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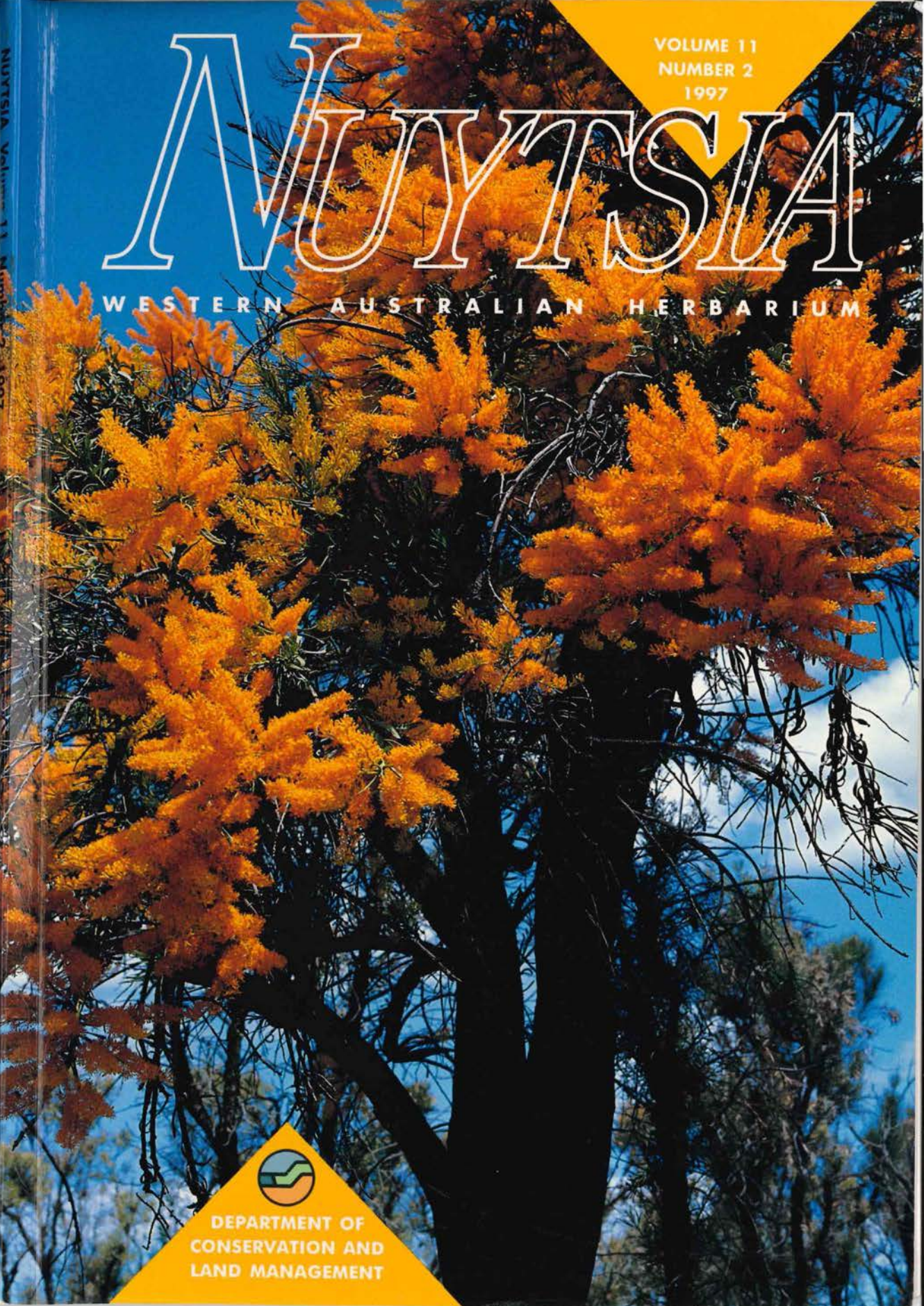

DEPARTMENT OF
CONSERVATION AND
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Department of Conservation and Land Management, Western Australia

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Cover

Nuytsia floribunda (Labill.) R. Br. ex Fenzl (Loranthaceae) - the Western Australian Christmas Tree is one of the few arborescent mistletoes in the world. This endemic tree is a semi-parasite common in sandy soil from the Murchison River to Israelite Bay. The journal is named after the plant, which in turn commemorates Pieter Nuijts, an ambassador of the Dutch East India Company, who in 1627 accompanied the "Gulde Zeepard" on one of the first explorations along the south coast of Australia.

Cover design by Sue Marais

Photograph A.S. George

Three new species of *Phyllanthus* (Euphorbiaceae: Phyllantheae) for the Northern Territory, one new species for Western Australia, and notes on other *Phyllanthus* species occurring in these regions

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Abstract

Hunter, J.T. and Bruhl, J.J. Three new species of *Phyllanthus* (Euphorbiaceae: Phyllantheae) for the Northern Territory, one new species for Western Australia, and notes on other *Phyllanthus* species occurring in these regions. Nuytsia 11(2): 147-163 (1997). *Phyllanthus cauticola*, *P. prominulatus* and *P. sulcatus* from the Northern Territory, and *P. baeckeoides* from Western Australia are described. Notes are presented on the nomenclatural problems of previously named taxa from these regions. A key to the species of *Phyllanthus* L. from the Northern Territory and Western Australia is presented.

Introduction

The taxonomy of *Phyllanthus* L. species (Euphorbiaceae: Phyllantheae) has presented a problem within Australia due to the lack of a continent-wide treatment since Bentham (1873). In our revision of the Phyllantheae for the "Flora of Australia", new taxa have been delimited and nomenclatural issues have been highlighted (e.g. Hunter & Bruhl 1996, 1997). This paper presents full descriptions of new *Phyllanthus* species we recognize for the Northern Territory and Western Australia. Other papers dealing with new taxa and issues in other states will be presented in other Australian taxonomic journals.

Detailed coverage of affinities, phylogeny and unusual morphological features are beyond the scope of this paper and we refrain from *ad hoc* discussions of such matters. They will be dealt with after further investigations, in subsequent papers.

Methods

Sampling and Organization of Data. Significant proportions of the *Phyllanthus* specimens held by the herbaria AD, BRI, CANB, DNA, HO, MEL, NSW, PERTH and QRS, and historically important *Phyllanthus* specimens from A and GH were provisionally sorted into taxa. Close inspection of these taxa and subsequent re-sorting of specimens formed the basis for our decisions on the status of these taxa. Ten representative specimens (where available) of these taxa were chosen for detailed analysis of quantitative micromorphological characters. Macromorphological characters (qualitative and

quantitative, e.g. leaf length) were scored in all available material. Selection of the ten specimens for study was based on specimen quality in terms of the amount and number of developmental stages displayed.

A DELTA (Dallwitz 1980; Dallwitz *et al.* 1993) list of 395 characters and their states has been created by the authors for the Phyllantheae (Bruhl & Hunter unpublished). This was used to score attributes measured in selected specimens, together with those measured in all available material.

Fresh material was used where possible, but in most instances floral measurements were based on re-hydrated material. Mature leaves only were used for scoring leaf characters.

Terminology. For purposes of consistency across the members of the Phyllantheae, the perianth segments of *Phyllanthus* are referred to as sepals. Further developmental investigations need to be carried out to confirm this interpretation (Webster pers. comm.).

Terminology for seed surface characters follows that of Stearn (1992). A bordered hilum is indicated by a discoloured and often raised region surrounding the hilum. This character is most obvious in *Phyllanthus fuernrohrii* F. Muell. (see Hunter & Bruhl 1996: Figure 1A, C).

There are sometimes differences between the leaves of branches, referred to as 'branch leaves', and those on ultimate branchlets referred to as 'branchlet leaves'. Phyllanthoid branching is indicated by a reduction of the leaf that subtends a branch/branchlet to a scale-like structure, as illustrated by Webster (1970). Branch leaves exhibiting intermediate reduction in size, but still clearly laminate, are referred to as 'reduced'. Care should be taken where leaves may have fallen, to check for a leaf scar which will always be present. The term 'prominulous' is as given by Stearn (1992).

Citation. Type specimens of all relevant taxa have been seen by one or both of the authors, unless stated otherwise. Photographs of type specimens examined at BM and K are held at NE, together with photographs taken of type specimens on loan to NE.

A list of all specimens studied will be deposited at NE. An INTKEY dataset for interactive identification will be made available on completion of our study of the Australian Phyllantheae.

Taxonomy

1. Phyllanthus aridus Benth, Fl. Austral. 6: 110 (1873). *Type*: Northern Australia, Barren Shores of Brunswick Bay and Port Warrender, Vansittart Bay, N.W. Coast, *A. Cunningham* (*holo*: K).

Phyllanthus polycladus W. Fitzg. *nom. illeg. non P. polycladus* Urb., Symb. Antill. 1: 333 (1898) - *P. hesperonotos* Govaerts & Radcl.-Sm., Kew Bull. 51: 177 (1995). *Type*: Edkins Range, Western Australia, August 1905, *W. V. Fitzgerald* 1437 (*holo*: NSW).

Phyllanthus sp. C, Wheeler *et al.*, Flora of the Kimberley Region 624 (1992).

Distribution. Phyllanthus aridus occurs chiefly in the Kimberley region of Western Australia, but is also known from sporadic localities south of Darwin in the Northern Territory.

Notes. The name *Phyllanthus aridus* seems to have been little used within Australia, especially in recent decades. More commonly the name *Phyllanthus polycladus* W. Fitzg. (see Wheeler *et al.* 1992) has been applied to specimens referable to *P. aridus*. *Phyllanthus aridus* has priority over *P. polycladus*. In any case, the latter is a secondary homonym of *P. polycladus* Urban, a North American species with no close affinity to *P. aridus*.

The recent publication of *Phyllanthus hesperonotos* Govaerts & Radcl.-Sm. overlooked the priority of the name *Phyllanthus aridus*. Govaerts & Radcliffe-Smith (1995: 177) state that "the species is found in the south of Western Australia", yet we have seen no specimens of *P. aridus* from southern Western Australia.

Phyllanthus aridus is a variable species that is in need of further close study, and may prove to contain more than one entity. One variant is distinguished by its linear leaves and very long pedicels (see *Dunlop* 8223 DNA, *Aplin* 5013 DNA), whereas most populations of this species possess elliptic leaves and shorter pedicels.

2. Phyllanthus baeckeoides J.T. Hunter & J.J. Bruhl, *sp. nov.*

A *Phyllanthus calycino* habitu dioeis, stipulis rubris ovatis, pedicellis brevioribus, fructibus et seminibus parvioribus, differt.

Typus: Merolia Station, Western Australia, 25 August 1989, *A. L. Payne* 2492 (*holo*: PERTH 01165577) [male].

Dioecious *shrubs*, 0.5-1.5 m tall. *Branchlets* persistent, rounded, 2.5-7 cm long, 0.4-0.7 mm wide, glabrous. *Stipules* persistent, free, 0.7-2.1 mm long, red, ovate, chartaceous, entire or sometimes lacerate, glabrous; base truncate to cordate; apex acute to acuminate. *Branch leaves* normal. *Branchlet leaves* alternate, distichous, jointed, symmetrical, concave, held close to the stem. *Petiole* 0.4-0.8 mm long, 0.2-0.4 mm wide, glabrous. *Lamina* 2.5-14.3 mm long, 0.8-2.4 mm wide, elliptic, light-green to mid-green, obscurely veined, glabrous; base symmetrical, rounded to obtuse; apex recurved, ecaudate, rounded to retuse, mucronate; margins revolute. *Bracts and bracteoles* deciduous. *Inflorescences* indeterminate, axillary, sessile. *Male flowers* solitary; pedicels 0.8-3.5 mm long, glabrous; sepals 6, free, ascending to divergent, 2-3.9 mm long, 1.3-2.7 mm wide, white to yellow, elliptic to circular, emarginate, retuse, rounded to obtuse, glabrous; disk comprising discrete lobes, 2-3.1 mm wide, lobes lenticular; stamens 3, 1-whorled, erect; filaments completely connate, erect, terete, 1.2-2.6 mm long; anthers extrorse, erect to ascending, oblong, 0.9-1.4 mm long; locules parallel. *Female flowers* solitary; pedicels at anthesis and in fruit 2.2-2.8 mm long, 0.3-0.5 mm wide, glabrous; sepals free, 6, 1.5-3 mm long, 1.2-2.1 mm wide, elliptic, circular to ovate ascending to divergent, green to yellow, with a distinct white margin, retuse to obtuse, glabrous; disk crenate, 1.5-2.1 mm wide; styles 3, free although connate at the base, erect to ascending, red, 0.7-1.1 mm long, 0.2-0.3 mm wide, narrow-terete, glabrous; ovary 0.5-1.2 mm long, 0.9-1.9 mm wide, transversely ellipsoid, apically depressed, smooth, glabrous. *Fruit* a capsule, septicidal, transversely ellipsoid, apically depressed, 2.4-2.9 mm long, 3.7-4 mm wide, yellow-brown or green, cartilaginous, smooth, glabrous, grooved septicidally; column persistent, 'lanceolate' to obtrullate, 1.4-1.8 mm long. *Seeds* yellow to yellow-brown, prismatic, laterally compressed, 1.8-1.9 mm long, 1.3-1.5 mm wide, smooth; hilum slightly depressed, circular to ovate, cavity more or less basal. (Figure 1A-C)

Specimens examined. WESTERN AUSTRALIA [precise localities withheld]: Mt Clifford, *Severne* 360269 (PERTH); White Cliffs Station, 24 July 1988, *S. Petty* 2083 & 2084 (PERTH); Laverton, Sep. 1990, *Barret s.n.* (PERTH).

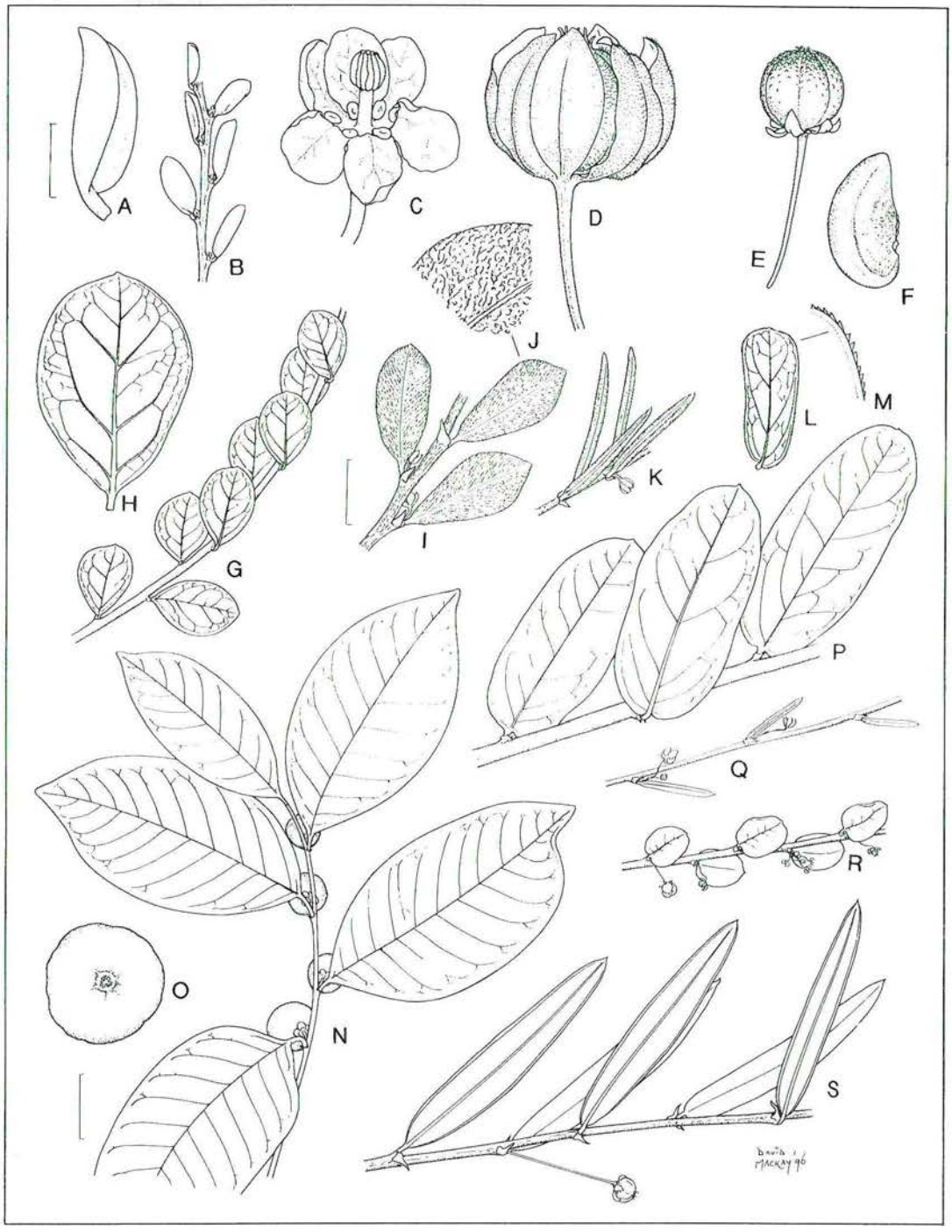

Figure 1. A-C *Phyllanthus baeckeoides* A - leaf, B - branchlet, C - male flower; D *P. carpentariae* D - fruit enclosed by sepals; E-F *P. exilis* E - fruit, F - seed; G-H *P. prominulatus* G - branchlet, H - leaf; I-K *P. scaber* I - branchlet, J - leaf detail, K - branchlet; L-M *P. sulcatus* L - leaf, M - leaf detail; N-O *P. reticulatus* N - branchlet, O - fruit; P-S *P. virgatus* - branchlets. Scale bars: A, C, D, E, H, J, M = 2 mm; B, G, I, K, L, P, Q, R, S = 5 mm; F = 1 mm; N = 1 cm; O = 4 mm. Drawn from *S. Petty* 2083 (PERTH) (A,B,C); *V.J. Neldner* 2755 (BRI) (D); *G.L. Wightman* 2573 & *M. Clark* (DNA) (E,F); *M.O. Parker* 739 (DNA) (G,H,); *G.L. Webster* 18628 (NSW) (I,J); *M.E. Phillips* 1418 (CBG) (K); *C.R. Dunlop* 6107 & *J. Taylor* (DNA) (L,M,); *K.F. Kenneally* 10468 (PERTH) (N,O); *C.R. Dunlop* 8673 & *N.G. White* (DNA) (P); *J.R. Clarkson* 4816 (BRI) (Q); *T.A. Halliday* 450 (BRI) (R); *I.D. Cowie* 1453 & *C.R. Dunlop* (DNA) (S). Drawn by D. Mackay.

Distribution. Only known from localities near Laverton.

Habitat. Known from granite outcrops, and red-lateritic and sandy-clay soils.

Flowering and fruiting period. July to September.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority One. A ROTAP code (Briggs & Leigh 1988) of 2E-W is suggested. This species is known only from a few close localities and a handful of specimens, none within a reserve.

Etymology. The specific epithet refers to the superficial resemblance of the plants in flower to *Baeckea* L., a genus in the Myrtaceae.

3. Phyllanthus cauticola J.T. Hunter & J.J. Bruhl, *sp. nov.*

P. exili affini sed habitu pendenti, ramulis rotundatis, laminis latioribus et sepalis masculinis majoribus differt.

Typus: Kakadu National Park [precise locality withheld], Northern Territory, April 1993, *J.T. Hunter* 1589, *J.J. Bruhl & J.L. Egan* (*holo*: DNA; *iso*: BRI, DAV, NE, PERTH).

Monoecious *shrubs*. *Branches* rounded, 8-9.5 cm long; 0.2-0.3 mm wide, the upper parts of the branchlets are often red, papillose. *Stipules* persistent, free, 0.4-0.9 mm long, red, narrowly triangular, chartaceous, entire, glabrous to papillose; base rounded to obtuse; apex acute. *Branch leaves* normal. *Branchlet leaves* alternate, distichous, jointed, symmetrical, plane. *Petiole* 0.6-1.5 mm long, 0.1-0.4 mm wide, glabrous to papillate. *Lamina* 9.3-13.2 mm long, 3.7-4.1 mm wide, obovate, light-green to mid-green, paler below, pinnately veined, obscurely veined, glabrous to sparsely papillate; base symmetrical, obtuse to attenuate; apex erect, ecaudate, rounded to emarginate and sometimes cuspidate, mucronate; margins plane. *Bracts and bracteoles* deciduous, glabrous. *Inflorescences* unisexual or occasionally bisexual with the sexes mixed, indeterminate, axillary, sessile. *Male flowers* solitary; pedicels 0.4-0.6 mm long, glabrous; sepals 6, free, ascending, 1.8-2 mm long, 0.9-1.1 mm wide, white to yellow, elliptic to ovate, obtuse to acute, glabrous; disk comprising discrete lobes, about 1 mm wide, lobes lenticular; stamens 3, 1-whorled, erect; filaments completely connate, erect, terete, 0.7 mm long; anthers extrorse, erect to ascending, oblong to elliptic, 0.6-0.7 mm long; locules parallel. *Female flowers* solitary; pedicels at anthesis 2-2.3 mm long, 0.1-0.2 mm wide, in fruit 2.7-3.3 mm long, 0.1-0.2 mm wide, glabrous or sometimes papillate; sepals free, 6, 1.6-2.3 mm long, 0.8-1 mm wide, elliptic, at anthesis ascending and incurved, in fruit ascending, white, green to yellow, with a distinct white margin, obtuse to acute, glabrous; disk crenate, 0.6-0.8 mm wide; styles 3, free, divided for about half their length, erect to recurved, red, 0.3-0.4 mm long, about 0.1 mm wide, narrow-terete, glabrous, branches entire, linear; ovary 0.7-0.9 mm long, 0.7-0.8 mm wide, globose to ellipsoid, smooth, glabrous. *Fruit* a capsule, septicidal, globose to ellipsoid, 2-2.2 mm long, 0.9-2 mm wide, yellow-brown to green, cartilaginous, smooth, glabrous, grooved septicidally; column persistent, narrow oblong to 'lanceolate', 1.3-1.5 mm long. *Seeds* bi-coloured with the upper half red and the lower half yellow, prismatic to crescentiform, laterally compressed, 1.7-1.8 mm long, 0.5-0.8 mm wide, smooth; hilum markedly depressed, bordered, circular, cavity more or less basal.

Distribution. Known only from a small population at the type locality within Kakadu National Park, Northern Territory.

Habitat. Grows horizontally then pendulously from the sides of sandstone cliffs.

Flowering and fruiting period. April.

Conservation status. A ROTAP code (Briggs & Leigh 1988) of 2EC-Y is suggested. The species is at present only known from the type locality.

Etymology. In reference to the habit of the whole plant as it projects horizontally from sandstone outcrops.

Notes. Phyllanthus cauticola is unusual in having elongated fruits and seeds, characters of *Phyllanthus* in Australia that are otherwise only known from *P. exilis*. These attributes are similar to those seen in *Sauropus*, however, a floral disk confirms the inclusion of *P. cauticola* in *Phyllanthus*. The seed of *P. cauticola* is unusual in being bi-colourous, a state not seen in other members of the genus.

4. *Phyllanthus debilis Klein ex Willd., Sp. Pl. 4: 582 (1805). *Type*: Ph. Niruri proxim Fankerb, 9 Jan[uary] 1799 (*holo*: BM).

Phyllanthus leai S. Moore, J. Linn. Soc. (Bot.) 45: 217 (1920). *Type*: North Australia, June-July 1886, *T.S. Lea* (*holo*: BM).

Distribution. This tropical weed has a sporadic and disjunct distribution within Australia. It is known from Darwin, and Kakadu National Park in the Northern Territory and from the Torres Strait Islands, Townsville and Mackay in Queensland.

Notes. Phyllanthus debilis is probably native to tropical Asia (Airy Shaw 1980). Until now *P. debilis* has not been recognized as occurring in Australia. Most collections of this species have been misidentified as *P. amarus* Schum. *Phyllanthus debilis* can be readily distinguished from *P. amarus* by the possession of six sepals rather than five.

Based on herbarium collections, *P. debilis* appears to have been introduced into Australia twice. The earliest known collection from Australia is the type specimen of *P. leai*, 1886 from Darwin. No more specimens of *P. debilis* appear to have been made until 1980, when it was again collected in Darwin.

5. Phyllanthus eutaxioides S. Moore, J. Linn. Soc. Bot. 45: 216 (1920). *Type*: East Coast [*sic*], *R. Brown* 3617 (*holo*: BM).

Phyllanthus sp. *Golden Sands*, Dunlop *et al.*, Flora of the Darwin Region 2: 233 (1995).

Distribution. Phyllanthus eutaxioides is restricted to the Darwin Region and the Gove Peninsula of the Northern Territory.

Notes. Although the name *P. eutaxioides* is valid, it seems not to have been used within Australia other than in Moore's original designation. Dunlop *et. al.* (1995) have referred to this species as *P.* 'Golden Sands' in the "Flora of the Darwin Region". *Phyllanthus eutaxioides* is variable and appears to have three variants: one (e.g. DNA 24813; DNA 24814) has larger stipules and leaves than the type variant, and a disc that is more inflated; another (e.g. DNA 5731; DNA 9440; MEL 226369) differs from the type variant in being papillose to scabrous on the stems and leaves. In both these variants the anther filaments are not fully fused, while they are in the type variant. For illustrations of *P. eutaxioides* see Dunlop *et. al.* (1995) [as *P.* 'Golden Sands']. Further studies of this complex are warranted.

Although *Phyllanthus eutaxioides* is restricted to the Darwin region and the Gove Peninsula within the Northern Territory, the type specimen locality is given as 'East Coast'. It appears that this was a mistaken locality, as Robert Brown, at the time of collecting this specimen, was in the Gulf of Carpentaria or part of Antrim's [Arnhem] Land (Dawson 1958).

6. Phyllanthus exilis S. Moore, J. Bot. 64: 97 (1926). *Type*: Groote Eylandt, February 1925, *S. Moore* 109 (*holo*: K).

Phyllanthus sp. aff. *virgatus*, Dunlop *et al.*, Flora of the Darwin Region 2: 233 (1995).

[*Phyllanthus trachygyne auct. non* Benth., Wheeler *et al.*, Flora of the Kimberley Region 622 (1992).]

Distribution. Phyllanthus exilis is a common species from the west coast of the Kimberley region of Western Australia to the Gulf country in Queensland.

Notes. Phyllanthus exilis, while a valid name, has not been used within Australia since its original publication. Most commonly specimens of *P. exilis* have been determined as *P. trachygyne* Benth. (Wheeler *et al.* 1992) which is a synonym of *P. virgatus* Forst. f.

Intriguingly both the name and description of *P. trachygyne* by Bentham (1873) indicate that its ovary is warted. However, the lectotype of *P. trachygyne* does not have a warted ovary and neither do any of the collections that otherwise conform to the type description. By contrast, specimens of the vegetatively similar *P. exilis* do have warted ovaries. Indeed, until we examined the ovary, fruits and seeds of type specimen of *P. exilis*, we were unable to determine to which species the type belonged. The fruit and seed are illustrated in Figure 1E,F. For further illustrations see Wheeler (1992) [as *P. trachygyne*] and Dunlop *et al.* (1995) [as *P.* sp. aff. *virgatus*].

7. Phyllanthus lacerosus Airy Shaw, Kew Bull. 35: 386 (1980). *Type*: black clay plain, Negri-Stirling area, 17°10' S 129°15' E, Northern Territory, 3 May 1974, *Dunlop* 3567 (*holo*: K).

Phyllanthus sp. A, Jacobs & Harden, Flora of New South Wales 1: 397 (1990)

Phyllanthus sp. A, Wheeler *et al.*, Flora of the Kimberley Region 623 (1992).

Notes. Independently, James & Harden (1990) and Wheeler (1992), treated *P. lacerosus* under *Phyllanthus* sp. *A*. The distribution of *P. lacerosus* indicates that it is not naturalized (as suggested in Wheeler 1992), but native. Hunter & Bruhl (1997) present a full description along with notes on distribution and synonyms. For illustrations see Wheeler (1992) [as *P.* sp. A] and James & Harden (1990) [as *P.* sp. A].

8. Phyllanthus prominulatus J.T. Hunter & J.J. Bruhl, *sp. nov.*

P. virgato affini a quo ramis angularibus as ellipsoideis, brevioribus, venis foliorum manifeste prominulis, sepalis femineis fructiferus brevioribus differt.

Typus: Kapalga [precise locality withheld], Northern Territory, *G.M. Wightman* 20 (*holo*: DNA).

Monoecious *herb*. *Branchlets* persistent, angular to ellipsoid, slightly winged, 0.6-1.7 cm long, 0.3-0.6 mm wide, glabrous. *Stipules* persistent, free, 0.5-0.7 mm long, red-brown, ovate to triangular, chartaceous, entire, glabrous; base cordate to amplexicaul; apex acute to acuminate. *Branch leaves* normal. *Branchlet leaves* alternate, distichous, jointed, brown when dry or remaining green, symmetrical, plane to concave. *Petiole* 0.3-0.8 mm long, 0.1-0.4 mm wide, glabrous. *Lamina* 5-8.8 mm long, 2.4-4.8 mm wide, elliptic, circular to obovate, light-green, paler below, pinnately veined, adaxially prominently veined, abaxially prominulous, glabrous; base symmetrical, rounded to obtuse; apex erect, ecaudate, obtuse to rounded, mucronate; margins plane, thickened; midrib abaxially raised with 4-8 raised parallel lateral veins per side, with marginal loops. *Bracts and bracteoles* deciduous, glabrous. *Inflorescences* at least sometimes bisexual with the sexes mixed, indeterminate, axillary, sessile. *Male flowers* solitary or sometimes clustered, 2-5 per cluster; pedicels 0.4-1.2 mm long, glabrous; sepals 6, free, ascending to divergent, 0.3-0.7 mm long, 0.2-0.5 mm wide, the margins are sometimes lobed once on each side (hastate), white to yellow, elliptic, circular, to ovate, obtuse and acute, glabrous; disk comprising discrete lobes, 0.2-0.4 mm wide, lobes lenticular; stamens 2-3, 1-whorled, erect; filaments free to connate for about half their length, erect, terete, 0.1-0.3 mm long; anthers extrorse, divaricate, elliptic to circular, 0.1-0.2 mm long. *Female flowers* solitary or sometimes clustered, 1-2 per cluster; pedicels jointed, at anthesis 0.3-1.1 mm long, 0.1-0.2 mm wide, in fruit 1-2.7 mm long, 0.1-0.2 mm wide, glabrous; sepals free, 6, 0.3-0.5 mm long, 0.2-0.3 mm wide, elliptic to ovate, at anthesis ascending to divergent, in fruit divergent to reflexed, white, green to yellow, with a distinct white margin, obtuse to acute, glabrous; disk crenate, 0.4-0.6 mm wide, glabrous; styles 3, free, divided for half or more of their length, divergent to recurved, yellow to green, 0.2-0.3 mm long, 0.1-0.2 mm wide, narrow-terete, glabrous, branches linear; ovary 0.2-0.5 mm long, 0.3-0.7 mm wide, transversely ellipsoid and apically depressed, smooth, glabrous. *Fruit* a capsule, septicidal, transversely ellipsoid and apically depressed, 0.8-0.9 mm long, 1.5-1.8 mm wide, yellow-brown, red-brown to green, cartilaginous, smooth, glabrous, grooved septicidally; column persistent, angular-ovoid to 'lanceolate', 0.3-0.5 mm long. *Seeds* pallid-brown to red-brown, prismatic, laterally compressed, 0.6-0.7 mm long, 0.5-0.7 mm wide, granulate; hilum slightly depressed, circular to ovate, cavity more or less basal. (Figure 1G,H)

Selected specimens examined. NORTHERN TERRITORY [precise localities withheld]: Munmalary Station, *P.K. Latz* 3890 (DNA); Kapalga, *G.M. Wightman* 20 (DNA); Berry Springs, *M.O. Parker* 739 (DNA); Hayward Creek, *I.D. Cowie* 1202 & *G.J. Leach* (DNA).

Distribution. Known from a few isolated localities within Kakadu National Park and around Darwin, Northern Territory.

Habitat. Known from sedgeland and damp places within savanna woodland.

Flowering and fruiting period. April to May.

Conservation status. A ROTAP code (Briggs & Leigh 1988) of 2EC-N is suggested.

Etymology. The specific epithet refers to the obviously prominulate veins on the leaves.

Notes. The *Phyllanthus virgatus* complex is morphologically similar to *P. prominulatus,* from which it can readily be distinguished by its distinctive, delicate and prominulous leaves.

9. Phyllanthus scaber Klotzsch, Pl. Preiss 1: 179 (1845). *Type*: In litore rupestri promontorii Cape Riche, 18 Nov[ember] 1840, *Preiss* 1200 (*holo*: K). (Figure 1I-K)

Phyllanthus scaber Klotzsch var. *angustifolius* Muell. Arg., Prodromus 15: 372 (1866). *Type*: In Nova-Hollandia austro occident, ad King George's Sound (Cuming qui misit anno 1860, in hb. DC.) (*holo*: G-DC).

Phyllanthus scaber Klotzsch var. *pallidiflorus* Muell. Arg., Prodromus 15: 372 (1866). *Type*: Ad King George's Sound Novae-Hollandiae (Cuming qui misit anno 1860, in hb. DC.) (*holo*: G-DC).

Phyllanthus maitlandianus Diels, Bot. Jahrb. Syst. 35: 338 (1904). *Type*: Hab. In distr. Irwin pr. Chapman River ad latera vallis umbrosa in calcareis humosis flor. m. Sep. *Diels* 4131 (*holo*: *n.v.*, presumed destroyed at B).

Distribution. Phyllanthus scaber has a disjunct distribution predominantly along the western and southern coasts and islands of Western Australia.

Notes. This species shows much morphological variation. In general, though, the most common variation is in leaf size and shape. Some specimens have wide leaves and others have very narrow leaves. The latter have often been identified as *Phyllanthus maitlandianus*. The narrowness of the leaves is not a constant character, however, as there is much variation between specimens, and even within a single collection. We therefore treat *Phyllanthus maitlandianus* as a synonym of *P. scaber*.

10. Phyllanthus sulcatus J.T. Hunter & J.J. Bruhl, *sp. nov.*

P. urinaria affini sed caulibus ellipsoideis brevioribus, ramulis brevioribus, fructu minus verrucato, seminibus parvioribus, et depressione extra hilum adest differt.

Typus: 15 km S of Kakadu National Park Headquarters, Jabiru, Burdulba River area flats, Northern Territory, 13 May 1988, *A.A. Munir* 5614 (*holo*: AD; *iso*: DNA, NE).

[*Phyllanthus urinaria auct. non* L.: Wheeler *et al.*, Flora of the Kimberley Region 622 (1992); Forster & Henderson, Queensland Vascular Plants: Names and Distributions 116 (1993).]

[*Phyllanthus leai auct. non* S. Moore: Dunlop *et al.*, Flora of the Darwin Region 2: 231 (1995).]

Monoecious *annual herb,* to 0.3 m tall. *Branchlets* persistent, ellipsoid to flattened, ribbed, 1-4 cm long, 0.2-0.4 mm wide, glabrous to papillose in longitudinal rows. *Stipules* persistent, free, 0.4-1.7 mm long, cream to pink, lanceolate, ovate to triangular, membranous, with a distinct white margin, entire to lacerate, glabrous; base truncate, rounded, cordate to sagittate; apex acute. *Branch leaves* reduced leaf-like to scale-like with the branches bearing modified leaves that are broadly ovate in appearance but are not reduced in size, upper branches are subtended by scales, pallid-brown, glabrous. *Branchlet leaves* alternate, distichous, jointed, symmetrical, plane. *Petiole* 0.2-0.7 mm long, 0.1-0.4 mm wide, glabrous. *Lamina* 5.2-12 mm long, 1.7-6 mm wide, oblong to ovate, mid-green, paler below, pinnately veined, abaxially prominulous, glabrous to glabrescent with younger leaves sometimes scabrous along the major veins; base sometimes ± oblique, rounded to cuneate; apex erect, ecaudate, acute, obtuse or rounded, mucronate, with a small callous; margins serrate to serrulate, plane; midrib abaxially raised with 3-7 lateral veins with marginal loops. *Bracts and bracteoles* deciduous, glabrous. *Inflorescences* unisexual, branchlets with distal males, indeterminate, axillary. *Peduncles* only on female flowers, 0.2-0.9 mm long at anthesis, otherwise sessile. *Male flowers* at least sometimes clustered, 1-2 per cluster; pedicels 0.1-0.4 mm long, glabrous; sepals 6, free, ascending to divergent, 0.3-0.8 mm long, 0.2-0.5 mm wide, white

to yellow, elliptic, ovate to obovate, rounded to acute, glabrous; disk comprising discrete lobes, 0.2-0.5 mm wide, lobes lenticular; stamens 3, 1-whorled, symmetrical, erect; filaments completely connate, erect, terete, *c.* 0.1 mm long; anthers extrorse, erect, connate, oblong to elliptic, 2-3 mm long; locules parallel. *Female flowers* solitary, sessile at anthesis; pedicels present only in fruit, jointed; sepals free, 6, 0.5-1 mm long, 0.2-0.4 mm wide, lanceolate to triangular, at anthesis ascending to divergent, in fruit divergent to reflexed, white, yellow-brown to green, with a distinct white margin, rounded to acute, glabrous; disk crenate, 0.4-0.6 mm wide; styles 3, free, divided for about half or less of their length, erect to ascending, white to yellow, 0.1-0.4 mm long, 0.1-0.2 mm wide, narrow-terete, glabrous, branches entire, linear; ovary 0.4-0.7 mm long, 0.6-1.4 mm wide, transversely ellipsoid, apically depressed, often red in colour, colliculate, glabrous. *Fruit* a capsule, septicidal, transversely ellipsoid, apically depressed, 1.1-1.4 mm long, 1.9-2.4 mm wide, red-brown to red, cartilaginous, verrucate towards the apex, glabrous, grooved septicidally; column persistent, angular-ovoid to broadly barrel shaped, 0.3-0.7 mm long. *Seeds* yellow to black, prismatic, laterally compressed, 0.7-1.2 mm long, 0.5-0.9 mm wide, prominently sulcate; hilum markedly depressed, centrally constricted, cavity more or less basal or sometimes slightly displaced towards the centre, extra-hilum lateral depression present. (Figure 1L,M)

Selected specimens examined. QUEENSLAND: 12.4 km N of Mareeba, along road to Mt Malloy, *D. Halford* Q335B (BRI); Norman River Crossing on Normanton-Croydon road, near Glenore homestead, 18 km out of Normanton, *V.J. Neldner* 2420 & *T.D. Stanley* (BRI).
NORTHERN TERRITORY: 15 km S of Kakadu National Park Headquarters, Jabiru, Burdulba River area, *A.A. Munir* 5614 (AD); Mary River, *C.R. Dunlop* 8381 & *B.A. Wilson* (DNA); 10 miles [16 km] W of Borroloola, *N. Henry* 61 (DNA); Alligator River, *C.R. Dunlop* 6107 & *J. Taylor* (DNA); 'Westmoreland', 30 km E of the Q/NT border, for NW Queensland, *R. Pullen* 9191 (MEL); 30 km N of Cape Crawford, *J.T. Hunter* 1539, *J.J. Bruhl & J.L. Egan* (NE).

Distribution. Known from Darwin in the Northern Territory, east across the Gulf country to Cooktown in Queensland.

Habitat. Occurs in periodically inundated areas such as the margins of swamps, lagoons, dams, stream and river flats.

Flowering and fruiting period. March to September.

Etymology. In reference to the distinctly furrowed seeds.

Notes. Phyllanthus urinaria, a pan-tropical species, is morphologically similar to *P. sulcatus*, and specimens of the latter have been misidentified as *P. urinaria* (Wheeler *et al.* 1992). *Phyllanthus sulcatus* can, however, be distinguished by branchlet, fruit and seed characters (Table 1). Dunlop *et al.* (1995) have presented a description referable to *P. sulcatus* as *P. leai*, which is a synonym of *P. debilis* (see discussion above). *Phyllanthus sulcatus* and *P. urinaria* are the only two Australian species of *Phyllanthus* that have pedunculate female flowers. For illustrations see Wheeler *et al.* (1992) [as *P. urinaria*] and Dunlop *et al.* (1995) [as *P. leai*].

Table 1. Comparison of selected characters for *Phyllanthus sulcatus* and *P. urinaria*

	P. sulcatus	*P. urinaria*
Branchlets	Ellipsoid to flattened	Rounded to angular
Branchlet length	1-4 cm	6.5-16.5 cm
Stipules	With a white margin	Without a white margin
Inflorescences	Always unisexual	Sometimes bisexual
Female flowers	Solitary	1 or 2 per axil
Female sepal margin	With a white margin	Without a white margin
Female sepal shape	Lanceolate to triangular	Elliptic to ovate
Fruit sculpturing	Sparsely warted	Densely warted
Seed length	0.7-1.2mm	1.4-1.9mm
Seed width	0.5-0.9mm	1-1.5mm
Hilum	Markedly depressed	Slightly depressed
Hilum constriction	Present	Absent
Extra-hilum depression	Present	Absent

11. Phyllanthus virgatus G. Forst., Fl. Ins. Austral. Prodr.: 65 (1786). *Type*: Tahiti, *Banks & Solander* (*?lecto* or *holo*: BM *n.v.*). (Figure 1P-S)

Phyllanthus simplex Retz., Obs. Bot. 5: 29 (1789). *Type*: none cited.

Phyllanthus minutiflorus Muell. Arg., Linnaea 34: 75 (1865) - *Phyllanthus simplex* Retz. var. *minutiflorus* (Muell. Arg.) Domin, Beit. Fl. Pflanz. Aust. 877 (1927). *Type*: Upper Victoria River, *F. Mueller* (*?syn*: K), Upper River Victoria, *F. Mueller* (*?syn*: K),), River Victoria, near the Main Camp, May 1856, *F. Mueller* (*?syn*: K), Victoria River, Arnhem Land, 1863, *F. Mueller* (*?syn*: G-DC).

Phyllanthus beckleri Muell. Arg., Linnaea 34: 74 (1865). *Type*: Clarence River, *Beckler* 668 (*n.v.*, location unknown).

Phyllanthus filicaulis Benth., Fl. Austral. 6: 111 (1873) - *P. simplex* Retz. var. *filicaulis* (Benth.) Domin, Beit. Fl. Pflanz. Aust. 876 (1927). *Type:* New England, *C. Stuart* (*holo*: K).

Phyllanthus trachygyne Benth., Fl. Austral. 6: 103 (1873). *Type*: Port Darwin, *Shultz* 668 (here designated *lecto*: K); *Shultz* 112 (*syn*: K, *n.v.*), 660 (*syn*: K), 788 (*syn*: K).

Phyllanthus simplex Retz. var. *leiospermus* Benth., Fl. Austral. 6: 111 (1873) - *Phyllanthus simplex* subvar. *leiospermus* (Benth.) Domin, Beit. Fl. Pflanz. Aust. 876 (1927) as *biospermus*. *Type*: Narran River, *Mitchell* (*n.v.*, location unknown).

Phyllanthus minutiflorus Muell. Arg. var. *gracillimus* Benth., Fl. Austral. 6: 112 (1873). *Type*: Moreton Bay, July 55, *F. Mueller* (*holo*: K).

Phyllanthus eboracensis S. Moore, J. Linn. Soc. (Botany) 45: 216 (1920). *Type*: Cape York, *Daemel* (*holo*: K).

Phyllanthus simplex Retz. var. *myrtifolius* Domin, Beit. Fl. Pflanz. Aust. 876 (1927). *Type*: Nordost-Queensland: Mischwälder bei Cairnes, auf Sand, XII 1909, *Domin* (*n.v.*, location unknown).

Phyllanthus simplex Retz. var. *pinifolius* Domin, Beit. Fl. Pflanz. Aust.: 877 (1927). *Type*: Qld: Sandsfeinhüyel der Dividing Range bei Pentland, II 1910, *Domin* (*n.v.*, location unknown).

Phyllanthus sp. B, Wheeler *et al.*, Flora of the Kimberley Region 624 (1992).

Distribution. The pan-tropical *Phyllanthus virgatus* is one of the most widespread and common Australian *Phyllanthus* species (Table 2), occurring from the Kimberleys in Western Australia, through northern and arid Australia, to as far south as Sydney in New South Wales.

Table 2. Distribution of Northern Territory and Western Australian species of *Phyllanthus* within Australia based on the regions adopted by Hnatiuk (1990)

Taxon	Distribution
**P. amarus* K. Schum. & Thom	4,25,43,45,53,55,44,59,60
P. aridus Benth.	1,2,4,25,26
P. baeckeoides J.T. Hunter & J.J. Bruhl	10,15
P. calycinus Labill.	16,17,18,19,20,21,2223,2436,39,40
P. carpentariae Muell. Arg.	25,26,27,43,44,46,45,49,51,53,54,55,65
P. cauticola J.T. Hunter & J.J. Bruhl	25
**P. debilis* Klein. ex Willd.	25,45,53,55
P. erwinii J.T. Hunter & J.J. Bruhl	4,29,30,47
P. eutaxioides S. Moore	25
P. exilis S. Moore	1,2,3,4,25,26,43
P. flagellaris Benth.	25
P. fuernrohrii F. Muell.	28,31,32,33,34,35,36,37,38,43,47,48,50,51,55,56,63,68,69
P. indigoferoides Benth.	1,25,45
P. lacerosus Airy Shaw	1,2,3,25,26,27,43,53,49
P. lacunellus Airy Shaw	29,31,32,33,34,35,36,37,38,47,70,71,72
P. maderaspatensis L.	1,2,3,4,7,12,14,18,25,26,27,31,34,43,44,45,46,47,49,50,51,53,54,55,56,68
P. oblanceolatus J. T. Hunter & J.J. Bruhl	29,30,34,35,69,70
P. prominulatus J.T. Hunter & J.J. Bruhl	25

Table 2 continued

Taxon	Distribution
P. reticulatus Poiret	1,2,3,4,25,26,45
P. saxosus F. Muell.	21,33,34,35,36,37,38,40,41,42,74
P. scaber Klotzsch	14,16,21
P. sulcatus J.T. Hunter & J.J. Bruhl	25,26,43,45
* *P. tenellus* Roxb.	3,45,53,54,57,52,59,60,62,63
P. urinaria L.	1,25
P. virgatus G. Forster	1,2,3,4,7,12,25,26,27,28,29,43,44,45,46,48,49,50,51, 52,53,54,55,56,57,58,59,60,62,65,68,70

Notes. The type of *P. virgatus* cited here follows the treatment of Smith (1981), and as accepted by Webster (1986). *Phyllanthus virgatus* forms a heterogeneous, cosmopolitan species complex. Due to the extreme variability of this species, both within and between regions, and the lack of consistent characters, we have included the following taxa within the limits of *P. virgatus*: *P. filicaulis* Benth., *P. minutiflorus* Muell. Arg., *P. simplex* Retz., *P. beckleri* Muell. Arg., *P. eboracensis* S. Moore and *P. trachygyne* Benth. It is likely, however, that after in-depth research, some of these taxa may be reinstated and others recognized.

The specimen *Shultz* 668 (K) was chosen to lectotypify *P. trachygyne* as it was a diagnostic female specimen, richer in material than *Shultz* 660 (K), and we had access to fragments of the specimen.

Key to *Phyllanthus* species of the Northern Territory and Western Australia

1 Branch leaves scale-like (phyllanthoid branching) 2

1: Branch leaves normal or sometimes reduced leaf-like 7

2 Leptocladus shrubs, 0.6-5 m tall; leaves 14.4-22 mm wide; secondary veins 8-15 per side; male pedicels 0.8-6.2 mm long; male sepals 0.8-2.2 mm wide; male disk lobes ellipsoid; female sepals 0.7-2.3 mm wide; stamens 5; ovary 0.6-1.5 mm long, 1-2.8 mm wide; fruit a berry, 2.5-7.6 mm long, 3.7-12.9 mm wide. ..... **P. reticulatus** (Figure 1N,O)

2: Herbs to 0.8 m tall; leaves 1.7-9.8 mm wide; secondary veins 3-8 per side; male pedicels 0.1-1.6 mm long; male sepals 0.2-0.9 mm wide; male disk lobes lenticular; female sepals 0.2-1 mm wide; stamens 3; ovary 0.3-0.8 mm long, 0.3-1.4 mm wide; fruit a capsule, 1-2.3 mm long, 0.7-2.4 mm wide 3

3 Leaf base oblique, margins serrate, veins abaxially prominulous; female inflorescences pedunculate; ovary colliculate; fruit verrucate; native herbs 4

3: Leaf base not oblique, margins entire, veins not abaxially prominulous; female inflorescences not pedunculate; ovary smooth; fruit smooth; weedy herbs. 5

4 Branchlets rounded to angular, 6.5-16.5 cm long; stipules without a white margin; inflorescences sometimes bisexual; female flowers 1 or 2 per axil; female sepals elliptic to ovate, without a white margin; fruit densely colliculose; seed 1.4-1.9 mm long, 1-1.5 mm wide; hilum slightly depressed, not constricted, extra-hilum depression absent ..... **P. urinaria**

4: Branchlets ellipsoid to flattened, 1-4 cm long; stipules with a white margin; inflorescences always unisexual; female flowers solitary; female sepals lanceolate to triangular, with a white margin; fruit sparsely colliculose; seed 0.7-1.2 mm long, 0.5-0.9 mm wide; hilum markedly depressed, constricted, extra-hilum depression present ..... **P. sulcatus**

5 Petiole 0.6-1.8 mm wide; sepals 5; female flowers solitary; style merely notched ..... **P. amarus**

5: Petiole 0.1-0.3 mm wide; sepals 6 rarely 5; female flowers 1-5 per axil; style divided for half or more of its length 6

6 Branchlets rounded, smooth; sepals 6 rarely 5; lamina margins undulate; stamens 4-6, free; seeds granulate to aculeate ..... ***P. tenellus**

6: Branchlets flattened, ribbed; sepals always 6; lamina rounded, margins not undulate; stamens 3, connate; seeds striate ..... ***P. debilis**

7 Plants dioecious 8

7: Plants monoecious 13

8 Lamina variously hairy, but not papillate 9

8: Lamina glabrous, or sometimes papillate 10

9 Prostrate subshrub to 0.15 m tall; stipules lacerate to erose, 0.5-1.5 mm long; lamina 4.9-14.8 mm long, margins revolute; female perianth not growing in fruit leaving the fruit exposed; ovary and fruit glabrous ..... **P. flagellaris**

9: Erect shrub or subshrub 0.2-1 m tall; stipules entire, 1.4-2.8 mm long; lamina 10-25.2 mm long, margins plane; female perianth growing and enclosing fruit; ovary pubescent and fruit pilose ..... **P. carpentariae** (Figure 1D)

10 Branchlets ellipsoid to flattened; male sepals 0.5-0.9 mm long, red to red-brown; female pedicels 0.1-0.2 mm wide in fruit; female sepals 0.4-1.2 mm long; ovary and fruit warted with a rounded apex ..... **P. exilis**

10: Branchlets rounded; male sepals 0.8-4 mm long, white, yellow or green; female pedicels 0.2-0.5 mm wide in fruit; female sepals 1.1-2.8 mm long; ovary and fruit smooth with a depressed apex. 11

11 Branchlets 0.4-0.7 mm wide; male sepals 2-3.9 mm long, 1.3-2.7 mm wide; male disk 2-3.1 mm wide; female sepals 1.2-2.1 mm long, 1.4-2.1 mm wide; filaments connate completely, 1.2-2.6 mm long; anthers 0.9-1.4 mm long; style divided less than half way; seeds smooth ..... **P. baeckeoides**

11: Branchlets 0.6-1.2 mm wide; male sepals 0.8-2 mm long, 0.8-2 mm wide; male disk 0.6-1.3 mm wide; female sepals 0.4-1.6 mm long, 0.6-1.6 mm wide; filaments free or connate for only half way, 0.2-0.7 mm long; anthers 0.3-1 mm long; style undivided; seeds sculptured 12

12 Female pedicels at anthesis 2-5 mm long; filaments free or connate for half their length; anthers 0.7-1 mm long; style 1.2-2.4 mm long; fruit 4.2-4.7 mm wide; column 1.2-2 mm long; seeds 2.1-2.3 mm long, striate ..... **P. saxosus**

12: Female pedicels at anthesis 0.7-2 mm long; filaments always free; anthers 0.3-0.4 mm long; style 0.3-1.2 mm long; fruit 1.5-4.1 mm wide; column 0.6-1 mm long; seeds 1.3-1.9 mm long, colliculate ..... **P. scaber**

13 Branchlets ribbed. 14

13: Branchlets smooth. 15

14 Branchlets angular; stipules 1.7-5.2 mm long; lamina 19-30 mm long, prominulous; male pedicel 1.2-4.3 mm long; seeds smooth or finely striate ..... **P. lacerosus**

14: Branchlets rounded; stipules 0.6-1.4 mm long; lamina 5.5-18 mm long; male pedicel 0.3-1 mm long; seeds rugose to ribbed ..... **P. lacunellus**

15 Female sepals enlarging and enclosing fruit 16

15: Female sepals not enlarging in fruit, fruit exposed 17

16 Male pedicels 4.2-9.5 mm long; female pedicels 3.5-14.5 mm long at anthesis; fruit 3-5.2 mm long, 5-6.6 mm wide; seed 2.5-3.9 mm long, 1.8-2.5 mm long ..... **P. calycinus**

16: Male pedicels 0.4-1.7 mm long; female pedicels 1-4.8 mm long; fruit 2.2-4.3 mm long, 2.5-5.2 mm wide; seeds 1.7-2.2 mm long, 1.2-1.8 mm wide .... **P. carpentariae**

17 Fruit ellipsoid, apex rounded not depressed; seeds elongated (distinctly longer than wide; falcoid) and bicolorous, yellow and red; filaments completely connate; plant growing pendulously from sandstone outcrops ..... **P. cauticola**

17: Fruit transversely ellipsoid, apex depressed; seeds not elongated (only slightly longer than wide), only one colour; filaments free to connate; plant not growing pendulously from sandstone outcrops 18

18 Seeds rugose; hilum slightly depressed, not bordered; fruit smooth and glabrous; filaments free ..... **P. erwinii**

18: Seeds granulate to tuberculate; hilum slightly depressed, not bordered; fruit smooth to verrucate, hairy or glabrous; filaments free or connate 19

18: Seeds smooth or rarely striate (*P. aridus*); hilum slightly or markedly depressed, bordered or not bordered; fruit smooth, hairy or glabrous; filaments free or connate 21

19 Leaf margins not thickened; female sepals 0.8-2 mm long, 0.6-2 mm wide; styles merely notched; stipule base rarely caudate. ..... **P. maderaspatensis**

19: Leaf margins thickened; female sepals 0.3-1.2 mm long, 0.2-0.7 mm wide; styles divided for half or more of their length; stipules commonly and distinctly caudate 20

20 Branchlets angular to ellipsoid, ± winged, 0.6-1.7 cm long; leaves prominently veined and prominulous; female sepals 0.3-0.5 mm long in fruit; rare species restricted to Darwin and Kakadu regions ..... **P. prominulatus**

20: Branchlets rounded, never winged, 5.5-30 cm long; leaves obscurely veined; female sepals 0.9-1.2 mm long in fruit; widespread and common species ..... **P. virgatus**

21 Male pedicels <1 mm long 22

21: Male pedicels 1-6.8 mm long 23

22 Branchlets papillose; stipule glabrous to papillose; lamina glabrous to papillose, paler below; male pedicels glabrous; female flowers 1-2 per axil; hilum not bordered ..... **P. aridus**

22: Branchlets scabrous to puberulous; stipules scabrous; lamina puberulous, both sides of equal intensity; male pedicels hairy; female flowers only 1 per axil; hilum bordered ..... **P. indigoferoides**

23 Hilum slightly depressed, not bordered; plants glabrous, rarely not; stipules cream; inflorescences unisexual; female flowers only 1 per axil; filaments connate ..... **P. eutaxioides**

23: Hilum markedly depressed, bordered; plants glabrous or hairy; stipules yellow-brown, red-brown or rarely cream; inflorescences at least sometimes bisexual; female flowers 1-3 per axil; filaments free to connate 24

24 Hairy shrub; branchlets rounded to ellipsoid; stipules 0.8-3.2 mm long; male sepals 1.3-2.5 mm long; male disk 1-1.4 mm wide; female disk 1.1-1.9 mm long; anther filaments 0.6-1.3 mm long; styles 0.6-1.3 mm long ..... **P. fuernrohrii**

24: Glabrous herb or small shrub; branchlets flattened to ellipsoid; stipules 1.2-2.5 mm long; male sepals 0.7-1.7 mm long; male disk 0.6-1 mm wide; female disk 0.7-1.3 mm wide; anther filaments 0.2-0.6 mm long; styles 0.2-0.7 mm long ..... **P. oblanceolatus**

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New *Sauropus* (Euphorbiaceae: Phyllantheae) taxa for the Northern Territory and Western Australia and notes on other *Sauropus* occurring in these regions

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Abstract

Hunter, J.T. and Bruhl, J.J. New *Sauropus* (Euphorbiaceae: Phyllantheae) taxa for the Northern Territory and Western Australia and notes on other *Sauropus* occurring in these regions. Nuytsia 11(2): 165-184 (1997). Eight new species of *Sauropus* Blume are described and notes are provided on their distribution and conservation status: *S. arenosus*, *S. dunlopii*, *S. filicinus*, *S. gracilis*, *S. paucifolius*, *S. rimophilus*, *S. salignus*, and *S. torridus*. A new combination, *S. stenocladus* (Muell. Arg.) J.T. Hunter & J.J. Bruhl is made and a new subspecies, *S. stenocladus* subsp. *pinifolius*, is described. Notes and synonymy are provided for *S. trachyspermus* (F. Muell.) Airy Shaw. A key to all species and subspecies of *Sauropus* occurring within the Northern Territory and Western Australia is presented.

Introduction

The Australian species of *Sauropus* Blume (Euphorbiaceae: Phyllantheae) were originally included within *Synostemon* F. Muell. Airy Shaw (1980: 670), however, considered that *Synostemon* was "too close to *Sauropus*" and that the former could not be maintained as a separate genus.

There are 26 species of *Sauropus* in Australia. All species of *Sauropus* in Australia are endemic, except for *S. macranthus* Hassk., which is native to north east Queensland, New Guinea and the Pacific islands. We recognize 12 new species, four endemic to Queensland (see Hunter & Bruhl 1997), and eight restricted to the Northern Territory and/or Western Australia.

This paper presents full descriptions of the new *Sauropus* species we recognize within the Northern Territory and Western Australia. Nomenclatural notes are presented for *Sauropus trachyspermus*, a new combination is made with *S. stenocladus*, and a key to the species of *Sauropus* of this region is provided.

Methods

Sampling and Organization of Data. Significant proportions of the *Sauropus* specimens held by the herbaria AD, BRI, CANB, DNA, HO, MEL, NSW, PERTH and QRS, and historically important *Sauropus*

specimens from A and GH were provisionally sorted into taxa. Close inspection of these taxa and subsequent re-sorting of specimens formed the basis for our decisions on the status of these taxa. Ten representative specimens (where available) of these taxa were chosen for detailed analysis of quantitative micromorphological characters. Macromorphological characters (qualitative and quantitative, e.g. leaf length) were scored in all available material. Selection of the ten specimens for study was based on specimen quality in terms of the amount and number of developmental stages displayed.

A DELTA (Dallwitz 1980; Dallwitz *et al.* 1993) list of 395 characters and their states has been created by the authors for the Phyllantheae (Bruhl & Hunter unpublished). This was used to score attributes measured in selected specimens, together with those measured in all available material.

Fresh material was used where possible, but in most instances floral measurements were based on re-hydrated material. Mature leaves only were used for scoring leaf characters.

Terminology. For purposes of consistency across the members of the Phyllantheae, the perianth segments of *Sauropus* are referred to as sepals. Further developmental investigations need to be carried out to confirm this interpretation (Webster pers. comm.).

Terminology for seed surface characters follows that of Stearn (1992). A bordered hilum is indicated by a discoloured and often raised region surrounding the hilum. This character is most obvious in *Phyllanthus fuernrohrii* F. Muell. (see Hunter & Bruhl 1996, Figure 1A, C)

There are sometimes differences between the leaves of branches, referred to as 'branch leaves', and those on ultimate branchlets referred to as 'branchlet leaves'. Phyllanthoid branching is indicated by a reduction of the leaf that subtends a branch/branchlet to a scale-like structure, as illustrated by Webster (1970). Branch leaves exhibiting intermediate reduction in size, but still clearly laminate, are referred to as 'reduced'. Care should be taken where leaves may have fallen, to check for a leaf scar which will always be present.

Citation. Type specimens of all relevant taxa have been seen by one or both of the authors. Photographs of type specimens examined at BM and K are held at NE, together with photographs taken of type specimens on loan to NE.

A list of all specimens studied will be deposited at NE. An INTKEY dataset for interactive identification will be made available on completion of our study of the Australian Phyllantheae.

Taxonomy

1. Sauropus arenosus J.T. Hunter & J.J. Bruhl, *sp. nov.*

S. huntio similis sed stipulis ovatis, squamis brunneis, lamina acuta, sepalis masculinis libris, antheris brevioribus, stylis connatis differt.

Typus: sandhills E of Gregory Range, Western Australia, 21 May 1947, *R.D. Royce* 1873 (*holo*: PERTH: PERTH 01640712; *iso*: PERTH: PERTH 01640720, PERTH 01640747).

[*Sauropus huntii auct. non* (Ewart & Davies) Airy Shaw: J.W. Green, Census of the Vascular Plants of Western Australia. 108 (1985).]

Dioecious *shrubs*, 0.5-0.8 m tall. *Branchlets* rounded, 14-30 cm long, 1-4 mm wide, pilose to hirsute. *Stipules* persistent, free, 2.3-6 mm long, cream to yellow-brown, ovate to depressed ovate, glabrous to scabrous; base truncate to rounded; apex acuminate to acute; margins dentate to lacerate. *Branch leaves* scale-like, pallid-brown, glabrous to scabrous. *Leaves* alternate, distichous, jointed. *Petiole* 0.6-1.5 mm long, 0.7-1.8 mm wide, glabrescent or with persistent indumentum. *Lamina* usually asymmetrical, although a few may appear symmetrical, plane, but may appear twisted, 13.6-29.2 mm long, 5-15.4 mm wide, elliptic to ovate, mid-green, blue-green or grey-green, obscurely pinnately 4-6 veined per side, pilose to hirsute, spreading, sparse; base usually oblique, rounded to obtuse; apex erect, acuminate to acute, mucronate; margins plane, thickened (more so abaxially). *Bracts and bracteoles* persistent, glabrous. *Inflorescence* indeterminate, axillary, sessile. *Male flowers* 2-4 per cluster; pedicels 0.2-1 mm long, with indumentum; sepals 6, free, erect, 0.9-2.8 mm long, 0.5-1.4 mm wide, green, elliptic to obovate, rounded, obtuse to acute, fleshy, abaxially sparsely pilose; stamens 3, symmetrical, erect; filaments completely connate, erect, terete, 0.2-1 mm long; anthers erect, linear, 0.4-0.9 mm long, ± apiculate, 0-0.1 mm long, cream; locules parallel. *Female flowers* solitary; pedicels at anthesis 0.8-2.5 mm long, 0.3-0.8 mm wide, in fruit 1.5-4.5 mm long, 0.3-1 mm wide, with indumentum; sepals free, 6, at anthesis erect to ascending, in fruit divergent to recurved, green, obtuse to acute, fleshy, abaxially spatially pilose to hirsute, 1.6-4.1 mm long, 0.9-2.3 mm wide, elliptic, ovate to obovate; styles well developed, 3, connate, notched, erect to recurved, green, 0.5-1.3 mm long, 0.2-0.6 mm wide, narrow-terete, glabrous to pilose, linear; ovary 1-2.8 mm long, 0.7-1.9 mm wide, ovoid to ellipsoid, smooth, puberulous. *Fruit* a septicidal capsule, ovoid to ellipsoid, 6.8-10 mm long, 5.5-8.5 mm wide, green, smooth, puberulous, pilose or hirsute, grooved septicidally; apex obtuse; column persistent, obconical, 5-9.2 mm long. *Seeds* yellow-brown, crescentiform, laterally compressed, 6-8 mm long, 1.5-3.5 mm wide, prominently ruminate; hilum slightly depressed, elliptic, more or less basal. (Figure 1A-C)

Selected specimens examined. WESTERN AUSTRALIA: Kimberley Division, small shrub on dune flank and crest, *T.J. Fatchen* 950 (AD); Kimberley Division, *T.J. Fatchen* 917 (AD); Great Sandy Desert, *J.S. Beard* 3231 (PERTH); 28 km SW of Well 35, Canning Stock Route, *A.S. George* 15657 (PERTH); just N of Tobin Lake, Great Sandy Desert, *A.S. George* 15593 (PERTH); 37 km SW of Gravity Lakes, Great Sandy Desert, *A.S. George* 15562 (PERTH); 14 km SW of Gravity Lakes, Great Sandy Desert, *A.S. George* 15558 (PERTH); Beyond the Mareo [?] Range, *Giles* (MEL).

Distribution. Restricted to the Canning region of Western Australia.

Habitat. Scrub and arid shrubland on red sand dunes.

Flowering and fruiting period. May.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority Three. A ROTAP code (Briggs & Leigh 1988) of 3VaW is suggested.

Etymology. The specific epithet refers to the restricted occurrence of *S. arenosus* on sand swales and dunes.

Notes. Sauropus arenosus is morphologically close to *S. huntii*, which it has been determined as in the past, but many characters can be used to separate them (Table 1).

