooper (2004: 145).

Dioecious vine or liana to canopy, perennial, seasonally senescent. **Stem** diameter to 40 mm, bark on older stems slightly flaky, fissured, lenticellate, not ribbed, adventitious roots at nodes when trailing; young branchlets 7-ribbed, diameter 4–6 mm, glabrescent or some trichomes clustered at nodes; nodes slightly swollen; discoid cystoliths present, usually denser at nodes. **Probracts** persistent, ovate, rotund, oblong, rhomboid or broadly elliptic, often cupular, base truncate, apex acute or acuminate; margin entire, crenate or serrate with 1–6 teeth, 2–14 mm long, 1.5–7 mm wide, glands 2–8, glabrous or sparse minute trichomes on both sides; discoid cystoliths may be present. **Tendrils** unbranched or 2– or 3-branched. **Leaves** compound, digitate with 3–5 leaflets (juveniles simple or 3-foliolate, cordate, ovate or elliptical, lobed or unlobed), coriaceous; petioles 15–60 mm long, trichomes sparse and minute, discoid cystoliths may be present; central leaflets sessile or petiolules up to 13 mm long; lamina elliptic, obovate, elliptic-obovate or ovate-elliptic, 45–160 mm long, 18–95 mm wide, base cuneate, rounded or decurrent, apex acute or acuminate with a soft mucro; margin serrate, remotely serrate or undulate; 3–7 teeth, mucros or calluses per side; lateral leaflets sessile or petiolules up to 12 mm long, ovate or oblique-cordate, 50–170 mm long, 22–110 mm wide, lobed or unlobed, base oblique, rounded, cuneate, attenuate or cordate, apex acute or acuminate with a soft mucro; margin serrate, remotely serrate or undulate with 3–13 teeth, mucros or callouses per side; upperside coarsely scabrous, glabrous or with a few minute trichomes along main veins especially near base, numerous small translucent rosette-shaped cystoliths; underside scabrous or smooth, glabrous or with a few translucent trichomes near base, discoid cystoliths on main veins; glands at base absent or up to 3, a few scattered usually present, diameter 0.6–1 mm. **Male inflorescences** with flowers racemose or coaxillary with a solitary flower, racemes 92–180 mm long with 3–14 flowers, rachis thickened and 6-ribbed and with sparse minute trichomes; peduncle 10–85 mm long, 3–5.25 mm wide, 6-ribbed; bracts obovate or rhomboid, 25–40 mm long, 23–33 mm wide, base truncate, apex obtuse or broadly obtuse, margin fimbriate in upper half, venation parallel, reticulation sparse, both sides pubescent, glands scattered, gland diameter 0.5–1 mm. **Male flowers:** pedicels 3–5 mm long; receptacle tube slender-funnelform, 10-angled or 10-ribbed, 38–46 mm long, sparse minute trichomes; sepals subulate or triangular, entire or 5-toothed, 22–38 mm long, 6–8 mm wide, green, 5-veined, trichomes sparse and minute; corolla diameter *c.* 50 mm (not including fimbrillae); petals obdeltoid, 14–25 mm long, 15–20 mm wide, white, pubescent. **Female inflorescences** with flowers solitary or paired (one much older). **Female flowers:** pedicel 10–19 mm long; receptacle tube, salverform, 10-angled or 10-ribbed, 40–47 mm long, glabrous or glabrescent; sepals narrow-triangular, entire, 5-veined, 11–15 mm long, green or yellowish-green, clothed in minute trichomes; corolla diameter 34–40 mm (not including fimbrillae); petals obdeltoid, 14–18 mm long, *c.* 9 mm wide, white, trichomes dense and minute on both sides; stigma green; ovary 13–16 mm long, trichomes sparse and minute; ovules several, in vertical rows, *c.* 1 mm long. **Fruit** globose, ellipsoid, apex beaked, 10-ribbed, 40–75 mm long, 50–65 mm wide, red, glabrous or with a few trichomes at base; mesocarp 11–14 mm wide, orange; pedicel 6–36 mm long, 3–7 mm thick, trichomes sparse, cystoliths absent or few to numerous; seeds several, oblong or elliptical, flat or slightly swollen, base rounded and may be flattened, apex obtuse or acute, seeds 7–15 mm long, 5–8 mm wide, 2–4 mm thick, testa brown, pulp dark green. Germination is hypogeal, cotyledons straight. **Figs. 1 & 6.**

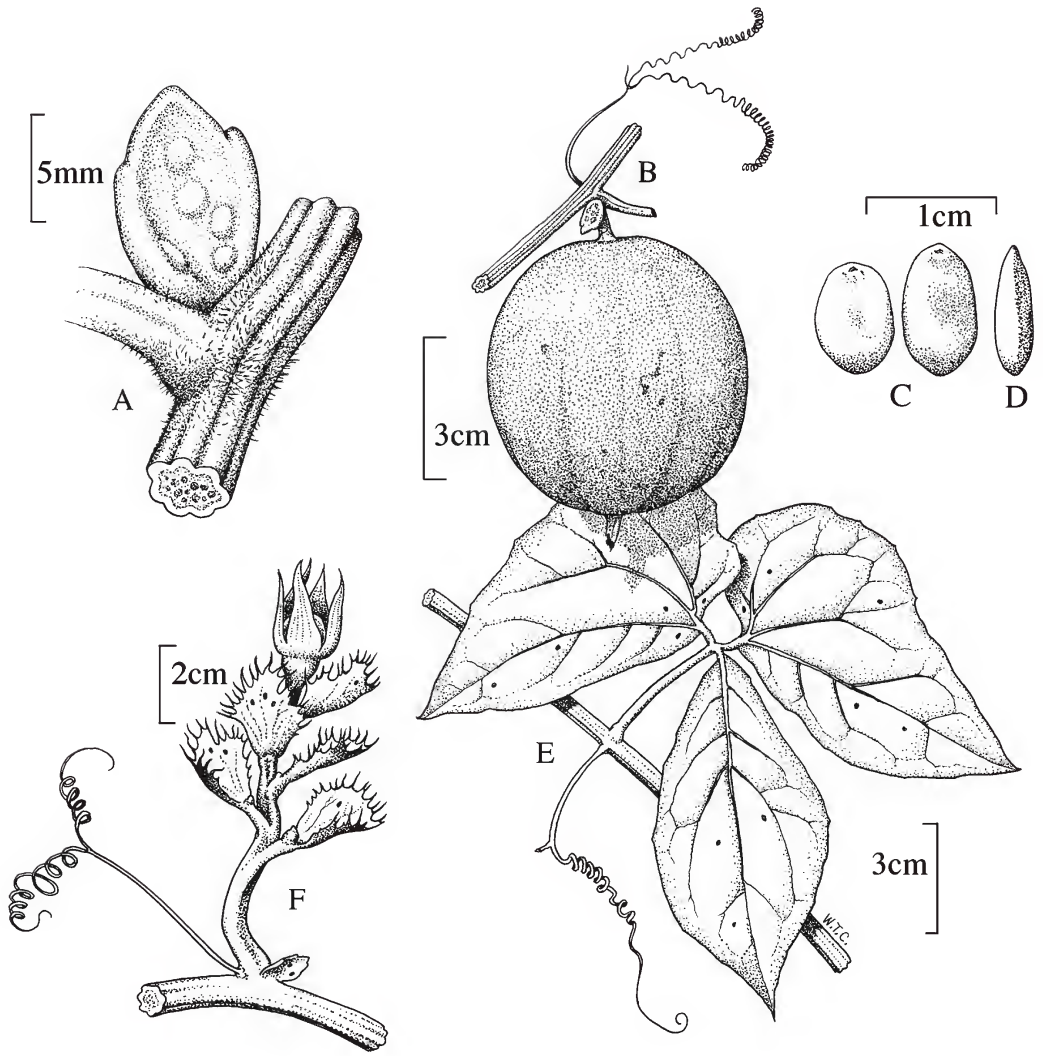

Fig. 6. . ***Trichosanthes pentaphylla***. A. glandular probract at node. B. fruit, probract and tendril. C. adaxial view of seeds. D. lateral view of seed. E. underside of leaf showing veins and glands. F. male inflorescence with glandular bracts and bud. A–D from *Cooper 2124 & Ford* (CNS); E & F from *Cooper 2134 & Jensen* (CNS) (scales as indicated). Del. W.T. Cooper.

***Additional selected specimens (from 59 examined)*: Queensland.** Cook District: 22 km NE of Bamaga, Feb 1994, *Fell 4040 & Stanton* (BRI); Lockerbie Scrub, Feb 1994, *Cooper 814* (CNS); Bamaga, May 1981, *Hyland 21136V* (CNS); Merluna, Oct 1999, *Hyland 16278* (CNS); Mowbray River Road, 3.5 km from highway, Jan 2000, *Gray 7762* (CNS); Oak Beach, May 1974, *Foley 431* (CNS); Kuranda, May 1993, *Cooper 535* (CNS); Kuranda Range Road, May 1976, *Gray 163* (CNS); Bank of Freshwater Creek, Freshwater, Nov 1936, *Hunter s.n.* (CNS [NQNC2541); Aloomba, edge of Mulgrave River, May 1998, *Kitchener 73* (CNS); SFR 310, Mar 1979, *Gray 20088V* (CNS); Royal Arch Tower, Chillagoe NP, Jun 2010, *Cooper 2124 & Ford* (CNS); Royal Arch Tower, Chillagoe NP, Feb 2011, *Cooper 2134 & Jensen* (CNS); Bank of North Johnstone River, Goondi near Innisfail, Mar 1973, *Colman s.n.* (BRI [AQ9203]). North Kennedy: Ingham, Jun 1997, *Waterhouse 4431* (BRI); Townsville, Jun 1936, *Rowse s.n.* (BRI [AQ310052]); Herbert River, Euramo Station, *Dansie s.n.* (CNS [QRS119011]); Ayr, Jan 1980, *McGuire s.n.* (BRI [AQ319650]); Home Hill district, 1964, *Wyatt s.n.* (BRI [AQ310049]).

***Distribution and habitat*:** *Trichosanthes pentaphylla* is known from northeast Queensland between Cape York and Home Hill south of Townsville (**Map 3**). It mostly occurs on riverbanks where it climbs into the canopy and hangs along the forest edge in wet lowland rainforest. It also occurs in the Chillagoe–Mungana Caves N.P. at Chillagoe where the habitat is deciduous vine thicket on limestone.

***Phenology*:** Flowers have been recorded in January, February, March, April and May; fruit has been recorded in January, February, March, April, May, June and December.

***Typification*:** A diverse range of specimens were cited in the original description of this species. These were widely distributed by Mueller to herbaria in Europe with some (but not all) having what are presumably duplicates retained at MEL. We have selected as lectotype of this name, a fertile collection that is labelled as being from "Mt Grame" and collected in June 1864, presumably by Dallachy.

Other residual syntypes are as follows – Australia: Queensland. North Kennedy District: Rockingham Bay, *s.dat.*, [probably *J.Dallachy s.n.* for F.Mueller] (BR6605889, photo!; K, photo!); Burdekin River, *s.dat.*, [probably *J.Dallachy s.n.* for F.Mueller] (MEL100121; K742661, photo!); Burdekin, *s.dat.*, [probably *J.Dallachy s.n.* for F. Mueller] (K, photo!).

***Notes*:** *Trichosanthes pentaphylla* specimens from the Chillagoe area are rather variable and could represent a new subspecies. However, DNA analysis has not confirmed this (de Boer & Cooper, unpublished). One collection with male inflorescences is typical of specimens from the lowland rainforests, with a thickened rachis; bracts obovate or rhomboid, margin fimbriate in upper half and sparse reticulation. A second specimen (*Cooper 2101 & Ford*) from the same vicinity has a slender rachis, bracts broadly ovate or reniform, with an acute or acuminate apex, margin denticulate not fimbriate, reticulate venation and female receptacle tube deeply ribbed. The morphology of this particular specimen has not been included in the general description.

***Affinities*:** Telford (1982) suggested that *Trichosanthes pentaphylla* may be conspecific with *T. trifolia* (L.) Merr. (syn. *T. wawrae*). However, *Trichosanthes wawrae* has narrowly ovate probracts, 3–5 × 1.5–3 mm; suborbicular juvenile leaves; adult leaves finely scabrous above, margin entire or minutely sparsely dentate, central leaflet base long-cuneate; male raceme not thickened; bracts obovate or oblong, 7–25 × 4–12 mm; sepals 4–6 mm long; fruit pedicel 2–3 mm thick. *T. pentaphylla* has probracts ovate, rotund, oblong, rhomboid or broadly elliptic, 2–14 mm long, 1.5–7 mm wide; juvenile leaves cordate, ovate or elliptical; adult leaves coarsely scabrous above, margin serrate, remotely serrate or undulate; central leaflet base cuneate, rounded or decurrent; male raceme thickened; bracts obovate or rhomboid, 25–40 mm long, 23–33 mm wide; sepals 22–38 mm long; fruit pedicel 3–7 mm thick.

***Etymology*:** The specific epithet is derived from the Greek *penta-* (five) and *-phyllus* (-leaved) referring to the digitate compound leaves, which often have 5 leaflets.

6. *Trichosanthes morrisii* W.E.Cooper **species nova** a *Trichosanthi pentaphyllae* similis, foliis simplicibus et sepalis margine laciniato differt. **Type:** Australia: Northern Territory. Kakadu National Park, near Gubara Saddle, 28 December 2010, *W.E.Cooper 2128, I.Morris & R.Dempster* (holo: CNS [2 sheets + spirit], iso: 8 sheets to be distributed to BR, BRI, CANB, DNA, L, MO, P, UPS).

Trichosanthes sp. (D55403); Liddle *et al.* (1994).

Trichosanthes sp. Kakadu (C.R. Dunlop 6639), Australian Plant Census (CHAH 2005); Australian Plant Names Index, http://www.anbg.gov.au/cgi-bin/apni Accessed February 2010.

Dioecious trailing vine or liana to about *c.* 6 m, perennial, seasonally senescent. **Stem diameter** to 20 mm, cream with numerous black warts; young branchlets 7-ribbed with cystoliths near nodes. **Probracts** persistent, broadly elliptical, obovate or oblong; apex acute or acuminate; margin denticulate, crenate or serrate with 5–7 teeth, base

truncate or cuneate, 5–10 mm long, 2–4 mm wide, adaxial surface with 4–7 glands, sparse trichomes on both sides, cystoliths may be present abaxially. **Tendrils** 2–4-branched. **Leaves** simple, discolorous, membranous; petioles 22–60 mm long, sparsely hairy, discoid cystoliths present, sparse minute trichomes may be present; lamina cordate, 3–5-lobed (juveniles cordate-deltoid, unlobed or remotely 3-lobed), 80–170 mm long, 68–160 mm wide, base truncate, cuneate or cordate, sinus deep and narrow or wide (juveniles with shallow and wide sinuses), apex acute or acuminate, usually with a soft mucro; margin remotely denticulate with 17–24 mucros or teeth per side; upperside scabrous, trichomes may be present on midrib and main lateral veins; cystoliths numerous, multicellular, rosette-shaped, diameter 0.3–1 mm; underside glabrous or a few trichomes may be present near base; glands sparse near base and towards apex, gland diameter 0.5–1.25 mm; cystoliths discoid, sparse, scattered along main veins. **Male inflorescences** with flowers (from mature buds) racemose, usually beside a solitary flower, racemes 140–240 mm long, up to 11-flowered, peduncle 95–105 mm long, rachis slender, trichomes sparse, discoid cystoliths present; bracts persistent, rhomboid or ovate, unlobed or shallowly lobed, 27–34 mm long, 17–24 mm wide, base attenuate, cuneate or decurrent, apex acuminate; margin denticulate, laciniate or fimbriate in upper half only (entire in lower half); venation palmate-pinnate, reticulation dense, both sides with sparse minute trichomes denser near margin towards apex, rarely with glands, gland diameter *c.* 0.5 mm; aberrant leaf-like bracts may be present towards base of inflorescence, ovate-cordate, 3-lobed, 26–57 mm long, 18–63 mm wide, base short cuneate or decurrent, apex acute or acuminate, margin denticulate, venation palmate-pinnate, 3–5-veined (venation similar to leaves), reticulate, trichomes as in main bracts. **Male flowers:** pedicel on solitary flowers *c.* 40 mm long,

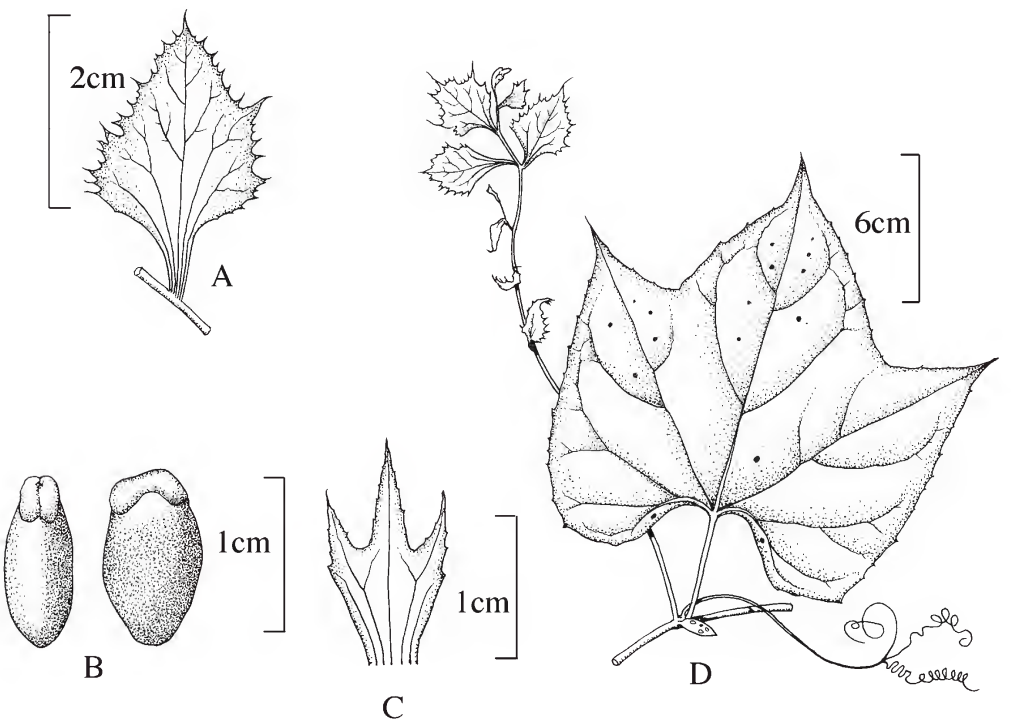

Fig. 7. ***Trichosanthes morrisii***. A. male bract. B. seeds: left, lateral view; right, adaxial view. C. male sepal. D. leaf underside with glands, tendril & male inflorescence. A, C, D from *Cooper 2128, Morris & Dempster* (CNS), B from *Dunlop 6626* (DNA) (scales as indicated). Del. W.T. Cooper.

sepals rhomboid, 3-veined, margin laciniate, hairy, reticulate; petals not seen. **Female flowers:** not seen. **Fruit** globose, apex beaked, 36–55 mm long, 35–60 mm wide, orange to red, probract persistent at base; mesocarp firm, 7–9 mm wide; pedicel up to 18 mm long and 5 mm wide, cystoliths present; seeds several, flat, oblong, both ends obtuse, base slightly bulbous, 11.2–12 mm long, 6.8–7.4 mm wide, 3.7–4.2 mm deep, testa brown, suspended in greenish-black pulp. Germination type unknown. **Fig. 7.**

***Additional selected specimens (from 8 examined)*: Australia: Northern Territory.** Arnhem Land, SE Mt Howship, Feb 1984, *Dunlop 6626* (DNA); Arnhem Land, SE Mt Howship, Feb 1984, *Dunlop 6639* (DNA); Groote Eylandt, Umbakumba, Mar 1988, *Russell-Smith 5099 & Lucas* (DNA); Groote Eylandt, 8 km SW Umbakumba, Jul 1987, *Russell-Smith 2750 & Lucas* (DNA); Groote Eylandt, Jul 1987, *Russell-Smith 2798 & Lucas* (DNA); Mt Brockman Outlier, Apr 1989, *Russell-Smith 8056* (DNA); 1 km east of the Gubara Saddle, Kakadu N.P., Dec 2009, *Cooper 2098 & Morris* (CNS).

***Distribution and habitat*:** *Trichosanthes morrisii* is endemic to the Northern Territory where it is currently known to occur in Kakadu N.P., Arnhem Land and on Groote Eylandt (**Map 3**). It inhabits *Allosyncarpia*-dominated forest in gorges on sandstone escarpments and in riparian evergreen vineforest on coastal dunes. It appears to favour areas with perennial water, which retain some moisture through the drier seasons. Other species it co-occurs with are *Remusatia vivipara* (Roxb.) Schott, *Drynaria quercifolia* (L.) J.Sm., *Calophyllum sil* Lauterb., *Myristica insipida* R.Br., *Tylophora benthamii* Tsiang and *Desmos wardianus* (F.M.Bailey) Jessup.

***Phenology*:** Male inflorescences without fully expanded flowers were collected in December, and flowering probably occurs between December and February; fruit has been collected in February and April.

***Affinities*:** *Trichosanthes morrisii* is closely related to *T. pentaphylla* with similar juvenile leaves and fruit. The former has simple leaves, male bracts which are reticulate with an acuminate apex, attenuate or cuneate base, and lacinate sepals, whereas, *T. pentaphylla* has compound leaves, male bracts are not reticulate and have an obtuse apex, a truncate base and entire sepals (excepting one aberrant collection [*Cooper 2101 & Ford*] in which the bracts are ovate, reticulate and acute).

***Etymology*:** Named for Northern Territory naturalist, Ian Morris (1951–), in honour of his extensive contribution to natural history knowledge.

Acknowledgements

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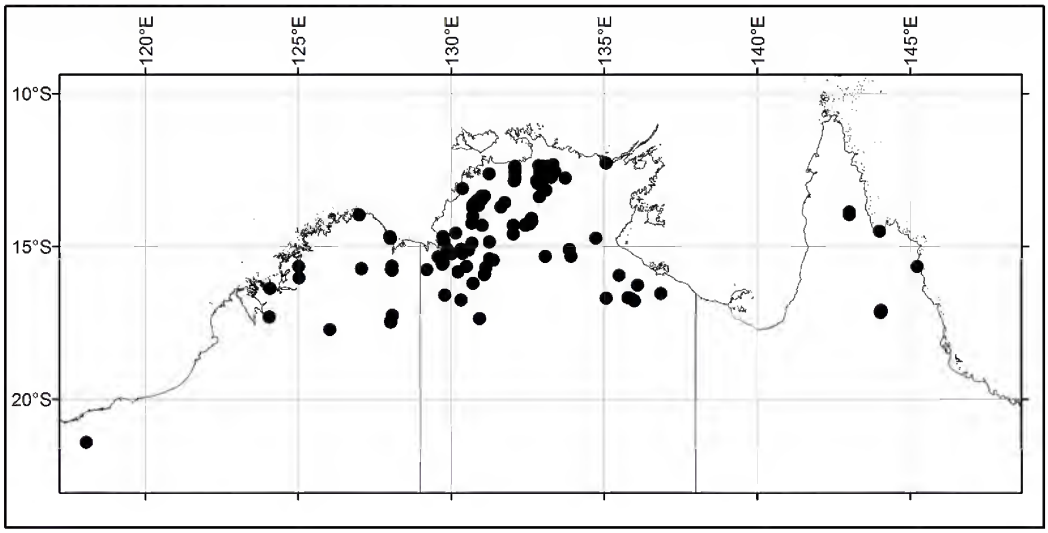
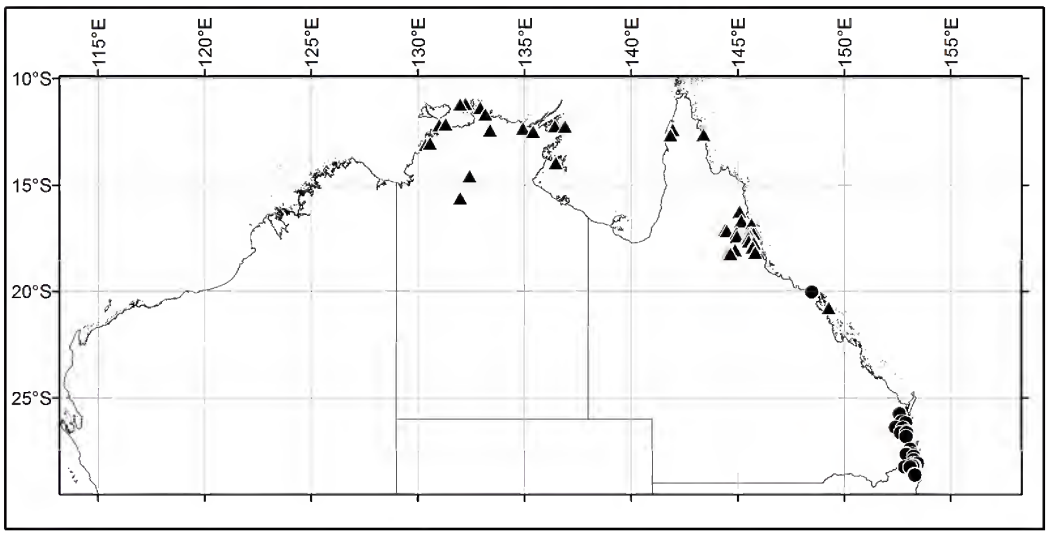
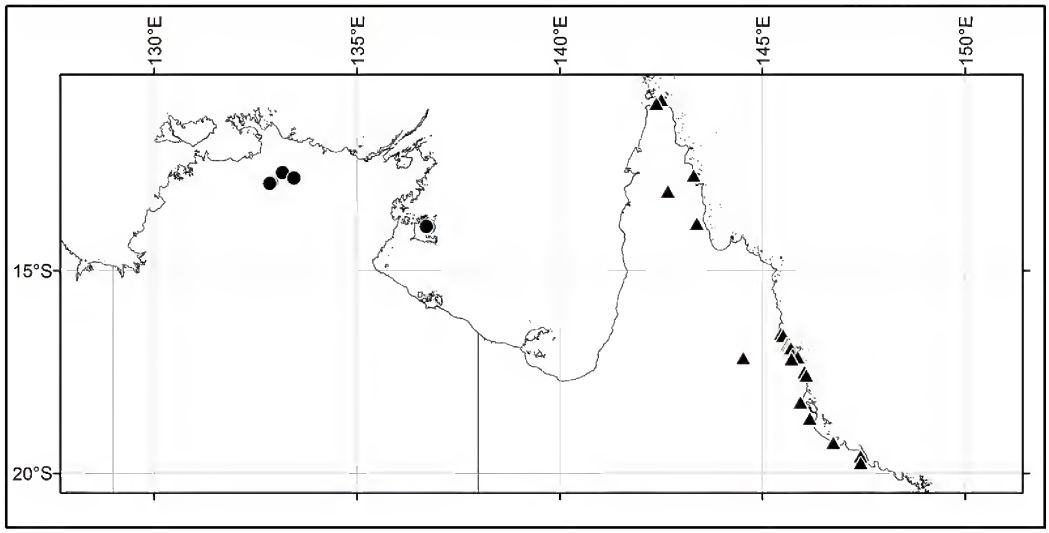


Map 1. Distribution of *Trichosanthes cucumerina* var. *cucumerina* (●) in Australia.



Map 2. Distribution of *Trichosanthes pilosa* (▲) and *T. subvelutina* (●) in Australia.



Map 3. Distribution of *Trichosanthes pentaphylla* (▲) and *T. morrisii* (●).

Five new species of *Plectranthus* L.Hér. (Lamiaceae) from New South Wales and Queensland

Paul I. Forster

Summary

Forster, P.I. (2011). Five new species of *Plectranthus* L.Hér. (Lamiaceae) from New South Wales and Queensland. ***Austrobaileya* 8(3): 387–404.** *Plectranthus caldericola* P.I.Forst. from New South Wales and *P. bellus* P.I.Forst., *P. fragrantissimus* P.I.Forst., *P. insularis* P.I.Forst. and *P. venustus* P.I.Forst. from Queensland are described as new species. All species are illustrated together with notes on their habitat, distribution, affinities and conservation status.

Key Words: Lamiaceae, *Plectranthus*, *Plectranthus bellus*, *Plectranthus caldericola*, *Plectranthus fragrantissimus*, *Plectranthus insularis*, *Plectranthus venustus*, Australia flora, New South Wales flora, Queensland flora, taxonomy, new species, conservation status

P.I. Forster, Queensland Herbarium, Department of Environment & Resource Management, Brisbane Botanic Gardens, Mt Coot-tha Road, Toowong, Queensland 4066, Australia. Email:paul.forster@derm.qld.gov.au

Introduction

The genus *Plectranthus* L.Hér. is highly diverse in Australia with at least 35 described species (Blake 1971; Forster 1992, 1994, 1996, 1997b, 1999, 2008). As noted previously, speciation in the genus has occurred where populations occur in isolated areas such as mountain peaks or ranges and where suitable habitat exists on areas of exposed rock pavements and outcrops. This suite of habitat factors has resulted in the 'islands on islands' effect (Porembski *et al.* 2000) and is widely recognized as being a driving force in genetic diversity and speciation (Carlquist 1974; Grant 1981; Hopper 2000; Seine *et al.* 2000; Kruckeberg 2002). The swift maturation of *Plectranthus* individuals from seed (one growing season) with the potential for rapid generation turnover enables speciation within a given locality if a suitable niche is present and once new genetic changes arise in a population. These changes are perhaps most likely to occur via genetic drift, rather than selection for markedly different growth forms. This has resulted in subtle differences in morphology with a 'non-adaptive radiation' and a 'high lineage diversification rate' (Savolainen & Forest 2005), i.e. there are a lot of similar appearing species in microhabitats that share edaphic and topographic similarities and that are often highly disjunct (Linder 2003).

Accumulation of a number of field collections, together with a critical examination of previously described taxa and herbarium collections, now enable a further five new species to be described, including one long recognized, unnamed species in the group (Forster 2002, 2007a; Bean & Forster 2007, 2010). Two of these species are currently known from single populations, whereas the others are more widely distributed. All of the newly described species occur in rocky areas of pavements and slabs, on a range of geological substrates.

Materials and methods

This work is based on herbarium specimen collections in BRI, CANB (including CBG), CNS (incorporating QRS) and MEL and a large collection of live material that was maintained in Brisbane in the 1990s. All taxa were examined in habitat. Descriptive terminology is similar to that previously used (Forster 1994). Conservation assessments are made using the IUCN (2001) criteria.

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Taxonomy

1. Plectranthus bellus P.I.Forst., **species nova** affinis *P. spectabili* S.T.Blake sed indumento in caulibus et lamina foliorum e trichomatibus glandulosis constanti (in illo absentibus) et eglandulosis divaricatis (adversum antrorsis), dentibus foliorum 10–19 in quoque latere (in illo 7–12) et lobo superiore calycis oblongo-ovato (non lanceolato-ovato) differens. **Typus:** Queensland. Cook District: Daintree National Park, Adeline Creek headwaters, 18 May 1999, *P.I.Forster PIF24610 & R.Booth* (holo: BRI [2 sheets]; iso: MEL).

Erect to decumbent herb or subshrub to 100 cm high; foliage with very faint 'lemon' scent when crushed, clammy; non-glandular and glandular trichomes uncoloured, sessile glands 8-celled and yellow. Roots thickened and tuberous to fibrous. Stems square, erect to straggling, succulent, the lower parts up to 12 mm diameter, pale green, upper parts with persistent indumentum, non-glandular trichomes dense and shaggy, divaricate, 6–16-celled up to 2 mm long, glandular trichomes sparse, sessile glands absent. Leaves discolorous, petiolate; petioles 4–18 × 2.5–3 mm, channelled on top, non-glandular trichomes dense and shaggy, divaricate, 6–16-celled up to 2 mm long, glandular trichomes sparse, sessile glands absent; laminae ovate to broadly ovate, ± succulent, 10–80 × 10–65 mm, crenate with 10–19 teeth up to 2 mm long on each margin, widest above middle, secondary teeth usually present; tip acute to obtuse; base rounded to truncate; upper surface silver-green, velutinous, veins impressed, non-glandular trichomes dense, divaricate, 4–12-celled up to 1 mm long, glandular trichomes absent or scattered to sparse, sessile glands absent; lower surface silver-white (due to the indumentum), velutinous, veins raised, non-glandular trichomes dense and shaggy, divaricate, 6–16-celled up to 2 mm long, glandular trichomes sparse, sessile glands absent. Inflorescence up to 210 mm long, single or with 1–4 side branches, pedunculate for 15–38 mm; axis square in cross-section, non-glandular trichomes dense and shaggy, divaricate, 4–16-celled up to 2 mm long, glandular trichomes sparse, sessile glands absent; bracts broadly ovate, 3–4.2 × 2.8–3 mm, usually forming a tight coma, non-glandular trichomes dense and shaggy, divaricate, 6–10-celled up to 1 mm long, glandular trichomes sparse, sessile glands occasional; cymes sessile; verticillasters 5 or 6-flowered, up to 7 mm apart; pedicels 2–2.5 × *c.* 0.5 mm, non-glandular trichomes dense and shaggy, antrorse to divaricate, 6–12-celled up to 1mm long, glandular trichomes sparse, sessile glands absent. Flower calyces 3–3.5 mm long, non-glandular trichomes dense and shaggy, divaricate, 6–12-celled up to 1 mm long, glandular trichomes sparse, sessile glands absent. Corolla 8–10 mm long, lilac to purple; tube 5–6 mm long, curved at 90–100° 3–4 mm from the base, slightly curved upwards, ± glabrous; upper lobes suborbicular, reflexed, 2–2.2 × 1.2–1.5 mm, non-glandular trichomes occasional to sparse, divaricate, 4–6-celled up to 0.8 mm long, glandular trichomes and sessile glands absent; lateral lobes oblong, 1.8–2 × 1–1.2 mm, glabrous; lower lobe broadly ovate, 4.5–5 × 3.8–4 mm, non-glandular trichomes dense, divaricate, 4–6-celled up to 1 mm long, glandular trichomes sparse, sessile glands absent; filaments filiform, 9–10 × *c.* 0.1 mm, lilac, fused for *c.* 4 mm from the base; anthers 0.6–0.7 × 0.4–0.5 mm; style filiform, 10–11 × *c.* 0.2 mm, lilac, bifid for *c.* 0.3 mm. Fruit calyces 3–4 mm long; upper lobe oblong-ovate, 1.8–2 × 0.8–1 mm; lateral lobes lanceolate-falcate, 2.6–3 × 0.7–0.8 mm; lower lobes lanceolate-falcate, 2.8–3 × 0.3–0.4 mm. Nutlets ± circular in outline, flattened to somewhat convex, 0.7–0.8 mm long, 0.7–0.8 mm wide, 0.4–0.5 mm thick, glossy brown, surface smooth. **Fig. 1–3.**

***Additional specimens examined*:** Cook District: Hann Tableland, track to Radar tower station, May 2006, *Forster PIF31735 & McDonald* (BRI); Hann Tableland N.P., Jul 2004, *McDonald KRM2982 & Bean* (BRI). Cultivated: Tolga (ex plant collected by G. & N. Sankowsky from base of Hann Tableland), Jul 1995, *Forster PIF17166* (BRI); Mt Coot-tha Botanic Gardens (ex plant [collector unknown] from Hann Tableland), Mar 2007, *Forster PIF32451* (BRI).

***Distribution and habitat*:** *Plectranthus bellus* is endemic to north-east Queensland and has been recorded once from the western edge of the Daintree N.P. and at two localities on the Hann Tableland. Sterile plants of what appears to be this species were also

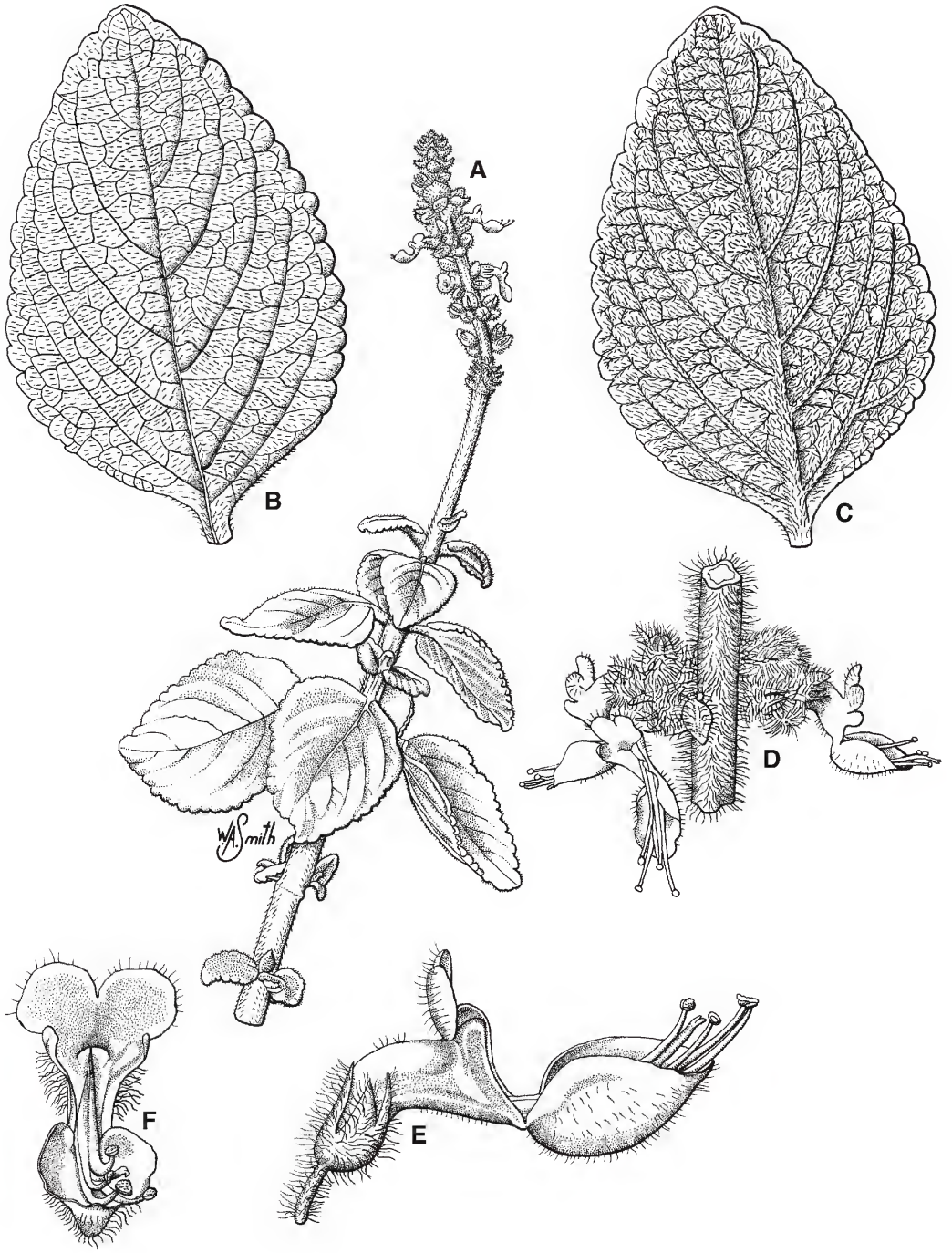


Fig. 1. ***Plectranthus bellus***. A. flowering stem ×0.6. B. abaxial view of leaf ×1. C. adaxial view of leaf ×1. D. portion of inflorescence with two verticillasters, buds and flowers ×2. E. lateral view of flower ×4. F. face view of flower ×4. All from *Forster PIF17166* (BRI). Del. W.Smith.

observed at several additional localities in the foothills of the Hann Tableland in May 2010. *Plectranthus bellus* is invariably found on rock surfaces and crevices on small (30–200 m²) areas of granite pavements that form irregular mosaics ('islands') within a greater area of eucalypt woodlands (**Fig. 2 & 3**). Only scattered perennial shrubs and small annual grasses and forbs are found in association.

***Notes*:** There are some morphological similarities to the much taller growing *Plectranthus spectabilis* (Forster 1996), that has been found close by with at least two populations within 10 km on upland parts of the Hann Tableland. Observed morphological differences between the two species are summarized in **Table 1**; however, the most important differences relate to the overall colour of the plants (due to a combination of epidermis colour and indumentum cover) (**Fig. 3**), together with the form of the flowers. Other species of *Plectranthus* that also occur on the Hann Tableland, but were not observed to be locally sympatric with *P. bellus*, include *P. apreptus* S.T.Blake and *P. mirus* S.T.Blake.

Plectranthus bellus is a quite spectacular appearing plant and has considerable potential in amenity horticulture and landscaping on account of its attractive foliage, upright form and the ability to grow in a range of soil types in cultivation. Clones are self sterile, further adding to its attraction as an amenity plant.

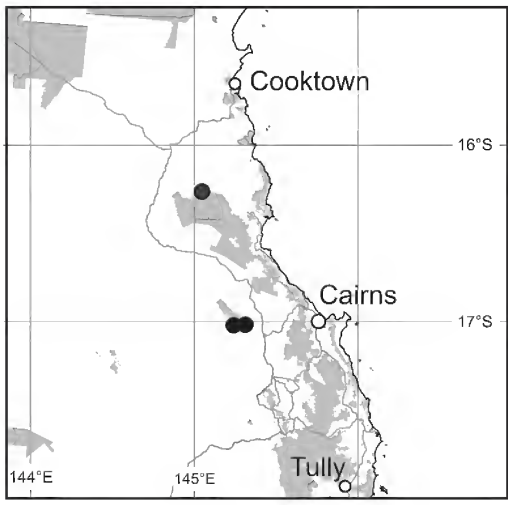
Fig. 2. *Plectranthus bellus*. Habitat at Hann Tableland (population voucher: *Forster PIF31735 & McDonald* [BRI]) Grasses in background are predominantly exotic species. Photo: P.I. Forster

Table 1. A comparison of selected morphological character states for *Plectranthus bellus* and *P. spectabilis*

Character state	*P. bellus*	*P. spectabilis*
life form	perennial, herb or subshrub to 1 m tall	annual or biennial, herb or subshrub to 1.6 m tall
indumentum on stems and leaf laminae	non-glandular trichomes dense and shaggy, divaricate; glandular trichomes generally present	non-glandular trichomes sparse to dense, antrorse; glandular trichomes absent
number of teeth on leaf laminae margins	10–19	7–12
inflorescence	up to 210 mm long with 1–4 branches from near the base; non-glandular trichomes divaricate	up to 320 mm long with 1–11 branches from near the base or further up the axis; non glandular trichomes antrorse
calyx indumentum	divaricate	antrorse
upper lobe of calyx	oblong-ovate, 1.8–2 × 0.8–1 mm	lanceolate-ovate, 2.3–4 × 0.8–1.3

Fig. 3. *Plectranthus bellus*. Habit of individual plant (population voucher: *Forster PIF31735 & McDonald* [BRI]). Photo: P.I. Forster

***Conservation status*:** This species is currently known from at least three populations with a known area of occupancy of less than 5 km². The population in the Daintree N.P. occurs in an area that is more or less pristine with little evidence of weed infestation. The populations at the Hann Tableland are besieged by invasive alien weeds that have been spread widely over the tableland by grazing cattle and uncontrolled wildfires prior to gazettal of the area as National Park. These small islands of granite pavement are under direct and current threat from weeds such as *Andropogon gayanus* Kunth, *Bidens pilosa* L., *Lantana camara* L., *Melinis minutiflora* P.Beauv., *M. repens* (Willd.) Zizka and *Praxelis clematidea* R.M.King & H.Rob. that compete for the scarce resources in these habitats and greatly increase fuel loads both on the pavements and in adjacent vegetation. These *Plectranthus* species are unable to survive hot fires with the plants being killed outright or being forced to resprout from subterranean rootstocks. Due to the shallow soils on these pavements, the heat and scorch from any fires often tends to also kill the rootstocks of *Plectranthus*. The infrequent occurrence of this species on small pavements (<20 m²) (**Fig. 2**) may be regulated by fires that occur not necessarily only on the pavement, but in adjacent grassy vegetation.



Map 1. Distribution of *Plectranthus bellus* in north-east Queensland. Shaded area on map indicates conservation reserves (National Parks, Forest Reserves and Conservation Parks).

The recommended conservation status for *Plectranthus bellus* is Vulnerable (criteria B2,a,b(i,ii,iii,iv,v), D2) based on the IUCN (2001) categories and criteria.

***Etymology*:** The specific epithet is formed from the Latin word *bellus* (beautiful) and alludes to the pleasing form of this plant.

2. Plectranthus caldericola P.I.Forst., **species nova** a *P. graveolenti* R.Br. foliis caulibusque siccis non viscidis leviter citriodoris (in illo humidis viscidis et praeditis odore anti-septico gravi), foliis dentibus paucioribus praeditis (14–18 non 20–42) et apicibus rotundatis (in illo acutis usque ad obtusis), verticillastris 2–14-floris (adversum 12–15) et floribus pedicellis brevioribus praeditis (0.8–1.8 mm non 2–4.5 mm) differt. **Typus:** New South Wales. The Pinnacle, 13 km W of Mt Warning, 6 April 1994, *P.I.Forster PIF15093 & G.Leiper* (holo: BRI [3 sheets ± spirit]; iso: MEL, NSW).

Subshrub to 50 cm high; foliage with faint 'lemon' scent when crushed, not clammy; non-glandular and glandular trichomes uncoloured to silver, sessile glands 8-celled and orange. Roots thickened and tuberous. Stems square, erect to straggling, fleshy, the lower parts up to 15 mm diameter, dark purple, non-glandular trichomes dense and shaggy, divaricate, 6–10-celled up to 3 mm long, glandular trichomes sparse, sessile glands scattered. Leaves discolorous, petiolate; petioles 5–33 × 2–2.5 mm, channelled on top, non-glandular trichomes sparse, divaricate, 6–10-celled up to 3 mm long, glandular trichomes sparse, sessile glands scattered; laminae broadly ovate to almost lobate, fleshy, 10–50 × 10–50 mm, crenate with 7–9 teeth up to 3 mm long on each margin, widest above middle, secondary teeth absent; tip rounded; base truncate, cordate or lobate; upper surface dark-green, veins impressed, non-glandular trichomes sparse, divaricate, 2–8-celled up to 1 mm long, glandular trichomes scattered, sessile glands sparse; lower surface pale-green, veins raised, non-glandular trichomes dense, divaricate, 2–10-celled up to 2 mm long, glandular trichomes sparse, sessile glands dense. Inflorescence up to 320 mm long, comprising 1–5 pedunculate branches from near the base; axis square in cross-section,

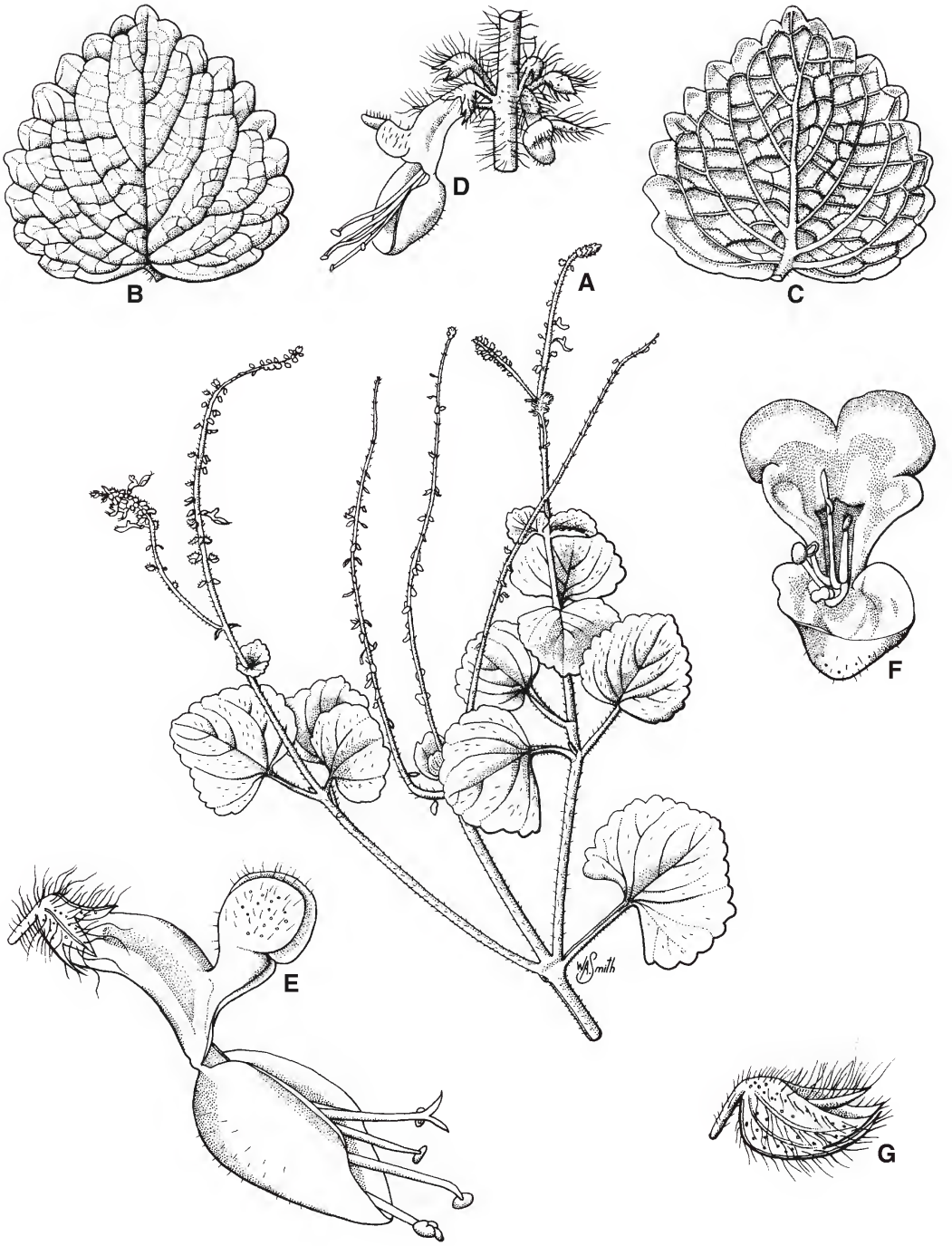


Fig. 4. ***Plectranthus caldericola***. A. flowering stem ×0.4. B. abaxial view of leaf ×1. C. adaxial view of leaf ×1. D. portion of inflorescence with two verticillasters, buds and flower ×3. E. lateral view of flower ×6. F. face view of flower ×6. G. lateral view of fruiting calyx ×6. All from *Forster PIF15093 & Leiper* (BRI). Del. W.Smith.

non-glandular trichomes sparse, divaricate, 6–10-celled up to 5 mm long, glandular trichomes dense, sessile glands scattered; bracts broadly-ovate to obovate, 3–5 × 2.5–4 mm, not forming a coma but approaching one, non-glandular trichomes dense, divaricate, 6–10-celled up to 3 mm long, glandular trichomes absent, sessile glands scattered; cymes sessile; verticillasters 2–14-flowered, 5–15 mm apart; pedicels 0.8–1.8 × *c.* 0.2 mm diameter, non-glandular trichomes dense, divaricate, 6–10-celled up to 2 mm long, glandular trichomes absent, sessile glands scattered. Flower calyces 1.8–2 mm long, non-glandular trichomes dense and shaggy, divaricate, 6–10-celled up to 3 mm long, glandular trichomes absent, sessile glands dense. Corolla 6–9 mm long, dark-purple; tube 3–4 mm long, ± straight or weakly curved at 160–170° 2–2.5 mm from base, slightly inflated upwards, glabrous; upper lobes orbicular, erect, 1–1.8 × 1–2 mm, non-glandular trichomes dense, divaricate, 2–4-celled up to 0.6 mm long, glandular trichomes absent, sessile glands scattered; lateral lobes oblong, 1–1.5 × 0.5–0.6 mm, glabrous; lower lobe ± orbicular, 3–4.5 × 3.5–4.5 mm, non-glandular trichomes sparse, divaricate, 2–4-celled up to 0.3 mm long, glandular trichomes absent, sessile glands scattered; filaments filiform, 7–11 × *c.* 0.2 mm, lilac, fused for 3–4 mm from base; anthers *c.* 0.5 × 0.3 mm; style filiform, 8–9 mm long, lilac, bifid for *c.* 0.8 mm. Fruit calyces 3–3.5 mm long; upper lobe orbicular-ovate, 1.2–1.6 × 1.5–1.7 mm; lateral lobes lanceolate, 1.2–1.5 × 0.9–1 mm; lower lobes lanceolate-falcate, 1.2–1.5 × 0.8–1 mm. Nutlets ± circular in outline, ± flattened, 0.6–0.7 mm long, 0.6–0.7 mm wide and *c.* 0.5 mm thick, glossy brown, surface smooth. **Fig. 4.**

***Additional specimens examined*: New South Wales.** The Pinnacle, Jan 1993, *McDonald s.n.* (BRI, NSW).

***Distribution and habitat*:** *Plectranthus caldericola* is known only from The Pinnacle in the Border Ranges of northern New South Wales. Plants grow on rock outcrops and pavements formed of porphyritic basalts between 920 and 1000 m with a shrubland dominated by *Leptospermum polygalifolium* Salisb. Other species of *Plectranthus* that occur sympatrically are *P. graveolens* and *P. parviflorus* Willd.

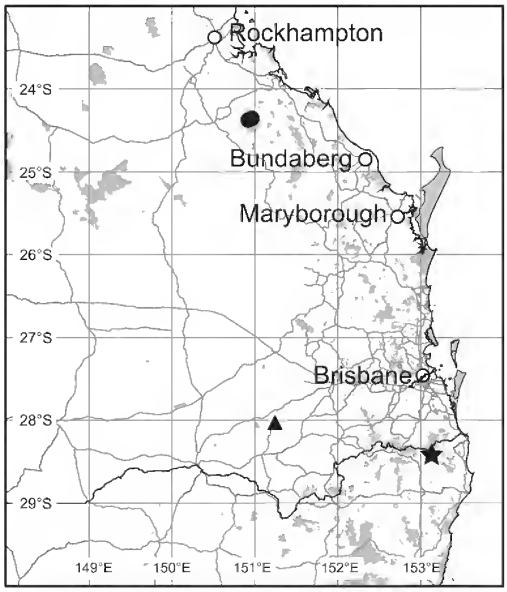
***Notes*:** This species was first brought to my attention by Graham McDonald in April 1994. *Plectranthus caldericola* is distinctive in the very broad leaves that are sometimes almost lobate, the shaggy indumentum on the foliage and the very hairy calyces and very short pedicels. It differs from *Plectranthus graveolens* in the non-clammy foliage with a faint 'lemon' scent (versus clammy with a strong antiseptic or foetid scent), leaves with fewer teeth to the lamina (14–18 versus 20–42) and rounded tips (versus acute to obtuse), the 2–14 flowered verticillasters (versus 12–15) and the flowers with short pedicels (0.8–1.8 mm versus 2–4.5 mm).