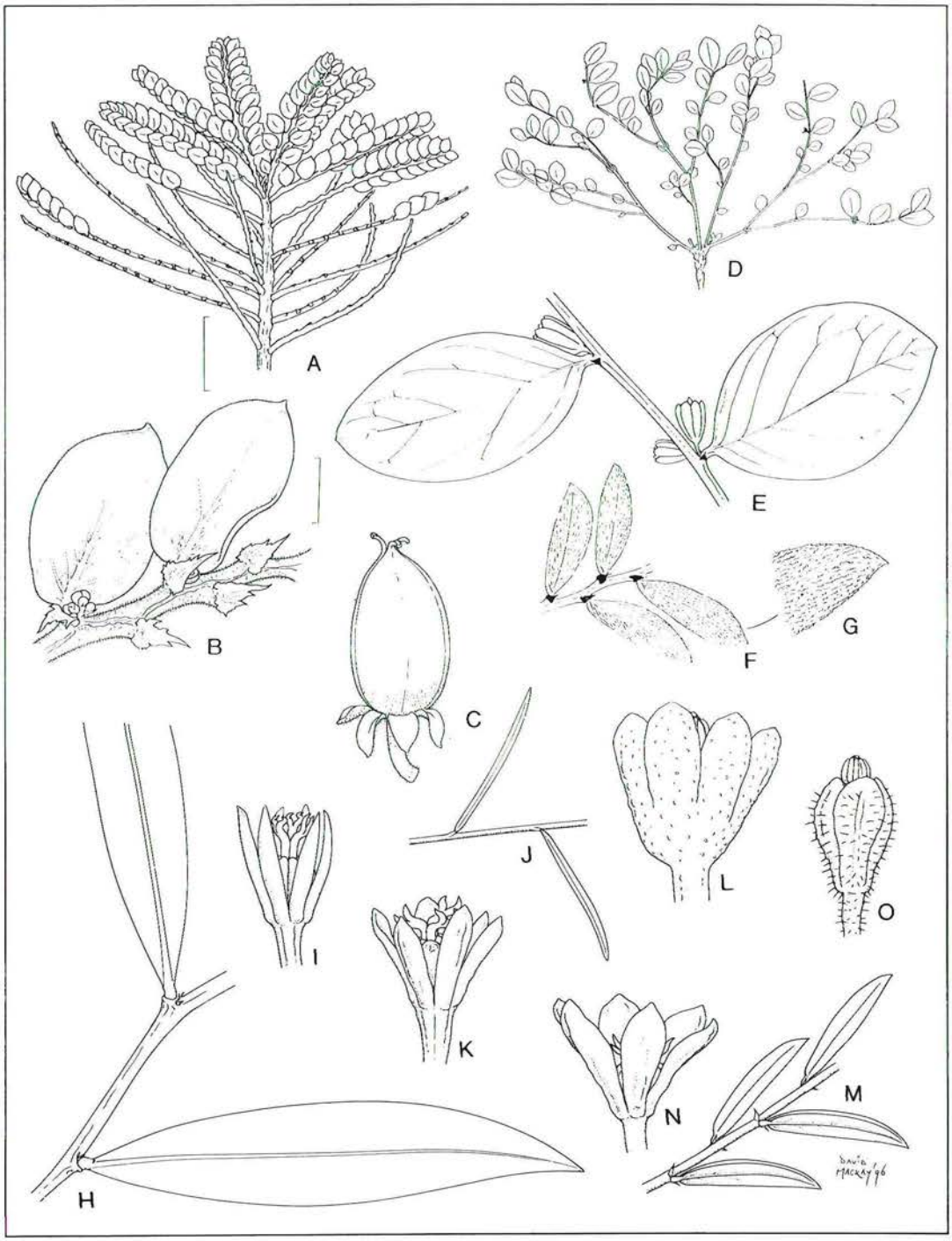

Figure 1. A-C *Sauropus arenosus* A - branch, B - branchlet, C - fruit; D-E *S. torridus* D - habit, E - flowering branchlet; F-G *S. elachophyllus* F - branchlet, G - leaf detail; H-I *S. glaucus* H - brachlet, I - female flower; J-K *S. stenocladus* subsp. *pinifolius* J - branchlet, K - female flower; L *S. stenocladus* subsp. *stenocladus* - male flower. M-O *S. dunlopii* M - branchlet, N - female flower, O - male flower. Scale bars: A, D = 4 cm; B, E, F, H, J, M = 5 mm; C = 4 mm; G, I, K, N = 2 mm; L,O = 1 mm. Drawn from *A.S. George* 15558 (PERTH) (A,B); *T.J. Fatchen* 950 (AD) (C); *K.F. Kenneally* 7720 (PERTH) (D,E); *M. Parris* 9199 (CBG) (F,G); *J.J. Bruhl* 1281, *J.T. Hunter & J.L. Egan* (NE) (H); *K.M. Manning* 487 (DNA) (I); *D. Bowman* 179 & *B. Wilson* (DNA) (J); *I.D. Cowie* 1437 & *C.R. Dunlop* (DNA) (K); *L.A. Craven* 5701 (MEL) (L); *J.T. Hunter* 1579, *J.J. Bruhl & J.L. Egan* (NE) (M); *J. Russell-Smith* 4899 & *Lucas* (DNA) (N); *J.T. Hunter* 1575, *J.J. Bruhl & J.L. Egan* (NE) (O). Drawn by D. Mackay.

Table 1. Comparison of selected characters for *Sauropus arenosus* and *S. huntii*

	S. arenosus	*S. huntii*
Branch scales	Pallid brown	Green
Stipules	Ovate to depressed ovate	Triangular to narrowly so
Margins	Dentate to lacerate	Entire to erose
Branchlet leaves		
Apex	Acute to acuminate	Obtuse, rounded to obcordate
Margin	Thickened	Not thickened
Male sepals	Free	Connate
Shape	Elliptic to obovate	Circular, ovate to trullate
Anther length (mm)	0.4-0.9	1-2.6
Female pedicel length		
At anthesis (mm)	0.8-2.5	2-6.5
Length in fruit (mm)	1.5-4.5	2.8-8
Styles	Connate	Free
Division	Merely notched	Variously divided

2. Sauropus dunlopii J.T. Hunter & J.J. Bruhl, *sp. nov.*

S. glauco similis sed sepalis masculinis brevioribus, pedicello femineo breviore, antheris majoribus et seminibus brevioribus differt.

Typus: Kakadu National Park stage 3, Northern Territory, 20 April 1993, *J.T. Hunter* 1575, *J.J. Bruhl & J.L. Egan* (*holo*: DNA; *iso*: AD, BRI, CANB, DAV, K, L, NE, NSW).

Dioecious *shrubs*, 0.1-0.3 m tall. Branchlets persistent, rounded, ribbed, 2-12.5 cm long, 0.4-0.9 mm wide, hirsute. *Stipules* persistent, free, 0.4-0.9 mm long, cream, yellow-brown to red-brown, ovate, narrowly triangular or triangular, chartaceous, pilose; base truncate, rounded or obtuse; apex acuminate to acute; margins entire. *Branch leaves* normal, reduced or scale-like; scales red-brown, chartaceous, pilose. *Branchlet leaves* alternate, distichous, jointed, grey. *Petiole* 0.3-0.7 mm long, with persistent indumentum. *Lamina* asymmetrical, concave, 2.1-10 mm long, 0.8-3.2 mm wide, elliptic, oblong or oblanceolate, mid-green, concolourous, sub-coriaceous, often wrinkled, hirsute, base oblique, rounded to obtuse; apex erect, acute to obtuse, mucronate to apiculate; margins plane, thickened. *Bracts and bracteoles* persistent, with indumentum. *Inflorescence* indeterminate, axillary, sessile. *Male flowers* solitary; pedicels 0.5-1 mm long, with indumentum; sepals 6, shortly connate, erect to ascending, 0.8-1.6 mm long, 0.4-0.9 mm wide, yellow or green, obovate, rounded to obtuse, fleshy, pilose; stamens 3, 1-whorled, symmetrical, erect; filaments completely connate, erect, terete, 0.6-1.3 mm long; anthers

extrorse, erect, oblong to elliptic, 0.3-0.5 mm long, ± apiculate, *c.* 0.1 mm long, red-brown; locules parallel. *Female flowers* solitary; pedicels at anthesis and in fruit 0.2-0.8 mm long, 0.3-0.5 mm wide, with indumentum; sepals free, 6, 1-1.4 mm long, 0.3-0.8 mm wide, ovate, green or yellow, rounded to obtuse, fleshy, hirsute; styles well developed, 3, free, divided to halfway, erect, red, 0.4-0.7 mm long, 0.2-0.3 mm wide, narrow-terete, glabrous to pilose; style branches linear; stigmatic surface papillate; ovary 0.7-1.1 mm long, 0.9-1.4 mm wide, turbinate, smooth, pubescent. *Fruit* a septicidal capsule, ovoid to ellipsoid, green, cartilaginous, smooth, pilose; column persistent, narrowly oblong. *Seeds* yellow-brown to red-brown, smooth, mature seeds not seen. (Figure 1M-O)

Specimens examined. NORTHERN TERRITORY: Coronation Hill, Kakadu National Park, *J.T. Hunter* 1565, *J.J. Bruhl & J.L. Egan* (NE); Kakadu National Park, stage 3, *J.T. Hunter* 1570, *J.J. Bruhl & J.L. Egan* (NE); Katherine Gorge National Park, sandstone plateau, *L.A. Craven* 6724 (DNA).

Distribution. This species is only known from Kakadu National Park and Katherine Gorge in the Northern Territory.

Habitat. Known from tropical woodland.

Flowering and fruiting period. April.

Conservation status. A ROTAP code (Briggs & Leigh 1988) of 2VC is suggested.

Etymology. In honour of Clyde Dunlop (DNA) who has contributed broadly to botanical knowledge, especially of the Top End of Australia.

Notes. Sauropus dunlopii grows low to the ground superficially resembling a fern, with grey-green leaves. It can be distinguished from *S. stenocladus* by the shorter male and female flower parts, the long filaments and short anthers, and its hairyness.

3. Sauropus filicinus J.T. Hunter & J.J. Bruhl, *sp. nov.*

S. rimophilo similis sed foliis ellipticis, sepalis masculinis brevioribus, pedicello femineo breviore, antheris brevioribus, et stylis libris differt.

Typus: Kakadu National Park [precise locality withheld], Northern Territory, April 1993, *J.T. Hunter* 1588, *J.J. Bruhl & J.L. Egan* (*holo*: DNA: we designate one of several unmounted specimens by our tag "holo of *Sauropus filicinus*"; *iso*: CANB, NE).

Dioecious dwarf pendulous *shrubs*. *Branchlets* rounded, 8-24 cm long, 0.4-0.5 mm wide, glabrous to sparsely puberulous. *Stipules* persistent, free, 0.4-0.7 mm long, red-brown to red, triangular, glabrous to puberulous; base truncate, rounded, to obtuse; apex acuminate to acute; margins entire. *Branch leaves* scale-like, red-brown, glabrous to puberulous. *Branchlet leaves* alternate, distichous, jointed, brown when dry or remaining green. *Petiole* 0.2-0.8 mm long, 0.3-0.4 mm wide, glabrous or with indumentum. *Lamina* symmetrical or slightly asymmetrical with one side of the mid-vein wider than the other, plane or rarely concave, 7-12 mm long, 3.9-9.1 mm wide, elliptic, circular to ovate, light-green to dark-green, paler below, pinnately 3-9 veined per side, glabrous to densely puberulous; base oblique, rounded to obtuse; apex erect, acute, obtuse to rounded, mucronate or appearing apiculate in some; margins entire, plane, ± thickened (more noticeable on the abaxial surface when occurring). *Bracts and*

bracteoles persistent, glabrous or with indumentum. *Inflorescence* indeterminate, axillary, sessile. *Male flowers* 3-15 per cluster; pedicels 0.6-1.2 mm long, glabrous or with indumentum; sepals 6, shortly connate, erect to ascending, lobes 0.4-0.9 mm long, 0.6-0.9 mm wide, green to pink, elliptic, glabrous to sparsely abaxially puberulous; apex rounded; stamens 3, symmetrical, erect; filaments completely connate, erect, terete, 0.4-0.6 mm long; anthers extrorse, erect, elliptic, 0.5-0.6 mm long; apiculum *c.* 0.1 mm long, red-brown; locules parallel. *Female flowers* solitary; pedicels at anthesis and in fruit 0.3-0.8 mm long, 0.2-0.4 mm wide, glabrous or with indumentum; sepals free, 6, at anthesis erect to ascending, in fruit divergent, reflexed or recurved, rounded to obtuse, fleshy, glabrous to abaxially puberulous, 0.8-1.4 mm long, 0.1-1.1 mm wide, obovate to obtrullate; styles well developed, 3, free, divided for about half their length, divergent with lobes erect, red to pink, 0.7-1 mm long, *c.* 0.4 mm wide, clavate, glabrous; branches linear; ovary 0.7-0.8 mm long, 1-1.3 mm wide, ovoid, ellipsoid, to globose, colliculate, glabrous. *Fruit* a septicidal capsule, ellipsoid, with ± observable venation, 5.5-7.5 mm long, 4-5 mm wide, red-brown, green or grey, smooth, glabrous to puberulous; apex rounded; column persistent, angular-ovoid to narrow oblong, *c.* 5 mm long. *Seeds* red-brown, crescentiform, laterally compressed, 5.2-6 mm long, 1.8-2.3 mm wide, smooth, winged; hilum slightly depressed but very elongated, taking up much of the length of the seed, oblanceolate, cavity more or less central.

Specimens examined. NORTHERN TERRITORY: Darwin & Gulf: East Alligator River, *Byrnes* 2719 (BRI).

Distribution. Both collections seen of this species come from Kakadu National Park in the Northern Territory.

Habitat. Sauropus filicinus grows pendulously from the crevices of sandstone cliffs.

Flowering and fruiting period. Flowering specimens have been collected in April and August. Fruiting specimens have only been collected in April.

Conservation status. A ROTAP code (Briggs & Leigh 1988) of 2ECtY is suggested.

Etymology. In reference to the fern-like appearance and habit.

Notes. Sauropus filicinus is morphologically close to *S. rimophilus* but differs in habit and in having longer sepals, and shorter pedicels, anthers and seeds (Table 2). Plants are variously glabrous to very hairy; our collection from one population included individuals that were glabrous or with a distinct indumentum.

4. Sauropus gracilis J.T. Hunter & J.J. Bruhl, *sp. nov.*

S. glauco similis sed planta monoecia, pedicello masculo longiore, filamentis brevioribus, et sepalis femineis longioribus differt.

Typus: Arnhem Land, [precise locality withheld], Northern Territory, *K. Brennan* 2283 (*holo*: DNA; *iso*: CBG, NE, OSS: OSS 9495, PERTH).

Monoecious *perennial plants. Branchlets* persistent, rounded, 12-24 cm long, 0.3-0.4 mm wide, glabrous. *Stipules* persistent, free, 0.5-0.8 mm long, yellow-brown to red-brown, triangular, membranous, glabrous; base truncate to rounded; apex acuminate to acute; margins entire. *Branch leaves* scale-like, yellow to pallid-brown, glabrous. *Branchlet leaves* alternate, distichous, jointed. *Petiole* 0.3-0.6 mm

long, 0.2-0.4 mm wide, glabrous. *Lamina* symmetrical to slightly asymmetrical, concave, 9.5-12 mm long, 1.4-3.4 mm wide, elliptic to oblanceolate, grey-green, paler below, obscurely pinnately veined, glabrous; base oblique, rounded; apex erect, acuminate to acute, mucronate; margins thickened, sometimes only slightly so. *Bracts and bracteoles* persistent, glabrous. *Inflorescence* unisexual or sometimes bisexual with the sexes mixed, indeterminate, axillary, sessile. *Male flowers* 2-3 per cluster; pedicels 1.8-3.2 mm long, glabrous; sepals 6, connate for half their length or less, erect and ascending, 1.2-1.9 mm long, 0.7-1.2 mm wide, green, elliptic to ovate, obtuse to acute, glabrous; stamens 3, symmetrical, erect; filaments completely connate, erect, terete, 0.3-0.4 mm long; anthers extrorse, erect, oblong to linear, 1-1.1 mm long; apiculum 0.05-0.15 mm long, red-brown; locules parallel. *Female flowers* solitary; pedicels at anthesis and in fruit 0.7-1 mm long, 0.2-0.3 mm wide; sepals 6, persistent, free, at anthesis erect to ascending, in fruit divergent to reflexed, red-brown or green, fleshy, glabrous; apex rounded to obtuse; 1.3-1.8 mm long, 0.4-0.8 mm wide, somewhat keeled; styles well developed, 3, free, divided for much less than half their length, erect, ascending to divergent, green, 1-1.1 mm long, 0.2-0.3 mm wide, narrow-terete to obloid, glabrous; style branches linear; ovary 0.6-1 mm long, 0.7-0.8 mm wide, ovoid to ellipsoid, smooth, glabrous. *Fruit* septicidal capsule, explosive, ovoid to ellipsoid, 5-6 mm long, 4.5-6 mm wide, green to grey, smooth, glabrous, grooved septicidally; apex rounded to obtuse; column persistent, 'lanceolate', 3.5-3.8 mm long. *Seeds* yellow-brown, crescentiform, laterally compressed, 4.6-5 mm long, 1.7-2 mm wide, smooth, winged; hilum slightly depressed, elliptic, cavity more or less central.

Distribution. Known only from the type locality within Arnhem Land, Northern Territory.

Habitat. Found growing in crevices in sandstone cliffs.

Conservation status. A ROTAP code (Briggs & Leigh 1988) of 1EY is given.

Etymology. The specific epithet refers to the delicate habit of the plants of this species.

Notes. The description of *Sauropus gracilis* is based on a single collection, therefore, the quantitative attributes presented should be viewed accordingly.

5. Sauropus paucifolius J.T. Hunter & J.J. Bruhl, *sp. nov.*

S. ochrophyllo affinis sed stipulis connatis, foliis magnis paucioribus, et ramulis angularibus differt.

Typus: 5 miles [8 km] north-west of Humpty Doo, Northern Territory, 11 November 1971, *J.L. McKean* B43 (*holo*: DNA: DNA 4154 ["2ND SHEET": branched specimen, right hand specimen with males and females]; *iso*: DNA: DNA 4154).

Sauropus sp. 'Darwin', Dunlop *et al.*, Flora of the Darwin Region 2: 235 (1995).

Monoecious or dioecious *perennial plants*, 0.2-0.5 m tall. *Branchlets* persistent, angular, mainly monopodial, ribbed, photosynthetic, 4-5.5 cm long, 0.5-2.1 mm wide, glabrous or papillose. *Stipules* persistent, free or connate, sometimes fused to leaf scales, 0.9-2.7 mm long, yellow-brown to red-brown, ovate to triangular, glabrous; base truncate, rounded to obtuse; apex acuminate to acute; margins lacerate to erose. *Branch leaves* scale-like but occasionally normal, scales pallid-brown to red-brown, glabrous. *Branchlet leaves* alternate, distichous, jointed, remaining green. *Petiole* 0.5-2 mm long, 0.5-1.2 mm wide, thickened, glabrous. *Lamina* symmetrical, convex or plane, 21.5-63.8 mm long, 10-25 mm wide, linear, elliptic, lanceolate, obovate or oblanceolate, light-green to mid-green, paler below,

obscurely pinnately 4-10 veined per side; base slightly oblique to symmetrical, rounded to obtuse; apex erect, acuminate, acute, to obtuse, mucronate to apiculate; margins entire, plane to revolute, thickened. *Bracts and bracteoles* deciduous, glabrous. *Inflorescence* unisexual with males and females often on different branches, indeterminate, axillary, sessile. *Male flowers* 2-12 per cluster; pedicels 1-3.5 mm long, glabrous; sepals 6, free, erect to ascending, 1.4-5.2 mm long, 0.6-2.4 mm wide, yellow, yellow-brown or green and sometimes tinged with purple, elliptic, lanceolate to ovate, fleshy, glabrous; apex retuse, rounded, obtuse to acute; stamens 3, symmetrical, erect; filaments completely connate, erect, terete, 0.3-1 mm long; anthers extrorse, erect, oblong to elliptic, 0.6-1 mm long; apiculum 0.5-2 mm long, cream; locules parallel to divergent. *Female flowers* 1-2 per cluster; pedicels at anthesis 1.5-7.5 mm long, 0.1-0.5 mm wide, in fruit 4-12 mm long, 0.3-0.7 mm wide, glabrous; sepals 6, persistent, free, at anthesis erect to ascending, in fruit divergent to reflexed, yellow-brown, green or yellow and sometimes tinged with purple, fleshy, glabrous; apex rounded, obtuse to acute, 1.4-4.1 mm long, 0.7-2.4 mm wide, elliptic, lanceolate to ovate; styles well developed, 3, free, divided for much less than half their length, ascending to divergent, yellow, red or green, 0.4-1.4 mm long, 0.1-0.3 mm wide, narrow-terete to obloid, glabrous; style branches linear and oblong; ovary 0.5-1.6 mm long, 0.5-1.9 mm wide, ovoid to ellipsoid, smooth, glabrous. *Fruit* a septicidal capsule, explosive, ovoid to ellipsoid, 5-8.5 mm long, 6.5-8.2 mm wide, green, smooth, glabrous, grooved septicidally; apex rounded to obtuse; column persistent, rhomboid to 'lanceolate', 3.6-4.1 mm long. *Seeds* yellow-brown, crescentiform, laterally compressed, 7-8 mm long, 2-2.5 mm wide, smooth; hilum slightly depressed, elliptic, cavity more or less central.

Selected specimens examined. NORTHERN TERRITORY: Kapalga CSIRO Research Station, *J.T. Hunter* 1591, *J.J. Bruhl & J.L. Egan* (NE); 5 miles [8 km] NW of Humpty Doo, 11 Nov. 1971, *J.L. McKean s.n.* (DNA); Mount Bundy, *C.R. Dunlop* 8764 *& I.D. Cowie* (DNA); Bees Creek Rd, *G.M. Wightman* 1794 (DNA); UDP Falls near El Sharana, *J.L. McKean & M. Jagoe* G876 (DNA); 13 km E of Howard Springs, *P.I. Forster* 5916 (BRI); Berry Springs, *P.I. Forster* 5917 (BRI); Darwin, *S.T. Blake* 17314 (BRI); Arnhem Hwy, 20 km W of West Alligator River, *G.M. Wightman* 3108 (BRI); 10 km S Cannon Hill, Kakadu National Park, *J. Russell-Smith* 844 (DNA).

Distribution. This species has been collected from Darwin to Katherine in the Northern Territory.

Habitat. Sauropus paucifolius is apparently widespread and abundant on sandy soils in woodland, however it has rarely been collected.

Flowering and fruiting period. October to January.

Etymology. In reference to the small number of leaves on each plant, typically 0-3.

Notes. Sauropus paucifolius is easily identified, due to its strongly ribbed, typically monopodial stems usually with only one or a few large leaves towards the base of the stems.

6. Sauropus rimophilus J.T. Hunter & J.J. Bruhl, *sp. nov.*

S. filicino similis sed sepalis masculinis majoribus obovatis, pedicello femineo longiore, antheris longioribus, et stylis connatis differt.

Typus: Kambolgie Creek camp, Northern Territory, 19 April 1993, *J.T. Hunter* 1246, *J.J. Bruhl & J.L. Egan* (*holo*: DNA; *iso:* BRI, CANB, DAV, MO, NE).

Dioecious *shrubs* to 1.5 m tall. *Branchlets* persistent 9-23.5 cm long, 0.4-1.1 mm wide, glabrous to sparsely hirsute. *Stipules* persistent, 0.5-1.2 mm long, red-brown to red, triangular, glabrous to puberulous; base rounded to obtuse; apex acute; margins entire. *Branch leaves* scale-like, red-brown, glabrous to puberulous. *Branchlet leaves* alternate, distichous, jointed, brown when dry or remaining green. *Petiole* present, 0.6-1.6 mm long, 0.2-0.7 mm wide, glabrous or hairy. *Lamina* asymmetrical, convex to plane, 4.8-16.5 mm long, 4.4-19.2 mm wide, elliptic, circular, ovate, rhombic, oblanceolate to transversely elliptic, mid-green to dark-green, paler below, obscurely pinnately 4-7 veined per side, glabrous to sparsely hirsute; base oblique, truncate, rounded or obtuse; apex erect, acute, obtuse, rounded or emarginate, mucronate to apiculate; margins plane. *Bracts and bracteoles* persistent, glabrous. *Inflorescence* indeterminate, axillary, sessile. *Male flowers* 1-4 per cluster; pedicels 0.6-2.6 mm long; sepals erect to ascending, 1.3-3.3 mm long, red-brown to green, obovate, fleshy, sparsely scabrous to pilose abaxially; apex sometimes appearing clawed, truncate, rounded, obtuse, to acute rarely emarginate or apiculate; stamens 3, symmetrical, erect; filaments completely connate, erect, terete, 0.4-1.3 mm long; anthers extrorse, erect, linear to narrowly elliptic, 1.2-1.7 mm long; apiculum 0.1-0.3 mm long, red-brown; locules parallel. *Female flowers* solitary; pedicels at anthesis 0.5-1.2 mm long, 0.3-0.5 mm wide, in fruit 1-1.6 mm long, 0.4-0.6 mm wide, with indumentum; sepals persistent, 6, free, erect to ascending, in fruit divergent to reflexed, green, obtuse to acute, fleshy, sparsely scabrous to pilose abaxially, at anthesis 1.4-3.9 mm long, 1-2 mm wide, obovate to obtrullate, sometimes clawed; styles well developed, 3, connate, divided for about half their length or more, ascending, red to pink, 1-1.5 mm long, 0.2-0.4 mm wide, narrow-terete, glabrous to papillose; style branches linear; stigmatic surface papillate; ovary 1.2-1.6 mm long, 1-1.4 mm wide, ovoid to globose, smooth, puberulous to pubescent. *Fruit* a septicidal capsule, ovoid to ellipsoid, 7.2-9.4 mm long, 5.5-6.5 mm wide, yellow-brown, smooth, puberulous, pubescent to pilose, grooved septicidally; apex obtuse to acute; column persistent, narrow oblong to oblanceolate, 6.8-8 mm long. *Seeds* yellow-brown to orange, crescentiform, laterally compressed, 6.8-9 mm long, 1.5-2.7 mm wide, smooth, with a small wing; hilum slightly depressed, oblanceolate, cavity more or less central extending most of the seed length.

Selected specimens examined. NORTHERN TERRITORY: Kambolgie Creek camp, *J.T. Hunter* 1246, *J.J. Bruhl & J.L. Egan* (NE); Twin Falls, *C. Dunlop* 6212 *& J. Taylor* (DNA); Kakadu National Park, Deaf Adder Creek Gorge, *I.R. Telford* 7977 *& J.W. Wrigley* (CBG); Kakadu National Park, 6 km SW of Mt Brockman, *I.R. Telford* 8063*A & J.W. Wrigley* (CBG); Kakadu National Park, 1 km E of East Alligator River Crossing Oenpelli road at Obiri rock turn-off, *I.R. Telford* 7612 *& J.N. Wrigley* (CBG); Kakadu National Park, 8 km NNE of Mt Evelyn, *K.A. Menkhorst* 314 (DNA); *c.* 70 km S of Jabiru, *L.A. Craven & G. Whitbread* 7673 (MEL); Kakadu National Park, Upper Koolpin Creek, *Russell-Smith* 5518A *& Lucas* (DNA).

Distribution. Sauropus rimophilus is known to occur from Jabiru in Kakadu National Park to Upper Katherine, Northern Territory.

Habitat. This species grows perpendicularly then pendulously from cracks and crevices on more or less vertical faces of the sandstone escarpment.

Flowering and fruiting period. Flowering March, April, and June and fruiting March and April according to herbarium specimens and our observations.

Conservation codes. A ROTAP code (Briggs & Leigh 1988) of 2EC-Y is suggested.

Etymology. The specific epithet alludes to the occurrence of this species in crevices of sandstone escarpments

Table 2. Comparison of selected characters for *Sauropus filicinus* and *S. rimophilus* (measurements in mm)

	S. filicinus	***S. rimophilus***
Male sepal shape	Elliptic	Obovate
Male sepal length	0.4-0.9	1.3-3.3
Anther length	0.5-0.6	1.2-1.7
Female pedicel length in fruit	0.5-0.7	1-1.6
Styles	Free	Connate
Ovary length	0.7-0.8	1.2-1.6
Fruit width	4-5	5.5-6.5
Seed length	5.2-6	6.8-9

Notes. Sauropus rimophilus appears to be morphologically similar to *S. filicinus*. Both species are restricted to sandstone cliffs in the Kakadu area. The former however, is larger in most floral parts and has connate styles (Table 2).

7. Sauropus salignus J.T. Hunter & J.J. Bruhl, *sp. nov.*

.*S. stenoclado* subsp. *pinifolio* similis sed caulibus angularibus, foliis latioribus, sepalis masculinis libris, filamentis longioribus, et antheris brevioribus differt

Typus: Osborne Island, Bonaparte Archipelago, Western Australia, 28 June 1973, *P.G. Wilson* 11107 (*holo*: PERTH: PERTH 01641840).

Sauropus sp. B, Wheeler *et al.*, Flora of the Kimberley Region 628 (1995).

Monoecious *shrubs. Branchlets* angular, ribbed, 8-15.5 cm long, 0.4-0.6 mm wide. *Stipules* persistent, free, 1-7 mm long, narrowly triangular to triangular, glabrous; base truncate to rounded; apex acuminate to acute; margins entire. *Branch leaves* scale-like, yellow, pallid-brown, to green, glabrous. *Branchlet leaves* alternate, distichous, jointed. *Petiole* 0.6-1 mm long, 0.2-0.4 mm wide, glabrous. *Lamina* symmetrical, concave to plane, 10.6-15.7 mm long, 4.9-8 mm wide, elliptic and obovate, light-green to mid-green, paler below, obscurely pinnately veined, glabrous; base oblique, obtuse to cordate; apex erect, acute to obtuse, muticous to apiculate; margins plane. *Bracts and bracteoles* deciduous, glabrous. *Inflorescence* unisexual or sometimes bisexual with distal females, determinate, axillary. *Male flowers* 1-4 per cluster; pedicels 0.5-1 mm long, glabrous; sepals 6, free, erect to ascending, 0.6-1.1 mm long, 0.5-0.9 mm wide, white or yellow or green, elliptic, ovate to obovate, rounded, obtuse to acute, glabrous; stamens 3, symmetrical, erect; filaments connate most of their length or completely connate, erect, terete, 0.6-1 mm long; anthers extrorse, erect to divaricate, oblong to elliptic, 0.2-0.4 mm long, not apiculate; locules parallel. *Female flowers* solitary; pedicels jointed, at anthesis 0.7-1.5 mm long, 0.1-0.2 mm wide, in fruit 1-2.1 mm long, 0.2-0.3 mm wide, glabrous; sepals 6, persistent, free, at anthesis erect to ascending, in fruit divergent to reflexed, white, green or yellow, obtuse to acute, glabrous, 1.1-2 mm long, 0.4-1 mm wide, elliptic to obovate; styles well developed, 3, free, divided for much less than half their length, erect

to ascending, yellow to green, 0.3-0.5 mm long, 0.1-0.2 mm wide, narrow-terete, glabrous; style branches linear; stigmatic surface papillate; ovary 0.7-0.9 mm long, 0.7-0.9 mm wide, ovoid to ellipsoid, smooth, glabrous. *Fruit* a septicidal capsule, explosive, ovoid to ellipsoid, 3.5-4 mm long, 4-5.2 mm wide, green, smooth, glabrous, grooved septicidally; apex rounded to obtuse; column persistent, rhomboid to 'lanceolate', 1.5-2 mm long. *Seeds* red-brown, crescentiform, laterally compressed, 2.9-3.6 mm long, 1.4-2.1 mm wide, smooth; hilum slightly depressed, not bordered, elliptic, cavity more or less central.

Specimens examined. WESTERN AUSTRALIA: 2.5 km N of Face Point, Carson Escarpment, *G.J. Keighery* 10668 (PERTH); Osborne Island, Bonaparte Archipelago, *P.G. Wilson* 11107 (PERTH).

Distribution. Only collected from the Carson Escarpment and Osborne Island in the Kimberley region of Western Australia.

Conservation codes. CALM Conservation Codes for Western Australian Flora: Priority One. A ROTAP code (Briggs & Leigh 1988) of 2E is suggested.

Etymology. The specific epithet refers to the weeping willow-like habit of this species.

8. Sauropus stenocladus (Muell.Arg.) J.T. Hunter & J.J. Bruhl, *comb. nov.*

Phyllanthus stenocladus Muell. Arg., Flora oder Allgemeine Botanische Zeitung 47: 536 (1864). *Type*: Port Essington, Northern Territory, *Armstrong* 503 (*holo*: K).

Notes. Airy Shaw (1980) transferred the Australian species of *Synostemon* to *Sauropus*. He treated *Phyllanthus stenocladus* as a synonym of *Sauropus glaucus*. The type of *P. stenocladus* does not conform to the type or description of *S. glaucus*. We therefore recognize *P. stenocladus* as a distinct species and transfer it to *Sauropus*, and recognize a new subspecies. The autonym has priority over the three taxonomic synonyms listed below.

8a. Sauropus stenocladus (Muell. Arg.) J.T. Hunter & J.J. Bruhl subsp. **stenocladus**

Phyllanthus lissocarpus S. Moore, J. Linn. Soc. (Botany). 45: 215 (1920); *Sauropus lissocarpus* (S. Moore) Airy Shaw, Kew Bull. 35: 680 (1980). *Type*: Groote Eylandt [Northern Territory], *s.d., R. Brown* 3606 (*holo*: BM).

Sauropus glaucus var. *glaber* Airy Shaw, Kew Bull. 35: 676 (1980). *Type:* Doingi airstrip [Northern Territory], 23 June 1972, *J. Must* 1050 (*holo*: K).

Sauropus latzii Airy Shaw, Kew Bull. 35: 680 (1980). *Type*: Wessel Islands, rare in lateritic gravel, 1 Oct[ober] 1972, *Latz* 3362 (*holo*: K; *iso*: DNA).

Dioecious *shrubs*, 0.3-1 m tall. Branchlets persistent, rounded to ellipsoid, ribbed, 2.2-17 cm long, 0.4-0.6 mm wide, glabrous or rarely scabrous to hirsute. *Stipules* persistent, free, 0.5-1.2 mm long, yellow-brown to red-brown, ovate to triangular, chartaceous, glabrous; base truncate, rounded or obtuse; apex acuminate to acute; margins entire. *Branch leaves* normal, reduced or scale-like, red-brown, chartaceous, glabrous. *Branchlet leaves* alternate, distichous. *Petiole* 0.1-0.6 mm long, glabrous. *Lamina* asymmetrical, concave, 5.5-18.5 mm long, 0.6-2.4 mm wide, linear to elliptic, grey-green, concolourous,

sub-coriaceous, wrinkled, glabrous; base oblique, rounded to obtuse; apex erect, acute to obtuse, mucronate to apiculate; margins revolute to plane, thickened. *Bracts and bracteoles* persistent, glabrous. *Inflorescence* indeterminate, axillary, sessile. *Male flowers* 1-6 per cluster; pedicels 0.5-1.5 mm long, glabrous; sepals 6, shortly connate to connate for half their length, erect, 2-2.6 mm long, 0.5-1 mm wide, yellow, linear, obovate or oblanceolate, rounded to obtuse, fleshy, glabrous; stamens 3, 1 whorled, symmetrical, erect; filaments completely connate, erect, terete, 0.8-1 mm long; anthers extrorse, erect, oblong to linear, 1.1-1.5 mm long; apiculum 0.1-0.4 mm long, red-brown; locules parallel. *Female flowers* solitary, pedicels at anthesis and in fruit 1-2.2 mm long, 0.3-0.6 mm wide, distally dilated, glabrous; sepals free, 6, 2-3.2 mm long, 0.7-1.4 mm wide, obovate to oblanceolate, yellow, rounded to obtuse, fleshy, glabrous; styles well developed, 3, free, divided about half way or more, erect to divergent, red, 0.8-1.3 mm long, 0.2-0.4 mm wide, narrow-terete, glabrous; style branches linear; stigmatic surface papillate; ovary 0.8-1.3 mm long, 1-1.4 mm wide, turbinate, smooth, glabrous. *Fruit* a septicidal capsule, explosive, ovoid to ellipsoid, 4.8-5.6 mm long, 4-5.5 mm wide, green, cartilaginous, smooth, glabrous; column persistent, narrow oblong, 3.7-4.5 mm long. *Seeds* yellow-brown to red-brown, crescentiform, laterally compressed, 4.8-5.2 mm long, 2.5-3 mm wide, smooth, winged; hilum slightly depressed, not bordered, oblanceolate, cavity more or less basal. (Figure 1L)

Selected specimens examined. NORTHERN TERRITORY: Port Essington, *Holtze s.n.* (MEL 1003725); Nabungwa, Groote Eylandt, *J. Waddy* 647 (DNA); on Katherine road, 4 km past Giddy River Crossing, 31 km from Gove Airport, 19 Nov 1989, *P.I. Forster s.n.* (BRI); Gove Road, 7.6 km S Dahlinbuy, turn-off, *M.J. Clark* 1544 (DNA); 22 km W of Liverpool river on the Oenpelli Rd, *M.J. Clark* 1139 (DNA).

Distribution. From Darwin to Groute Eylandt in the Gulf of Carpentaria, Northern Territory.

Habitat. Known from tropical woodland.

Flowering and fruiting period. January to December.

Notes. This subspecies can be distinguished from subspecies *pinifolius* by its wider leaves and smooth rather than viscid or crustaceous appearance. Specimens of *Sauropus stenocladus* have been misidentified as *S. elachophyllus*, a north Queensland species, but the two can be distinguished, *inter alia*, by the smooth leaves of the former (Figure 1J) and the wrinkled (when dry) leaves of the latter. (Figure 1F-G)

8b. Sauropus stenocladus subsp. **pinifolius** J.T. Hunter & J.J. Bruhl, *subsp. nov.*

A subsp. *stenoclado* differt planta distincte viscida, foliis multo angustioribus et ramulis costatis.

Typus: Litchfield National Park, above Florence Falls, Northern Territory, 24 April 1993, *J.J. Bruhl* 1278 *& J.L. Egan* (*holo*: DNA; *iso*: NE).

Monoecious *shrubs*, 0.2-0.6 m tall, plant viscid and turning crustaceous on drying giving a warty or scabrous appearance. *Branchlets* rounded to ellipsoid, ribbed, 4-22 cm long, 0.4-1 mm wide, glabrous. *Stipules* persistent, free, 0.3-1.2 mm long, yellow-brown, red-brown or red, ovate, narrowly triangular or triangular, chartaceous, glabrous; base truncate, rounded or obtuse; apex acuminate to acute; margins entire. *Branch leaves* scale-like, pallid-brown to red-brown, chartaceous. *Branchlet leaves* alternate, distichous, jointed, grey. *Petiole* 0.2-0.6 mm long, glabrous. *Lamina* asymmetrical, concave, 3.5-16 mm

long, 0.3-1.6 mm wide, linear, concolourous, sub-coriaceous, glabrous; base oblique, rounded to obtuse; apex erect, acuminate, acute or obtuse, mucronate to apiculate, often bent to one side; margins revolute or plane, thickened. *Bracts* and *bracteoles* persistent, glabrous. *Inflorescence* with males and females on different branches, indeterminate, axillary, sessile. *Male flowers* 1-4 per cluster; pedicels 0.2-1.3 mm long, glabrous; sepals 6, shortly connate to connate for half their length, erect, 0.8-2 mm long, 0.4-0.9 mm wide, white or red-brown, linear to oblanceolate, rounded, obtuse or acute, fleshy, glabrous; stamens 3, 1 whorled, symmetrical, erect; filaments completely connate, erect, terete, 0.1-0.5 mm long; anthers extrorse, erect, oblong to linear, 0.8-1 mm long, ± apiculate, 0-0.1 mm long, red-brown; locules parallel. *Female flowers* solitary; pedicels at anthesis and in fruit 1-6 mm long, 0.4-0.6 mm wide, glabrous; sepals free, 6, 1.8-3.2 mm long, 0.5-1 mm wide, linear to oblanceolate, red-brown or yellow, rounded, obtuse or acute, fleshy, glabrous; styles well developed, 3, free, divided half way or more, erect or divergent, red or green, 0.7-1.4 mm long, 0.2-0.6 mm wide, narrow-terete, glabrous; style branches linear; stigmatic surface papillate; ovary 0.8-1.5 mm long, 0.8-1.4 mm wide, turbinate, smooth, glabrous. *Fruit* a septicidal capsule, explosive, ovoid to ellipsoid, 8-9.5 mm long, 7-8.5 mm wide, green, cartilaginous, smooth, glabrous; column persistent, narrow oblong, 7.5-8.5 mm long. *Seeds* yellow-brown or red-brown, crescentiform, laterally compressed, 8-9 mm long, 2.5-2.8 mm wide, smooth, winged; hilum slightly depressed, not bordered, oblanceolate, cavity more or less basal. (Figure 1J-K)

Selected specimens examined. NORTHERN TERRITORY: Litchfield National Park, above Florence Falls, *J.J. Bruhl* 1278 & *J.L. Egan* (NE); Litchfield National Park, track to lost city, *I.D. Cowie* 1437 & *C.R. Dunlop* (DNA); 10 km SE of Nourlangie Ranger Station, Pine Creek road, *L.A. Craven* 5701 (DNA); Jim Jim Creek, *C. Dunlop* 6200 & *J. Taylor* (NSW); Stapleton Park, *D. Bowman* 179 & *B. Wilson* (DNA); Arnhem Hwy, 3.4 km W of Shady Camp turn-off, *I.D. Cowie* 1367 & *R. Booth* (DNA); Tabletop Range, *C. Dunlop* 6795 (DNA); Nitmiluk Ampitheatre, *M. Evans* 3395 (DNA); 65 km from Pine Creek on UDP Falls road, *C.H. Gittins* (BRI).

Distribution. From Litchfield to Katherine in the Northern Territory.

Habitat. Known from tropical woodland.

Flowering and fruiting period. January to December.

Etymology. The subspecific epithet is in reference to the very narrow and linear leaves.

Notes. This subspecies is easily recognizable by its very narrow branchlet leaves and crustaceous appearance on drying.

9. Sauropus torridus J.T. Hunter & J.J. Bruhl, *sp. nov.*

S. ochrophyllo similis sed stipulus triangularibus, sepalis masculinis brevioribus, pedicello femineo longiore, antheris longioribus, et seminibus longioribus differt.

Typus: Mitchell Plateau, N of Mining Camp top of plateau, Western Australia, 18 June 1976, *K.F. Kenneally* 5092 (*holo*: PERTH: PERTH 01640771).

[*Sauropus ochrophyllus auct. non* (Benth.) Airy Shaw: J.W. Green, Census of the Vascular Plants of Western Australia: 108 (1985).]

Phyllanthus sp. B, Wheeler *et al.*, Flora of the Kimberley Region 624 (1992).

Dioecious *perennial plants*. *Branchlets* persistent, ellipsoid, 5.5-17 cm long, 0.6-1.5 mm wide, glabrous to sparsely papillose or scabrous. *Stipules* persistent, free, 0.5-1.6 mm long, yellow-brown to red-brown, triangular, glabrous or papillose to scabrous; base truncate to rounded; apex acuminate to acute; margins entire. *Branch leaves* reduced leaf-like or scale-like, pallid-brown to red-brown, glabrous or papillose to scabrous. *Branchlet leaves* alternate, distichous, jointed, brown when dry. *Petiole* 0.5-1.6 mm long, 0.5-1.1 mm wide, glabrous or with persistent indumentum. *Lamina* symmetrical although some slightly falcate, plane, 11.5-35 mm long, 4-19.6 mm wide, elliptic to obovate, obscurely pinnately veined, glabrous or sparsely papillose to scabrous; base oblique, attenuate; apex erect, acute, mucronate to apiculate, occasionally with a small callous; margins plane, not thickened. *Bracts and bracteoles* persistent, glabrous or with indumentum. *Inflorescence* indeterminate, axillary, sessile. *Male flowers* 1-2 per cluster; pedicels 0.6-1.3 mm long, glabrous; sepals 6, variously connate, erect, lobes 17-24 mm long or to 44 mm including tube, sepals 0.7-1.2 mm wide, elliptic to ovate, fleshy, glabrous; apex rounded to obtuse; margins lacerate to erose; stamens 3, symmetrical, erect; filaments completely connate, erect, terete, 0.6-0.8 mm long; anthers extrorse, erect, linear to elliptic, 3-3.4 mm long; apiculum 0.8-0.9 mm long, red-brown; locules parallel. *Female flowers* solitary; pedicels at anthesis 0.8-1.5 mm long, 0.5-0.7 mm wide, in fruit 6.2-9.5 mm long in fruit, 0.5-0.7 mm wide; sepals persistent, 6, free, at anthesis erect, in fruit divergent to reflexed, white to yellow, fleshy, glabrous; apex rounded, obtuse to acute; 1.8-4.5 mm long, 0.4-1.3 mm wide, linear, elliptic, obovate, to oblanceolate; styles well developed, 3, free, variously divided, erect to ascending, red, 1-1.7 mm long, 0.2-0.5 mm wide, narrow-terete, glabrous to papillose; style branches linear; stigmatic surface papillate; ovary 0.8-1.4 mm long, 0.2-0.5 mm wide, ovoid to globose, smooth, glabrous, sometimes appearing glaucous. *Fruit* a septicidal capsule, ovoid to ellipsoid, *c.* 8.5 mm long, *c.* 10 mm wide, red-brown, smooth, glabrous, grooved septicidally; apex rounded to obtuse; column persistent, narrow oblong to 'lanceolate', 5.1-6.5 mm long. *Seeds* red-brown, prismatic, laterally compressed, 6.9-7.6 mm long, 3.3-3.8 mm wide, smooth, sometimes with a minor wing; hilum slightly depressed, not bordered although the region around the hilum is distinctly paler in colour, ovate, cavity more or less basal. (Figure 1D-E)

Selected specimens examined. WESTERN AUSTRALIA: Surveyors vine thicket, Mitchell Plateau, NW Kimberley, *K.F. Kenneally* 8561 (PERTH); Airstrip, 5 km NW of mining campsite Mitchell Plateau, N Kimberley, *K.F. Kenneally* 7720 (PERTH); 43.8 km N of campsite of Port Warrender track, Mitchell Plateau, N. Kimberley, *K.F. Kenneally* 8561 (PERTH).
NORTHERN TERRITORY: Mt Wells, 15 July 1886, *J.E. Tennison Woods s.n.* (MEL).

Distribution. Known only from the Mitchell Plateau in Western Australia and Mt Wells in the Northern Territory.

Flowering and fruiting period. August to October.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority Two. A ROTAP code (Briggs & Leigh 1988) of 2xE-Wy is suggested. Only one collection has been seen from the Northern Territory, and that specimen was collected in 1886. No subsequent collections have been made in the Northern Territory, where this species may now be extinct.

Etymology. The specific epithet means hot place and refers to the locality of the collections which are from the tropical north.

Notes. Very few specimens of this species have been seen. Only one male specimen is known, and the fruit measurements are based on only one mature fruit. Therefore, caution must be applied in regard to

the measurements given here. Morphologically, *Sauropus torridus* is similar to *S. ochrophyllus*, but differs in having shorter sepals, and longer pedicels, anthers and seeds (Table 3).

Table 3. Comparison of selected characters for *Sauropus ochrophyllus* and *S. torridus* (measurements in mm)

	S. ochrophyllus	***S. torridus***
Stipules	Linear, lanceolate, or narrow triangular	Triangular
Lamina base	Truncate, rounded or obtuse	Attenuate
Male sepals	Free	Connate
Male sepal length	2.8-5.4	1.7-2.4
Male sepal apex	Rounded to obtuse	Acute to acuminate
Anther length	1.3-2.6	3-3.4
Female pedicel in fruit	3.5-5	6.2-9.5
Female sepal length	1.6-1.8	0.7-1.2
Seed length	5.8-6.2	6.9-7.6

10. Sauropus trachyspermus (F. Muell.) Airy Shaw, Kew Bull. 35: 685 (1980) - *Phyllanthus trachyspermus* F. Muell. ,Trans. Phil Soc. Vict 1: 14 (1855) - *Glochidion trachyspermum* (F. Muell.) H. Eichler, Flora of South Australia Supplement 2nd edn 210 (1965). *Type*: junction of the Darling and Murray Rivers, [New South Wales or Victoria], *F. Mueller* (MEL).

Phyllanthus rhytidospermus F. Muell. ex Muell. Arg., Linnaea 34: 70 (1855) - *Glochidion rhytidospermum* (Muell. Arg.) H. Eichler, Flora of South Australia Supplement 2nd edn 210 (1965). *Type*: Depot Creek, Upper Victoria River [Northern Territory], *F. Mueller* (*holo*: MEL).

Sauropus hubbardii Airy Shaw, Kew Bull. 35: 677 (1980). *Type*: Nonda, between Hughenden and Cloncurry in mixed grassland in heavy dark brown soil, 160 m [Queensland], 6 Feb[ruary] 1931, *Hubbard & Winders* 7295 (*holo*: K).

Sauropus sp. A, Wheeler *et al.*, Flora of the Kimberley Region 628 (1992).

Distribution. Sauropus trachyspermus is the most widespread and common *Sauropus* species within Australia, with a far greater range than the other species from Northern Territory and Western Australia (Table 4). It grows from the Kimberley region of Western Australia across northern and central Australia, down to western Victoria.

Notes. It is likely that this species forms a complex of at least two if not more species. Airy Shaw (1980) separated *Sauropus hubbardii* on the basis of larger habit and leaves, obtuse to rounded sepals, and completely divided styles. We, however, found that these characters were not constant and that these

features varied widely within *Sauropus trachyspermus s. str.* and *S. hubbardii*. Certainly there are very low-growing variants and variants that have been found over 2 m tall. This variation in habit does not seem to co-vary with any other feature that we recorded for the species. While features of seed sculpturing showed some promise in separating these variants, no clear co-varying discontinuities were found.

Table 4. Distribution of Northern Territory and Western Australian species of *Sauropus* within Australia based on the regions adopted by Hnatiuk (1990)

Taxon	**Distribution**
S. arenosus J.T. Hunter & J.J. Bruhl	6, 12
S. brunonis (S. Moore) Airy Shaw	25
S. crassifolius (Muell. Arg.) Airy Shaw	7, 13, 14, 15, 16
S. ditassoides (Muell. Arg.) Airy Shaw	25
S. dunlopii J.T. Hunter & J.J. Bruhl	25
S. filicinus J.T. Hunter & J.J. Bruhl	25
S. glaucus (F. Muell.) Airy Shaw	25
S. gracilis J.T. Hunter & J.J. Bruhl	25
S. huntii (Ewart & O. Davies) Airy Shaw	26,27,28
S. ochrophyllus (Benth.) Airy Shaw	25
S. paucifolius J.T. Hunter & J.J. Bruhl	25
S. ramosissimus (F. Muell.) Airy Shaw	29, 31, 35, 43, 56, 65, 68, 70
S. rigens (F. Muell.) Airy Shaw	29, 34, 47, 54, 55, 48, 56, 70
S. rigidulus (F. Muell. ex Muell. Arg.) Airy Shaw	25
S. rimophilus J.T. Hunter & J.J. Bruhl	25
S. salignus J.T. Hunter & J.J. Bruhl	1
S. stenocladus (Muell. Arg.) J.T. Hunter & J.J. Bruhl	25
S. torridus J.T. Hunter & J.J. Bruhl	1,25
S. trachyspermus (F. Muell.) Airy Shaw	1, 2, 3, 4, 12, 14, 25, 26, 27, 28, 29, 30, 31, 34, 35, 43, 45, 47, 48, 50, 51, 53, 54, 55, 56, 68, 70, 71, 73, 74

Key to the *Sauropus* species and subspecies of the Northern Territory and Western Australia

1 Branch leaves only ever scale-like (Phyllanthoid branching) 2

1: Branch leaves normal, reduced in size or if scale-like then with a mixture of normal and/or leaves reduced in size over the plant 11

2 Stipules white, cream, yellow-brown or green 3

2: Stipules red, red-brown or black 5

3 Plants monoecious; branchlets ribbed and glabrous; lamina 0.2-4.5 mm wide; fruit 3.56 mm long; seed 2.5-5 mm long ..... **S. trachyspermus**

3: Plants dioecious; branchlets not ribbed, with indumentum; lamina 4.7-15.4 mm wide; fruit 6.8-10.6 mm long; seed 5.9-8.2 mm long 4

4 Lamina apex acute to acuminate, margins thickened; male sepals free; anthers 0.4-0.9 mm long; female pedicel length at anthesis 0.8-2.5 mm long, in fruit 1.5-4.5 mm long; styles connate ..... **S. arenosus**

4: Lamina apex obtuse, rounded to obcordate, margins not thickened; male sepals connate; anthers 1-2.6 mm long; female pedicel length at anthesis 2-6.5 mm long, in fruit 2.8-8 mm long; styles free ..... **S. huntii**

5 Branchlets ribbed 6

5: Branchlets not ribbed, although some may be finely striate 7

6 Stems angular; leaves green, 4.9-8 mm wide, elliptic to obovate, margins not thickened, paler below; sepals elliptic, ovate or obovate; male sepals free; filaments 0.6-1 mm long; anthers 0.2-0.4 mm long; styles divided less than half way, 0.3-0.5 mm long ..... **S. salignus**

6: Stems rounded to ellipsoid; leaves grey, 0.3-1.6 mm wide, linear, margins thickened, concolourous; sepals linear to oblanceolate; male sepals connate; filaments 0.1-0.5 mm long; anthers 0.8-1 mm long; styles divided more than half way, 0.7-1.4 mm long ..... **S. stenocladus** subsp. **pinifolius**

7 Stipules ovate, glabrous; scales often purple in colour; male sepals free; female flowers 1-2 per cluster; seeds undulate ..... **S. crassifolius**

7: Stipules triangular to narrow-triangular, with indumentum; scales brown to red-brown; male sepals fused if only basally; female flowers solitary; seeds smooth 8

8 Lamina base cordate; female pedicel at anthesis 1-3.5 mm long ..... **S. ditassoides**

8: Lamina base various but never cordate; female pedicels at anthesis to 1.2 mm long 9

9 Stipules 0.8-1.6 mm long; lamina concave, concolourous; erect and not growing out of sandstone cliffs ..... **S. rigidulus**

9: Stipules 0.4-1.2 mm long; lamina plane to convex, paler below; growing pendulously, or horizontally from sandstone cliffs 10

10 Male sepals obovate, 1.3-3.3 mm long; female pedicel length in fruit 1-1.6 mm; anther length 1.2-1.7 mm; styles connate; ovary length 1.2-1.6 mm; seed length 6.8-9 mm long ..... **S. rimophilus**

10: Male sepals elliptic, 0.4-0.9 mm long; female pedicel length in fruit 0.5-0.7 mm; anther length 0.5-0.6; styles free; ovary length 0.7-0.8 mm; seed length 5.2-6 mm long ..... **S. filicinus**

11 Plants viscid ..... **S. ramosissimus**

11: Plants not viscid 12

12 Branchlets spinose, leaves pseudo-verticellate ..... **S. rigens**

12: Branchlets not spinose, leaves never pseudo-verticellate 13

13 Plants pilose to hirsute, rarely glabrous; filaments 0.05-0.3 mm long; anthers 0.2-0.4 mm long; not apiculate ..... **S. brunonis**

13: Plants glabrous or scabrous, if hirsute then lamina only to 3.2 mm wide; filaments 0.3-1.6 mm long; anthers 0.3-3.4 mm long; usually apiculate 14

14 Lamina 0.6-3.8 mm wide 15

14: Lamina 4-35 mm wide 18

15 Plants monoecious; leaves green when dry, paler below; flowers green; male pedicels 1.8-3.2 mm long; female sepals 1.3-1.8 mm long; filaments 0.3-0.4 mm long; anthers 1-1.1 mm long; growing from sandstone cliffs ..... **S. gracilis**

15: Plants dioecious; leaves greyish when dry, concolourous; flowers yellow when fresh; male pedicels 0.5-1.5 mm long; female sepals 0.4-1 mm long; filaments 0.4-1 mm long; anthers 0.3-0.5 mm long or 1.1-2.7 mm long; growing in tropical woodland 16

16 Plants hirsute; lamina margins plane; male flowers solitary; sepals obovate; male sepals shortly connate, 0.8-1.6 mm long; female pedicels 0.2-0.8 mm long at anthesis; female sepals 1-1.4 mm long at anthesis; anthers 0.3-0.5 mm long; apiculum *c.* 0.1 mm long; style 0.4-0.7 mm long ..... **S. dunlopii**

16: Plants glabrous or rarely scabrous; lamina margins plane to revolute; male flowers 1-6 per cluster; sepals linear to oblanceolate; male sepals variously connate, 2-4.5 mm long; female pedicels 1-8 mm long at anthesis; female sepals 2-4.9 mm long at anthesis; anthers 1.1-2.7 mm long; apiculum 0.1-0.6 mm long; style 0.1-0.6 mm long 17

17 Branchlets not ribbed; lamina 8-43 mm long, 1.5-8 mm wide, commonly elliptic to oblanceolate and more or less straight; male sepals 3.6-4.5 mm long; anthers 2.4-2.7 mm long; fruit 7-9.5 mm long; column 7-8.5 mm long; seeds 8-9.2 mm long ..... **S. glaucus** (Figure 1H,I)

17: Branchlets ribbed; lamina 5.5-18.5 mm long, 0.6-2.4 mm wide, commonly narrow and bent to one side; male sepals 2-2.6 mm long; anthers 1.1-1.5 mm long; fruit 4.8-5.6 mm long; column 3.7-4.5 mm long; seeds 4.8-5.2 mm long ..... **S. stenocladus** subsp. **stenocladus**

18 Branchlets angular and ribbed; lamina paler below, usually only 1-3 leaves per plant ..... **S. paucifolius**

18: Branchlets ellipsoid to flattened; lamina concolourous, leaves many per plant 19

19 Male sepals free; anthers 1.3-2.6 mm long; apiculum 0.1-0.4 mm long, cream; seeds 5.8-6.2 mm long ..... **S. ochrophyllus**

19: Male sepals fused; anthers 2.4-3.4 mm long; apiculum 0.4-0.9 mm long, red-brown; seeds 6.9-9.2 mm long 20

20 Male sepals 1.7-2.4 mm long, 0.7-1.2 mm wide, elliptic to ovate; female pedicels at anthesis 0.8-1.5 mm long; anthers 3-3.4 mm long; apiculum 0.8-0.9 mm long; column 5.1-6.5 mm long; seeds 6.9-7.6 mm long ..... **S. torridus**

20: Male sepals 3.6-4.5 mm long, 0.3-0.6 mm wide, oblanceolate; female pedicels at anthesis 2-8 mm long; anthers 2.4-2.7 mm long; apiculum 0.4-0.6 mm long; column 7-8.5 mm long; seeds 8-9.2 mm long ..... **S. glaucus** (Figure 1H,I)

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Six new species of triggerplant (*Stylidium*: Stylidiaceae) from south-west Western Australia

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Abstract

Lowrie, A. and Kenneally, K.F. Six new species of triggerplant (*Stylidium*: Stylidiaceae) from south-west Western Australia. Nuytsia 11(2): 185-198 (1997). Six new *Stylidium* species from the south-west of Western Australia, *Stylidium burbidgeanum, S. glabrifolium, S. kalbarriense, S. torticarpum, S. tylosum* and *S. udusicola* Lowrie & Kenneally, are described and illustrated. Three of these species have conservation priority.

Introduction

Six miscellaneous new species of triggerplant (*Stylidium*: Stylidiaceae) from the south-west of Western Australia are described and illustrated. They belong to the following subgeneric and sectional classifications as devised by Mildbraed (1908): *Stylidium burbidgeanum* belongs to subg. *Nitrangium* Endl. sect. *Thyrsiformia* (Benth.) Mildbr.; *S. udusicola* belongs to subg. *Tolypangium* Endl. sect. *Despecta* Mildbr.; and *S. glabrifolium, S. kalbarriense* and *S. torticarpum* belong to subg. *Tolypangium* Endl. sect. *Saxifragoidea* Mildbr.

Taxonomy

Stylidium burbidgeanum Lowrie & Kenneally, *sp. nov.* (Figure 1)

S. neglecto Mildbr. affini sed foliis *c.* 15 mm longis, hypanthio *c.* 6 mm longo, sepalis 5 ad basim omnino discretis, corolla *c.* 11 mm lata, et appendicibus lateralibus labelli carentibus differt.

Typus: On Watheroo road, 2 km east of Brand Highway, Western Australia, 30°21'S, 115°30'E, 27 October 1989, *A. Lowrie* 296 (*holo*: PERTH 04431308; *iso:* MEL).

Creeping *perennial herb* with 2-4 (sometimes more) leafy major axes up to 6 cm long arising from bulb-like bases of the old tufts elevated up to 5 cm above the soil surface by wiry prop roots; lower leaves

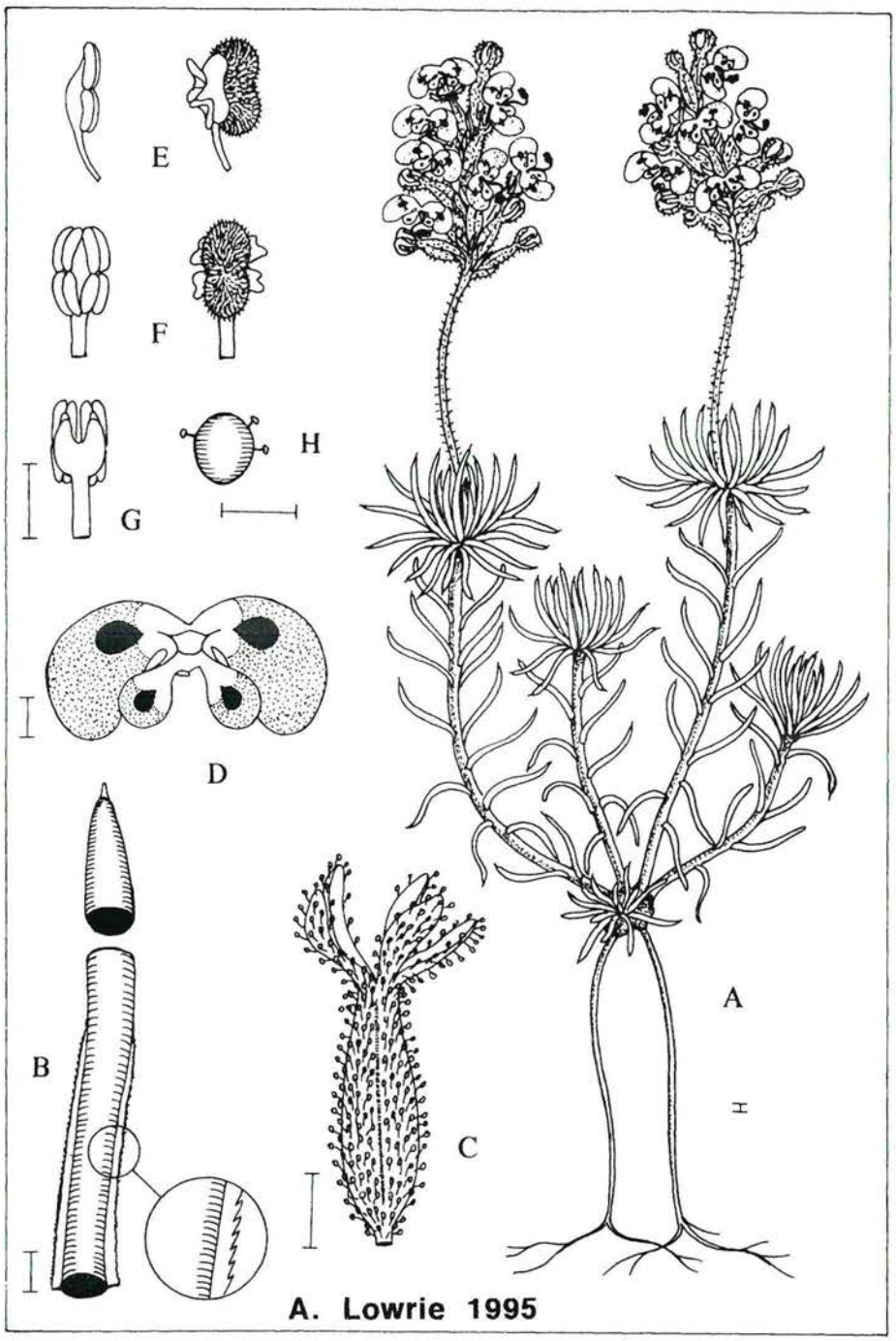

Figure 1. *Stylidium burbidgeanum* A - habit of flowering plant; B - leaf; C - hypanthium and sepals; D - corolla; E - lateral view of gynostemium tip (with stigma at right); F - front view of gynostemium tip (with stigma at right); G - back of gynostemium; H - labellum. Scale bar = 1 mm.

scattered along the major axis; upper leaves in a terminal tuft, each with a small apical (not sharp) projection. *Leaves* linear, 5-15 (mostly 10-12) mm long, 1-1.2 mm wide, terete in the upper part, semiterete in the lower part with margins hyaline, minutely serrate, non-mucronate at first, becoming mucronate at anthesis. *Inflorescence* a dense spike, to 5 cm high (including the scape), densely covered with long and short glandular hairs; bracts, linear, 3-4 mm long; bracteoles 2-2.5 mm long. *Hypanthium* lanceolate, figure 8-shaped in section, sessile, *c.* 6 mm long, *c.* 1.8 mm wide at the base, *c.* 1 m wide at the apex, covered with dense glandular hairs. *Sepals* 5, all free to the base, *c.* 2 mm long. *Corolla* predominantly pink, lobes laterally paired; anterior lobes obovate, *c.* 2.5 mm long, *c.* 1.5 mm wide; posterior lobes obovate, curved, *c.* 5.5 mm long, *c.* 2.7 mm wide; abaxial surface very pale pink, sparsely glandular. *Throat* and petal bases white, with a purple mark between the white and the pink zones of each corolla lobe; appendages absent. *Labellum* boss attached to the base of the corolla tube sinus, round, *c.* 0.8 mm long, *c.* 0.7 mm wide, without basal appendages, margins near the base with a few glandular hairs. *Gynostemium c.* 5 mm long; anthers green with grey pollen, with a few short marginal translucent-white moniliform hairs; stigma elliptic, cushioned, *c.* 1.1 mm long, *c.* 0.6 mm wide. *Capsule c.* 7 mm long. *Seeds* unknown.

Other specimen examined. WESTERN AUSTRALIA: South end of Banovich Rd, first creek crossing *c.* 2.5 km N of the Jurien Bay road, 30° 12' S, 115° 12' E, 27 Nov. 1988, *A. Lowrie s.n.* (PERTH).

Distribution and habitat. Known from two regions of south-western Australia, Kalbarri National Park and the area from Badgingarra and Mt Lesueur north-east to the Green Head road. Grows in loamy soil on winter-wet creek margins and adjacent watersheds and in white silica sand in winter-wet depressions.

Flowering period. October-November.

Conservation status. This species occurs in two widely separated regions, neither of which is under threat.

Etymology. The epithet, *burbidgeanum* is in honor of Dr Allan Burbidge, Principal Research Scientist, CALM, who first discovered this species north-east of Mt Lesueur.

Affinities. The nearest relative to *Stylidium burbidgeanum* is *S. neglectum* Mildbr. From *S. neglectum*, *S. burbidgeanum* differs in having leaves *c.* 15 mm long, hypanthum *c.* 6 mm long, 5 sepals all free to the base, corolla *c.* 11 mm wide, and labellum without lateral appendages.

Stylidium glabrifolium Lowrie & Kenneally, *sp. nov.* (Figure 2)

S. lineato Sond. affinis sed foliis et scapis glaberrimis differt.

Typus: On Great Northern Highway, between Bindoon and New Norcia [precise locality withheld], Western Australia, 26 October 1991, *A. Lowrie* 429 (*holo:* PERTH 04452437; *iso*: MEL).

Perennial herb; rhizome short, often supporting more than one leafy rosette; leaves deciduous during dormancy but a central compact cluster of small fleshy scale-like juvenile leaves is retained. *Leaves* basal, appressed to the soil, elliptic-spathulate, narrowing into a petiole, thin coriaceous, striate with flabellate venation; lamina 6-18 (mostly *c.* 10) mm long, 5-9 (mostly *c.* 8) mm wide, margins very finely hyalined translucent-white, not scarious; petiole linear, *c.* 8 mm long. *Inflorescence* an unbranched raceme, 19-40 cm high (including the scape); scape with appressed alternate linear bracts 3-6 mm long,

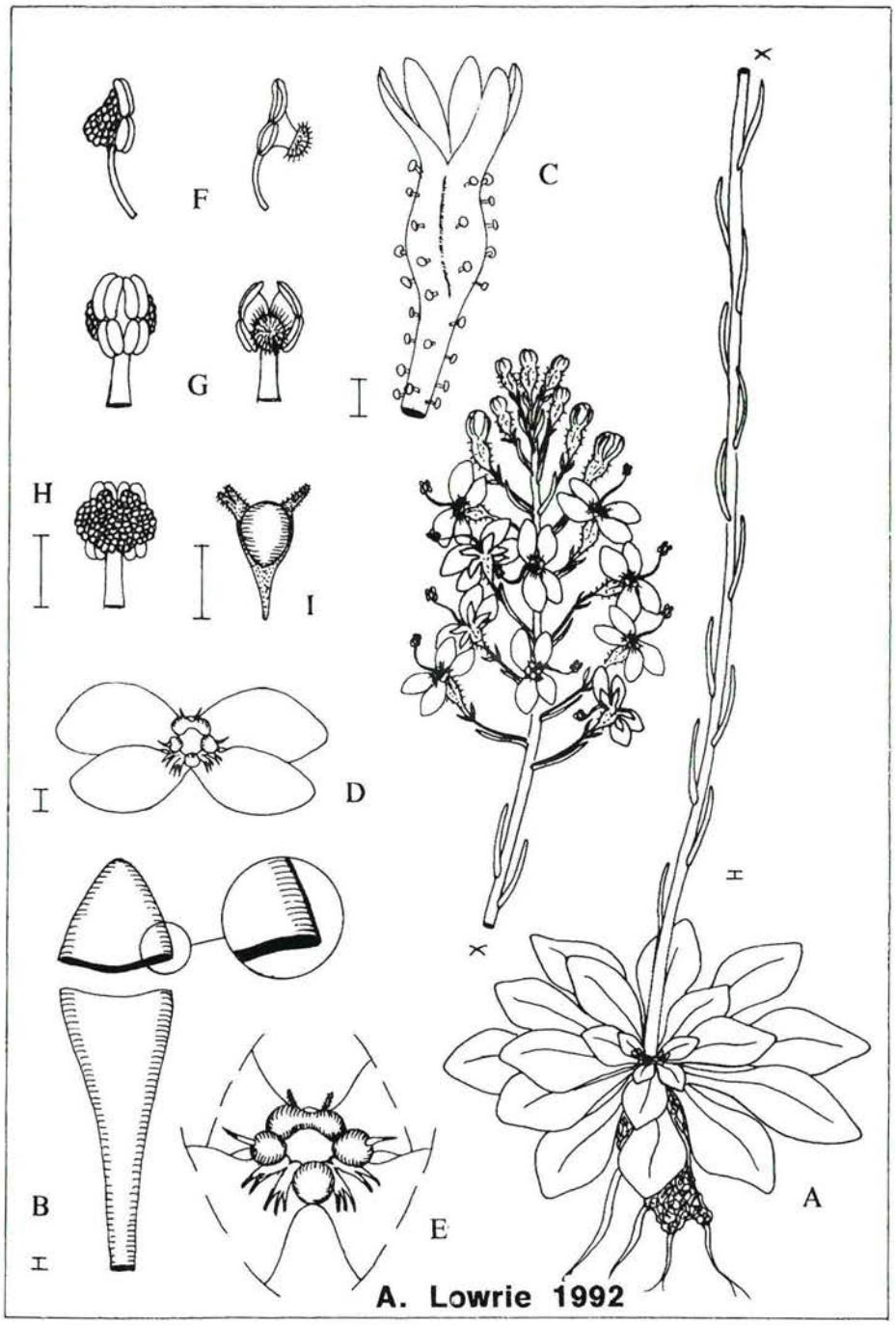

Figure 2. *Stylidium glabrifolium* A - habit of flowering plant; B - leaf; C - hypanthium and sepals; D - corolla; E - throat appendages, enlarged; F - lateral view of gynostemium tip (with stigma at right); G - front view of gynostemium tip (with stigma at right); H - back of gynostemium; I - labellum. Scale bar = 1 mm.

glabrous; bracts, linear, 2.5-4 mm long, glabrous; pedicels 8-14 (mostly 8-10) mm long, distally glandular; bracteoles narrowly ovate, 1-2 mm long, glabrous. *Hypanthium* clavate, *c.* 2 mm long, *c.* 1.5 mm diam. at anthesis, with sparse glandular hairs. *Sepals* 5, all free to the base, elliptic, obtuse, *c.* 3 mm long, glabrous. *Corolla* predominantly pale yellow fading quickly to creamy white, lobes laterally paired; anterior lobes elliptic, *c.* 6.3 mm long, *c.* 3 mm wide; posterior lobes elliptic, *c.* 6 mm long, *c.* 3 mm wide; abaxial surface colouring similar to adaxial surface, glabrous. *Throat* pale green, appendages 6, *c.* 0.7 mm long, entire and bi- (sometimes tri-) furcate, blackish maroon, reddish at base, with 3 mound-like silvery appendages with a yellow margin; bordering the throat near the labellum but hidden by the gynostemium in the set position is a smooth pale green swelling. *Labellum* boss attached to the base of the corolla tube sinus, pale green, ovate, *c.* 0.8 mm long, *c.* 0.7 mm wide; basal appendages yellow, *c.* 0.3 mm long, papillose; apical point yellow, *c.* 0.7 mm long; corolla tube *c.* 1 mm long. *Gynostemium* *c.* 6 mm long; anthers pale yellow, pollen yellow; stigma *c.* 0.5 mm diam., mushroom-like, *c.* 0.5 mm long. *Capsule* unknown. *Seeds* unknown.

Distribution and habitat. Known only from the type location north of Bindoon in south-western Australia. Grows in clayey sand amongst small, scattered flat granitic alluvial rocks in a watershed surrounded by laterite soils and *Eucalyptus wandoo* forest.

Flowering period. October.

Chromosome number. n = 14 (*A. Lowrie* 429).

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority Two. This species is only known from one small location bordering a rehabilitated gravel pit on a flora reserve.

Etymology. From the Latin *glabri* - glabrous and *folium* - leaf, in reference to the smooth leaves.

Affinities. The nearest relative to *Stylidium glabrifolium* is *S. lineatum* Sond. From *S. lineatum*, *S. glabrifolium* differs by having glabrous leaves and scape, hypanthium with sparse glandular hairs, entire and bi- (sometimes tri-) furcate blackish-maroon throat appendages, and 3 mound-like silvery light-reflecting appendages.

Notes. The pale yellow flowers of *Stylidium glabrifolium* bear throat appendage projections as well as silvery mirror-like mounds. Similar mirror-like mounds have also been discovered in *S. squamellosum* DC., *S. cymiferum* Lowrie & Carlquist and *S. tylosum*.

The mirror-like mounds are convex and so reflect sunlight regardless of the sun's position throughout the day. The sunlight reflection signals are further enhanced by flashing as the flowers quiver even in the lightest breeze. The glistening mounds contain no nectar but act as a ruse to entice any flying insects that might act as pollinators. This deception is not without reward as nectar is available to the pollinator within the corolla tube. This nectar reward ensures the pollinator is deceived more than once, permitting cross-pollination.

Stylidium kalbarriense Lowrie & Kenneally, *sp. nov.* (Figure 3)

S. macrocarpo (Benth.) Erickson and Willis affini sed mucrone unguiformi ad apicem foliorum adultorum affixo, marginis lateralibus laevibus albis, carina minute serrata, sepalis glandulosis, stigmate duplo-tumidiformi, capsula glandulosa nec leviter convoluta differt.

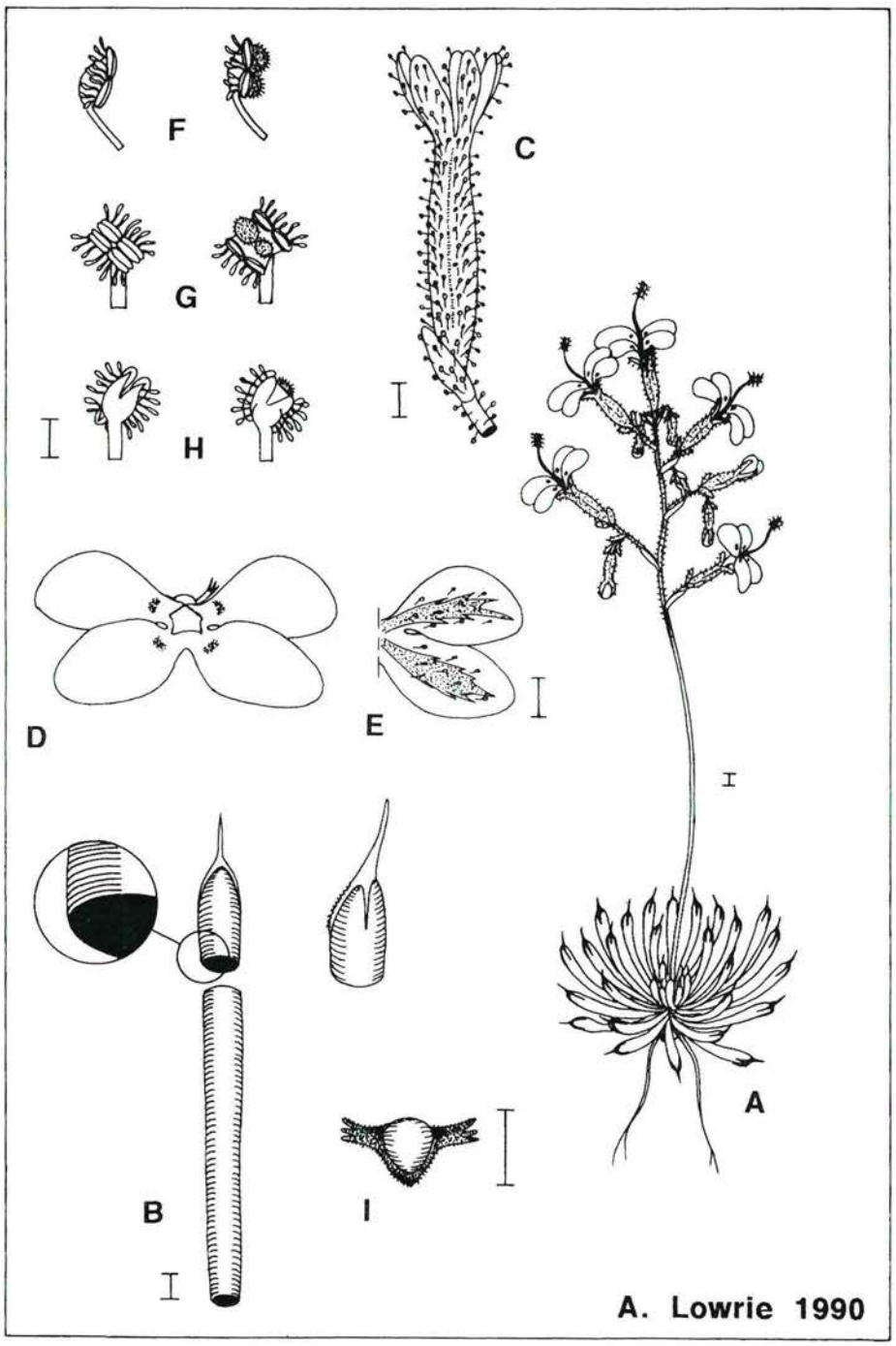

Figure 3. *Stylidium kalbarriense* A - habit of flowering plant; B - leaf, enlarged section left, enlarged lateral view of leaf tip, mucro and 3-lobed claw-like attachment, right; C - hypanthium and sepals; D - corolla; E - abaxial surface of corolla; F - lateral view of gynostemium tip (with stigma at right); G - front view of gynostemium tip (with stigma grown out, right); H - back of gynostemium (with stigma at right); I - labellum. Scale bar = 1 mm.

Typus: 20 km east of Kalbarri, on Ajana-Kalbarri road, south side of road, Western Australia, 27° 46' S, 114° 18' E, 4 September 1992, *A. Lowrie* 638 (*holo*: PERTH 04452445; *iso*: MEL).

Perennial herb; stem short; leaves in a basal tuft at soil level or elevated above the soil surface by prop roots 1-1.5 cm long. *Leaves* oblanceolate, 1-4.5 (mostly 2.5-3) cm long, terete in section, 1-1.7 mm wide, with a white mucro 1 mm long, subterminally attached, becoming claw-like in adult leaves by its 2 smooth lateral white hyaline margins and a minutely serrate keel. *Inflorescence* 1-4, the central inflorescence dominant and up to 12 cm high (including the scape), when more than one arising from the basal tuft of leaves; lateral inflorescences when present of a lesser height; scape glabrous; inflorescence glandular, of cymose branches with 2-3 flowers; bracts linear with an apical mucro, 2-3 mm long. *Hypanthium* lanceolate, pedicellate, 6.5-10 mm long, *c.* 1.2 mm wide, figure 8-shaped in section, glandular. *Sepals* 5, all free to the base, 2-2.5 mm long. *Corolla* predominantly white, lobes laterally paired, anterior lobes obovate-elliptic, *c.* 3.8 mm long, *c.* 2.3 mm wide; posterior lobes obovate, *c.* 4 mm long, *c.* 2.3 mm wide; abaxial surface of each lobe white with a distinctive dark red wine-coloured and glandular oblanceolate serrate margined zone along the mid vein. *Throat* white, bordered by reddish marks; appendages absent. *Labellum* boss attached to the base of the corolla tube sinus, green, ovate, *c.* 0.7 mm long, *c.* 0.7 mm wide; basal appendages dark red, *c.* 0.6 mm long, *c.* 0.3 mm wide, distally 3-lobed, papillose, margins and apex dark red, beard-like, papillose, corolla tube *c.* 1.5 mm long. *Gynostemium* *c.* 9.5 mm long; anthers green; pollen white, with marginal translucent-white moniliform hairs; stigma a double dome-like projection, *c.* 1 mm long, *c.* 0.4 mm wide. *Capsule c.* 1.5 cm long, not twisted at maturity. *Seeds* orange, *c.* 0.5 mm long.

Other specimen examined. WESTERN AUSTRALIA: Murchison Gorge, 30 Aug. 1984, *R. Bates* 3894 (PERTH); Kalbarri, 15 Aug. 1966, *R. Erickson s.n.* (PERTH); Kalbarri-Adjana Rd, 8 Sep. 1966, *R. V. Smith* 66/375 (MEL, PERTH); on the road to The Loop, Kalbarri National Park, 8 Aug. 1990, *A. Lowrie s.n.* (PERTH).

Distribution and habitat. Occurs in the Kalbarri National Park region of south-western Australia, on pale yellow sandy soils in heathland.

Flowering period. August-September.

Conservation status. Common in Kalbarri National Park and not under threat.

Etymology. The epithet, *kalbarriense* refers to the Kalbarri region where this species occurs.

Affinities. The nearest relative to *Stylidium kalbarriense* is *S. macrocarpum* (Benth.) Erickson & Willis. From *S. macrocarpum, S. kalbarriense* differs by having glandular sepals, all free to the base, the stigma a double dome-like projection and the capsule glandular and not twisted.

Stylidium torticarpum Lowrie & Kenneally, *sp. nov.* (Figure 4)

Species capsula matura valde torsiva congeneribus diversa.

Typus: South end of Banovich Rd, 0.1 km south of the creek crossing, Mt Lesueur region, Western Australia, 18 October 1991, *A. Lowrie* 414 (*holo*: PERTH 04452461; *iso:* MEL).

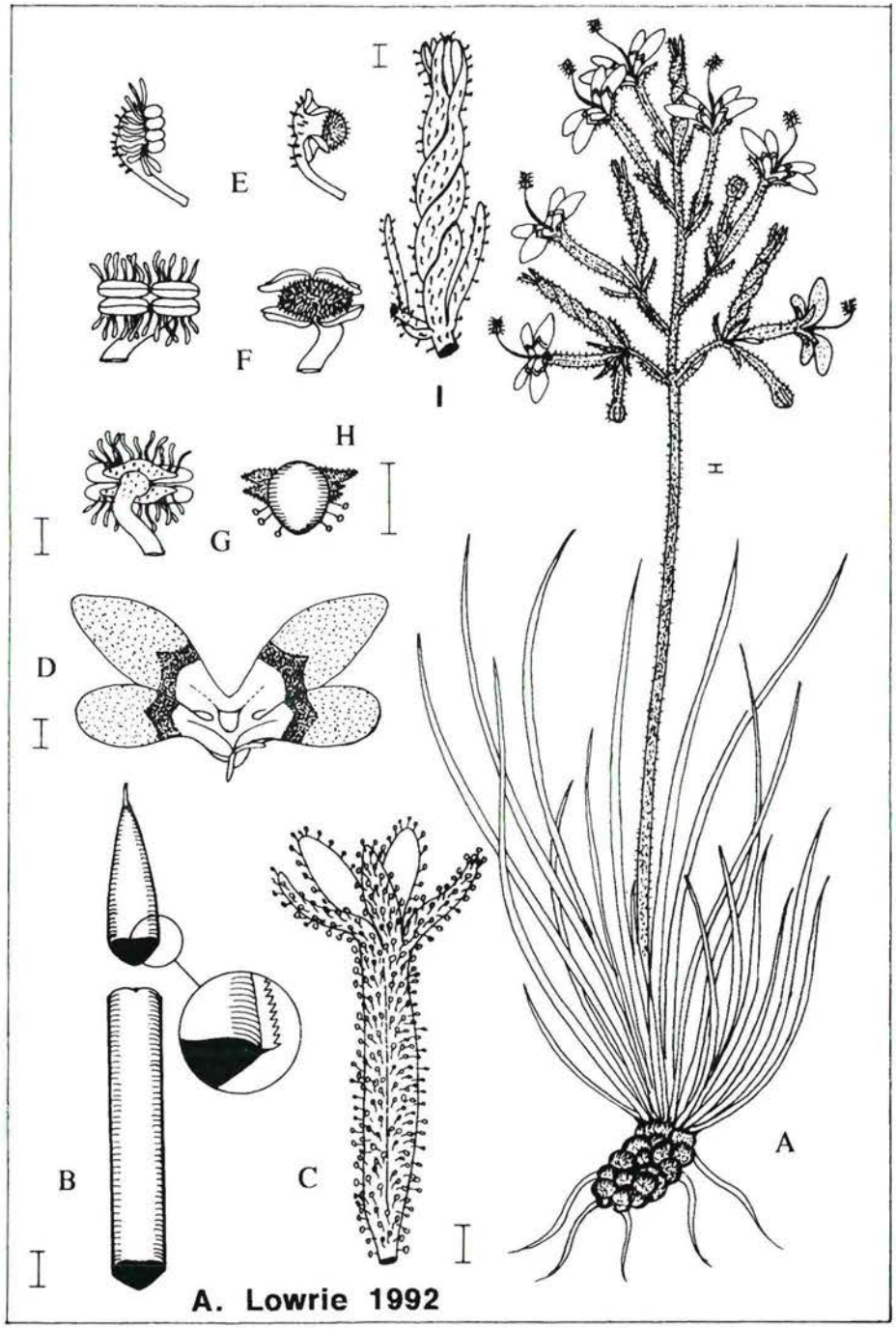

Figure 4. *Stylidium torticarpum* A - habit of flowering plant; B - leaf; C - hypanthium and sepals; D - corolla; E - lateral view of gynostemium tip (with stigma at right); F - front view of gynostemium tip (with stigma at right); G - back of gynostemium; H - labellum; I - seed capsule showing the 360° twisting at maturity. Scale bar = 1 mm.

Perennial herb; rhizome short, thick and densely leafy. *Leaves* basal, narrowly linear, 3-10 (mostly 9) cm long, 1-1.5 mm wide, triangular in section; margins hyaline white and minutely serrate; apex with a red mucro *c.* 0.5 mm long. *Inflorescence* up to 20 cm high (including the scape), rose-coloured, densely glandular hairy throughout, simple only at tip but otherwise composed of cymose branches with 2-3 flowers; bracts, linear, 4-8 mm long. *Hypanthium* linear, sessile, *c.* 9 mm long, *c.* 1.2 mm diam, and not twisted at anthesis, densely covered with glandular hairs. *Sepals* 5, all free to the base, *c.* 3 mm long. *Corolla* predominantly pale or dark pink, lobes laterally paired; anterior lobes obovate, *c.* 4.5 mm long, *c.* 2.5 mm wide; posterior lobes oblanceolate, *c.* 5.5 mm long, *c.* 2.5 mm wide; abaxial surface pink, white at the base, glandular. *Throat* white, without appendages, bordered by a very dark pink margin. *Labellum* boss attached to the base of the corolla tube sinus, ovate, *c.* 1 mm long, *c.* 0.8 mm wide; basal appendages *c.* 0.5 mm long, papillose, margins towards the apex provided with a few glandular hairs, corolla tube *c.* 1.5 mm long. *Gynostemium c.* 9 mm long; anthers grey with blue-grey pollen, with marginal translucent-white moniliform hairs; stigma elliptic, cushion-like, *c.* 1.5 mm long, *c.* 1 mm wide. *Capsule* slightly twisted when juvenile, markedly twisted at maturity. *Seeds* dark brown, *c.* 0.8 mm long, minutely tuberculate.

Other specimens examined. WESTERN AUSTRALIA: Cockleshell Gully, 15 Nov. 1946, *C.A. Gardner* 8410 (PERTH); S end of Banovich Rd, 0.1 km S of creek crossing, Mt Lesueur region, 18 Oct. 1991, *A. Lowrie* 419 [in fruit] (PERTH); 3 km N on Banovich Rd from Jurien Rd, 27 Oct. 1989, *A. Lowrie s.n.* (PERTH); Arrowsmith River crossing on Robb Rd, 6.7 km E of Brand Highway, Shire of Three Springs, 28 June 1996, *A. Lowrie s.n.* (PERTH); *c.* 0.5 km N of Limpfield Farm gate, a few km E of Mazza Road on Marchagee Track, Herschell Range, Shire of Coorow, 30 Oct. 1996, *M. Hancock s.n.* (PERTH).

Distribution and habitat. Endemic to south-western Australia. Known only from two locations in the Mt Lesueur region on winter-wet creek margins and adjacent watersheds in red loam soil, one location in the Herschell Range east of Mt Lesueur, and one location along the Arrowsmith River north of Eneabba.

Flowering period. October.

Chromosome number. Stylidium torticarpum is a polyploid with n = 28 (*A. Lowrie* 414), compared to n = 14 (*A. Lowrie* 279) in *S. ricae*.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority Two. This species is known from two populations in the Mt Lesueur region, one location in the Herschell Range, and one location on the Arrowsmith River, all of which are not under threat.

Etymology. From the Latin *torti* - twisted and *carpum* - fruit, in reference to the markedly twisted seed capsule.

Affinities. The nearest relative to *Stylidium torticarpum* is *S. ricae* Carlquist. *S. torticarpum* differs from *S. ricae* in chromosome number and in the following morphological characters: leaves linear rather than oblanceolate, not channelled but triangular in sectional view, minutely serrate; inflorescence with cymose branches rather than simple; sepal apex obtuse rather than acute; and capsule markedly twisted *c.* 360° rather than slightly twisted *c.* 90°.

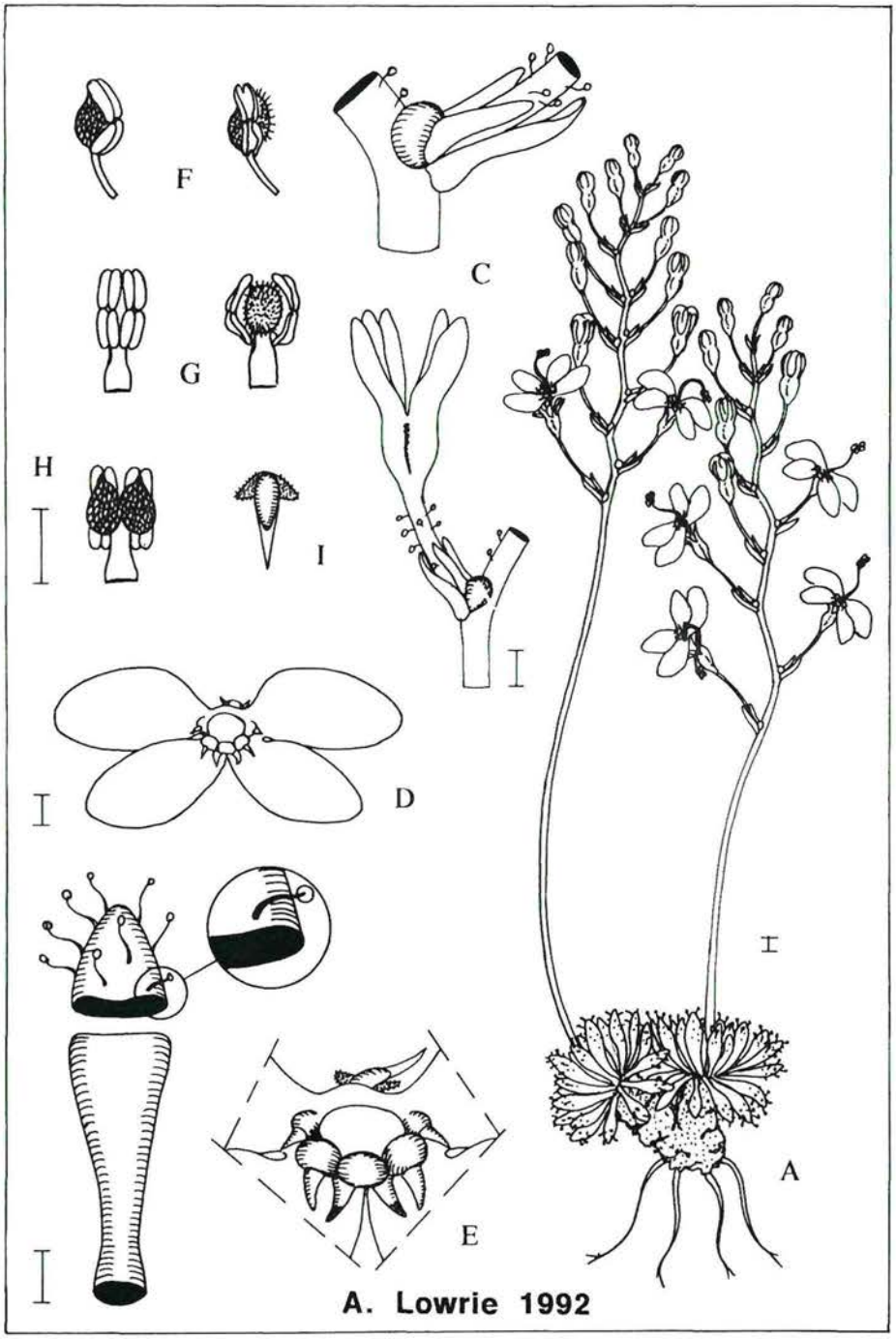

Figure 5. *Stylidium tylosum* A - habit of flowering plant; B - leaf; C - hypanthium, sepals and attachment to the scape, with enlargement (above) of bract, bacteoles and mound-like swelling at the base of the pedicel; D - corolla; E - throat appendages, enlarged; F - lateral view of gynostemium tip (with stigma at right); G - front view of gynostemium tip (with stigma at right); H - back of gynostemium; I - labellum. Scale bar = 1 mm.

Stylidium tylosum Lowrie & Kenneally, *sp. nov.* (Figure 5)

S. cymifero Lowrie & Carlquist affini sed plantis parvis, inflorescentia racemosa florum pedicellatorum alternorum constata, corollae appendicibus faucis 6 tumulis argentiis 6, bracteis et bracteolis una aggregatis supra tumulum ad basim pedicelli positis, appendicibus labelli differt.

Typus: Moodiarrup Rd West, 2.1 km east of Gibbs Road, east of Moodiarrup, Western Australia, 33° 36' S, 116° 47' E, 31 October 1994, *A. Lowrie* 1082 (*holo:* PERTH 04452488; *iso*: MEL).

Perennial herb; stem short, single or branched; leaves basal and rosette. *Leaves* oblanceolate, petiolate, 4.5-8 mm long, 0.8-1.8 mm wide, oblong in section, with a few glandular hairs on the adaxial surface. *Inflorescence* solitary, a raceme of alternate flowers; scape and inflorescence glabrous (except for a few scattered glands on the pedicels); bracts *c.* 1.5 mm long; bracteoles *c.* 1 mm long, grouped together and located on a large mound-like swelling (visible in live specimens only) at the base of the pedicel. *Hypanthium* turbinate, tube shorter than the sepals, 1.5-2 mm long, *c.* 1.1 mm wide, glabrous. *Sepals* 5, all free to the base, 2-3 mm long. *Corolla* yellow, lobes laterally paired; anterior lobes obovate, *c.* 5.5 mm long, *c.* 3 mm wide; posterior lobes obovate-elliptic, *c.* 5 mm long, *c.* 2.5 mm wide; abaxial surface of each lobe yellow with a little purple staining (appearing brown) blotched along the midvein, glabrous. *Throat appendages* 6, the longest *c.* 0.7 mm long, horn-like, dark yellow, the tips often brown, with 3 large silver coloured light -reflecting mounds. *Labellum* boss attached to the base of the corolla tube sinus, yellow, narrowly ovate, *c.* 0.7 mm long, *c.* 0.3 mm wide; basal appendages yellow, *c.* 0.2 mm long, *c.* 0.2 mm wide, apical point *c.* 0.5 mm long; corolla tube shorter than the sepals. *Gynostemium c.* 5.5 mm long, anthers black with yellow pollen; stigma cushion-like. *Capsule* unknown. *Seeds* unknown.

Other specimens examined. WESTERN AUSTRALIA: On private property *c.* 1 km diagonally in from the corner of Knight and Washpool Roads, *c.* 9 km N of the Porongurup Range, 34° 35' S, 117° 51' E, 21 Oct. 1991, *P. Mann s.n.* (PERTH).

Distribution and habitat. Endemic to south-western Australia. Known only from one collection in the Moodiarrup region and another collection *c.* 170 km to the south-east in the Porongurup region. Grows in sandy clay in watershed run-off areas from granite outcrops.

Flowering period. October-November.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority One. This species is only known from two populations, one in the Moodiarrup region on public land, the other in the Porongurup region on private property. Neither one is currently under threat.

Etymology. From the Greek *tylos* - lump or swelling, in reference to the large mound-like swelling at the base of the pedicel.

Affinities. The nearest relative to *Stylidium tylosum* is *S. cymiferum* Lowrie & Carlquist. *S. tylosum* is distinguished from *S. cymiferum* by its smaller plants; inflorescence a raceme of alternate flowers; corolla throat appendages 6 with 3 silver-coloured mounds; bract and bracteoles grouped together, located on a large mound-like swelling at the base of the pedicel (visible in live specimens only); and labellum having basal appendages.

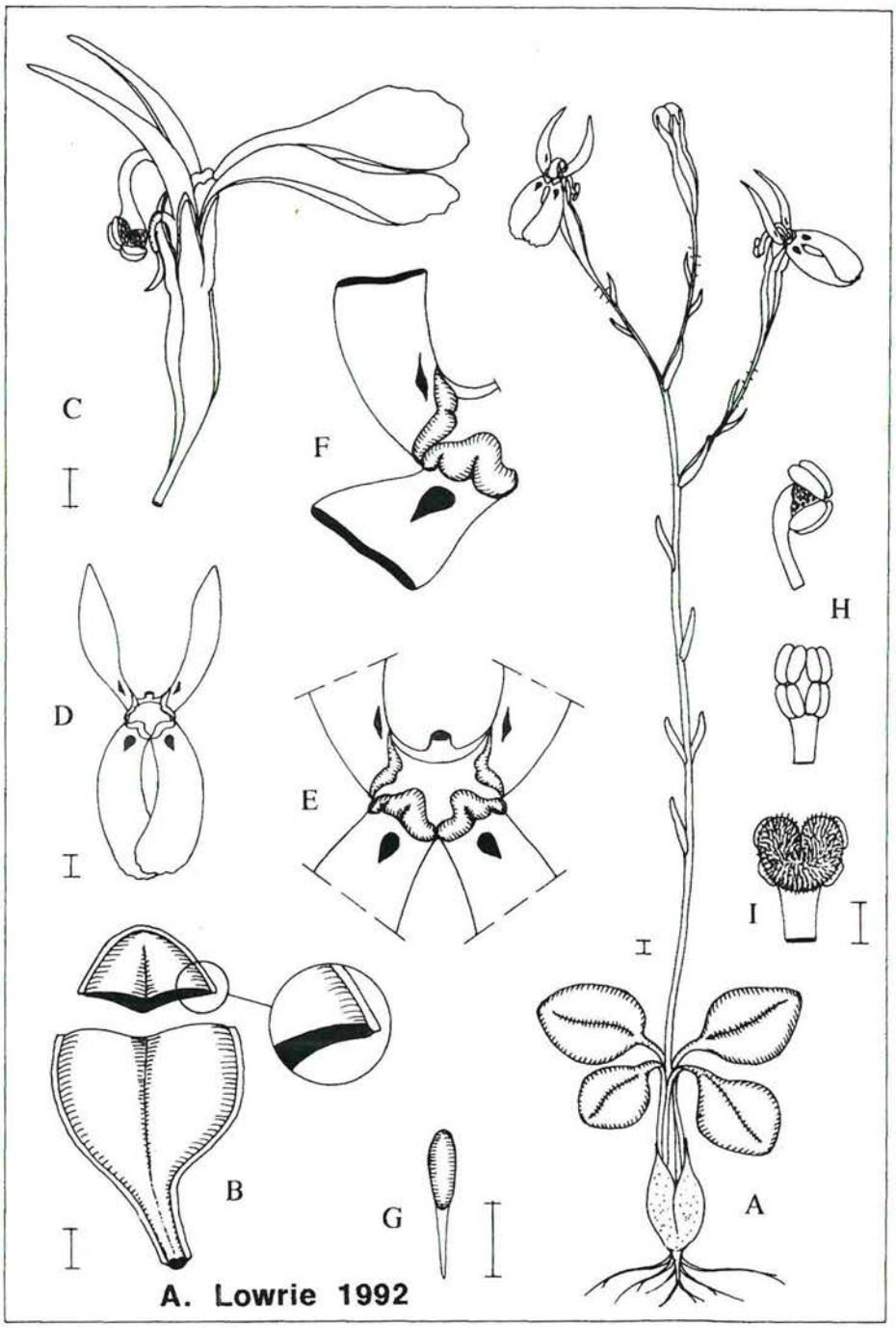

Figure 6. *Stylidium udusicola* A - habit of flowering plant; B - leaf; C - lateral view of flower; D - corolla; E - throat appendages; F - throat appendages, enlarged; G - labellum; H - lateral view above and front view below of gynostemium tip; I - front view of gynostemium tip (with stigma grown out). Scale bar = 1 mm.

Stylidium udusicola Lowrie & Kenneally, *sp. nov.* (Figure 6)

S. petiolari Sond. affini sed scapo infra inflorescentiam bractiis ornato, appendicibus faucis 4, V-shaped, tumuloideis differt.

Typus: On the corner of Richardson Rd and Great Northern Highway, north-east of Miling, Western Australia, 30° 29' S, 116° 26' E, 28 September 1991, *A. Lowrie* 337 (*holo*: PERTH 04452518; *iso*: MEL).

Bulbous *perennial herb* with ephemeral upper parts; bulb covered with brown scale-like papery sheaths; leaf petioles arising from the bulb apex appressed for much of their length to the base of the scape below the soil, leaves on the soil surface basal and rosetted. *Leaves* broadly ovate, fleshy, petiolate; lamina *c.* 6.5 mm long, *c.* 5.5 mm wide, hyaline on margin, *c.* 0.5 mm thick and gull-winged in section. *Inflorescence* solitary, slightly racemose (including scape) up to 12 cm long; scape glabrous, bearing 1-5 (mostly 2-3) bracts *c.* 3 mm long; pedicels glandular; floral bract *c.* 3 mm long; bracteoles *c.* 2 mm long. *Hypanthium* elliptic, *c.* 4 mm long, *c.* 1.5 mm wide, glabrous. *Sepals* 5, all free to the base, subulate, glabrous with a fine marginal translucent-white hyaline, *c.* 2.8 mm long. *Corolla* white blushed pink with small reddish marks near the throat, lobes vertically paired; anterior lobes oblanceolate, slightly falcate but remaining erect (not bent towards or over each other like *S. petiolare* Sond.), *c.* 6.5 mm long, *c.* 1.3 mm wide; posterior lobes oblong-falcate, *c.* 7 mm long, *c.* 2.5 mm wide, often cruciate, abaxial surface of each lobe white, reddish along the midvein. *Throat appendages* 4, yellowish-white, those on the posterior lobes larger, V-shaped-undulate, mound-like, *c.* 0.5 mm high. *Labellum* boss attached to the base of the corolla tube sinus, reddish, narrowly ovate, *c.* 1 mm long, *c.* 0.4 mm wide, without basal appendages; apical point *c.* 1 mm long; corolla tube shorter than the sepals. *Gynostemium c.* 8 mm long, anthers blackish brown, pollen purple, stigma almost double cushion-like. *Capsule* unknown. *Seeds* unknown.

Other specimens examined. WESTERN AUSTRALIA: Dewar's Pool-Bindoon road, 19.5 km E of Great Northern Highway, 31° 16' S, 116° 20' E. 14 Sep. 1991, *A. Lowrie* 306 (PERTH); Banovich Rd, near creek crossing *c.* 2 km N of Jurien road, 30° 12' S, 115° 12' E, 23 Sep. 1990, *A. Lowrie* 276 (PERTH); *c.* 20 km E of Kalbarri, 27° 46' S, 114° 18' E, 4 Sep. 1992, *A. Lowrie* 633 (PERTH).

Distribution and habitat. Known from four areas in south-western Australia: Dewar's Pool, Miling, Mt Lesueur region and east of Kalbarri. A distance of *c.* 560 km separates the southernmost and northernmost populations of this species. Grows in clayey sand in winter-wet depressions; in red loam on creek margins; and on seepage areas on granite outcrop aprons.

Flowering period. September-October.

Conservation status. A common species and not under threat.

Etymology. From the Latin *udus* - wet and *cola* - dweller in reference to this species preferred habitat.

Affinities. The nearest relative to *Stylidium udusicola* is *S. petiolare* Sond. *S. udusicola* is distinguished from *S. petiolare* (in parenthesis) by its scape below the inflorescence bearing bracts (bracts on scape absent); throat appendages 4, V-shaped-undulate, mound-like (throat appendages 8, 6 tooth-like and 2 small bumps); and leaf lamina broadly ovate, (lamina narrowly elliptic).

Acknowledgements

We would like to thank Professor Sid James, Botany Department, University of Western Australia for the unpublished chromosome counts from the A. Lowrie flower bud collections; Paul Wilson for his assistance with the Latin diagnoses; Barbara Rye for her comments, and the staff of the Western Australian Herbarium (PERTH).

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Eight new species of triggerplant (*Stylidium*: Stylidiaceae) from northern Australia

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Abstract

Lowrie, A. and Kenneally, K.F. Eight new species of triggerplant (*Stylidium*: Stylidiaceae) from northern Australia. Nuytsia 11(2): 199-217 (1997). Eight new *Stylidium* species, *S. adenophorum, S. barrettorum, S. clarksonii, S. mucronatum, S. perizostera, S. prophyllum, S. rivulosum* and *S. turbinatum* Lowrie & Kenneally, are described and illustrated.

Introduction

Three of the new species of triggerplant (*Stylidium*: Stylidiaceae) from northern Australia, *Stylidium adenophorum, S. mucronatum* and *S. turbinatum,* have been treated by previous authors as variants of/or *S. floodii* F. Muell. Following the leptotypification of *S. floodii* (Lowrie & Kenneally 1994), further study has established that the three new species here described are morphologically distinct. Another new species, *S. rivulosum,* also shows superficial morphological similarities to the *S. floodii* complex.

Of the remaining four new species, *S. barrettorum, S. perizostera* and *S. prophyllum* are only known from the Kimberley, north-west Australia, while the fourth species, *S. clarksonii* is known only from north Queensland. Two of these Kimberley species are currently listed as priority flora for conservation.

Taxonomy

Stylidium adenophorum Lowrie & Kenneally, *sp. nov.* (Figure 1)

A *S. floodii* folio prope apicem pilis glandularibus 1-3 ornatis, corolla appendicibus faucis 4, duobus aliformibus 1.2 mm longis, duobus tumoriformibus statim dignoscendo.

Typus: Mount Barnett Roadhouse picnic grounds, Kimberley; Western Australia, 16° 45' S, 125° 56' E, 11 June 1995, *A. Lowrie* 1227 (*holo:* PERTH 04452542; *iso*: DNA, MEL).

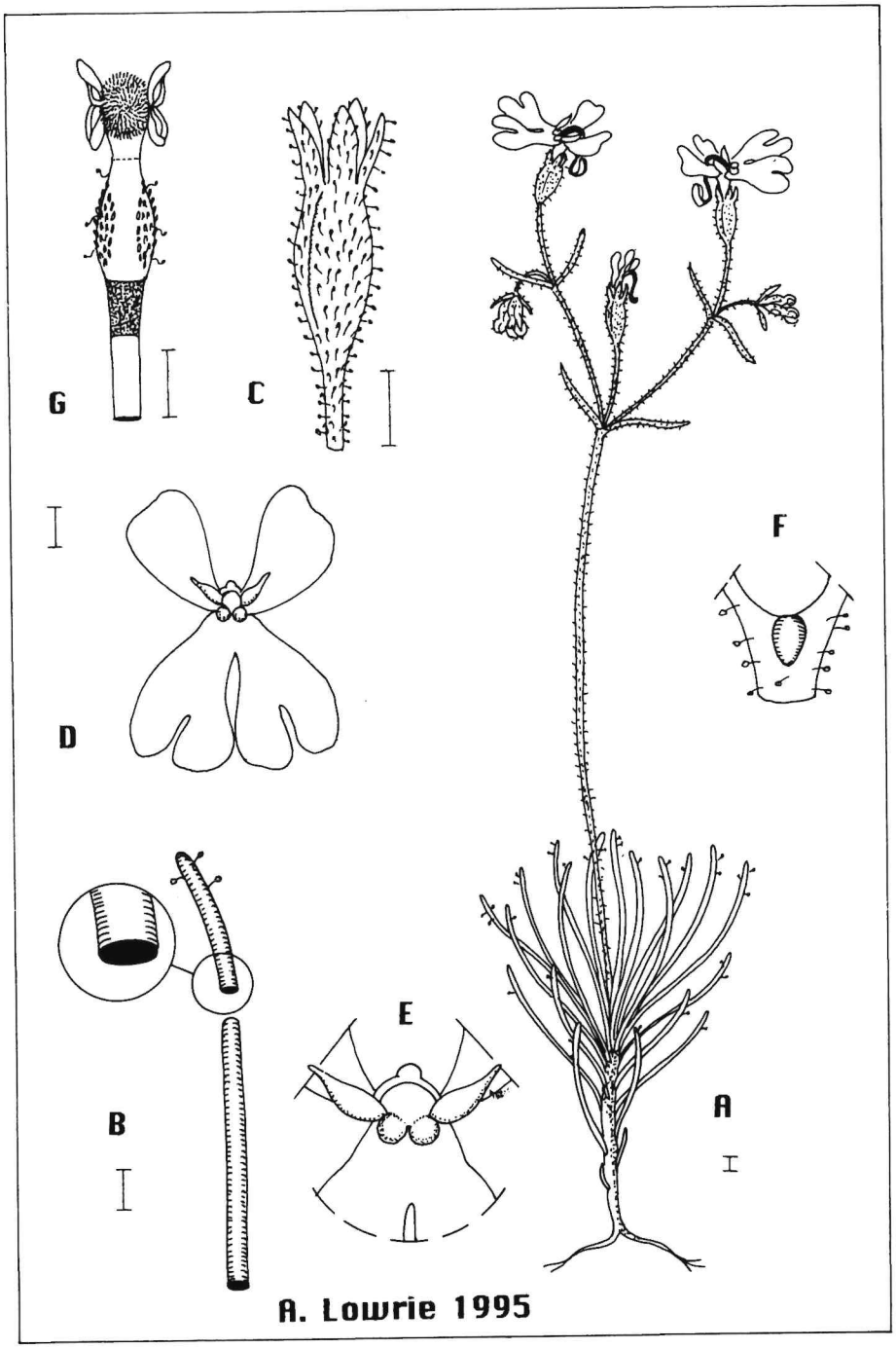

Figure 1. *Stylidium adenophorum* A - habit of flowering plant; B - leaf of basal tuft, enlarged section upper left; C - hypanthium and sepals; D - corolla; E - enlarged section of the corolla showing throat appendages; F - enlarged section of the corolla tube showing labellum on sinus; G - adaxial view of gynostemium column and stigma showing hinged portion (dotted) immediately below stigma, the dilated cunabulum with marginal papillae and the sensitive torosus (stippled). Scale bar for all = 1 mm.

Erect *annual herb* 5-25 cm (mostly 5-15 cm) high, with a glabrous stem 1-3 cm long, lower leaves scattered and often caducous, upper leaves in a terminal tuft. *Leaves* terete, 8-30 mm long, *c.* 0.6 mm diameter, bearing a few glands near the apex, often with additional glands scattered along the leaf, rarely glabrous. *Inflorescence* racemose, scape glandular-hairy. *Bracts* subulate, 1.5-3 mm long, sparsely glandular-hairy; pedicels slender, 3-10 mm (mostly 6 mm) long, glandular-hairy. *Hypanthium* ellipsoid, 1.5-1.8 mm long, *c.* 1 mm diam. at anthesis, glandular-hairy. *Sepals* 5, all free to the base, subulate, 1.5-2 mm long, glandular-hairy. *Corolla* dark pink, lobes vertically paired, abaxial surface a little glandular; anterior lobes obovate, the apex entire or emarginate, *c.* 3.5 mm long, *c.* 1.5 mm wide; posterior lobes obovate, apex deeply 2-lobed to emarginate, *c.* 4.5 mm long, *c.* 2.8 mm wide. *Throat appendages* 4, dark pink; upper pair lanceolate, wing-like, *c.* 1.2 mm long; lower pair small, round, bump-like. *Labellum* attached to the base of the corolla tube sinus, ovate, *c.* 0.7 mm long, *c.* 0.4 mm wide. *Gynostemium* *c.* 5.7 mm long, hinged below the anthers, with a dilated cunabulum bearing 2 crowded marginal rows of short, non-glandular projections above the sensitive torosus, abaxial surface sparsely glandular-hairy. *Capsule* obovoid, 2.5-3 m long. *Seeds* pale orange, *c.* 0.2 mm long.

Other specimens examined. NORTHERN TERRITORY: Towards Churchills Head by 0.5 km on old road, *c.* 80 km N of Tennant Creek, 18° 58' S, 134° 07' E, 10 July 1993, *D.E. Murfet* 1808 (PERTH); Edith Falls Loop Walk, 14° 10' S, 132° 11' E, 19 June 1993, *D.E. Murfet* 1799 (PERTH); Caranbirini Waterhole area S of Borroloola, 16° 16' 30" S, 136° 04' 57" E, 11 May 1996, *D.E. Murfet* 2421 (PERTH).
QUEENSLAND: 24 km S of Wakooka Outstation, Cook district, 14° 45' 13" S, 144° 30' 50" E, 28 May 1993, *V.J. Nelder* 4050 (DNA, K, MBA, MEL, NSW, PERTH); 36.3 km from Dixie Station on the track to Killarney, Cape York, Cook District, 15° 20' S, 143° 27' E, 5 June 1989, *J.R. Clarkson* 8153 & *V.J. Nelder* (MBA, PERTH).
WESTERN AUSTRALIA: On road to Ord Dam, 13.3 km SW of Victoria Highway, Kununurra, 16° 01' S, 128° 51' E, 27 June 1993, *A. Lowrie* 778 (PERTH); Matchbox Creek, on road to Ord Dam, 19.9 km SW of Victoria Highway, Kununurra, 16° 02' S, 128° 47' E, 27 June 1993, *A. Lowrie* 781 (PERTH); On road to Grevillea Gorge, *c.* 20 km N.W. of Beverley Springs, 16° 36' S, 125° 36' E, 6 June 1995, *A. Lowrie* 1183 (PERTH); *c.* 50 km N of Merry Creek crossing on road to Bachsten Creek, Mount Elizabeth Station, 12 June 1995, *A. Lowrie* 1252 (PERTH); 14 km W of Kununurra on Victoria Highway, 15° 46' S, 128° 36' E, 19 June 1995, *A. Lowrie* 1323 (PERTH); Little Mertens Creek, *c.* 0.5 km W of 14° 49' 10" S, 125° 43' 08" E, 28 Apr. 1996, *A. Lowrie* 1408 (PERTH); *c.* 1 km W of Little Mertens Creek on walk trail to Mitchell Falls, *c.* 1.8 km W of 14° 49' 10" S, 125° 43' 08" E, 28 Apr. 1996, *A. Lowrie* 1412 (PERTH).

Distribution. Occurs in northern parts of the Kimberley in Western Australia. Known from the Katherine, Tennant Creek and Boroloola regions in Northern Territory and the Cook district, Cape York region in north Queensland.

Habitat. Grows in grey sands on flat plains in north Queensland; sandy plains bordering creek margins and on watershed areas in Western Australia and Northern Territory.

Flowering period. April-July.

Conservation status. A common species in the Kimberley and not under threat. The conservation status of this species in Northern Territory and Queensland is not known.

Etymology. The specific epithet *adenophorum* is from the Greek *adenos* - gland and *phorus* -bearing, in reference to the glands found on the leaves.

Affinities. The nearest relative to *Stylidium adenophorum* is *S. floodii* F. Muell. *S. adenophorum* is distinguished from *S. floodii* (in parentheses) by having terete leaves bearing a few glands near the apex, often with additional glands scattered along the leaf (leaves linear, acuminate, glabrous); corolla throat appendages 4, upper pair lanceolate and wing-like, lower pair round and bump-like (throat appendages 5, crown-like); labellum *c.* 0.7 mm long, glabrous (labellum *c.* 0.4 mm long, glandular-hairy on margins and apex); gynostemium column *c.* 5.7 mm long, hinged below the anthers, with a dilated cunabulum bearing 2 crowded marignal rows of short, non-glandular projections above the sensitive torosus (gynostemium column strap-like *c.* 5 mm long, narrowing towards the anthers from the sensitive torosus).

Notes. The outline shape of the corolla lobes of this species is commonly variable even within the same population. The anterior lobes range from narrowly to broadly obovate with the apex of lobes entire, emarginate or deeply 2-lobed.

The degree of glandular cover to the leaf is also variable. In the western Kimberley, at least 1 to 3 glands are commonly present on some of the leaves on any given specimen. In the eastern Kimberley near Kununurra the degree of glandular cover to the leaves is greater. Specimens examined from Tennant Creek in the Northern Territory and the Cook district in Queensland show an even greater degree of glandular covering to the leaves.

Stylidium barrettorum Lowrie & Kenneally, *sp. nov.* (Figure 2)

S. leptorrhizo F. Muell. affini sed foliis glabris et appendicibus binatis faucis alatis ornatis differt.

Typus: Grevillea Creek, Beverley Springs Station, Western Australia, 16°29'S, 125°21'E 31 May 1992, *Mathew D. Barrett* 4 (*holo*: PERTH 04452666; *iso*: DNA, MEL).

Annual herb to 8-25 cm high. *Leaves* in a basal rosette, oblanceolate, basal portion petiolate, apex with acute point but not sharp, flat in section, margins with an extremely fine white hyaline, 1.5-6 cm long, 4-8 mm wide, glabrous. *Inflorescence* racemose, scape glandular. *Bracts* 1.5-4 mm long, glandular. *Hypanthium* narrowly obovoid, 1.5-2.5 mm long, *c.* 1.2 mm diam. at anthesis, glandular. *Sepals* ovate, 5 free to the base, 1-1.5 mm long. *Corolla* predominantly magenta, lobes vertically paired, abaxial surface mottled red and cream, glandular; anterior lobes broadly obovate, *c.* 4 mm long, *c.* 2.5 mm wide; posterior lobes fused for half to two-thirds of their length, together cuneate in outline, *c.* 5 mm long, *c.* 3 mm wide. *Throat* white, striped pink; throat appendages 2, wing-like, opposite. *Labellum* attached to the base of the corolla tube sinus, ovate, *c.* 0.8 mm long, *c.* 0.4 mm wide. *Gynostemium* narrowly strap-like, *c.* 9.5 mm long, hinged below the anthers, with a dilated cunabulum bearing marginal rows of raised projections above the sensitive torosus, abaxial surface of this section glandular. *Capsule* obovoid, glandular, *c.* 3.5 mm long. *Seeds* orange, *c.* 0.2 mm long.

Other specimens examined. WESTERN AUSTRALIA: Victoria Highway, 2.3 km NW of the Ord Dam turnoff, SE of Kununurra, 15°57'S, 128°57'E, 16 June 1993, *A. Lowrie* 715 (PERTH); Gibb River road, Dawn Creek crossing, 15°59'S, 127°02'E, 18 June 1993, *A. Lowrie* 720 (PERTH); King Edward River crossing, 15°07'S, 126°43'E, 18 June 1993, *A. Lowrie* 724 (PERTH); On walk trail from Mertens Creek camp site to Mitchell Falls before the first rainforest thicket, Mitchell Plateau, 20 June 1993, *A. Lowrie* 730 (PERTH); King Edward River crossing, 15°07'S, 126°43'E, 24 June 1993, *A. Lowrie* 767 (PERTH); Unamon Creek on road to Pago Mission, 14°06'S, 126°43'E, 26 June 1994, *A. Lowrie* 1021 (PERTH); On the margins of creek near Pago Mission ruins, 14°08'S, 126°43'E, 26 June 1994, *A. Lowrie* 1027 (PERTH); Camping ground just W of King Edward River crossing, 14° 52' 57" S, 126° 12' 09" E, 25 Sep. 1995, *A. Lowrie* 1337 (PERTH); Peter Lacy's camp, tributary of Bachsten Creek, 15°59'21"S, 125°19'46"E, 31 July 1996, *A. Lowrie* 1510 (PERTH).

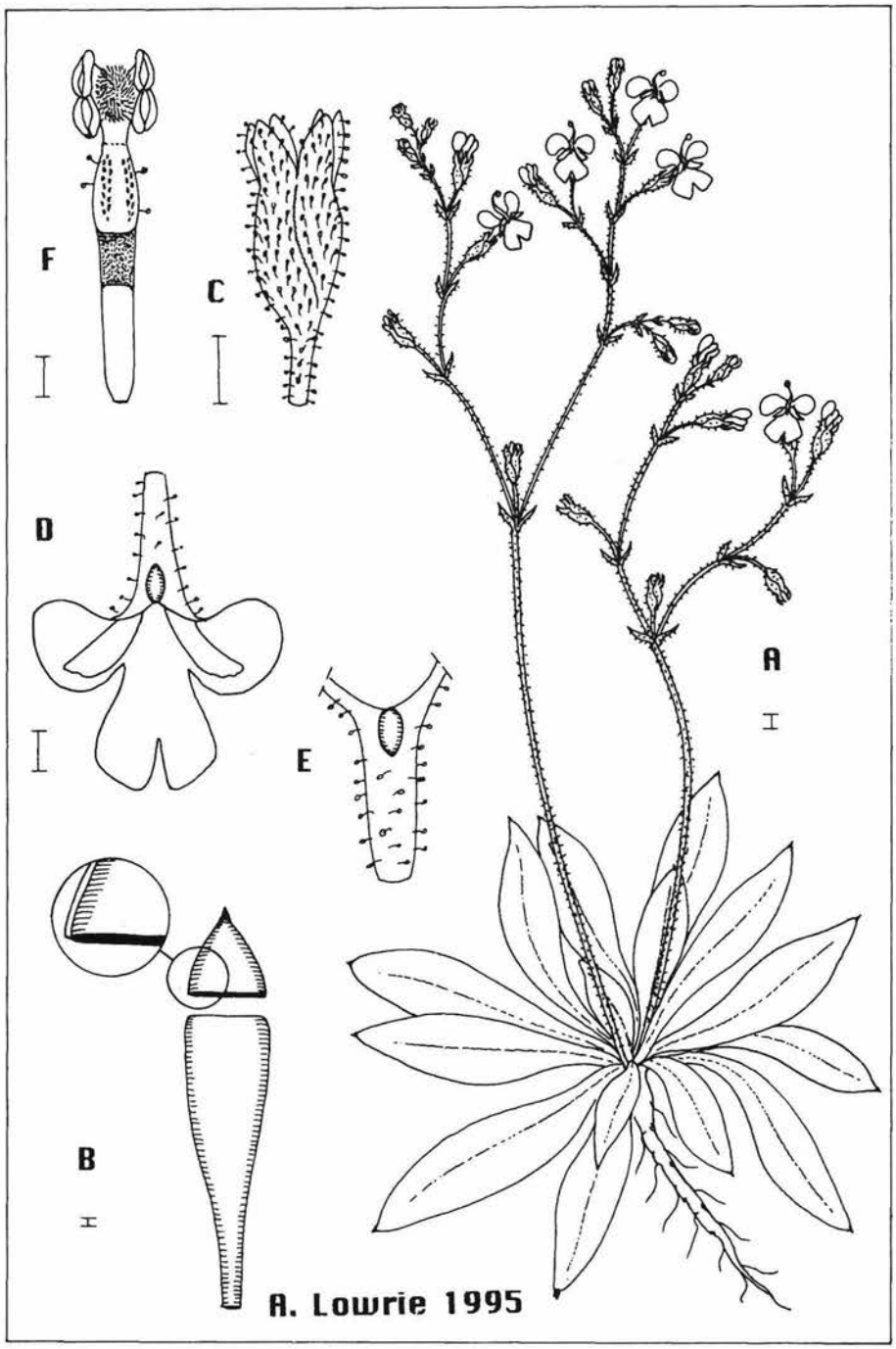

Figure 2. *Stylidium barrettorum* A - habit of flowering plant; B - leaf of basal rosette, enlarged section upper left; C - hypanthium and sepals; D - corolla; E - enlarged section of the corolla tube showing labellum on sinus; F - adaxial view of gynostemium column and stigma showing hinged portion (dotted) immediately below stigma, the dilated cunabulum with marginal papillae and the sensitive torosus (stippled). Scale bar for all = 1 mm.

Distribution. Occurs in northern parts of the Kimberley region of Western Australia. There are no records to date from the Northern Territory.

Habitat. In sandy soils, on floodways, thinly covered with cane grass (*Sorghum* species); on the banks of creeks and rivers; herbfields bordering creeks and rivers; amongst sandstone boulders in wet season seepage areas.

Flowering period. May-September.

Conservation status. A common species in the Kimberley and currently not under threat.

Etymology. Named in honor of the Barrett family, former owners of Beverley Springs Station, whose sons Matthew and Russell Barrett collected many valuable botanical specimens from the region.

Affinities. The nearest relative to *Stylidium barrettorum* is *S. leptorrhizum* F. Muell. *S. barrettorum* is distinguished from *S. leptorrhizum* (in parentheses) by having glabrous leaves (leaves sparsely glandular-hairy) and 2 wing-like throat appendages c. 1.3 mm long (throat appendages 6, upper pair terete-falcate and *c.* 1 mm long, central pair pointed and *c.* 0.2 mm long and the lower pair triangular and *c.* 0.3 mm long).

Notes. Stylidium barrettorum as well as *S. rubriscapum* W. Fitzg., *S. dunlopianum* S. Carlquist, *S. claytonioides* W. Fitzg., *S. longicornu* S. Carlquist and *S. schizanthum* F. Muell. have been observed in the field closing their flowers for the night. Well before sunset, the petals roll up along the length before they fold together. The flowers open the following morning only when they have been warmed by direct sunlight.

Stylidium clarksonii Lowrie & Kenneally, *sp. nov.* (Figure 3)

Herba annua ad 40 cm longa, caulis flaccidis. Folia linearia, dispersa sed aggregata ad basim inflorescentiae. Hypanthium anguste oblanceolatum, 2.5-3.5 mm longum, *c.* 0.7 mm diam. per anthesin. Sepala lanceolata, duo per 3/4 longitudinis connata, tria ad basim discreta, 2-2.5 mm longa. Corollae lobi lateraliter binati; lobi antici obovati, *c.* 4.5 mm longi, *c.* 2.5 mm lati; lobi postici elliptici, *c.* 5.5 mm longi, *c.* 2.5 mm lati. Appendices faucis 2, tumuloideae, ad basim loborum posticum prope marginem faucis positi. Labellum ovatum; umbo margine glandulosus, *c.* 0.6 mm longus, *c.* 0.4 mm latus, ad basim sini corolla-tubi affixus.

Typus: 4.7 km south of the Chester River crossing on the road east of the McIlwraith Range towards Nesbit River, 13°41'S, 143°28'E, Cape York mapping site 802 (ROK 29), Queensland, Australia, 21 June 1993, *J.R. Clarkson* 10108 & *V.J. Nelder* (*holo*: PERTH 04453026; *iso:* BRI, DNA, K).

Lax-stemmed *annual herb* to 40 cm long, basal portion of stem red. *Leaves* scattered along the lax stem, crowded a little when branching in the upper parts and at the base of an inflorescence, linear, flat in section, 10-25 mm long, *c.* 0.6 mm wide. *Inflorescence* paniculate, glabrous. *Bracts* 2-10 mm long. *Hypanthium* narrowly oblanceolate, 2.5-3.5 mm long, *c.* 0.7 mm diam. at anthesis, glandular. *Sepals* lanceolate, 2 fused for three quarters of their length, 3 free to the base, 2-2.5 mm long. *Corolla* predominantly dull red, lobes laterally paired, abaxial surface greenish cream, glandular; anterior lobes obovate, *c.* 4.5 mm long, *c.* 2.5 mm wide; posterior lobes elliptic, *c.* 5.5 mm long, *c.* 2.5 mm wide. *Throat* yellow with dark red blotches near the petal bases; throat appendages 2, mound-like at the base of the

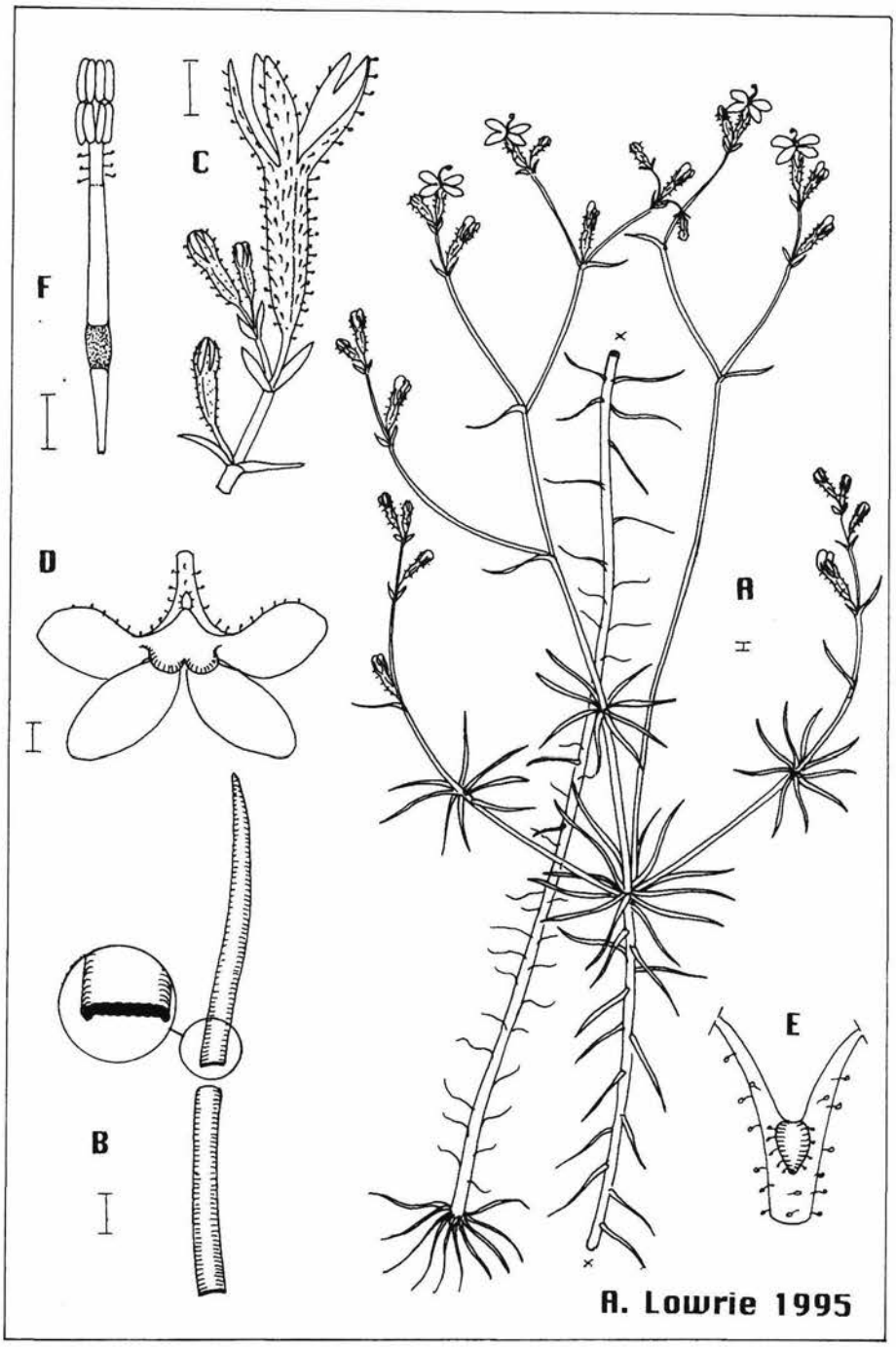

Figure 3. *Stylidium clarksonii* A - habit of flowering plant; B - leaf, enlarged section left; C - portion of an inflorescence showing mature hypanthium with three free sepals and the fusion of two sepals for three quarters of their length; D - corolla; E - enlarged section of the corolla tube showing labellum on sinus; F - adaxial view of gynostemium column and anthers showing hinged portion (dotted) immediately below anthers (the abaxial surface of this section glandular) and the sensitive torosus (stippled). Scale bar for all = 1 mm.

posterior lobes near the rim of the throat. *Labellum* attached to the base of the corolla tube sinus,ovate, margins of the boss glandular, *c.* 0.6 mm long, *c.* 0.4 mm wide. *Gynostemium* narrowly strap-like, *c.* 7.5 mm long, hinged below the anthers (abaxial surface of this section glandular), slightly dilated towards the sensitive torosus, then narrowing towards the base. *Capsule* narrowly oblanceolate, sparsely glandular, *c.* 5.5 mm long. *Seeds* dark brown, *c.* 0.4 mm long.