The possibility that this species is an example of an allotetraploid derived from an initial hybridization between *Plectranthus graveolens* and *P. parviflorus* needs investigation. *Plectranthus caldericola* is not typical of what one would expect from an F1 hybrid in terms of its morphology and 'wild' hybrids of *Plectranthus* have proven to be rarely encountered (Blake 1971: 29; Forster 1991). Further localities should be sought for this species in adjacent areas and the status of somewhat similar plants (perhaps also from putative hybridization events) at the North Obelisk in New South Wales and Buchanan's Fort in Queensland requires further work.

***Conservation status*:** *Plectranthus caldericola* is presently known only from the type locality where it is a very common plant. Although this locality is within National Park, the plants may be subjected to trampling from bushwalkers and from the occasional wildfire. The recommended conservation coding is Vulnerable based on the criterion D2 (IUCN 2001).

***Etymology*:** The specific epithet is derived from *calderus* (a caldera) and *cola* (loving) and refers to the occurrence of this species on part of the Mt Warning caldera.

3. Plectranthus fragrantissimus P.I.Forst., **species nova** affinis *P. suaveolenti* S.T.Blake, sed lamina foliorum minore angustiore (lanceolato-ovata usque ovata, 10–40 × 6–25 mm non ovata usque late ovata, 30–75 × 20–60 mm), florum pedicellis multo longioribus (4–5.5. mm adversum 1.5–4 mm),



Map 2. Distribution of *Plectranthus caldericola* ★, *P. fragrantissimus* ● and *P. insularis* ▲ in southern Queensland and northern New South Wales. Shaded area on map indicates conservation reserves (National Parks, Forest Reserves and Conservation Parks).

calyce lobis inferioribus lobos laterales plus minusve aequantibus et lobis superioribus ovatis (non subcircularibus) differens. **Typus:** Queensland. Port Curtis District: State Forest 316, Kroombit Tops, 16 February 1995, *P.I.Forster PIF16246* (holo: BRI [2 sheets + spirit]; iso: MEL, NE).

Low growing herb to 30 cm high; foliage with sweetly aromatic scent when crushed, clammy; non-glandular and glandular trichomes uncoloured, sessile glands absent. Roots thickened, fibrous. Stems square, erect to straggling, fleshy, the lower parts up to 4 mm diameter, pink-purple, non-glandular trichomes sparse to dense, retrorse, 2–6-celled up to 0.3 mm long, glandular trichomes absent or scattered to sparse. Leaves discolorous; petioles 2–19 × 1–1.7 mm, channelled on top, non-glandular trichomes dense, retrorse, 2–6-celled up to 0.8 mm long, glandular trichomes sparse; laminae lanceolate-ovate to ovate, fleshy to succulent, 10–40 × 6–25 mm, crenate with 7–14 teeth up to 2 mm long on each margin, widest above middle, secondary teeth sometimes present; tip acute; base cuneate to truncate; upper surface dark-green to silver-green, veins impressed, non-glandular trichomes sparse to dense, antrorse to divaricate, 6–8-celled up to 1 mm long, glandular trichomes sparse to dense; lower surface silver-green, veins raised, non-glandular trichomes dense (particularly on veins), retrorse, 6–8-celled up to 1 mm long, glandular trichomes sparse to dense. Inflorescence up to 230 mm long, usually unbranched (rarely with two side branches); axis square in cross-section, non-glandular trichomes sparse to dense, retrorse, 2–6-celled up to 0.2 mm long, glandular trichomes scattered to sparse; bracts obovate, 1.8–2 × 1.4–2 mm, not forming a coma, non-glandular trichomes sparse to dense, antrorse to divaricate, 2–8-celled up to 0.6 mm long, glandular trichomes sparse; cymes sessile; verticillasters 6–14-flowered, 4–20 mm apart; pedicels 4–5.5 × *c.* 0.2 mm diameter, non-glandular trichomes sparse to dense, antrorse to divaricate, 2–4-celled up to 0.2 mm long, glandular trichomes scattered to sparse. Flower calyces 2.5–3.5 mm long, non-glandular trichomes scattered to sparse, antrorse to divaricate, 2–6-celled up to 0.5 mm long, glandular trichomes sparse to dense. Corolla 9–10 mm long, lilac; tube 5–5.5 mm long, weakly curved at 10–20° *c.* 2 mm from base, slightly inflated upwards, non-glandular trichomes scattered, divaricate to retrorse, 2–4-celled up to 0.2 mm long, glandular trichomes absent; upper lobes suborbicular, erect, 1.8–2 × 1.8–2 mm, non-glandular trichomes scattered to sparse, divaricate, 2–4-celled up to 0.2 mm long, glandular trichomes scattered to sparse; lateral lobes oblong, 1.3–1.8 × 0.6–0.8 mm, glabrous or as in upper lobes; lower lobe oblong-ovate, 4.8–5 × 3.8–4 mm, indumentum as in upper lobes; filaments filiform, 6–8 × *c.* 0.2 mm, lilac, fused for 3–4 mm from base; anthers *c.* 0.4 × 0.3 mm; style filiform, 8–9 mm long, lilac, bifid for *c.* 0.3 mm. Fruit calyces 3.5–4.8 mm long; upper lobe ovate, 1.5–2 × 1.7–2 mm; lateral lobes lanceolate, 1.5–2 × 0.8–0.9 mm; lower lobes lanceolate-falcate, 1.5–2.2 × *c.* 0.5 mm. Nutlets ± circular in outline, ± flattened, 0.7–0.9 mm long, 0.7–0.9 mm wide, 0.4–0.5 mm thick, glossy dark brown, surface smooth. **Fig. 5.**

***Additional specimens examined*: Queensland.** Port Curtis District: S.F. 316 Kroombit Tops, Feb 1995,

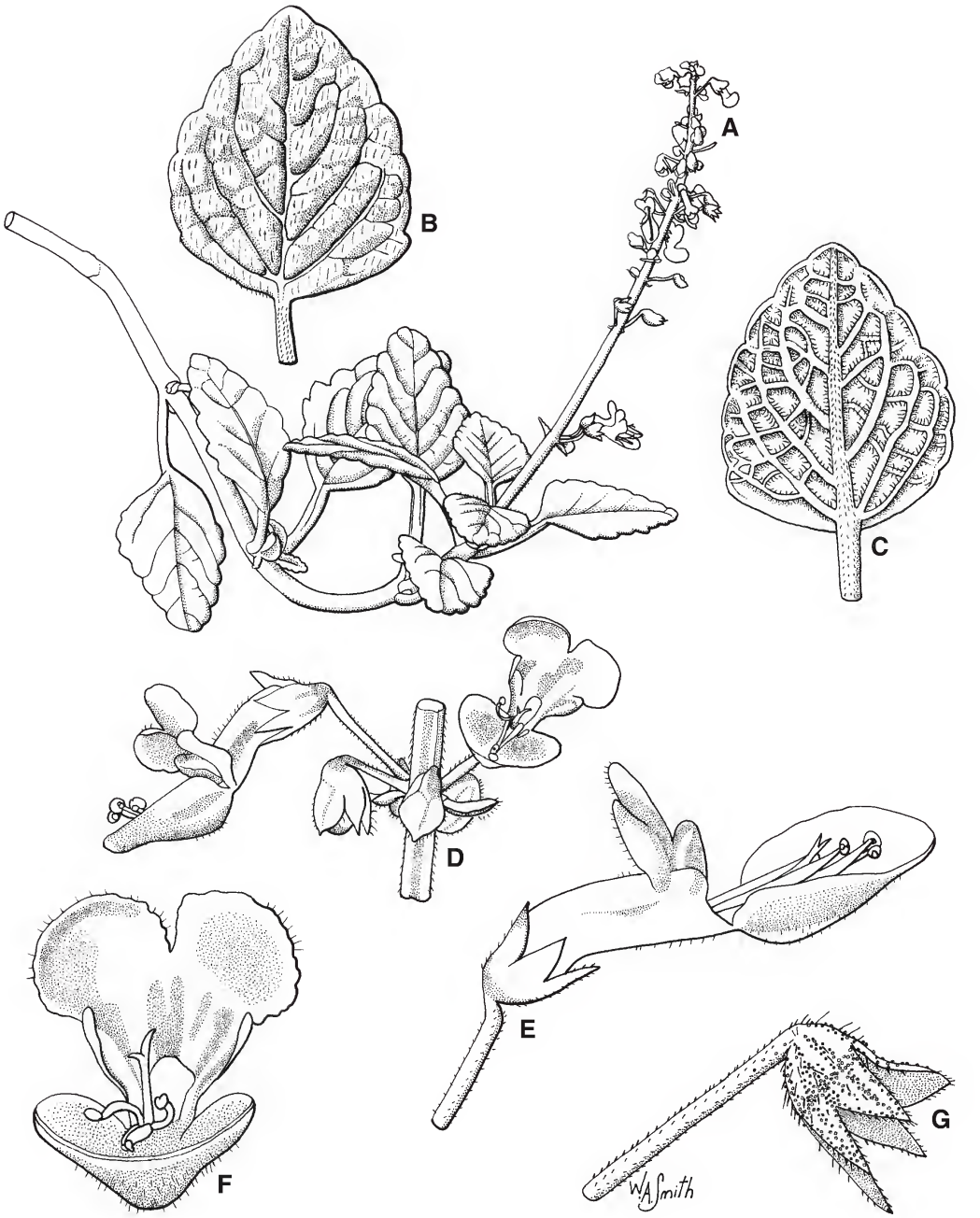


Fig. 5. ***Plectranthus fragrantissimus***. A. flowering stem ×1. B. abaxial view of leaf ×2. C. adaxial view of leaf ×2. D. portion of inflorescence with two verticillasters, buds and flowers ×4. E. lateral view of flower ×6. F. face view of flower ×9. G. pedicel and calyx ×9. All from *Forster PIF29770 & Halford* (BRI). Del. W.Smith.

Forster PIF16252 (BRI, MEL, NSW); *loc. cit.*, Feb 1995, *Forster PIF16254* (BRI); Kroombit Tops F.R., near radio tower, Nov 2003, *Forster PIF29770 & Halford* (BRI, MEL); Kroombit Tops, S.F. 316, Mar 1995, *Thompson BIL156 et al.* (BRI); Kroombit Creek, Kroombit Tops N.P., Feb 2009, *Mathieson MTM307* (BRI); top of range, Tableland Road, Kroombit Tops N.P., Dec 2010, *Mathieson MTM980* (BRI).

***Distribution and habitat*:** *Plectranthus fragrantissimus* is endemic to Kroombit Tops National Park (formerly State Forest or Forest Reserve) where it occurs in a series of locally disjunct populations that may represent subpopulations of one large metapopulation. The plants occur at altitudes between 800 and 900 m on large outcrops or pavements of metamorphosed quartzose sandstone that are scattered within woodland dominated by *Eucalyptus eugenioides* Sieber ex Spreng., *E. longirostrata* (Blakely) L.A.S.Johnson & K.D.Hill and *E. montivaga* A.R.Bean. Typical *Plectranthus parviflorus* is also widespread at Kroombit Tops.

***Notes*:** This species has obvious affinities to *Plectranthus suaveolens*, from which it is disjunct by about 450 km with the most northerly recorded population of that species west of Mt Huntley in the Main Range near the Queensland/New South Wales border. *Plectranthus suaveolens* occurs on granophyre (Mt Barney), trachyte (Mt Ballow), rhyolite (Mt Ernest) or granite (Granite Belt and northern New South Wales), but has not yet been recorded from sandstone. As with *Plectranthus suaveolens* there is an absence of sessile glands on the foliage of *P. fragrantissimus*; however, the two species differ by the latter with smaller, narrower leaf laminae (lanceolate-ovate to ovate, 10–40 × 6–25 mm versus ovate to broadly ovate, 30–75 × 20–60 mm), much longer flower pedicels (4–5.5 mm versus 1.5–4 mm), the calyx with lower lobes much the same length as the lateral lobes (versus much longer) and the ovate upper lobes (versus subcircular).

Plectranthus fragrantissimus is the third angiosperm taxon endemic to the Kroombit Tops tableland, the others being *Bulbophyllum weinthalii* subsp. *striatum* D.L.Jones and *Parsonsia kroombitensis* J.B.Williams. The tableland is also botanically notable for a number of significant species disjunctions (northern limits, indicated *) or for geographically restricted species with a significant proportion of their populations being present there, including **Amperea xiphoclada* (Sieber ex Spreng.) Druce var. *xiphoclada*, *Astrotricha brachyandra* A.R.Bean, *Boronia palasepala* Duretto, **Bossiaea rupicola* A.Cunn. ex Benth., **Bulbine vagans* E.M.Watson, *Bulbophyllum globuliforme* Nicholls, **Callicoma serratifolia* Andrews, **Ceratopetalum apetalum* D.Don, *Chiloglottis sylvestris* D.L.Jones & M.A.Clem., **Lasiopetalum ferrugineum* Sm. var. *ferrugineum*, **Maytenus silvestris* Lander & L.A.S.Johnson, *Myrsine ireneae* subsp. *curvata* Jackes, **Persoonia volcanica* P.H.Weston & L.A.S.Johnson, **Thismia rodwayi* F.Muell., *Triplarina volcanica* subsp. *borealis* A.R.Bean and *Zieria distans* Duretto & P.I.Forst. Consequently Kroombit Tops is often regarded as an important Pleistocene refugial area for both plant communities and species (e.g. Rozefelds & Barnes 2001) and can be considered a cooler upland 'island' analogous with the 'sky island' concept applied elsewhere (Heald 1951; Watling & Donnelly 2006). The small number of endemic plants does not justify it being considered as even a minor centre of endemism (*sensu* Crisp *et al.* 2001); however, when combined with an increasing number of vertebrate and invertebrate animals that are being recognized as endemic to the area (e.g. Ponniah & Hughes 2004), it easily qualifies as such. A logical hypothesis is to regard *Plectranthus fragrantissimus* and *P. suaveolens* as sister taxa originating from an allopatric speciation event following 'stranding' of the lineage on 'sky islands' at Kroombit Tops and the New England Tableland and Border Ranges/Scenic Rim of southern Queensland and adjacent New South Wales.

***Conservation status*:** *Plectranthus fragrantissimus* is abundant at most of its recorded localities; however, the overall area of occurrence and occupancy is very small. The recommended conservation status is Vulnerable based on the criterion D2 (IUCN 2001).

***Etymology*:** The specific epithet is derived from the Latin *fragrans* (fragrant) and *–issima*

(most) and alludes to the sweetly smelling foliage of this plant.

4. Plectranthus insularis P.I.Forst. **species nova** a *P. intraterranea* S.T.Blake lamina foliorum lanceolata, lanceolato-ovata vel oblanceolata (in illo ovata usque late ovata), dentibus foliorum longitudine plus quam 1/3 partes latitudinis laminae ad medianum ejus, et calyce fructificanti majore (5.8–6.5 mm non 3.8–5.5 mm) differt. **Typus:** Queensland. Darling Downs District: Mingimarny State Forest 131, Pine Hill, 20 km S of Millmerran, 28 April 1995, *P.I.Forster PIF16468 & S.J.Figg* (holo: BRI [2 sheets + spirit]; iso: MEL).

Low multistemmed herb to 50 cm high; foliage with faint aromatic scent, not clammy; non-glandular and glandular trichomes clear, sessile glands 8-celled and red. Roots thickened-tuberous, but not 'carrot'-like. Stems square, erect to decumbent, fleshy with the lower parts slightly woody and up to 5 mm diameter, green to pink-purple, non-glandular trichomes dense, retrorse, 2–4-celled up to 0.1 mm long, glandular trichomes absent, sessile glands dense. Leaves discolorous, petiolate; petioles 3–8 × 1–1.8 mm, grooved on top, non-glandular trichomes dense, retrorse, 2–4-celled up to 0.2 mm long, glandular trichomes scattered, sessile glands dense; laminae lanceolate, lanceolate-ovate or oblanceolate, fleshy, 15–60 × 5–28 mm, markedly crenate with 5–8 teeth 1.5–5 mm long on each margin, 2–6 mm wide at base, secondary teeth absent; tip acute; base attenuate; upper surface pale green, veins impressed, non-glandular trichomes sparse, antrorse, 4–8-celled up to 2 mm long, glandular trichomes sparse, sessile glands sparse; lower surface pale green, veins raised, non-glandular trichomes sparse, retrorse, 2–8-celled up to 1 mm long (usually much shorter), glandular trichomes scattered, sessile glands dense. Inflorescence up to 180 mm long, single-stemmed; axis square in cross-section, non-glandular trichomes dense, retrorse, 2–4-celled up to 0.1 mm long, glandular trichomes scattered, sessile glands sparse; cymes sessile; verticillasters 10–12 flowered, up to 22 mm apart; bracts lanceolate-ovate, 2.5–3 × *c.* 1.5 mm, not forming a coma, non-glandular trichomes sparse, antrorse, 2–4-celled to 0.2 mm long, glandular trichomes absent, sessile glands sparse; pedicels 4.5–5 × *c.* 0.3 mm, non-glandular trichomes dense, divaricate, 2-celled up to 0.1 mm long, glandular trichomes dense, sessile glands scattered. Flower calyces 3.5–4 mm long, non-glandular trichomes sparse, divaricate, 2–4-celled up to 0.1 mm long, glandular trichomes absent, sessile glands dense. Corolla 10–11 mm long, purple; tube 2–2.5 mm long, weakly curved at 30–45° 2–2.5 mm from base, barely inflated upwards, glabrous; upper lobes subcircular, reflexed, 2.2–2.5 × 2.2–2.5 mm, non-glandular trichomes sparse, divaricate to retrorse, 2–4-celled up to 0.1 mm long, glandular trichomes absent, sessile glands dense; lateral lobes oblong, 2–2.2 × 0.9–1 mm, glabrous; lower lobe orbicular-ovate, 5–5.5 × 4.5–5.5 mm, non-glandular trichomes scattered, divaricate, 2-celled up to 0.1 mm long, glandular trichomes absent, sessile glands sparse; filaments filiform, 12–13 × *c.* 0.3 mm, lilac, fused for *c.* 4 mm from base; anthers 0.4–0.5 × *c.* 0.3 mm; style filiform, 13–14 × 0.2–0.3 mm, lilac, bifid for *c.* 0.5 mm. Fruit calyces 5.8–6.5 mm long; upper lobe broadly ovate, 2.3–3.1 × 2.2–2.8 mm; lateral lobes lanceolate-falcate, 2.5–3 × 0.5–0.7 mm; lower lobes lanceolate-falcate, 3–3.5 × 0.3–0.5 mm. Nutlets ± circular in outline, convex, 0.8–0.9 mm long, 0.8–0.9 mm wide, *c.* 0.6 mm thick, glossy brown, surface smooth. **Fig. 6.**

***Additional specimens examined*: Queensland.** Darling Downs District: Pine Hill S.F., *c.* 22 km S of Millmerran, Nov 1997, *Grimshaw PG2925 & van Baalen* (BRI); Pine Hill, Mingimarny S.F. 131, 20 km S of Millmerran, May 2000, *Menkins ILM96* (BRI).

***Distribution and habitat*:** *Plectranthus insularis* is currently known only from the type locality in an isolated State Forest south of Millmerran in south-east Queensland where it is the only species of this genus present. This locality is unusual in being an outlier of granite (with pavements and outcrops) supporting low eucalypt woodland or shrubland surrounded by dissimilar geology (mainly heavy clay soils) that used to support brigalow open forest prior to conversion to agricultural land. The granite appears similar to that found near Texas and Stanthorpe; however, the only species of *Plectranthus* found in those areas are *P. graveolens*, *P. parviflorus* and *P. suaveolens*.

Notes*: *Plectranthus insularis is perhaps one of the most distinctive species in the genus in Australia on account of the extreme lobing (in comparison with the overall leaf laminae size) with the marginal teeth commonly up to 5 mm long. Suggested affinities are somewhat difficult to deduce based purely on morphology, but include *Plectranthus parviflorus* (which is closest geographically) and *P. intraterraneus* (which is markedly disjunct with the nearest locality in western Queensland, but perhaps closest on morphological similarity). A comparison of morphological character states for these three species is given in **Table 2** with notable distinctions for *Plectranthus insularis* being the leaf laminae shape, floral bract shape and the length of the fruiting calyx.

Table 2. Comparison of some morphological character states for *Plectranthus insularis*, *P. intraterraneus* and *P. parviflorus*

Character state	*P. insularis*	*P. intraterraneus*	*P. parviflorus*
Habit	Erect to decumbent herb to 50 cm high	Erect subshrub to 1 m high	Erect to decumbent herb to 70 cm high
Root system	thickened tuberous	'carrot' tuberous	distinct tuber at stem base with fibrous roots
Foliage	faintly scented, not clammy	sweetly scented, clammy	faintly scented, not clammy
Lamina shape	lanceolate, lanceolate-ovate or oblanceolate	ovate to broadly ovate	ovate to oblong-ovate; more rarely ± orbicular or truncate-ovate
Leaf teeth	markedly crenate; 5–8 pairs with the teeth length being over 1/3 of the lamina width at its midpoint	crenate to dentate-crenate; 4–9 pairs with the teeth length being less than 1/3 of the lamina width at its midpoint	crenate to dentate-crenate; 4–8 (–12) with the teeth length being less than 1/3 of the lamina width at its midpoint
Marginal teeth length (mm)	1.5–5	1–4	0.8–2 (–4)
Number of flowers per verticillaster	10–12	6–10	6–10
Floral bracts	lanceolate-ovate, 2.5–3 mm long	broadly ovate to circular ovate, 1.2–2.7 mm long	broadly ovate to obovate, 1.1–2.5 mm long
Fruiting calyx length (mm)	5.8–6.5	3.8–5.5	3.7–5.5

***Conservation status*:** State Forest 131 is an isolated pocket of intact vegetation within a much greater area of cleared land. The granite geology of this State Forest is also unique within the context of the local Millmerran area. *Plectranthus insularis* is locally very common on pavement areas within the State Forest, particularly at the western end. The plants have been observed to either die, or shrivel back to the rootstocks during periods of drought.

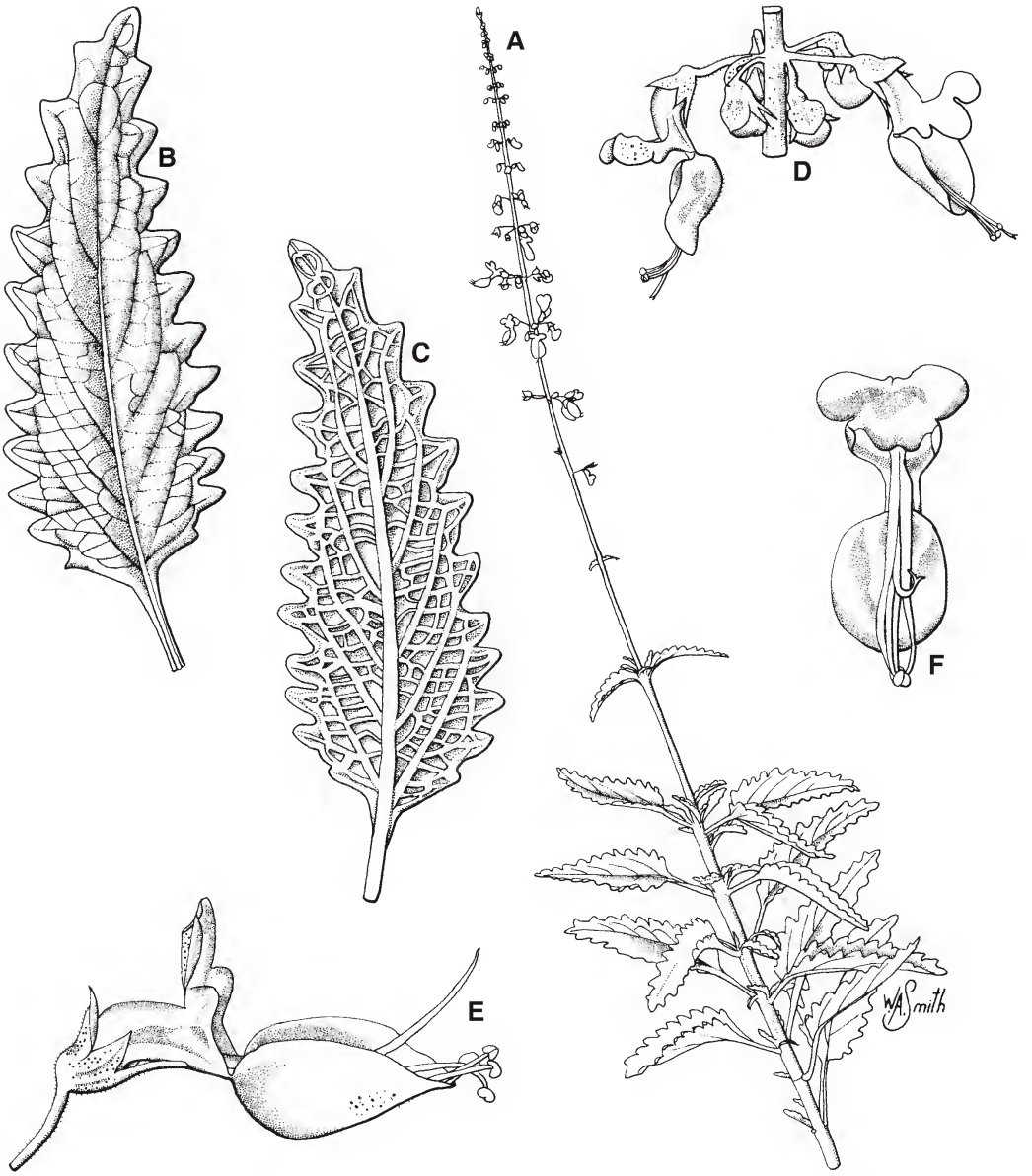


Fig. 6. ***Plectranthus insularis***. A. flowering stem ×0.4. B. abaxial view of leaf ×1.5. C. adaxial view of leaf ×1.5. D. portion of inflorescence with two verticillasters, buds and flowers ×2. E. lateral view of flower ×4. F. face view of flower ×4. All from *Forster PIF16468 & Figg* (BRI). Del. W. Smith.

The recommended conservation status for *Plectranthus insularis* is Vulnerable (criterion D2) based on the IUCN (2001) categories and criteria. This species is known from a single population (or single metapopulation with subpopulations) with a very restricted area of occupancy (<20 km²) that is prone to stochastic events in the short to long term.

***Etymology*:** The specific epithet is derived from the Latin adjective *insularis* (pertaining to islands) and alludes to the occurrence of this species on an island of granite pavement, further surrounded by a 'sea' of cleared land.