Other specimen examined. QUEENSLAND: 5.2 km S of the Hann River on the Laura to Musgrave road (15° 13' S, 143° 44' E), Cape York mapping site 8 (DIX 7), 31 May 1989, *J.R. Clarkson* 8006 & *V.J. Neldner* (BRI, DNA, K, L, MBA, PERTH).

Distribution. Known from two locations: Hann River region and *c.* 170 km further north at the type location in the Chester River region, Cape York, north Queensland.

Habitat. In deep white sand at the foot of a gentle slope adjacent to broad drainage area with low woodland with *Thryptomene oligandra* and *Grevillea pteridifolia* (*J.R. Clarkson* 8006 & *V.J. Nelder*); With *Melaleuca viridiflora*, *Asteromyrtus symphyocarpa* low open woodland with *Xanthorrhoea johnsonii* prominent in the scrub layer (*J.R. Clarkson* 10108 & *V.J. Nelder*).

Flowering period. May-June.

Conservation status. Unknown. No attempt has been made to survey this species from north Queensland.

Etymology. Named in honour of John R. Clarkson, principal botanist with the Queensland Herbarium and specialist in tropical botany based in Mareeba, Queensland.

Affinities. The lax leafy-stemmed growth habit of *Stylidium clarksonii* is unique in comparison with all other known northern Australian triggerplants.

Stylidium mucronatum Lowrie & Kenneally, *sp. nov.* (Figure 4)

A *S. floodii* folio ad apicem mucrone aciculari, corolla appendicibus faucis 4, duobus teretibus ad apicem leviter dilatis 0.7 mm longis, duobus tumoriformibus statim dignoscendo.

Typus: Grevillea Creek *c.* 35 km north-west of Beverley Springs Station, Kimberley, Western Australia, 16° 33' S, 125° 10' E, 7 June 1995, *A. Lowrie* 1188 (*holo*: PERTH 04452712; *iso*: DNA, MEL).

Erect *annual herb* 8-16 cm (mostly 10-12 cm) high, with a glabrous stem 1-1.5 cm long, lower leaves scattered and often caducous, upper leaves in a terminal tuft. *Leaves* terete, 10-15 mm long, *c.* 0.6 mm diameter, bearing a needle-like mucro at the apex, glabrous. *Inflorescence* racemose, including scape glandular-hairy. *Bracts* subulate, 0.6-0.8 mm long, glandular-hairy; pedicels slender, 4-7 mm (mostly 5 mm) long, glandular-hairy. *Hypanthium* ellipsoid, 1-1.7 mm long, *c.* 0.9 mm diam. at anthesis, glandular-hairy. *Sepals* 5, all free to the base, subulate, 0.6-0.9 mm long, glandular-hairy. *Corolla* predominantly pink with anterior lobe tips red, lobes vertically paired, abaxial surface yellow with red midvein, glandular; anterior lobes obovate-oblanceolate, *c.* 2.5 mm long, *c.* 1.5 mm wide; posterior lobes obovate, apex emarginate, *c.* 3 mm long, *c.* 2.5 mm wide. *Throat appendages* 4; upper pair terete with the apex slightly dilated, papillose, *c.* 0.7 mm long; lower pair small, round and bump-like, papillose. *Labellum* attached to the base of the corolla tube sinus, triangular, *c.* 0.3 mm long, *c.* 0.2 mm wide. *Gynostemium*, *c.* 5.2 mm

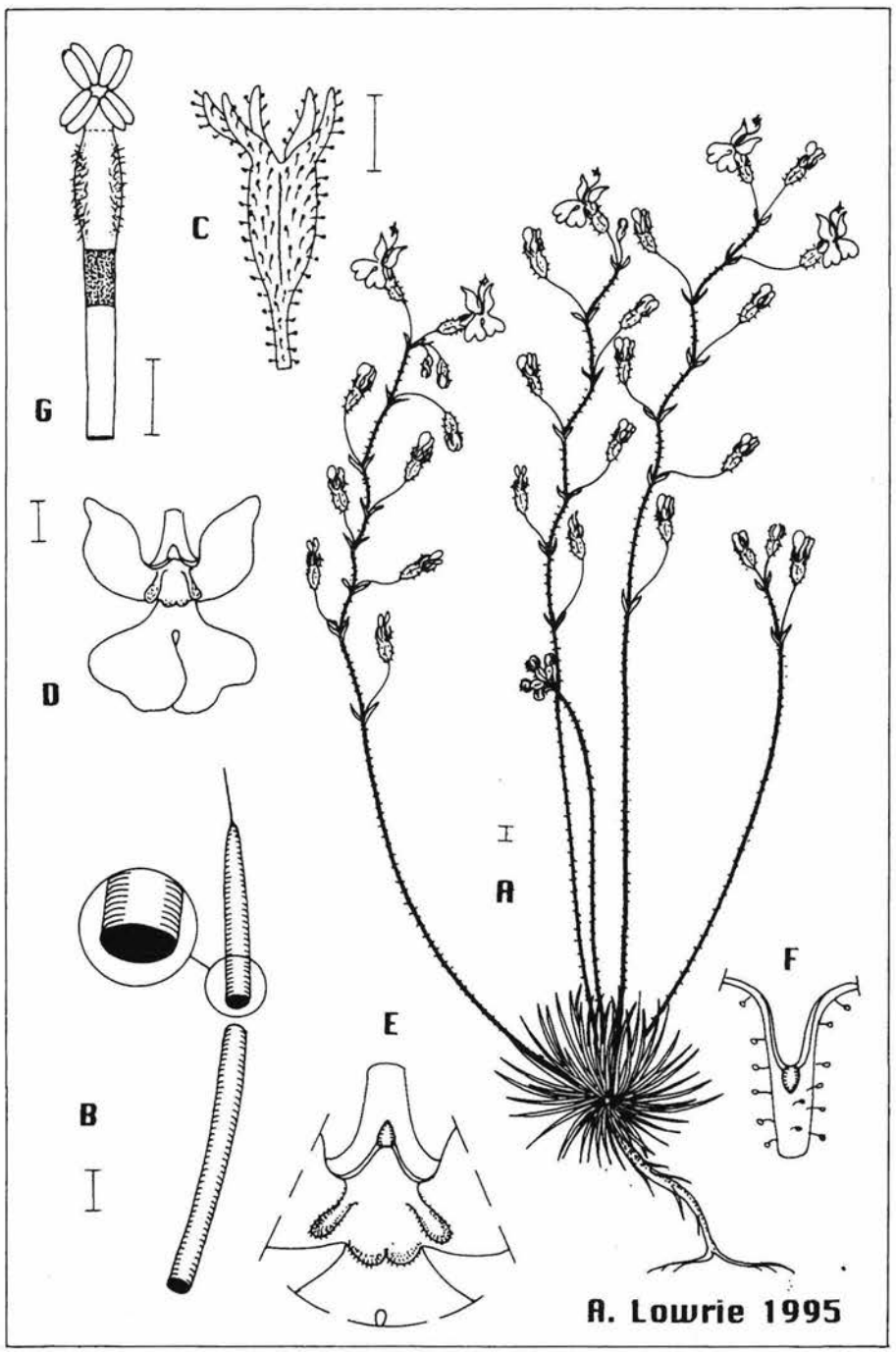

Figure 4. *Stylidium mucronatum* A - habit of flowering plant; B - leaf of basal tuft, enlarged section upper left; C - hypanthium and sepals; D - corolla; E - enlarged section of the corolla showing throat appendages; F - enlarged section of the corolla tube showing labellum on sinus; G - adaxial view of gynostemium column and anthers showing hinged portion (dotted) immediately below anthers, the dilated cunabulum with marginal brush-like rows of short, non-glandular hair-like projections and the sensitive torosus (stippled). Scale bar for all = 1 mm.

long, hinged below the anthers, with a dilated cunabulum bearing 2 crowded marginal brush-like rows of short, non-glandular hair-like projections above the sensitive torosus. *Capsule* obovoid, 2-2.5 mm long. *Seeds* pale brown, *c.* 0.2 mm long.

Other specimens examined. WESTERN AUSTRALIA: Coolabah Creek, Beverley Springs Station, 6 June 1992, *M.D. Barrett* 19 (PERTH); *c.* 50 km W of Merry Creek crossing at 16° 11' 52" S, 126° 02' 19" E on road to Bachsten Creek, Mount Elizabeth Station, 12 June 1995, *A. Lowrie* 1251 (PERTH); Drysdale River crossing on road to Bachsten Creek, Mount Elizabeth Station, 16° 09' 08" S, 125° 58' 16" E, 13 June 1995, *A. Lowrie* 1266 (PERTH); Headwaters of the Hann River, Mount Elizabeth Station, 16° 16' 48" S, 126° 06' 28" E, 14 June 1995, *A. Lowrie* 1299 and *A. Lowrie* 1307 (PERTH).

Distribution. Known from Beverley Springs Station and Mount Elizabeth Station in the Kimberley region of Western Australia.

Habitat. Grows on the margins of creeks in sandy soils over sandstone.

Flowering period. April-June.

Conservation status. An abundant species at its known collection sites and not under threat.

Etymology. The specific epithet *mucronatum* is from the latin *mucronate* - equipped with a mucro, in reference to the hard needle-like point at the leaf tips.

Affinities. S. rubiscapum W. Fitzg. is similar to *S. mucronatum* in the distinctive red colour on the tips of anterior corolla lobes and the sharp apical mucro of the leaves. The two species are often found growing together but no hybrids have been observed.

S. muconatum is easily distinguished from *S. rubiscapum* (in parenthesis), by its glandular-hairy ellipsoid hypanthium (glabrous turbinate hypanthium); sepals glandular-hairy, shorter than the hypanthium, (sepals sparsely glandular-hairy, longer than the hypanthium); leaves terete in section (lenticulate in section); and multiflowered scapes (uniflowered scapes).

Stylidium perizostera Lowrie & Kenneally, *sp. nov.* (Figure 5)

S. claytonioides W. Fitzg. affini sed lobis anticis corollae pallido rubris, lobis posticis aurantiacis zona interiore hyalina flava et alba, scapis sparse glandulosis, hypanthio supra glanduloso, corollae tubo sepalo 2-plo longiore differt.

Typus: Near Roe River mouth, *c.* 4 km north-west of Mount Brookes, Mitchell Plateau, Kimberley, Western Australia, 15° 10' 51" S, 125° 22' 00" E, 2 May 1996, *A. Lowrie* 1442 (*holo*: PERTH 04452771; *iso*: DNA, MEL).

Annual herb up to *c.* 11 cm high, lower stem fleshy and *c.* 2 cm long. *Leaves* terete, up to *c.* 7.5 mm long, with a short blunt apical mucro, glabrous. *Inflorescence* of few to many uniflowered scapes arising from the group of leaves on the upper stem, scape sparsely glandular. *Hypanthium* linear, continuous with the scape, *c.* 27 mm long, *c.* 0.7 mm diam. at anthesis, sparsely glandular only in the upper portion. *Sepals* fused together to form 2 lobes, marginally glandular, otherwise glabrous, *c.* 1.5 mm long. *Corolla* lobes vertically paired; anterior lobes pale red, broadly obovate, apex emarginate,

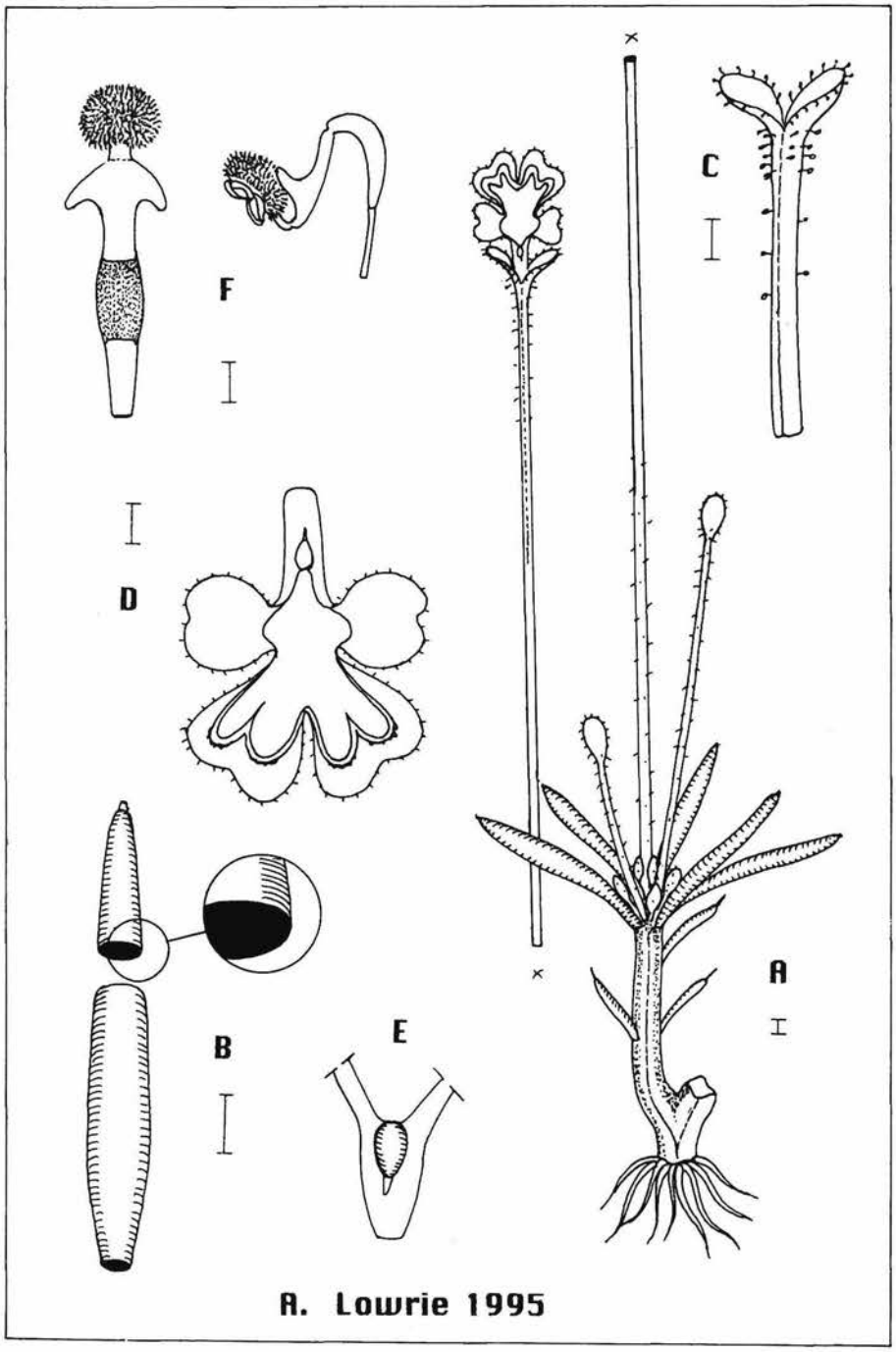

Figure 5. *Stylidium perizostera* A - habit of flowering plant; B - leaf, enlarged section upper right; C - hypanthium with sepals fused into two lobes; D - corolla; E - enlarged section of the corolla tube showing labellum on sinus; F - left, adaxial view of gynostemium column and stigma showing hinged portion (dotted) immediately below stigma, the dilated cunabulum bearing curved and erect lateral wings and the sensitive torosus (stippled); right, lateral view in the set position. Scale bar for all = 1 mm.

c. 3.5 mm long, *c.* 2.5 mm wide; posterior lobes with a narrow white zone separating the yellow basal portion from the orange distal portion, cuneate, apex emarginate, *c.* 6 mm long, *c.* 3.5 mm wide. *Throat appendages* absent. *Labellum* attached to the base of the corolla tube sinus, ovate, *c.* 0.6 mm long, *c.* 0.3 mm wide, apical point *c.* 0.2 mm long. *Gynostemium* strap-like, *c.* 8.5 mm long, hinged below the anthers, with a dilated cunabulum bearing curved and erect lateral wings that shroud the anthers as well as act as a rest to keep the stigmatic cushion free of the cunabulum surface above the sensitive torosus, glabrous. *Capsule* linear, sparsely glandular at the apex, similar in size and shape to the hypanthium at anthesis. *Seeds* brown, *c.* 0.2 mm long.

Other specimens examined. WESTERN AUSTRALIA: South central Bigge Island, Bonaparte Archipelago, 14° 34' S, 125° 10' E, 25 May 1991, *T. Willing* 410, *Roger Shivas & I. Riley* (spirit collection), (PERTH); *c.* 4 km SE of Mitchell Falls, Mitchell Plateau, 14° 50' 14" S, 125° 40' 45" E, 1 May 1996, *A. Lowrie* 1423 (PERTH); gauging station on Camp Creek, 12 km SW of the mining camp, Mitchell Plateau, 14° 53' S, 125° 45' E, 30 Apr. 1982, *K. F. Kenneally* 8180 (PERTH).

Distribution. Known only from three widely scattered locations on the Mitchell Plateau and one location on Bigge Island in the Kimberley region of Western Australia.

Habitat. Grows in yellow sand over basalt along rocky creek line on south central Bigge Island; in beige coloured skeletal sandy soils over sandstone pavements in drainage lines of sandstone outcrops on the Mitchell Plateau.

Flowering period. May-June.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority Three. This species is poorly collected due to the lack of roads in the remote region of the west Kimberley where it occurs. All herbarium collections have been gathered on the Mitchell Plateau as well as on Bigge Island with the aid of a helicopter.

Etymology. From the Greek *peri* - around and *zostera* - belt, in reference to the yellow-coloured apron on the orange posterior corolla lobes.

Affinities. The nearest relative to *Stylidium perizostera* is *S. claytonioides* W. Fitzg., both species having a terminal group of terete leaves on a short fleshy stem, the inflorescence of few to many uniflowered scapes and sepals fused together to form 2 lobes. *S. perizostera* differs from *S. claytonioides* (in parentheses) by its corolla anterior lobes coloured pale-red, posterior lobes orange with a yellow inner zone (lobes cerise, purple towards throat with yellow markings near the throat at the base of the prosterior lobes); scapes sparsely glandular (scapes glabrous); hypanthium upper portion glandular (hypanthium glabrous); and corolla tube, as measured to the labellum sinus, twice as long as the sepals (corolla tube one third longer than the sepals).

Stylidium prophyllum Lowrie & Kenneally, *sp. nov.* (Figure 6)

S. fissilobio F. Muell. affini sed corollae lobis integris, appendicibus faucis 4 et subulatis, labello ad basim sini tubi corollae affixo.

Typus: On the road to Bell Gorge, 2 km west of Silent Grove camping area, Western Australia, 17° 03'S, 125° 15' E, 5 June 1995, *A. Lowrie* 1180 *(holo*: PERTH 04452828; *iso*: DNA, MEL).

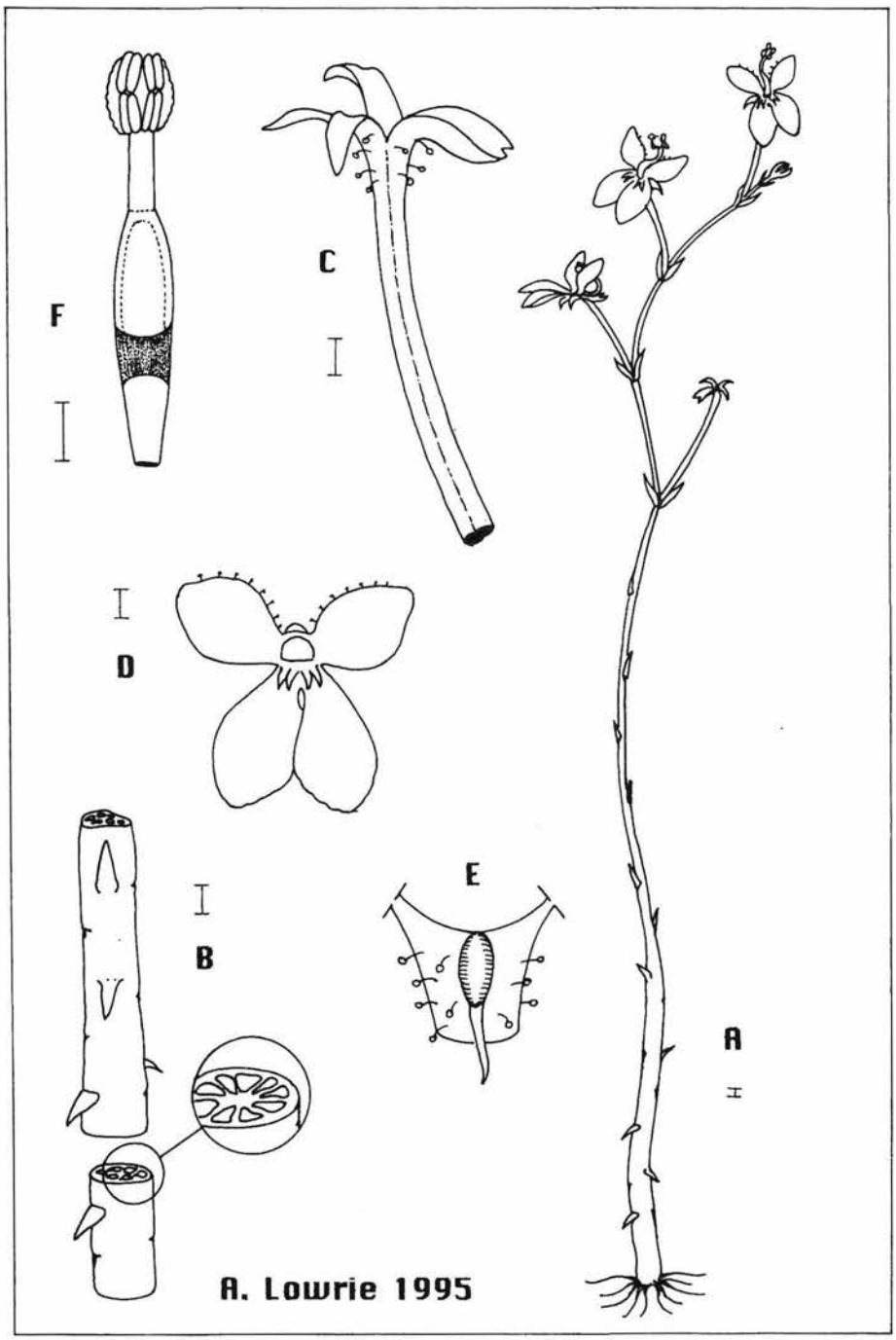

Figure 6. *Stylidium prophyllum* A - habit of flowering plant; B - lower portion of the stem showing the bract-like leaves and enlarged section right showing the irregular shaped internal longitudinal air cavities; C - hypanthium and horizontal sepals, with almost total fusion of two sepals; D - corolla; E - enlarged section of the corolla tuba showing labellum on sinus; F - adaxial view of gynostemium column and anthers showing hinged portion (dotted) immediately below the anthers, the dilated cunabulum and the sensitive torosus (stippled). Scale bar for all = 1 mm.

Annual herb to 30 cm high, taller specimens leaning on nearby herbs for support, lower portions of stem inflated, containing irregular-shaped longitudinal air cavities. *Leaves* few, scale-like, triangular, to 1.5 mm long, glabrous, confined to the basal portions of the stem. *Inflorescence* of 1 or more racemes arising from the dilated lower stem, often branching in the upper portions, glabrous. *Bracts* 1-2 mm long. *Hypanthium* linear, 10-15 mm long, *c.* 0.6 mm diam. at anthesis, glandular only at the apex. *Sepals* oblanceolate, 3 free to base, 2 fused almost to apex *c.* 3 mm long, all horizontally positioned. *Corolla* predominantly pink, lobes vertically paired, abaxial surface white; anterior lobes obovate-elliptic, *c.* 6 mm long, *c.* 3 mm wide; posterior lobes obovate-elliptic, *c.* 8 mm long, *c.* 4 mm wide. *Throat* white; throat appendages pink, 4, subulate, in opposite pairs. *Labellum* attached to the base of the corolla tube sinus, ovate, *c.* 1 mm long, *c.* 0.4 mm wide, apical point *c.* 1 mm long. *Gynostemium* strap-like, *c.* 7 mm long, narrow between the hinge and the anthers, with a dilated and slightly concave cunabulum above the sensitive torosus, glabrous. *Capsule* linear, glabrous, similar in size and shape to the hypanthium at anthesis. *Seeds* brown, *c.* 0.2 mm long.

Other specimens examined. WESTERN AUSTRALIA: 16.1 km W of Kununurra, 15° 46' S, 128° 36' E, 18 Apr. 1996, *A. Lowrie* 1391 (PERTH); On the road to Bell Gorge, 0.4 km W of Silent Grove camping area, 17° 04' S, 125° 15' E, 5 June 1995, *A. Lowrie* 1178 (PERTH); Between Beverley Springs airstrip and homestead on creek margin, 16° 43' S, 125° 28' E, 21 Apr. 1995, *A. Lowrie* 1092 (PERTH).

Distribution. Known from three areas in the Kimberley region of Western Australia: the Silent Grove region on Mount Hart CALM reserve, Beverley Springs and west of Kununurra.

Habitat. In white sandy soils, black silty soils and sand and laterite soils on wet season seepage areas and floodways, growing long and lax up through dense grass in wetter areas, shortly erect and self supporting in open areas amongst open grass and herbs with *Stylidium fissilobium* F. Muell., *S. costulatum* Lowrie & Kenneally, *Drosera derbyensis* Lowrie, *D. indica* L, *Byblis liniflora* subsp. *occidentalis* Conran & Lowrie and *Utricularia chrysantha* R. Br. in Silent Grove region; with *Drosera ordensis* Lowrie, *Byblis liniflora* subsp. *liniflora* Salisb., *Byblis liniflora* subsp. *occidentalis* Conran & Lowrie, *D. indica* L, *Utricularia tridactyla* P. Taylor and *Utricularia chrysantha* R. Br. west of Kununurra.

Flowering period. May-June.

Conservation status. CALM Conservation Codes of Western Australian Flora: Priority Three.

Etymology. The specific epithet - *prophyllum* alludes to the scale-like prophylls that are confined to the basal portions of the stem.

Affinities. The nearest relative to *Stylidium prophyllum* is *S. fissilobium* F. Muell, the two species having similar erect stem growth habit. *S. prophyllum* is differentiated from *S. fissilobium* (in parentheses) by having entire corolla lobes (corolla lobes bilobed at the apex); 4 subulate throat appendages in 2 opposite pairs (3 round bumps with 2 v-shaped round-tipped appendages); and labellum attached to the base of the corolla tube sinus (labellum attached to the outer corolla tube wall below the sinus).

Notes. The lower portions of the stem are inflated. In section, irregular-shaped internal longitudinal air cavities are revealed. This adaptation acts as a buoy-like floatation device to keep juvenile plants erect in shallow flooded habitats during the wet season.

Stylidium rivulosum Lowrie & Kenneally, *sp. nov.* (Figure 7)

A *S. floodii* F. Muell. lobis posticis corollae cuneatis, ad apicem emarginatis et 2/3 connatis, cunabulo gynostemii dilatato, fauci-appendicibus corollae 2, aliformibus 1.5 mm longis recedit.

Typus: On the road to Pago Mission (abandoned) from Honeymoon Beach on the margins of Unamon Creek, Kimberley, Western Australia, 14° 06' S 126° 43' E, 26 June 1994, *A. Lowrie* 1022 (*holo:* PERTH 04452879; *iso:* DNA, MEL).

Erect *annual herb* 7-14 cm high, with a glabrous stem 1-2 cm long, lower leaves scattered and often caducous, upper leaves in a terminal tuft. *Leaves* linear, 10-25 mm long, *c.* 0.8 mm diam., apex pointed but not mucronate, glabrous. *Inflorescence* of many racemes, glandular-hairy; scape slender, 5-10.5 cm long, glandular-hairy. *Bracts* subulate, 0.8-1.4 mm long, sparsely glandular-hairy; pedicels slender, 4-7 mm long, pendulous in fruit, glandular-hairy. *Hypanthium* obovoid, 1.5-2.5 mm long, 1-1.5 mm diam. at anthesis, glandular-hairy. *Sepals* 5, all free to the base, broadly ovate, 1-1.2 mm long, glandular-hairy. *Corolla* pink, lobes vertically paired; anterior lobes obovate, the apex emarginate, *c.* 3.5 mm long, *c.* 2.5 mm wide; posterior lobes cuneate, apex emarginate, fused for two thirds of their length, *c.* 4.5 mm long, *c.* 2 mm wide; abaxial surface yellow with maroon streaky blotches, glandular. *Throat appendages* 2, lanceolate, wing-like, *c.* 1.5 mm long, *c.* 0.3 mm wide, with small darker pink markings around the entrance to the throat. *Labellum* attached to the base of the corolla tube sinus, ovate, *c.* 0.6 mm long, *c.* 0.4 mm wide. *Gynostemium c.* 8.5 mm long, hinged below the anthers, with a dilated cunabulum bearing 2 crowded marginal rows of short, non-glandular projections above the sensitive torosus; abaxial surface sparsely glandular-hairy a little below the anthers, otherwise glabrous. *Capsule* obovoid, *c.* 4 mm long. *Seeds* orange, *c.* 0.2 mm long.

Other specimens examined. WESTERN AUSTRALIA: On the road to Pago Mission (abandoned) from Honeymoon Beach on the margins of Garlcarinangui Creek, Kimberley, 14° 08' S, 126° 43' E, 26 June 1994, *A. Lowrie* 1019 (PERTH); *c.* 0.5 km from start of Mitchell Falls walk trail from Little Merten's campsite at 14° 49' 10" S, 125° 43' 08" E, 29 Apr. 1996, *A. Lowrie* 1418 (PERTH); Tributary of the Mitchell River at the meeting of the freshwater and the saltwater tidal zone down stream of Mitchell Falls, 14° 40' S, 125° 38' E, 30 Apr. 1996, *A. Lowrie* 1422 (PERTH); *c.* 4 km SE of Mitchell Falls, 14° 50' 14" S, 125° 40' 45" E, 1 May 1996, *A. Lowrie* 1424 (PERTH).

Distribution. Known from widely separated locations over a distance of *c.* 295 km, from the Edkins Range in the south, northwards to the Mitchell Plateau and north-east to Kalumburu in the Kimberley region of Western Australia.

Habitat. Growing in sandy skeletal soils over sandstone on the banks of creeks; in the cracks of sandstone pavement along the margins as well as in the beds of creeks; and in sandy skeletal soils along the drainage lines and on the watersheds off sandstone outcrops.

Flowering period. April-July.

Conservation status. A common species at the known locations in the Kimberley and not under threat.

Etymology. The specific epithet *rivulosum* is from the Latin *rivulosus* - a streamlet, in reference to the habitat where this species occurs.

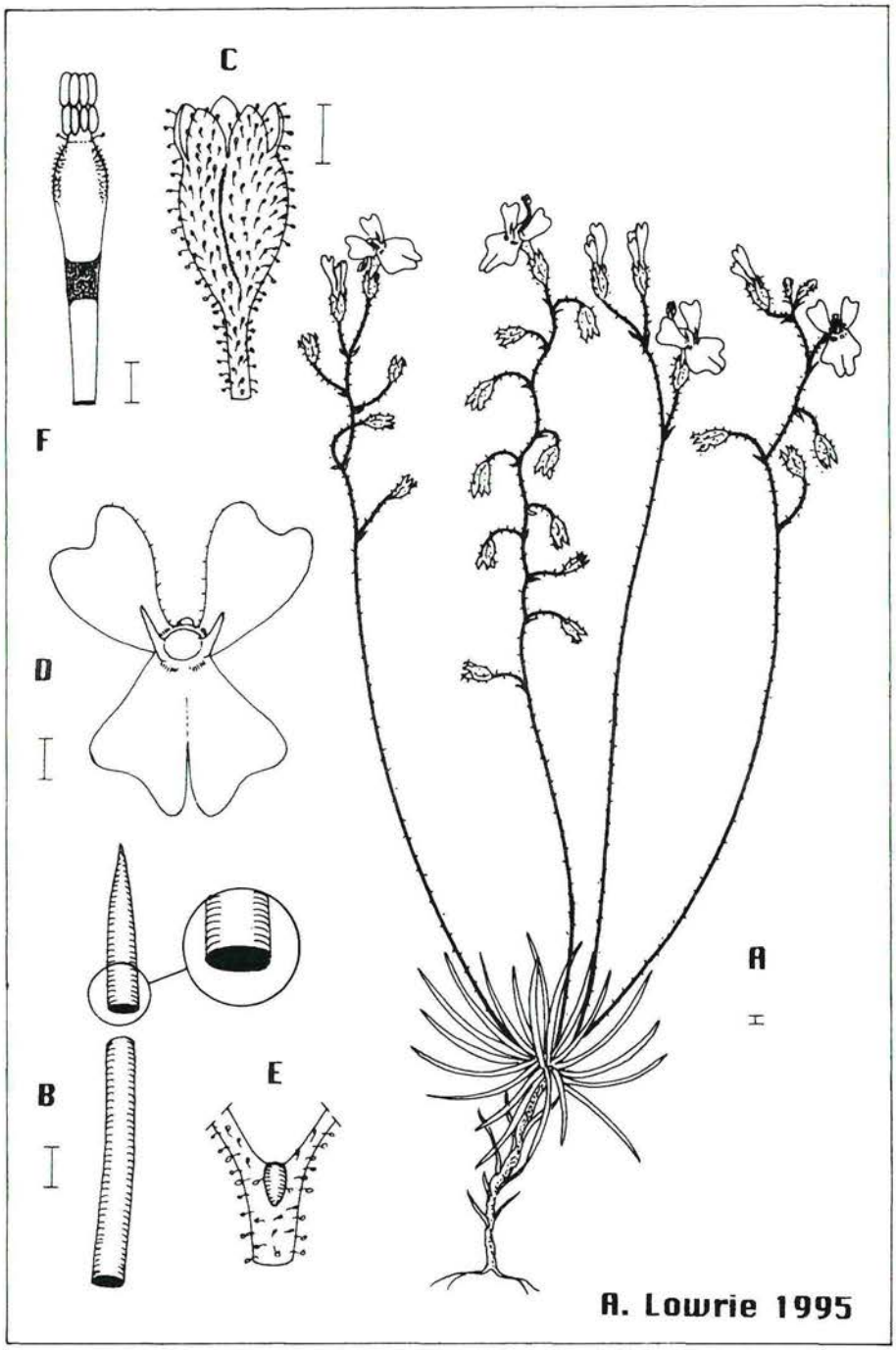

Figure 7. *Stylidium rivulosum* A - habit of flowering plant; B - leaf of basal tuft, enlarged section upper right; C - hypanthium and sepals; D - corolla; E - enlarged section of the corolla tube showing labellum on sinus; F - adaxial view of gynostemium column and anthers showing hinged portion (dotted) immediately below anthers, the dilated cunabulum with marginal papillae and the sensitive torosus (stippled). Scale bar for all = 1 mm.

Affinities. The nearest relatives to *Stylidium rivulosum* are S. *adenophorum, S. mucronatum, S. turbinatum* and *S. floodii* F. Muell. *S. rivulosum* and *S. floodii* are distinguished from *S. adenophorum, S. mucronatum* and *S. turbinatum* by having glabrous linear leaves with the apex pointed but not mucronate. *S. rivulosum* is distinguished from *S. floodii* (in parentheses) by having corolla throat appendages 2, lanceolate, wing-like, (throat appendages 5, crown-like); labellum *c.* 0.6 mm long, glabrous (labellum *c.* 0.4 mm long, glandular-hairy on margins and apex); gynostemium column *c.* 8.5 mm long, hinged below the anthers, with a dilated cunabulum bearing 2 crowded marginal rows of short, non-glandular projections above the sensitive torosus (gynostemium column strap-like, *c.* 5 mm long, narrowing towards the anthers from sensitive torosus).

Notes. The outline shape of the corolla lobes of this species is variable in the population at the type locality. The anterior lobes range from obovate with the apex of lobes emarginate to almost cuneate with the apex deeply emarginate. This character has been observed on occasion in other populations.

Stylidium turbinatum Lowrie & Kenneally, *sp. nov.* (Figure 8)

A *S. floodii* folio ad apicem mucrone parvo obtusoque, hypanthio turbinato in sectio pentagoniformi angulis manifeste verticaliter costatis, sepalis hypanthium superantibus, corolla appendicibus faucis sparse U-formatis, appendicibus duobus oppositis dentiformibus 0.3 mm longis, projectura labiacea revoluta inter appendices posita statim dignoscendo.

Typus: 1. 5 km east-south-east of the Elephant Rock end of the Sleeping Buddha hill formation south of Kununurra, Kimberley, Western Australia, 15° 50' S, 128° 46' E, 25 April 1995, *A. Lowrie* 1095 *(holo*: PERTH 04452925; *iso:* DNA, MEL).

Erect *annual herb* 6-15 cm (mostly 8-10 cm) high, with a glabrous stem 2-5 cm long, lower leaves scattered and often caducous, upper leaves in a terminal tuft. *Leaves* terete, 10-20 mm long, *c.* 0.7 mm diameter, with a small blunt mucro at the apex, glabrous. *Inflorescence* of many racemes, glandular-hairy; scape slender, 2-5 cm (mostly 2.5-3 cm) long, glandular-hairy. *Bracts* subulate, 1-2.5 mm long, sparsely glandular-hairy. *Pedicels* slender, 3-8 mm (mostly 6-8 mm) long, glandular-hairy. *Hypanthium* turbinate, pentagonal in section, the angles distinctly vertically ribbed, 1-2.3 mm long, *c.* 1 mm diam. at anthesis, glandular-hairy. *Sepals* 5, all free to the base, subulate, 1.2-1.5 mm long, glandular-hairy. *Corolla* pink, lobes vertically paired, abaxial surface a little glandular; anterior lobes obovate-oblanceolate, *c.* 2 mm long, *c.* 1.5 mm wide; posterior lobes obovate, apex emarginate, *c.* 3 mm long, *c.* 2.3 mm wide. *Throat appendages* forming a sparsely glandular U-shaped arrangement of 2 opposite *c.* 0.3 mm long tooth-like projections with a lip-like ledge rolled under between. *Labellum boss* attached to the base of the corolla tube sinus, ovate, smooth, convex, with a hyaline margin, *c.* 0.5 mm long, *c.* 0.25 mm wide. *Gynostemium c.* 7.7 mm long, hinged below the anthers, with a dilated cunabulum bearing 2 crowded marginal brush-like rows of short, non-glandular projections above the sensitive torosus; torosus adaxial surface scabrid, abaxial surface glabrous; margins and abaxial surface of anthers sparsely glandular-hairy. *Capsule* obovoid, 2.5-3 mm long. *Seeds* pale orange, *c.* 0.2 mm long.

Other specimens examined. NORTHERN TERRITORY: Howard Springs, 12° 27' S, 131° 03' E, 20 June 1990, *P. Simmons* 8 (PERTH); Howard Springs, 12° 27' S, 131° 03' E, 21 Apr. 1994, *A. Lowrie* 886 (PERTH); Paddy Rd, off Bridge Mary Rd, Koolpinyah, 12° 23' S, 131° 11' E, 29 Apr. 1995, *A. Lowrie* 1125 (PERTH); Noonamah, 12° 38' S, 131° 03' E, 24 July 1993, *D.E. Murfet* 1824 (PERTH); Noonamah, 12° 38' S, 131° 04' E, 24 Apr. 1994, *A. Lowrie* 939 (PERTH).
WESTERN AUSTRALIA: Pack Saddle Plains Rd, S of Kununurra, 15° 53' S, 128° 44' E, 18 June 1994, *A. Lowrie* 958 (PERTH); Cave Spring, N of Kununurra, 15° 34' S, 128° 48' E, 3 July 1994, *A. Lowrie* 1050 (PERTH).

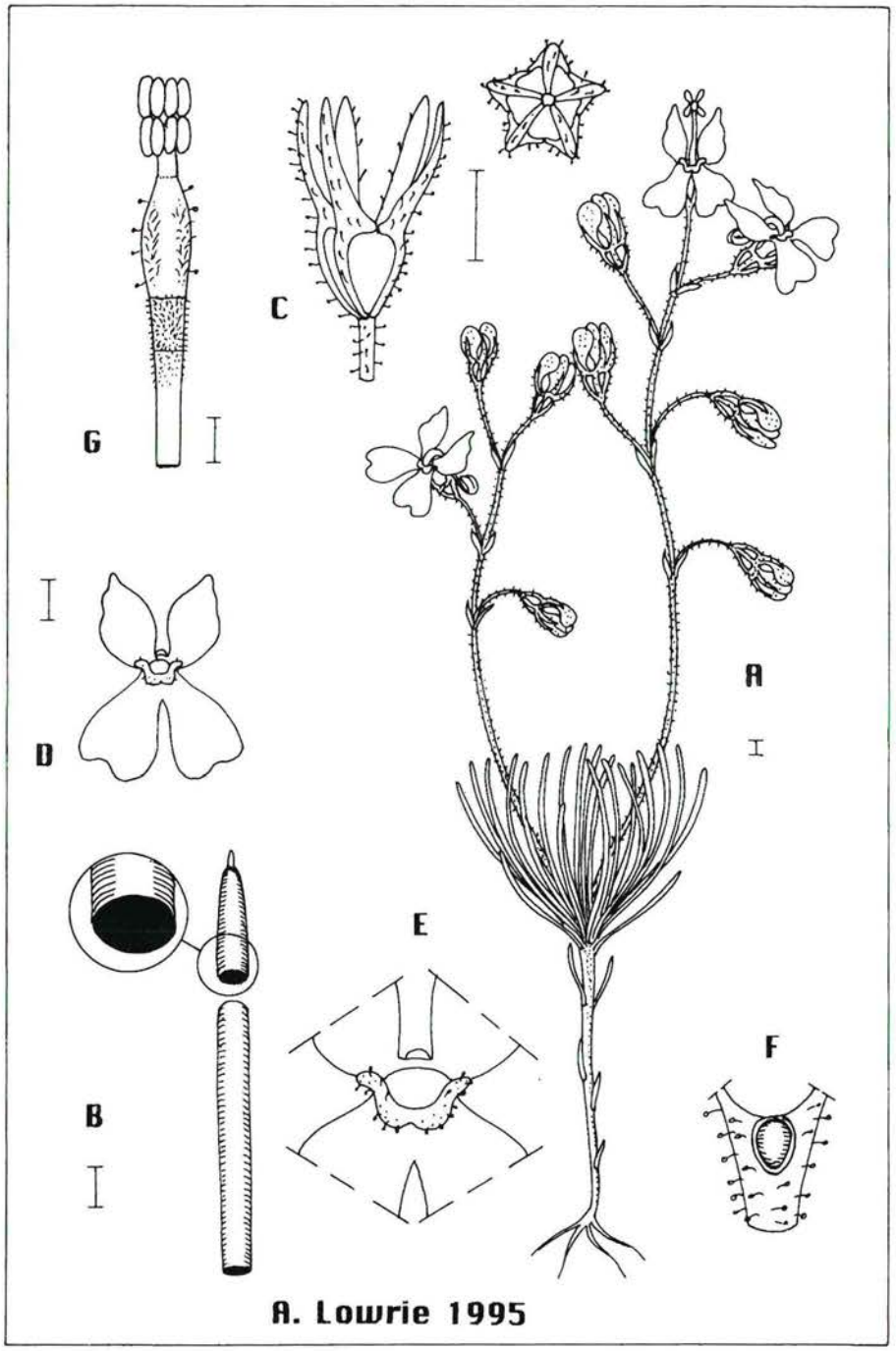

Figure 8. *Stylidium turbinatum* A - habit of flowering plant; B - leaf of basal tuft, enlarged section upper left; C - hypanthium and sepals left with base view of hypanthium right; D - corolla; E - enlarged section of the corolla showing throat appendages; F - enlarged section of the corolla tube showing labellum on sinus; G - adaxial view of gynostemium column and anthers showing hinged portion (dotted) immediately below anthers, the dilated cunabulum with marginal brush-like rows of short, non-glandular hair-like projections and the sensitive torosus with scabrid papillae. Scale bar for all = 1 mm.

Distribution. Occurs in the Northern Territory from Darwin southwards to Katherine. Found at scattered locations around Kununurra in the east Kimberley in Western Australia.

Habitat. Grows in sandy soils on the margins of creeks and floodways, watersheds and wet season herb fields.

Flowering period. June-July.

Conservation status. A common species in the Northern Territory and not under threat. Frequent around the Kununurra region and not under threat.

Etymology. The specific epithet *turbinatum* is from the latin *turbinatus* - obconical, in reference to the shape of the hypanthium.

Affinities. The hypanthium shape, corolla lobes outline, and throat appendages of *Stylidium turbinatum*, although smaller, are similar to those found in *S. rubiscapum* W. Fitzg. *S. turbinatum* can be distinguished from *S. rubiscapum* (in parentheses) by the lack of the distinctive red colour marking on the tips of anterior corolla lobes (anterior corolla lobes tipped red); leaves terete, round in section, terminating with a short blunt apical mucro (leaves linear, lenticulate in section, terminating with a sharp apical mucro); and multi-flowered scapes (uni-flowered scapes).

Acknowledgements

We would like to thank Denzel Murfet, Paul Simmons, Matthew and Russell Barrett for their field observations; Gordon Graham for his companionship on expeditions to the Kimberley; the leaders and CALM volunteers on the 1993, 1994, 1995 and 1996 *LANDSCOPE* Expeditions for the opportunity to collect material of *Stylidium* in remote regions of the Kimberley; Paul Wilson for his assistance with the Latin diagnoses; Barbara Rye for her comments, and the staff of the Western Australian Herbarium.

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Acacia colei var. *ileocarpa* (Leguminosae: Mimosoideae), a new taxon from the tropical dry-zone of north-west Australia

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Abstract

M.W. McDonald and B.R. Maslin. *Acacia colei* var. *ileocarpa* (Leguminosae: Mimosoideae), a new taxon from the tropical dry-zone of north-west Australia. Nuytsia 11(2): 219-223 (1997). *Acacia colei* var. *ileocarpa* M.W. McDonald & Maslin, a newly recognized variant of *A. colei* Maslin & L.A.J. Thomson, is described, illustrated and its natural distribution mapped. This variety differs most significantly from var. *colei* by its tightly, irregularly coiled or twisted pods which are very similar to those found on the related species *A. holosericea* A. Cunn. ex Don and *A. neurocarpa* A. Cunn. ex Hook.

Introduction

In their reappraisal of the taxonomy of *Acacia holosericea* A. Cunn. ex Don (Leguminosae: Mimosoideae: section *Juliflorae),* Maslin & Thomson (1992) described *A. colei* as a new species and noted a putative hybrid involving *A. colei* Maslin & L.A.J. Thomson and *A. neurocarpa* A. Cunn. ex Hook. (represented by *Thomson* LXT 1291-95 and 1300-05, all PERTH). Recent field studies and an examination of herbarium material now show this entity to be a variety of *A. colei*, described here as var. *ileocarpa.* It differs most significantly from the typical variety by its tightly, irregularly coiled or twisted pods (which are very similar to those found in the related species *A. holosericea* and *A. neurocarpa*). Variety *ileocarpa* has commonly been misidentified as *A. holosericea* or *A. neurocarpa* or as a hybrid between *A. colei* and either *A. holosericea* or *A. neurocarpa.* Both varieties of *A. colei* have become widely planted in tropical dry-zones of West Africa (such as Senegal and Niger) where they are grown for amenity purposes, fuelwood production and, more recently, for human food.

Taxonomy

Acacia colei var. *ileocarpa* M.W. McDonald & Maslin, *var. nov.* (Figure 1)

A varietate typica leguminibus arcte irregulariter tortuosis differt.

Typus: about 38 km east of Gibb River turnoff at Derby, on road to King Leopold Range, Western Australia, 13 October 1992, *B.R. Maslin* 7219 (*holo:* PERTH 2571714; *iso:* CANB, K).

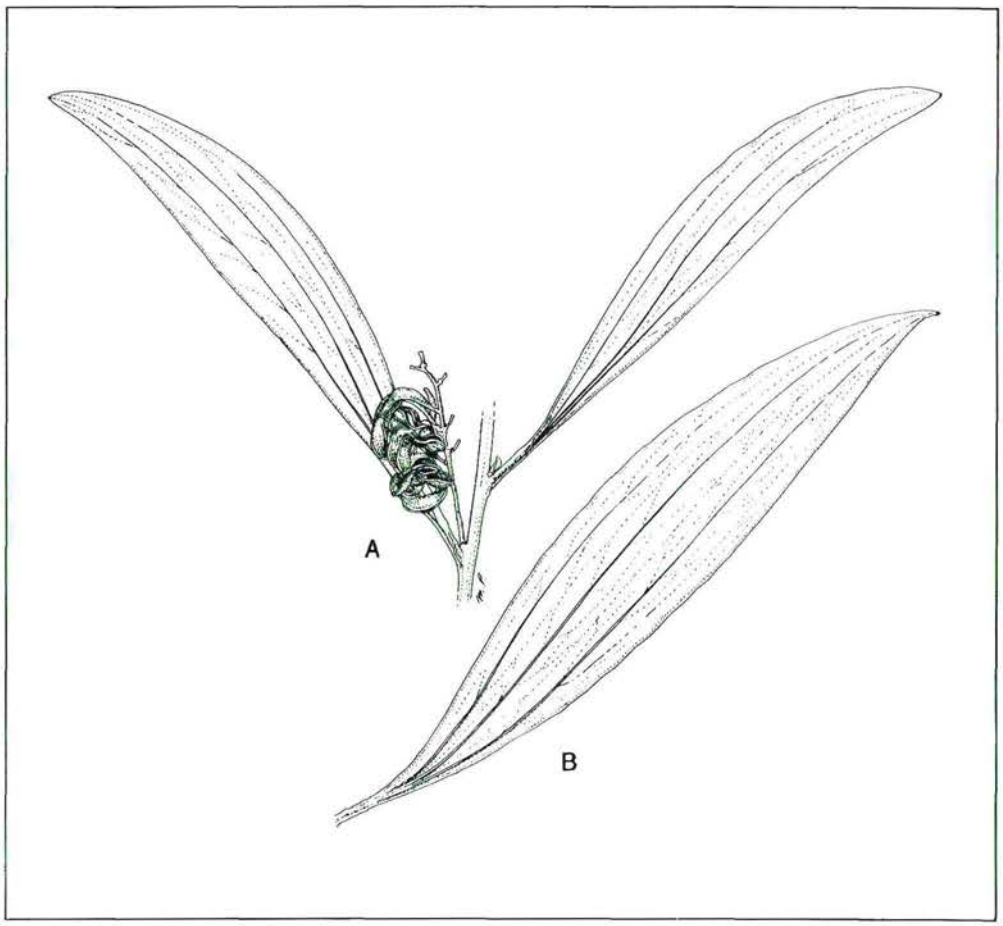

Figure 1. *Acacia colei* var. *ileocarpa* A - portion of fruiting branchlet (x0.5); B - larger than normal phyllode (x0.5). Drawn from *M. McDonald* 1936 (A) and *A.N. Rodd* 2837 (B).

Differs most significantly from *A. colei* var. *colei* in having tightly, irregularly coiled or twisted pods (curved, sometimes into an open circle, in *var. colei*). Other differences include its often orange-coloured terminal branchlets (brown in var. *colei*), commonly narrower phyllodes 10-25(40) mm wide (20-45(55) mm in var. *colei*) and slightly shorter seeds 3-3.5(4) mm long (3.5-4 mm in var. *colei*).

Selected specimens examined. WESTERN AUSTRALIA: between Rober [Robe River] and Millstream, *H. Demarz* 7663 (BRI, PERTH); Gibb River road, 68.2 km SE of Windjana Gorge turnoff, *C.E. Harwood & M. McDonald* CEH474 (PERTH); Rockhole Creek, 11 km SW of Halls Creek on Great Northern Highway, *B.R. Maslin* 7306 (PERTH); Great Northern Highway, 16 km SW of Halls Creek (*c.* 1 km NE of turnoff to Carranya Station at Koongie Park), *B.R. Maslin* 7155 (PERTH); *c.* 400 m S of the Negri River crossing, 136.6 km S along Duncan Highway (from turnoff at Victoria Highway), *M. McDonald* 1931 (PERTH); "Palm Springs" (tributary of Fortescue River), 11 km W of Millstream Station, *A.N. Rodd* 2837 (PERTH); 17 km E of Halls Creek on Duncan Highway, *L. Thomson* LXT 1291-1295 (all PERTH); Koongie Park, 0.1 km N of Tanami road turnoff on Great Northern Highway, *L. Thomson* LXT 1300-1303 (all PERTH); 4.5 km S of Great Northern Highway on Tanami road, *L. Thomson* LXT 1305 (PERTH).
NORTHERN TERRITORY: 7 km SE of Negri River on Duncan Highway, SSE of Kununurra, *B.R. Maslin* 7120A (PERTH); 23.6 km S of the Negri River crossing along the Duncan Highway, *M. McDonald* 1936 (PERTH).

Distribution. *Acacia colei* var. *ileocarpa* has a scattered distribution in the southern Kimberley region of Western Australia, it extends eastward to the western extremity of Northern Territory at the Negri River. It also occurs in the Pilbara region of Western Australia where it appears to be restricted to the Fortescue River drainage system. This Kimberley-Pilbara disjunct distribution pattern is not uncommon in *Acacia* and occurs also in other genera. The distributions of both var. *ileocarpa* and var. *colei* are shown in Figure 2. Although populations of var. *colei* and var. *ileocarpa* are normally allopatric some sympatric occurrences are known from a few locations in the Kimberley region, including Luluigui Station (west of Fitzroy Crossing), south of the Negri River crossing on the Duncan Highway (south of Kununurra) and at Rockhole Creek (south of Halls Creek). Herbarium specimens suggest that sympatry may occur in some Pilbara populations but this needs to be confirmed by further field observations.

Habitat. In the southern Kimberley var. *ileocarpa* occurs in proximity to floodplains and drainage lines on clay loams (pH 5.5-6.5) derived from alluvia or limestone. It is commonly found in open or low open woodlands dominated by *Corymbia grandifolia* (R. Br. ex Benth.) K.D. Hill & L.A.S. Johnson, *C. confertiflora* (F. Muell.) K.D. Hill & L.A.S. Johnson, *Eucalyptus pruinosa* Schauer, *Lysiphyllum cunninghamii* (Benth.) de Wit and shrub species such as *Acacia monticola* J.M. Black, *A. tumida* F. Muell. and *A. thomsonii* Maslin & M.W. McDonald. In the Pilbara it occurs on alkaline sandy loam (pH 7.5-8.5) associated with tall open shrublands of *A. bivenosa* DC., *A. farnesiana* (L.) Willd., *A. ancistrocarpa* Maiden & Blakely and sometimes open woodlands of *Eucalyptus leucophloia* Brooker. Also found colonizing disturbed soils along roadsides.

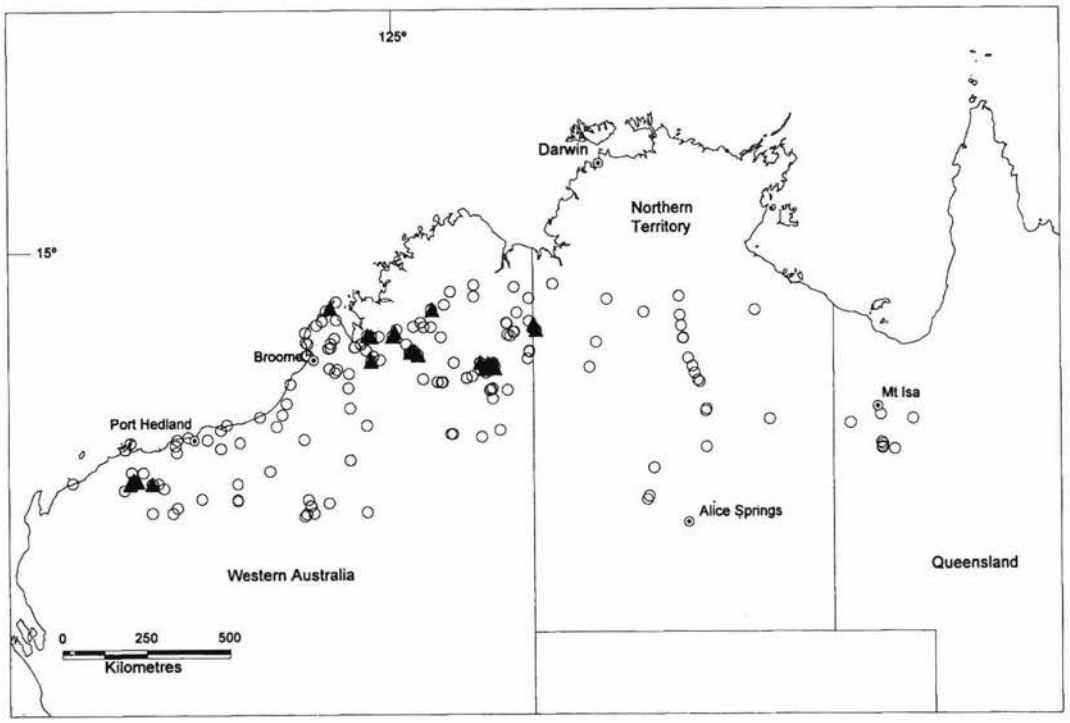

Figure 2. Distribution of *A. colei* var. *colei* (open circles) and *A. colei* var. *ileocarpa* (closed triangles).

Flowering and fruiting period. Variety *ileocarpa* flowers during June-July and pods mature September-November. Variety *colei* has essentially the same flowering and fruiting period (see Maslin & Thomson 1992).

Variation. Plants of var. *ileocarpa* display a range of variation in phyllode size and shape similar to or perhaps even greater than var. *colei*. Variety *ileocarpa* phyllodes are commonly 10-25 mm wide and as such tend to be slightly narrower (and often more attenuate) than those of var. *colei*. However, plants with wider than normal phyllodes (to 40 mm across and clearly within the range of variation for var. *colei*) occur scattered throughout the geographic range of the taxon (e.g. *A.N. Rodd* 2837, see Figure 1B). Further field work is required to ascertain whether these specimens represent collections from young plants, because many taxa in this group have a tendency to produce larger than normal phyllodes during this phase.

Plants of var. *ileocarpa* from the Kimberley region have seeds 3-3.5 mm long and this appears to be a slight, but consistent, difference from var. *colei* which occurs in the same area (seeds 3.5-4 mm long). In the Pilbara region, however, the seeds of var. *ileocarpa* tend to be slightly longer (to 4 mm).

Affinities. In the absence of pods it is normally difficult to distinguish var. *ileocarpa* from var. *colei*. Judging from both field and herbarium observations pod curvature appears to be a consistent and reliable difference between the two varieties; even in sympatric populations no intergradation between the taxa has been observed for this character (see below under *Genetics*).

Acacia colei var. *ileocarpa* is most readily distinguished from *A. holosericea* and *A. neurocarpa* (all of which have similar pods) by its phyllodes which lack a gland at the base of their apical mucro, are shallowly recurved towards their apices (straight in *A. holosericea* and *A. neurocarpa*) and have a different nervation pattern (see Maslin & Thomson 1992 for details).

Genetics. The chromosome number (2n = 78) recorded from progeny of plants grown in Maradi, Niger, show var. *ileocarpa* to be hexaploid (Helen Stace, pers. comm.). This is the same ploidy level as reported by Moran *et al.* (1992) for var. *colei*. Moran also reported that *A. colei* has an unusual breeding system and that individuals within populations have the same allozymic genotypes. The apparent "fixed" nature of their genetic make-up (perhaps due to selfing or apomixis) may explain why morphologically intermediate individuals are not present where the two have sympatric occurrences.

Application of rank. In applying rank to this new taxon we have followed the basic premises outlined by Cowan & Maslin (1995), namely, that taxa are biological entities with an evolutionary history, and they generally have geographic integrity and some degree of morphological distinctness. It is the subjective assessment of the importance of the morphological differences that contributes heavily to our determining what rank is applied to taxa. Therefore, one's level of knowledge of the group being studied and capacity to assess the relative significance of variation patterns are important factors. Furthermore, the application of rank is commonly influenced by how past authors have regarded taxa within the group.

Based on current knowledge it appears that there is only a single character (i.e. pod curvature) that consistently and reliably distinguishes *A. colei* var. *ileocarpa* from var. *colei*. Thus, in the absence of pods (which occur on the plants for a relatively short period of time) it is normally not possible to confidently place specimens in one variety or the other. Future studies may well reveal additional distinguishing characters and elucidate the genetic basis of the variation, leading to our varieties being treated as separate species. While we could have here treated var. *ileocarpa* as a cryptic species this

would not be in keeping with the general approach to ranking which is currently applied in *Acacia*. We therefore consider it most appropriate to treat the taxon as a variety of *A. colei* even though it sometimes occurs sympatrically with the typical variety. We regard this as a pragmatic, albeit perhaps temporary, solution because it enables non-fruiting specimens to be classified at least to species.

Utilization. Both varieties of *A. colei* have shown potential for multipurpose use in tropical dry-zones of West Africa. In Senegal and Niger they have been grown as a source of fuelwood and for environmental rehabilitation (Thomson *et al.* 1994). Recently their seeds have been used as an alternative source of human food in these regions; the seeds are ground to produce a flour which can be incorporated into local recipes (Rinaudo *et al.* 1995). Farmers near Maradi, Niger have shown a clear preference for var. *ileocarpa* as it has good harvesting characteristics (Tony Rinaudo pers. comm.). Pods mature within a short period of time, the seeds are held in the pods after ripening and the compact clusters of pods are easy to harvest.

Conservation status. Not considered to be under threat.

Etymology. The varietal epithet is derived from the Latin - *ileum,* last part of the small intestine, alluding to the twisted and coiled state of its pods; and from the Greek - *carpa,* fruit.

Common name. "Curly-podded Cole's Wattle".

Acknowledgements

Margaret Pieroni is thanked for preparing the illustration (Figure 1). Ian Brooker prepared the Latin diagnosis; Doug Boland, Chris Harwood, Steve Hopper and Lex Thomson provided useful comments on the manuscript; and Tony Rinaudo is thanked for providing information on plants grown in Maradi, Niger. Field work has been supported in part by the Seeds of Australian Trees (SAT) project implemented by the Australian Tree Seed Centre funded by the Australian Centre for International Agricultural Research (ACIAR). The research was conducted at the Australian Tree Seed Centre and the Western Australian Herbarium.

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A revision of *Gardenia* (Rubiaceae) from northern and north-western Australia

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Abstract

Puttock, C.F. A revision of *Gardenia* (Rubiaceae) from northern and north-western Australia. Nuytsia 11 (2): 225-262 (1997). The twelve species of *Gardenia* Ellis endemic to tropical Australia west of the Queensland Gulf country are revised. *Gardenia dacryoides* Puttock, *G. faucicola* Puttock, *G. gardneri* Puttock, *G. jabiluka* Puttock, *G. kakaduensis* Puttock and *G. sericea* Puttock are described as new to science. *Gardenia megasperma* var. *arborea* Ewart is raised to species rank as *G. ewartii* Puttock. A new name, *G. schwarzii* Puttock and neotype are provided for *G. petiolata* O. Schwarz. *Gardenia keartlandii* Tate is reduced to a subspecies of *G. pyriformis* A. Cunn. ex Benth., and three new subspecies are recognized: *G. pyriformis* subsp. *orientalis* Puttock, *G. resinosa* subsp. *kimberleyensis* Puttock and *G. ewartii* subsp. *fitzgeraldii* Puttock. Descriptions and a key to all taxa are provided.