5. Plectranthus venustus P.I.Forst., **species nova** affinis *P. gratae* S.T.Blake sed caulibus praeditis trichomatibus antrorsis non-glandularibus (adversum divaricatis), foliis numero dentium marginalium majore (22–33 in latere quoque non 13–15), bracteis inflorescentiae obovatis quae comam format (adversum ovatis et comam non formans) et floris pedicellis multo brevioribus (0.5–1 mm non 2.5–3 mm) differens. **Typus:** Queensland. Cook District: Kennedy Hill Gorge, 21 June 1989, *P.I.Forster PIF5388 & M.C.Tucker* (holo: BRI [1 sheet + spirit]; iso: CNS, MEL).

Plectranthus sp. (Restoration Island J. Le Cussan 285); Forster (1997: 98); Forster (2002: 96); Bean & Forster (2007: 95); Bean & Forster (2010: 90).

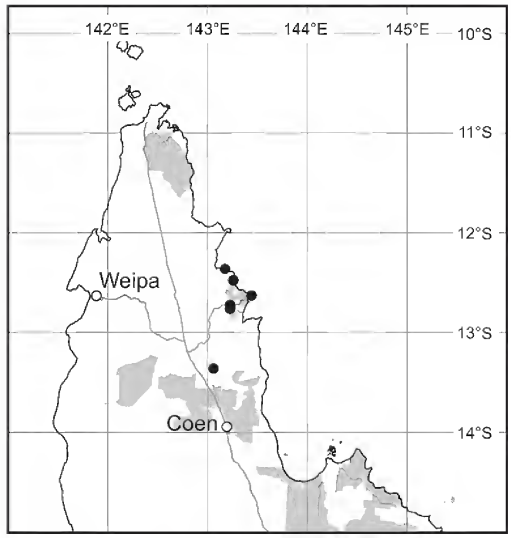
Prostrate to semi-erect herb or subshrub to 40 cm high; foliage with very faint 'lemon' scent when crushed, not clammy; non-glandular and glandular trichomes uncoloured to purplish, sessile glands 8-celled and orange-red. Roots fibrous. Stems square, erect to straggling, succulent, the lower parts up to 10 mm diameter, green to pink, upper parts with indumentum, non-glandular trichomes sparse, retrorse, 6–10-celled up to 1.2 mm long, glandular trichomes absent, sessile glands absent. Leaves discolorous, petiolate; petioles 2–16 × 2.5–4 mm, slightly channelled on top, non-glandular trichomes dense, divaricate, 6–12-celled up to 1.5 mm long, glandular trichomes absent, sessile glands scattered to dense; laminae lanceolate to narrow-ovate, ± succulent, 26–90 × 14–50 mm, crenate with 22–33 teeth up to 1 mm long on each margin, widest above middle, secondary teeth usually present; tip acute; base cuneate to rounded; upper surface silver-green, veins impressed, velutinous, non-glandular trichomes sparse, antrorse to divaricate, 6–10-celled up to 0.8 mm long, glandular trichomes absent, sessile glands absent; lower surface silver, veins raised, velutinous, non-glandular trichomes dense, divaricate, 6–12-celled up to 1.5 mm long, glandular trichomes absent, sessile glands scattered to dense. Inflorescence up to 150 mm long, with 3–5 pedunculate branches from near the base; axis square in cross-section, non-glandular trichomes scattered, retrorse, 6–10-celled up to 2 mm long, glandular trichomes absent, sessile glands absent; bracts obovate to broadly-ovate, 2–3 × 2.4–3.2 mm, usually forming a coma, non-glandular trichomes dense, antrorse, 6–8-celled up to 1.8 mm long, glandular trichomes absent, sessile glands scattered; cymes sessile; verticillasters 18–22-flowered, up to 10 mm apart; pedicels 0.5–1 × 0.2–0.3 mm, non-glandular trichomes dense, divaricate, 6–10-celled up to 1.8 mm long, glandular trichomes absent, sessile glands scattered. Flower calyces 2.2–2.8 mm long, non-glandular trichomes dense, divaricate, 4–10-celled up to 2 mm long, glandular trichomes absent, sessile glands sparse. Corolla 10–12.5 mm long, pale-lilac; tube 4.8–5.5 mm long, curved at 100–120° 1.7–2 mm from base, slightly inflated upwards, ± glabrous; upper lobes suborbicular, reflexed, 2–2.2 × 1.8–2.2 mm, non-glandular trichomes sparse, divaricate, 4–6-celled up to 0.7 mm long, glandular trichomes absent, sessile glands sparse; lateral lobes oblong, 1.5–2 × 0.9–1 mm, non-glandular trichomes scattered, divaricate, 4–6-celled up to 0.7 mm long, glandular trichomes absent, sessile glands scattered; lower lobe broadly ovate, 4–4.5 × 4.2–4.8 mm, non-glandular trichomes sparse, divaricate, 6-celled up to 1 mm long, glandular trichomes absent, sessile glands scattered; filaments filiform, 7–8 × *c.* 0.2 mm, lilac, fused for 4–4.5 mm from base; anthers *c.* 0.5 × 0.4 mm; style filiform, 7–8 mm long, lilac, bifid for *c.* 0.5 mm. Fruit calyces 3.5–4 mm long; upper lobe oblong-ovate, 1.2–2 × 1.3–1.5 mm; lateral lobes lanceolate-falcate, 1.2–2 × 0.7–0.8 mm; lower lobes lanceolate-falcate, 1.2–1.6 × 0.5–0.6 mm. Nutlets ± circular in outline, ± flattened, 0.8–0.9 mm long, 0.9–1 mm wide, 0.5–0.6 mm thick, glossy brown, surface smooth. **Fig. 7.**

***Additional specimens examined*: Queensland.** Cook District: 1.8 km W of Mosquito Point, just E of Hunter Inlet, Temple Bay, Lockhart River Aboriginal Reserve, May 1992, *Fell DF2575* (BRI); Restoration Island, Apr 1995, *Le Cussan 285* (BRI); South Pap, Tozers Gap, Jul 1991, *Forster PIF9072* (BRI); Puff de Looney Ridge [Mt Tozer, Iron Range N.P.], Jul 1972, *Irvine 264* (BRI, QRS); Brown's Creek, Pascoe River, Jul 1948, *Brass 19590* (BRI); 19 km from the Peninsula Development road on a track to Wolverton via the Cook tin mine, Jun 1993, *Clarkson 10114 & Neldner* (BRI).

***Distribution and habitat*:** *Plectranthus venustus* occurs on Cape York Peninsula in far north-eastern Queensland in an area bounded by Mosquito Point in the north to 'Wolverton' in the south. Plants occur on granite pavements and outcrops, but never on granite rock piles where it is replaced by the much taller growing *Plectranthus excelsus* P.I.Forst.

***Notes*:** At Iron Range both *Plectranthus excelsus* and *P. venustus* may occur in close geographical proximity but have not been observed growing sympatrically.

Plectranthus venustus appears to have morphological similarities to *P. gratus* (Forster 1996) from the Wet Tropics, Queensland. Observed morphological differences between these three species are summarized in **Table 3.**



Map 3. Distribution of *Plectranthus venustus* in far north Queensland. Shaded area on map indicates conservation reserves (National Parks, Forest Reserves and Conservation Parks).

Table 3. Comparison of some morphological character states between *Plectranthus gratus* and *P. venustus*

Character state	*P. gratus*	*P. venustus*
stem indumentum	non-glandular trichomes antrorse	non-glandular trichomes divaricate
petiole indumentum	non-glandular trichomes antrorse, glandular trichomes sparse, sessile glands absent	non-glandular trichomes divaricate, glandular trichomes absent, sessile glands scattered to dense
laminae form and colour	ovate; bluish-green above, silver-green below	lanceolate to narrow-ovate; silver-green above, silver below
number of marginal teeth per side of leaf lamina	13–15	22–33
pedicels	2.5–3 × c. 0.2 mm; antrorse non-glandular trichomes	0.5–1 × 0.2–0.3 mm; divaricate non-glandular trichomes
inflorescence bracts	not forming a coma; ovate, 1.3–1.8 × 1.3–1.8 mm	usually forming a coma; obovate to broadly ovate, 2–3 × 2.4–3.2 mm

***Conservation status*:** This species is known from six localities (two in Iron Range N.P. and one in Restoration Island N.P.) and is not considered to be threatened at this time. It is likely that further populations exist within the area of occurrence which is poorly explored from a botanical view.

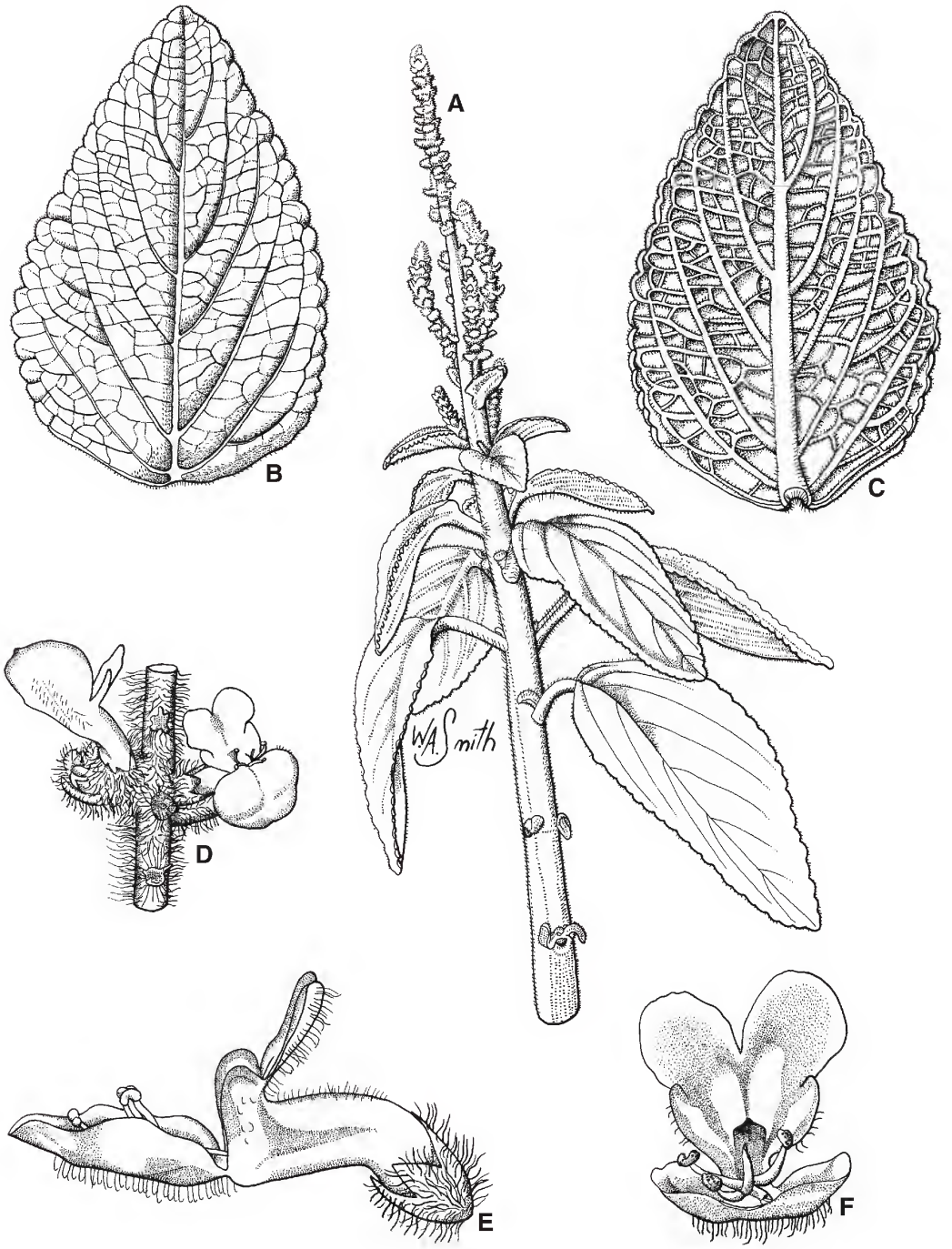


Fig. 7. ***Plectranthus venustus***. A. flowering stem ×0.6. B. abaxial view of leaf ×1. C. adaxial view of leaf ×1. D. portion of inflorescence with two verticillasters, buds and flowers ×3. E. lateral view of flower ×6. F. face view of flower ×6. All from *Forster PIF5388 & Tucker* (BRI). Del. W.Smith.

***Etymology*:** The specific epithet is based on the Latin word *venustus* (beautiful) and alludes to the form of this plant.

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Wilkiea kaarruana Zich & A.J.Ford (Monimiaceae), a new species from north-east Queensland

F.Zich[1] & A.J.Ford[2]

Summary

Zich, F. & Ford, A.J. (2011). *Wilkiea kaarruana* Zich & A.J.Ford (Monimiaceae), a new species from north-east Queensland. ***Austrobaileya* 8(3): 405–411.** *Wilkiea kaarruana* Zich & A.J.Ford endemic to the Wet Tropics of north-east Queensland is described, illustrated and distinguished from related Australian species. Notes on habitat, distribution, and conservation status are provided.

Key Words: Monimiaceae, *Wilkiea*, *Wilkiea kaarruana*, Australia flora, Queensland flora, new species, taxonomy, identification key, hyperstigma

[1]F.Zich, Australian Tropical Herbarium, Sir Robert Norman Building, James Cook University Cairns Campus, PO Box 6811, Cairns, Queensland 4870, Australia

[2]A.Ford, CSIRO, Ecosystem Sciences, Tropical Forest Research Centre, P.O. Box 780, Atherton, Queensland 4883, Australia

Introduction

Wilkiea F.Muell. (Monimiaceae) is a genus of approximately 12 species distributed from Papua New Guinea to Australia (Philipson 1980; Whiffin & Foreman 2007). In their treatment of the genus for the *Flora of Australia*, Whiffin & Foreman (2007) elected not to describe two poorly known taxa from north Queensland. Recent collections of one of these taxa, *Wilkiea* sp. A (Whiffin & Foreman 2007) by the authors have provided for the first time female flowers, and abundant new male flowering specimens, which have enabled confident placement of the taxon in the genus *Wilkiea*.

The flowers of *Wilkiea* have been recorded as possessing a hyperstigma (Endress 1979, 1980); that is, a sticky surface receiving pollen that is not the stigma itself. Mucilaginous secretion from the stigmas as a reward for pollinators has been reported for at least one other genus of Monimiaceae, namely the Madagascan *Tambourissa* Sonn. (Lorence 1985), which is pollinated by flies and beetles, while the pollination of Australian *Wilkiea huegeliana* (Tul.) A.DC. appears to be mainly by thrips (Williams *et al.* 2001).

Staedler & Endress (2009) have revealed that all taxa in Monimiaceae that possess a hyperstigma also have a complex, whorled floral phyllotaxis, in which merism may increase or decrease once or several times between whorls. They call organs tepals when they are anywhere on the floral cup (regardless of whether on top of the cup or toward the base of the cup), and bracts when they are below the floral cup on the pedicel.

Materials and methods

The study is based upon the examination of herbarium material from BRI and CNS (formerly QRS) combined with field observations. All specimens cited have been seen by one or both authors.

Measurements of the floral parts of *Wilkiea kaarruana* are based on fresh material and material preserved in 70% ethanol. Common abbreviations in the specimen citations are: L.A. (Logging Area), N.P./R. (National Park/ Reserve), S.F./R. (State Forest/Reserve) and T.R. (Timber Reserve).

NCA is an acronym for the Queensland Nature Conservation Act (1992) and its associated schedules. Discussions of conservation status are made in reference to the criteria of the IUCN (2001).

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The abbreviation RE in the distribution and habitat notes refers to Regional Ecosystem, descriptions of which can be viewed at (in this case):

http://www.derm.qld.gov.au/wildlife-ecosystems/biodiversity/regional_ecosystems/search.php?&page=31

Extent of occurrence estimates were derived from the validation of original collection localities. These data points were loaded into ESRI ArcView 3.2 and the draw polygon feature was used to calculate the area between the points. The area of occupation estimates were principally derived from a digital Regional Ecosystem map supplemented by expert opinion of vegetation types and habitats within the Wet Tropics bioregion (hereafter referred to as the Wet Tropics) (Environment Australia 2005).

Taxonomy

Wilkiea kaarruana Zich & A.J.Ford, **species nova** affinis *Wilkiea smithii* Whiffin a qua cortice suberoso, ramulis glabris, pedicellis glabris, floribus femineis longioribus (22–24 mm longis), et stigmate conico differt. **Typus:** Queensland. Cook District: Wooroonooran National Park, 9.5 km along Maple Creek Road from South Johnstone River bridge, 20 November 2007, *A.Ford 5205* (holo: BRI; iso: A, BO, CANB, CNS, H, K, L, LAE, MO, NSW, SYD, MEL, SING, US, Z *distribuendi*).

Wilkiea sp. Palmerston (B.P.Hyland 80); Jessup (2007, 2010).

Wilkiea sp. Palmerston (BH 80RFK); Hyland *et al.* (2003).

Wilkiea sp. Palmerston; Cooper & Cooper (2004: 320).

Wilkiea sp. A; Whiffin & Foreman (2007: 81).

***Illustration*:** Cooper & Cooper (2004: 320), as *Wilkiea* sp. (Palmerston).

Shrub or small tree 5–12 m tall, androdioecious or monoecious; bark corky, thick and longitudinally fissured. Leaves glabrous, slaty green above when fresh; petiole 5–12 mm long. pink-red; lamina elliptic to oblong-elliptic, 6–15 cm long, 2.5–6 cm wide, cuneate to attenuate at base, entire, acuminate at apex, mucronate; midrib raised above and below. Male inflorescence axillary, terminal and ramiflorous, often fasciculate, 1–4 cm long; occasionally solitary, mostly triads (botryoids sensu Endress [2010]), sometimes fascicles of triads (botryoids), in total 1–15 flowers; pedicels 5–18 mm long, glabrous; bracts lanceolate, *c.* 1.1 mm long. Male flowers globose to depressed globose, *c.* 2–3.5 mm wide, yellow to yellow-orange; tepals rounded to truncate 4–6, *c.* 1.8 mm long, glabrous on both surfaces, two pairs around ostiole, third pair if present near base of floral cup; stamens 4, *c.* 1.1 mm long, in equal pairs, outer 2 positioned on floral cup wall and higher than inner two which are positioned on the base of receptacle, anthers opening by apical slit curving over apex, filaments very short, hairy. Female inflorescence terminal, 3–5 cm long, fascicles of triads (botyroids), in total 6–14 flowers, pedicels 11–24 mm long, glabrous. Female flowers depressed globose, *c.* 7 mm diameter, yellow-orange fading to green at base; tepals 4–6, 2 pairs around ostiole, outer pair thin, inner pair greatly thickened, forming a floral cup, third pair when present often consisting of one tepal near the base of floral cup and the opposing tepal on the side of the floral cup; carpels 21–26, angular, tapering, densely pubescent with golden, more or less appressed hairs; stigma short, conical and black; staminodes absent. Fruiting receptacle, 6–10(–15) mm wide, pubescent; mature fruit not known. **Fig. 1.**

***Additional selected specimens examined*: Queensland.** Cook District: Big Tableland via Cooktown, *s.dat.*, *Jack in Eldridge s.n.* (BRI [AQ63833]); Gap Creek, *c.* 22 miles [36 km] S by E of Cooktown, Oct 1969, *Smith s.n.* (BRI [AQ339983]); *loc. cit.*, *Smith s.n.* (BRI [AQ339984]); *loc. cit.*, *Smith s.n.* (BRI [AQ339988]); Daintree N.P., Cedar Bay Section, Gap Creek, Nov 2000, *Forster PIF26462 et al.* (BRI); Daintree N.P., Daintree River headwaters, May 1998, *Forster PIF22947 et al.* (BRI); Mitchell Bomber crash site, East Bartle Frere, Wooroonooran N.P., Nov 1994, *Hunter 2147* (BRI); Jordan L.A., 16.5 km SE of Millaa Millaa, site 2, Oct 1988, *Jessup GJM 2095 et al.* (BRI); Wooroonooran N.P., 1.1 km along K-Tree road from Kaarru Creek crossing, Nov 2007, *Ford 5208*[1] (BRI, CNS); Wooroonooran N.P., 1.1 km along K-Tree road from Kaarru Creek crossing, Nov 2008, *Zich 626*[1] (BRI, CNS); Wooroonooran N.P., Maple Creek Road, CSIRO Climate Change Plot, Charappa, Nov

2008, *Zich 627*[l] (BRI, CANB, CNS); Palmerston F.R., old logging road towards Karang-Garee Falls, off South Johnstone Forestry road, Oct 2003, *Ford 4174 & Holmes* (BRI, CNS); ([l]= flowering specimen).

***Distribution and habitat*:** *Wilkiea kaarruana* is endemic to the Wet Tropics bioregion in north-eastern Queensland, where it is currently known to occur from the Cooktown area (Big Tableland and Mt Finnigan environs) to the South Johnstone River (south-east of Millaa Millaa) (**Map 1**). However, within this large range *Wilkiea kaarruana* is confined to four distinct and disjunct populations (from north to south):

1. Mt Finnigan area (from Big Tableland to Gap Creek)
2. Daintree River headwaters
3. Mt Bartle Frere
4. South Johnstone River catchment.

It inhabits predominantly the wetter and more mountainous notophyll vine-forests/ rainforests on soils derived from granite, fine grained metasediments (including mudstone) and basalt. However, it is more commonly encountered on granitic substrates, with occurrences on basalt and metasediments being less common. Common canopy species that grow in association with *Wilkiea kaarruana* include: *Cardwellia sublimis* F.Muell., *Carnarvonia araliifolia* F.Muell., *Cryptocarya mackinnoniana* F.Muell., *Doryphora aromatica* (F.M.Bailey) L.S.Sm., *Elaeocarpus ruminatus* F.Muell., *Flindersia bourjotiana* F.Muell., *Flindersia pimenteliana* F.Muell., *Franciscodendron laurifolium* (F.Muell.) B.Hyland & Steenis, *Sloanea macbrydei* F.Muell., *Syzygium johnsonii* (F.Muell.) B.Hyland, *Syzygium papyraceum* B.Hyland and *Xanthophyllum octandrum* (F.Muell.) Domin. Common small trees and shrubs throughout most of its range include: *Apodytes brachystylis* F.Muell., *Ardisia brevipedata* F.Muell., *Bobea myrtoides* (F.Muell.) Valeton, *Bubbia semecarpoides* (F.Muell.) B.L.Burtt, *Chionanthus axillaris* R.Br., *Citronella smythii* (F.Muell.) R.A.Howard, *Gossia* spp., *Pilidiostigma tropicum* L.S.Sm., *Pittosporum rubiginosum* A.Cunn., *Polyscias australiana* (F.Muell.) Philipson and *Psychotria* spp. Altitudinal range, from existing specimens, is 60–1090 m.

Wilkiea kaarruana has been collected or reliably reported in the following REs: 7.8.2a (rarely); 7.11.1a (occasionally); 7.12.1a (occasionally), 7.12.16a (commonly) and 7.12.19a (rarely).

***Phenology*:** Flowers have been recorded in October and November; immature fruits have been recorded in March.

***Affinities*:** *Wilkiea kaarruana* is morphologically most similar to *W. smithii* and *W. hylandii* Whiffin. However these species are easily distinguished by several key features and geographic distribution. All three species have pubescent carpels and glabrous to glabrescent adaxial leaf surfaces. A comparison of diagnostic differences between these three species (and *Wilkiea austroqueenslandica*) is provided in **Table 1**.

Whiffin (2007) suggests that *Wilkiea austroqueenslandica, W. hylandii* and *W. smithii* form a "distinctive group", as they all have pubescent inflorescences and carpels. Although *W. kaarruana* has glabrous inflorescences, the carpels are distinctly pubescent. Molecular studies by Renner *et al.* (2010, Fig. 2) and Renner *pers. comm.* (2009) place *Wilkiea kaarruana* close to *W. austroqueenslandica* Domin., *W. smithii and W. hylandii*.

***Notes*:** In habitat *Wilkiea kaarruana* is easily recognized by the thick and longitudinally fissured pale corky bark. A specimen from the Big Tableland (*Jack in Eldridge s.n.*) consists of a piece of bark 20mm thick mounted on a sheet and the name "Corkwood Tree" on the original label. No other species of *Wilkiea*, or Monimiaceae, in Australia have this striking feature though it has been reported for at least two species of Monimiaceae on the island of New Guinea, currently assigned to the island endemic genus *Kairoa* Philipson (Renner & Takeuchi 2009). Recent molecular research on *Kairoa* indicates it should be included with *Wilkiea*, along with *Kibara* Endl., which is likewise embedded among species of *Wilkiea* (Renner *et al.* 2010).

Table 1. Morphological comparison between *Wilkiea austroqueenslandica*, *W. hylandii*, *W. kaarruana* and *W. smithii*

Character state	*W. austroqueenslandica*	*W. hylandii*	*W. kaarruana*	*W. smithii*
Bark	finely wrinkled	not recorded (but not corky)	corky	tessellated flaky
Leaf indumentum	glabrous	pubescent when young, glabrescent or persisting on midrib	glabrous	densely pubescent when young, esp. midrib, glabrescent
Leaf margin	prominently, irregularly toothed	prominently toothed in upper half	entire	entire
Male inflorescence position	axillary	axillary, sometimes fasciculate	axillary, terminal and ramiflorous, often fasciculate	axillary, sometimes fasciculate
Male inflorescence	triad or fascicle of triads	triad or fascicle of triads	occasionally solitary, mostly 2-flowered or sometimes triads or fascicle of triads	triad or fascicle of triads
Male flower pedicel length & indumentum	*c.* 8 mm densely pubescent	4–5 mm densely pubescent	5–18 mm glabrous	6–8 mm densely pubescent
Male flowers tepal number	8 as 4 pairs	6, with 2 pairs around ostiole, and 1 lower on floral cup	4 to 6. 2 as pairs around an ostiole. 3rd pair, if present at base of floral cup	8 in 2 whorls
Male flowers stamen number	30	(6) 8 (10)	4	usually 4
Female inflorescence position	axillary	axillary or terminal	terminal	axillary or terminal
Female flower pedicel length & indumentum	10–15 mm densely silky pubescent	7–15 mm densely pubescent	22–24 mm glabrous	5–8 mm densely pubescent
Female flower tepal number	4	4	4 or 6	4
Carpel number	35	40	21–26	20–40
Stigma shape	hemispherical	hemispherical	conical	hemispherical

Although *Wilkiea kaarruana* is a small tree, it is remarkable that there are so few fertile specimens in herbaria. The few flowering collections have sometimes made it difficult to determine levels of dioecy and monoecy. As noted by Whiffin & Foreman (2007) the genus *Wilkiea* is monoecious or perhaps rarely dioecious, and "It is likely that many (perhaps all) species described as dioecious have male and female flowers on the same plant but usually not at the same time. For example, many plants with mature fruit have young flowers that are male". Observations made during this study corroborate these statements, with *Ford 5208* having mature female flowers and younger male flowers. These male flowers would likely come into anthesis after the female flowers were fertilized. Also, despite regular monitoring of several plants before and after flowering, we found no evidence of male plants (*Ford 5205* and *Zich 628*) ever producing female flowers. Accordingly, we suggest that *Wilkiea kaarruana* is androdioecious (male dioecious) and monoecious (having pure male plants growing together with monoecious plants). Further field observations are required to assess the reproductive strategy within *Wilkiea kaarruana*, and indeed for all Australian Monimiaceae.