Introduction

Gardenia Ellis (Rubiaceae) is a moderately large genus of 120-140 species confined to the tropics of Africa, Asia, Australia and the western Pacific region to Hawaii. The taxonomic treatment of the Australian species of *Gardenia* has been divided into two sections, the eastern species confined to Cape York Peninsula, north-eastern Queensland, and the western species, occurring west of the clay plains of the Flinders and Norman Rivers of the Gulf country, north-west Queensland. All the north-eastern Queensland species formerly placed in *Gardenia s.l.* have now been revised. These taxa have been placed in *Gardenia* (Puttock 1988), *Kailarsenia* Tirveng. (Puttock 1989) and *Atractocarpus* Schltr. & K. Krause (Puttock in press). *Gardenia suffruticosa* F. Muell., a species endemic to the Darwin and Gulf District of the Northern Territory, has previously been transferred to *Kailarsenia* (Puttock 1989, 1994). Presented here is a taxonomic revision of the remaining western species of *Gardenia*, all of which are endemic in Australia.

Nineteen species of *Gardenia* are now recognized in Australia and all are currently placed in the subgenus *Gardenia*. A cladistic analysis of these species (Puttock & Quinn in press) revealed several groups that may warrant subgeneric status. However, the amount of homoplasy within the western group and the likelihood of hybrid zones between several taxa make any subdivision of the Australian *Gardenia* premature. The western species form a closely related group. In all these species the fruits are circular in transverse section, the placental pulp is pink, and the seeds are reddish brown in contrast to the claret

coloured seeds of north-eastern species. The flowers are white, 5- to 9-merous, turning yellow with age; the corolla tube is tubaeform or crateriform with the anthers affixed medially and partially exserted, and the stigmas are white. In most species the sclerification of the mesocarp of the fruit is highly developed. Species without mesocarp sclerification form a subgroup more closely related to *G. vilhelmii*, one of the north-eastern species.

Twelve species are recognized within the region west of the Gulf country of Queensland, of which only three pose little taxonomic difficulty: *G. dacryoides, G. kakaduensis* and *G. sericea.* One species, *G. gardneri*, remains poorly known and appears to have characters intermediate between its sister species, *G. dacryoides* and the more distantly related *G. pyriformis* subsp. *pyriformis.* There are two species complexes which present great difficulties for species determinations. These are the *G. resinosa* complex, which includes *G. schwarzii, G. ewartii* and *G. megasperma*; and the *G. fucata* complex, which includes *G. pyriformis, G. faucicola* and *G. jabiluka.* The two complexes are not entirely independent, with the possibility of gene flow between *G. pyriformis* subsp. *keartlandii* and *G. resinosa* subsp. *kimberleyensis.* With such taxonomic difficulties, the treatment presented here aims to identify the recognizable elements within the complexes, and by so doing draw attention to the continuing need to refine the understanding of all the taxa involved. A conservative approach would have hidden much of the observable diversity and led to the assumption that the taxonomic problems are resolved. The complexity of this savannah woodland group is comparable to the equally problematic subgenus *Bergkias* (Sonn.) Verdc. of central and southern Africa (Verdcourt 1979).

Materials and methods

Descriptions of taxa were made from dried herbarium specimens, ethanol or FAA (formalin-acetic acid-alcohol) preserved specimens, and living material. Data collection followed that described in Puttock & Quinn (in press). Morphological terminology used in this paper follows that of Puttock (1988). The vertical extension of the calyx, generally regarded as calyx lobes, is termed 'calyx spur'. In some species this structure is continuous with the hypanthium and may not be homologous with the calyx lobes. The terminology used for bark and blaze follows Hyland (1982) with the exception of *smooth* being substituted for *nondescript.* Conservation status was determined from field observations, local knowledge and herbarium collections, using the standards provided by Briggs & Leigh (1996).

All taxa were examined across their known distributional ranges in the field with the exception of *Gardenia gardneri.* Much of the material was collected during several field trips that resulted in a floristic survey of the Magela Creek catchment area of Northern Territory (Puttock & Waterhouse 1981). All species were also examined on herbarium material held at, or available for loan from, the following herbaria: AD, BISH, BR, BRI, BM, CANB, CBG, DNA, JCT, K, L, MEL, NSW, NY, PERTH, QRS, SYD, UNSW, US.

Relatively little taxonomic literature dealing with Australian *Gardenia* was published during the first half of this century, and this consists of little more than species lists, and likewise in the recent ecological and floristic studies such as the floristic surveys in the Kakadu and Kimberley regions. Generally the species names cited in these earlier accounts cannot be relied upon. For this treatment I have attempted to obtain all collections used in those published accounts and have listed the treatments under their appropriate species wherever possible.

The calyx, which was the central taxonomic character used by Bentham (1867) in his key to the species, was found to be extremely variable within some species (e.g. *G. resinosa*) and is avoided in the current key for species where it is unreliable. The key presented here endeavours to use vegetative and fruit

characters wherever possible, since the flowering season is generally brief and flowers are not known for all taxa. As far as is known the corolla shape is uniform throughout this group and is only variable in size and number of lobes. Full descriptions of all species are provided to enable assimilation of this treatment with that of the north-eastern *Gardenia* (Puttock 1988).

Key to northern and north-western species and subspecies of *Gardenia*

1 Leafy twigs slender, 1-2(3) mm in diameter 2

1* Leafy twigs robust, 3-9 mm in diameter 9

2 Leaves sessile or subsessile, glabrous or if indumentum present, minutely and sparsely scabrous; domatia absent 3

2* Leaves petiolate; indumentum sparsely sericeous to tomentose; domatia present 4

3 Leaves 30-45 mm long, with 9 to 11 pairs of secondary veins; corolla tube 15-18 mm long; fruit ellipsoid, 13-16 mm long ..... ***G. faucicola***

3* Leaves 18-22 mm long, with 7 to 9 pairs of secondary veins; corolla tube 8-9 mm long; fruit spherical, 6-14 mm diameter ..... ***G. jabiluka***

4 Leaves with (9)10 to 13 pairs of veins 5

4* Leaves with 7 to 9(10) pairs of veins 6

5 Fruit spherical, 16-20(30) mm diameter; pedicel abruptly tapering into the fruit, rugulose when dry; indumentum on leaves sparse ..... ***G. fucata***

5* Fruit ovoid, 15-22(27) mm long; pedicel cylindrical, not tapering into the fruit; fruit, smooth when dry; indumentum on leaves dense ..... ***G. pyriformis*** subsp. ***pyriformis***

6 Fruit spherical, 10-16 mm diameter, with pedicels 2-5 mm long .... ***G. pyriformis*** subsp. ***orientalis***

6* Fruit subspherical to ovoid, 22-35 mm long, with pedicels 5-35 mm long 7

7 Plants with grey mottled ochre to rusty yellow bark; fruit 22-30 mm long, with pedicels 5-10 mm long ..... ***G. pyriformis*** subsp. ***keartlandii***

7* Plants with dark brown bark; fruit 30-35 mm long, with pedicels 10-35 mm long 8

8 Leaves with lamina ovate to elliptic; stipules (5)8-17 mm long usually copiously resinous (north-western Northern Territory and eastern Kimberley, Western Australia) ..... ***G. resinosa*** subsp. ***resinosa***

8* Leaves with lamina oblanceolate to narrowly elliptic; stipules 3-6 mm long, not resinous (Mitchell Plateau, Western Australia) ..... ***G. resinosa*** subsp. ***kimberleyensis***

9 Leaves tomentose to sericeous 10

9* Leaves glabrous to minutely hairy 12

10 Fruit 20-25 mm long; bark glaucous mauve to dark brown; corolla tube 10-12 mm long; leaves subsessile, petioles 0-3 mm long ..... ***G. sericea***

10* Fruit 35-70 mm long; bark light grey, mottled ochre to rusty yellow; corolla tube 15-25 mm long; petioles 3-15 mm long 11

11 Fruit narrowly obovoid to shortly fusiform; mesocarp 3-4 mm thick, possessing a rhomboid stony layer and thick putamen endocarp; pedicel 10-15 mm long ..... ***G. megasperma***

11* Fruit broadly ellipsoid to subspherical; mesocarp *c.* 2 mm thick, without a rhomboid stony layer and endocarp a thin putamen; pedicel 3-8 mm long ..... ***G. kakaduensis***

12 Leafy twigs 5-9 mm diameter; calyx tube more than 10 mm long; calyx lobes flattened into radial blades 13

12* Leafy twigs 3-5 mm diameter; calyx tube less than 8 mm long; calyx lobes linear or absent, not flattened into blades 15

13 Fruit with laterally flattened calyx spurs more than 5 mm wide; leaves with 6 to 9 pairs of secondary veins, often covered with sticky resin; stipules bullet-shaped, mammilliform ..... ***G. dacryoides***

13* Fruit with narrow laterally flattened calyx spurs less than 5 mm wide; leaves with 10 to 15 pairs of secondary veins, not often covered with sticky resin and stipules conical, not mammilliform 14

14 Fruits 20-30 mm long, smooth when dry; calyx spurs 5, laterally flattened, 4-5 mm wide ..... ***G. gardneri***

14* Fruits 30-55 mm long, striate when dry; calyx spurs 6(7), laterally flattened, 2-3 mm wide ..... ***G. schwarzii***

15 Leaves ovate to elliptic, resinous ..... ***G. resinosa*** subsp. ***resinosa***

15* Leaves obovate to oblanceolate, not resinous 16

16 Fruits 30-45 mm long on erect, gradually tapering pedicels; leaves with 11 to 13 pairs of secondary veins ..... ***G. ewartii*** subsp. ***ewartii***

16* Fruits 20-30 mm long on reflexed, abruptly tapering pedicels; leaves with 8 to 10 pairs of secondary veins ..... ***G. ewartii*** subsp. ***fitzgeraldii***

Descriptions

Gardenia dacryoides A. Cunn. ex Puttock, *sp. nov.*

Arbor parva resinoso-gummifera, flavescens, tenuissime hispida, foliis subrotundo-obovatis nervosis, axillis venarum foveolatis; fructus 4-5 alatis terminalibus. *G. hansemannii* forma calycis similis sed foliis fructibusque minoribus differt.

Typus: rocky hillside [between King River pumping station and Kununurra], Gardner District, Western Australia, 1 November 1969, *D.H. Mackenzie* 691101-15 & *F. Lullfitz* (*holo*: PERTH; *iso:* CANB 266208, Kununurra).

Gardenia dacryoides A. Cunn. *ms*; S.J. Forbes *et al.*, W. Austral. Naturalist 17:191 (1988).

Gardenia megasperma auct. pro parte; G. Bentham, Fl. Austral. 3: 409 (1867); W.V. Fitzgerald, J. & Proc. Roy. Soc. Western Australia 3:109 (1918); C.A. Gardner, Botanical notes. Kimberley region of Western Australia 92 (1923); S.J. Forbes *et al.*, W. Austral. Naturalist 17:184 (1988).

Gardenia sp. nov. aff. *megasperma* F. Muell., S.J. Forbes *et al.*, W. Austral. Naturalist 17:184 (1988).

Gardenia sp., R.J. Petheram & B. Kok, Plants of the Kimberley Region of Western Australia 467, fig. 466 (1983).

Gardenia sp. B., C.F. Puttock *In:* J.R. Wheeler *et al.*, Flora of the Kimberley Region 913, fig. 281D (1992).

Facultatively deciduous small *tree* to 8 m high; trunk at breast height to 250 mm diameter; branches spreading. *Bark* to 20 mm thick, furfuraceous, light grey mottled yellow, ochre or orange; outer bark layered, with an orange to cream blaze; inner bark blaze fawn to cream. *Wood* brittle, cream to white. *Leafy twigs* 5-9 mm diameter, often copiously resinous, minutely hairy. *Stipules* bullet-shaped, mammilliform, (15)20-25 mm long, 7-9 mm diameter, minutely hairy; colleters lanceolate, 0.5-0.9 mm long, 0.1-0.2 mm wide. *Leaves* opposite, coriaceous, glossy, usually resinous, mid green to yellowish green above and below, with very dense, very short hairs; petioles 10-25(30) mm long, 3-5 mm wide, yellow; lamina ovate, 70-180 mm long, 50-120(150) mm wide, with an obtuse apex and cordate to obtuse base; secondary veins (6)7 or 8(9) pairs, raised above and below, yellow, 50-60° to the midvein with weak intersecondary veins; tertiary venation very weakly percurrent to reticulate, opaque; ciliated pit domatia large and conspicuous. *Flowers* minutely hairy, on pedicels 9-12 mm long. *Hypanthium* 10-15 mm long, pale green, pronounced longitudinally ridges that are contiguous with the calyx spurs. *Calyx* 4(5)-merous; tube cylindrical, 10-12 mm long, coriaceous; lobes falcate-decurved coriaceous, laterally flattened spurs 15-25 mm long, 5-10 mm wide. *Corolla* tubaeform, (7)8- or 9-merous, white at anthesis, turning yellow; tube 25-32 mm long, 4-5 mm diameter at the base, 8-10 mm diameter in the upper part, villose outside, long hairy inside; lobes ovate to elliptic, 18-32 mm long, 10-15(20) mm wide, glabrous. *Anthers* 10-12 mm long, attached 4-5 mm from their apices, inserted 4-5 mm below the sinuses of the corolla lobes, partially included, the tips exceeding the corolla tube by 2-3 mm. *Style* 20-35 mm long, exceeding the corolla by several millimetres; stigmatic lobes 3 or 4, 12-14 mm long. *Ovary* with (5)7 or 8 placentas. *Fruit* spherical to ovoid, (15)20-40 mm long, (15)20-30 mm diameter, smooth (not striate when dry) with 4(5) longitudinal ridges; abruptly tapering into a slender pedicel 12-25 mm long; calyx persistent, the spurs 25-45(50) mm long, 7-15 mm wide; exocarp pale green whilst developing, yellow when mature; mesocarp outer part parenchymatous with few fibres, inner part stony and fused to endocarp; endocarp brittle, 3-4 mm thick; placental mass malleable. *Seeds* 3.7-4.7 mm diameter, 1.4-1.8 mm thick; hilum occupying one third to one half of the perimeter; seed coat brown; exotestal cells sinuate in outline; thickening of inner and lower tangential wall with perforations. (Puttock 1992: Figure 281D)

Additional specimens examined (38). WESTERN AUSTRALIA, GARDNER DISTRICT: Enid Falls (Site E5), Prince Regent River Reserve, 15°07'S, 125°33'E, without date, *Wilson* 2 (PERTH); unnamed tributary of Mitchell River, 14°45'S, 125°38'E, 8 Dec. 1982, *Kenneally* 8663 (PERTH); near Mitchell River Falls, Mitchell Plateau, 14°49'S, 125°40'E, 13 Sep. 1978, *Beard* 8308 (PERTH); Little Falls, 14°49'S, 125°42'E, 17 June 1976, *Kenneally* 5036 (PERTH); Mitchell Falls track, 14°49'S, 125°43'E, 31 May 1988, *Wilson* 315 & *Jacobs* (NSW, UNSW); Camp Creek gauging station, 12 km SSW of CRA mining campsite, 14°53'S, 125°45'E, 21 Apr. 1982, *Kenneally* 8057 (PERTH); Camp Creek, 14°52'S, 125°46'E, 13 June 1976, *Kenneally* 4797 (PERTH); Crystal Creek, W of Crystal Head, near Port Warrender, 14°29'S, 125°47'E, 11 July 1987, *Puttock* UNSW 20654 (UNSW); ditto, *Puttock* UNSW 20655 (UNSW); Crystal Creek area near gorge, 14°30'S, 125°47'E, 12 July 1987, *Puttock* UNSW 20663 (UNSW); Vansittart Bay, 10 Aug. 1921, *Gardner s.n.* (PERTH 1021, 1521, NSW); base of Anjo Peninsula between Napier Broome Bay & Vansittart Bay, 14°03'15"S, 126°24'45"E, 22 May 1984, *Forbes* 2118 (MEL, NSW, PERTH); S side of Gibb River crossing Kalumburu road, 16°05'S, 126°30'E, 11 July 1987, *Puttock* UNSW 20640 (UNSW); Anjo Peninsula, Sharp Point, 13°56'S, 126°32'E, 31 May 1984, *Forbes* 2256 (CANB, DNA, NSW, PERTH); Cape Anjo, 13°56'S, 126°34'E, 2 July 1973, *Wilson* 11294 (PERTH); Kalumburu, 25 Oct. 1974, *Rodd* 2885 (NSW); Nymphaea Creek, Drysdale River National Park, 14°49'S, 126°55'E, 13 Aug. 1975, *Kenneally* 4290 (PERTH); near junction of Drysdale River & Mogurnda Creek, *c.* 15°02'S, 126°55'E, 8 Aug. 1975, *George* 13572 (PERTH); SE of Cape Londonderry, 13°53'S, 127°04'E, 5 Aug. 1975, *George* 13345 (PERTH); 1.5 km N of King River crossing Gibb River road, 15°39'S, 128°05'E, 14 July 1987, *Puttock* UNSW 20689 (UNSW); ditto, *Puttock* UNSW 20690 (UNSW); between King River pumping station & Kununurra, 1 Nov. 1969, *Mackenzie & Lullfitz* 691101-15 (Kununurra, PERTH, CANB); hills round Wyndham, Sep. 1906, *Fitzgerald s.n.* (PERTH 1591, NSW); The Grotto area, 35 km from Wyndham on Kununurra road, 15°46'S, 128°16'E, 14 June 1984, *Rankin* 2942 (DNA); lower Ord River, 23 Jan. 1968, *Leutert* 71 (PERTH), [also] near

Kununurra, 23 Jan. 1968, *Leutert* 71 (CANB); 'Ivanhoe', 22 July 1952, *Langfield* 327 (PERTH); Kellys Knob, N side of Kununurra, 22 June 1970, *Briggs* 3682 (NSW); Hidden Valley, Kununurra, 15°47'S, 128°45'E, 8 Jan. 1985, *Wightman* 1735 & *Dunlop* (DNA, NSW); vicinity of Lake Argyle, S of Kununurra, 9 Aug. 1981, *Croat* 52361 (NSW); Weaber Range, 3 July 1937, *Stokes* 49 (PERTH); Weaber Range, 15°23'S, 128°59'E, 20 Nov. 1975, *Dunlop* 4041 (CANB, DNA).
FITZGERALD DISTRICT: Rollies Jump-up, Gibb River road, 13 July 1987, *Puttock* UNSW 20677 (UNSW); Gregory Jump-up, Gibb River road, 14 July 1987, *Puttock* UNSW 20688 (UNSW).
NORTHERN TERRITORY. VICTORIA RIVER DISTRICT: Victoria Hwy, 8.2 km from the Western Australia border, 16°00'S, 129°03'E, 5 July 1974, *Waterhouse* UNSW 4186 & *Wilson* (UNSW); Keep River, near Burt Range, 15°47'S, 129°05'E, 22 Sep. 1975, *Mitchell* 342 (CANB, DNA); Skinners Point, between Kununurra and Timber Creek, 15°56'S, 130°35'E, 16 July 1987, *Puttock* UNSW 20694 (UNSW); near Joes Creek, 7 km W of Victoria River crossing, 15°36'S, 131°05'E, 17 July 1987, *Puttock* UNSW 20704 (UNSW).

Distribution and habitat. Gardenia dacryoides is a common species in open woodland on alluvial sand and amongst outcropping sandstone across the northern Kimberley region and eastwards to the Victoria River, Northern Territory. (Figure 1)

Phenology. Flowering occurs between November and January. The flowers are mildly perfumed. Fruits are borne most of the year, maturing late in the dry season.

Conservation status. Gardenia dacryoides is not under threat, owing to its remote and rugged habitat and its wide distribution. It is also well conserved in the Drysdale River National Park and a number of other smaller parks.

Etymology. The epithet *dacryoides* refers to the large tear-drop of resin held apically from the stipules.

Vernacular names. Malava (Kununurra aborigines); Wild Gardenia (Petheram & Kok 1983).

Affinities. The remarkable feature of this species is the large, laterally flattened calyx spurs. Similar calyx spur development also occurs in the New Guinean endemic species *Gardenia hansemannii* K.Schum., and to a much lesser extent in *G. gardneri* from the western part of the Gardner District. Like the former species, *G. dacryoides* has large stipules producing copious amounts of viscid resin but differs by its smaller ovate leaves and fewer secondary veins.

Typification and notes. Bentham (1867) confused this widespread species with *Gardenia megasperma;* the species have a superficial resemblance on the basis of their large leaves. *Gardenia dacryoides* is distinguishable from this and all other Australian species by its large resinous stipules, leaves with fewer secondary veins, and flowers with large persistent calyx spurs. Although Cunningham's manuscript name is here taken up for this species, I have preferred to typify it on *Mackenzie* 691101-15 & *Lullfitz,* which is an excellent, replicated, flowering specimen. Cunningham provided a short description of this species in his diary to which he gave the manuscript name *G. dacryoides,* which was reproduced along with descriptions of others in Cunningham's diaries by Forbes *et al.* (1988:191). The authors of that paper stated they did not intend publication of the manuscript names therein.

A single specimen (*Telford* 6296 & *Butler*) with elliptic leaves (60-75 mm long, 30-48 mm wide), fine indumentum and stipules not exuding resin, from the Stewart River valley near the Wyndham Ranges, Fitzgerald District, may represent a separate taxon.

The leaves are used as a medicinal inhalant by Kununurra aborigines.

Gardenia ewartii Puttock, *nom. et stat. nov.*

Gardenia megasperma F. Muell. var. *arborea* Ewart & Cookson *In:* A.J. Ewart & O.B. Davies, Flora of the Northern Territory 257 (1917); C.R. Dunlop, Checklist of Vascular Plants of the Northern Territory 72 (1987). *Type*: 28 miles [44.8 km] south-east of Newcastle Waters, Barkly Tablelands District, Northern Territory, 8 July 1911, *G.F. Hill* 498 (*holo*: MEL).

Facultatively deciduous small *tree* to 7 m high; trunk at breast height to 275 mm diameter. *Bark* to 25 mm thick, furfuraceous, glaucous salmon pink or grey mottled rusty yellow; outer bark layered, blaze orange; inner bark blaze tan. *Wood* brittle, cream. *Leafy twigs* 3-5 mm diameter, glabrous, usually not resinous. *Stipules* conical, not mammilliform, 5-17 mm long, 3-5 mm diameter, minutely hairy; colleters lanceolate, 0.3-0.5 mm long, *c.* 0.1 mm diameter. *Leaves* opposite, coriaceous, mid to pale green, concolorous, with scattered very short hairs; petiole 10-20 mm long, 2-3 mm wide; lamina obovate to oblanceolate, 38-135 mm long, 25-75 mm wide, with an acute to obtuse apex and decurrent to obtuse base; secondary veins 8 to 13 pairs, 45-65° to the midvein, yellow to pale green, not raised above and below; tertiary venation weakly percurrent, opaque; ciliated pit domatia large and very conspicuous. *Flowers* 6- or 7-merous, glabrous, solitary on pedicels 10-15 mm long. *Hypanthium* 4-6 mm long, pale green, ridges absent. *Calyx* crateriform, with or without ribs, chartaceous; tube 5-7 mm long; lobes unequal and weakly developed, 8-20 mm long, laterally flattened 2-3 mm wide. *Corolla* tubaeform; tube 10-15 mm long, *c.* 3 mm diameter at the base, 5-6 mm diameter in the upper part, hairy inside; lobes ovate, 10-12 mm long, 6-8 mm wide. *Anthers* 10-13 mm long, attached 5-7 mm from their apices, inserted 3-4 mm below the sinuses of the corolla lobes, partially included, the tips exceeding the corolla tube by several millimetres. *Style* 18-25 mm long, exceeding the corolla tube by several millimetres; stigmatic lobes 4 or 5, 10-12 mm long. *Ovary* with 4 or 5 placentas. *Fruit* subspherical to ovoid, 30-50 mm long, 25-42 mm diameter, smooth when mature (smooth or with longitudinal striations when dry), gradually or abruptly tapering into a robust pedicel 10-15 mm long; calyx persistent, coriaceous with 6 or 7 robust, linear lobes, 8-20 mm long, laterally flattened, 1-3 mm wide; exocarp green whilst developing, yellow or brown when mature; mesocarp parenchymatous, 2-5 mm thick with many longitudinal fibres over interlocking stony layer fused to thin endocarp, 3-5 mm thick; placental mass malleable, brown. *Seeds* 3.0-5.6 mm diameter, 1.4-1.9 mm thick; hilum occupying one third to one half of the perimeter; seed coat reddish brown; exotestal cells sinuate in outline, thickening of inner tangential and lower part of radial walls with perforations.

Phenology. The flowers are mildly perfumed. Fruits are present on the plants for most of the year.

Etymology. The species is named after A.J. Ewart who, with O.B. Davies, compiled the first flora of the Northern Territory and gave varietal status to this taxon.

Vernacular name. None known.

Affinities. Ewart and Cookson (*In:* Ewart & Davies 1917) described this species as a variety of *Gardenia megasperma*, on account of the large fruits, seeds and ovary with five placentas, but with the oblong-ovate leaves of *G. pyriformis*. On the basis of these characters *G. ewartii* has closer affinities to *G. schwarzii* and *G. resinosa,* with which hybrids are suspected in the eastern part of its range in the vicinity of Katherine Gorge and the Victoria River. *Gardenia ewartii* differs from *G. schwarzii* by its smaller leaves, and from *G. resinosa* by its lack of copious resin.

Notes. The varietal name *arborea* cannot be elevated to species rank since it is already occupied. Two subspecies are recognized.

Gardenia ewartii subsp. **ewartii**

Stipules 5-17 mm long, 3-5 mm wide, minutely hairy. *Leaves* coriaceous; petioles 10-20 mm long; lamina obovate to oblanceolate, 45-110 mm long, 25-50 mm wide; secondary veins 11 to 13 pairs, 55-65° to the midvein. *Anthers* 10-13 mm long, attached 5-7 mm from their apices, inserted 3-4 mm below the sinuses of the corolla lobes, partially included, the tips exceeding the corolla tube by several millimetres. *Style* 18-25 mm long, exceeding the corolla tube by several millimetres; stigmatic lobes 10-12 mm long. *Fruit* 30-45 mm long, 25-35 mm diameter, subspherical to ovoid, smooth when mature (striate when dry), gradually tapering into a robust, erect (not reflexed) pedicel, 10-20 mm long. Calyx persistent on fruit, not constricted below the tube; calyx spurs linear, 8-20 mm long, 1-3 mm wide.

Additional specimens examined (26). WESTERN AUSTRALIA. GARDNER DISTRICT: Kimberley Research Station, Deception Range, 14 Feb. 1950, *Langfield* 172 (CANB); ditto, 30 Mar. 1952, *Langfield* 295 (CANB, PERTH); vicinity of Kimberley Research Station, near Kununurra, 28 Feb. 1969, *MacKenzie* 690228-1 (CANB); ditto, 15 Nov. 1969, *MacKenzie* 691115-7 (CANB); 8 km SE of Kununurra, 15°50'S, 128°47'E, 23 Mar. 1978, *Paijmans* 2627 (CANB, PERTH); 6.2 km W of Weavers Creek, between Wyndam and Kununurra, 16 July 1987, *Puttock* UNSW 20691 (UNSW); Cockatoo Sound, 'Argyle', Ord River, *Gardner* 7235 (PERTH); 9 km W of Red Creek, E of Kununurra, 16 July 1987, *Puttock* UNSW 20693 (UNSW).
NORTHERN TERRITORY. VICTORIA RIVER DISTRICT: Jasper Gorge, 16°02'S, 130°41'E, 13 July 1977, *Parker* 1058 (CANB, DNA, K, NE); Jasper Gorge, 36 miles [58 km] NNW of 'Victoria River Downs', 10 June 1949, *Perry* 2125 & *Lazarides* (CANB); near Joes Creek, 7 km W of Victoria River crossing, 15°36'S, 131°05'E, 17 July 1987, *Puttock* UNSW 20706 (UNSW); 10 miles [16 km] SE of 'Montejinni', 9 June 1952, *Perry & Lazarides* 2889 (AD, BRI, CANB, MEL, NSW).
DARWIN & GULF DISTRICT: 28.5 km N of Larrimah, Stuart Hwy, 15°18'S, 133°08'E, 19 Nov. 1982, *Puttock* UNSW 14463 & *St George* (UNSW); 'Kalarla', near Daly Waters, 16°14'S, 133°21'E, 14 Apr. 1979, *Rankin* 1918 (DNA 15076); 28 miles [45 km] SE Newcastle Waters, 8 July 1911, *Hill* 498 (MEL 598390); 4.1 miles [6.6 km] of Dunmara, 15 July 1947, *Perry* 377 (CANB); 'Cox River', 14 km W of Arnold River hut, 15°15'S, 134°23'E, 14 July 1977, *Henshall* 1371 (AD, CANB, DNA, MEL, NSW); 16°28'S, 134°59'E, 4 May 1947, *Blake* 17634 (BRI, DNA); 27.6 km N of Towns River crossing Roper Bar-Borroloola road, 14°56'S, 135°01'E, 22 July 1987, *Puttock* UNSW 20735 (UNSW); Battern Creek, 28 km S of Bing Bong, 15°54'S, 135°18'E, 30 June 1988, *Smith* 1254 (NSW); 5.2 km N of The Fletcher (Ck), 36.1 km S of Borroloola, 16°06'S, 136°35'E, *Puttock* UNSW 20741 (UNSW); 59.7 km W of 3 Ways Crawfords Crossing, 16°44'S, 135°12'E, 19 Nov. 1982, *Puttock* UNSW 14465 & *St George* (UNSW); Macarthur River area, 16°16'S, 136°04'E, 12 Feb. 1976, *Craven* 3890 (CANB).
BARKLY TABLELANDS DISTRICT: 53 miles [84.8 km] NNE of 'Creswell [?Downs]', 13 July 1948, *Perry* 1655 (CANB); 18.5 km S of Calvert River, 17°05'S, 137°30'E, 23 July 1987, *Puttock* UNSW 20742 (UNSW); ditto, *Puttock* UNSW 20743 (UNSW).
QUEENSLAND. BURKE DISTRICT: 1 mile W of 'Westmoreland', 17°20'S, 138°15'E, 5 June 1948, *Perry* 1318 (BRI, CANB).
Intergrade. Gardenia ewartii - G. schwarzii: DARWIN & GULF DISTRICT: upper Katherine River, *c.* 50 miles [*c.* 80 km] NE of Katherine, NAUC area, Aug. 1954, *Bateman* 17 (BRI, CANB).

Distribution and habitat. This subspecies grows in sandy soils often associated with dry watercourses. It occurs in the Durack and Deception Ranges, Western Australia, and the Jasper Range of the Victoria River District, Northern Territory. Few collections, including the type specimen, represent its semi-desert distribution to the north of the Barkly Tableland. (Figure 2)

Conservation status. Widespread and not endangered.

Notes. In the area of Katherine Gorge to 16 Mile Caves this subspecies appears to intergrade with both *Gardenia schwarzii* and *G. resinosa*. In the south-eastern part of its distribution, north of the Barkly Tableland, the leaves become smaller and sericeous, although remaining stiffly coriaceous. These latter specimens may represent another undescribed taxon.

Gardenia ewartii subsp. **fitzgeraldii** Puttock, *subsp. nov.*

A subsp. *ewartii* venis lateralibus paucioribus, fructibus minoribus in pedicellis abrupte attenuatis reflexisque differt.

Typus: Gibb River crossing, Kalumburu road, Gardner District, Western Australia, 16°05'S, 126°30'E, 13 July 1987, *C.F. Puttock* UNSW 20671 (*holo:* PERTH; *iso:* DNA, MEL, NSW).

Gardenia sp. D, C.F. Puttock *In:* J.R. Wheeler *et al.*, Flora of the Kimberley Region 914, fig. 281E (1992).

Stipules 8-12 mm long, 4-5 mm wide. *Leaves* thinly coriaceous; petiole 15-30 mm long; lamina obovate to elliptic, 50-135 mm long, 25-75 mm wide; secondary veins 8 to 10 pairs, 45-60° to the midvein, yellow. *Flowers* unknown. *Fruit* 20-30 mm long, 15-20 mm diameter, spherical to ovoid, smooth when mature (smooth when dry), abruptly tapering into a reflexed, robust pedicel 8-20 mm long. *Calyx* persistent on fruit, constricted at the base of the crateriform calyx tube; calyx spurs lorate, 8-25 mm long, 2-4 mm wide. (Puttock 1992: Figure 281E)

Additional specimens examined (12). WESTERN AUSTRALIA. FITZGERALD DISTRICT: Kongorow Pool, 17°07'S, 124°46'E, 12 May 1988, *Wilson* 229 (NSW, UNSW); Mt Eliza, May 1905, *Fitzgerald* (PERTH 723); Inglis Gap, Gibb River road, 17°07'S, 125°11'E, 10 July 1987, *Puttock* UNSW 20632 (UNSW); ditto, *Puttock* UNSW 20633 (UNSW); Mt Bell, 23 May 1967, *Byrnes* NB 354 (DNA); 0.5 km E of Same Creek, Gibb River road, 17°10'S, 125°18'E, 17 May 1988, *Wilson* 252 (NSW, UNSW); King Leopold Range, 17°17'S, 125°19'E, 9 Nov. 1981, *Dunlop* 6024 & *Done* (DNA, NSW, PERTH); 16 miles [25.7 km] SW of 'Mt House', 28 July 1959, *Lazarides* 6449 (CANB); 1 km W of Adcock Gorge, Gibb River road, 16°52'S, 125°48'E, 10 July 1987, *Puttock* UNSW 20635 (UNSW).
GARDNER DISTRICT: near 'Beverley Springs' homestead, 10 Aug. 1974, *George* 12200 (PERTH); S side of Gibb River crossing Kalumburu road, 16°05'S, 126°30'E, 10 July 1987, *Puttock* UNSW 20636 (UNSW); Gibb River crossing, Kalumburu road, 16°05'S, 126°30'E, 13 July 1987, *Puttock* UNSW 20671 (UNSW).

Distribution and habitat. This subspecies grows in sandy soils often associated with dry watercourses of the King Leopold Ranges. (Figure 2)

Conservation status. Not endangered.

Etymology. Named after the botanist W.V. Fitzgerald, who made collections of this subspecies.

Notes. *Gardenia ewartii* subsp. *fitzgeraldii* has smaller fruits than subsp. *ewartii* and these on strongly reflexed pedicels. The fruits are also smooth when dry (*cf.* striate in subsp. *ewartii*). On the Mitchell Plateau where *G. ewartii* subsp. *fitzgeraldii* is sympatric with *G. resinosa* subsp. *kimberleyensis*, they are readily discriminated by the longer petioles, and larger fruits with a gradual tapering and erect pedicel of the former. The flowers of *Gardenia ewartii* subsp. *fitzgeraldii* are not known.

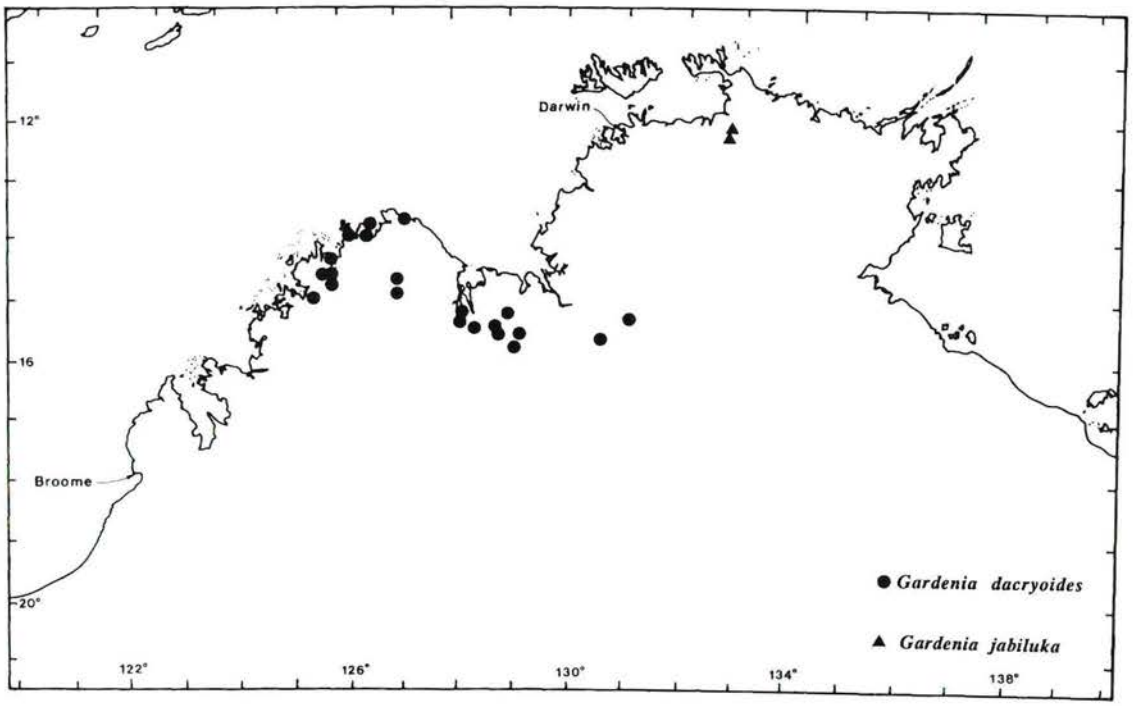

Figure 1. Distribution of *Gardenia dacryoides* and *G. jabiluka*.

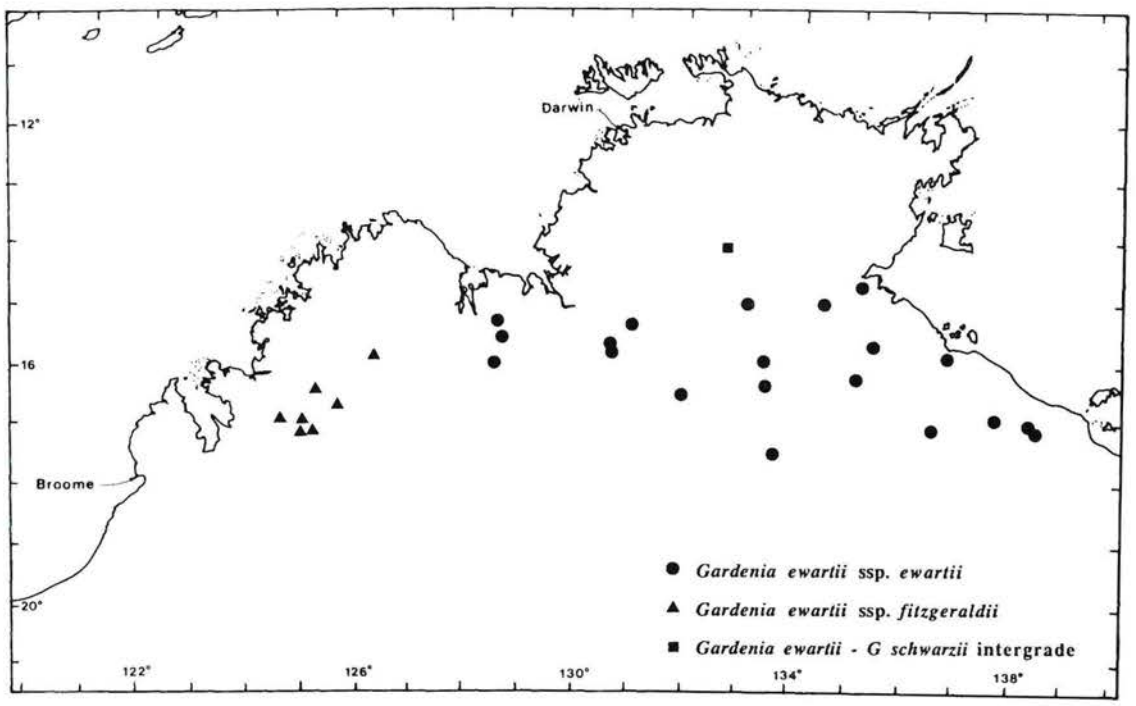

Figure 2. Distribution of *Gardenia ewartii*.

Gardenia faucicola Puttock, *sp. nov.*

A *G. pyriformi* foliis subsessilibus plusminusve glabris domatia deficientibus et fructibus ovoideis differt.

Typus: east-south-east of 'Mudginberry', 12°36'S, 132°58'E, Darwin and Gulf District, Northern Territory, 19 February 1973, *C.R. Dunlop* 3302 (*holo:* DNA; *iso:* BRI, CANB, NSW).

Gardenia sp., M. Lazarides *et al.*, ANPWS Occasional Paper 15:23 (1988).

Gardenia fucata sensu J. Brock, Top End Native Plants 193 (1988).

Facultatively deciduous *tree* to 4 m high; trunk at breast height to 120 mm diameter; branches spreading. *Bark* to 10 mm thick, smooth, furfuraceous, glaucous dark brown; outer bark layered with reddish brown blaze; inner bark blaze reddish orange. *Wood* brittle, orange to yellow. *Leafy twigs* 1-2 mm diameter. *Stipules* bullet-shaped, mammilliform, 2-4 mm long; colleters lanceolate, 0.3-0.4 mm long, *c.* 0.1 mm wide. *Leaves* opposite, thinly coriaceous, glossy dark green above, greyish green below, glabrous or minutely scabrous, subsessile; lamina elliptic to ovate, 30-45 mm long, 13-25 mm wide, with an obtuse apex and obtuse to cordate base; secondary veins 9 to 11 pairs, 45-55° to the midvein, not raised above and below; tertiary venation reticulate, opaque; domatia absent. *Flowers* 6 or 7-merous, solitary on pedicels 2-3 mm long. *Hypanthium* 2-3 mm long, pale green, ridges absent. *Calyx* crateriform; tube 1-2 mm long, chartaceous between thin coriaceous lobe-ridges; lobes linear, 7-12 mm long, not flattened in the radial plane. *Corolla* tubaeform; tube 15-18 mm long, *c.* 2 mm diameter at the base, increasing to *c.* 4 mm diameter in the upper part, scattered retrose hairs outside, hairy inside; lobes ovate, 7-12 mm long, 5-7 mm wide. *Anthers* 5-6 mm long, attached 2-3 mm from their apices, inserted *c.* 2 mm below the sinuses of the corolla lobes, mostly included, the tips exceeding the corolla tube by *c.* 1 mm. *Style* 14-18 mm long, scarcely exceeding the corolla tube; stigmatic lobes (2)3, 4-5 mm long. *Ovary* with (2)3 placentas. *Fruit* ellipsoid (occasionally pyriform when young), 13-16 mm long, 9-11 mm diameter, smooth (with 6-12 longitudinal striations when dry), abruptly tapering into a erect, slender pedicel 3-4 mm long; calyx remnant a 2-3 mm crown and spreading to reflexed lobes 10-12 mm long; exocarp pale green whilst developing, yellow green when mature; mesocarp parenchymatous, 1-2 mm thick, with few sclereid striations; endocarp bony, compact, *c.* 1 mm thick; placental mass malleable, pink. *Seeds* 3.0-4.2 mm diameter, 1.3-1.5 mm thick; hilum occupying one-third to one-half of the perimeter of seed; seed coat reddish brown; exotestal cells sinuate in outline, thickening of inner tangential and lower part of radial walls reticulate.

Additional specimens examined (18). DARWIN & GULF DISTRICT: South Alligator mine area, 7 km SE of UDP Falls, 13°29'S, 132°27'E, 15 June 1977, *Parker* 885 (CANB, DNA); 4 miles NW of El Sharana, 13°28'S, 132°28'E, 23 Jan. 1973, *Martensz* AE 494 & *Schodde* (BRI, CANB, DNA); Katherine Gorge, 15 miles [24 km] NE of Katherine, 14°19'S, 132°28'E, 15 Dec. 1963, *Lazarides* 6986 (NSW); top of Jim Jim Falls, 13°17'S, 132°51'E, 30 June 1981, *Dunlop* 5680 (CANB, DNA, NSW, UNSW); Kolondjarluk Creek, Deaf Adder Creek valley, *c.* 13°05'S, 132°52'E, 1 June 1976, *Olsen* 2675 (NSW); headwaters of Baroalba Creek, Koongarra, 12°50'S, 132°53'E, 16 July 1974, *Waterhouse* UNSW 4082 (UNSW); Site 49, Buffalo Springs, Mt Brockman, 5 km NE of Koongarra, 12°50'S, 132°53'E, 22 May 1980, *Lazarides* 8911 (CANB); *c.* 3 miles [5 km] E Jim Jim Falls (Site 130), 13°17'S, 132°53'E, 14 July 1972, *Byrnes* 2725 (CANB, DNA, K); *c.* 10 miles [16 km] ESE Noranda Mining Co., 12°55'S, 132°55'E, 12 July 1972, *Martensz* AE 125 (CANB, DNA); Deaf Adder Gorge, 13°07'S, 132°56'E, 22 Apr. 1980, *Dunlop* 5472 (CANB, DNA, NSW); 1.5 miles [2.4 km] SW Cannon Hill, 12°22'S, 132°56'E, 2 Feb. 1973, *Martensz* AE 709 (BRI, CANB, DNA); Bulbe gardar (rock pool), base of 'Gerringbar' Escarpment, ENE of Ja Ja, 12°29'30"S, 132°56'40"E, 24 July 1980, *Puttock* UNSW

10168 & *Waterhouse* (UNSW); 6 miles [10 km] SE of East Alligator River crossing, 22 July 1971, *Balgooy/ Barnes* 1293 (CANB); ESE of Mudginberry, 12°36'S, 132°58'E, 19 Feb. 1973, *Dunlop* 3302 (BRI, CANB, DNA, NSW); Deaf Adder Gorge, 13°07'S, 132°58'E, 21 Feb. 1977, *Fox* 2514 (BRI, DNA); Nabarlek area, 2 km N of airstrip, 12°17'S, 133°19'E, 26 Apr. 1979, *Rankin* 2188 (CANB, DNA, L); 24 miles [38.6 km] SE of Oenpelli, 12°32'S, 133°19'E, 7 July 1972, *Adams* 2763 (CANB, K); Q59, *c.* 31 miles [*c.* 50 km] ENE of 'Mudginberry' homestead, 12°32'S, 133°19'E, 19 Feb. 1973, *Lazarides* 7773 (BRI, CANB).

Distribution and habitat. A species endemic to the sandstone escarpment country along the western edge of Arnhem Land, from the East Alligator River (longitude 132°56'E) in the north and Katherine Gorge (longitude 132°28'E) in the south. This species favours the rock crevices and steep cliff walls of the escarpment gorges. (Figure 3)

Phenology. Flowering known only between January and March at which time the plants have fully developed leaves. The flowers are mildly perfumed. Fruits mature from April until July. The species has not been collected between September and December.

Conservation status. It is not currently under threat despite its localized distribution, being well conserved in the Kakadu and Katherine Gorge National Parks.

Etymology. The specific epithet is derived from the Latin *fauces* -gorge and *-cola* - dweller, in reference to its habitat.

Vernacular name. None known.

Affinities. Gardenia faucicola is closely related to *G. jabiluka* from which it differs by its larger leaves, longer corolla tube, ovoid fruits and less gnarled habit. It is distinguished from the eastern part of the *G. pyriformis* complex by its leaves lacking the silky tomentum and domatia characteristic of that species.

Notes. This species was previously confused with *Gardenia edulis* F. Muell. (= *G. vilhelmii* Domin) from which it differs by the shape of its leaves, the size of the fruit, and its reflexed calyx spurs.

Gardenia fucata R. Br. ex Benth., Fl. Austral. 3:410 (1867). *Type*: Point R [Cape Barrow, Blue Mud Bay, Groote Eylandt], Gulf of Carpenteria, Darwin and Gulf District, Northern Territory, 15 January 1803, *R. Brown* (*lecto* - here designated: BM; *iso:* NSW).

Other literature. F. Mueller, Syst. Census Austral. Pl. 74 (1882), Second Syst. Census Austral. Pl. 25 (1889); F.M. Bailey, Catalogue of Indigenous and Naturalised Plants of Queensland 22 (1890), Queensland Flora 3:757 (1900); A.J. Ewart & O.B. Davies, Flora of the Northern Territory 305 (1917); R.L. Specht *In*: R.L. Specht & C.P. Mountford, Record of the American-Australian scientific expedition to the Arnhem Land 305 (1958); W.R. Elliot & D.L. Jones, Encyclopaedia of Australian Plants 4:332 (1986).

Facultatively deciduous *tree* 8(10) m high; trunk at breast height to 300 mm diameter. *Bark* to 20 mm thick, smooth, furfuraceous, light grey mottled ochre to mustard yellow; outer bark layered with tan to orange blaze; inner bark blaze cream. *Wood* cream. *Leafy twigs* 1-2 mm in diameter, glabrous or subglabrous. *Stipules* bullet-shaped, not mammilliform, 3-8 mm long; colleters lanceolate, 0.28-0.34 mm long, *c.* 0.1 mm wide. *Leaves* coriaceous, glossy dark to mid green above, greyish green below, with scattered very short hairs; petiole 1-2(4) mm long, *c.* 1 mm wide; lamina narrowly oblong to narrowly elliptic, 30-80 mm long, 5-20 mm wide, with a decurrent base and obtuse apex; secondary veins 9 to 13

pairs, 40-50° to the midvein, not raised above and below; tertiary venation weakly percurrent, opaque; ciliated pit-domatia in secondary/mid vein angles small, often inconspicuous. *Flowers* 5- to 7-merous, solitary, glabrous to subglabrous; pedicel to 6 mm long. *Hypanthium* 6-10 mm long, pale green, ridges absent. *Calyx* tube cylindrical, 1-3 mm long, chartaceous between coriaceous lobe-ridges; lobes linear, 7-10 mm long, laterally flattened, 1-2 mm wide, terminating with small leaf-like spathulate tips in some specimens. *Corolla* tube cylindrical, 14-20 mm long, *c.* 2 mm diameter at the base, increasing to 3(4) mm diameter in the upper part, glabrous or with scattered hairs outside, hairy inside, glabrous; lobes elliptical, 7-15 mm long, 3-6 mm wide, glabrous. *Anthers* 10-11 mm long, attached *c.* 5 mm from their apices, inserted 3-4 mm below the sinuses of the corolla lobes, partially included, the tips exceeding the corolla tube by 1-2 mm. *Style* 15-22 mm long, exceeding the corolla tube by several millimetres. *Ovary* with 3 or 4 placentas. *Fruit* spherical, 16-20(30) mm in diameter, smooth (with longitudinal reticulate striations when dry), abruptly tapering into a pedicel 6-8 mm long; calyx very brittle and often lost, when persistent a short crown and several lobes up to 15 mm long, not reflexed; exocarp pale green whilst developing, yellow when mature; mesocarp parenchymatous with fibrous outside *c.* 1 mm thick and with large angular stones fused to a thin endocarp, 2-4 mm thick; placental mass malleable, cream. *Seeds* 2.6-5.0 mm diameter, 1.2-1.8 mm thick; hilum occupying one third to one half of the perimeter; seed coat fawn coloured; exotestal cells sinuate in outline, thickening of the inner tangential and lower part of radial walls reticulate.

Additional specimens examined (64). NORTHERN TERRITORY. DARWIN & GULF: Port Darwin, Telegraph Line, 1886, *Holtze* (MEL); [?] Alligator River (Port Darwin), 1885, *Holtze* (MEL); 164° from Darwin, 16 Aug. 1965, *Story* 7800 (CANB); 65 miles [104 km] from Pine Creek on UDP Falls road, 13°38'S, 132°11'E, Apr. 1973, *Gittens* 2575 (BRI, NSW); Edith Falls Reserve, 14°12'S, 132°11'E, 4 Oct. 1977, *Parker* 1102 (CANB?, DNA); Edith Falls Reserve, 14°12'S, 132°11'E, 5 Oct. 1977, *Must* 1667 (BRI, CANB, DNA); 42 miles [67.6 km] from Pine Creek on El Sharana road, 12 Jan. 1973, *Hearne* 1530 (DNA); 1.6 km E of South Alligator River crossing on road from Pine Creek to E1 Sharana camp, 13°16'S, 132°20'E, 19 July 1974, *Waterhouse* UNSW 4100/3 (UNSW); 18 miles [29 km] NE of Katherine, 7 Feb. 1965, *Wilson* 314 (CANB); Katherine Gorge, 14°19'S, 132°25'E, 13 Oct. 1946, *Blake* 17207 (BRI); Katherine Gorge, 15 miles [24 km] NE of Katherine, 15 *Dec.* 1963, *Lazarides* 6986 (BRI, CANB, NSW); ditto, *Lazarides* 6989 (CANB); Katherine Gorge, 16 Jan. 1967, *Byrnes* NB 63 (DNA); Katherine Gorge, 14°19'S, 132°27'E, 20 July 1987, *Puttock* UNSW 20724 (UNSW); Katherine Gorge National Park, 16 Feb. 1968, *Byrnes* NB 1182 (DNA, NSW); Upper Katherine River, *c.* 50 miles [*c.* 80 km] NE of Katherine, NAUC area, 5 Sep. 1954, *Bateman* 18 (BRI, CANB); Site 53, 1 km S of Twin Falls, 13°19.5'S, 132°47'E, 23 May 1980, *Lazarides* 8927 (CANB); Maude Creek goldfield area, 21 miles [33.8 km] E of Katherine, 23 Jan. 1956, *Wilson* 179 (CANB); 4 miles [7 km] NW of El Sharana, Pine Creek road, 23 Jan. 1973, *Martensz* AE 518 *& Schodde* (BRI, CANB, DNA); Nourlangie Creek, 12°52'S, 132°47'E, 28 Feb. 1973, *Dunlop* 3385 (CANB, DNA); Nourlangie Rock, 12°52'S, 132°47'E, 5 June 1974, *Fox* 501 (DNA, NE); Nourlangie Rock, 4 July 1972, *Schodde* AE 39 (CANB, DNA, K, NSW); Little Nourlangie Rock, 12°52'S, 132°48'E, 11 Mar. 1919, *Dunlop* 5058 (BRI, CANB, DNA, K); Little Nourlangie Rock, 12°42'S 132°49'E, 29 Sep. 1974, *Gibbs* 666 (DNA); Little Nourlangie Rock, 12°42'S, 132°49'E, 29 July 1980, *Puttock* UNSW 10270 *& Waterhouse* (UNSW); Little Nourlangie Rock, 12°52'S, 132°50'E, 17 Oct. 1980, *Maconochie* 2554 (BRI, CANB, DNA, K, MEL); Koongarra, 12°51'S, 153°50'E, 3 June 1978, *Rice* 2922 (CANB); Deaf Adder Gorge, 13°05'S, 132°51'E, 24 Feb. 1977, *Fox* 2562 (BRI, CANB, DNA); Koongarra area, 12°51'S, 132°51'E, 19 Apr. 1979, *Rankin* 1967 (DNA, NE); 1.5 km NE of Koongarra, 12°52'S, 132°51'E, 12 Sep. 1978, *Rankin* 1403 (DNA); ditto, 18 June 1978, *Rankin* 1329 (CANB, CBG, DNA, K); top of Jim Jim Falls, 13°17'S, 132°51'E, 31 Jan. 1981, *Dunlop* 5706 (DNA, K, MEL, NSW); vicinity of Nourlangie Rock, 12°49'S, 132°52'E, 9 Aug. 1972, *Martensz* AE 197 (CANB, K, NSW); 0.5 miles [0.8 km] W of Nourlangie Rock, 20 July 1972, *Martensz* AE 171 (CANB, DNA); Nourlangie Rock area, 8 Nov. 1972, *McKean* B788 (CANB, DNA, K); ditto, *McKean* B793 (CANB, DNA, K); 5 miles [8 km] E of Nourlangie Rock, 9 Nov. 1972, *Martensz* AE 298 (BRI, CANB, DNA); near Baroalba Springs, Mt Brockman, 12°50'S, 132°55'E, May 1978, *Webb* 12356 *& Tracey* (BRI); *c.* 4 miles [*c.*7 km] NNE of Mudginberry Homestead, 4 July 1972, *Lazarides* 7521 (CANB, DNA, K, L, US); escarpment under Cannon Rock, western side of

Jabiluka Outlier, 23 Mar. 1980, *Waterhouse* UNSW 9554 (UNSW); Bulilumbu Creek halfway up slope Jabiluka Outlier, 27 July 1980, *Puttock* UNSW 10233 & *Waterhouse* (UNSW); top of ridge on Jabiluka Outlier, SE of Ja Ja Campsite, 4 Sep. 1980, *Puttock* UNSW 8522 & *Murray* (UNSW); top of ridge on Jabiluka Outlier, E of Ja Ja Campsite, 5 Sep. 1979, *Puttock* UNSW 8556 & *Murray* (UNSW); East Alligator River, Cahills Crossing & Cannon Hill, 12°02'S, 132°55'E, 2 Oct. 1946, *Blake* 17120 (BRI); 1-2 miles [1.6-3.2 km] S of Cannon Hill, 16 Aug. 1972, *Martensz* AE 262 (BRI, CANB, DNA, K, L, NSW); N facing wall in central part of Mt Brockman, 12°44'S, 132°54'E, 23 Feb. 1973, *Craven* 2373 (A, CANB, L, NT); Mt Brockman, 12°45'S, 132°57'E, 24 Feb. 1977, *Barnett* 47 & *Azzopardi* (DNA); ditto, 25 Feb. 1977, *Barnett* 51 & *Azzopardi* (DNA); East Alligator River, *c.* 3 miles [*c.* 5 km] S of Cahills Crossing, 16 May 1968, *Carolin* 6868 (SYD); East Alligator River, 19 May 1968, *Byrnes* NB 833 (DNA); near Cahills Crossing, East Alligator River, 12°30'S, 133°00'E, 16 May 1974, *Fox* 437 (DNA, NE); Oenpelli, 12°18'S, 133°04'E, 2 Oct. 1948, *Specht* 1119 (AD, BRI, CANB, MEL, NSW, PERTH); 2 km W of Nabarlek airstrip, 12°18'S, 133°16'E, 24 Apr. 1979, *Rankin* 2181 (CANB, DNA, K); 0.5 km E of Sandy Creek on Roper Bar on Roper Hwy, 14°04'S, 134°03'E, 21 July 1987, *Puttock* UNSW 20728 (UNSW); Hells Gate, 9.2 km W of Roper Bar crossing on Roper Hwy, 14°43'S, 134°26'E, 17 Nov. 1982, *Puttock* UNSW 14453 & *St George* (UNSW); 7.5 km W of Roper Bar crossing on Roper Hwy, 14°43'S, 134°27'E, 17 Nov. 1982, *Puttock* UNSW 14454 & *St George* (UNSW); 6 km W of Roper Bar crossing on Roper Hwy, 14°43'S, 134°27'E, 18 Nov. 1982, *Puttock* UNSW 14454 & *St George* (UNSW); 12 km SW of Phelp River crossing, 14°27'S, 135°03'E, 12 Oct. 1987, *Clark* 1682 (DNA, NSW); 8 km E of turn off on road to Port Roper, 14°54'S, 135°03'E, 21 July 1987, *Puttock* UNSW 20729 & *King* (UNSW); Groote Eylandt, 15 Jan. 1803, *Brown s.n.* (BM, NSW); Wessel Island, 11°11'S, 136°44'E, 1 Oct. 1972, *Latz* 3367 (CANB, DNA); Lake Emeda, 14°13'S, 136°44'E, 17 Mar. 1979, *Waddy* 770 (DNA); Lower Settlement Creek, 18°00'S, 138°07'E, Aug. 1922, *Brass* 178 (BRI).

Distribution and habitat. A widespread species of the Darwin and Gulf District of Northern Territory from Katherine Gorge to Groote Eylandt. It is generally found in savannah woodland on the scree slopes of sandstone escarpments. (Figure 4)

Phenology. Flowering from late September to February and aseasonally in May. Early in the flowering season the trees are virtually leafless. The flowers are mildly perfumed. Fruits are borne on the trees almost all year and mature between July to November.

Conservation status. This species has a wide distribution, and is well conserved in the Kakudu and Katherine Gorge National Parks.

Etymology. The specific epithet '*fucata*', which means coloured or stained, presumably refers to the ochreous bark, a feature which is not unique to this species.

Vernacular name. None known.

Affinities. *Gardenia fucata* is related to *G. pyriformis* but differs by its spherical fruits and almost glabrous leaves. The species also has affinities to *G. resinosa* but is distinguished by its smaller leaves, flowers and fruits.

Typification and notes. The type material consists of two specimens. The specimen retained by Bentham, now at the British Museum, is here designated as lectotype.

The names *Gardenia fucata*, *G. pyriformis*, and *G. edulis* have been used almost indiscriminately in species checklists for northern Australia. The confusion is largely due to the presence of more species than *G. edulis*, a name used by Mueller for all these taxa in the early period of collecting across northern

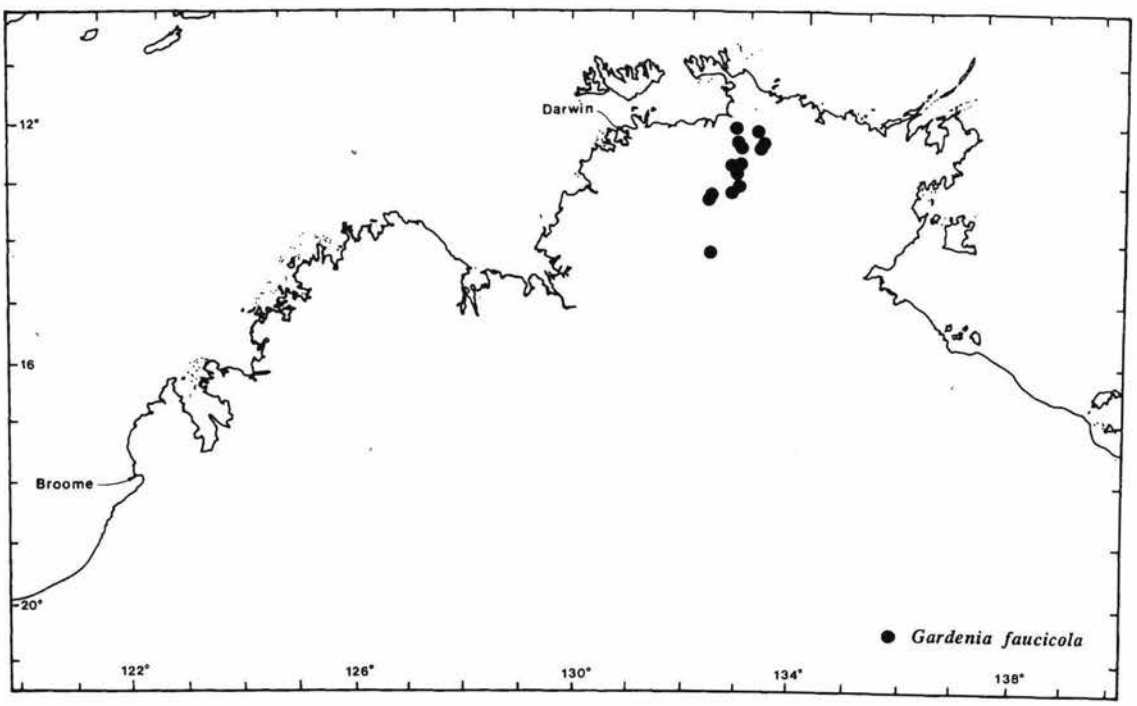

Figure 3. Distribution of *Gardenia faucicola*.

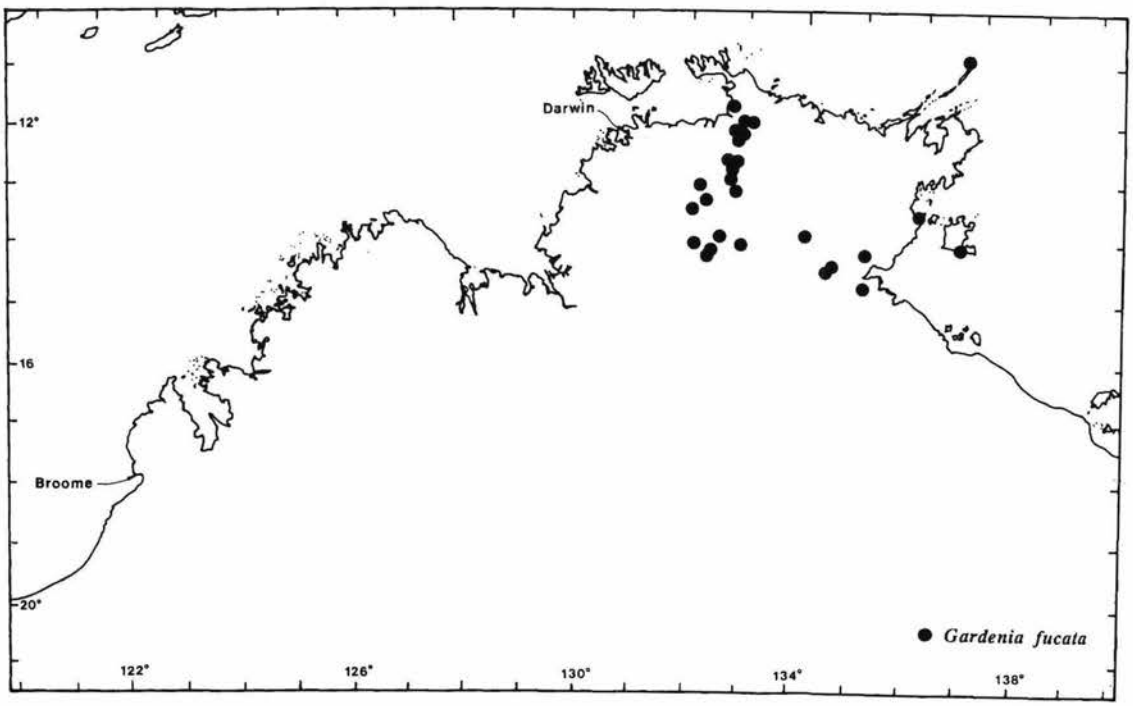

Figure 4. Distribution of *Gardenia fucata*.

Australia. *Gardenia edulis* F. Muell. is an illegitimate name. The Australian taxon has been lectotypified to *G. vilhelmii* Domin (Puttock 1988), an endemic species in north-eastern Queensland.

Gardenia gardneri Puttock, *sp. nov.*

A *G. dacryoide* lobis calycis minoribus non decurrentibus, foliis venis multijugis differt.

Typus: E6 [Garimbu Creek] Prince Regent River Reserve, Gardner District, Western Australia, 15°28'S, 125°29'E, 19 August 1974, *K.F. Kenneally* 2080 (*holo:* PERTH 02796856).

Gardenia sp. C, C.F. Puttock *In:* J.R. Wheeler *et al.*, Flora of the Kimberley Region 913 (1992).