Floral observations of female *Wilkiea kaarruana* conducted as part of this study have confirmed the presence of a hyperstigma. The outline of the flower is globular, the inner pair of tepals is greatly thickened and appears to produce mucilage at anthesis. The amount of mucilage in dissected flowers varied but was observed to fill the floral cup creating a continuous cover over the carpels to the apical pore (see **Fig. 1**). Despite examination of many flowers no insects or their larvae were found, though possible evidence of insect damage was observed in the partial destruction of the apical pore as described and illustrated by Endress (1980: 85, fig.35).

The presence of a third whorl of tepals in both male and female flowers in *W. kaarruana* is not unusual within *Wilkiea*; however, it is more usual for male flowers to possess more whorls than female flowers (Whiffin 2007).

Leaf oils in Australian species of *Wilkiea* have been studied by Brophy *et al.* (2009). *Wilkiea kaarruana* produced a sesquiterpenoid oil similar to the related *Wilkiea smithii* Whiffin; although this latter species also contained very small amounts of monoterpenes. *Wilkiea austroqueenslandica* Domin, another closely related species, yielded an oil also dominated by sesquiterpenes, but had a much higher proportion of monoterpenes. *Wilkiea hylandii* Whiffin was not sampled in their study.

***Conservation status*:** Most existing collections of this species have been made within the World Heritage Area of the Wet Tropics. *Wilkiea kaarruana* has been collected in Daintree and Wooroonooran National Parks. The species has a wide, albeit restricted and disjunct geographical range with an area of occupation estimated to be 110 km^2. It is not considered at risk.

***Etymology*:** The specific epithet honours Kaarru (pronounced Kaa-roo) Creek and Kaarru Logging Area, where several collections of the species, including the first female flowering collection were made. Now known as Wooroonooran National Park, the area was previously referred to as State Forest Reserve 756.

Acknowledgements

The authors wish to thank Will Smith for the illustrations. Peter Bostock provided the distribution map and Lyn Craven the translation of the diagnosis into Latin. Peter Endress and Susanne Renner improved an earlier draft. Permits to collect in the Wet Tropics were issued by the Department of Environment & Resource Management. The curators and staff at BRI are thanked for allowing access to specimens and the use of their facilities.

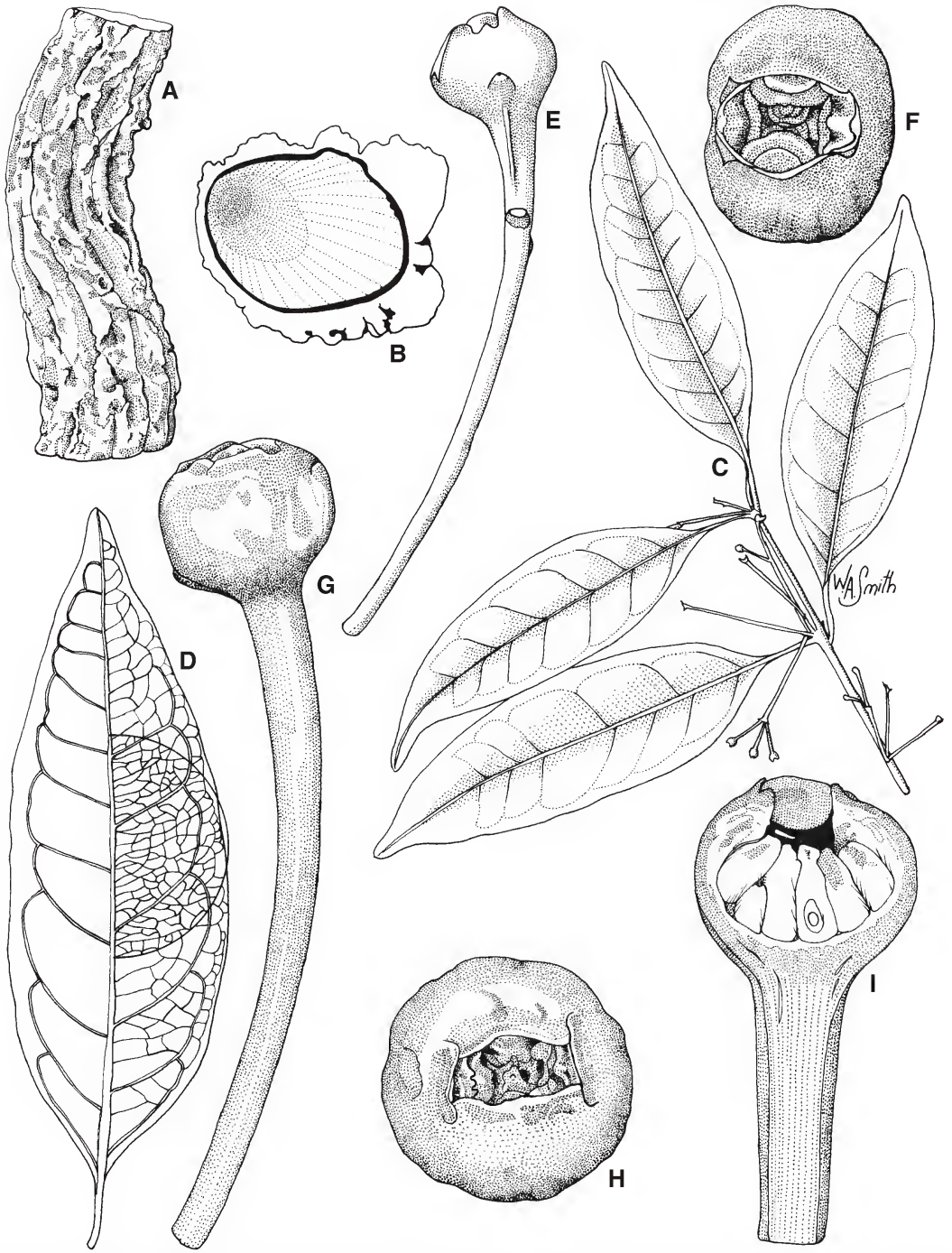

Fig. 1. ***Wilkiea kaarruana***. A. large branch showing longitudinal corky fissures × 1. B. transverse section of large branch × 2. C. branchlet with male inflorescences × 0.5. D. leaf adaxial surface with extra venation detail × 1. E. lateral view of male flower showing off-set tepal on floral tube and bract on pedicel × 10. F. face view of male flower showing tepals around ostiole and anthers × 12. G. lateral view of female flower showing off-set tepals on floral cup × 10. H. face view of female flower showing tepals around ostiole and off-set tepal on floral cup × 12. I. section of female flower showing hairy carpels and mucilaginous cover from the hyperstigma × 12. A–B from *Forster PIF26462 et al.* (BRI); C–F from *Ford AF5205* (CNS); G–I from *Ford AF5208* (CNS). Del. W.Smith

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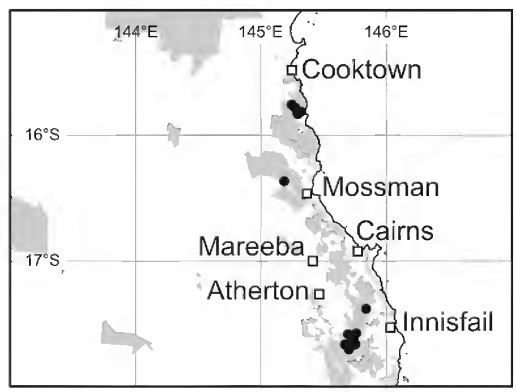

Map 1. Distribution of *Wilkiea kaarruana* in Queensland. Shaded areas indicate conservation reserves.

New and reinstated species of the *Solanum ellipticum* R.Br. (Solanaceae) species group

A.R.Bean

Summary

Bean, A.R. (2011). New and reinstated species of the *Solanum ellipticum* R.Br. (Solanaceae) species group. ***Austrobaileya* 8(3): 412–430**. The *Solanum ellipticum* species group is endemic to Australia, and is here considered to comprise 13 species. *Solanum lithophilum* F.Muell. and *S. cleistogamum* Symon are reinstated. *Solanum aridicola* A.R.Bean, *S. callosum* A.R.Bean, *S. emmottii* A.R.Bean and *S. unispinum* A.R.Bean are described as new. The four new species and *Solanum lithophilum* are illustrated and distribution maps are provided for them. A key to the identification of species in the *Solanum ellipticum* group is presented.

Key Words: Solanaceae, *Solanum*, *Solanum aridicola*, *Solanum callosum*, *Solanum ellipticum*, *Solanum emmottii*, *Solanum lithophilum*, *Solanum unispinum*, Australia flora, New South Wales flora, Northern Territory flora, Queensland flora, Western Australia flora, taxonomy, new species, identification key

A.R. Bean, Queensland Herbarium, Department of Environment & Resource Management, Brisbane Botanic Gardens, Mt Coot-tha Road, Toowong 4066, Queensland, Australia. E-mail: tony.bean@derm.qld.gov.au

Introduction

Solanum ellipticum was named by Robert Brown in 1810, based on type material collected near St Lawrence on the central Queensland coast. For many years, the name has been widely applied to *Solanum* species with the following characteristics: prostrate or low growing, stems moderately prickly, calyx prickly; leaves ovate to elliptical with entire (or repand) margins, densely stellate-hairy at least on the lower surface; inflorescences racemose; fruits green, yellow-green or almost white at maturity; calyx not accrescent. *Solanum* specimens matching these criteria occur in all mainland states except Victoria.

The current author was able to distinguish some taxa (*Solanum crebrispinum* A.R.Bean, *S. senticosum* A.R.Bean) within *S. ellipticum sens. lat.* based on herbarium material (Bean 2004). Subsequent field studies have provided new insights and revealed characters that are not readily apparent from the standard herbarium specimen. For instance, there are consistent differences between taxa in growth habit (**Figs. 1 & 2**), corolla shape and indumentum, style orientation (erect or eccentric), stigma size and colour, fruit colour and placentation, and pericarp thickness.

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Bean (2004) included 10 species within the informal *Solanum ellipticum* group (Group 27), which is endemic to Australia. The membership of that group needs alteration. On morphological grounds, the author now recognises that the affinities of *S. crassitomentosum* Domin lie with *S. furfuraceum* R.Br. (Group 27B), that *S. angustum* Domin belongs near *S. graniticum* A.R.Bean in Group 25, and that *S. argopetalum* A.R.Bean belongs in the *S. esuriale* Lindl. group (Group 27C). Additions to the group comprise the reinstated *S. cleistogamum* Symon and *S. lithophilum* F.Muell., and the four species named in this paper (*S. unispinum, S. emmottii, S. callosum* and *S. aridicola*). With these changes, Group 27 now comprises 13 species, namely *S. aridicola, S. callosum, S. cleistogamum, S. crebrispinum* A.R.Bean, *S. dianthophorum* Dunal, *S. ellipticum, S. emmottii, S. horridum* Dunal ex Poir., *S. lithophilum, S. quadriloculatum* F.Muell., *S. senticosum* A.R.Bean, *S. terraneum* Symon and *S. unispinum*.

Solanum terraneum is tentatively retained in the *S. ellipticum* group following Symon (1981), but no specimens have been seen by the present author, and so it is not included in the key to species and is not considered further in this paper.

Fig. 1. Plant of ***Solanum ellipticum*** at Homevale National Park (*Bean 30650 et al.*). Photograph: A. R. Bean

Full descriptions are given for the new species, the reinstated species (*Solanum cleistogamum* and *S. lithophilum*), and for the recircumscribed *Solanum ellipticum*.

Materials and methods

Relevant specimens have been examined in the herbaria BRI, MEL, NSW and NT; as have specimens of *Solanum ellipticum sens. lat.* from CANB, and material of *S. cleistogamum* from PERTH.

Measurement techniques and terminology are as per Bean (2004). All species except *Solanum dianthophorum* and *S. terraneum* have been examined in the field. Species treatments are in alphabetical order.

Taxonomy

Key to the species in the *Solanum ellipticum* group

1 Stems and branchlets without prickles . . . . . **S. dianthophorum**
1. Stems and branchlets sparsely to densely prickly **2**

2 Style protruding between anthers or slightly bent, displacing one anther, erect for most of its length but recurved near apex **3**
2. Style bent strongly near base, displaced from the centre of the flower (eccentric) **10**

3 Stems ultimately ascending or erect; bushy plants **4**
3. Stems ultimately prostrate or procumbent; ground-covering plants **8**

4 Calyx prickles 40–70, very stout and pungent **5**
4. Calyx prickles rather flimsy, 1–40, or sometimes absent. **6**

5 Leaves 1.6–1.8 times longer than broad, base obtuse or cordate; ovary and style with very shortly stalked glandular hairs; calyx stellate hairs 0.7–0.9 mm across . . . . . **S. crebrispinum**
5. Leaves 1.9–2.7 times longer than broad, base cuneate; ovary and style glabrous; calyx stellate hairs 0.4–0.6 mm across. . . . . **S. senticosum**

6 Leaves 2.2–3.5 cm long; calyx prickles 0–5; inflorescences 1 or 2 flowered . . . . . **S. unispinum**
6. Leaves 4.9–14.5 cm long; calyx prickles 5–40; inflorescences 7–15 flowered

7 Stellate hairs consistently present on inner surface of corolla; branchlets terete; prickles glabrous. . . . . **S. callosum**

7. Stellate hairs consistently absent from inner surface of corolla; branchlets usually ridged; prickles with stellate hairs attached at their bases . . . . . **S. quadriloculatum**

8 Calyx prickles >50; fruits 18–22 mm diameter; inflorescences 1(–2)-flowered . . . . . **S. horridum**
8. Calyx prickles 5–50; fruits 9–17 mm diameter; inflorescences 1–6-flowered **9**

9 Fruits 9–12 mm diameter; anthers 2–2.8 mm long; central ray of stellate hairs 1–2 times as long as laterals . . . . . **S. cleistogamum**
9. Fruits 13–17 mm diameter; anthers 4–5.5 mm long; central ray of stellate hairs 0.5–1 times as long as laterals . . . . . **S. ellipticum**

10 Plant prostrate to procumbent; calyx prickles pungent, 3.5–8 mm long . . . . . **S. aridicola**
10. Plant bushy, with ascending stems; calyx prickles flimsy, 0.5–4 mm long **11**

11 Branchlet hairs not floccose (stalks 0–0.2 mm); calyx prickles 0.5–2 mm long; corolla 9–13 mm long. . . . . **S. emmottii**
11. Branchlet hairs floccose (stalks 0–2 mm); calyx prickles 2–4 mm long; corolla 14–20 mm long . . . . . **S. lithophilum**

Fig. 2. Population of ***Solanum lithophilum***, north of Alice Springs (site of collection for *Bean 25457 & Albrecht*). Photograph: A.R.Bean

Solanum aridicola A.R.Bean **species nova** *S. horrido* affinis sed ab eo inflorescentiis 3–8-floris, praesentia pilorum stellatorum longe stipitatorum in pagina superiore foliorum et marginibus foliorum aequabiliter integris differens. **Typus:** Northern Territory. Larapinta trail, Standley Chasm area. *c.* 40 km W of Alice Springs, 1 August 2006, *A.R.Bean 25449 & D.E.Albrecht* (holo: BRI; iso: CANB, MEL, NSW, NT).

S. ellipticum form "b"; Symon (1981).

S. ellipticum var. Ranges (D.E.Albrecht 5807); Kerrigan & Albrecht (2007), Albrecht et al. (2007: 176).

Herbaceous resprouter or rhizomatous perennial shrub 0.1–0.3 m high. Stems initially ascending, then prostrate or sprawling. Adult branchlets yellow or rusty; prickles 35–56 per cm, straight, acicular, 4–12 mm long, 14–20 times longer than wide, glabrous; stellate hairs very dense, lateral rays 8–9, porrect or ascending, central ray 1–2 times as long as laterals; Type 2 hairs absent. Adult leaves elliptical or ovate, entire or shallowly lobed throughout with 2–3 on each side; lobes obtuse, lobing index 1–1.1; lamina 2.8–9.8 cm long, 1.3–4.4 cm wide, 2.1–2.8 times longer than broad, apex acute, base cuneate or obtuse, oblique part 0–4.5 mm long, obliqueness index 0–6%; petioles 1.3–4 cm long, 26–56% length of lamina, prickles present. Upper leaf surface green; prickles present on midvein only or present on midvein and lateral veins, 1–20, straight, acicular, 3.5–13 mm long; stellate hairs distributed throughout, very dense; lateral rays 8, porrect or ascending, central ray 1–2 times as long as laterals; simple hairs absent; Type 2 hairs absent. Lower leaf surface yellowish; prickles present on midvein only or present on midvein

and lateral veins, 3–35, straight, acicular; stellate hairs very dense, lateral rays 8–12, porrect, ascending or multiradiate, central ray 0.9–2 times as long as laterals; simple hairs absent; Type 2 hairs absent. Inflorescence supra-axillary, cymose (pseudo-racemose), common peduncle 11–27 mm long, rachis prickles present, 2–8-flowered. Flowers 5-merous. Pedicels at anthesis 3–5 mm long, same thickness throughout, prickles absent or present; calyx tube 2–3 mm long; lobes attenuate, 3.5–8 mm long; prickles 22–50 per flower, 3.5–8 mm long; stellate hairs very dense, lateral rays 7–12, central ray 1–2 times as long as laterals; simple hairs absent; Type 2 hairs absent. Corolla rotate, 9–15 mm long, purple, inner surface glabrous; anthers 3.6–4.3 mm long; filaments *c.* 1 mm long; ovary glabrous. Functional style 8–8.5 mm long, strongly bent near base, not touching anthers, eccentric, glabrous; stigma expanded, darker than style, obscurely lobed. Fruiting calyx lobes less than half length of mature fruit. Mature fruits 1–3 per inflorescence, oblate or globular, 18–21 mm diameter, brown or yellow, 2-locular; placenta stalked, anvil-shaped, pericarp 0.5–0.7 mm thick; pedicels 7–12 mm long. Seeds 1.8–2.5 mm long, white or pale yellow. **Fig. 3.**

***Additional selected specimens examined*: Northern Territory.** Un-named gorge between Hugh and Spencer Gorge, Mar 1994, *Albrecht 5807* (AD, NT); Valley of Eagles, 35 miles [58.3 km] ENE of Alice Springs, Oct 1966, *Beauglehole 20671* (NT); James Range, 3 miles [5 km] N of Hugh River, Aug 1967, *Beauglehole 24592* (AD, NT); Standley Chasm, MacDonnell Ranges, Jul 1968, *Orchard 818* (AD, NT); Palm Valley, Sep 1970, *Latz 790* (NT); Kings Canyon, Dec 1968, *Latz 321* (NSW, NT); 'Derry Downs', Dulcie Range, Oct 1974, *Latz 5828* (NT); Redbank Gorge, 3 Jul 1985, *Leach 666* (MEL, NT); Emily Gap, 8 miles [13 km] E of Alice Springs, Feb 1968, *Nelson 1618* (MEL, NSW, NT); Stuart Highway, 10.7 km N of Aileron, Aug 2006, *Bean 25455 & Albrecht* (BRI, NT).

***Distribution and habitat*:** *Solanum aridicola* is known only from the southern parts of the Northern Territory (**Map 1**), although it probably occurs in adjacent parts of Western Australia and South Australia. It inhabits granite or quartzite hills and ranges with shallow sandy loam soils. Associated species include *Eucalyptus intertexta* R.T.Baker, *E. terminalis* F.Muell. and *Grevillea wickhamii* Meisn.

***Phenology*:** Flowers have been recorded for July and August; fruits in August and February.

***Notes*:** *Solanum aridicola* is most closely related to *S. horridum* as both species are more or less prostrate, with very prickly stems and leaves and have flowers and fruits of about the same size and colour. *Solanum aridicola* is most readily distinguished by the 3–8-flowered inflorescences (1 or 2-flowered in *S. horridum*), and by the eccentric style in the flower. It also differs from *Solanum horridum* by the entire leaves (often shallowly lobed in *S. horridum*) and the upper leaf surface with many long-stalked stellate hairs (all ± sessile in *S. horridum*).

***Etymology*:** From the Latin *aridus* meaning 'arid' and *–cola* meaning 'to inhabit'. This refers to the arid landscape that the species inhabits.

Solanum callosum A.R.Bean **species nova** *S. quadriloculato* affinis sed ab eo fasciculis pilorum stellatorum in corollam, lobis calycum apicibus longis linearibus praeditis, caulibus teretibus et ovario interdum 2-loculari differens. **Typus:** Queensland. Gregory South District: 20.2 km WSW of Eromanga, on Cooper Development Road, 27 August 2010, *A.R. Bean 30027* (holo: BRI [1 sheet + spirit]; iso: NSW).

S. ellipticum R.Br., *auct. non* Bean (2004), *pro parte.*

***Illustrations*:** Cunningham *et al.* (1981: 592), as *S. quadriloculatum*; Brooke & McGarva (1998: 112), as *S. ellipticum*.

Rhizomatous perennial shrub 0.15–0.6 m high. Stems initially sprawling, then spreading to erect. Adult branchlets yellow, rusty or brown; prickles 8–70 per cm, straight, acicular, 2–7 mm long, 14–18 times longer than wide, glabrous; stellate hairs very dense, 0.6–1.1 mm diameter, stalks 0–0.2 mm long, lateral rays 7–8, porrect or ascending, central ray 0.7–1.4 times as long as laterals; Type 2 hairs absent. Adult leaves ovate or broadly ovate, entire, lamina 4.9–9 cm long, 3–4.8 cm wide, 1.5–2.4 times longer than broad, apex obtuse or acute, base cuneate or obtuse, oblique part 1–3.5 mm long, obliqueness

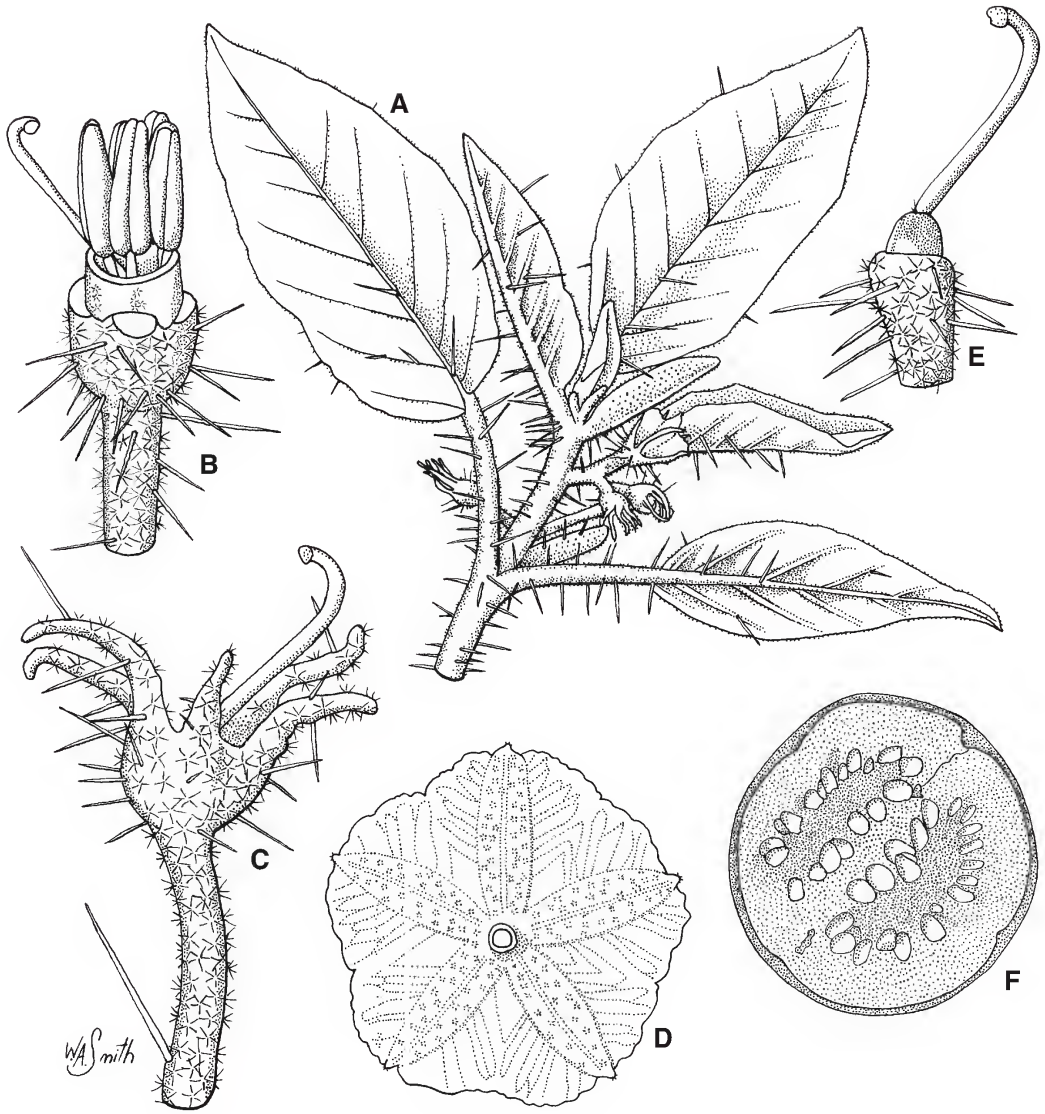

Fig. 3. ***Solanum aridicola***. A. flowering branchlet × 0.8. B. flower with corolla and calyx lobes removed × 4. C. pedicel, calyx and style × 4. D. corolla × 2. E. ovary and style × 4. F. cross-section of mature fruit × 2. All from *Bean 25449 & Albrecht* (BRI).

index 1–4%; petioles 1.2–3 cm long, 17–33% length of lamina, prickles present. Upper leaf surface grey; prickles absent or with 1–4 on midvein only, straight, acicular, 2–4.5 mm long; stellate hairs distributed throughout, dense or very dense; 0.05–0.2 mm apart, 0.5–0.7 mm across, stalks 0–0.15 mm long, lateral rays 6–8, porrect or ascending, central ray 0.7–1.3 times as long as laterals; simple hairs absent; Type 2 hairs absent. Lower leaf surface white or grey; prickles 3–10, present on midvein only or present on midvein and lateral veins, straight, acicular; stellate hairs very dense, 0.05–0.1 mm apart, 0.6–0.9 mm diameter, stalks 0–0.3 mm long, lateral rays 7–8, porrect, central ray 0.7–1.3 times as long as laterals; simple hairs absent; Type 2 hairs absent. Inflorescence supra-axillary, cymose (pseudo-racemose), common peduncle 15–41 mm long, rachis prickles present, 7–11-

flowered, with all flowers bisexual. Flowers 5-merous. Pedicels at anthesis 5–11 mm long, same thickness throughout, prickles absent or present. Calyx tube at anthesis 2.5–4 mm long; lobes deltate or attenuate, 1.5–7.5 mm long; prickles 14–40 per flower, 1–3 mm long; stellate hairs very dense, white or purplish, 0.4–0.8 mm across, stalks 0.1–0.5 mm long, lateral rays 7–8, central ray 0.8–1.4 times as long as laterals; simple hairs absent; Type 2 hairs absent. Corolla shallowly lobed, 9–14 mm long, purple, inner surface densely stellate-hairy at distal end; anthers 4.4–6.1 mm long; ovary glabrous; style 7.5–8.5 mm long, protruding between anthers, glabrous; stigma unexpanded, same colour as style, obscurely lobed. Fruiting calyx lobes less than or more than half length of mature fruit, prickles 2–4 mm long. Mature fruits 2–4 per inflorescence, globular, 18–20 mm diameter, green, 2-locular or 4-locular, placenta stalked, anvil-shaped, interior moist but not juicy, pericarp 3–3.3 mm thick. Pedicels at fruiting stage 8–21 mm long. Seeds pale yellow, 2.5–2.7 mm long. **Fig. 4.**

***Additional specimens examined*: Queensland.** Mitchell District: 42.7 km along Silsoe Road, W of Longreach, May 2004, *Bean 22213* (BRI); Longreach, Thompson River, Apr 1963, *Gittins 670* (BRI); Milo Station, Old Gooyea Outstation ruins, near Powell Creek, NNW of Adavale, Aug 2009, *Forster PIF35347 & Thomas* (BRI, NSW); 'Springdale', N of Aramac, Jul 2000, *Fensham 3947* (BRI); road from Adavale to Windorah, 64 miles [102 km] WNW of Adavale, Jun 1967, *Gittins 1232* (BRI); Idalia N.P., SW of Blackall, Jun 1990, *Rogers s.n.* (BRI [AQ624125]). Gregory North District: Kangaroo Mountains, between Bedourie and Windorah, Jun 1978, *Althofer 8363* (BRI). Gregory South District: 3.7 km From Poison Tank Bore, GiGi Paddock, Mt Margaret Station, 30 km SW of Eromanga, Oct 1995, *Stol & Landsberg QSL382* (CANB); near Jackson, south-west Qld, Jul 2003, *Hines s.n.* (BRI [AQ779478]); *c.* 40 miles [64 km] W of Windorah, Jun 1949, *Everist 3894* (BRI); 19.1 km W of central Tank turnoff, Thargomindah – Nockatunga Road, Sep 1990, *Prendergast HDP346* (BRI). Warrego District: Eulo sports ground, 0.8 km S of Eulo, Aug 2006, *Bean 25634* (BRI); 42.3km from Charleville, towards Quilpie, Aug 2010, *Bean 29925* (BRI, MEL); 'Gilruth Plains', E of Cunnamulla, May 1939, *Blake 14034* (BRI); Currawinya N.P., 4 km WNW of Gidgee Bore, Mar 1997, *Forster PIF20444 & Watson* (BRI, DNA, MEL); *c.* 27 km NE of Thargomindah, on road to Quilpie, Sep 1973, *Henderson H2083 & Boyland* (BRI); 'Yarronvale', 66 miles [106 km] from Charleville on Quilpie road, Sep 1963, *Everist 7520* (BRI). Maranoa District: 'Murra Murra', River paddock, at Brumby Lake, SW of Bollon, Feb 2007, *Eddie CPE1091* (BRI).