Gardenia megasperma sensu A.S. George & K.F. Kenneally *In:* J.F. Miles & A.A. Burbidge, A biological survey of the Prince Regent River Reserve 63 (1975).

Gardenia ?resinosa sensu A.S. George & K.F. Kenneally *In:* J.F. Miles & A.A. Burbidge, A biological survey of the Prince Regent River Reserve 63 (1975).

Small *tree* to 6 m high. *Bark* light grey mottled ochre yellow. *Leafy twigs* 5-9 mm in diameter, glabrous, not resinous. *Stipules* conical, not mammilliform, 10-16 mm long, 5-6 mm wide, minutely hairy; colleters lanceolate, 0.47-0.71 mm long, 0.1-0.2 mm wide. *Leaves* glabrous, glossy mid green, with very dense, very short hairs; petiole 15-30 mm long, 1-4 mm wide; lamina ovate to suborbicular, 65-140 mm long, 35-110 mm wide, with an obtuse base and apex; secondary veins 12 to 14 pairs, 50-60° to the midvein; hair tuft to pocket domatia large and very conspicuous. *Flowers* not known. *Ovary* with 5 placentas. *Fruit* spherical to ovoid, 20-30 mm long, 12-20 mm diameter, smooth without longitudinal ridges (not striate when dry); calyx persistent, the tube cylindrical, 5-merous, 10-12 mm long and with laterally flattened spurs 5-10 mm long, 4-5 mm wide, erect.

Additional specimens examined (4). WESTERN AUSTRALIA. GARDNER DISTRICT: Augustus Island, Bonaparte Archipelago, 15°25'S, 124°35'E, 14 May 1972, *Wilson* 10771 (PERTH); near Gariyeli Creek, 15°32'S, 125°13'E, 24 Aug. 1974, *George* 12584 (PERTH); Lushington Brook, Prince Regent River, 3 July 1950, *Gardner* 9566 (PERTH); W5 [Python Cliffs] Prince Regent River Reserve, 15°20'S, 124°56'E, 27 Aug. 1974, *Kenneally* 2165 (PERTH).

Distribution and habitat. Prince Regent River Reserve in open woodland on sandstone. (Figure 5)

Phenology. Flowers unknown. Fruiting material collected in May, July and August.

Conservation status. This species is conserved in the Prince Regent River Reserve and with its limited known distribution it is coded 2KC. Although the annotations on sheets of this species describe it as common for Prince Regent River Reserve (*Kenneally* 2165, 2080) it is currently only known from few specimens. CALM Conservation Codes for Western Australian Flora: Priority Three.

Etymology. Named after Charles A. Gardner (1896-1970), Western Australian government botanist, who made the first collection of this species.

Vernacular name. None known.

Affinities. This species is apparently related to *Gardenia dacryoides* on the basis of its large leaves and long, erect, laterally flattened calyx spurs, but has more leaf veins. The radial development of the calyx does not continue onto the fruit as it does in *G. dacryoides*.

Notes. Specimens previously determined as *Gardenia megasperma* (George & Kenneally 1975) are correctly identified as *G. gardneri*.

Gardenia jabiluka Puttock, *sp. nov.*

A *G. faucicola* foliis minoribus, tubo corollae breviore, fructibus sphaericis et in modum ramificationis differt.

Typus: north side of 'Swift' Creek, 0.7 km from crossing, 4.1 km from Oenpelli road turn-off to 'Gerringbar' Escarpment, 12°29'S, 132°50'E, Darwin and Gulf District, Northern Territory, 8 September 1979, *C.F. Puttock* UNSW 9044 & *A. Murray* (*holo:* NSW; *iso:* BRI, CANB, DNA, UNSW) (fruiting specimen).

Facultatively deciduous *tree* 3-4 m high with divaricate branching; trunk at breast height to 100 mm diameter. *Bark* to 8 mm thick, smooth, furfuraceous, glaucous dark brown; outer bark layered with reddish brown blaze; inner bark blaze orange. *Wood* very brittle, orange to yellow. *Leafy twigs* 1-2(3) mm in diameter. *Stipules* bullet-shaped, 1-3 mm long; colleters lanceolate, 0.24-0.35 mm long, *c.* 1 mm wide. *Leaves* glossy dark green above, greyish green below, glabrous or minutely scabrous, subsessile; leaf-base 1-2 mm wide; lamina elliptic, 18-22 mm long, 8-12 mm wide, with an obtuse apex and base; secondary veins 7 to 9 pairs, 50-60° to the midvein, not raised above or below; tertiary venation reticulate, opaque; domatia absent. *Flowers* 5 or 6-merous, solitary on pedicels 2-5 mm long. *Hypanthium* 2-3 mm long, pale green, ridges absent. *Calyx* crateriform; tube 1-2 mm long, chartaceous between thin coriaceous lobe-ridges; lobes linear, 3-5 mm long, not laterally flattened. *Corolla* tube cylindrical, 8-9 mm long, *c.* 2 mm diameter, fine retrose hairs outside, long hairs inside; lobes ovate, 5-6 mm long, 4-5 mm wide. *Anthers* 4-5 mm long, attached *c.* 2 mm from their apices, inserted *c.* 2 mm below the sinuses of the corolla lobes, partially included, the tips exceeding the corolla tube by *c.* 1 mm. *Style* 8-9 mm long, scarcely exceeding the corolla tube; stigmatic lobes 2 or 3, 3-4 mm long. *Ovary* with 2 or 3 placentas. *Fruit* spherical, 6-14 mm diameter, smooth (with few longitudinal striations when dry), abruptly tapering into a pedicel 3-5 mm long; calyx remnant a 1-2 mm crown with spreading to reflexed lobes, *c.* 5 mm long; exocarp pale green whilst developing, yellow green when mature; mesocarp parenchymatous, 1-2 mm thick, with few sclereid striations; endocarp bony, *c.* 1 mm thick; placental mass malleable, pink. *Seeds* 2.0-3.3 mm diameter, 1.2-1.4 mm thick; hilum occupying one third to one half of the perimeter; seed coat reddish brown; exotestal cells sinuate in outline, thickening of inner tangential and lower part of radial walls reticulate.

Additional specimen examined (1). NORTHERN TERRITORY. DARWIN & GULF DISTRICT: East Alligator River, upstream from Cahills Crossing on a rocky island, 24 Feb. 1980, *Kerle* UNSW 9184 (DNA, UNSW).

Distribution and habitat. A species endemic to the sandstone escarpment country of the East Alligator River area on the western edge of Arnhem Land, this species grows amongst rocks and boulders along ridges and exposed sites. (Figure 1)

Phenology. A single flowering specimen known from February with fully developed leaves. Flowers are mildly perfumed. Mature fruits have been collected in September.

Conservation status. *Gardenia jabiluka* is unlikely to be under threat despite its localized distribution, being well conserved on the escarpments of the Kakadu National Park. Its conservation status should be listed as 2KCt.

Etymology. The specific epithet is the Gagadu name for the outlier of the escarpment close to the type locality. It means 'mosquito dreaming'.

Vernacular name. None known.

Affinities. This species is related to *Gardenia faucicola,* from which it differs by its smaller leaves, shorter corolla tube, spherical fruits, and habit with divaricate branching and twisted appearance.

Note. The characteristic divaricate branching of this species makes it particularly brittle.

Gardenia kakaduensis Puttock, *sp. nov.*

Ab aliis speciebus megacarpis australiensibus pericarpio tenui sine calculis mesocarpicis, foliis dorsiventralibus paucinervatis, domatia deficientibus differt.

Typus: 44 km south-east of Oenpelli, 12°34'S, 133°23'E, Darwin and Gulf District, Northern Territory, 13 June 1978, *P.K. Latz* 7768 (*holo:* DNA; *iso:* NSW).

Small arborescent *shrub* 1-3 m high. *Bark* to 5 mm thick, light grey, smooth, not furfuraceous; outer and inner bark blaze cream. *Wood* white. *Leafy twigs* 4-5 mm diameter, tomentose. *Stipules* narrowly bullet-shaped, long mammilliform, 13-19 mm long, 5-6 mm wide, tomentose; colleters lanceolate, 0.4-0.6 mm long, 0.1-0.2 mm wide. *Leaves* opposite, dark to mid green above, pale yellow green below, with moderately dense short hairs (tomentose); petiole 3-6 mm long, *c.* 3 mm wide; lamina ovate to broadly ovate, 40-105 mm long, 30-75 mm wide with obtuse apex and base; secondary veins 7 to 9(11) pairs, 45-50° to the midvein, prominently raised below, yellow; intersecondary veins occasional; tertiary venation moderately percurrent, opaque; domatia absent. *Flowers* 6- to 8-merous, tomentose, solitary on pedicels 1-2 mm long. *Hypanthium* 5-6 mm long, yellow green, ridges absent. *Calyx* crateriform; tube 9-10 mm long with coriaceous lobe-ridges; lobes linear, 6-8 mm long, not laterally flattened. *Corolla* tubaeform; tube 17-18 mm long, 2-3 mm diameter at the base, 5-6 mm diameter in the upper part, with retrose indumentum outside, hairy inside; lobes elliptic, 22-24 mm long, 9-10 mm wide, partially sericeous. *Anthers* 10-11 mm long, attached 3-4 mm from their apices, inserted *c.* 2 mm below the sinuses of the corolla lobes, mostly included, the tips exceeding the corolla tube by 1-2 mm. *Style* 19-20 mm long; stigmatic lobes 3 or 4, 8-10 mm long. *Ovary* with 3 or 4 placentas. *Fruit* wide-ellipsoid to subspherical, 45-70 mm long, 35-50 mm diameter, smooth (remaining smooth when dry), tomentose, abruptly tapering into a robust pedicel, 3-8 mm long; calyx tube often persistent with several lobes to 7 mm long, erect, above a 3-5 mm long recepticular collar; exocarp pale green whilst developing, yellowish when mature; mesocarp fibrous, *c.* 2 mm thick; endocarp brittle, *c.* 1 mm thick, lacking a rhomboid stony layer; placental mass texture and colour unknown. Fully mature seeds unknown.

Additional specimens examined (15). NORTHERN TERRITORY. DARWIN & GULF DISTRICT: Top of ridge, Jabiluka Outlier, E of 'Ja Ja' campsite, Magela Creek, 12°31'S, 132°54'E, 4 Sep. 1979, *Puttock* UNSW 8523 *& Murray* (UNSW); Bulilumbu Creek, on top of Jabiluka Outlier, 27 July 1980, *Puttock* UNSW 10240 *& Waterhouse* (UNSW); *c.* 4 miles [*c.* 7 km] NNE of 'Mudginberry' homestead, 4 July 1972, *Lazarides* 7527 (CANB); ditto, 7528 (CANB); Kakadu National Park, Gulungul Creek, Radon Gorge, 4 km WSW of Mt Brockman, 12°45'S, 132°55'E, 24 Apr. 1970, *Telford* 7887 *& Wrigley* (CBG); East Alligator

Ranger Station, Kakadu National Park, 12°26'S, 132°56'E, 5 Oct. 1983, *Russell-Smith* 815 (DNA, NSW); ESE Mudginberry, 12°36'S, 132°58'E, 19 Feb. 1973, *Dunlop* 3308 (DNA); halfway up escarpment, E side of East Alligator River, *c.* 4 km up stream from Cahills crossing, 12°28'S, 132°59'E, 2 Mar. 1980, *Waterhouse* UNSW 9454 & *Burgman* (UNSW); Q316, near Table Top, *c.* 20 miles [*c.* 32 km] ESE of Mt Basedow, 13°07'S, 132°58'E, 28 Feb. 1973, *Lazarides* 7935 (BRI, CANB, DNA); N bank of East Alligator River, 4 Sep. 1968, *Byrnes* NB 917 (DNA); Magela Creek, 12°40'S, 133°03'E, 25 Feb. 1973, *Dunlop* 3368 (BRI, CANB, DNA, NSW); 10 km S of Oenpelli, 12°23'S, 133°10'E, *Munir* 5868 (AD); Deaf Adder Creek basin, 18 Aug. 1972, *Martensz* AE 282 (CANB, DNA); 2 km N of Nabarlek airstrip, 12°17'S, 133°19'E, 22 Apr. 1979, *Rankin* 2108 (BRI, CANB, DNA); headwaters of East Alligator River, 12°48'S, 133°21'E, 1 June 1984, *Wightman* 1396 (BRI, CANB, DNA, MEL, NSW); 44 km SE of Oenpelli, 12°34'S, 133°23'E, 13 June 1978, *Latz s.n.* (DNA, NSW).

Distribution and habitat. Endemic to the sandstone escarpment country at the western edge of Arnhem Land, Northern Territory, this species favours rocky crevices and steep slopes of the vine-forested gorges. (Figure 5)

Phenology. Flowering is known from a single specimen (October). This species bears large fruit from February to September and which are ripe only at the end of this period.

Conservation status. It is not currently under threat despite its local distribution. It appears to be well conserved in the Kakadu National Park (2KC).

Etymology. The specific epithet takes its name from the region and the Gagadu people of the area to which it is endemic.

Vernacular name. None known.

Affinities. Gardenia kakaduensis has no close affinities, being the only species with a large, thin-walled fruit. Two other sympatric but small-fruited species, *G. faucicola* and *G. jabiluka*, share the same type of fruit wall structure, as does the southern Cape York species, *G. vilhelmii*.

Typification and notes. Fruiting material has been chosen as the type as fruit characters are more important than flower characters in distinguishing the species. *Gardenia kakaduensis* has large leaves and flowers, morphologically convergent with *G. megasperma* and as a consequence all available specimens to date had been determined as that species. However, *G. kakaduensis* is clearly distinguished from *G. megasperma* by its thin-walled fruit and discolorous leaves with longer indumentum, fewer veins and lack of domatia.

Gardenia megasperma F. Muell., Fragm. 1:54 (1858). *Type*: Victoria River, [1856,] Victoria River District, Northern Territory, *F. Mueller s.n.* (*lecto* - here designated: MEL; *isolecto:* K; see typification).

Other literature. G. Bentham, Fl. Austral. 3:409 (1867); F. Mueller, Syst. Census Austral. Pl. 74 (1882); Second Syst. Census Austral. Pl. 125 (1889); F.M. Bailey, Bot. Bull. 1:5 (1890) (= *G. tessellaris* Puttock), The Queensland Flora 3:758 (1900) (= *G. resinosa*); A.J. Ewart & O.B. Davies, Flora of the Northern Territory 257 (1917); C.A. Gardner, Botanical notes. Kimberley region of Western Australia 92 (1923), Enum. Pl. Austral. Occ. 122 (1930); R.L. Specht *In:* R.L. Specht & C.P. Mountford, Record of the American-Australian scientific expedition to Arnhem Land 305 (1958); J. Harmer, North Australian Plants 122 (*c.* 1975); A.S. George & K.F. Kenneally *In*: J.F. Miles & A.A. Burbidge, A biological survey of the Prince

Regent River Reserve 63 (1975) (= *G. gardneri*); J.W. Green, Census of the Vascular Plants of Western Australia 97 (1981); K. Brennan, Wildflowers of Kakadu 57, fig. 93 (1986); W.R. Elliot & D.L. Jones, Encyclopedia of Australian Plants 4:333 (1986); J. Brock, Top End Native Plants 194 (1988); J.W. Wrigley & M. Fagg, Australian Native Plants, 3rd edn 489 (1988); C.F. Puttock *In:* J.R. Wheeler *et al.*, Flora of the Kimberley Region 910 (1992).

Gardenia foveolata R. Br. *herb.*

Small *tree* to 7 m high; trunk at breast height to 200 mm diameter. *Bark* to 25 mm thick, furfuraceous, light grey mottled ochre to rusty yellow; outer bark layered with pale brown blaze; inner bark blaze cream. *Wood* brittle, cream to white. *Leafy twigs* 6-9 mm in diameter, tomentose, not covered in resin. *Stipules* bullet-shaped, not mammilliform, 8-15 mm long, 6-9 mm wide, tomentose; colleters lanceolate, 0.46-1.0 mm long, 0.1-0.14 mm wide. *Leaves* opposite, coriaceous, mid to grey green above and below, with very dense short hairs, hoary to tomentose; petiole (3)10-15 mm long, 3-5 mm wide; lamina broadly elliptic to suborbiculate, 100-220 mm long, 85-180 mm wide with a cordate to obtuse base and obtuse apex; secondary veins 10 to 12(14) pairs, 40-60° to the midvein with weak intersecondary veins; tertiary venation weakly percurrent, opaque; ciliated pit domatia large and conspicuous. *Flowers* tomentose to subglabrous; pedicel 10 to 15 mm long. *Hypanthium* 12-17 mm long, ridges absent. *Calyx* 6- or 7-merous; tube cylindrical, 8-12 mm long, with coriaceous lobe-ridges; lobes poorly developed, linear, 10-30 mm long, laterally flattened, 2-3 mm wide. *Corolla* 7- or 8-merous; tube tubaeform, 15-25 mm long, *c.* 3 mm diameter at the base, *c.* 6 mm diameter in the upper part, subglabrous outside, hairy inside; lobes elliptic, 12-24 mm long, 6-12 mm wide, glabrous. *Anthers* 4-5 mm long, attached *c.* 2 mm from their apices, inserted 2-3 mm below the sinuses of the corolla lobes, partially included, the tips exceeding the corolla tube by *c.* 1 mm. *Style* 17-25 mm long, exceeding the corolla tube by several millimetres; stigmatic lobes 3 to 5 mm long. *Ovary* with 4 or 5 placentas. *Fruit* narrowly obovoid to shortly fusiform, 35-70 mm long, 25-35 mm diameter, smooth (with longitudinal reticulate striations when dry), glabrescent, gradually tapering into a robust pedicel 10-15 mm long; calyx tube often persistent with several lobes to 20 mm long, erect; exocarp pale green whilst developing, yellow when mature; mesocarp outer part with many longitudinal fibres, 3-4 mm thick; inside interlocking stones fused to endocarp, 4-5 mm thick; placental mass malleable, brown. *Seeds* 4.6-6.4 mm diameter, 1.4-1.9 mm thick; hilum occupying one third to one half of the perimeter; seed coat brown; exotestal cells sinuate in outline, thickening of inner tangential and lower part of radial walls reticulate.

Additional specimens examined (61). WESTERN AUSTRALIA. GARDNER DISTRICT: Carson Escarpment, 34 km E of new 'Theda' homestead, 14°47'S, 126°48'E, 26 July 1977, *Telford* 6153 & *Butler* (CANB, CBG, DNA, PERTH); Pseudomys Hills, Drysdale River National Park, 15°17'S, 127°12'E, 8 Aug. 1975, *Kenneally* 4075 (PERTH); upper slopes of Cockburn Range, 15°52'S, 128°06'E, 16 Mar. 1978, *Hartley* 14607 (CANB).
NORTHERN TERRITORY. VICTORIA RIVER DISTRICT: near Brownies Creek, 22 km W of Sandy Creek, Victoria Hwy, 15°42'S, 130°07'E, 17 July 1987, *Puttock* UNSW 20702 (UNSW).
DARWIN & GULF DISTRICT: 3 miles [5 km] W of Bathurst Island Mission, 11°45'S, 130°40'E, 17 Nov. 1973, *Stevenson s.n.* (DNA); Port Darwin, Mar.-June 1870, *Schultz* 556 (K); ditto, June 1870, *Schultz* 703 (K); Darwin, 12 Nov. 1914, *Hill s.n.* (MEL 611503); ditto, 1914, *Hill s.n.* (MEL 103674); Escape Cliffs, Port Darwin, without date or collector (MEL 103675); rocky ground near Darwin, without date, *Allen* 406 (NSW); Lee Point - Buffalo Creek, Darwin, 12°20'S, 130°54'E, 18 July 1987, *Puttock* UNSW 20718 (UNSW); Plot 12, Melville Island, 11°30'S, 131°00'E, 22 Nov. 1966, *Stokes* 747 & *Fox* (DNA); Stapleton, 5 Nov. 1914, *Hill s.n.* (MEL 103677); Gunn Point area, 12°10'S, 131°03'E, 9 Nov. 1978, *Rankin* 1573 (DNA); Narramoor Billabong, S of Arnhem Hwy, May 1978, *Webb* 12272 & *Tracey* (BRI); 8 miles [13 km] NW of Adelaide River township, Marrabaird, 13 Nov. 1971, *McKean* B53 (CANB, DNA); 3 miles [5 km] E of Adelaide River,

Marrabai road, 25 Nov. 1966, *Byrnes* NB111 (DNA); Marrakai track, 18 miles [29 km] from Hwy, near Adelaide River, 29 Sep. 1964, *Robinson* R908 (DNA); Whitestone Creek area, 12°30'S, 131°26'E, 18 Oct. 1975, *Rankin* 1529 (CANB, DNA, NSW); Mary River camp, June 1955, *White* MR10 (CANB); 12 km S of Hayes Creek, Stuart Hwy, 13°37'S, 131°32'E, 18 July 1987, *Puttock* UNSW 20717 (UNSW); Depot Creek, 28 Apr. 1891, *Bradshaw & Allen s.n.* (MEL 103680); 10.4 miles [16.7 km] W of Burrundie, 13°32'S, 131°33'E, 16 Mar. 1961, *Chippendale s.n.* (DNA, NSW); near Edith River, 24 June 1946, *Blake* 16079A (BRI, DNA); S of Edith River crossing, Stuart Hwy, 14°11'S, 132°02'E, 17 July 1987, *Puttock* UNSW 20708 (UNSW); 15.7 km S of Edith River, Stuart Hwy, 14°19'S, 132°06'E, 8 July 1979, *Tindale* 6023 & *Dunlop* (DNA, NSW, UNSW); W side of West Branch of West Alligator River, *c.* 14°48'S, 132°10'E, 19 July 1987, *Puttock* UNSW 20720 (UNSW); 57 miles [92 km] from Pine Creek towards UDP Falls, *c.* 13°25'S, 132°20'E, July 1973, *Gittens* 2595 (NSW); on Stuart Hwy, 14 miles [22.5 km] SE of Katherine, 18 July 1963, *Lazarides* 7002 (BRI, CANB, MEL, NSW, PERTH); track to Katherine Creek, July-Aug. 1911, *Baldwin Spencer s.n.* (MEL, NSW); Katherine Gorge National Park, 25 Nov. 1968, *Byrnes* NB 1185 (DNA); 'Munmalary', 12°19'S, 132°37'E, 15 Apr. 1973, *Latz* 3862 (BRI, DNA); S of Jim Jim Creek, Jim Jim road, 19 July 1980, *Puttock* UNSW 11137 & *Waterhouse* (UNSW); *c.* 1 mile [1.6 km] N of Nourlangie Rock, 8 Nov. 1972, *Martensz* AE 297 (DNA); vicinity of Nourlangie Rock, 13 July 1972, *Martensz A*E 135 (CANB, DNA); E side of Nourlangie Rock, 12°51'S, 132°51'E, 29 July 1980, *Puttock* UNSW 10266 & *Waterhouse* (UNSW); between Jim Jim and Jabiru, 9.5 km SW of Jim Jim rd turn-off from Hwy, 12°43'S, 132°48'E, 29 July 1980, *Puttock* UNSW 10285 & *Waterhouse* (UNSW); road to Jabiluka billabong, *c.* 2 km NW from turn off on Oenpelli road, 7 Mar. 1980, *Waterhouse* UNSW 9460 & *Burgman* (UNSW); Mt Brockman, 12°44'S, 132°54'E, 21 Feb. 1973, *Dunlop* 3321 (BRI, CANB, DNA, NSW); 5 miles [8 km] E of Nourlangie Rock, 9 Nov. 1972, *Martensz* AE 300 (CANB, DNA); 3.1 km E along track over Jabiluka Hill from Oenpelli road, NE of Ja Ja, 12°30'S, 132°55'E, 24 July 1980, *Puttock* UNSW 10189 & *Waterhouse* (UNSW); 'Ant Hill drive', *c.* 0.5 km E of Oenpelli road, 7.5 km N of Ja Ja, 20 Feb. 1980, *Waterhouse* UNSW 9160 (UNSW); between 'Swift' Creek and 'Gerringbah' Escarpment, *c.* 7.1 km SE of Oenpelli road, 17 *Dec.* 1980, *Waterhouse* UNSW 10987 (UNSW); Granite Hill, near Ja Ja, 6 Feb. 1979, *Waterhouse* UNSW 7946 (UNSW); Oenpelli, 12°18'S, 133°04'E, 23 Oct. 1948, *Specht* 1255 (BRI, CANB, MEL, NSW, PERTH); 39 miles [62.5 km] E of Beswick, 14°40'S 133°10'E, 14 June 1972, *Maconochie* 1422 (DNA, NSW); 16 miles [25.7 km] SE of Oenpelli, 12°29'S, 133°12'E, 7 July 1972, *Adams* 2751 (CANB); Mt Sir James *c.* 9 km N of Roper Hwy on road to 'Moroak', 14°50'S 133°38'E, 18 Nov. 1982, *Puttock* UNSW 14461 & *St George* (UNSW); Weimoor Spring, 13°02'S, 134°00'E, 9 Aug. 1962, *Cole* 131 & *Provan* (BRI); ditto, 12 Aug. 1962, *Cole* 153 & *Provan* (BRI); 2.5 km W of Sherwin Creek, Harts Range, 14°42'S, 134°17'E, 21 July 1987, *Puttock* UNSW 20725 (UNSW); ditto, *Puttock* UNSW 20726 (UNSW); 6.0 km W of Roper Bar Crossing on Roper Valley Hwy, 14°42'S, 134°27'E, 18 Nov. 1982, *Puttock* UNSW 14455 & *St George* (UNSW); North Australia, 1886, *Tenison-Woods & Holtze s.n.* (MEL 103670).

Distribution and habitat. This species grows in savannah woodland on sandy plains and on sandstone scree slopes. In the Kimberley region of Western Australia it is locally common along the Carson Escarpment in Drysdale River National Park. It is also found between Kununurra and the Victoria River and is common in the sandy soils above the floodplains of Kakadu National Park, Northern Territory. The Daly River area to the south-west of Darwin has been poorly collected for any species of *Gardenia* and it is anticipated from this region also. (Figure 6)

Phenology. Flowering occurs in late October and November and with aseasonal records in July. Early in the flowering season the trees are virtually leafless. The flowers are mildly perfumed somewhat like pawpaw (*Carica papaya* L.). Fruits have been recorded on plants almost all year and are edible when mature (*fide* Brock 1988).

Conservation status. A widespread and common species in the open woodlands throughout the region.

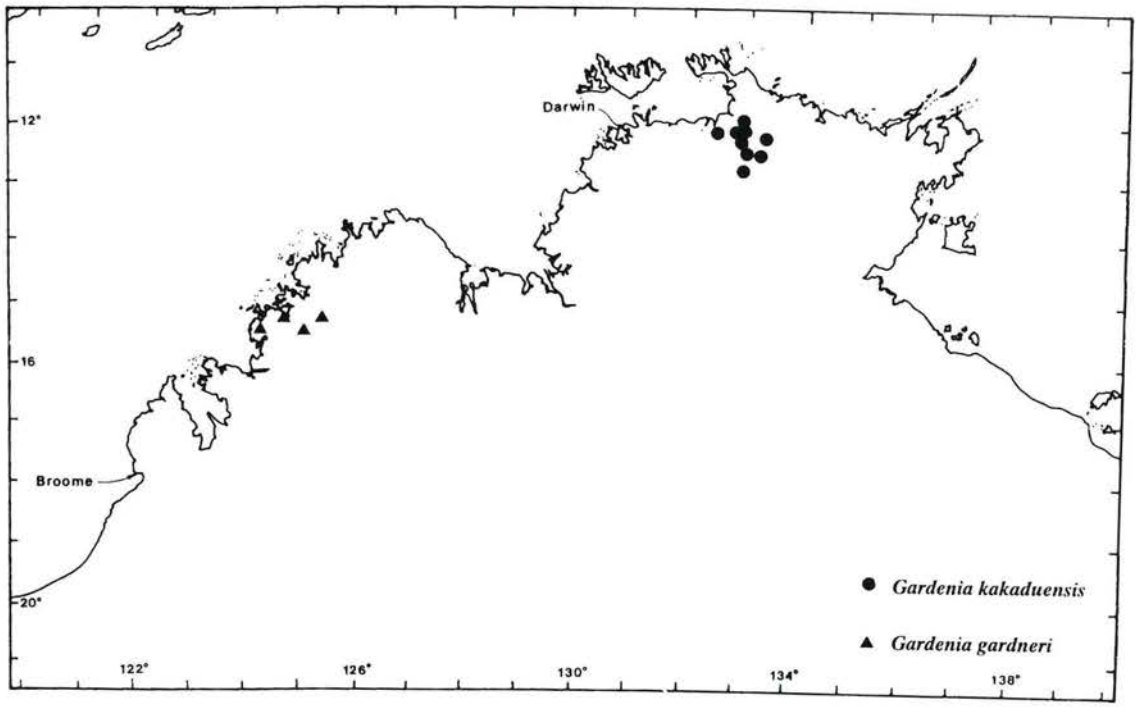

Figure 5. Distribution of *Gardenia gardneri* and *G. kakaduensis*.

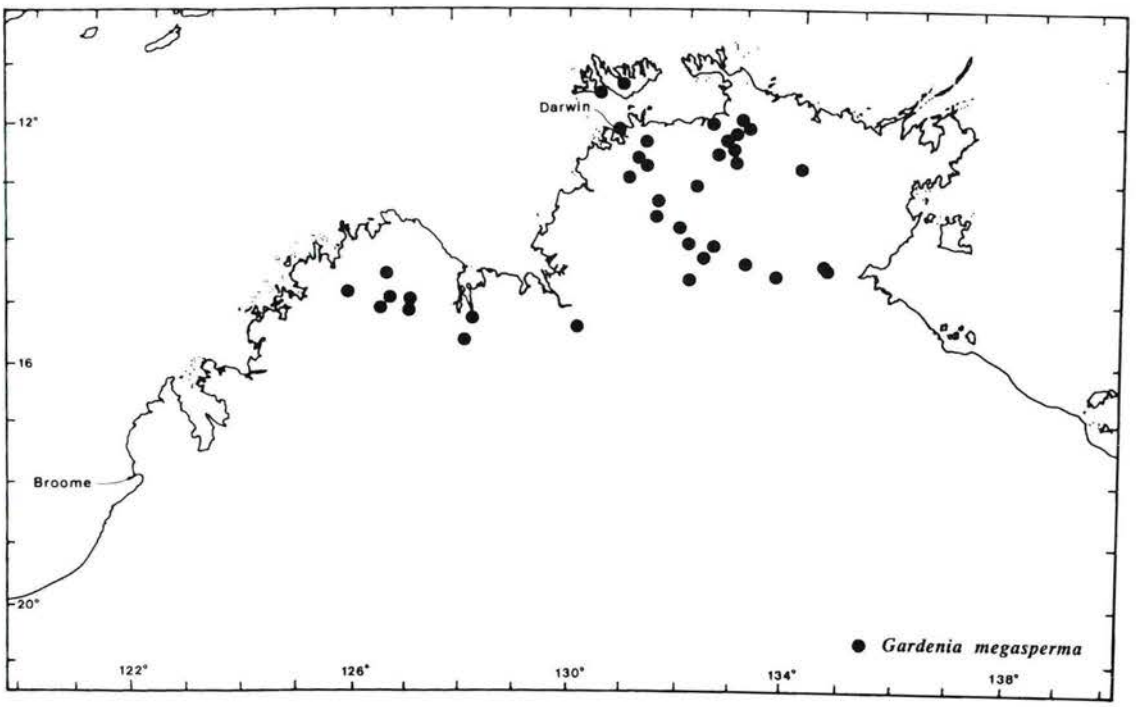

Figure 6. Distribution of *Gardenia megasperma*.

Etymology. The epithet '*megasperma*' refers to the comparatively large seeds (or fruits) of this species,

Vernacular name. None known.

Affinities. Gardenia megasperma is closely related to *G. schwarzii* and *G. resinosa* but it differs from the former by the short petioles, velvety indumentum, and glabrescent elongated fruits, and from the latter by its large suborbicular leaves and the absence of resin-covered branchlets.

Typification and notes. No Gregory Expedition collections, annotated *Gardenia megasperma* with the protologue's type locality "in rocky places near the Victoria River", have been located. It is likely that Mueller confused the material and collecting localities of *G. megasperma* and *G. resinosa*, which he described at the same time. The two species are sympatric, although it is *G. megasperma* that is more commonly found on sandy plains than in rocky places. In the absence of a specimen with the precise locality given by Mueller (1858), a specimen at MEL is selected as lectotype from the available (probably all) syntype material.

Gardenia megasperma is usually completely leafless when flower buds form. As the flowers open the young leaves begin to emerge from the stipules. The leaves take several months to expand and mature to the suborbicular shape typical for this species. Later leaves, presumably initiated during the early dry season, do not attain the size of the leaves initiated during the wet season. The circumscription (Mueller 1858) appears to describe mature leaves of a fruiting specimen and the accompanying protologue describes the young leaves of a flowering specimen.

Although the species does occur in Western Australia, all Western Australian specimens cited by Gardner (1923) as *Gardenia megasperma* are now determined to other taxa, including *G. resinosa, G. schwarzii* and *G. pyriformis*.

Gardenia pyriformis A. Cunn. ex Benth., Fl. Austral. 3:409 (1867). *Type*: York Sound, Gardner District, Western Australia, *A. Cunningham* (*lecto* - here designated: BM).

Other literature. F. Mueller, Syst. Census Austral. Pl. 74 (1882), Second Syst. Census Austral. Pl. 125 (1889); A.J. Ewart & O.B. Davies, Flora of the Northern Territory 257 (1917); C.A. Gardner, Enum. Pl. Austral. Occ. 122 (1930); J.W. Green, Census of the Vascular Plants of Western Australia 97 (1981); W.R. Elliot & D.L. Jones, Encyclopaedia of Australian Plants 4:334 (1986); S.J. Forbes & K.F. Kenneally, W. Austral. Naturalist 16:160 (1987); C.F. Puttock *In:* J.R. Wheeler *et al.*, Flora of the Kimberley Region 910 (1992).

Gardenia edulis pro parte. F. Mueller, Syst. Census Austral. Pl. 74 (1882), Second Syst. Census Austral. Pl. 125 (1889); A.J. Ewart & O.B. Davies, Flora of the Northern Territory 257 (1917); W.V. Fitzgerald, J. & Proc. Roy. Soc. Western Australia 3:109 (1918); C.A. Gardner, Enum. Pl. Austral. Occ. 122 (1930); J.W. Green, Census of the Vascular Plants of Western Australia 97 (1981).

Facultatively deciduous shrub or small *tree*, to 5 m tall; trunk at breast height to 130 mm diameter; branches spreading. *Bark* to 10 mm thick, smooth, furfuraceous, light grey mottled ochre yellow; outer bark layered with tan blaze; inner bark blaze tan. *Wood* brittle, yellow to cream. *Leafy twigs* 1-2(3) mm diameter. *Stipules* bullet-shaped, 3-8 mm long; colleters lanceolate, 0.3-0.5 mm long, *c.* 0.1 mm wide. *Leaves* opposite, thinly coriaceous, with dense very short hairs, finely sericeous to subglabrous; petioles 2-8 mm long, 1-2 mm wide; lamina narrowly obovate to obovate, 18-64 mm long, 7-37 mm wide, with an obtuse apex and obtuse to decurrent base; secondary veins 7 to 13 pairs; ciliated pocket domatia

small, usually conspicuous. *Flowers* sericeous to subglabrous on pedicels 2-8 mm long. *Hypanthium* 2-4 mm long with shallow ridges, sometimes absent. *Calyx* 5- or 6-merous; tube cylindrical to turbinate, 2-10 mm long, chartaceous occasionally only splitting along 1 or 2 lines between the thinly coriaceous lobe-ridges; lobes linear, 2-11 mm long, laterally flattened, *c.* 1 mm wide. *Corolla* 6- to 8-merous; tube tubaeform, 10-18 mm long, 2-3 mm diameter at the base, 4-5 mm diameter in the upper part, sericeous outside, hairy inside; lobes ovate, 6-10 mm long, 5-10 mm wide, sericeous to subglabrous. *Anthers* 4-7 mm long, attached 3-4 mm from their apices, inserted 3-5 mm below the sinuses of the corolla lobes, mostly included, the tips exceeding the corolla tube by *c.* 1 mm. *Style* 10-22 mm long, scarcely exceeding the corolla tube; stigmatic lobes 3 to 5, 5-8 mm long. *Ovary* with (?3)4 or 5 placentas. *Fruit* spherical to ovoid, 10-30 mm long, 13-25 mm wide, smooth (smooth or striate when dry), tapering or not tapering into the pedicel; pedicel slender 2-12 mm long; calyx remnant a cylindrical to turbinate tube with several lobes, 4-11 mm long, erect or rotate; exocarp pale green whilst developing, yellow when mature; mesocarp parenchymatous with few sclereid striations; endocarp bony, compact, 2-3 mm thick, placental mass malleable, pink. *Seeds* 3.6-4.5 mm diameter, 1.3-1.7 mm thick; hilum occupying one third to one half of the perimeter of seed; seed-coat reddish brown; exotestal cells sinuate in outline, thickening of inner tangential and lower part of radial walls reticulate.

Phenology. Flowering recorded from December, March and July. Flowers are mildly perfumed. Fruit present for most of the year.

Etymology. Pyriformis (pear-shaped) is more characteristic of dried immature fruits (*i.e.*, those of the type collection); mature fruits are usually ovoid.

Vernacular name. Dalwarr or Dulwurr (Bardi name).

Affinities. This species is closely related to *Gardenia fucicola* from which it differs by its finely tomentose leaves, and more distantly to *G. fucata* which differs by its narrowly oblong to narrowly elliptic leaves and larger fruits.

Notes. A highly variable species including at least two subspecies. The leaves of subsp. *pyriformis* from the Bungle Bungle Ranges and adjacent Northern Territory have a sericeous indumentum and are at the lower end of the size range. The leaves tend to become progressively larger to the north-west (*i.e.* Mitchell Plateau and York Sound). Subspecies *pyriformis* has slender pedicels that do not taper into the fruit. Subspecies *keartlandii* from the Dampier Peninsula west to Legrange Bay has larger flowers than subsp. *pyriformis*, and the fruit and leaves are similar to those of *G. resinosa* subsp. *kimberleyensis.*

Gardenia pyriformis subsp. **pyriformis**

Literature. C.F. Puttock *In:* J.R. Wheeler *et al.,* Flora of the Kimberley Region 911, fig. 281A (1992).

Gardenia ?resinosa A.S. George & K.F. Kenneally *In:* J.F. Miles & A.A. Burbidge, A biological survey of the Prince Regent River Reserve 63 (1975) *pro parte* (ASG 12805).

Small *tree. Leafy twigs* 1-2 mm in diameter. *Stipules* 3-8 mm long. *Leaves* dull dark green to mid green, sericeous to minutely hairy; lamina narrowly obovate to obovate, 18-64 mm long, 7-37 mm wide; secondary veins (9)10 to 13 pairs. *Hypanthium* ridges absent. *Calyx* tube cylindrical to turbinate, 2-10 mm long, chartaceous, usually only splitting along 1 or 2 lines between thin coriaceous lobe-ridges; lobes linear, 2-11 mm long. *Corolla* tube 10-14 mm long, sericeous; lobes ovate, 6-10 mm long, 5-10 mm wide. *Anthers* 5-6 mm long. *Style* 10-15 mm long. *Fruit* ovoid, 15-22(27) mm long, 13-16(20) mm wide,

smooth (remaining smooth when dry), not tapering into the pedicel; pedicel slender 5-12 mm long; calyx remnant cylindrical to turbinate with several lobes 5-11 mm long, erect. (Puttock 1992: Figure 281A).

Additional specimens examined (32). WESTERN AUSTRALIA. GARDNER DISTRICT: summit of Mt Trafalgar, Prince Regent River, 15°17'S, 125°04'E, 29 Aug. 1974, *George* 12805 (PERTH); Boongaree Island, Prince Fredrick Harbour, 15°04'S, 125°10'E, 4 July 1973, *Wilson* 11339 (PERTH); Katers Island, 9 June 1972, *Marchant s.n.* (PERTH); unnamed tributary of Mitchell River, 14°45'S, 125°38'E, 8 Dec. 1982, *Kenneally* 8680 (PERTH); Mitchell Falls, 14°49'S, 125°40'E, 17 June 1976, *Kenneally* 5012 (PERTH); Mitchell River Falls, 14°49'S, 125°41'E, 22 Jan. 1952, *Kenneally* 7898 (PERTH); Mitchell Falls track, 14°48'S ,125°43'E, 31 May 1988, *Wilson* 314 & *Jacobs* (NSW); Surveyor Falls near Mitchell River, *c.* 14°41'S, 125°44'E, 18 June 1975, *George* 13128 (PERTH); above falls, gorge of Crystal Creek, near tidal limit, W of Crystal Head, 14°29'S, 125°47'E, *Puttock* UNSW 20668 (UNSW); Port Warrender, 14°33'S, 125°55'E, 20 Aug. 1979, *Done* 58 (DNA); Port Warrender, eastern side of 'Mindjau Ck', 14°42'S, 125°56'E, 16 Jan. 1982, *Maslin* 5097 (PERTH); Euro Gorge, Drysdale River National Park, 15°03'S, 126°44'E, 17 Aug. 1975, *Kenneally* 4397 (PERTH); 3 miles [5 km] NNW of Kalumburu Mission, 4 Sep. 1954, *Speck* 4914 (BRI, CANB); Kalumburu Mission, 30 May 1971, *Maconochie* 1254 (DNA); Planigale Creek, Drysdale River National Park, 14°43'S, 126°54'E, 19 Aug. 1975, *Kenneally* 4457 (PERTH); Forest Creek, near Drysdale River, *c.* 14°39'S 126°57'E, 21 Aug. 1975, *George* 14122 (PERTH); Solea Fall, Drysdale River National Park, *c.* 14°40'S, 127°00'E, 5 Aug. 1975, *George* 13425 (PERTH); Dillen Springs, Oct. *1906*, *Fitzgerald s.n.* (PERTH 1653); Gibb River road, 15°57'S, 127°13'E, 14 July 1987, *Puttock* UNSW 20686 (UNSW); southern slopes of the Weaber Range, 15°20'S, 128°48'E, 11 Mar. 1978, *Hartley* 14461 (CANB, PERTH); Point Spring, base of Weaber Range, 15°24'S, 128°53'E, 22 Mar. 1978, *Hartley* 14737 (CANB, PERTH); Point Spring, 29 miles [41.7 km] E of 'Carlton', 15°24'S, 128°53'E, 29 July 1949, *Lazarides* 2653 & *Perry* (AD, BRI, CANB, MEL, NSW).
HALL DISTRICT: between Njitparriya and Dilmariyu, 3 km SE of Bungle Bungle Outcamp, 17°21'30"S, 128°21'30"E, 8 July 1984, *Forbes 2572* (PERTH); in gorge in Bungle Bungle Range, 3 km SE of Bungle Bungle Outcamp, 17°22'S, 128°2'E, 8 July 1984, *Kenneally* 9255 (PERTH); Piccaninny Creek Gorge, 15 km SE of Bungle Bungle Outcamp, Bungle Bungle Range, 17°27'S, 128°25'E, 6 Apr. 1985, *Blackwell* BB352 (PERTH); Piccaninny Creek Gorge in Bungle Bungle Massif, 15 km SE of Bungle Bungle Outcamp, 17°27'S, 128°25'E, 12 July 1984, *Kenneally* 9296 (PERTH).
NORTHERN TERRITORY. VICTORIA RIVER DISTRICT: Keep River National Park, 15°46'S, 129°06'E, 24 Feb. 1981, *Dunlop* 5758 (DNA, UNSW); Victoria Hwy, 10 km E of Keep River, 15°58'S, 129°30'E, 5 July 1974, *Benson* 943 (NSW); Victoria Hwy, 30 km E of 'Newey', 15°59'S, 129°31'E, 5 July 1974, *Waterhouse* UNSW 4189 (UNSW); Pinkerton Range, 19 Mar. 1971, *Dunlop* 2133 & *Byrnes* (DNA); Jasper Gorge, 16°02'S, 130°42'E, 4 May 1969, *Byrnes* NB 1583 (DNA); Jasper Gorge, 13 July 1977, *Parker* 1063 (CANB, DNA); 29 miles WSW of 'Victoria River Downs', 18 June 1949, *Perry* 2169 & *Lazarides* (AD, CANB).

Distribution and habitat. Growing on sandstone cliffs and scree slopes, a common species in gorges from Prince Regent River to Drysdale River and from the Weaber, Deception and Bungle Bungle Ranges in the eastern Kimberley, Western Australia and adjacent Victoria River District (e.g. Jasper Gorge and Keep River), Northern Territory. (Figure 7)

Conservation status. It is not currently under threat, being well conserved in the National Parks.

Gardenia pyriformis subsp. **keartlandii** (Tate) Puttock, *comb. et stat. nov.*

Gardenia keartlandii Tate, Trans. & Proc. Rep. Roy. Soc. South Australia 21:70 (1897). *Type*: Fitzroy River [near junction with Margaret Creek], Calvert Exploring Expedition, Dampier District, Western Australia, January 1897, *G.A. Keartland s.n.* (*holo*: AD).

Other literature. C.A. Gardner, Enum. Pl. Austral. Occ. 122 (1930); J.W. Green, Census of the Vascular Plants of Western Australia 97 (1981).

Gardenia pantoni F. Mueller, Trans. & Proc. Roy. Soc. Austral. (Vict. Branch) 3-4:80 (1887) *nomen*; J.G.O. Tepper, Trans. & Proc. Rep. Roy. Soc. South Australia 17:18 (1893) *nomen*.

Gardenia pantonii F. Muell. *ex* W.V. Fitzgerald, J. & Proc. Roy. Soc. Western Australia 3:109 (1918); C.A. Gardner, Botanical notes. Kimberley Region of Western Australia 92 (1923), Enum. Pl. Austral. Occ. 122 (1930). *Type*: Roebuck Bay, Dampier District, Western Australia, October 1889, *J.W.O. Tepper* 48 (*lecto* - here chosen: MEL).

Gardenia sp. J. Jessop (ed.), Flora of Central Australia 284 (1981).

Gardenia pyriformis subsp. A, C.F. Puttock *In:* J.R. Wheeler *et al.*, Flora of the Kimberley Region 911 (1992).

Low shrub to small *tree*. *Leafy twigs* 2-3 mm in diameter. *Stipules* 3-8 mm long. *Leaves* mid green, minutely hairy to subglabrous; lamina 32-58 mm long, 11-24 mm wide; secondary veins 7 to 9(10) pairs. *Hypanthium* with shallow ridges. *Calyx* tube cylindrical, 4-8 mm long; lobes 4-10 mm long. *Corolla* tube 15-22 mm long; lobes ovate, 7-10 mm long, 5-7 mm wide, subglabrous. *Anthers* 6-7 mm long. *Style* 16-21 mm long. *Fruit* ovoid, 22-30 mm long, 13-16(20) mm diameter, smooth (becoming striate when dry), abruptly tapering into a slender pedicel, 5-10 mm long; calyx cylindrical with lobes 5-11 mm long, rotate.

Additional specimens examined (34). WESTERN AUSTRALIA. GARDNER DISTRICT: Kunmunya, near Carden Sound, 15°03'S, 128°07'E, 13 Aug. 1967, *Gardner* 22238 (PERTH).
DAMPIER DISTRICT: 50 miles [80 km] NE of 'Callawa', 27 Apr. 1964, *Beard* 3261 (PERTH); 'Nalgi', 80 Mile Beach, 3 July 1941, *Burbridge* 1330 (PERTH); 11 km W of Great Northern Hwy, on track to False Cape Bossut, 18°03'S, 121°05'E, 7 July 1987, *Puttock* UNSW 20615 (UNSW); ditto, *Puttock* UNSW 20616 (UNSW); between Radi Hills and 'Wallal Downs', 9 May 1965, *Beard* 4057 (PERTH); Mt Phire, *c.* 50 miles [*c.* 80 km] E of Anna Plains, Aug. 1963, *Butler s.n.* (PERTH); 18°44'S, 121°44'E, 1879, *Forrest & Carey s.n.* (MEL 103686); Legrange Bay, 1879, *Forest & Carey s.n.* (MEL 103673); Legrange Bay, 1884, *Panton s.n.* (MEL 103671); Roebuck Bay, Oct. 1889, *Tepper* 48 (MEL); Gantheaume Point, Broome, 17°59'S, 122°11'E, 24 Sep. 1959, *Lazarides* 6575 (BRI, NSW, MEL, PERTH); Broome, New Jetty area, 7 Aug. 1965, *Beauglehole* ACB11244 (PERTH); Broome, Apr. 1905, *Fitzgeralds.n.* (PERTH 133); Broome, Nov. 1922, *Owen s.n.* (PERTH 652); Broome, Jan. 1933, *Wise s.n.* (PERTH); Broome, 3 May 1944, *Gardner* 7037 (PERTH); ditto, *Gardner* 7038 (PERTH); Broome, June 1968, *Kerr* 8281, *Webb & Tracey* (CANB); Wonganut Spring Creek, 19 km ESE of Coulomb Point, Dampier Peninsula, 17°25'S 122°20'E, 18 June 1984, *Forbes* 2371 (MEL, NSW); Wonganut Spring Creek, 18 June 1984, *Kenneally* 9048 (PERTH); 24 km due E of James Price Point, 17°29'30"S, 122°22'30"E, 18 June 1984, *Forbes* 2358 (MEL, NSW); 24 km E of James Price Point, 17°30'S 122°23'E, 18 June 1984, *Kenneally* 9037 (PERTH); 61.6 km N of Broome on Cape Leveque road, 17°29'S 122°26'E, 20 June 1981, *Kenneally* 7615 (PERTH); 49 miles [79 km] E of Broome, 28 May 1967, *Scrymgeour* 1913 (PERTH); 7 km SW of Martins Well, Dampierland, 16°36'S, 122°47'E, 26 Apr. 1977, *Kenneally* 6209 (PERTH); Balk Bore at head of Pender Bay, Dampier Peninsula, 16°49'S, 122°52'E, *Bessarab* 6 (PERTH); 50 miles [80 km] E of Broome, 17°50'S, 123°00'E, 24 May 1967, *Byrnes* 366 (DNA); Juwon, N side of Curlew Bay, Dampier Peninsula, 16°24'S, 123°01'E, 25 Apr. 1985, *Smith* 85.29 (PERTH); (Site D2) Red Dune near Edgar Range, 18°55'S, 123°15'E, 11 Aug. 1976, *Kenneally* 5881 (PERTH); R2, Edgar Range site, SE of Broome, 18°49'S, 123°17'E, 7 Aug. 1976, *Kenneally* 5522 (PERTH); (Site D1) Red Dune near Edgar Range, 18°53'S, 123°43'E, 12 Aug. 1976, *Kenneally* 5602 (PERTH); Goody

Goody, Apr. 1905, *Fitzgerald s.n.* (PERTH 305); Fitzroy River, 18°04'S, 123°53'E, 1883, *Forrest s.n.* (MEL 103679); 5 km W of turnoff to Jacks Hole on Gibb River road, 15°48'S, 127°39'E, 5 June 1979, *Petheram* 378 (DNA).
CANNING DISTRICT: McLarty Hills, Great Sandy Desert, *c.* 19°31'S, 123°30'E, 5 Aug. 1977, *George* 14658 (PERTH).

Distribution and habitat. Grows on red sandy soils (pindan) in Dampier District and extends to the south-east into the McLarty Hills of Canning District. (Figure 7)

Phenology. Flowering May to September (but the subspecies has not been collected during the wet season). Flowers are mildly perfumed. Fruits present for most of the dry season.

Conservation status. Widespread and not currently under threat.

Etymology. Named after George A. Keartland, the ornithologist on the Calvert Exploring Expedition from Cue to the Kimberley in 1896-97.

Vernacular names. Dulwurr, Urdar, Lida (from herbarium sheet annotations).

Typification and notes. Only a single specimen of the type material of *Gardenia keartlandii* from the Calvert Exploring Expedition is known and it is therefore assumed to be the holotype. Specimens listed by Fitzgerald (1918:109) as *G. edulis* F. Muell. from Ord, Denham, and King Rivers and Dillen Springs belong here.

The name *Gardenia pantoni* appeared as a *nomen nudum* in Mueller (1887). Tepper (1893) listed the name amongst the species collected by his son, J.W.O. Tepper, from the "neighbourhood of Roebuck Bay" (1889-1891). These specimens and many others from the vicinity of Broome, at MEL and PERTH, were determined as *G. pantoni* by Mueller. Fitzgerald (1918) annotated his checklist with short diagnoses and in doing so he (probably unwittingly) provided a diagnosis with syntypes from Roebuck Bay (J.W.O. Tepper) and Broome (W.V. Fitzgerald) that satisfy formal ICBN publication requirements for the taxon. Tepper's collection is chosen as the lectotype of the name.

Gardenia pyriformis subsp. *keartlandii* may be a distinct species but further field investigations are needed to establish this.

Gardenia pyriformis subsp. **orientalis** Puttock *subsp. nov.*

A subsp. *pyriformi* venis plus numerosis, pedicellis brevioribus, lobis calycis erectis differt.

Typus: 300 m below waterfalls, Lawn Hill Gorge, 17 km west of Adel's Grove, Burke District, Queensland, 18°43'S 138°29'E, 23 November 1982, *C.F. Puttock* UNSW 14477 *& S. St George* (UNSW).

Gardenia pyriformis sensu K.A.W. Williams, Native Plants of Queensland 3:138 (1987).

Small *tree*. *Leafy twigs* 1-2 mm in diameter. *Stipules* 3-5 mm long. *Leaves* mid green, minutely hairy; lamina 20-35 mm long, 8-18 mm wide; secondary veins 7 to 9(10) pairs. *Hypanthium* with shallow ridges. *Calyx* tube cylindrical, 4-8 mm long; lobes 4-10 mm long. *Corolla* tube 12-18 mm long; lobes ovate,

5-8 mm long, 4-7 mm wide, subglabrous. *Anthers* 4-5 mm long. *Style* 12-18 mm long. *Fruit* spherical, 10-16 mm diameter, smooth (becoming striate when dry), abruptly tapering into a pedicel slender 2-5 mm long; calyx cylindrical with lobes 4-5 mm long, linear, erect.

Additional specimens examined (13). NORTHERN TERRITORY. BARKLY TABLELAND DISTRICT: 30 miles [50 km] S of 'McArthur River', 24 July 1948, *Perry* 1698 (BRI, CANB); Sandstone ridges of the Glyde River area, *c.* 304 km ENE of Newcastle Waters, *c.* 16°30'S, 136°01'E, 4 Sep. 1971, *Gill s.n.* (BRI, DNA); McArthur River area, 16°16'S, 136°04'E, 12 Feb. 1976, *Craven* 3890 (CANB); Caranbirini Creek, 16°17'S, 136°04'E, 4 June 1971, *Latz* 1437 (BRI, DNA, PERTH); Sandstone hills, Settlement Creek, Nov. 1923, *Brass* 383 (BRI, CANB);
QUEENSLAND. BURKE DISTRICT: Hells Gate area, S of Westmoreland, 17°02'S, 138°02'E, 24 July 1987, *Puttock* UNSW 20745 (UNSW); 16.0 km SE of 'Westmoreland' turnoff on Burketown - Wollogorang road, Dilldoll Rock, 17°27'S, 138°20'E, 12 Nov. 1982, *Puttock* UNSW 14408 & *St George* (UNSW); Hells Gate, between Doomagee and 'Westmoreland', 17°28'S, 138°22'E, 9 May 1974, *Pullen* 9172 (CANB); 2 km NW of 'Cliffdale' turnoff on Burketown - Wollogorang road, 17°32'S, 138°24'E, 12 Nov. 1982, *Puttock* UNSW 14403 & *St George* (UNSW); ditto, *Puttock* UNSW 14404 & *St George* (UNSW); 300 m below waterfalls, Lawn Hill Gorge, 17 km W of Adel's Grove, 18°43'S, 138°29'E, 23 Nov. 1982, *Puttock* UNSW 14477 & *St George* (UNSW); Lawn Hill Creek Gorge, 17 km W of Adel's Grove, 18°43'S, 138°29'E, 23 Nov. 1982, *Puttock* UNSW 14482 & *St George* (UNSW); rocky cliffs and banks, Adel's Grove via Camooweal, 17 Feb. 1948, *de Lestory* 403 (BRI).

Distribution and habitat. This taxon grows on sandstone outcropping in the Lawn Hill area of western Queensland and westwards to the Walls of China at the eastern edge of the Barkly Tableland, Northern Territory. (Figure 7)

Phenology. Flowering is known from September to November. Flowers are mildly perfumed. Fruits are present for most of the dry season.

Conservation status. Widespread in arid country and not under threat.

Etymology. Named *'orientalis'* on account that it is the most eastern subspecies.

Vernacular names. None known.

Note. Subspecies *orientalis* differs from subsp. *pyriformis* by the length of the pedicel, the erect calyx spurs and slightly smaller flowers and differing flowering time. It is separated from the other subspecies by a 600 km disjunction.

Gardenia resinosa F. Muell., Fragm. 1:54 (1858). *Type*: banks of the Victoria River, Victoria River District, Northern Territory, December 1855, *F. Mueller s.n.* (*lecto* - here designated: MEL 598354).

Other literature. G. Bentham, Fl. Austral. 3:408 (1867); F. Mueller, Syst. Census Austral. Pl. 74 (1882), J. & Proc. Roy. Soc. New South Wales 14: 90 (1880), Second Syst. Census Austral. Pl. 125 (1889); A.J. Ewart & O.B. Davies, Flora of the Northern Territory 257 (1917); W.V. Fitzgerald, J. & Proc. Roy. Soc. Western Australia 3:109 (1918) [Dillen Springs = *G. pyriformis*]; C.A. Gardner, Enum. Pl. Austral. Occ. 122 (1930); R.L. Specht, Records of the American-Australian expedition to the Arnhem Land 305 (1958); J.W. Green, Census of the Vascular Plants of Western Australia 97 (1981); W.R. Elliot & D.L. Jones, Encyclopedia of Australian Plants 4:334 (1986); C.R. Dunlop, Checklist of Vascular Plants of the Northern

Territory 72 (1987); M. Lazarides *et al.*, Checklist of the Flora of Kakadu National Park and Environs 23 (1988); C.F. Puttock *In:* J.R. Wheeler *et al.*, Flora of the Kimberley Region 912 (1992).

Facultative deciduous small *tree* to 7 m high, trunk at breast height to 250 mm diameter. *Bark* to 20 mm thick, furfuraceous, glaucous dark brown to pink; outer bark layered, the blaze reddish orange; inner bark blaze tan. *Wood* brittle, cream. *Leafy twigs* 1-3 mm in diameter, with scattered short hairs, subglabrous, resinous or not (in subsp. *kimberleyensis*). *Stipules* conical to bullet-shaped, mammilliform or not, 3-17 mm long, 1-3 mm in diameter, minutely hairy; colleters lanceolate, 0.37-0.42 mm long, 0.09-0.13 mm wide. *Leaves* glossy, resinous or not, mid green above, slightly paler below to concolorous, minutely hairy on veins; petiole 4-22(30) mm long, 1-3 mm; lamina ovate to oblanceolate, 30-80(90) mm long, 12-50(70) mm wide with a cordate to decurrent base and acute to obtuse apex; secondary veins 7 to 11 pairs, 45-65° to the midvein; tertiary venation weakly percurrent, opaque; domatia small to large and conspicuous. *Flowers* glabrous; pedicel to 10 mm long. *Hypanthium* 5 mm long, without longitudinal ridges. *Calyx* tube crateriform, with or without ribs and chartaceous, 2-10 mm long, splitting along 1 or 2 lines or bearing several-6(7) lobes, unequal and weakly developed, to 12 mm long, laterally flattened *c.* 1 mm wide. *Corolla* tubaeform; tube 15-22 mm long, 3 mm diameter at the base, 6-7 mm diameter in the upper part, hairy inside; lobes ovate, 12-20 mm long, 8-12 mm wide. *Anthers* 10-13 mm long, attached 5-7 mm from their apices, inserted 3-4 mm below the sinuses of the corolla lobes, partially included, the tips exceeding the corolla tube by several millimetres. *Style* 18-25 mm long, exceeding the corolla tube by several millimetres. *Ovary* with 4 or 5 placentas. *Fruit* subspherical to ovoid, 30-50 mm long, 20-35 mm in diameter, rugulose when mature, gradually tapering into a robust pedicel 10-35 mm long; calyx persistent in more robust specimens, spreading; exocarp green whilst developing, brown when mature; mesocarp parenchymatous, 3-4 mm thick with many longitudinal fibres over interlocking stony layer fused to thin endocarp, 4-5 mm thick; placental mass malleable, brown. *Seeds* 4.5-6.0 mm diameter, 1.4-1.8 mm thick; hilum occupying one third to one half of the perimeter; seed coat brown. Embryo length *c.* 2.8 mm, blade width *c.* 2.4 mm.

Etymology. Presumably named '*resinosa*' for the viscous resin that covers the buds and expanding leaves of this and many other species in the genus.

Typification. Although the protologue describes the collecting locality for the species as "*In collibus petraeis terrae Arnhemicae*", the specimens collected by Mueller on the Gregory Expedition (late December 1855) are annotated "Banks of the Victoria River", "Sea Range" and "Rocky plains, Victoria River". Only the first of these was retained by Mueller and it (MEL 598354) is here designated as the lectotype. This specimen is now in fragments. All pieces of the specimen are considered part of the lectotype with the exception of a 4-leaved piece mounted on the left just above the middle of the sheet. This is excluded as it appears to be from another and separate collection. Two syntype sheets, "Sea Range" and "Rocky plains, Victoria River" at K, and a collection from BM labelled "Vict R" Bynoe, were used by Bentham for the description in the "Flora Australiensis". It is not possible to determine the species to which Bynoe's collection belongs with certainty, but it is probably correctly placed here.

Affinities. Bentham (1867) related this species to the Indian *Gardenia costata* Roxb. (= *G. gummifera* L. f.) but gives no reason for this affinity. The similarities with *G. gummifera* are only superficial, both species producing copious amounts of resin, a characteristic that is common in *Gardenia* and not confined to any species group. *Gardenia resinosa* is closely related to *G. schwarzii, G. ewartii*, and *G. pyriformis*; and with these species it appears to form intermediates in Arnhem Land, in the Victoria River and Roper River areas, and in the Kimberley region, respectively. It differs from the first two on the basis of its dark brown bark, and from the last by its larger flowers and fruits.

As noted in the Materials and methods section, it is now apparent that the calyx morphology is not a reliable character in some species. However, the key to *Gardenia* in Bentham (1867) and its later extractions (Bailey 1900, Ewart & Davies 1917), utilize this character as the first step in the key and it is from this character that confusion in the determination of species has largely arisen. *Gardenia resinosa* is one such species; in the same populations the calyx tube may be well formed with prominent calyx spurs or the spurs may be absent and the tube splitting down one side. The calyx tube of the lectotype lacks spurs. Large-leaved resinous specimens without calyx spurs, however, are almost invariably *G. resinosa*, thus the possible confusion of the type specimen of *G. resinosa* with specimens of *G. megasperma* and *G. ewartii* (both not resinous) is eliminated.

On specimens with dried fruits it is virtually impossible to distinguish *Gardenia resinosa* from *G. ewartii*. *Gardenia resinosa* is also problematic because of its wide range of variation in leaf shape. In the Katherine area large-leaved specimens indicate possible intermediates with *G. ewartii*; in the western part of the Gardner District the small-leaved *G. resinosa* subsp. *kimberleyensis* approaches *G. pyriformis* subsp. *keartlandii*. In the field *G. resinosa* is readily distinguishable from both *G. ewartii* and *G. pyriformis* by its resinous buds and leaves, and its narrow leafy twigs bearing large green rugulose fruit. In the regions where *G. resinosa* is sympatric with *G. schwarzii* and *G. ewartii*, *G. resinosa* has rich chocolate-brown bark.

Gardenia resinosa subsp. **resinosa**

Small *tree* with leafy twigs 1-2(3) mm in diameter. *Stipules* conical, not mammilliform, (5)8-17 mm long. *Leaves* with petiole 8-22(30) mm long, 1-(2) mm; lamina ovate to elliptic, 30-80(90) mm long, 15-50(70) mm wide with an obtuse to cordate base and acute to obtuse apex; secondary veins 8 to 11 pairs. *Flowers* as described for species. *Fruit* 30-50 mm long, 25-35 mm in diameter, gradually tapering into a robust pedicel 10-35 mm long; calyx persistent in more robust specimens, the chartaceous tube splitting along 1 or 2 lines, bearing several to 6(7) lobes, 2-10 mm long, unequal and often weakly developed, spreading.

Additional specimens examined (44). WESTERN AUSTRALIA. GARDNER DISTRICT: 11 miles [17.7 km] NE of Kalumburu Mission, 3 Sep. 1954, *Speck* 4896 (CANB); Kalumbaru, 6 Jan. 1974, *Crawford* 57 (PERTH); ditto, 11 Jan. 1974, *Crawford* 75 (PERTH); S of Kalumburu, 30 Oct. 1976, *Johnson* 26 (PERTH); Gibb River road, 21.7 km E from junction with Kalumburu road, 16°02'S, 126°40'E, 13 July 1987, *Puttock* UNSW 20675 (UNSW); Gibb River road, 37.3 km E from junction with Kalumburu road, 16°00'S, 126°48'E, 13 July 1987, *Puttock* UNSW 20676 (UNSW); 1.0 km E of Jacks Hole Homestead, 'Durack River', Gibb River road, 15°57'S, 127°13'E, 14 July 1987, *Puttock* UNSW 20687 (UNSW); 'Durack River', 10 km NNE of Durack River crossing on Ellenbrae-Wyndham road, 1973, *Kubicki* 33 (PERTH); headwaters of Nyia Creek, 15°26'S, 127°20'E, 20 Mar. 1978, *Hartley* 14727 (CANB, PERTH); S base of Mt King, Durack Range, 17°20'S, 127°22'E, 24 Oct. 1974, *Rodd 2860* (NSW); 'Karunjie', Oct.-Nov. 1954, *Rust* 8K (CANB, PERTH); 29 miles [46.7 km] NW of 'Springvale', 16 Apr. 1955, *Lazarides* 5072 (CANB, NSW, PERTH); Mt Nyulasy, 32.6 km N of Turkey Creek, 16°45'S, 128°17'E, 16 July 1987, *Puttock* UNSW 20692 (UNSW); *c.* 58 miles [*c.* 94 km] N of Kununurra [via] Ninbing & Carlton, 2 Nov. 1969, *Lullfitz* 18 & *MacKenzie* (CANB, DNA, PERTH); Ord River Dam site, 7 June 1944, *Gardner* 7368 (PERTH); Kimberlite Pipe Gap, at head of Smoke Creek, SW of Lake Argyle, 16°45'S, 128°30'E, 6 May 1980, *Weston* 12324 (PERTH); headwaters of Packsaddle Creek, northern Carr Boyd Range, 15°56'S, 128°40'E, 8 Mar. 1978, *Hartley* 14392 (CANB, PERTH).
NORTHERN TERRITORY. VICTORIA RIVER DISTRICT: range S of Timber Creek, 15°40'S, 130°27'E, 6 May 1988, *Wilson* 190 & *Jacobs* (BRI, DNA, NSW); rocky places, without date, *Mueller s.n.* (K); banks of the Victoria River, without date, *Mueller s.n.* (MEL); Sea Range, [22-24] Dec. 1855, *Mueller s.n.* (K). DARWIN & GULF DISTRICT: 8 miles [12.9 km] E of Anson Bay, Aug. 1946, *Blake s.n.* (BRI); 14.1 miles

[22.6 km] SE of Fenton, 13°04'S, 131°02'58'E, 29 June 1946, *Blake* 16235 (BRI); 4 miles [7 km] W of first Creek crossing S of Banyan, 14°05'S, 131°15'E, 28 Dec. 1964, *McCormack* M33 (DNA); Twin Falls area, 13°18'S, 132°47'E, 15 Aug. 1974, *Fox* 537 (DNA); 7 miles [11.2 km] N of 'Mudginberry', 12°30'S, 132°53'E, 17 July 1972, *Adams* 2847 (CANB, K); 9 miles W of East Alligator River, 26 Aug. 1973, *Parker* 167 (BRI, DNA); 44 km SE Oenpelli, 12°34'S, 133°23'E, 15 June 1978, *Dunlop* 4935 (CANB, DNA); vicinity of Obiri Rock, Kakadu National Park, 11 Aug. 1981, *Croat* 52420 (NSW); SE corner of Jabiluka Outlier, 19 Nov. 1980, *Waterhouse* UNSW 10898 (UNSW); S of Jabiluka Outlier, E of 'Burnt Truck' Creek, 22 Sep. 1980, *Waterhouse* UNSW 11269 (UNSW); SE foothill of the Jabiluka Outlier, 27 Aug. 1980, *Waterhouse* UNSW 10562 (UNSW); ditto, *Waterhouse* UNSW 10563 (UNSW); Old Oenpelli road, *c.* 0.6 km E of intersection at Jabiluka end with Oenpelli road, 4 Oct. 1980, *Waterhouse* UNSW 11296 (UNSW); N side of Cannon Creek, E side of Oenpelli road, near Ja Ja, 15 May 1979, *Puttock* UNSW 8313 *& Waterhouse* (UNSW); on W side of Oenpelli road, 1.5 km N of Ja Ja campsite, opposite Jabiluka 1 site, 8 Sep. 1979, *Puttock* UNSW 9033 *& Murray* (UNSW); '7J' road, S end of Jabiluka Outlier, Magela Creek, 7 Sep. 1979, *Kerle* UNSW 9031 *& Fleming* (UNSW); between 'Ant Hill' track and the E side of N end of Jabiluka Outlier, Oenpelli road, 20 Feb. 1980, *Waterhouse* UNSW 9156/2 (UNSW); Jabiluka Hill, near Ja Ja, 6 Feb. 1979, *Waterhouse* UNSW 7948 (UNSW); 2.3 km E along '7J' rd from Oenpelli road, SE of Ja Ja Billabong, 12 Sep. 1979, *Puttock* UNSW 9107 *& Murray* (UNSW); Katherine River, *c.* 50 miles [*c.* 80 km] NE of Katherine, NAUC area, 5 Sep. 1954, *Bateman* 19 (BRI); 16 miles [25.8 km] W of El Sharana, Pine Creek road, 22 Jan. 1973, *Martensz* AE 477 *& Schodde* (CANB); 3.5 km N of Waterfall Creek Falls turnoff on Kakadu Hwy, 20 July 1987, *Puttock* UNSW 20723 (UNSW); Oenpelli road, 2.5 miles [4 km] S of Cannon Hill turnoff, 8 Feb. 1973, *Martensz* AE 804 *& Schodde* (BRI, CANB, DNA).

Distribution and habitat. An open woodland species growing in sandy soil and also on lower scree slopes from Kalumburu south-west to Kununurra, Western Australia and from the Victoria River north-east to the Coberg Peninsula, Northern Territory. In Arnhem Land it is common in sandy soils above the flood plains. Its distribution is unknown in the Daly River area to the south-west of Darwin, where further collecting is required to clarify its relationship with *Gardenia ewartii* subsp. *ewartii.* (Figure 8)

Phenology. Flowering occurs from August to March. The flowers are mildly perfumed. The fruits are present on the plants for most of the year.

Conservation status. Its widespread distribution in woodlands on sandy soils will ensure its survival.

Vernacular name. None known.

Gardenia resinosa subsp. **kimberleyensis** Puttock *subsp. nov.*

A subsp. *resinosa* foliis minoribus oblanceolatis, stipulis brevioribus non resinosis differt.

Typus: Crystal Creek area, 1.2 km west of bay, west of Crystal Head, Gardner District, Western Australia, 14°29'S 125°48'E, 12 July 1987, *C.F. Puttock* UNSW 20665 (*holo:* PERTH; *iso:* DNA, K, MEL, NSW).

Gardenia ?keartlandii sensu A.S. George & K.F. Kenneally *In:* J.F. Miles & A.A. Burbidge, A biological survey of the Prince Regent River Reserve 63 (1975).

Gardenia sp. A.S. George & K.F. Kenneally *In:* J.F. Miles & A.A. Burbidge, A biological survey of the Prince Regent River Reserve 63 (1975).

Gardenia resinosa F. Muell. subsp. A, C.F. Puttock *In:* J.R. Wheeler *et al.*, Flora of the Kimberley Region 913, fig. 281B (1992).

Small *tree* with leafy twigs 1-2 mm diameter. *Stipules* bullet-shaped, mammilliform, 3-6 mm long, not resinous. *Leaves* with petiole 4-12 mm long, 1-(2) mm; lamina concolorous, narrowly elliptic to oblanceolate, 30-70 mm long, 12-33 mm wide, with an obtuse to decurrent base and obtuse apex; secondary veins 7 or 8 pairs. *Flowers* unknown. *Fruit* 30-35 mm long, 20-28 mm in diameter, gradually tapering into a robust pedicel 10-15 mm long; calyx persistent or not, the crateriform tube without ribs or lobes, chartaceous and splitting along 1 or 2 lines of weakness. (Puttock 1992: Figure 281B)

Additional specimens examined (14). WESTERN AUSTRALIA. GARDNER DISTRICT: Blyxa Creek, Prince Regent River Reserve, 15°48'S, 125°20'E, 21 Aug. 1974, *George* 12517 (PERTH); Bushfire Hill, Prince Regent River Reserve, 15°28'S, 125°39'E, 15 Aug. 1974, *George* 12314 (PERTH); Surveyors Vine Thicket, Mitchell Plateau, 14°45'S, 125°40'E, 18 June 1976, *Kenneally* 5116 (PERTH); near Mitchell River Falls, 14°49'S, 125°40'E, 13 Sep. 1978, *Beard* 8305 (PERTH); Surveyors Pool road, 14°41'S, 125°44'E, 18 Aug. 1979, *Done* 53 (DNA); Patch vine thicket, Mitchell Plateau, 14°56'S, 125°47'E, 20 May 1978, *Kenneally* 6746 (PERTH); 14 km from Crystal Creek, W of Crystal Head, *c.* 14°35'S, 125°47'E, 12 Jul.y 1987, *Puttock* UNSW 20666 (UNSW); Crystal Creek area, 1.2 km W of bay, W of Crystal Head, 14°29'S, 125°48'E, 12 July 1987, *Puttock* UNSW 20665 (UNSW); 30.5 miles [49.1 km] from Drysdale River crossing towards Woorakin Creek, 17 Aug. 1969, *Mains.n.* (PERTH); 72 miles [116 km] NNW of 'Gibb River', 7 Sep. 1954, *Speck* 4964A (CANB); 34 km N of 'Drysdale River', Kalumburu road, 15°25'S, 126°18'E, 11 July 1987, *Puttock* UNSW 20641 (UNSW); 16 km N of 'Drysdale River', Kalumburu road, 15°51'S, 126°21'E, 11 July 1987, *Puttock* UNSW 20642 (UNSW); 3 miles [5 km] S of 'Gibb River', 3 Oct. 1968, *Banks* B1409A (CANB); Dromaius Creek, Drysdale River National Park, 15°16'S, 126°43'E, 4 Aug. 1975, *George* 13268 (PERTH); Nymphaea Creek, Drysdale River National Park, 14°49'S, 126°55'E, 13 Aug. 1975, *Kenneally* 4287 (PERTH).
Intergrades. Gardenia resinosa subsp. *kimberleyensis* - *G. pyriformis* subsp. *keartlandii*: WESTERN AUSTRALIA. GARDNER DISTRICT: Lennard River, 17°02'S, 124°00'E, Mar. 1922, *Edwards s.n.* (PERTH); between Isdell River & Station Creek, 16°41'S, 125°00'E, May 1905, *Fitzgerald s.n.* (PERTH 1085). FITZGERALD DISTRICT: Sunday Island, Nov. 1906, *Fitzgerald s.n.* (NSW).

Distribution and habitat. Widespread on sandy plains with outcropping sandstone, supporting open woodlands bordering deciduous vine thickets of the Mitchell Plateau area of Western Australia. (Figure 8)

Phenology. Flowers not known. Fruits present for most of the year.

Conservation status. This subspecies appears to be widespread and not under threat.

Etymology. Named after the region in which it is found.

Vernacular name. None known.

Notes. This subspecies is not as resinous as the typical subspecies but has similar dark chocolate brown stems and large fruit. Subspecies *kimberleyensis* is distinguished from it by the small oblanceolate leaves and small stipules. In the south it is not easily distinguishable from herbarium material of *Gardenia ewartii* subsp. *fitzgeraldii*. Generally the latter has erect and thicker twigs, with the pedicel of the fruit curved downwards. In contrast *G. resinosa* has fruit on straight pedicels; their weight and thin twigs

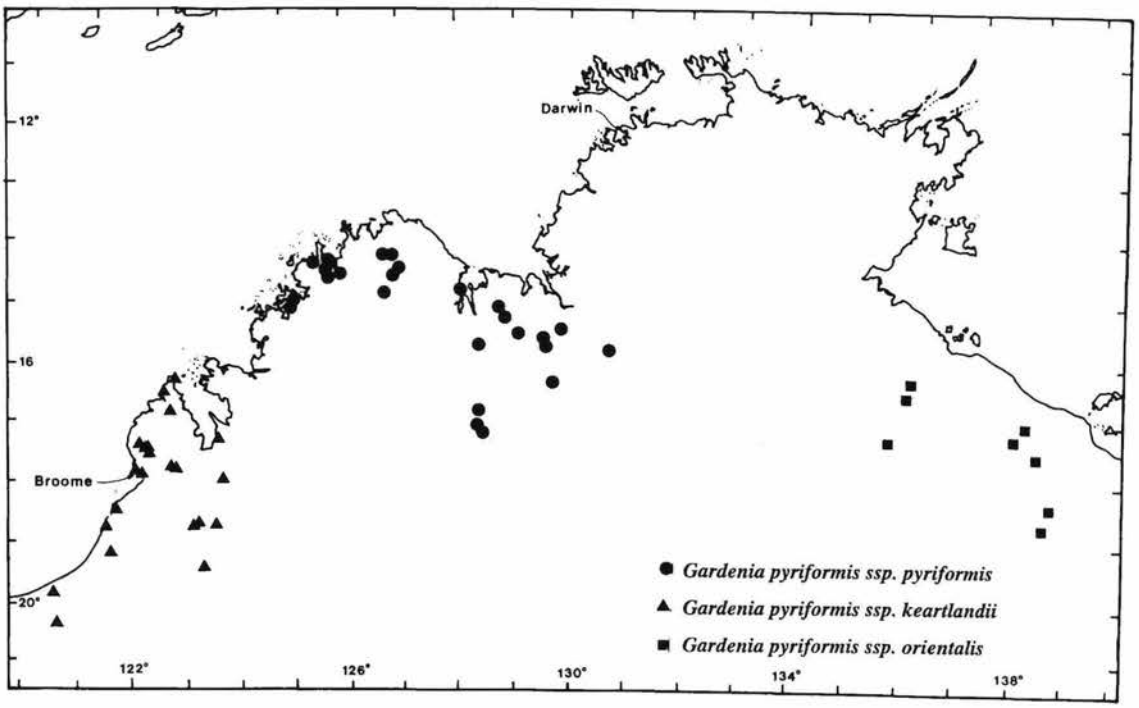

Figure 7. Distribution of *Gardenia pyriformis.*

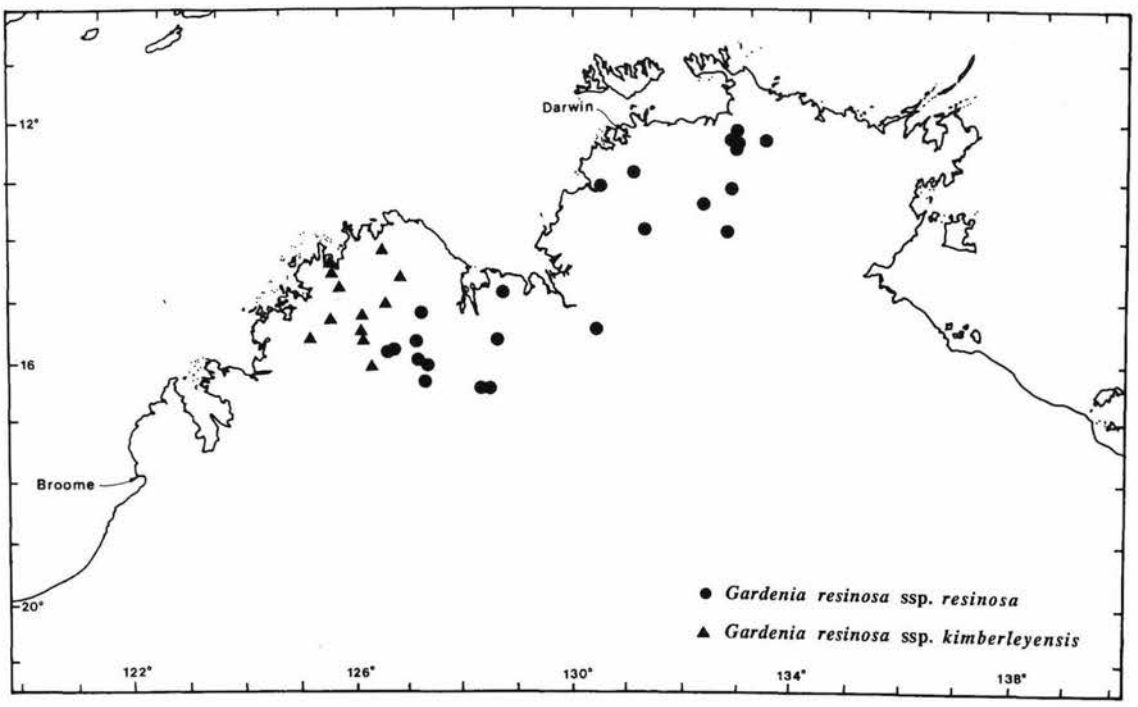

Figure 8. Distribution of *Gardenia resinosa.*

make them appear somewhat pendulous. Calyx spurs and apical hypanthial extensions usually present in *G. ewartii* are generally absent from the fruit of this subspecies.

In the western part of the Gardner District this subspecies becomes almost indistinguishable from *Gardenia pyriformis* subsp. *keartlandii* on vegetative characters because, in this area and across to northern Dampierland, both taxa have thin twigs and oblanceolate lamina on narrow petioles. However, typical *G. pyriformis* subsp. *keartlandii* differs from *G. resinosa* subsp. *kimberleyensis* by its elliptic leaves and much smaller fruit and from *G. resinosa* subsp. *resinosa* by the much smaller flowers; the flowers of subsp. *kimberleyensis* are unknown.

Gardenia schwarzii Puttock, *nom. nov.*

Gardenia petiolata O. Schwarz, Repert. Spec. Nov. Regni Veg. 24:100 (1927), *nom. illeg. non G. petiolata* Farwell, Amer. Midl. Naturalist 8:35 (1922). *Type*: Koolpinyah, Darwin & Gulf District, Northern Territory, without date, *F.A.K. Bleeser* 451 (*holo:* B - presumed destroyed). *Neotype* (here designated): road between 3-ways and Garden Point, Melville Island, Darwin & Gulf District, Northern Territory, 23 June 1971, *M.I.H. Brooker* 3182 (*neo:* DNA 16487; *iso:* CANB, NSW).

Gardenia sp. aff. *megasperma* Benth., R.L. Specht *In:* R.L. Specht & C.P. Mountford, Record of the American-Australian expedition to the Arnhem Land 305 (1958).

Facultatively deciduous small *tree* to 7 m high; trunk at breast height to 250 mm diameter, branches spreading. *Bark* to 25 mm thick, furfuraceous, grey mottled rusty yellow; outer bark layered, the blaze orange; inner bark blaze tan. *Wood* brittle, cream. *Leafy twigs* 3-5 mm in diameter, glabrous, not resinous. *Stipules* conical, elongate mammilliform, 5-7(10) mm long, 3-5 mm wide, minutely hairy; colleters lanceolate, 0.45-0.97 mm long, 0.2-0.15 mm wide. *Leaves* opposite, mid green, slightly paler below, with scattered minute hairs; petiole 15-35 mm long, 2-3 mm wide; lamina ovate to oblanceolate, 70-140 mm long, 20-50(110) mm wide, with a decurrent to obtuse base and obtuse apex; secondary veins 9 to 12 pairs, 45-50° to the midvein with weak intersecondary veins; tertiary venation weakly percurrent; ciliated pit domatia large and conspicuous. *Flowers* 6 or 7-merous, tomentose to subglabrous; pedicel 5-12 mm long. *Hypanthium* 5-7 mm long, ridges absent. *Calyx* tube crateriform, 2-3 mm long, with coriaceous lobe-ridges; lobes linear, 18-23 mm long, laterally flattened, 2-3 mm wide. *Corolla* tube tubaeform, 15-32 mm long, *c.* 3 mm diameter at the base, *c.* 6 mm diameter in the upper part, subglabrous outside, hairy inside; lobes elliptic, 8-15 mm long, 5-7 mm wide, glabrous. *Anthers* 11-14 mm long, attached 5-8 mm from their apices, inserted 3-4 mm below the sinuses of the corolla lobes, partially included, the tips exceeding the corolla tube by several millimetres. *Style* 18-35 mm long, exceeding the corolla tube by several millimetres; stigmatic lobes 4 or 5, 10-12 mm long. *Ovary* with placentas 4 or 5. *Fruit* subspherical to ovoid, 30-55 mm long, 25-40 mm diameter, smooth when mature (striate when dry), abruptly tapering into a robust pedicel, 15-20 mm long; apex constricted into a *c.* 6 mm long hypanthial collar; calyx persistent, coriaceous with 6(7) robust, linear lobes, 10-25 mm long, laterally flattened, 2-3 mm wide, spreading; exocarp pale green whilst developing, yellowish brown when mature; mesocarp 5-7 mm thick, inner part sclerenchymatous and fused to endocarp, brittle, 1-2 mm thick. *Seeds* 5.5-6.6 mm diameter, 1.5-1.8 mm thick; hilum occupying one third to one half of the perimeter; seed coat brown; exotestal cells sinuate in outline, thickening of inner tangential and lower part of radial walls reticulate.

Additional specimens examined (16). NORTHERN TERRITORY: DARWIN & GULF DISTRICT: Melville Island, *c.* 11°33'S, 130°34'E, 10 June 1973, *Dunlop* 3058 (DNA 7554); Bathurst Island, 11°45'S, ,130°35'E, 14 Dec. 1975, *Stevenson* 128 (DNA 10452); road between 3-ways and Garden Point, Melville Island, 23 June 1971, *Brooker* 3182 (CANB, DNA 16487, NSW); 13.4 miles [21.6 km] S of Adelaide River

township, 9 June 1972, *McKean* B607 (CANB, DNA); Humpty Doo, 10 Feb. 1961, *McKee* 8297 (CANB, NSW); 18 miles [29 km] N of 'Tipperary', 16 Aug. 1961, *Lazarides* 6665 (CANB, MEL, NSW, PERTH); NE of Cannon Hill, East Alligator River, May 1978, *Webb* 12339 & *Tracey* (BRI, CANB); 6.0 km along road to Jabiluka Billabong from turnoff at Oenpelli road, Magela Creek, 6 Sep. 1979, *Puttock* UNSW 8591 & *Murray* (UNSW); 2 km W of Nabarlek airstrip, 12°18'S 133°16'E, 24 Apr. 1979, *Rankin* 2180 (DNA); *c.* 4 km N of Nabarlek, 12°15'S 133°19'E, 23 Apr. 1979, *Rankin* 2137 (CANB, DNA, K); 27 miles [43.5 km] N of Wilton River crossing, 15 June 1972, *Byrnes* 2626 (CANB, DNA 4832, NT, K, L, NSW); 15.3 km N of Cox River crossing track between 'Nathan River' and Roper Bar, 15°13'S 135°18'E, 16 Nov. 1982, *Puttock* UNSW 14433 & *St George* (UNSW); Burrupadala, Nangalala, 18 Dec. 1972, *Reeves* 500 & *Bona* (CANB); Mud Cod Bay, Groote Eylandt, 14°04'S 136°26'E, July 1978, *Waddy* 732 (DNA 4118); Ayakamindadina, 13°58'S 136°41'E, 19 Aug. 1979, *Waddy* 810 (DNA 15603); Hemple Bay, 13°44'S 136°42'E, 24 Apr. 1948, *Specht* 428B (AD, BRI).

Intergrades. Gardenia schwarzii - G. megasperma: NORTHERN TERRITORY: DARWIN & GULF DISTRICT: near Darwin, June 1963, *Webb s.n.* (BRI, CANB); 11.9 km W of Mary River, Arnhem Hwy, 12°50'S, 131°33'E, *Waterhouse* UNSW 4013 & *Wilson* (UNSW); Jabiru, 12°41'S, 132°55'E, 11 Aug. 1979, *Cruikshank* 1108D (CANB).

Distribution and habitat. This species occurs on the sandy edges of floodplains and lower slopes of escarpments and outliers of Arnhem Land and off-shore islands of the Northern Territory. (Figure 9)

Phenology. Flowering occurs between November and January. The flowers are perfumed. Fruits are found on the trees most of the year and mature late in the dry season when they ripen and fall to the ground.

Conservation status. It is a widespread species across Arnhem Land and is not considered threatened.

Etymology. Named after Otto Schwarz (1900-1983) who studied Florenz Bleeser's collections from Arnhem Land for his doctoral dissertation in 1928, a work that has been largely overlooked.

Vernacular name. None known.

Affinities. This species is closely related to *G. megasperma*, with which suspected intermediates appear in the collections. In the vicinity of Katherine it may also intergrade with *G. resinosa* and *G. ewartii*. It differs from these two species by its more robust leafy twigs, longer calyx spurs and long pedicels, and from *G. megasperma* by its glabrous leaves and subspherical to ovoid fruits on longer pedicels.

Typification and notes. The collections of Rubiaceae and thus the type specimen of this species were destroyed in the burning of the herbarium at Berlin. In the absence of any duplicates a neotype has been chosen from the gathered collections. The most substantial collection that matches the circumscription well, comes from Melville Island, some 200 km north of the original locality. A collection closer to Koolpinyah (*McKee* 8297) has lamina that are decurrent to the petiole which contradicts the circumscription: "*vix decurrentia*".

Gardenia sericea Puttock, *sp. nov.*

A *G. megasperma* foliis subsessilibus, indumento sericeo, fructibus floribusque minoribus differt.

Typus: west side of Russ Creek, Gibb River road, Fitzgerald District, Western Australia, 16°02'S, 126°41'E, 13 July 1987, *C.F. Puttock* UNSW 20674 (*holo:* PERTH; *iso:* DNA, NSW, UNSW).

Gardenia megasperma pro parte: C.A. Gardner, Botanical notes. Kimberley region of Western Australia 92 (1923), Enum. Pl. Austral. Occ. 122 (1930).

Gardenia sp. A, C.F. Puttock *In:* J.R. Wheeler *et al.*, Flora of the Kimberley Region 913, fig. 281C (1992).

Facultatively deciduous small *tree* to 6 m high; trunk at breast height to 150 mm diameter. *Bark* to 10 mm thick, smooth, furfuraceous glaucous mauve to dark brown bark; outer bark layered with orange blaze; inner bark blaze tan. *Leafy twigs* 5-6 mm in diameter, tomentose. *Stipules* conical, not mammilliform, 6-12 mm long, tomentose. *Leaves* pale green, tomentose, subsessile, with very dense short hairs; lamina ovate to broadly ovate, 32-65 mm long, 25-55 mm, with a cordate base and obtuse apex; secondary veins 11 to 14 pairs; 60-70° to the midvein, raised above and below; tertiary venation percurrent, opaque; ciliated pit domatia, when present, small and inconspicuous. *Flowers* tomentose; pedicel to 4 mm long. *Hypanthium* 2-4 mm long, with several ridges. *Calyx* tube crateriform, 10-17 mm long, chartaceous between thin coriaceous lobe-ridges, usually splitting along 2 lines only; lobes 5(6), poorly developed, linear, to 3 mm long, *c.* 1 mm wide, connate with the chartaceous tube. *Corolla* 6- to 8-merous; tube cylindrical, 10-12 mm long, *c.* 3 mm in diameter, sericeous outside, tomentose inside; lobes ovate, 9-12 mm long, 5-6 mm wide, sericeous. *Anthers c.* 7 mm long, attached 3-4 mm from their apices, inserted 2-3 mm below the sinuses of the corolla lobes, partially included, the tips exceeding the corolla tube by 1 mm. *Style* 10-21 mm long, tomentose. *Ovary* with 4 placentas. *Fruit* ovoid to obovoid, 20-25 mm long, 15-18 mm diameter, smooth (not striate when dry), tomentose, abruptly tapering into a pedicel 3-4 mm long; calyx persistent, the tube 10-15 mm long and lobes 2-5 mm long, erect. *Seeds* unknown.

Additional specimens examined (6). WESTERN AUSTRALIA. GARDNER DISTRICT: Cracticus Falls, Drysdale River National Park, 14°47'S, 127°05'E, 9 Aug. 1975, *Kenneally* 4139 (PERTH); Pseudomys Hills, Drysdale River National Park, 15°17'S, 127°12'E, 8 Aug. 1975, *Kenneally* 4074 (PERTH); Pseudomys Hills, 15°17'S, 127°12'E, 8 Aug. 1975, *Kenneally* 4105 (PERTH). FITZGERALD DISTRICT: W side of Russ Creek, Gibb River road, 16°02'S, 126°41'E, 13 July 1987, *Puttock* UNSW 20672 (UNSW); ditto, *Puttock* UNSW 20673 (UNSW); ditto, *Puttock* UNSW 20674 (UNSW).

Distribution and habitat. A local endemic species growing in savannah woodland on sandy plains and scree slopes near Russ Creek on the Gibb River road in the Fitzgerald District and of the Pseudomys Hills, Drysdale River National Park in the adjacent Central Gardner District of the Kimberley region. (Figure 9)

Phenology. Flowering specimen collected in July; leaves fully developed. The flowers are mildly perfumed. Mature fruits unknown.

Conservation status. Although known only from few specimens it is apparently locally common. CALM Conservation Codes for Western Australian Flora: Priority Three.

Etymology. Named '*sericea*' after the soft velvety indumentum of the leaves and young stems.

Vernacular name. None known.

Affinities. This species appears to be related to *Gardenia megasperma* with which it has until now been confused. It differs by its subsessile leaves with long sericeous indumentum, and smaller flowers and fruits.

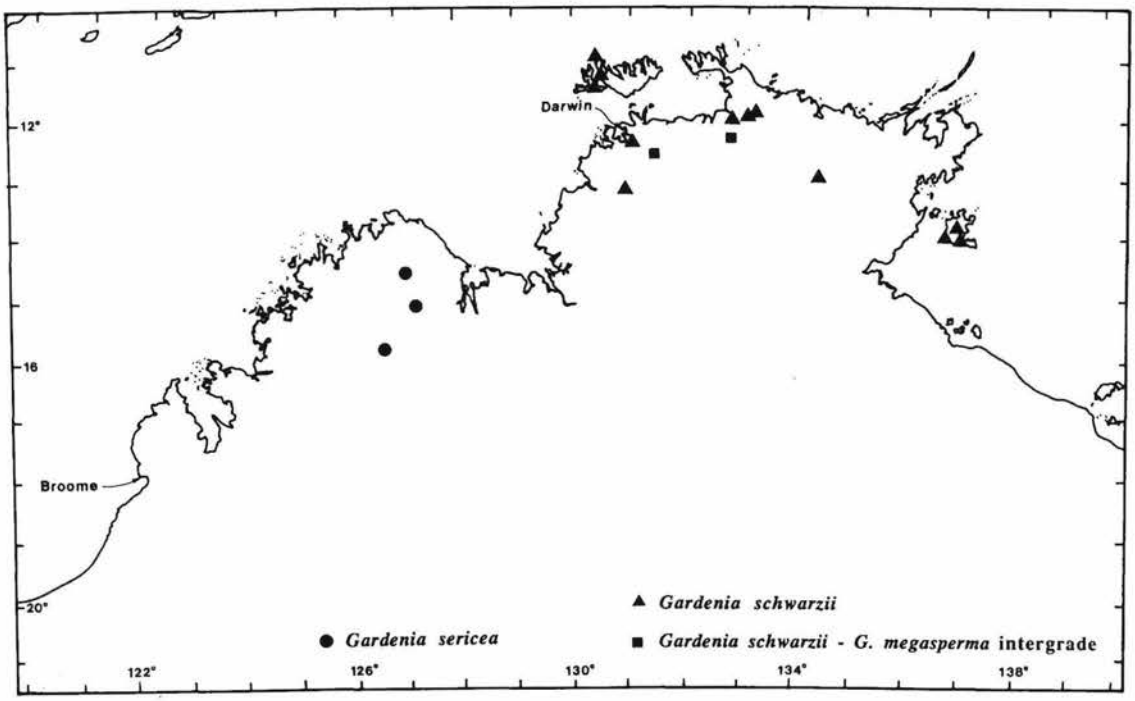

Figure 9. Distribution of *Gardenia schwarzii* and *G. sericea.*

Acknowledgements

I thank the directors of herbaria cited above for making facilities and specimens available to me, Dr Peter G. Wilson for assisting with the latin diagnoses and Mr Lawrie Adams for reviewing the manuscript. This revision forms part of a doctoral thesis undertaken at the University of New South Wales. Professor Christopher Quinn is thanked for his supervision following the death of Mr John Waterhouse, with whom my work on the Rubiaceae was initiated by a floristic survey of the Magela Creek catchment area, now mostly within Kakadu National Park, Northern Territory.

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Three new annual species of *Schoenus* (Cyperaceae) from the south-west of Western Australia

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Abstract

Rye, B.L. Three new annual species of *Schoenus* (Cyperaceae) from the south-west of Western Australia. Nuytsia 11 (2): 263-268 (1997). Three new species in the Cyperaceae, *Schoenus badius* Rye, *S. plumosus* Rye and *S. variicellae* Rye, are described and illustrated. All are annual plants apparently endemic to the south-west of Western Australia and one of them is on the Priority Flora List.

Introduction

A survey of annual Cyperaceae species of the South West and Eremaean Botanical Provinces of Western Australia has recently been undertaken to locate taxa of conservation significance (Rye 1997). From this survey it appears that at least nine of the annual species of Cyperaceae have never been named. Most of the new taxa are considered to be too poorly known to name formally at this stage as there is only one collection of each. Two of the new taxa are known from many collections and a third taxon is known from two collections, all three being new species of *Schoenus*. These three *Schoenus* species are described and illustrated here. A key and distribution maps for all the annual *Schoenus* species of Western Australia are given in Rye (1997).

Descriptions of new taxa

Schoenus badius Rye, *sp. nov.*

Schoeno penniseti affinis sed nuce ad apicem leviter 3-lobata, seriebus cellularum grandioris in quoque pagina minus numerosis differt.

Typus: Vacant Crown Land, south of Mt Adams, east of Dongara, Western Australia, 10 September 1980, *E.A. Griffin* 2811 (*holo:* PERTH 01050397).

Schoenus sp. *Mt Adams* (*E.A. Griffin* 2811) on Priority Flora List of 1995.

Annual herb 50-120 mm high, glabrous except for the perianth segments, scabrous on the distal margins of the leaves, the margins of the bract blades and the ridges of the peduncles. *Stems* very slender, *c.* 0.3 mm diam., 4-6-ridged and sometimes more or less 4-angled. *Leaves* sheathing the base of each stem, the lowest ones with an open sheath 2-8 mm long and blade up to 14 mm long or sometimes absent, the uppermost ones with a closed sheath 7-15 mm long and blade 23-30 mm long; sheath pale brown with reddish tinges to red throughout, ribbed; blade 0.2-0.3 mm wide, channelled on adaxial surface. *Bracts* erect, with a reddish sheath 1.5-3 mm long and slender blade 3-32 mm long. *Inflorescence* of usually 4-6 short- to long-pedunculate spikelets per stem in 1-3 (usually 2) clusters or levels each subtended by a bract, the longest peduncle of the basal cluster 4-12.5 mm long. *Spikelets* narrowly ovoid, 5-6 mm long, 2- or 3-flowered, with 3 empty basal glumes, chestnut-coloured with pale green stripes corresponding with the margins and keel of the glumes. *Basal glumes* broadly ovate and keeled, 1-2.5 mm long. *Floral glumes* ovate and keeled, 4-5 mm long. *Perianth segments* exceeding the nut, 1.2-1.5 mm long, hair-like in the distal half, becoming slightly broader and with long fine antrorse hairs in basal half, white, shed with the nut. *Stamens* 3; anther *c.* 2.5 mm long. *Style* with 3 stigmatic branches. *Nut* trigonous-obovoid or broadly so and shortly beaked, *c.* 1.0 x 0.7 mm, 3-ridged, with 5-7 rows of medium-sized cells on each surface, each of the ridges protruding and smoothly rounded at the almost truncate summit of the nut, white; beak *c.* 0.2 mm long, slender. (Figure 1A-C)

Other specimen examined. WESTERN AUSTRALIA: Moresby Range, 16 Sep. 1978, *D. & N. McFarland* 1336a (PERTH).

Distribution. Probably endemic to the South West Botanical Province of Western Australia, known only from Moresby Range (north of Geraldton) and near Mt Adams (east of Dongara).

Habitat. One record from 'wet areas', the other from grey sand. One of the two herbarium sheets bears mixed material of *Schoenus badius* and *S. variicellae*.

Phenology. Ephemeral annual herb, germinating after the winter rains have moistened the habitat sufficiently, with flowers and fruits recorded in September. One of the specimens was in an advanced stage of flowering and fruiting on 10 September, so probably began flowering in August.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority 2. There are only two collections of the species, the northern one from a reserve. Attempts to relocate the northern population in September 1995 were unsuccessful (S. Patrick pers. comm.), possibly because it was a particularly dry year not suiting ephemeral species. It could easily be overlooked in the field because of its small size and the presence of other, much more common, *Schoenus* species in its geographical range.

Etymology. From the Latin *badius* - chestnut brown, referring to the colour of the spikelets.

Notes. Similar to *Schoenus pennisetis*, which differs in its smoother nut with a rounded (not 3-lobed) summit and numerous rows of tiny cells on each surface. *S. pennisetis* also tends to have shorter glumes, the floral glumes being 3-4.5 mm long.

Schoenus plumosus Rye, *sp. nov.*

Schoenus sp. *south-west* (*G.J. Keighery* 5677).

Species haec ab *Schoeno humili* differt periantho exuto ad nuci affixo et seriebus cellularum super superficie nucis paucioribus; ab *Schoeno sculpto* differt glumis longioribus et segmentis perianthi multo prominentibus.

Typus: 1 km north of Serpentine, Western Australia, 18 September 1982, *G.J. Keighery* 5239 (*holo:* PERTH 02332523; *iso:* CANB).

Annual herb 70-180 mm high, erect, glabrous except for the perianth segments and sometimes the glume apices. *Stems* 0.5-1.2 mm diam., *c.* 10-ribbed. *Leaves* sheathing the base of each stem, the basal ones reduced to an open sheath or with a short blade, the uppermost ones with a closed sheath 11-24 mm long and blade 22-150 mm long; sheath red-brown to almost black, ribbed; blade 0.4-1.2 mm wide, channelled on adaxial surface. *Bracts* erect, becoming shorter up the stem, the uppermost ones with a pale to very dark red-brown sheath 3-5 mm long and blade 3-8 mm long. *Inflorescence* of up to 12 (usually 3-7) spikelets per stem borne in several 'clusters', each subtended by a bract, sometimes with short branches bearing 2-4 spikelets (each at a different level) as well as stout peduncles of varied sizes arising in the axil of each main bract, the longest peduncle or branch of the basal cluster 5-26 mm long. *Spikelets* narrowly ovoid, 6-7 mm long, 3-6-flowered, with the basal glume empty, pale green with dark red-brown stripes. *Basal glume* broadly ovate and keeled, 1.5-4 mm long, sometimes with a short blade. *Floral glumes* ovate to broadly ovate and keeled, (3.5)4-5.5 mm long, with a broad pale green keel and dark red-brown on each side of keel, sometimes with a narrow yellowish stripe separating the main two colours, the extreme margins often white to yellowish, sometimes with a few hairs or fine teeth on the keel or margins close to the apex. *Perianth segments* exceeding the nut, 2.0-2.6 mm long, plumose (with very dense fine cilia), white throughout at first, usually becoming pale ferruginous to dark red-brown in distal half, shed with the nut. *Stamens* 3; anther 0.6-1 mm long. *Style* with 3 stigmatic branches. *Nut* trigonous-ovoid or broadly so and prominently beaked, 1.4-1.7 x 0.7-1.0, 3-ridged, with 3-5 rows of cells between the ridges, the cells of the central rows large (usually much larger than the rest), the ridges tapering at the summit into the beak, white to pale brown throughout or sometimes with some cells (especially along the ridges) becoming dark red-brown to black; beak 0.3-0.4 mm long, broad. (Figure 1J-M)

Other specimens examined. WESTERN AUSTRALIA (all PERTH): Wambellup Nature Reserve, 11 Oct. 1994, *A.R. Annels* 4599 & *R.W. Hearn*; Gnangara, 19 Sep. 1945, *C.A. Gardner* 7692; Western side of Lake Indoon, 8 Sep. 1979, *G.J. Keighery* 2481; 9 km N of Capel, 1 Oct. 1982, *G.J. Keighery* 5677; Beaufort River flats, 19 km N of Kojonup, 22 Oct. 1983, *G.J. Keighery* 6841; above Misery Beach, Torndirrup National Park, 5 Dec. 1988, *G.J. Keighery* 8658a; Duranillin, 4 Nov. 1988, *G.J. Keighery* 10493; J. & B. Martyn Reserve, 13 km N of Midland, 31 Oct. 1988, *G.J. Keighery* 11614; *c.* 1 mile [1.6 km] from junction on Denmark-Albany road on the lower end, 21 Nov. 1980, *M. McCallum Webster* 647; 4 km N of Arthur River townsite, 18 Oct. 1975, *K. Newbey* 4862; Elgin, 16 Oct. 1947, *R.D. Royce* 2286; Capel, 25 Sep. 1948, *R.D. Royce* 2694.

Distribution. Endemic to the South West Botanical Province of Western Australia, extending from Lake Indoon south to near Capel and south-east to Albany.

Habitat. Occurs on the margins of winter-wet depressions and watercourses and in other damp habitats.

Phenology. Ephemeral annual herb, germinating after the winter rains have moistened the habitat sufficiently, and producing flowers and fruits between September and November.

Conservation status. Not considered to be at risk.

Etymology. From the Latin *plumosus* - feathery, referring to the prominent plumose perianth segments.

Notes. Somewhat intermediate in morphology between *Schoenus sculptus* and *S. humilis* but occurring mainly in more humid areas and therefore only slightly overlapping in geographical range with the other two taxa. *Schoenus sculptus* can be distinguished from *S. plumosus* by its shorter glumes (3-3.5 mm long) and lack of perianth segments, and also tends to have a smaller habit and a shorter beak on the nut. *Schoenus humilis* differs from *S. plumosus* in its persistent perianth, which is not shed with the nut, as well as in the patterning on its nut, which has more numerous rows of cells of more uniform size.

Schoenus variicellae Rye, *sp. nov.*

Schoeno odontocarpo arcte affinis sed glumis longioribus, antheris grandioribus et seriebus longitudinalibus cellularum super superficie nucis paucioribus differt.

Typus: 3 km south-east of Nanson Rd on Erupting Mud Rd, between Howatharra and Geraldton, Western Australia, 29 August 1983, *R.J. Cranfield* 3080 (*holo:* PERTH 02261448; *iso:* CANB, MEL, NSW).

Annual herb 30-160 mm high, erect, glabrous except for the inflorescence branches. *Stems* 0.3-0.4 mm diam., 4-6-ribbed. *Leaves* sheathing the base of each stem, the basal ones reduced to an open sheath, the uppermost ones with a closed sheath 6-20 mm long and blade 13-50 mm long; sheath pale to very dark red-brown, ribbed; blade 0.3-0.5 mm wide, channelled on adaxial surface. *Bracts* erect or spreading, becoming shorter up the stem, the uppermost ones with a pale to very dark red-brown sheath 1.3-1.6 mm long and blade 3-14 mm long. *Inflorescence* sometimes a single terminal cluster of up to 7 spikelets, sometimes of two dense clusters on each stem and sometimes of 2-4 clusters with one or more long-pedunculate spikelets or branches bearing a small cluster of spikelets as well as the densely clustered spikelets, each cluster subtended by a bract, the longest peduncle or branch of the basal cluster 1-25 mm long. *Spikelets* ovoid, 3.5-5 mm long, 2-4-flowered, with 2(3) empty basal glumes. *Basal glumes* broadly ovate and keeled, 1.3-2 mm long, often with a minute apical point 0.1-0.2 mm long. *Floral glumes* ovate to broadly ovate and keeled, (2.5)3-4 mm long, with a broad pale green keel (becoming reddish towards the base) and medium to dark red-brown on each side of keel, sometimes with a narrow yellowish stripe separating the main two colours, the extreme margins pale, often with a minute subterminal mucro. *Stamens* 3; anther 1.2-2.4 mm long. *Perianth segments* absent or minute (much shorter than the nut). *Style* with 3 stigmatic branches. *Nut* broadly trigonous-obovoid, often with a small apical point, 0.6-1.0 x 0.4-0.7 mm, 3-ridged, each of the ridges shortly produced at the summit into a horn, with 3-5 rows of cells between the ridges on each surface, the central rows usually with very large cells, white. (Figure 1G-I)

Selected specimens examined. WESTERN AUSTRALIA (all PERTH): 3.2 km S of Namban on Geraldton Highway, 22 Aug. 1965, *A.C. Beauglehole* 12222; Perup River, E of Manjimup, Oct. 1948, *H. Butler*; 3.5 km NE of Cumby Cumby Soak, Jingemarra Station, 16 Sep. 1988, *R.J. Cranfield* 6151; Midland Junction, Sep. 1900, *W.V. Fitzgerald*; Gnangara, Oct. 1945, *C.A. Gardner*; Gingilup Swamps Nature Reserve, 19 Nov. 1991, *N. Gibson & M. Lyons* 1237; 9 km N of Capel, 1 Oct. 1982, *G.J. Keighery* 5758; Wooroloo, 1937, *M. Koch*; below Moore Hill, near Merredin, 11 Oct. 1980, *M. McCallum Webster* 507; Walga Rock, 5 Sep. 1991, *D.E. Murfet* 1123; Howatharra Hill Reserve, 26 Sep. 1995, *S. Patrick* 2423; *c.* 3 km NW of Shannon township, 12 Nov. 1986, *P.G. Wilson* 12375c.

Distribution. Endemic to Western Australia. Occurs mainly in the South West Botanical Province, extending from Kalbarri National Park south to Gingilup Swamps Nature Reserve (Scott River area) and

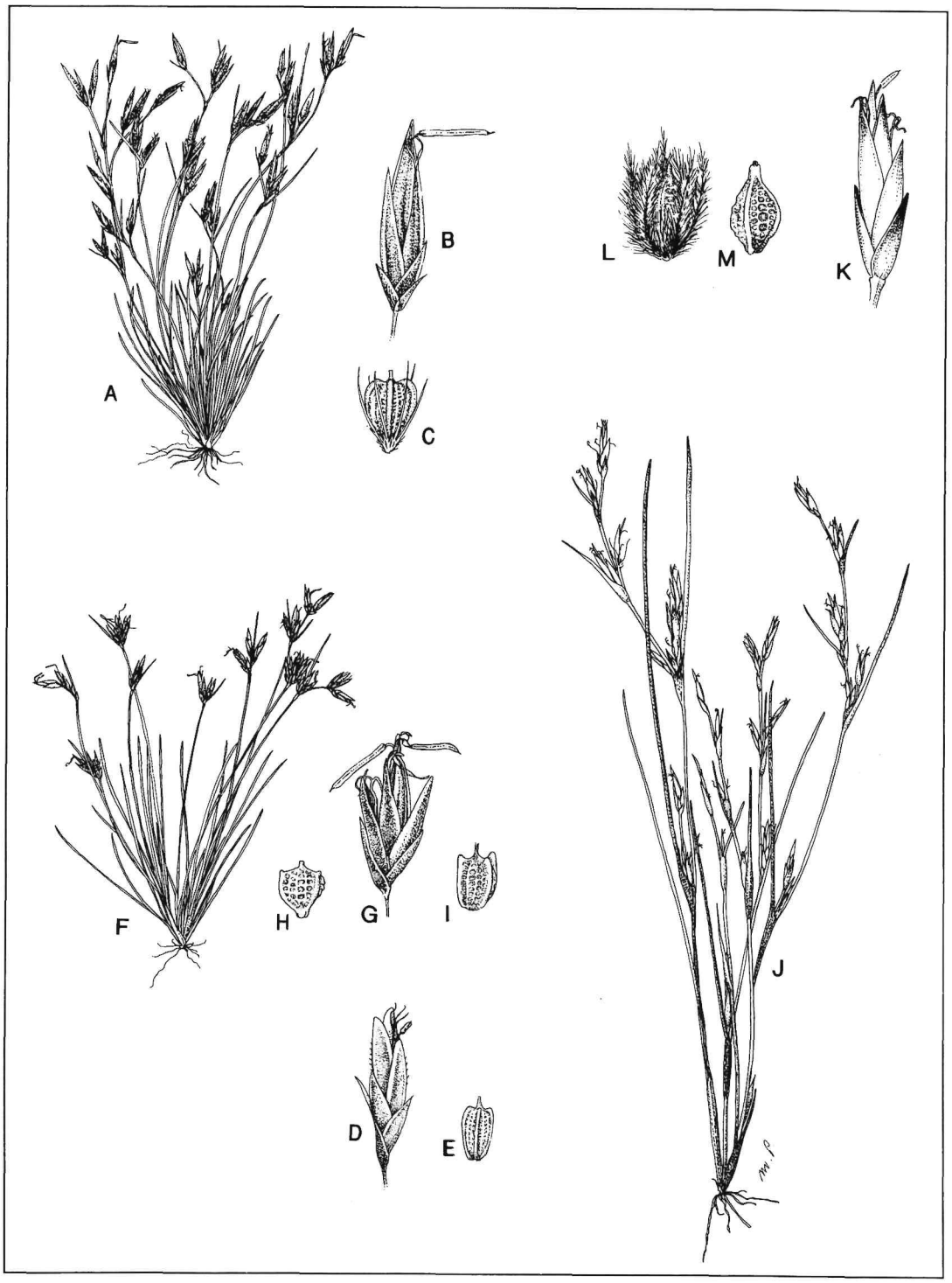

Figure 1. A-C - *Schoenus badius* A - whole plant (x1), B - spikelet (x5), C - fruit with perianth segments (x8); D,E - *Schoenus odontocarpus* D - spikelet (x5), E - fruit (x8); F-I - *Schoenus variicellae* F - whole plant (x1), G - spikelet(x6), H,I - fruit from two different collections to show variation in shape (x9); J-M - *Schoenus plumosus* J - whole plant (x1), K - spikelet (x4), L - fruit with perianth segments (x8), M - fruit (x8). Drawn from *E.A. Griffin* 2811 (A-C), *M. McCallum Webster* 655 (D,E), *R.J. Cranfield* 7459 (F-H), *E. Lindgren* 23 Sep. 1963 (I), *G.J. Keighery* 8658 (J,K) and *M. McCallum Webster* 647 (L,M).

Perup River, with a few scattered records inland to Walling Rock Station (west of Menzies) in the South-western Interzone.

Habitat. Occurs mainly in clay soils in winter-wet depressions or other damp situations near the west coast, also sometimes occurring inland and then often associated with granite or laterite.

Phenology. Ephemeral annual herb, germinating after the winter rains have moistened the habitat sufficiently, and producing flowers and fruits between August and November.

Conservation status. Widespread and commonly collected.

Etymology. From the Latin *varius* - varied or different and *cella* - chamber, referring to the varied sizes of the cells on the the surface of the nut. The epithet is treated as a noun in apposition.

Notes. Until recently, this species was generally included within *Schoenus odontocarpus* as in Rye (1987). In 1995, type material of *S. odontocarpus* was examined at MEL to determine which of the two taxa was true *S. odontocarpus* and then specimens of the new taxon were redetermined temporarily as *Schoenus* sp. aff. *odontocarpus*. *Schoenus odontocarpus* can be distinguished from the new species by its shorter floral glumes (1.5-2.5 mm long), which tend to have coarse hairs or teeth on the keel towards the apex, smaller anthers (0.5-0.8 mm long) and distinctive patterning on the nut. Its nut has 5-7 rows of cells between the ribs and the cells are of more uniform size than in *S. variicellae*.

There are two main variants of *Schoenus variicellae*. The typical variant has anthers 1.7-2.4 mm long and extends from Kalbarri south to Guildford and Wooroloo and inland to Walling Rock Station. The atypical variant has anthers 1.2-1.5 mm long and occurs in the extreme south-west from near Bunbury south-west to the lower Scott River and south-east to the upper Shannon River. The south-western variant also tends to have less densely clustered spikelets and shorter glumes than the typical variant but the two variants overlap in these characters.

Acknowledgements

I am grateful to Karen Wilson for advice on the annual *Schoenus* species and comments on the manuscript, Paul Wilson for preparing the Latin diagnoses and Margaret Pieroni for the illustration.

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New species of Cyperaceae in Western Australia

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Abstract

K.L. Wilson. New species of Cyperaceae in Western Australia. Nuytsia 11 (2): 269-282 (1997). The following new species of Cyperaceae from Western Australia are described: *Cyathochaeta equitans* K.L. Wilson (*C. clandestina auct.*), *C. stipoides* K.L. Wilson, *Eleocharis keigheryi* K.L. Wilson, *Gahnia sclerioides* K.L. Wilson, *Schoenus calcatus* K.L. Wilson, *S. griffinianus* K.L. Wilson and *S. insolitus* K.L. Wilson.

Introduction

The family Cyperaceae has numerous genera and species in Western Australia, including many endemics in the south-west of the State. There are numerous undescribed species in that region, not only in the large genera like *Lepidosperma* and *Schoenus* but even in small genera such as *Cyathochaeta*. Several of these species are here described, particularly some of the rarer species that are of conservation concern. Detailed locality information has sometimes been omitted for the apparently rare species; this is available to researchers on application through PERTH. Rarity is indicated by the Conservation Codes used by CALM for its "Declared Rare and Priority Flora List" (these are detailed at the end of each issue of Nuytsia) and also those used by Briggs & Leigh (1996) in the ROTAP classification.

It should be noted that measurements of culm and leaf widths are taken about halfway along the relevant organ. Culm length is measured from the base of the plant to the base of the inflorescence. In some species, the culm is short but the plant as a whole is quite tall because the inflorescence is much longer than the culm.

Cyathochaeta Nees

Cyathochaeta equitans K.L. Wilson, *sp. nov.*

Species basibus plantarum equitantibus, apice obtuse vaginae folii ligula obtusa membranacea brunnea, setis perianthii partim connatis, a congeneribus diversa.

Typus: Intersection of Mallee Rd and Ridge Rd, Whicher Range, south-south-east of Busselton, Western Australia, 19 November 1994, *K.L. Wilson* 8959 & *K. Frank* (*holo:* NSW; *iso:* K, PERTH).

Tall tussock-forming *perennial*, equitant, with short woody rootstock. *Culms* erect, 1-2-noded, terete, smooth, yellow-green, 60-120 cm high, *c.* 3 mm diam. *Leaves* basal and cauline; blade thickly canaliculate (margins can be inrolled with age and then can appear terete) to flat near apex, scabrous on margins, shorter than culms, to 80 cm long; ligule brown-membranous, obtuse, to 7 mm long; sheath strongly flattened, striate, pale yellow to grey-brown, split deeply with margins overlapping. *Involucral bracts* leaf-like, with blade to 10 cm long; sheath (5)6-8 cm long, with overlapping margins. *Inflorescence* narrow, interrupted, spike-like, 40-70 cm long, with *c.* 7 more or less distant nodes; internodes to *c.* 12 cm long. *Spikelets* 2 or 3, rarely 5 per node, sessile or on pedicel to 12 cm long, mostly hidden by sheathing base of bract at upper nodes but pedicellate spikelets at lowest 1 (or 2) node(s) much exceeding the sheath (by up to 5 cm). *Glumes* 4 (2 sterile at base, 1 sterile at apex, 1 nut-producing in middle), glabrous, with very long-acute mucronate apex, pale yellow-brown, 2.5-5 cm long, *c.* 4 mm wide when spread out. *Perianth bristles* free above, seta-like and scabrous, densely antrorsely white-ciliate in lower half, fused for 3-5 mm from base of the nut, falling with nut, exceeding to as long as nut, to 2.5 cm long. *Stamens* 2; anthers 2.0-2.7 cm long, excluding linear apical appendage 0.4-1.0 mm long. *Style* 2-fid; style-base awn-like, very elongated, persistent, geniculate or strongly bent about halfway along length, twisted with age in lower half, scabrous, about 3-6 times as long as nut, 5-7 cm long. *Nut* more or less linear in outline, terete in cross-section, with 2 longitudinal pale nerves, scabrous near apex, otherwise glabrous, dark yellow-brown to blackish, *c.* 10 mm long including pungent callus-like base, *c.* 1.5 mm diam.

Selected specimens examined. WESTERN AUSTRALIA: Junction of Tootbardie Rd and Coorow-Green Head road, Alexander Morrison National Park, 9 Nov. 1994, *K.L. Wilson* 8828 & *K. Frank* (NSW, PERTH); Gales Road, Ambergate, 22 Oct. 1979, *K.L. Wilson* 3063 (NSW); Albany District Reserve 18739, 18 Oct. 1975, *J.S. Beard* 7713 (NSW); 7 km SE of Wellstead on Cape Riche road, 16 Oct. 1979, *K.L. Wilson* 2950 (NSW); East Mt Barren, Fitzgerald River National Park, 15 Oct. 1979, *K.L. Wilson* 2889 (NSW); western end of Lucky Bay, Cape Le Grand National Park, 30 Nov. 1994, *K.L. Wilson* 9199 & *K. Frank* (NSW, PERTH); 3 km W of Israelite Bay ruins, 7 Jan. 1979, *M.D. Crisp* 4885 (CANB, NSW).

Distribution. A widespread species in south-western Western Australia from Israelite Bay in the east to the Albany region, with an apparent gap in distribution west to the Busselton area, with another gap north to the Alexander Morrison National Park south-east of Eneabba. These apparent gaps may reflect unsuitable habitats or (perhaps more likely) inadequate collecting.

Habitat. Grows in tall heathlands and low Jarrah/Marri woodland, on sandy soils.

Phenology. Flowering January-February; fruiting probably February-March.

Conservation status. Apparently a common and widespread species, adequately conserved. In contrast, *C. clandestina*, the species that most specimens of *C. equitans* have been misidentifed as, appears to be of much more limited distribution (known only from the southern part of the Donnelly River to the Scott River Plain) and should be surveyed to determine its conservation status.

Epithet. From the Latin *equitare*, to ride, referring to the strongly equitant base of the plant, whereby the flattened leaf bases are in two ranks, 'riding' over their neighbours. This condition is best developed in this species; of the other species, only *C. clandestina* shows partial flattening of the bases.

Relationships. This species is unique in the genus in having strongly equitant bases and an obtuse apex to the leaf sheath with an obtuse brown membranous ligule up to 7 mm long (it may be partially lost with age).

Formerly, specimens of this have been misnamed as *C. clandestina* (R. Br.) Benth., which is a similarly robust species with long spikelets that are mostly hidden by the long sheaths of the involucral bracts, at least at the upper nodes. However, spikelets at the lowest 1 or occasionally 2 inflorescence nodes in *C. equitans* are more numerous and often on branches to 12 cm long that extend beyond the sheath by up to 5 cm. Plants of *C. clandestina* have only slightly flattened bases, and they are thicker textured, smooth, glossy, and brighter yellow in colour. Leaf blades are thicker in *C. clandestina*, being thickly canaliculate to hemispherical for most of their length (flat at apex). *C. stipoides* (*q.v.*) also has long spikelets more or less hidden by the sheaths, but differs in being more slender and having perianth bristles reduced to a completely fused, cone-like, white-ciliate base (at least at maturity - it is possible that immature bristles may have a seta-like apex as in other species).

Cyathochaeta stipoides K.L. Wilson, *sp. nov.*

Aff. *C. clandestinae* sed omnibus partibus graciliori, laminis teretibus brevioribusque, setis perianthii reductis connatisque, differt.

Typus: 5 km north of Windy Harbour on road to Northcliffe, D'Entrecasteaux National Park, Western Australia, 22 November 1994, *K.L. Wilson* 9020 & *K. Frank* (*holo*: NSW; *iso:* K, PERTH).

Tall tussock-forming *perennial*, very shortly rhizomatous. *Culms* erect, 1-3-noded, terete, smooth, (25)35-100 cm high, 1.0-1.7 mm diam. *Leaves* basal and cauline; blade terete, sulcate at the base, smooth, shorter than culms, very reduced or to 20 cm long; ligule membranous, delicate and often breaking up into 2 long-narrow-triangular vertical extensions to 5 mm long, hyaline or white or red-tinged; sheath rounded, greenish to yellow-brown with reddish tinges, split deeply with margins overlapping. *Involucral bracts* leaf-like, with 'blade' to 5 mm long; sheath 4-5 cm long, with overlapping margins. *Inflorescence* narrow, interrupted, spike-like, to 30 cm long, with 3-7 more or less distant nodes; internodes 3-4 cm long. *Spikelets* solitary at nodes, sessile, all except apex hidden by sheathing base of bract. *Glumes* 3 (1 sterile at base and apex, 1 nut-producing in middle), glabrous or faintly scabrous, with very long-acute apex, inrolled, red-brown, 3.5-4.7 mm long, *c.* 3.5 mm wide when spread out. *Perianth bristles* reduced and fused to form a close-fitting cone over the base of the nut, densely antrorsely white-ciliate, adnate to and falling with nut, 7-10 mm long. *Stamens* 2; anthers not seen. *Style* 2-fid; style-base awn-like, very elongated, persistent, geniculate or strongly bent about halfway along length, twisted with age in lower half, scabrous, about 3 times as long as nut, 5-6 cm long. *Nut* more or less linear in outline, terete in cross-section, with 2 longitudinal pale nerves or faint furrows, glabrous, yellow-brown to dark yellow-brown, 10-18 mm long including pungent callus-like base, *c.* 1.5 mm diam. (Figure 1A, B)

Other specimens examined. WESTERN AUSTRALIA: 9 km SW of Bow Bridge on Ficifolia Rd, 20 Oct. 1979, *K.L. Wilson* 3006 (NSW, PERTH); Maringup Rd, 1.2 km S of Chesapeake Rd junction, 18 Jan. 1992, *N. Gibson & M. Lyons* 813 (PERTH); Windy Harbour Rd, *c.* 6.2 km NE of Windy Harbour, 3 May 1991, *N. Gibson & M. Lyons* 645 (PERTH); Windy Harbour Rd, *c.* 3 km NE of Windy Harbour, 3 May 1991, *N. Gibson & M. Lyons* 643 (PERTH); Scott River Rd, 2 km N of Milyeannup Coast Rd junction, 0.6 km W of road, Scott River National Park, 9 Apr. 1990, *N. Gibson & M. Lyons* 153 and 24 Oct. 1990, 955 (PERTH); Scott River Plains, 24 Oct. 1948, *R.D. Royce* 2971 (PERTH); Scott River Rd, *c.* 4 km W of intersection with Milyeannup Coast Rd, Scott National Park, 20 Nov. 1994, *K.L. Wilson* 8972 & *K. Frank* (NSW, PERTH).

Distribution. Near Bow Bridge, Windy Harbour and on Scott River Plain, so presumably occurring in the intervening coastal heath regions.

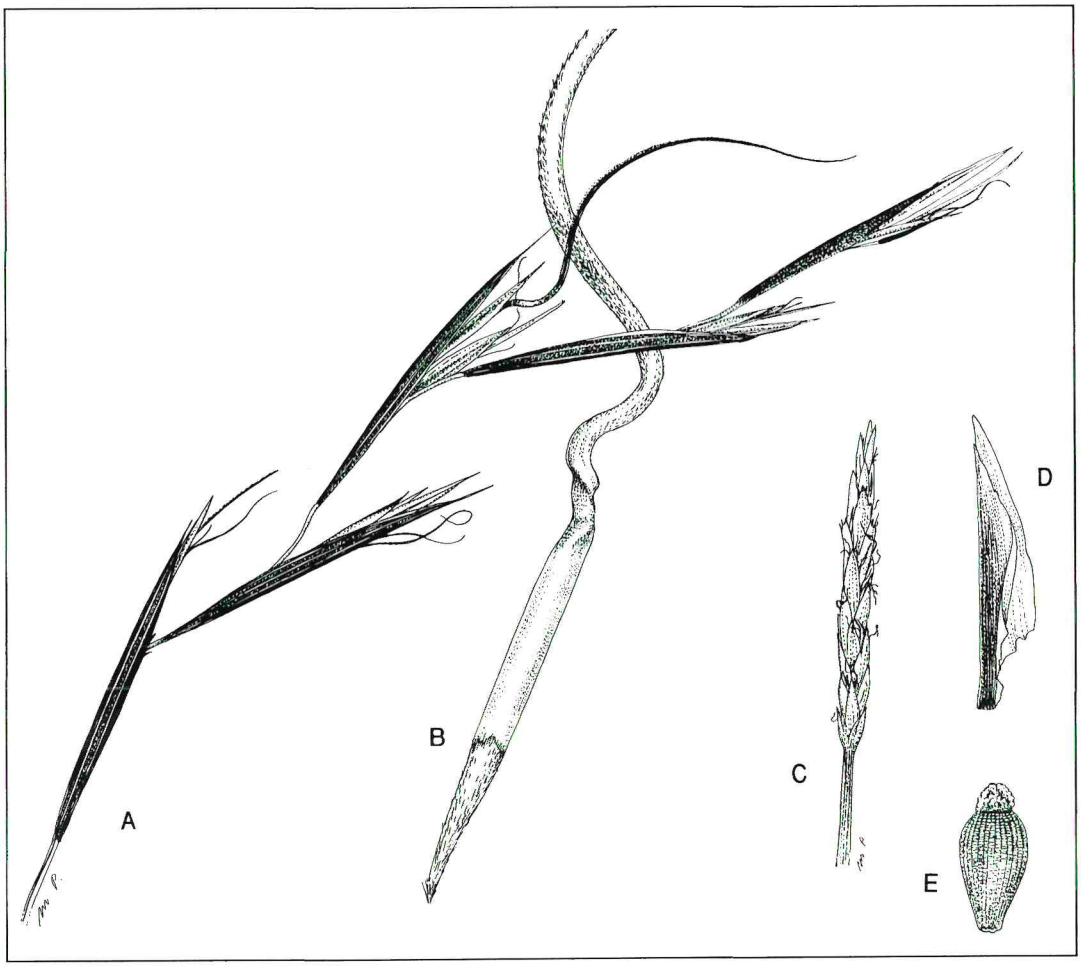

Figure 1. A, B *Cyathochaeta stipoides* A - portion of inflorescence showing spikelets mostly enclosed by sheathing bract, and with one persistent, twisted style-base protruding from a spikelet (x1); B - nut, showing portion of the persistent style-base at the apex and the white, ciliate 'cap' of reduced perianth bristles at base (x3). C-E. *Eleocharis keigheryi* C - inflorescence (x1.8); D - glume (x9); E - nut, showing persistent, fused style-base at apex (x9). Drawn from the type *K.L. Wilson* 9020 & *K. Frank* (A, B), *G.J. Keighery* 5154 (C) and *G.J. Keighery* 1832 (D, E).

Habitat. On winter-wet flats in low heathy sedgelands, on grey sandy soils.

Phenology. Flowering October-January and possibly to February; fruiting November-May.

Conservation status. Should be considered for listing as a Priority 3 taxon in the CALM Conservation Code and ROTAP Conservation Code 3KC- (Briggs & Leigh 1996) since it is known from a few populations (but their size unknown), at least two in a national park.

Epithet. Refers to the resemblance of the diaspore to that of species of the grass genus *Stipa* L. and its relatives in the tribe Stipeae. The resemblance is only superficial but is striking. The 'awn' of *Cyathochaeta* is in fact the very elongated, tough style-base persistent on the nut, whereas the awn of *Stipa sens. lat.* is an apical outgrowth of the lemma (Vickery, Jacobs & Everett 1986).