New South Wales. North Far Western Plains: Ursino – Yamba Station road, 30 miles [48 km] W of Wanaaring, Oct 1963, *Constable 4583* (BRI, NSW); 14 miles [23 km] W of Wanaaring, Dec 1969, *Martensz 260* (AD, CANB, NSW); Peery Station, Apr 1963, *Bailey 2862* (CANB). North Western Plains: 65.7 km from Bourke – Cobar Road, towards Coolabah, Mar 2008, *Bean 27637* (BRI); 0.1 km W of Condobolin – Cobar Road, *c.* 40 km N of Condobolin, Mar 2008, *Bean 27694* (BRI); Coolabah, Apr 1900, *Helms s.n.* (NSW).

***Distribution and habitat*:** *Solanum callosum* is widespread from north of Muttaburra in central Queensland to Condobolin in central New South Wales (**Map 2**). It grows on plains and low stony hills on sandy loam to clay loam soils. Associated tree species include mulga (*Acacia aneura* F.Muell. ex Benth.), *A. excelsa* Benth., *Eucalyptus terminalis* F.Muell. and *E. populnea* F.Muell.

***Phenology*:** Flowers are recorded for all months of the year. Fruits are recorded between February and September.

***Notes*:** This species is most closely allied to *Solanum quadriloculatum*; however, there a number of differences; *S. callosum* has a cluster of stellate hairs on the distal portion of the inner surface of the corolla, with scattered stellate hairs extending down the midvein for about half the corolla length (in *S. quadriloculatum* the corolla is glabrous, except for two or three collections which bear simple hairs at the distal end of the lobes); calyx lobes narrowly deltate with long linear apices (broadly deltate, with or without short linear apices for *S. quadriloculatum*); stems terete (usually ridged for *S. quadriloculatum*); no stellate hairs on prickles (stellate hairs on at least some prickles for *S. quadriloculatum*); ovary 2- or 4-locular (consistently 4-locular for *S. quadriloculatum*); fruits 18–20 mm diameter (14–17 mm for *S. quadriloculatum*).

***Etymology*:** The species epithet is from the Latin *callosus* meaning tough, hard, or thick-skinned. This is given in reference to the fruits that are hard when dry, and for the very thick pericarp.

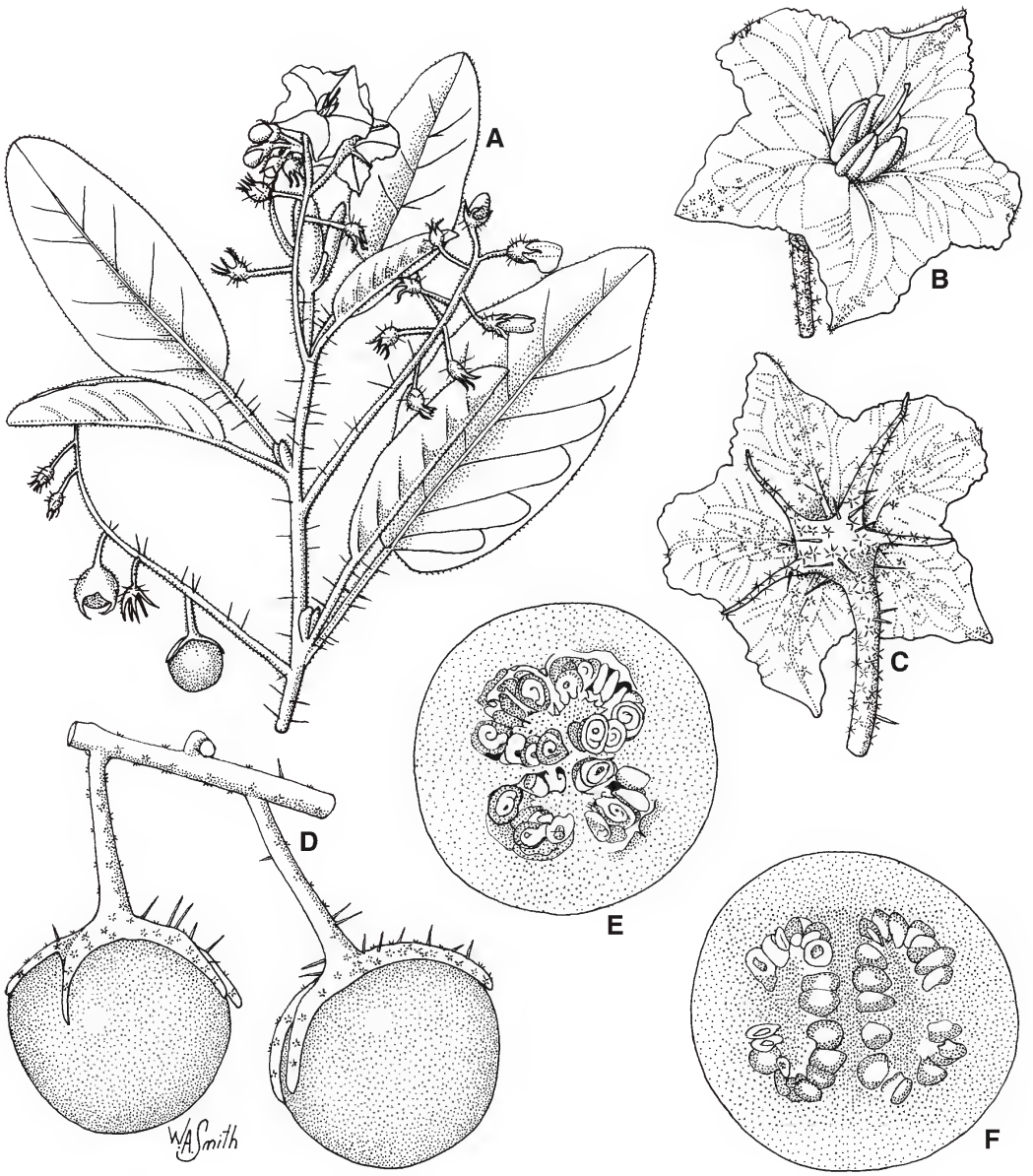

Fig. 4. ***Solanum callosum***. A. flowering branchlet × 0.6. B. oblique view of an open flower × 2. C. base of flower showing calyx and corolla × 2. D. mature fruits attached to rachis × 1.5. E. cross-section of a 4-locular fruit × 2. F. cross-section of a 2-locular fruit × 2. A from *Gittins 670* (BRI); B,C from *Bean 29925* (BRI); D,F from *Bean 30027* (BRI); E from *Hines s.n.* (BRI [AQ779478]).

Solanum cleistogamum Symon, *Trans. & Proc. Roy. Soc. South Australia* 95: 227 (1971). **Type:** Western Australia. *c.* 32 km N of Onslow, 1 July 1967, *D.E.Symon 5418* (holo: PERTH; iso: AD, CANB, K, L).

S. petrophilum var. *pedicellatum* Ewart & Davies, *Fl. Northern Territory* 243 (1917). **Type:** Northern Territory. Lat. 19° long. 132°, 4 July 1911, *G.F. Hill 435* (holo: MEL [2 sheets]).

***Illustrations*:** Cunningham *et al.* (1981: 592); Symon (1981: 194)

Herbaceous resprouter, 0.15–0.25 m high. Stems initially ascending, then prostrate and trailing. Adult branchlets white to rusty-brown; prickles 7–18 per cm, straight, acicular, 1–6 mm long, 15–20 times longer than wide, glabrous; stellate hairs dense or very dense, lateral rays 8–15, porrect, ascending or multiradiate, central ray 1–2.5 times as long as laterals. Adult leaves lanceolate or ovate, entire or with 2 or 3 shallow obtuse lobes on each side, lobing index 1–1.1; lamina 2.8–4.7 cm long, 1.2–3.6 cm wide, 1.2–2.4 times longer than broad, apex obtuse, base obtuse or cordate, oblique part 0–4.5 mm long, obliqueness index 0–10%; petioles 1.4–3.1 cm long, 40–70% length of lamina, prickles present. Upper leaf surface grey-green, prickles absent; stellate hairs moderately dense or dense, stalks 0–0.1 mm long, lateral rays 6–8, porrect, central ray 1.1–2 times as long as laterals. Lower leaf surface green or greenish-white, prickles absent or with 1–10 on midvein only, straight, acicular. Lower leaf surface stellate hairs moderately dense or dense, stalks 0–0.1 mm long, lateral rays 7–8, porrect; central ray 1.2–2 times as long as laterals, sometimes gland-tipped. Inflorescence supra-axillary, cymose (pseudo-racemose), common peduncle 8–21 mm long, rachis prickles present, 1–5-flowered, with all flowers bisexual. Flowers 5-merous. Pedicels at anthesis 7–14 mm long, prickles present. Calyx tube at anthesis 2–3.5 mm long; lobes deltate or rostrate, 2–4 mm long; prickles present, 10–25 per flower, 1.5–3 mm long; stellate hairs dense, lateral rays 6–8; central ray 1.2–2.2 times as long as laterals, sometimes gland-tipped. Corolla rotate, 6–9 mm long, white or mauve, inner surface glabrous; anthers 2–2.8 mm long; filaments 1.2–1.3 mm long; ovary glabrous; style 5–6 mm long, erect near base, then bent, displacing one anther, glabrous; stigma slightly expanded, obscurely lobed. Fruiting calyx lobes less than or more than half length of mature fruit, prickles 1.5–5 mm long. Mature fruits 1–3 per inflorescence, globular, 9–12 mm diameter, yellow, 2-locular; placenta sessile, semi-circular; interior juicy, pericarp 0.4–0.8 mm thick; pedicels 15–23 mm long. Seeds 2–2.5 mm long, white or pale yellow.

***Additional selected specimens examined*: Western Australia**. Horridum Hill, near highway, *c.* 50 km E of Port Hedland, Apr 2006, *Bean 25014 & Lepschi* (BRI, CANB, PERTH). **Northern Territory.** Track to Lake Lewis, S of Tilmouth Bore, *c.* 160 km NW of Alice Springs, Aug 2006, *Bean 25472 & Albrecht* (BM, BRI, CANB, MEL, NSW, NT, NY); North-west Simpson Desert, Sep 1973, *Latz 4658* (AD, BRI, NT); Curlew Waterhole, Lander River, 70 miles [113 km] NW of Willowra Homestead, Central Australia, Jul 1958, *Chippendale 4799* (BRI, NT); W margin of Lake Ruth, *c.* 5 km SE of Mongrel Downs Homestead, Tanami Desert, Aug 1978, *Donner 6283* (AD, BRI). **Queensland.** Burke District: Roxmere Station, S of Cloncurry, Apr 2003, *Booth 3168 & Kelman* (AD, BRI, NSW). South Kennedy District: Lake Buchanan, May 1980, *Hyland 10525* (BRI, CNS). Warrego District: Thargomindah, Jun 1936, *Blake 11781* (BRI); 10.9 km from Adavale towards Blackall at tank, Oct 1983, *Canning 6206* (BRI, CANB). Maranoa District: Karoola Road, S of Dirranbandi, 10 km N of state border, Sep 2004, *Bean 22847* (BRI). **New South Wales.** 3.6 km NE of Cumborah, towards Lightning Ridge, Sep 2004, *Bean 22893* (BRI); Fowlers Gap, N of Broken Hill, Oct 1975, *Jacobs 2337* (BRI, NSW); 'Tundulya', *c.* 25 miles [40 km] SE of Louth, Apr 1967, *Moore 4949* (CANB). **South Australia.** E side of Lincoln Highway, 17 km N of Whyalla, Oct 1998, *Jobson 5736 & Downs* (BRI, NSW).

***Distribution and habitat*:** *Solanum cleistogamum* is widespread in mainland Australia south of about latitude 19°, from the west coast of Western Australia to the slopes of the Great Divide in New South Wales and Queensland. In South Australia, it occurs as far south as Spencer Gulf.

It grows on a range of habitats but prefers sandy or sandy-loam soils, often on rather low-lying terrain, but also sometimes on steep hillsides.

***Phenology*:** Flowers and fruits may be found throughout the year.

***Notes*:** This species was previously included in the synonymy of *Solanum ellipticum* (Bean 2004). I now recognise that this was incorrect, and that the two are distinct. While the two species are closely related and rather difficult to distinguish in the herbarium, the relatively small tasty yellow fruits, the small corolla, and the ± cordate leaf bases of *S. cleistogamum* readily distinguish it.

Solanum ellipticum R.Br., *Prodr.* 446 (1810); *S. ellipticum* var. *ellipticum*, Benth., Fl. Austral. 4: 464 (1868); *S. ellipticum* f. *ellipticum*, Wawra, *Itin. Princ. S. Coburgi* 100 (1883); *S. ellipticum* var. *typicum* Domin, *Biblioth. Bot.* 89: 588 (1929), *nom. inval.* **Type:** [Queensland. Port Curtis District:] 'Broadsound', 25 September 1802, *R. Brown [Bennett Number 2674]* (lecto: BM [000596888]; isolecto: MPU, *fide* Symon [1981: 188]).

Herbaceous resprouter, or rhizomatous perennial shrub 0.1–0.25 m high. Stems initially ascending, then prostrate and trailing. Adult branchlets grey, purple, yellow or brown; prickles 1–10 per cm, straight, acicular, 1–8 mm long, 8–14 times longer than wide, glabrous or with dense stellate hairs on lower part; stellate hairs dense to very dense, 0.5–0.8 mm diameter, stalks 0–0.1 mm long, lateral rays 7–10, lateral rays porrect or ascending, central ray 0.5–1.2 times as long as laterals. Adult leaves elliptical or ovate, entire; lamina 3.5–14 cm long, 1.5–5.2 cm wide, 1.7–2.9 times longer than broad, apex obtuse or acute, base cuneate or obtuse, oblique part 0–9 mm long, obliqueness index 0–6%; petioles 0.8–4 cm long, 20–45% length of lamina, prickles absent or present. Upper leaf surface green or grey-green, prickles 2–20, present on midvein only or on midvein and lateral veins, straight, acicular, 1–7 mm long; stellate hairs distributed throughout, sparse to dense, 0.1–0.5 mm apart, 0.4–0.7 mm across, stalks 0–0.1 mm long, lateral rays 7–8, porrect, central ray 0.5–1 times as long as laterals; simple hairs absent; Type 2 hairs absent. Lower leaf surface greenish-white to grey or yellowish; prickles 0–20, absent or present on midvein only or on midvein and lateral veins, straight, acicular; stellate hairs moderately dense to very dense, 0.05–0.3 mm apart, 0.5–0.8 mm diameter, stalks 0–0.2 mm long, lateral rays 7–8, porrect, central ray 0.5–1.2 times as long as laterals; simple hairs absent; Type 2 hairs absent. Inflorescence supra-axillary, solitary or cymose (pseudo-racemose), common peduncle 0–6 mm long, rachis prickles present, 1–5-flowered, with some bisexual and some male flowers. Flowers 5-merous. Pedicels at anthesis 4–11 mm long, 0.7–0.9 mm thick at mid-point, prickles absent or present. Calyx tube at anthesis 1.5–3 mm long; lobes deltate or attenuate, 2–6 mm long; prickles 5–50 per flower, 1–5 mm long; stellate hairs moderately dense to very dense, white to yellow or rusty, 0.4–0.8 mm across, stalks 0–0.3 mm long, lateral rays 7–8, central ray 0.8–1.3 times as long as laterals; simple hairs absent; Type 2 hairs absent. Corolla shallowly or deeply lobed, 7–12 mm long, mauve or purple, inner surface with a few stellate hairs near lobe apices. Anthers 4–5.5 mm long. Ovary glabrous or with Type 2 hairs only; functional style 5.5–10 mm long, protruding between anthers, glabrous or with Type 2 hairs only; stigma unexpanded, same colour as style. Fruiting calyx lobes less than or more than half length of mature fruit, prickles 1–5 mm long. Mature fruits 1–2 per inflorescence, globular, 13–17 mm diameter, yellowish-green, 2-locular; placenta stalked, anvil-shaped; interior moist but not juicy, pericarp 0.6–1 mm thick; pedicels 7–19 mm long, 0.8–2.1 mm thick at mid-point. Seeds 2.2–2.7 mm long, pale yellow. **Fig. 1.**

***Additional selected specimens examined*: Queensland.** Leichhardt District: Slopes of Marling Spike, Homevale N.P., NNW of Nebo, Dec 2010, *Bean 30650 et al.* (BRI). Port Curtis District: Orange Creek, *c.* 20 miles [32 km] NW of Biloela, Jun 1959, *Johnson 857* (BRI); 4 km WSW of St Lawrence, Apr 2000, *Bean 16250* (BRI, MEL). Burnett District: 'Neaavie', NE of homestead towards Barambah Creek, Aug 1996, *Grimshaw PG2536 & Turpin* (BRI); *c.* 6 km NE of Allies Creek and 7.5 km SW of 'Weir Weir', Jul 1998, *Pollock ABP617 & Dean* (BRI). Wide Bay District: Bruce Highway, between Gin Gin and Miriam Vale, Jan 2006, *Bohs 3540 & Bean* (BRI); Bingera, Dec 1896, *Bailey s.n.* (BRI [AQ39062]). Darling Downs District: 8 km WSW of Oakey, Apr 1994, *Fensham 1444* (BRI); 14 km N of Goondiwindi, towards Moonie, Feb 1996, *Bean 9907* (BRI, MEL, NSW). Moreton District: Gatton, Nov 1916, *Bick s.n.* (BRI [AQ39059]); 2 km ESE of Laidley, Jun 2002, *Bean 19062* (BRI). **New South Wales.** North West Plains: 4 km SSW of 'The Glen' Homestead, *c.* 70 km W of Moree, Jan 1999, *Wannan 1036 et al.* (AD, BRI, NSW).

***Distribution and habitat*:** The limits of distribution of *Solanum ellipticum sens. str.* are not yet known with certainty, but it is found in the Queensland Pastoral districts of Moreton, Darling Downs, Wide Bay, Burnett, Leichhardt and Port Curtis. It also occurs on the north-western plains of New South Wales near Moree.

***Phenology*:** Flowers and fruits can be found throughout the year.

***Notes*:** *Solanum ellipticum* is a prostrate to semi-erect plant with trailing stems (**Fig. 1**). It has a small inflorescence with 1–5 flowers, and some of these are functionally male (styles very short and non-functional). It is perhaps the only species of the group in which the flowers are not all bisexual. The common peduncle is usually absent, although it can be up to 6 mm long. The number of fruits is one or two.

Solanum ellipticum var. *chillagoense* Domin, *S. ellipticum* f. *albiflora* Domin, and *S.* sp. (Newcastle Range D.E. Symon 4907) were included by Bean (2004) in the synonymy of *S. ellipticum*. The author now recognises that this is incorrect; however, further study is required to accurately place these names beyond synonymy with *S. ellipticum*.

Solanum emmottii A.R.Bean **species nova** *S. lithophilo* affinis sed ab eo corolla minore, calycis aculeis paucioribus brevioribusque et pilis stellatis omnibus stipitibus quam 0.2 millimetris longitudine brevioribus praeditis differens. **Typus:** Queensland. Gregory North District: Near homestead, Ethabuka Reserve, 8 November 2010, *A.J. Emmott B690* (holo: BRI [1 sheet + spirit]; iso: AD, NT, NY, W, *distribuendi*).

Rhizomatous perennial shrub 0.2–0.5 m high. Stems initially sprawling, then more or less erect. Adult branchlets white, grey or yellowish; prickles 1–28 per cm, straight, acicular, 1–5 mm long, 10–14 times longer than wide, glabrous; stellate hairs very dense, 0.4–0.8 mm diameter, stalks 0–0.2 mm long, lateral rays 7–13, porrect, ascending or multiradiate, central ray 0.8–1.3 times as long as laterals; Type 2 hairs absent. Adult leaves ovate, entire; lamina 3.5–8.8 cm long, 1.4–3.8 cm wide, 1.7–2.9 times longer than broad, apex obtuse or acute, base cuneate, obtuse or cordate, oblique part 0–4 mm long, obliqueness index 0–7%; petioles 0.6–4.2 cm long, 18–48% length of lamina, prickles absent or present. Upper leaf surface grey-green or grey, prickles absent; stellate hairs dense to very dense, 0.05–0.2 mm apart, 0.4–0.7 mm across, stalks 0–0.1 mm long, lateral rays 6–10, porrect, central ray 0.7–1.2 times as long as laterals; simple hairs absent; Type 2 hairs absent. Lower leaf surface white or grey; prickles absent or present on midvein only, 0–2, straight, acicular; stellate hairs dense to very dense, 0.05–0.1 mm apart, 0.4–0.6 mm diameter, stalks 0–0.3 mm long, lateral rays 7–11, porrect or ascending, central ray 0.7–1.2 times as long as laterals; simple hairs absent; Type 2 hairs absent. Inflorescence supra-axillary, cymose (pseudo-racemose), common peduncle 15–50 mm long, rachis prickles absent or present, 2–6-flowered, with all flowers bisexual. Flowers 5-merous; pedicels at anthesis 4–15 mm long, same thickness throughout, prickles absent or present; calyx tube at anthesis 2.5–4 mm long; lobes deltate or attenuate, 2–7 mm long; prickles 1–25 per flower, 0.5–2 mm long; stellate hairs very dense, yellow or white, 0.4–0.8 mm across, stalks 0–0.3 mm long, lateral rays 8–10, central ray 0.7–1.3 times as long as laterals; simple hairs absent; Type 2 hairs absent. Corolla rotate or shallowly lobed, 9–13 mm long, purple, inner surface sparsely stellate-hairy; anthers 4.2–5.5 mm long; filaments 1.2–1.6 mm long. Ovary glabrous; functional style 8–9.5 mm long, strongly bent near base, not touching anthers, eccentric, glabrous or rarely with stellate hairs; stigma expanded, darker than style, obscurely lobed. Fruiting calyx lobes less than or more than half length of mature fruit. Mature fruits 1–3 per inflorescence, globular, *c.* 13 mm diameter, colour unknown, 2-locular; placenta sessile, semicircular; interior moist but not juicy, pericarp 0.3–0.4 mm thick; pedicels 8–13 mm long, 1.2–1.5 mm thick at mid-point. Seeds 2.5–3.3 mm long, pale yellow. **Fig. 5.**

***Additional specimens examined*: Northern Territory.** *c.* 5 km east of Lake Caroline, northern Simpson Desert, Jul 2007, *Albrecht 12300 & Duguid* (BRI, NT); *c.* 1 km west of Lake Caroline, northern Simpson Desert, Jul 2007, *Albrecht 12340 & Duguid* (BRI, NT); Near Hale River, Simpson Desert, Sep 1955, *Perry 5421* (BRI, CANB); 12 miles [20 km] NW of Lucy Creek Homestead, Jul 1957, *Chippendale 3523* (BRI). **Queensland.** Mitchell District: Valetta Bore paddock, 'Valetta', near 'Noonbah', *c.* 170 km SW of Longreach, May 2010, *Bean 29753 & Emmott* (AD, BM, BRI, NSW, NT); south boundary of Valetta Bore paddock, 'Valetta', *c.* 180km SW of Longreach, May 2010, *Bean 29757 & Emmott* (BRI, MEL). Gregory North District: 10 km NNW of Bedourie, (1.6 km W of Duck Hole), Kamaran Downs Station, Jun 1995, *Edmunds 23* (BRI). Gregory

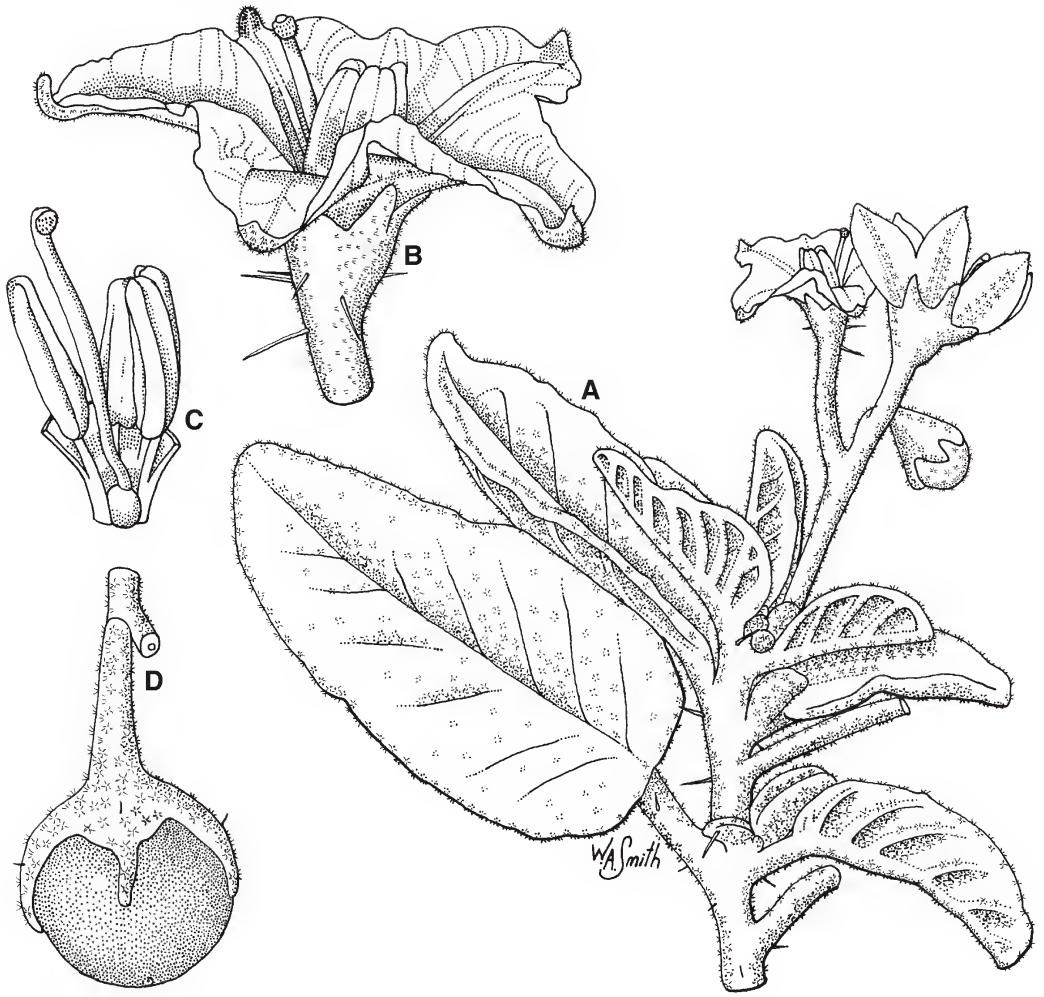

Fig. 5. ***Solanum emmottii***. A. flowering branchlet × 1.5. B. lateral view of flower × 4. C. stamens, style and ovary × 4. D. immature fruit × 2. All from *Bean 29753 & Emmott* (BRI).

South District: Mt Howitt Station, 80 miles [133 km] W of Eromanga, Jul 1936, *Blake 11926* (BRI); 10 miles [16 km] W of Betoota, Jul 1936, *Blake 12184* (BRI); 'Kyra', 40 miles [67 km] W of Quilpie, Jul 1965, *Emmerson s.n.* (BRI [AQ39068]); 35 km W of Betoota on Birdsville road, Aug 1979, *Williams 78187* (BRI). **South Australia.** 54 km by road S of Birdsville on the Birdsville Track to Marree, Mar 2001, *Thomas 2049 & Fechner* (BRI).

Distribution and habitat: *Solanum emmottii* is known from the far south-west of Queensland, and adjacent areas of Northern Territory and South Australia (**Map 3**). It grows almost exclusively on or adjacent to sand dunes, in red to orange sandy soil, associated with shrubs such as *Crotalaria eremaea* F.Muell. However, at the most north-easterly location, it occurs on the slopes of gravelly hills in brown or yellow loam, and in association with *Atalaya hemiglauca* (F.Muell.) F.Muell. ex Benth., *Acacia ensifolia* Pedley, *Eremophila mitchellii* Benth. and *Triodia longiceps* J.M.Black.

***Phenology*:** Flowers have been recorded from March to November; a potentially mature fruit was collected in July.

***Notes*:** *Solanum emmottii* differs from *S. lithophilum* by the non-floccose branchlet indumentum and the stellate hairs stalks less than 0.2 mm (floccose branchlet indumentum with stalks 0–2 mm long for *S. lithophilum*);

stellate hairs with shorter central rays; shorter calyx lobes; calyx prickles 1–25, each 0.5–2 mm long (25–50 calyx prickles, each 2–4 mm long for *S. lithophilum*); corolla 9–13 mm long (16–20 mm for *S. lithophilum*); the presence of stellate hairs on the inner corolla surface (glabrous for *S. lithophilum*); and the smaller fruits.

Edmunds 23 (cited above) differs from the other cited specimens by the presence of numerous stellate hairs on the style, but is in other regards quite typical.

***Conservation status*:** This species appears to be fairly common and is not currently considered to be under threat. A conservation status of 'Least Concern' is recommended.

***Etymology*:** The species is named for Angus James Emmott (1962-), grazier, accomplished naturalist, and dedicated advocate for the preservation of natural ecosystems in arid Australia.

Solanum lithophilum F.Muell., *Linnaea* 25: 434 (1853). **Type:** South Australia. Near Cudnaka [Kanyaka Homestead], Flinders Ranges, October 1851, *F. Mueller s.n.* (lecto: MEL11873, *fide* Symon [1981: 188]).

S. ellipticum var. *mollibaccalis* J.M.Black, *Trans. & Proc. Roy. Soc. South Australia* 52: 227 (1928). **Type:** South Australia. Finniss Springs near Lake Eyre, *s.dat., F.D.Warren s.n.* (syn: AD, *fide* Symon [1981: 188], *n.v.*).

S. ellipticum var. Foot hills (*G.J.Leach 1145*); Kerrigan & Albrecht (2007), Albrecht *et al.* (2007: 176).

S. ellipticum R.Br. *auct. non* Symon (1981), *pro parte.*

Herbaceous resprouter, 0.3–0.45 m high. Stems initially sprawling, then more or less erect. Adult branchlets grey, yellow or rusty; prickles 9–40 per cm, straight, acicular, 2–7 mm long, 13–18 times longer than wide, glabrous; stellate hairs very dense, stalks 0–2 mm long, lateral rays 8–13, porrect or multiradiate, central ray 1.1–2.2 times as long as laterals. Adult leaves elliptical or ovate, entire; lamina 3.6–10.1 cm long, 1.5–5.3 cm wide, 1.9–3.8 times longer than broad, apex acute, base cuneate or obtuse, oblique part 0–6 mm long, obliqueness index 0–7%; petioles 1.3–6 cm long, 33–60% length of lamina, prickles present. Upper leaf surface grey-green or grey; prickles absent or present on midvein only, 0–2, straight, acicular, 3–7 mm long; stellate hairs dense, stalks 0–2 mm long, lateral rays 7–10, porrect or ascending, central ray 1.2–2 times as long as laterals. Lower leaf surface white, grey or silvery; prickles absent or present on midvein only, 0–4, straight, acicular; stellate hairs very dense, lateral rays 8–15, porrect or multiradiate, central ray 1.2–2 times as long as laterals. Inflorescence supra-axillary, cymose (pseudo-racemose), common peduncle 20–52 mm long, rachis prickles present, 3–7-flowered, with all flowers bisexual. Flowers 5-merous. Pedicels at anthesis 7–16 mm long, same thickness throughout, prickles absent or present. Calyx tube at anthesis 3–4 mm long; lobes attenuate, 5–11 mm long; prickles present, 25–50 per flower, 2–4 mm long; stellate hairs very dense, yellowish-white or purple, lateral rays 8–13, central ray 1–2 times as long as laterals. Corolla rotate, 14–20 mm long, purple, inner surface glabrous. Anthers 4.7–6 mm long. Filaments 1–1.2 mm long. Ovary glabrous; style 9–13 mm long, strongly bent near base, not touching anthers, eccentric, glabrous; stigma expanded, darker than style, obscurely lobed. Fruiting calyx lobes less than or more than half length of mature fruit, prickles 2.5–4 mm long. Mature fruits 1–2 per inflorescence, globular or ellipsoidal, 18–21 mm diameter, purplish-green or almost white, 2-locular; placenta stalked, anvil-shaped; interior juicy, succulent; pericarp 0.3–0.8 mm thick; pedicels 12–25 mm long. Seeds 2.8–3.2 mm long, pale yellow or white. **Figs. 2 & 6.**

***Additional selected specimens examined*: Western Australia.** 100 miles [161 km] N of Eucla, *s.dat., Batt s.n.* (MEL). **Northern Territory.** Stuart Highway, 10.7 km N of Aileron, Aug 2006, *Bean 25457 & Albrecht* (AD, BRI, NT); track to Lake Lewis, S of Tilmouth Bore, *c.* 160 km NW of Alice Springs, Aug 2006, *Bean 25473 & Albrecht* (BRI, NT); Western side of Kings Canyon Range, 1 km south of Carmichael Crag, Aug 1986, *Menkhorst s.n.* (MEL); Orange Creek, 1 km S of Homestead on Stuart Highway, 24 km S of Alice Springs on Adelaide Road, Jun 1968, *Must 17* (MEL); 4 miles [6 km] W of Central Mt Wedge Homestead, Jun 1955, *Chippendale 1283* (BRI); Uluru N.P.: Kata Tjuta, on the Docker River Road, 35.7 km WNW of Ranger Station, May 1988, *Lazarides & Palmer 108* (CANB); Beside Todd River, N of Schwarz

Crescent, Alice Springs, Aug 2006, *Bean 25494* (BRI, CANB, NT); N'Dahla Gorge, Ross River area, E MacDonnell Ranges, Jun 1974, *Willis s.n.* (MEL); S bank of upper Finke River opposite Mt Sonder, Jul 1966, *Willis & Morrison s.n.* (MEL). **Queensland.** Gregory South District: on track 13.4 km due NW of 'Old Karmona' cottage, Aug 2008, *Turpin GPT1280 & May* (BRI, CNS); on track 26.9 km due NW of Orientos Station, Aug 2008, *Turpin GPT1279 & May* (BRI, CNS). **New South Wales.** Tarella, Aug 1887, *Baeuerlen 118* (MEL); Golden Gully mining area adjacent to the Deadhorse Gully camping area, 1 km N of Tibooburra in Sturt N.P., Sep 1989, *Coveny 13598 et al.* (AD, BRI, MO, NSW); ridge at end of Mootwingee Gorge Road, Mootwingee N.P., Aug 1989, *Porteners 33 & Plaza* (NSW, NT); 2 km W of Big Wallaby tank, 5 km NNW of Koonenberry Mountain, Sep 1971, *De Nardi 847* (NSW); Silverton near Barrier Range, Nov 1884, *Harris s.n.* (MEL); Mt Koonenberry, Dec 1860, *Beckler s.n.* (MEL). **South Australia.** near Mt Everard, 1882, *Giles s.n.* (MEL); Fogarty's claypan, Mar 1984, *Jackson 5255* (MEL); Strangways Springs, 1895, *Gratwick 16* (MEL); NW of Ooldea, *s.dat.*, *Tietkins s.n.* (MEL); Brachina Creek, Jun 1960, *Filson 2115* (MEL); 2 miles [3.3 km] S of Emu, Aug 1956, *Forde 389* (MEL); Innamincka Homestead, Jun 1980, *Lay 1493* (MEL); Lake Torrens Basin, east Mernmerna, *c.* 150 km NE of Port Augusta, on road to Marree, Oct 1968, *Weber 729* (MEL).

***Distribution and habitat*:** *Solanum lithophilum* is widespread in South Australia (except in the south-east) and the southern one-third of the Northern Territory. It also extends to far eastern parts of Western Australia and north-western New South Wales and it has recently been recorded from the extreme south-west of Queensland (**Map 3**). In South Australia, it is frequently recorded from rocky hill slopes, but in the Northern Territory it often grows on rather sandy colluvial and alluvial soils, with only limited occurrences on steep hillsides.

***Phenology*:** Flowers are recorded from all months of the year; fruits are recorded from March to September.

***Affinities*:** *Solanum lithophilum* may be readily distinguished from *S. ellipticum*. *Solanum lithophilum* is a multi-stemmed plant to 45 cm high; the stems are at first sprawling, but finally erect and have a floccose tomentum; the lower leaves have very long petioles, the inflorescences are well displayed and the very showy flowers (corolla 14–20 mm long) have a prominently eccentric style. The fresh fruits are large, 18–21 mm in diameter, and often bone-white when mature, at least at the distal end.

By contrast, *Solanum ellipticum* rarely exceeds 20 cm in height, the stems are ascending near the base, but then prostrate or procumbent, the tomentum is not floccose, all leaves have petioles of a similar length, the inflorescences are not well displayed and the flowers could not be described as showy (corolla 7–12 mm long). The style is erect rather than eccentric, protruding between the anthers. The fruits are smaller, 13–17 mm across, and green to yellow-green at maturity.

There are further differences at the microscopic level. Some stellate hairs on the branchlets of *Solanum lithophilum* are multiradiate with 10–13 lateral rays, and the central ray on all plant parts is 1.1–2.2 times longer than the laterals. The stigma of *Solanum lithophilum* is conspicuously swollen, and green in colour (cf. *S. ellipticum* where the stigma is scarcely broader than the style, and is the same colour as it).

***Notes*:** Well-developed plants of *Solanum lithophilum* form a small multi-stemmed bush with numerous, large, well-displayed purple flowers (**Fig. 2**). Such plants are very attractive and have considerable horticultural potential.

Solanum unispinum A.R.Bean **species nova** *S. cleistogamo* affinis sed ab eo corolla profunde lobata, antheribus longioribus, radio centrali pilorum stellatorum breviore, calyce aculeis pauculis vestito et habitu fruticoso differens. **Typus:** Queensland. Gregory North District: Winton – Jundah Road, 2.7 km N of Mayne River crossing, 25 May 2004, *A.R. Bean 22512* (holo: BRI; iso: CANB, NSW, *distribuendi*).

Herbaceous resprouter or rhizomatous perennial shrub, to 0.3 m high. Stems initially sprawling, then more or less erect. Adult branchlets purplish, yellow or rusty. Adult branchlet prickles 1–4 per cm, straight, acicular, 3–8 mm long, 12–16 times longer than wide, glabrous; stellate hairs very dense, 0.4–0.7 mm diameter, stalks 0–0.1 mm long; lateral rays 8–10, porrect; central ray

Fig. 6. ***Solanum lithophilum***. A. flowering branchlet × 0.8. B. leaf from lower part of plant × 0.8. C. oblique view of an open flower × 2. D. lateral view of a flower bud × 2. E. mature fruit with attached calyx × 1.5. F. cross-section of mature fruit × 2. A, E, F from *Bean 25457 & Albrecht* (BRI); B–D from *Bean 25494* (BRI).

0.4–0.8 times as long as laterals, not gland-tipped. Adult leaves ovate or broadly ovate, entire; lamina 2.2–3.5 cm long, 1.4–2.1 cm wide, 1.6–1.7 times longer than broad, apex obtuse or acute, base obtuse, oblique part 0–2 mm long, obliqueness index 0–9%. Petioles 1.4–2.7 cm long, 58–77% length of lamina, prickles present. Upper leaf surface grey-green, prickles absent; stellate hairs distributed throughout, dense, 0.15–0.2 mm apart, 0.4–0.5 mm across, stalks 0–0.1 mm long, lateral rays 8, central ray 0.6–0.9 times as long as laterals, not gland-tipped; simple hairs absent; Type 2 hairs absent. Lower leaf surface white or grey; prickles absent or present on midvein only, 0–3, straight, acicular; stellate hairs dense or very dense, 0.05–0.1 mm apart, 0.4–0.55 mm diameter, stalks 0–0.1 mm long, lateral rays 8–9, porrect; central ray 0.4–1 times as long as laterals, not gland-tipped; simple hairs absent; Type 2 hairs absent. Inflorescence supra-axillary, cymose (pseudo-racemose), common peduncle 3–10 mm long, rachis prickles absent or present, 1–2-flowered, with all flowers bisexual. Flowers 5-merous. Pedicels at anthesis 6–13 mm long, same thickness throughout, 0.5–0.6 mm thick at mid-point, prickles absent. Calyx tube at anthesis 2.5–3 mm long; lobes attenuate, 1.5–2 mm long. Calyx prickles absent or present, 0–4 per flower, 1–4 mm long. Calyx stellate hairs very dense, yellow or white or purple, 0.3–0.5 mm across, stalks absent, lateral rays 7–8, central ray 0.5–1 times as long as laterals, not gland-tipped; simple hairs absent; Type 2 hairs absent. Corolla deeply lobed, 7–10 mm long, purple, inner surface glabrous. Anthers 3.7–4.6 mm long. Ovary glabrous; style 7.5-9 mm long, straight, protruding between anthers or slightly bent, displacing one anther, glabrous; stigma expanded, yellow, obscurely lobed. Fruiting calyx lobes less than or more than half length of mature fruit; prickles absent or present, 2–4 mm long. Mature fruits 1–2 per inflorescence, globular, 11–13 mm diameter, yellowish-green, 2-locular; placenta sessile elliptical to semi-circular; interior juicy, succulent; pericarp 0.2–0.5 mm thick; pedicels 12–20 mm long. Seeds 2.5–2.7 mm long, pale yellow. **Fig. 7.**

***Additional specimens examined*: Queensland.** MITCHELL DISTRICT: *c.* 160 km S of Longreach, Apr 1989, *Emmott 286* (BRI); Noonbah Station, in Back Paddock, SW corner of Back Paddock, Jan 2008, *Emmott B516* (BRI, CANB); SW corner of Back Paddock, 'Noonbah', *c.* 170 km SW of Longreach, May 2010, *Bean 29771 & Emmott* (BRI); SW corner of Back Paddock, 'Noonbah', *c.* 170 km SW of Longreach, May 2010, *Bean 29772 & Emmott* (BRI, MEL). GREGORY NORTH DISTRICT: 86.6 km W of Winton on the Winton – Boulia Road, Nov 2010, *Emmott B682 & Denny* (BRI, NY); 98.9 km W of Winton on the Winton – Boulia Road, Nov 2010, *Emmott B683 & Denny* (BM, BRI); Winton – Jundah Road, 4.4 km S of 'Elvo' Homestead, May 2004, *Bean 22553* (BRI).

***Distribution and habitat*:** Endemic to south-western Queensland between Stonehenge and Winton (**Map 1**). It grows in shrubland or low open woodland, on stony hills and ranges, with shallow sandy soil. Associated species include *Eucalyptus normantonensis* Maiden & Cambage, *Acacia shirleyi* Maiden, *A. aneura* and *Triodia* sp.

***Phenology*:** Flowers have been recorded in April, May and November; fruits in January, May and November.

***Notes*:** *Solanum unispinum* is similar in appearance to *S. cleistogamum*, but differs by the bushy habit and ascending branches, branchlet prickles 1–4/cm (7–18/cm for *S. cleistogamum*), the central ray of the stellate hairs 0.4–1 times as long as laterals (1–2.5 times for *S. cleistogamum*), the leaf bases not cordate, the calyx prickles 0–5 (10–25 for *S. cleistogamum*), the deeply lobed corolla (rotate for *S. cleistogamum*), and the anthers 3.7–4.6 mm long (2–2.8 mm for *S. cleistogamum*).

***Conservation status*:** At the two sites on the Winton – Boulia road, four plants and one plant were found respectively. At 'Noonbah', it is known from fewer than 20 plants. Only two plants were seen near 'Elvo' Homestead, while at the type locality there were fewer than 10 plants. Using the criteria of the IUCN Red List (IUCN 2000), a conservation status of Critically Endangered (Criterion D) is recommended.

***Etymology*:** From the Latin *uni* meaning one and *spinus* meaning spine. The calyces of this species have no more than a single prickle on each lobe, and sometimes only one calyx lobe bears a prickle.

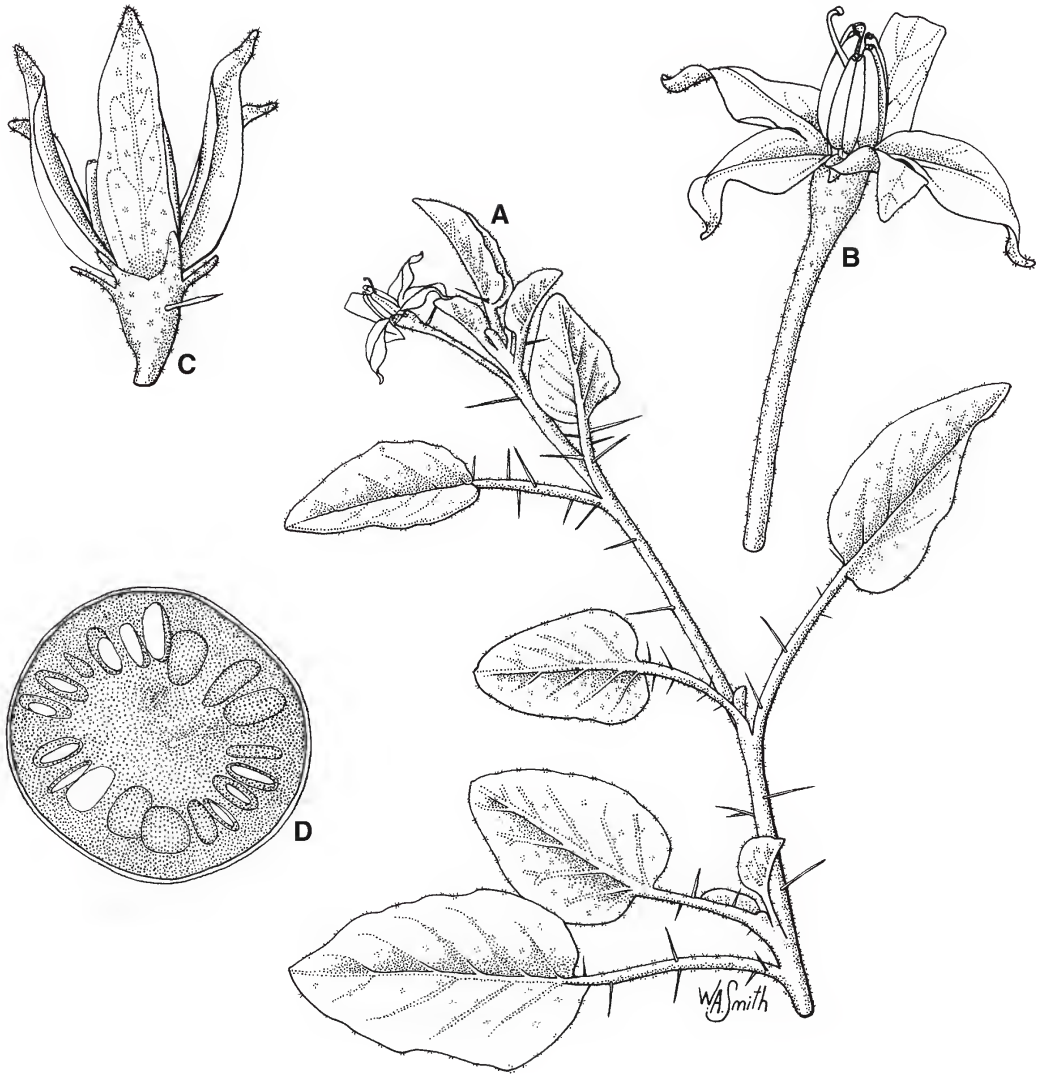

Fig. 7. ***Solanum unispinum***. A. flowering branchlet × 1. B. oblique view of an open flower × 3. C. lateral view of flower × 3. C. stamens, style and ovary × 4. D. cross-section of mature fruit × 3. All from *Bean 22512* (BRI).

Acknowledgements

I am grateful to David Albrecht (NT) for taking me into the field around Alice Springs to study various *Solanum* taxa, and for convincing me that *S. cleistogamum* is a distinct species. Angus Emmott of Noonbah Station kindly escorted me around his property to see noteworthy solanums that he had found, and supplied many images of them; he has also made excellent collections from other parts of western Queensland at my request. Will Smith (BRI) provided the illustrations and the distribution maps. Peter Bostock expertly translated the diagnoses into Latin.

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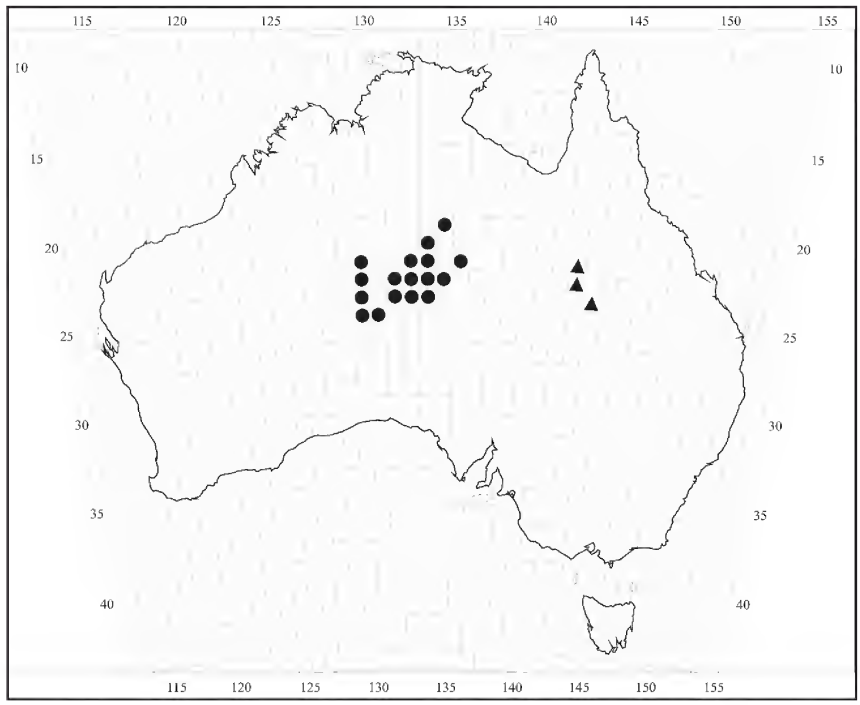
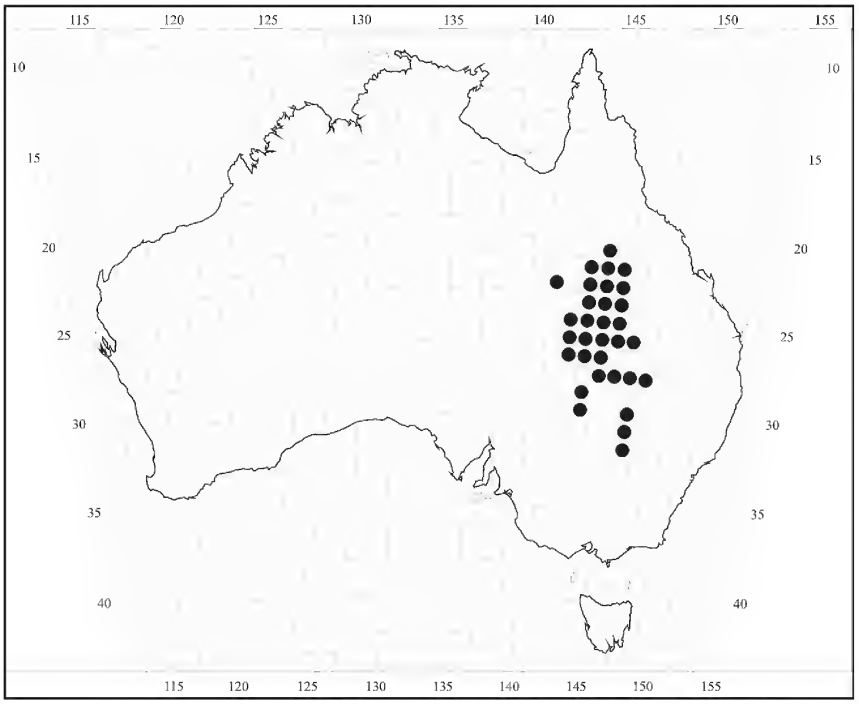
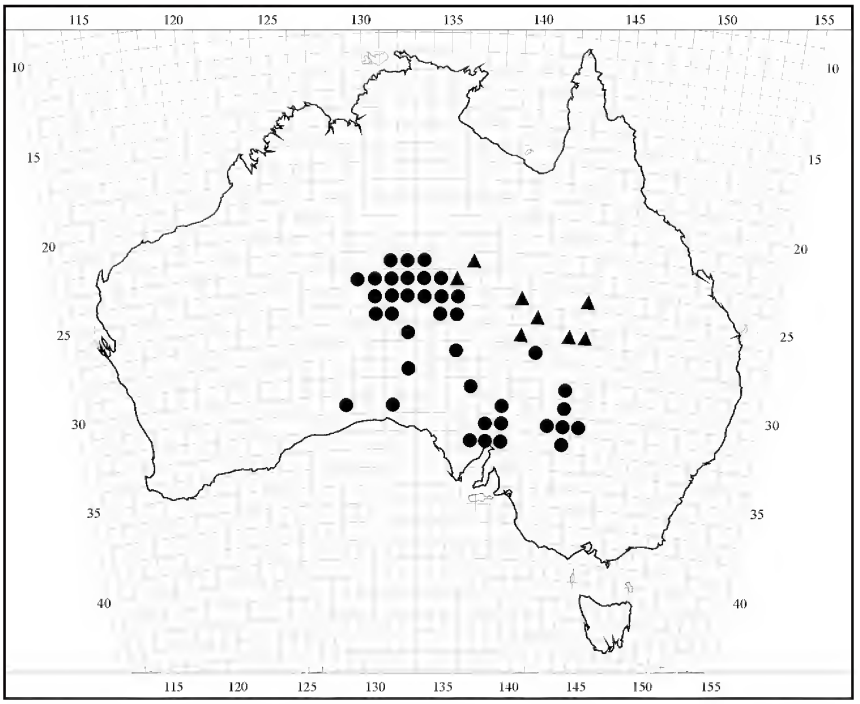


Map 1. Distribution of *Solanum aridicola* ● and *S. unispinum* ▲



Map 2. Distribution of *Solanum callosum*



Map 3. Distribution of *Solanum emmottii* ▲ and *S. lithophilum* ●

SHORT COMMUNICATION

Luvunga monophylla (DC.) Mabb. (Rutaceae): a new species for Queensland

David G. Fell[1,3] & David J. Stanton[2]

[1]3D Environmental, P.O. Box 337, Alstonville NSW 2477, Australia. Email: davidfell@3denvironmental.com.au; [3]corresponding author

[2]3D Environmental, PO Box 959, Kenmore, Queensland 4069, Australia.