Relationships. A slender species compared with other Western Australian species in this genus. It is most similar in floral characters to *C. clandestina* and *C. equitans*. The long sheathing base to the involucral bract hides most of the subtended spikelet as in *C. clandestina* but is usually shorter than in that species (4-5 cm long versus 4-8 cm in *C. clandestina).* The spikelets at the upper nodes in *C. equitans* are similarly hidden by the long sheathing bases, which are (5)6-8 cm long. However, spikelets at the lowest inflorescence node in *C. equitans* are more numerous and often on branches to 12 cm long that extend beyond the sheathing base by 5 cm. The awn-like persistent style-base of *C. stipoides* is similar to that of *C. equitans* but is shorter. The perianth bristles are reduced and fused in a cone-like cap about 7-10 mm long over the base of the nut whereas in *C. equitans* the bristles have a scabrous, seta-like apical portion as well as the fused basal portion (which is only 3-5 mm long). The reduced perianth bristles of *C. stipoides* are unique in the genus so far as known (mature nuts are unknown for *C. clandestina*), but a greater range of material needs to be collected to determine whether a deciduous, scabrous upper portion is present at early stages of growth. The nuts of *C. stipoides* and *C. equitans* are very similar, both being terete in cross-section, with the style-base being relatively much longer than the nut. Only immature nuts are known for *C. clandestina*; these are concavo-convex with inrolled margins, and attached perianth bristles are reduced, not fused at the base, and apparently only 3 in number. The leaf blades of *C. stipoides* are terete in cross-section, unlike those of the other species, which are crescentiform to flat in *C. equitans*, thickly canaliculate to hemispherical to flat at the apex in *C. clandestina*, hemispherical to crescentiform in *C. avenacea* (R. Br.) Benth., or oval (sulcate near the base) in *C. teretifolia* W.V. Fitzg. The ligule in *C. stipoides* is delicate and often breaks up into two long-narrow-triangular membranous vertical extensions, and is hyaline or white or red-tinged, whereas that of *C. equitans* is obtuse, brown, and membranous. The tufted bases of the plants are rounded, similar to those of *C. avenacea* and unlike those of *C. equitans*, which are equitant (fan-shaped).

The only non-western species in this genus, *C. diandra* Nees from south-eastern Australia, is similar in size to *C. stipoides* but differs in various characters, notably in having a compound inflorescence with several lateral branches at each node; short sheaths on the involucral bracts not hiding the spikelets; nuts more or less concavo-convex in cross-section with margins inrolled, and about as long as the (short) awn; leaf sheaths that soon disintegrate to form fibrous remains around the culm bases; and leaf blades triangular to v-shaped in cross-section.

Eleocharis R. Br.

Eleocharis keigheryi K.L. Wilson, *sp. nov.*

Ab *E. ochrostachye* et specie inedita aff. *E. ochrostachyis* combinatione characterum sequenti differt: achenium leniter 3-angulare, stylobasis angusta, setae hypogynae nullae, medulla culmi densiori.

Typus: Ellen Brook Tortoise Reserve, 21 miles [34 km] north of Perth, Western Australia, 19 October 1978, *G.J. Keighery* 1832 (*holo:* PERTH 02266865).

Slender *perennial,* tufted, very shortly rhizomatous. *Culms* erect, terete, smooth, yellow-green, with multiple septa internally (not visible externally), 20-40 cm high, 1-2 mm diam., often with numerous filiform sterile leaf-like culms at base of tuft. *Leaves* reduced to basal sheaths, straw-coloured or red-tinged, more or less dull, with oblique apex. *Inflorescence* a single terminal spikelet, narrow-cylindrical, erect, slightly broader than culm, 1.3-4 cm long, 2-3 mm diam. *Glumes* spirally arranged, oblong to narrow-obovate, with obtuse apex, more or less chartaceous with hyaline margin 0.2-0.3 mm wide (or sides occasionally

more or less hyaline for most of width), with the midvein occasionally obvious but otherwise very similar to the rest of the veins, 4.5-5.5 mm long, 1.5-2 mm wide. *Perianth bristles* absent or 1 short vestigial bristle present at least in younger flowers. *Stamens* 3; anthers 2.0-2.7 mm long, plus apical appendage *c.* 0.1 mm long. *Style* 3-fid; style-base enlarged and persistent on nut, glabrous, *c.* 0.3 mm long, 1/3-1/2 width of nut. *Nut* obovate in outline, planoconvex with a weak third rib on the convex surface, trabeculate with 14-20 columns of transversely elongated cells per face, pale straw-coloured, 1.8-2.2 mm long (not including style-base), *c.* 1.0 mm diam. (Figure 1C-E)

Other specimens examined. WESTERN AUSTRALIA: Proposed Lesueur National Park *c.* 5.5 km E of Mount Peron trig, NE of Jurien, 5 Sep. 1985, *E.A. Griffin* 4209 (CANB, PERTH); Cataby Creek, 3 km S of Cataby, *c.* 160 km N of Perth, 28 Aug. 1982, *G.J. Keighery* 5154 (NSW, PERTH); 3.3 km N along Wannamal road from Gingin road intersection of Wells Glover Rd, South Bindoon, 18 Sep. 1983, *R.J. Cranfield* 4153 (PERTH); 2 km N of Waroona (Reserve C53) on road to Pinjarra (South Western Highway), 14 Nov. 1994, *K.L. Wilson* 8893 *et al.* (NSW, PERTH); 9 km along Railway Rd, Boyanup to Capel, 29 Aug. 1984, *G.J. Keighery* 6981 (PERTH).

Distribution. Known from the Mt Lesueur area near Jurien and south along the Swan Coastal Plain to near Capel.

Habitat. In seasonally water-filled clay pans and drainage lines, in water to about 15 cm deep, in clayey soils.

Phenology. Flowering August-November; fruiting September-November.

Conservation status. CALM Conservation Code: listed as Priority 3. Briggs & Leigh (1996) list it as 3KC- (geographic range > 100 km; poorly known; occurring in reserves but population size(s) not accurately known).

Epithet. Named after Gregory J. Keighery, who collected the first specimens of this species and who has extensively collected the sedges of the south-west when many have ignored them.

Relationships. The species is probably best placed in *Eleocharis* series *Mutatae* Svenson (terminology as in Blake 1939) despite the variable venation of the glumes in *E. keigheryi* (the central vein is often more prominent than the lateral veins, which may be few in number, unlike most species of series *Mutatae*, which usually have numerous equal-sized veins). It is unusual in that series in being a temperate species; most of the other species are tropical. The only other species of that section in the south-west is *E. sphacelata* R. Br., readily distinguished by its obviously transversely septate, mostly dark green culms, its stout and rather woody rhizome, its broad nut with more or less isodiametric epidermal cell outlines, and its well-developed perianth bristles.

In series *Mutatae*, the species morphologically most similar to *E. keigheryi* are *E. ochrostachys* Steud. and a related undescribed species from northern Australia that produces many filiform sterile leaf-like culms. However, there are numerous differences between *E. keigheryi* and these species, most notably in the absence of perianth bristles in *E. keigheryi* and in the form of the nut and style-base.

Nuts with a trabeculate surface are also found in series *Aciculares* (C.B. Clarke) Svenson. However, there are many differences between *E. keigheryi* and species in series *Aciculares*, which are generally

much more slender plants than *E. keigheryi*, with a distinct midvein on the glumes, and mostly with the lowest glume fertile (*E. atricha* R. Br. is a notable exception to that). The nut in that series is generally more or less terete and there is a distinct division, often a small neck, between the top of the nut and the persistent style-base, unlike that of *E. keigheryi*, which is less clearly delineated from the nut in the few fruiting examples known.

Notes. Specimens of this taxon have been given the phrase name *Eleocharis* sp. Kenwick (*G.J. Keighery* 5179) in PERTH.

Gahnia Forst. & Forst. f.

Gahnia sclerioides K.L. Wilson, *sp. nov.*

Species habitu graminoideo glumis subsimilibus cum *G. insignis* optime congruens, sed differt in glumis pluribus, culmis cavis, foliis latioribus sed in partes ceteri minores.

Typus: c. 33 km south-west of Busselton by road, north end of Yelverton State Forest, Western Australia, 18 November 1994, *K.L. Wilson* 8936 & *K. Frank* (*holo:* NSW; *iso:* CHR, K, P, PERTH).

Lax, slender, rhizomatous *perennial. Culms* slender, terete, hollow, with 4-6 nodes, branching at the base, 30-90 cm high, 1-1.5 mm diam. *Leaves* with blades more or less flat, relatively soft-textured, erect to spreading, twisted 180° about halfway along their length, with scabrous margins, shorter than culms, to 35 cm long, 2.5-4 mm wide; ligule white-ciliate, 0.1-0.2 mm long, occasionally with hairs to 1.5 mm long near the margins; sheath greenish. *Inflorescence* slender, lax with branches rather drooping, 20-50 cm long. *Spikelets* not clustered, with 1 nut-producing flower above 0-2 male flowers; subtending bract usually similar to glumes; glumes 4 or 5, ovate, with long-acute apex *c.* 0.5 mm long, lower 2 glumes sterile and occasionally slightly shorter and narrower than upper glumes, all glabrous or with a few fine hairs near apex, greenish to pale straw-coloured with dark purple-red patches towards apex, (2.7)3.5-4.5 mm long. *Stamens* 3; anthers 1.3-1.6 mm long, plus apical appendage *c.* 0.2 mm long; filaments not strongly elongated or persistent. *Style* 3-fid. *Nut* obovate to oblong-obovate, trigonous, glabrous, very finely reticulate-colliculate, glistening, pale straw-coloured to dark yellow-brown at maturity, 2.0-2.2 mm long, 1.0-1.2 mm diam. (Figure 2A-C)

Other specimens examined. WESTERN AUSTRALIA: West Cape Howe, 6 Mar. 1956, *R.D. Royce* 5405 (PERTH); William Bay National Park, 23 Nov. 1994, *K.L. Wilson* 9050 & *K. Frank* (NSW, PERTH); Parryville [Denmark Shire], 5 Sep. 1947, *J. Willis,* Grimwade Expedition (PERTH); 7 km ENE of Walpole, 28 Jan. 1992, *G. Wardell-Johnson* GWJ43 (PERTH); Yelverton State Forest, 8 Nov. 1989, *G. Keighery* 10820 (PERTH).

Distribution. Known from only six collections, from Yelverton State Forest, and further south-east from the areas of William Bay, Denmark, Walpole and West Cape Howe.

Habitat. In moist, shaded situations in Jarrah forest, on sandy soil. The only other south-west species of *Gahnia* in a similar situation is *G. decomposita* (R. Br.) Benth., but that is a very different-looking plant, being taller and stouter, and scabrous-papillose on most surfaces except the black uppermost fertile glumes in each spikelet.

Phenology. Flowering time unknown; fruiting time includes November.

Conservation status. CALM Conservation Code: should be considered a Priority 3 taxon since its distribution is poorly known although it has been collected from at least one site in a national park. In the Briggs & Leigh (1996) ROTAP classification, it would be 3KC- (geographic range > 100 km; poorly known; occurring in reserves but population size(s) not accurately known).

Epithet. Named from the superficial resemblance of its spikelets to those of some slender species of the genus *Scleria* Berg.

Relationships. Not closely related to any of the Western Australian species. It is curious that this species is morphologically most similar to *G. insignis* S.T. Blake, another slender species from similarly shaded, rather moist habitats in south-eastern Queensland and north-eastern New South Wales. These two species differ from most other species of *Gahnia* in having the sterile glumes of a similar size and shape to the fertile glumes in a spikelet (Blake 1957). Both species have numerous cauline leaves, one nut-producing flower in each spikelet, and staminal filaments that are not greatly elongated or persistent as in many other species in the genus (Benl 1937). However, *G. insignis* differs from *G. sclerioides* in having spikelets with only 2 or 3 glumes (4-6 mm long); anthers 3-3.5 mm long, with an apical appendage 0.3-0.4 mm long; and nuts 2.2-2.8 mm long, 1.0-1.3 mm diam. The culms of *G. insignis* are often longer (50-200 cm) and coarser (1-2.5 mm diam.), and are usually solid or rarely with the narrow pith-filled core breaking down, unlike those of *G. sclerioides*, which have a large hollow cylindrical core. *G. insignis* usually has narrower leaves (1.5-2.7 mm wide) that inroll strongly when dried; the leaves of *G. sclerioides* tend to remain flattish when dried.

Notes. This taxon has been known by the phrase name *Gahnia* sp. Yelverton (*G.J. Keighery* 10820) in PERTH.

There is variation between the Yelverton specimens and those from farther east. Yelverton specimens have shorter leaf blades and clusters of longer hairs on the margins of the ligule; their spikelets have two basal sterile glumes, which are slightly shorter than the fertile glumes but all are in the range 3.5-4.5 mm long. In contrast, the more easterly specimens lack longer hairs on the ligule margins; there are two or three sterile glumes at the base of the spikelet, which are not shorter than the fertile glumes (they may even be slightly longer than them) all being in the range 2.7-4 mm long.

Schoenus L.

Schoenus calcatus K.L. Wilson, *sp. nov.*

Species ab aliis congeneribus combinatione characterum sequenti distinguitur: pulvinos humiles tenaces formans; lamina folii rigida reductaque, vagina folii fulva orificio lanato; inflorescentia 1-spiculata.

Typus: 28 miles [45 km] east of Newdegate, Western Australia, 25 April 1969, *A.S. George* 9284 (*holo:* NSW; *iso:* PERTH).

Small *perennial,* forming cushions to 30 cm diam. *Culms* densely tufted and intertwining, noded with leaves hiding the culms, erect, to 2.5 cm long. *Leaves* arranged spirally; blades reduced, oval in cross-section, smooth, with broad-acute apex, adaxially usually with a pale central longitudinal band without

stomates, abaxially with 3 such bands on the margins and centrally, 2.5-4 mm long; sheaths yellow-brown, with hyaline margins, smooth; apex of sheath split deeply (margins not overlapping), very woolly (hairs lost with age). *Inflorescence* of a single small, erect, terminal spikelet; involucral bract leaf-like, with woolly apex to sheath. *Spikelet* sessile, not falcate, *c.* 4 mm long, with 1 nut-producing flower, often with a male flower below it; glumes 2 or 3, straw-coloured, shining, stiffly membranous, without prominent midrib, with broad-acute to retuse apex, with leaf-like mucro on lowest glume, with margins woolly on lower 1 or 2 glumes and glabrous on upper glume(s), 3-4 mm long. *Perianth bristles* absent. *Stamens* 3 or 4; anthers yellow, 1.7-2.2 mm long, plus apical appendage 0.1-0.2 mm long. *Style* 3-4-fid. *Nut* (so far as seen) elliptic in outline, symmetrical, obscurely 3-angled, golden-pubescent over at least upper half, mid-brown, minutely granular, *c.* 2.3 mm long, *c.* 1.2 mm diam. (Figure 2D,E)

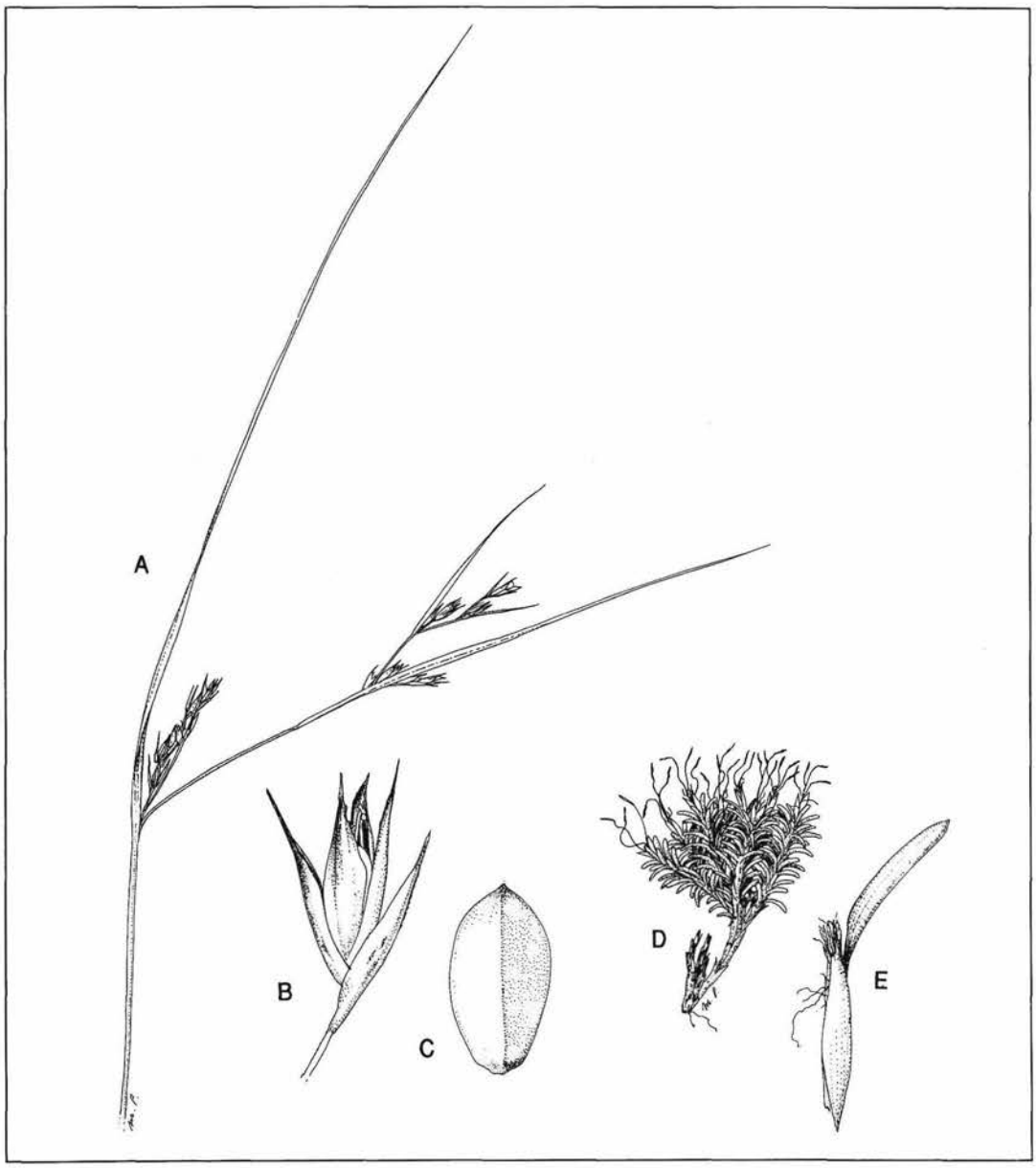

Figure 2. A-C *Gahnia sclerioides* A - portion of inflorescence (x1); B - spikelet (x7); C - nut (x12). D, E. *Schoenus calcatus* D - tuft of whole plant, showing several culms, with anthers protruding from spikelets (x1); E - leaf, showing short blade and sheath, with ciliate apex to sheath (x10). Drawn from the type *K.L. Wilson* 8936 *& K. Frank* (A-C) and *A.S. George* 7382 (D, E).

Selected specimens examined. WESTERN AUSTRALIA: Durokoppin Reserve, 4 June 1987, *L. Atkins* HLA 36 (PERTH); 14 km E of Newdegate on Lake King road, 12 Oct. 1979, *K.L. Wilson* 2785 (NSW, PERTH); Lake King-Ravensthorpe road, Jan.-Feb. 1966, *A.S. George s.n.* (NSW, PERTH), 16 Jan. 1966, *A.S. George* 7382 (PERTH), 27 Oct. 1985, *J. McCarthy* 6 *et al.* (NSW); One Mile Rocks Reserve, SE of Lake King, 2 June 1979, *A.S. George* 15731 (PERTH); Dunn Rock Nature Reserve, 30 km SW of Lake King, 15 Apr. 1984, *D.J. Backshall* 228 (PERTH); 2 km S of Mt Gibbs, 10 Aug. 1979, *K.R. Newbey* 5480 (PERTH).

Distribution. Apparently most common in the Newdegate-Lake King region, with two apparent outlying occurrences farther north near Kellerberrin and Ballidu. Probably occurs (or did occur) in suitable habitats in the intervening areas.

Habitat. Forming low cushions or mats in open shrubland on clayey soils (over laterite).

Phenology. Flowering March-April; fruiting April (rarely collected in fruit).

Conservation status. CALM Conservation Code: this species should be treated as a Priority 3 taxon to encourage further surveys. In the terminology of Briggs & Leigh (1996), this species would be classified as 3KC- (geographic range > 100 km; poorly known; occurring in reserves but population size(s) not accurately known).

Epithet. From the Latin *calcare*, to tread upon, walk over, referring to one of the potential threats to this species with its low, mat- or cushion-like form.

Relationships. Not closely related to any other member of the genus described so far, but further study is needed of other (un-named) cushion-forming species before its relationships can be understood. For this purpose, more fruiting material of *S. calcatus* is needed.

Notes. Specimens of this taxon in PERTH have been housed under the phrase name *Schoenus* sp. Newdegate Cushion (*A.S. George* 9284).

This is unusual in the genus in often having one of the three style-branches secondarily divided (e.g. in *George* 9284 and *Atkins* HLA 36). It is also unusual in apparently being a 'resurrection plant' - its foliage is reported to become orange in summer (A. George pers. comm.; note on *Atkins* HLA 36).

Schoenus griffinianus K.L. Wilson, *sp. nov.*

Inter species sectionis *Stricti* combinatione sequenti characterum distinguitur: nux papillosa, erugosa; culmi quam inflorescentiarum breviores, valde costati, valde hispidulae; apex vaginae foliis longe ciliatus; spiculae 4-7 mm longae.

Typus: c. 4 km east-north-east of Eneabba on Three Springs road, Western Australia, 9 November 1994, *K.L. Wilson* 8835 & *K. Frank* (*holo:* NSW 363902; *iso:* K, P, PERTH).

Small tufted *perennial. Culms* erect, more or less terete, strongly ribbed, strongly hispidulous to more or less long-papillose, usually with 1 node, not swollen at the base, much shorter than the inflorescence, 0.5-5 cm long. *Leaf blades* exceeding the culms but shorter than the inflorescence, to 3 cm long, 0.5-0.7 mm wide, somewhat curly, rigid, thick, more or less flat in cross-section, with hispid margins,

adaxially smooth, abaxially strongly and thickly 3-ribbed and hispid between the ribs, with acute to obtuse apex; sheaths split to base, yellow-brown to dark red-brown towards the base, white on the margins and towards the apex, glabrous, more or less dull, membranous to chartaceous; apex of sheath truncate, long-ciliate, produced beyond the attachment point of the blade. *Involucral bracts* leaf-like but with the sheath occasionally only split for about half its length and occasionally scabrous; the blade portion exceeding the subtended spikelet, to 2.5 cm long. *Inflorescence* raceme-like, erect, with spikelets solitary at 2 or 3 widely separated nodes, occasionally reduced to a single small cluster of spikelets or with uppermost nodes reduced to give an apparent cluster of spikelets, longer than the culms, to 4 cm long. *Spikelets* sessile, 4-7 mm long, *c.* 2.5 mm wide in side view; mature rachilla zigzag; glumes 3, lowest or uppermost sterile, other 2 nut-producing, 3.5-5 mm long (uppermost slightly smaller than others), hyaline or whitish with red-brown tinge or patches with prominent green keel, more or less shining, margins ciliate, midrib hispidulous, lowest glume shortly mucronate, upper 2 glumes acute. *Perianth* absent. *Stamens* 3; anthers 1.1-1.3 mm long, plus apical appendage 0.1-0.2 mm long. *Style* 3-fid. *Nut* ellipsoid narrowing to a short stipe-like base, trigonous, faintly 3-ribbed, yellow-brown overlaid with red-brown patches, more or less dull, glabrous but with scattered large papillae on upper half and tiny papillae all over surface, *c.* 1.5 mm long (including stipe-like base 0.2-0.3 mm long), *c.* 1 mm diam. (Figure 3A-C)

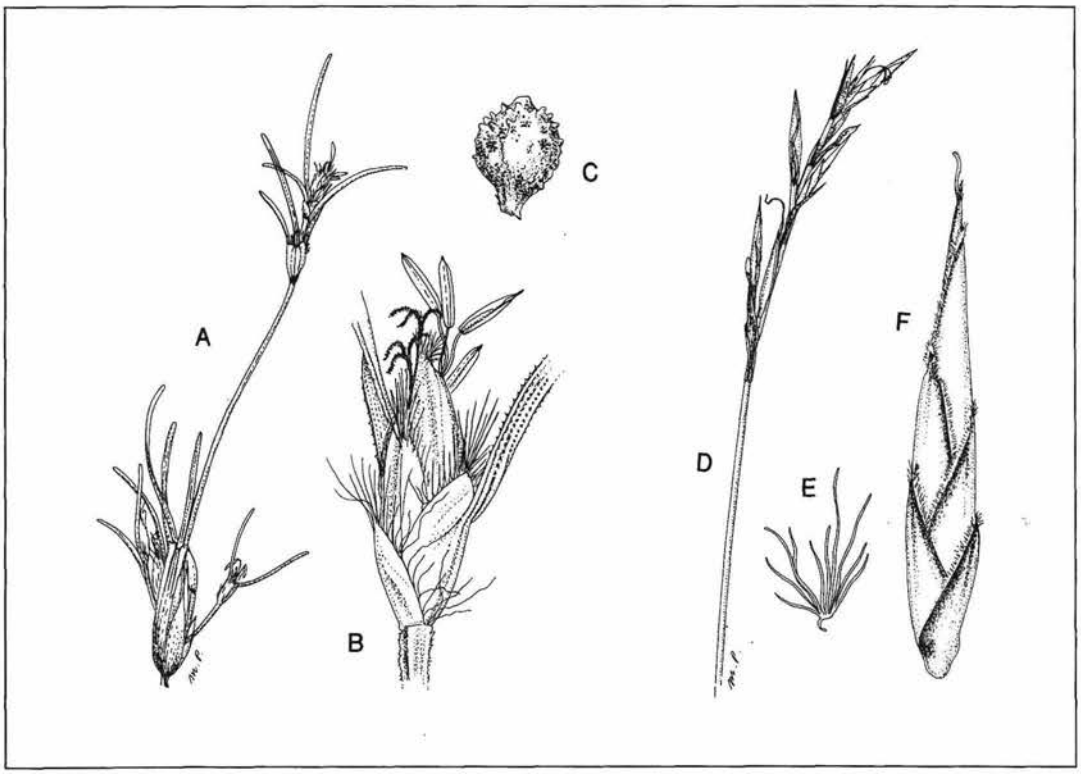

Figure 3. A-C *Schoenus griffinianus* A - inflorescence (x1); B - spikelet (x7.5); C - nut (x10). D-F. *Schoenus insolitus* D - inflorescence (x1); E - a substellate hair from leaf sheath (x20); F - spikelet (x6). Drawn from *C.M. Parker* 276 (A-C), *E.A. Griffin* 4712 (D, F) and the type *K.L. Wilson* 8823 & *K. Frank* (E).

Other specimens examined. WESTERN AUSTRALIA: Victoria location 10240, 8 km SSE of Eneabba, 7 Nov. 1984, *E.A. Griffin* 3841 (NSW, PERTH); *c.* 8 km S of Eneabba, 28 Sep. 1977, *R.J. Hnatiuk* 771442 (PERTH); Wongan Hills Experimental Farm, Reserve 18672, 24 Oct. 1984, *C.M. Parker* 276 (NSW, PERTH), 11 Oct. 1985, *C.M. Parker* 354 & *P.J. Poli* (CANB, CHR, K, NSW, PERTH).

Distribution and habitat. Only known from a few collections from near Eneabba and Wongan Hills, growing in disturbed areas such as firebreaks in low heath, on sand.

Phenology. Flowering September-October; fruiting November.

Conservation status. CALM Conservation Code: listed as Priority 2 - a poorly known taxon that is only known from a few populations, one of which is in a reserve near Wongan Hills. Briggs & Leigh (1996) list this species as 3K (geographic range > 100 km; poorly known); I suggest modification to 3KC- since one population is in a reserve.

Epithet. The species is named after E.A. (Ted) Griffin, an ecologist who has collected one of the specimens of this species, amongst many others collected during his survey work.

Relationships. This species fits in *Schoenus* section *Stricti* (Benth.) Benth. in Kuekenthal's classification of the genus (Kuekenthal 1938), which is still a convenient framework to use pending further study of other species in the genus. This species differs from others in that section in not having a rugose nut but is otherwise similar in being a smallish perennial species, with an erect raceme-like inflorescence with distant nodes and sessile spikelets, and lacking perianth bristles. Its most distinctive features are the deeply ribbed, strongly hispidulous culms, long-ciliate apex to the leaf-sheath, and the papillose nut. It does not closely resemble any known species, but has some similarities to *S. grammatophyllus* F. Muell., *S. asperocarpus* F. Muell., S. *obtusifolius* (Nees) Boeck. and *S. unispiculatus* F. Muell. ex Benth. The latter species was placed in section *Oligostachyi* (Benth.) Benth. by Kuekenthal, presumably because of its small inflorescence, but its affinities seem to lie with the small perennial species in section *Stricti*.

Notes. Specimens of this species in PERTH have been given the phrase name *Schoenus* sp. Wongan (*E.A. Griffin* 3841).

Schoenus insolitus K.L. Wilson, *sp. nov.*

Inter species sectionis *Nudicaules* indumento foliorum conferto albo substellatoque singulari distinguitur.

Typus: 30 km east of Brand Highway on the Green Head to Coorow road, Alexander Morrison National Park, Western Australia, 8 November 1994, *K.L. Wilson* 8823 & *K. Frank* (*holo:* NSW 363883; *iso:* PERTH).

Tufted *perennial. Culms* slender, wiry, erect, terete, smooth, not or rarely 1-noded, yellow-green, (15)35-45 cm high, *c.* 1.2 mm diam. *Leaf blades* reduced, erect, more or less triangular in cross-section, smooth (including margins) or occasionally with white hairs, abaxially 1-ribbed, with acute apex, much shorter than culm, to 8 mm long, 0.7-0.8 mm diam.; sheaths very shortly split at the apex in a v-shaped opening, margins not overlapping, pale to dark yellow-brown, densely hairy at least when young, can be lost with age; hairs white, more or less stellate but arms of unequal length so that the overall impression

is of antrorse hairs, 0.5-1 mm long. *Inflorescence* panicle-like, erect, (4)9-25 cm long, with 4-6 nodes, the lower nodes more distant (internodes to 16 cm long), each node with 2-4 spikelets. *Involucral bract* leaf-like, smooth or scabrous or minutely white-hairy, much shorter than the inflorescence, to 1 cm long; sheath often scabrous, with apex glabrous or sparsely white-hairy, shortly split in a v-shaped opening. *Spikelets* on pedicel to 4 cm long, narrow-elliptical to ovate in outline, not falcate, 11-17 mm long, *c.* 1.5 mm wide in side view; glumes 5 or 6, lowest 4 sterile, gradually increasing in length from base to apex of spikelet, lowest glume *c.* 7 mm long, upper (nut-producing) glumes 11-12 mm long, yellowish with red-brown to dark red-brown patches, often paler towards margins and apex, more or less shining, stiff, with more or less prominent midrib, sides glabrous or occasionally white-hairy, with margins white-ciliate at least near apex, with apex long-acute and mucronate. *Perianth bristles* absent or 1 vestigial bristle, white, deciduous, *c.* 1 mm long. *Stamens* 3; anthers *c.* 4.5 mm long, plus apical appendage to 1.5 mm long. *Style* 3-fid. *Nut* (slightly immature) narrow-elliptical to oblong in outline, glabrous, shining, dark red-brown, 4-6 mm long, *c.* 1 mm diam. (Figure 3D-F)

Selected specimens examined. WESTERN AUSTRALIA: 50 km W of Winchester on Eneabba road, 24 Aug. 1965, *A.C. Beauglehole* 12159 (PERTH); Alexander Morrison National Park, N of Coorow-Green Head road, 21 Oct. 1987, *E.A. Griffin* 4712 (NSW, PERTH); Victoria location 10240, 8 km SSE of Eneabba, 7 Nov. 1984, *E.A. Griffin* 3842 (PERTH); *c.* 11 km S of Leeman turn-off on Brand Highway, Eneabba South Nature Reserve, 9 Nov. 1994, *K.L. Wilson* 8841 & *K. Frank* (NSW, PERTH); 1 km W of Brand Highway along Green Head road, 2 Oct. 1979, *K.L. Wilson* 2690 (NSW, PERTH); between Scenic Rd and Capitella Rd, S of Dandaragan, 10 Sep. 1988, *E.A. Griffin* 4988 (PERTH); W of Watheroo near Magnetic Observatory, 19 Sep. 1958, *H. & E. Walter* 744 (PERTH).

Distribution. From near Carnamah and Eneabba south to the Dandaragan area.

Habitat. In low heath and shrubland, on sand (often over laterite).

Phenology. Flowering April-October; fruiting October-November.

Conservation status. CALM Conservation Code: was previously listed as a Priority 2 taxon but was removed following further collections being identified. Briggs & Leigh (1996) list this species as 2KC- (geographic range < 100 km; poorly known; population(s) in reserve(s) but population size(s) unknown).

Epithet. From the Latin *insolitus*, unusual, uncommon, strange, referring to the white, more or less stellate hairs that cover the leaves at least when young but are easily rubbed off. They are unique in the genus.

Relationships. This species is unique in the genus in its dense white substellate indumentum on leaves and occasionally also on involucral bracts and glumes; the indumentum is apparently often lost with age except near the base of the leaf sheaths. Other features such as its reduced leaf blades and slender but rigid panicle-like inflorescence with pedicellate spikelets clearly place it in *Schoenus* section *Nudicaules* Kuek. as defined by Kuekenthal (1938). *S. laevigatus* often has similarly coloured leaf sheaths with a shortly split apex but differs in having the split sheath margins overlapping.

Notes. Specimens of this taxon have been given the phrase name *Schoenus* sp. Warradarge (*E.A. Griffin* 3842) in PERTH.

No specimens have been seen with fully mature fruits. The species seems to drop its spikelets whole, rather than the individual glumes falling and leaving the rachilla behind as is usual in this genus.

Acknowledgements

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SHORT COMMUNICATIONS

A new subspecies of *Lambertia echinata* (Proteaceae)

During the field work for a floristic survey of the Swan Coastal Plain (Gibson *et al.* 1994) a series of areas of unusual plant communities on shallow soils over sheet ironstone were documented. A number of plant taxa found in these areas, including *Lambertia echinata* R. Br., have been reduced to a single or very few populations with critically low numbers of individuals.

This population is one of a number of disjunct populations of Proteaceae that are found in the Whicher Range and foothills. These include *Conospermum teretifolium* R.Br., *Dryandra formosa* R. Br., *Franklandia fucifolia* R. Br. and *Lambertia rariflora* Meisn. subsp. *rariflora*. The occurrence of such taxa at the ends of their ranges is a major feature of the vascular flora of the Whicher Range area (Keighery unpublished data). Some of these disjunct populations, including *Lambertia echinata*, have genetic (D. Coates pers. comm.) and morphological discontinuities between the Whicher populations and their main ranges elsewhere and deserve taxonomic recognition.

In the treatment of *Lambertia* for the "Flora of Australia" (Hnatiuk 1995), populations previously placed in *L. echinata* and *L. propinqua* R. Br. were combined under *L. echinata* as two disjunct subspecies, *L. echinata* R.Br. subsp. *echinata* occurring east of Esperance and *L. echinata* subsp. *citrina* Hnatiuk occurring around Albany. Hnatiuk did not see any material of the Whicher Range variant, which was not discovered until late 1994. Subspecific rank within this species also appears appropriate for the third disjunct variant described here.

Taxonomy

Lambertia echinata subsp. **occidentalis** G.J. Keighery *subsp. nov.*

Typus: Abba Forest Block, south-west of Busselton [precise locality withheld for conservation purposes], Western Australia, 10 September 1995, *N. Gibson* 2377 (holo: PERTH sheet 04183622; iso: CANB, K, MEL).

Species haec ab *Lambertiae echinatae* subsp. *citrinae* differt foliis vegetivis integris linearibus, foliis floralibus plerumque integris vel trilobatis, et bracteis floralibus grandioribus, anguste obovatis.

Shrub, to 3 metres tall, not lignotuberous, much branched at the base with many short vegetative branches and a few long erect floral branches. *Vegetative leaves* entire, 17-45 mm long, linear-lanceolate, apex pungent. *Floral leaves* on erect branches, a few immediately below the inflorescence with up to 5 points, the remainder either trifid (50-80%) or entire (20-50%), 12-30 mm long. *Flowers* yellow. *Inflorescences* crowded at ends of branchlets, 7-flowered. *Floral bracts* scarious, entire, brown, acute, narrowly obovate, 15-19 mm long. *Perianth* 23-26 mm long; lobes recurved, 3-5 mm long. *Style* yellow, 33-36 mm long.

Other specimens examined. WESTERN AUSTRALIA: Abba Block, *B.J. Keighery & N. Gibson* 726 (PERTH); Abba Block, *J.A. Cochrane* 1213 (PERTH); Abba Block, *J.A. Cochrane* 1258 (PERTH).

Conservation status. The subspecies is known from only a single population of seven individuals. Plants lack a lignotuber and are killed by fire. Like most other members of the genus , it is very susceptible to dieback disease caused by *Phytophthora cinnamomi,* which is present in the immediate area. The subspecies is legally protected as declared rare flora under the manuscript name *Lambertia echinata* subsp. *septentrionale.*

Etymology. Occidentalis is derived from the Latin word meaning western, referring to the disjunct western occurrence of this subspecies.

Discussion. Lambertia echinata subsp. *echinata* is a compact shrub to 1 metre tall which has inflorescences of pink-red flowers on short branchlets in the main body of the plant. Both subspecies *citrina* and *occidentalis* have inflorescences of yellow flowers on short branchlets borne on long erect flowering branches to 3 metres tall above the main body of the plant. In *Lambertia echinata* subsp. *citrina* all vegetative and floral leaves have 3-5 rigid points, whereas *L. echinata* subsp. *occidentalis* has entire vegetative leaves and most floral leaves 3-pointed or entire. The floral bracts of subsp. *occidentalis* are longer, measuring 15-19 mm compared to 12-16 mm in subspecies *citrina.* There is also a difference in length between the floral leaves of all subspecies, 30-40 mm in subsp. *echinata,* 15-35 mm in subsp. *citrina* and 12-30 mm in subsp. *occidentalis.*

Acknowlegements

Thanks to Paul Wilson for providing the Latin diagnosis.

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Occurrence and spread of Sea Spurge (*Euphorbia paralias*) along the west coast of Western Australia

Euphorbia paralias L. (Sea Spurge) is a herbaceous perennial native to the Atlantic and Mediterranean coasts of Europe, where it is locally abundant on sandy shores, young sand dunes and fine shingle (Blamey & Grey-Wilson 1987). It has become established along the southern coast of mainland Australia from Western Australia to Victoria and north-east Tasmania (Hnatiuk 1990).

In Western Australia the first specimens of *E. paralias* were collected at Albany in 1927 and the species was only known from the south coast until 1987. Heyligers (1989) reported that Sea Spurge was widespread in 1987 on beaches between Walpole and Eucla, then disjunct to the Busselton area of the west coast, with a single plant found further north at Rockingham. He postulated that the species reached new areas by transport on boats and that the Rockingham plant had been introduced from the Busselton area.

In 1992 Sea Spurge was found in abundance along the seaward face of the dunes at Herring Bay (voucher: *Keighery* 12949) on the north-west coast of Garden Island, opposite Rockingham. Because this area is a major public mooring site, this population probably arrived on a boat or in gear which had seeds on it. The size of the population suggests that it had been resident for some time. In 1993 numerous plants were also located on beaches to the north and south of Herring Bay and scattered plants were found on the eastern side of the island. Since this abundant and highly visible species was not recorded previously, it must have arrived since the date of the last survey of Garden Island in 1979 by Marchant & Abbott (1981). The plant at Rockingham (Heyligers 1989) almost certainly came from Garden Island, not the Busselton area.

Surveys in 1995 showed that *Euphorbia paralias* was also abundant between Minninup Beach (*Keighery* 13947) and Busselton and present in scattered but large populations around Bunbury Harbour and along the Leschenault Peninsula north of Bunbury (*Keighery* 13948), especially near boat ramps. An isolated population was located at Halls Head, Mandurah, also near a boat ramp.

In 1996 a total of 36 adult and juvenile plants of Sea Spurge were found along 100 metres of the eastern end of Longreach Bay at Rottnest Island (*Dodd s.n.*), growing with juvenile *Spinifex longifolius* at the seaward base of a foredune. No plants were found along the neighbouring Basin or Pinky Beaches. Longreach Bay is one of Rottnest's recognised mooring sites, which again suggests an association with boats.

These recent records suggest that *Euphorbia paralias* is actively colonising the west coast at present and the initial introductions are probably by boats. However, once established it can spread by drift, as seen in the Recherche Archipelago (Keighery 1995) where it was recorded on one island in 1950 and is now present on all islands with beaches throughout the Archipelago. It seems inevitable that Sea Spurge will colonise the beaches of all offshore islands around Perth, and probably extend north to at least the Jurien Bay Islands (30° 15'S, 115° 01'E). It could also become a major component of the strand flora of mainland beaches along the west coast between Bunbury (33° 19'S, 115° 38'E) and Perth (32° 02'S, 115° 44'E) during this period. The effects of this invasion on the strand and dune flora are currently unknown, but require monitoring.

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The Rhamnaceae of the Kimberley Region of Western Australia

Six native species of Rhamnaceae, all in different genera, are known from the Northern Botanical Province of Western Australia. This province is equivalent to the Kimberley Region as defined in "Flora of the Kimberley Region", in which five of the Rhamnaceae species are described and illustrated (Wheeler 1992). Since publication of the Kimberley flora, a further species and genus, *Colubrina asiatica*, has been discovered at Koolama Bay in the far north of the Kimberley, and there has been an alteration of the specific name used for the *Alphitonia* species in the region. In addition, unpublished work on generic boundaries in the Rhamnaceae suggests that the species currently known as *Cryptandra intratropica* should be placed in a new genus (K. Thiele pers. comm.).

Prior to publication of the Kimberley regional flora, *Colubrina asiatica* was included in a census of Western Australian plants (Green 1985), but this record was apparently based on a misidentified specimen (*P.G. Wilson* 11141) of *Emmenosperma cunninghamii*. *Colubrina* has been collected from many locations on sandy coasts in Northern Territory and Queensland and has a wide distribution in tropical regions of the world. However, since it is known from only one locality in Western Australia, it has been placed on the Declared Rare and Priority Flora List.

This publication provides a key and distribution maps for the Rhamnaceae species of the Kimberley Region, a description and illustration of the priority taxon *Colubrina asiatica* and a synopsis of the other species in the region. Abbreviations used here for the botanical districts of the Northern Botanical Province follow those used in "Flora of the Kimberley Region".

Key to genera in Kimberley Region

1. Shrubs up to 2.5 m high, with densely stellate-hairy leaves 2-20(30) mm long. Floral tube with a short but distinct free portion extended above a stellate-hairy disc. Aril basal, succulent ..... **CRYPTANDRA**
1. Scrambling shrubs or trees up to 25 m high, with partially to fully glabrous leaves 30-170 mm long. Floral tube either fully adnate to ovary or (in *Emmenosperma*) extended above the ovary and lined with a glabrous disc. Aril (when present) enclosing seed, dry.
   2. Leaves more or less linear. Petals absent. Fruit a samara, compressed, prominently winged, brown ..... **VENTILAGO**
   2. Leaves more or less narrowly elliptic to broadly ovate. Petals 5. Fruit a 2-4-celled schizocarp or drupe, more or less globular, not winged, yellow to red or purple to black.
      3. Leaves pinnately veined, with 6-12 main lateral veins on each side of the midvein. Fruit casing shed leaving shiny orange to red seeds persistent on the receptacle.
         4. Floral tube fully adnate to the ovary and the margin of the broad horizontal disc which covers the summit of the ovary. Fruit succulent at first, becoming black and splitting, with a distinctive mealy layer below the thin outermost layer. Seed coat greenish; aril almost covering seed, reddish ..... **ALPHITONIA**
         4. Floral tube with an erect free portion, lined by the disc and surrounding the largely free superior ovary. Fruit dry, brittle, yellow to orange, without a mealy layer. Seed coat orange to red; aril absent ..... **EMMENOSPERMA**

3. Leaves either palmately 3-veined or with 2-4 main lateral veins on each side of midvein. Fruit casing shed with or after the dull brown seeds.
   5. Scrambing shrub, with inconspicuous caducous stipules. Leaves pinnately veined, with 2-4 main lateral veins on each side of midvein. Fruit a schizocarp, 3-celled ..... **COLUBRINA**
   5. Tree, with stipules on juvenile shoots modified to prominent deciduous spines. Leaves palmately 3-veined. Fruit a drupe, (3)4-celled ..... **ZIZIPHUS**

Colubrina Rich. ex Brongn.

Shrubs, *trees* or rarely woody *vines*, sometimes thorny; indumentum (where present) of simple hairs. *Young stems* usually hairy. *Stipules* usually caducous. *Leaves* alternate or opposite, usually with minute glands. *Flowers* pedicellate, often in axillary cymes, bisexual. *Sepals* 5. *Petals* 5, usually with a hooded lamina enclosing an anther. *Stamens* 5. *Disc* broad, covering summit of ovary, glabrous. *Ovary* 3-celled. *Style* 3-lobed or 3-branched. *Fruit* a schizocarp, dry, largely superior, usually subglobular and shallowly 3-lobed; outer layer thin, leathery to crustaceous, irregularly dehiscent; cocci crustaceous or membranous, usually longitudinally dehiscent along adaxial line and over summit. *Aril* absent or very reduced and obscure. A genus of over 30 species, distributed through the tropics from the east coast of Africa east to the Caribbean and extending to temperate parts of the Americas.

Colubrina asiatica (L.) Brongn.

Scrambing *shrub* up to 2 m high. *Young stems* sparsely hairy. *Stipules* small, caducous. *Leaves* alternate; petiole 10-15 mm long; blade broadly ovate, commonly 60-75 x *c.* 50 mm, discolorous, with 3-5 main veins arising on each side of the midvein, including 1 or 2 basal veins, glabrous except for a few hairs scattered along the main veins, the base broadly rounded or shallowly cordate, the apex attenuate, the margins shallowly serrate, each tooth terminating in a small dark gland. *Inflorescence* usually of 2 or 3 pedunculate axillary clusters each of 5 or more flowers, about as long as the petioles, much shorter than the full leaves; peduncles and pedicels hairy. *Flowers* yellowish green, somewhat hairy outside especially on floral tube, glabrous inside. *Sepals* broadly ovate, *c.* 1.5 mm long. *Disc c.* 2 mm across. *Style* deeply 3-lobed, the lobes about as long as the entire portion. *Fruit* depressed obovoid with a slightly 3-lobed summit, 7-10 mm long, on a long pedicel (commonly 5-8 mm long). *Seeds* dull pale brown, *c.* 6 mm long, broad and somewhat compressed. (Figure 1)

Specimens examined. WESTERN AUSTRALIA: Koolama Bay, 30 Mar. 1993, *A.A. Mitchell* 2983 (PERTH)
NORTHERN TERRITORY: Wessel Islands, 5 Oct. 1972, *P.K. Latz* 3424 (PERTH).
QUEENSLAND: Cooktown, along Leprosy Creek, 16 May 1970, *S.T. Blake* 23333 (PERTH).

Distribution and habitat. Occurs on the coast, recorded in white sand next to mangroves at Koolama Bay in the far north of the Kimberley Region (CGa). Also occurs in Northern Territory and Queensland. Extends through the tropics from the east coast of Africa east to Hawaii and the Caribbean area. (Figure 2B)

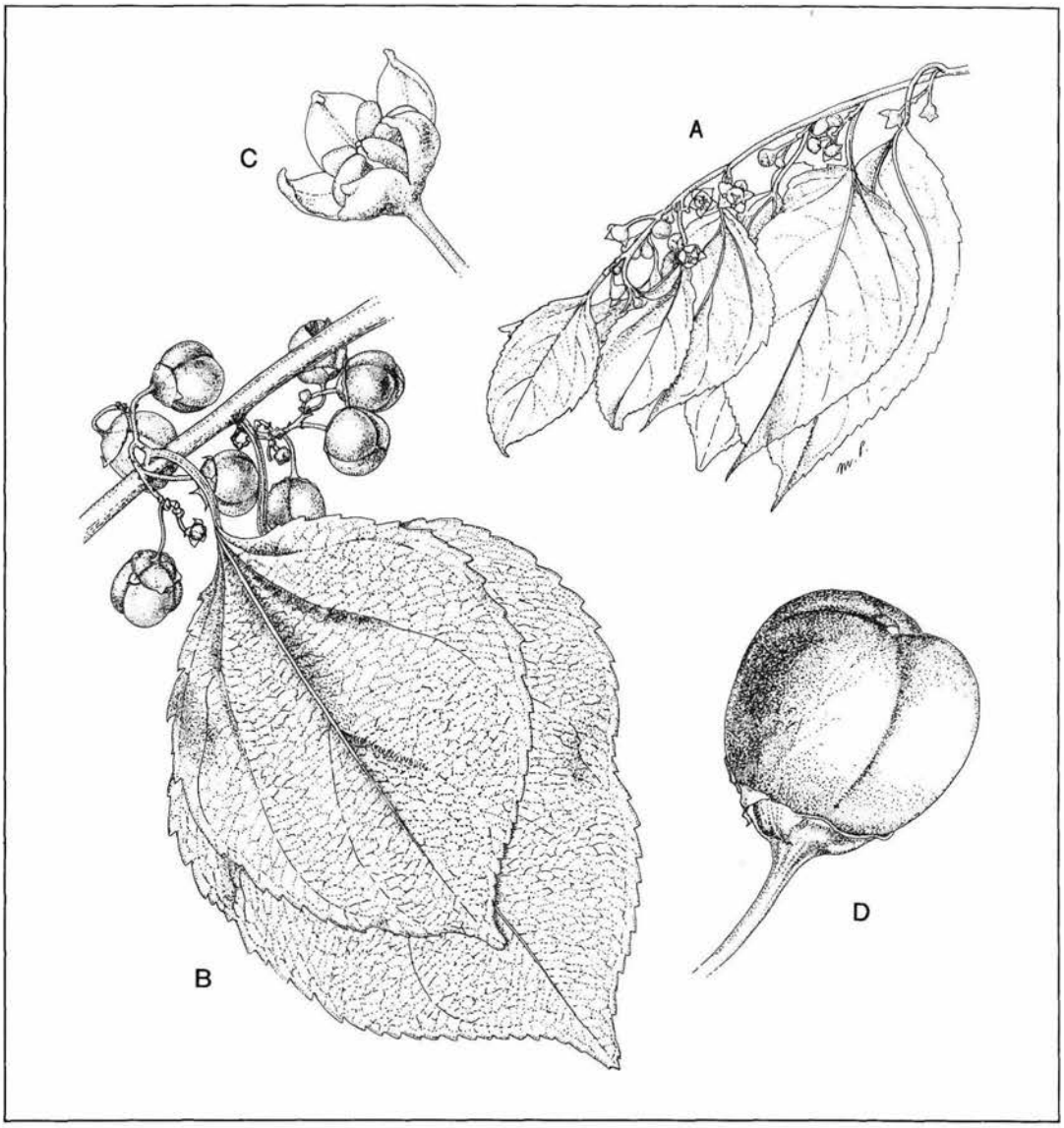

Figure 1. *Colubrina asiatica*. A - flowering stem (x1), B - fruiting stem (x1), C - flower (x6), D - fruit (x4). Drawn from *A.A. Mitchell* 2983.

Phenology. Flowers and fruits recorded March-April.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority 1.

Notes. All Australian material is of *C. asiatica* var. *asiatica*. Judging from material from other parts of Australia, the species can grow much larger than indicated in the description above, which is based on the single Kimberley specimen. For a full description of the species throughout its geographical range see Johnston (1971: 47-49). Johnston lists many synonyms for the species, including the two nomenclatural synomyms *Ceanothus asiaticus* L. and *Rhamnus asiaticus* (L.) Lam.

Other Kimberley species

Alphitonia incana (Roxb.) Teijsm. & Binn. ex Kurz. Tree 3-20 m high. Illustrated in Wheeler (1992: Figure 193A, as *A. excelsa*). Occurs along watercourses, often in sandstone gorges or gullies, sometimes in vine thickets. Extends from Bougainville Peninsula south to King Leopold Range and from Kuri Bay east to Drysdale River National Park in the Kimberley Region (WGa, CGa, Fi). Also occurs in Northern Territory and Queensland. Flowers: April-June. Fruits: May-October. *Rhamnus incanus* Roxb. Previously misidentified as *Aphitonia excelsa* (A. Cunn. ex Fenzl) Reissek ex Benth., a species occurring in adjacent parts of Northern Territory; possibly *A. excelsa* extends into the eastern Kimberley but there are no records from this region to date. (Figure 2A)

Cryptandra intratropica W. Fitzg. Shrub 0.7-2.5 m high. Illustrated in Wheeler (1992: Figure 193B). Occurs on a variety of sandstone habitats in the Kimberley Region (WGa, CGa, EGa, Fi), extending from Bonaparte Archipelago and Talbot Bay east to an isolated record in Weaber Range and from Napier Broome Bay south to isolated records from Mt Broome and Mt Wells. Most records are from near the coast. Since the species occurs close to the Northern Territory border, it may well extend into that region, although no specimens have been collected outside Western Australia to date. However there are two closely related species occurring in Northern Territory and Queensland (K. Thiele pers. comm.), both lacking formal taxonomic names; at least one of these has been confused with *C. intratropica*. Flowers and fruits: March-August. Atypical of the genus *Cryptandra* in having completely free stipules and long pedicels. (Figure 2C)

Emmenosperma cunninghamii Benth. Tree 3-25 m high. Illustrated in Wheeler (1992: Figure 193C). Occurs mainly on sandstone outcrops, slopes or plateaus but also recorded from quartzite, often in vine thickets in the Kimberley Region (WGa, CGa), extending from near Cone Mountain and the Osborne Island group south-west to Glenelg River. Also occurs in Northern Territory and Queensland. Flowers and fruits: February-September. (Figure 2D)

Ventilago viminalis Hook. Tree 3-10 m high, with drooping branches. Illustrated in Wheeler (1992: Figure 193D). Occurs mainly on red soils, with two main areas of occurrence, one in the southern half of the Kimberley Region (Fi, Da, Ha) and far north of the Eremaean, extending from Pentacost Downs Station south to near Gilgie Downs Station and from Broome east to Nicholson Station. The other area is in the Pilbara Region of Western Australia, extending from Barrow Island south-east to Hamersley Station. Also occurs in Northern Territory, Queensland and New South Wales. Flowers: mainly June-September. Fruits: recorded September-October, March. (Figure 2E)

Ziziphus quadrilocularis F. Muell. Semi-deciduous tree 5-12 m high. Illustrated in Wheeler (1992: Figure 194B). Juvenile shoots of this species bear prominent stipules in the form of large spines and have broader, more papery leaves than the mature shoots. There are two main areas of occurrence in the Kimberley Region (WGa, CGa, EGa, Ha). The first is in vine thickets or forest, often on rocky sites (basalt, sandstone or laterite), around the north coast from near Evelyn Island south-west to near Mt Talbot (Walcott Inlet), with an isolated record from Drysdale River National Park. The other is associated with springs and watercourses from Behn River south-west to the upper Ord River. Also occurs in Northern Territory. Flowers: October-March. Fruits: January-September. (Figure 2F)

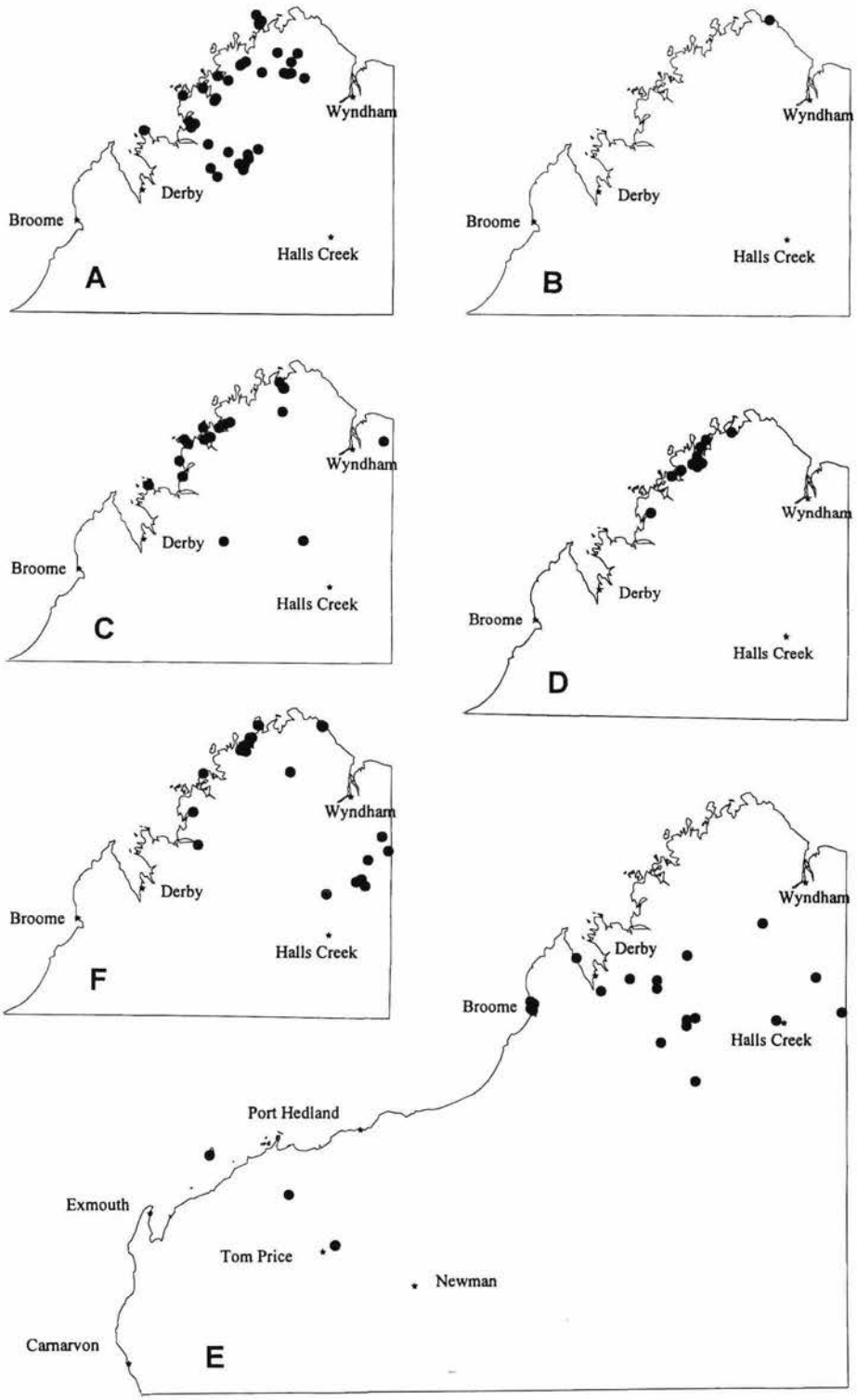

Figure 2. Geographical distributions in Western Australia. A - *Alphitonia incana*, B - *Colubrina asiatica*, C - *Cryptandra intratropica*, D - *Emmenosperma cunninghamii*, E - *Ventilago viminalis*, F - *Ziziphus quadrilocularis*.

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CONSERVATION CODES FOR WESTERN AUSTRALIAN FLORA

R: Declared Rare Flora - Extant Taxa (= Threatened Flora = Endangered + Vulnerable)

Taxa which have been adequately searched for, and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such, following approval by the Minister for the Environment, after recommendation by the State's Endangered Flora Consultative Committee.

X: Declared Rare Flora - Presumed Extinct Taxa

Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such, following approval by the Minister for the Environment, after recommendation by the State's Endangered Flora Consultative Committee.

1: Priority One - Poorly Known Taxa

Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat, e.g. road verges, urban areas, farmland, active mineral leases, etc., or the plants are under threat, e.g. from disease, grazing by feral animals, etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

2: Priority Two - Poorly Known Taxa

Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

3: Priority Three - Poorly Known Taxa

Taxa which are known from several populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in need of further survey.

4: Priority Four - Rare Taxa

Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years.

Publication date of Nuytsia Volume 11 Number 1: 31 July 1996

Notes for Authors

The aim of *Nuytsia* is to publish original papers on systematic botany with preference given to papers relating to the flora of Western Australia. All papers are refereed and the Editorial Advisory Committee reserves the right to reject papers. Opinions expressed by authors are their own and do not necessarily represent the policies or views of the Department of Conservation and Land Management.

After final acceptance of papers, authors are requested to provide discs readable directly by IBM computer or internet attachments. Wherever possible, the MS-WORD software should be used. Original figures should not be lettered but accompanied by copies indicating lettering. Page proofs will be forwarded to authors for checking. Twenty reprints of each paper will be provided free of charge; no additional copies may be ordered.

Style and layout should follow recent numbers of *Nuytsia*. Within a paragraph two spaces are required between sentences; after colons, semicolons, commas and dashes a single space is required. Italics should be used for formal taxonomic names, from the genus level down to the lowest infraspecific categories, and for collectors' names when citing specimens. Incidental Latin words in the text should be italicized but not the Latin diagnosis.

Title. Should include the family name of the genera or species treated, but not authorities. New taxa should be named if not too numerous. The type of paper (e.g. revision, synopsis) and geographic area of study should be given where appropriate.

Structure of papers. Authors are encouraged to use the conventional structure of scientific papers, especially when a complete study, such as a revision, is being reported.

(1) *Abstract.* Should be indented and commence with bibliographic information. New taxa, combinations and names should be listed with their authorities. The major contents of the paper should be concisely summarized but no additional material given.

(2) *Introduction.* Should give some background information and state the purpose of the paper.

(3) *Methods* or *Materials and methods*. May include the method of drawing up the description from specimens, extent of search for types and discussion of concepts of taxonomic categories.

(4) *Results* or *Taxonomy* or *Taxonomic treatment* or various alternative headings as appropriate to the data being presented in the paper.

(5) *Discussion.* A discussion section should be considered, which would include some or all of the following: a summary of the findings emphasizing the most significant; interpretation of the results in the light of other relevant work; statement of new problems which have arisen; advising of aspects which are to be followed up; suggestion of topics which others might usefully pursue; prediction and speculation.

Short Communications. These are short concise contributions, usually with few or no main headings. They lack an abstract and authors' names and addresses are placed at the end.

Headings. All headings should be mainly in lower case, major headings centred and bold, secondary headings (where required) left-justified and bold, and minor headings left-justified and italicized.

Keys. May be either indented (e.g. Nuytsia 11: 94) or bracketed (e.g. Nuytsia 11: 55-56). Indented keys involving more than nine levels of indentation should be avoided. Where a key is indented, tabs should be used and not space bars.

Species treatments. Use of certain named paragraphs, or sets of paragraphs, for matter following the descriptions is encouraged. The desired sequence and examples of commonly used headings are shown below. Italicized headings should be followed by text on the same line.

(1) Taxon name (in bold) and authority. For previously published taxa this should be followed by the reference, nomenclatural synonyms (if any) and *Type:* heading with full type details.

(2) Other synonyms with their type details, significant manuscript or phrase names. Recent papers should be consulted for examples of an appropriate format for citing synonyms.

(3) Latin diagnoses (for new taxa - not indented).

(4) *Typus:* (for new taxa - not indented).

(5) English description (indented).

(6) *Other specimens examined* or *Selected specimens examined.*

(7) *Distribution.*

(8) *Habitat.*

(9) *Phenology* or *Flowering period.*

(10) *Conservation status.* Department of Conservation and Land Management Conservation Codes for Declared Rare and Priority Flora should be cited for any endangered or rare Western Australian plants.

(11) *Etymology.*

(12) *Typification.*

(13) *Affinities.*

(14) *Notes* or *Discussion* or *Comments.*

Threatened species. The Department of Conservation and Land Management has a policy not to publish precise locality data for threatened species. When describing threatened taxa authors are therefore requested to use generalized localities accompanied by the bracketed statement [precise locality withheld].

Standard abbreviations. When abbreviations are used, the following standards should be followed.

(1) Author abbreviations. Follow Brummitt, R.K. & Powell, C.E. (1992). "Authors of Plant Names." (Royal Botanic Gardens: Kew.).

(2) Book titles. These should not be abbreviated in the references but any literature citations in the text should follow Green, J.W. (1985). "Census of the Vascular Plants of Western Australia." Edn 2. pp. 20-24. (Department of Agriculture: Perth.). A more complete list of book title abbreviations is given in Stafleu, F.A. & Cowan, R.S. (1976-83). "Taxonomic Literature." Edn 2. (Bohn, Scheltema & Holkema: Utrecht.), but capital initial letters need to be used in *Nuytsia.*

(3) Journal titles. Follow Lawrence, G.H.M. *et al.* (1968). "B-P-H. Botanico-Periodicum-Huntianum." (Hunt Botanical Library: Pittsburgh.)

(4) Dates and directions. Generally should not be abbreviated except under the *Specimens examined* section. In that section, dates should be written in full only if they have less than five letters (e.g. July), otherwise should be shortened to the first three letters and a stop (e.g. Oct.), while compass directions should be abbreviated to capital letters with no stops (e.g. N and SSW).

(5) Other abbreviations. Standard abbreviations for measurements (e.g. mm), Latin abbreviations (e.g. *c.*, *nom. illeg.*), mountains and roads (e.g. Mt Koscuisko, Brooke Rd) are used in *Nuytsia.* Other abbreviations, especially ones that are ambiguous (e.g. Pt), should be avoided.

Figures. Numbers should follow a single sequence including maps.

References. Citation of references in the text should give the author's surname and date (e.g. Smith 1963) and full details should be given in the reference section. This format is also recommended to replace the traditional abbreviations for references listed under taxonomic names, for example using Benth. (Bentham 1878: 234) rather than Benth., Fl. Austral. 7: 234 (1878).