The genus *Luvunga* Buch.-Ham. ex Wight & Arn. contains twelve species occurring in Asia, Malesia and Australia (Hyland *et al.* 2003). *Luvunga monophylla* is the sole Australian representative of Rutaceae subtribe *Triphasiineae* in the tribe *Aurantieae* Rchb. (Mabberley 1998); however, infrafamilial relationships in this part of the family remain to be fully resolved utilising molecular data and this group may not be recognized in the future (Kubitzki *et al.* 2010).

Luvunga monophylla (DC.) Mabb. is a facultatively deciduous, spiny shrub or climber, 0.5–3 m high with white, cream, yellow flowers, obovoid fleshy fruit to 10 mm diameter, and one or two seeds per fruit (Pedley 1987; Russell-Smith & Dunlop 1992; Hyland *et al.* 2003; Department of Environment and Conservation 2010). It was first collected from Australia in the Sir Edward Pellew Group of islands, Gulf of Carpentaria, in December 1802 by Robert Brown during Flinders' *Investigator* circumnavigation of Australia and was collected in Timor by J.B.L.C.T. Leschenault de la Tour during Baudin's 1800–1803 expedition in *Le Géographe* and *Le Naturaliste* (Mabberley 1998).

It has now been recorded on Iama (Yam Island), Torres Strait which is the first record of the species for Queensland. Prior to this collection it had been recorded from Australia in the North Kimberley and Dampierland bioregions of Western Australia (Department of Environment & Conservation 2010) and in the Arnhem Coast, Central Arnhem, Tiwi, Gulf Coastal, Gulf Fall and Uplands and Darwin Coastal Bioregions of the Northern Territory. The habitat in these areas includes monsoon forest, deciduous vine thicket and semi-deciduous vine thicket on coastal dunes and basalt scree slopes (Pedley 1987; Russell-Smith & Dunlop 1992; Liddle *et al.* 1994; Department of Planning & Infrastructure 2010). It is also found in the Philippines, Indonesia (Java) and Timor-Leste (Hyland *et al.* 2003; Cowie 2006).

A survey of the vegetation of the Torres Strait Islands, north Queensland, Australia, was carried out in 2007 (Stanton *et al.* 2008). The survey's primary objective was to map vegetation communities at 1: 25,000 and Regional Ecosystems at 1: 50,000, supplemented by floristic inventory and collections of voucher specimens for Australian herbaria. Collections of *Luvunga monophylla* from Iama (also known as Yam Island) were made in October 2007 (*Fell 8851 & Stanton* [BRI]). This occurrence extends its geographical range eastwards from the eastern Arnhem Land coast of the Northern Territory.

Iama (Yam Island)

Iama is a continental island of 186 ha located at 9°54′S 142°46′E. It is situated 91 km north-north-east of Cape York Peninsula and belongs to the Central Group of Torres Strait Islands. The island is the homeland of the Iamalgal people. As at the 2006 Census, the population was 309, of whom over 90% were Indigenous (Australian Bureau of Statistics 2007). Land tenure is Deed of Grant in Trust (DOGIT) and Native Title.

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The primary geology of the island is granite with a range of Holocene aged landforms fringing its margins. Coarse-grained granite, which forms the dominant landform feature, represents the most easterly extension of the Badu Granite batholith. Soil development is typically skeletal, with large granite boulders on lower slopes and littoral margins. Small areas of acid volcanic rock form a headland in the island's east. Holocene features include ridges of coralline sand and fine-grained estuarine deposits associated with a broad embayment on the island's northern coast (Willmott & Powell 1977; Stanton *et al.* 2008).

Remnant vegetation occurs over 75% of the island with the balance supporting regrowth, exotics, bamboo groves and cleared land. Broad vegetation types are deciduous and semi-deciduous vine forest and thicket, *Acacia* dominated open forests and woodlands, shrublands and shrubland complexes, coastal dune complexes, grasslands and mangrove forest (Stanton *et al.* 2008).

Luvunga monophylla on Iama

Our vegetation survey recorded *Luvunga monophylla* at eight sites on the island, within open forest dominated by *Acacia auriculiformis* A.Cunn. ex Benth. and in deciduous vine forest and semi-deciduous vine thicket. These vegetation types occur on rocky granitic hillslopes and the *Acacia* dominant vegetation is considered to have developed in response to past disturbance.

The *Acacia* open forest habitat is endemic to Iama and the Torres Strait Islands and is mapped as Regional Ecosystem 3.12.35f (Stanton *et al.* 2008). Vine forest species such as *Canarium australianum* F.Muell., *Terminalia subacroptera* Domin, *Bombax ceiba* var. *leiocarpum* A.Robyns and *Diospyros hebecarpa* A.Cunn. ex Benth. are typical canopy associates. Groves of the naturalised Bamboo (*Bambusa vulgaris* Schrad.) and scattered Mango trees (*Mangifera indica* L.) occur throughout this habitat and are indicative of a long history of traditional use by local people.

Deciduous vine forests and semi-deciduous vine thickets (RE3.12.35a and RE3.12.21a) are extensive on the lower exposed rocky slopes and feature canopy species such as *Erythrina insularis* F.M.Bailey, *Antiaris toxicaria* var. *macrophylla* (R.Br.) Corner, *Terminalia subacroptera*, *Canarium australianum*, *Bombax ceiba* var. *leiocarpum*, *Acacia auriculiformis*, *Manilkara kauki* (L.) Dubard, *Gyrocarpus americanus* Jacq. subsp. *americanus, Diospyros* sp. (Mt White P.I. Forster PIF14415), *Sterculia quadrifida* R.Br. and *Premna dallachyana* Benth.

The habitats in which *Luvunga monophylla* occurs are in good condition and at the time of survey were relatively undisturbed and free of weeds. A conservative estimate of population size for *Luvunga monophylla* is between 50 and 100 individuals. The area of extent is 50 ha.

Discussion

The nature of the disturbance history in the *Acacia* open forest is unknown, although the community would be expected to burn in hot conditions. Old charred stumps indicate that it is occasionally burnt, largely in a wildfire regime. Resilience to fire is documented from Northern Territory populations of *Luvunga* which have an ability to resprout from epicormic and basal lignotubers and display less than 30% mortality rate when subject to 100% leaf scorch. Life span is over 20 years with first seeding occurring between 6–20 years (Tropical Savannas Cooperative Research Centre 2010).

The fact that the *Acacia* dominant community is found only on Iama presents another puzzle. The nearby continental islands of Mabuyag (Mabuiag Island) and Gebar are dominated by open and closed forests of *Welchiodendron longivalve* (F.Muell.) Peter G. Wilson & J.T.Waterh., although not a single individual of this species was found on Iama. This may suggest that forests on Iama have developed independently from forest types on these neighbouring islands (Stanton *et al.* 2008). Extensive field surveys by Stanton *et al.* (2008) in similar habitats across the majority of the Torres Strait islands did not locate *Luvunga* elsewhere.

Prior to European contact the people of Iama practised traditional horticulture growing crops such as banana, yam and sweet potato (Haddon 1935; Neal 1989; Fuary 1991) with archaeological evidence suggesting that some gardening took place on rocky hillslopes (Neal 1989). It is likely that a combination of human disturbance, wind and fire have played a role in the development of *Luvunga* habitat.

No uses are documented for Australian populations of *Luvunga monophylla*. Specimens were shown to numerous members of the community during our visit to Iama in November 2010. Although they recognized the plant, they stated that they had no name or use for it. In Java, it is occasionally cultivated as a hedge plant (Kruse 2001: 1013). In India, the dried fruits of *Luvunga scandens* Roxb. are used in the production of a medicinal oil said to be effective in treating dermal infections and baldness (Garg & Jain 1999) and the roots and fruits are used for treatment of scorpion stings (Lien *et al*. 2002).

It is interesting to note that the occurrence of *Luvunga monophylla* across northern Australia appears to be coterminous with those areas visited in the past by Macassan bêche-de-mer fishermen from southern Sulawesi in what is now Indonesia, Timor-Leste and between Cape Leveque in Western Australia and the Sir Edward Pellew Group in the Northern Territory (Macknight 1969: 2, 27; Stacey 2007: 58). There is no firm evidence that this trade included Torres Strait, although there is an 1881 record of an Ambonese prau (boat) being driven into the region during the northwest monsoon season (Anonymous 1881). This raises the possibility that *Luvunga monophylla* was introduced to Australia by human vectors.

Conservation status of *Luvunga monophylla*

In the Northern Territory this species is assigned 'least concern' status under the *Territory Parks and Wildlife Conservation Act 2000*, and in Western Australia it is 'Not Threatened' according to the *Wildlife Conservation Act 1950*.

Cowie (2006) records the taxon from dry deciduous forest in Timor-Leste, noting that the forest type is under ongoing pressure from conversion to agriculture. The heavy exploitation of dry deciduous forests elsewhere in the Timor region for swidden agriculture has resulted in large-scale conversion to anthropogenic grassland–*Chromolaena* shrubland (Cowie 2006). The extent of its occurrence and condition in habitats in the Philippines and Java is not known.

Potential threats to the Iama population include habitat disturbance from infrastructure and residential development, weed incursion and perhaps wildfire. Pressures on the limited availability of land suitable for housing and infrastructure development is intensified by population growth and coastal erosion associated with regular tidal surges. This presents a considerable challenge for the island community and planning agencies.

In combination, these threats represent a risk of stochastic extinction of the species in Queensland due to its small population size and highly localised occurrence. Accordingly, the species should be assigned regional significance in the Cape York Peninsula Bioregion. Integration of ecological and genetic studies will be required to determine the management requirements of *Luvunga monophylla* on Iama. Further assessments of population size, phenology and recruitment is achievable at the local level with the assistance of the local ranger program.

Acknowledgements

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SHORT COMMUNICATION

Hydrocharis dubia (Blume) Backer (Hydrocharitaceae) is an alien species in Australia

A.R. Bean

Queensland Herbarium, Department of Environment & Resource Management, Brisbane Botanic Gardens, Mt Coot-tha Road, Toowong 4066, Queensland, Australia. Email: tony.bean@derm.qld.gov.au

Hydrocharis dubia (Blume) Backer, is an aquatic plant with a white 3-petaled flower that occurs widely in eastern Asia. It has been accepted as an indigenous species in Australia but recently this has been repeatedly questioned by weed control authorities. This note examines the evidence relating to its origin status and concludes that it is not native in Australia.

The genus *Hydrocharis* L. was revised by Cook & Luond (1982), with the recognition of three species, *H. morsus-ranae* L., *H. chevalieri* (De Wild.) Dandy and *H. dubia*. *Hydrocharis morsus-ranae* is widely distributed in Europe, with scattered occurrences in western Asia. It has become a serious weed in south-eastern Canada (Cook & Luond 1982) and in the north-eastern U.S.A. (Catling *et al.* 2003; O'Neill 2007). *Hydrocharis chevalieri* is restricted to central Africa, and is not recorded as a weed. *Hydrocharis dubia* is widely distributed in south-eastern Asia, from India to Japan and south to Java and New Guinea, and in Australia (Cook & Luond 1982). It has been referred to as a "noxious weed" in Japan (Oki 1994). Shaffer-Fehre (1991) transferred *Hydrocharis dubia* to *Limnobium*, a genus which until then had comprised two species confined to the Americas; however, this transfer has not been followed in the *Flora of Australia* (Jacobs & McColl 2011) and is not supported by molecular data (Les *et al.* 2006).

Hydrocharis dubia was first recorded for Australia by Bentham (1873) under the misapplied name *H. morsus-ranae*. The record was based on a specimen (now at K) collected by J. Bidwill, from "Wide Bay" between 1848 and 1853. This specimen was cited by Cook & Luond (1982) under *Hydrocharis dubia*. Bentham (1873) entertained the idea that it could be an introduced species in Australia.

Bailey (1902) recorded *Hydrocharis morsus-ranae* from "the still waters about the Brisbane River". There is a specimen record of *Hydrocharis dubia* on the BRI database with the locality "Brisbane River", but the specimen cannot currently be located.

Hydrocharis dubia has been found at 13 Australian locations in Queensland (Qld) and New South Wales (NSW) based on herbarium records (**Table 1**).

Hydrocharis dubia (as *Limnobium dubium* by some authors) has been regarded as an indigenous species in Australia (Aston 1973; Stanley & Ross 1989; Jacobs 1993; Holland & Hansen 2009; Jacobs & McColl 2011). The reasons for this have not been expounded, but they are probably two-fold: that the species is indigenous to south-east Asia, and natural dispersal from that region to Australia is not an unreasonable hypothesis; and that the species is included in Bentham's *Flora Australiensis*. Thomas & McDonald (1989) gave *Hydrocharis dubia* a status of '2V', meaning a Vulnerable species with a geographic range in Australia of less than 100 km. Presumably the authors, at that time, considered it native to south-eastern Queensland. Subsequently it was classified as "Vulnerable" under the Queensland Nature Conservation Act 1992, and "Vulnerable" under the Environment Protection and Biodiversity Conservation Act 1999.

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Table 1. Locations for *Hydrocharis dubia* in Australia over time

Localities	Time period of collections
Wide Bay, Qld	1848–1853
Clarence River, NSW	1882
Brisbane River, Qld	pre-1902
Harrisville, Qld	1960, 1985, 1986
Bountiful Creek, Richmond River, NSW	1967
Frederickton near Kempsey, NSW	1968
Beaudesert, Qld	1971, 1977
Toomba, Qld	1977, 1996, 1997, 2001, 2008
16 km W of Casino, NSW	1978
Ayr, Qld	1994
Rosewood, Qld	1999, 2001, 2009
Fletcher Ck, Qld	2002, 2004
Giru, Qld	2004

The following observations are made on *Hydrocharis dubia* in Australia drawing on criteria used by Bean (2007) to assess its origin status:

1. it grows in disturbed or modified sites, and has not been found in remote "intact" areas. This is consistent with a species introduced by man, and transported to other sites via machinery or with soil, or dumping of plants

2. it is persistently invasive (one label reports it covering two dams), and is not in ecological balance with surrounding biota

3. it does not appear to have any pests or diseases, suggesting it has arrived recently in evolutionary terms

4. it has substantially expanded its geographical range over the last 40 years (see list of locations above)

5. its distribution is highly discontinuous, and the discontinuities cannot be explained by climatic or other natural criteria

6. the initial locations in Australia are highly disjunct geographically from nearest known occurrences in Asia

7. the first record for Australia (Wide Bay, between 1848 and 1853, by John Bidwill) is not early enough to preclude human introduction

Hydrocharis dubia fails all of the ecological criteria for an indigenous species, and the historical criteria are equivocal. In the key of Bean (2007) it readily keys to "alien" (1x, 2).

In conclusion, there is a strong weight of evidence to support an alien status for *Hydrocharis dubia* with regard to its occurrences in Australia. I recommend that this species be recorded as naturalised for Australia, and de-listed from the *Queensland Nature Conservation Act 1992*, and the *Environment Protection and Biodiversity Conservation Act 1999*.

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SHORT COMMUNICATION

Reinstatement of *Vigna suberecta* Benth. (Fabaceae: *Phaseoleae*)

Ailsa E. Holland

Queensland Herbarium, Department of Environment & Resource Management, Brisbane Botanic Gardens, Mt Coot-tha, Toowong, Queensland 4066, Australia. Email: Ailsa.Holland@derm.qld.gov.au.

The genus *Vigna* Savi is a pantropical, herbaceous legume genus of about 200 species distributed throughout the tropics and subtropics of both hemispheres. In Australia, there are a number of endemic *Vigna* taxa, including those in the wide ranging *V. lanceolata* Benth. complex (Lawn & Holland 2003).

Vigna lanceolata and *Vigna suberecta* Benth. were both originally described by Bentham in Mitchell (1848). On the 10th of October 1846 Mitchell arrived at the summit of Mt Farraday (Mitchell 1848: 347) where he first encountered "the yellow *Vigna lanceolata*" and collected specimen number 376, the left hand specimen on Kew sheet H/1215/89 4, labelled "*Vigna lanceolata* Benth. in Mitch Austr. Trop. p. 350. 1846. 376. Oct 10 402, small twining herb. fl yellow, top of Mount Farraday" and annotated as the type by Marechal, although he later refers to specimen 370 (Marechal *et al.*: 1978: 168) which is probably an error.

On 13th of October 1846, Mitchell had advanced to Mt Owen (Mitchell 1848: 350), where he found "a new species of *Vigna* with yellow flowers" and collected specimen number 401. This is the right hand specimen labeled as "Oct 13 420 on Mt Owen…probably label changed with *Swainsona phasoides*", on another Kew sheet H/1215/89 3 and is the same taxon as the previous. This species was described by Bentham in the footnote on this page (translated): "V. LANCEOLATA (Benth. MS.). *Glabrous, twining. Leaflets lanceolate, reticulate, entire, hastate or lobed at the base. Peduncles much longer than leaves, with few flowers clustered at apex. Calyx glabrous, campanulate, the lobes shorter than the tube; keel beak acute.*"

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Mitchell arrived on the Moonie River on the 18th November 1846 (Mitchell 1848: 387) and collected another specimen "in the thick forest, a new species of *Vigna* very near *V. lanceolata*, though very different in habit". This is specimen number 466, Kew sheet H/1215/89 5, label "1846. 466. *Vigna suberecta* Benth. in Mitch Austral. trop." This species was described by Bentham in a footnote (Mitchell 1848: 388) translated as: "V. SUBERECTA (Benth. MS.); *slightly pubescent, sub-erect, branched. Leaflets broadly lanceolate leaflets, entire, hastate or 3-lobed at base. Peduncles somewhat shorter than the leaves, few-flowered at the apex. Calyx pubescent, campanulate; calyx lobes subequal to the tube; keel beaked, acute. Pod sparsely pubescent.*"

Bentham later (1864) placed *Vigna suberecta* in synonymy under *V. lanceolata*, but did not give a reason. Examination of the type material (the sheets indicated above) shows that the specimens labelled "*V. lanceolata*" (376 and 401) do indeed belong to the same taxon, but the specimen labelled "*V. suberecta*" (466) is quite distinct and so this name is here reinstated for a relatively widespread species.

Vigna suberecta Benth., in T.L.Mitchell, *J. Exped. Trop. Australia [Mitchell]* 388 (1848). **Type:** subtropical New Holland [Queensland. Darling Downs District: Moonie River], [18 November] 1846, *T.L. Mitchell 466* (holo: K).

Vigna sp. (Jimbour A.R.Bean 12534); Holland & Pedley (2007: 84).

Herb with perennial tuberous rootstock; tubers cylindrical, up to 15 mm diameter. **Aerial parts** annual or short-lived perennial. **Stems** to 80 cm long, initially semi-erect, becoming twining in upper parts at maturity, with a few appressed, retrorse white hairs to 0.8 mm

long. First leaves unifoliolate, petiolate; blade narrowly triangular, 2–2.5 cm long, 4–7 mm wide, truncate to slightly sagitate at base. Remaining leaves trifoliolate; **petiole** 2.2–5.7 cm long; **rachis** 5–15 mm long; **stipels** lanceolate, 1–2.3 mm long. **Terminal leaflets** lanceolate, becoming linear towards the plant apex, 2.5–7 cm long, 3–17 mm wide; 3 to 13 times as long as wide, apex acute, base cuneate with rounded or acute **lobes**, 1–4 mm long and wide; upper surface glabrous or nearly so, lower surface very sparsely appressed hairy; **midrib** uniformly coloured (not silver striped), **secondary nerves** forming an angle of 45–80° to the midrib, looped at margin. **Lateral leaflets** similar, slightly shorter than terminal leaflet. **Stipules** triangular to lanceolate, 1.8–3.5 mm long, 3 or 5-veined, acute, base ± cordate. **Subterranean inflorescences** absent. **Aerial inflorescences** with 2–10 flowers crowded towards the apex; flowers developing sequentially in pairs with a swollen **extrafloral nectary** between each pair. **Peduncle** terete, striate, 2–16 cm long; pedicel 1–2.2 mm long; bracts and bracteoles ovate, acute, 0.8–1.2 mm long; bracteoles inserted at base of calyx. **Calyx** campanulate, 2.2–4.5 mm long, glabrous or minutely ciliate; tube 1.5–2.5 mm long; lobes triangular, equal to or slightly shorter than tube, upper two joined almost to apex, lower one longest. **Corolla** pale yellow, glabrous. **Standard** transversely elliptic, emarginate, 6–9 mm long, 10–14 mm wide; the inner surface with two U-shaped pockets with vertical ridges, *c.* 2 mm long; apex emarginate; base somewhat auriculate; claw 1–1.5 mm long. **Wings** 6–10 mm long, 4–7 mm wide, expanding from a narrow base into a broadly rounded apex covering the keel; upper margin with a small spur near base; lower margin without a spur; claw 1.5–2 mm long. **Keel** 5–9 mm long, 4–6 mm wide; upper margin with a shallow pocket near base; lower margin strongly curved; beak strongly upturned and twisted through *c.* 180°; claw 2–3 mm long. **Filament tube** *c.* 10 mm long, strongly upturned; filaments free for 1/3 – 1/2 their length; anthers 2–3 mm long. **Ovary** pubescent, 4–6 mm long; style terete, twisted, anterior face hairy for 1/3–1/2 the length; stigma situated near apex, the **style** slightly prolonged past stigma into a beak 2–3 mm long, straight or slightly curved by less than 90°. **Pods** slightly curved, 2.5–4 cm long, 3–6 mm wide, sparsely puberulent when young, glabrescent, brown or black at maturity. **Seeds** 6–10, oblong, dark brown or reddish, 3–4.2 mm long, 3–3.7 mm wide, 2–2.6 mm thick; hilum central, 1–1.3 mm long.

***Additional selected specimens examined*: Queensland.** Leichhardt District: 169 km from Clermont toward Mackay on Peak Downs Highway, Dec 1987, *Lawn & Cottrell ACC906* (BRI); 9 km N of Capella, Mar 1995, *Fensham 2769* (BRI); 9 miles [14.4 km] SSW of Comet, Feb 1960, *Johnson 1382* (BRI). Burnett District: Wooroolin, Portion 31, Nov 1961, *Bailey s.n.* (BRI [AQ239116]). Maranoa District: Roma, Mar 1936, *Blake 10854A* (BRI). Darling Downs District: Marnhull, SE of Jandowae, Dec 2001, *Bean 18199* (BRI); Jimbour Plain, Mar 1951, *Bisset S758* (BRI); CSIRO experimental area, Nandi, Dalby, Apr 1983, *Watkinson ACC207* (BRI); 19 km SSW of Dalby, Feb 1995, *Fensham 1909* (BRI); Jondaryan, Feb 1935, *Blake 7753* (BRI); 8 km S of Cecil Plains turnoff (E of Dalby) at Duncan's road turnoff, Nov 2001, *Holland 1388 et al.* (BRI, US); Cecil Plains to Milmerran Road at River Road turnoff, Mar 1987, *Lawn et al. ACC261* (BRI). **New South Wales.** Yalleroi, *s.dat., Wilson ACC210* (BRI); Moree, Mar 1962, *Cutting s.n.* (NSW); Delungra, Feb 1968, *Gilroy s.n.* (NSW); Wee Waa, *c.* 32 km NW of Narrabri, Feb 1981, *Nehrkorn s.n.* (NSW); Edgeroi, 16 miles [25.6 km] N of Narrabri, Feb 1966, *Quick s.n.* (NSW); Gunnedah, May 1938, *O'Reilly s.n.* (NSW).

***Distribution and habitat*:** *Vigna suberecta* is a widespread species occurring mainly in the Brigalow Belt bioregion of Queensland from Clermont in the north to as far west as Roma, and as far south as Gunnedah in New South Wales. It is confined to heavy clay soils in grassland or open eucalypt woodland with grassy understorey.

***Phenology*:** Flowers in summer, mostly between November and March and fruits through to June, depending on rainfall.

***Notes*:** *Vigna suberecta* is distinguished from *V. lanceolata* by the leaflets lacking a silver midrib, wing petals rounded, keel beak twisted *c.* 180°, and seeds with a longer (1–1.3 mm) hilum (**Table 1**).

While *Vigna suberecta* is a semi-erect herb in the early stages, it becomes vine-like and twining at maturity. *Vigna suberecta* often resprouts from tubers in spring, or after fire.

Table 1. Morphological character differences between *Vigna lanceolata* Benth. and *V. suberecta* Benth.

Character	*V. lanceolata*	*V. suberecta*
Underground inflorescences	yes	no
leaflets midrib silver striped	yes	no
standard with raised vertical ridges	no	yes
wing shape	triangular	rounded
keel beak twist	*c.* 90°	*c.* 180°
seed hilum length	0.7–1.1 mm	1–1.3 mm

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