

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

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### Abstract

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### 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 exerted, 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. wilhelmii*, 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 Fallstrack, 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, *Pajmans* 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-Borrooloola 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 Borrooloola, 16°06'S, 136°35'E, *Puttock* UNSW 20741 (UNSW); 59.7 km W of 3 Ways Crawford's 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.

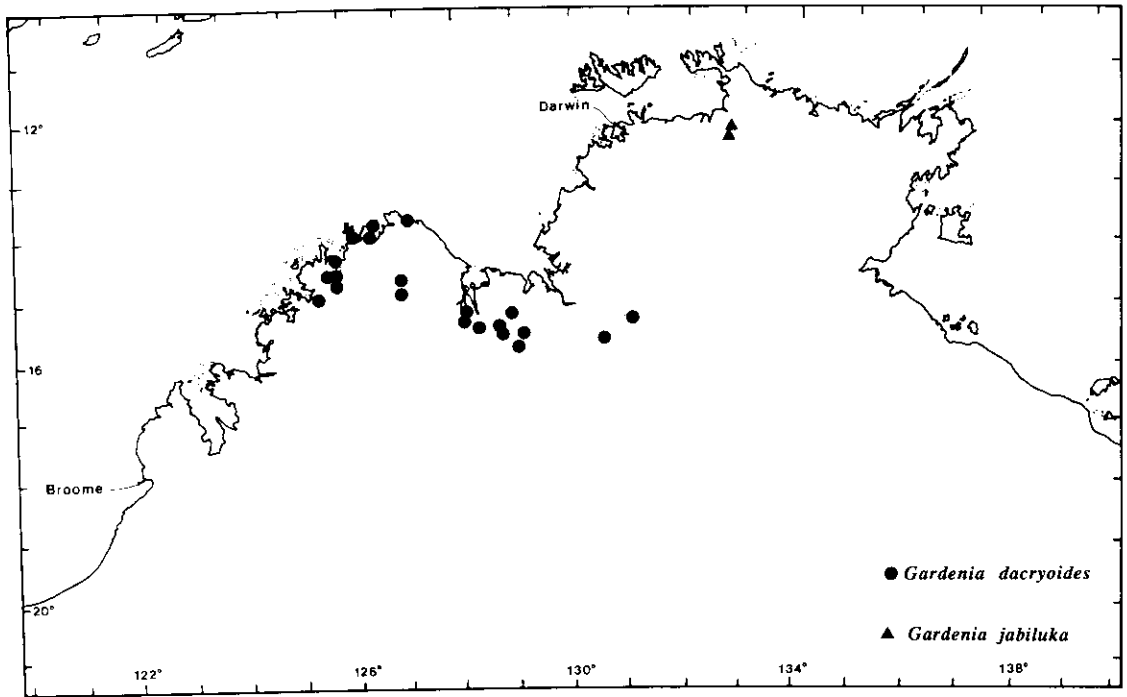


Figure 1. Distribution of *Gardenia dacryoides* and *G. jabiluka*.

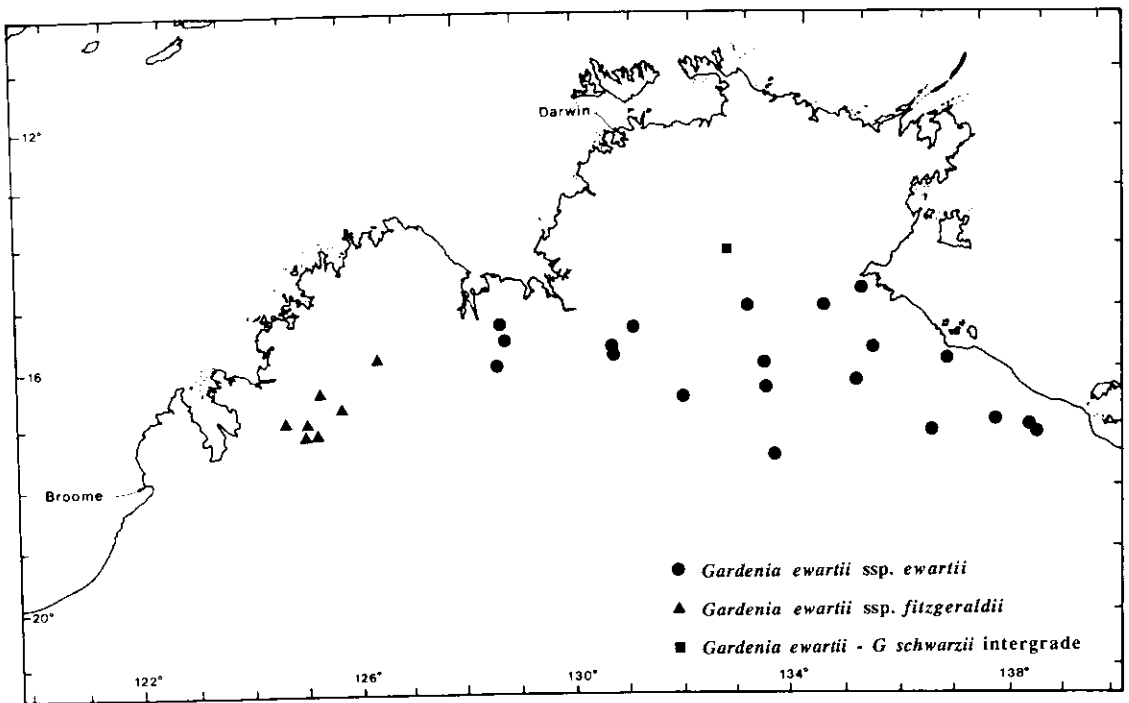


Figure 2. Distribution of *Gardenia ewartii*.

***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 retrorse 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 Carpentaria, 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 spatulate 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 El 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 half way 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 Kakadu 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

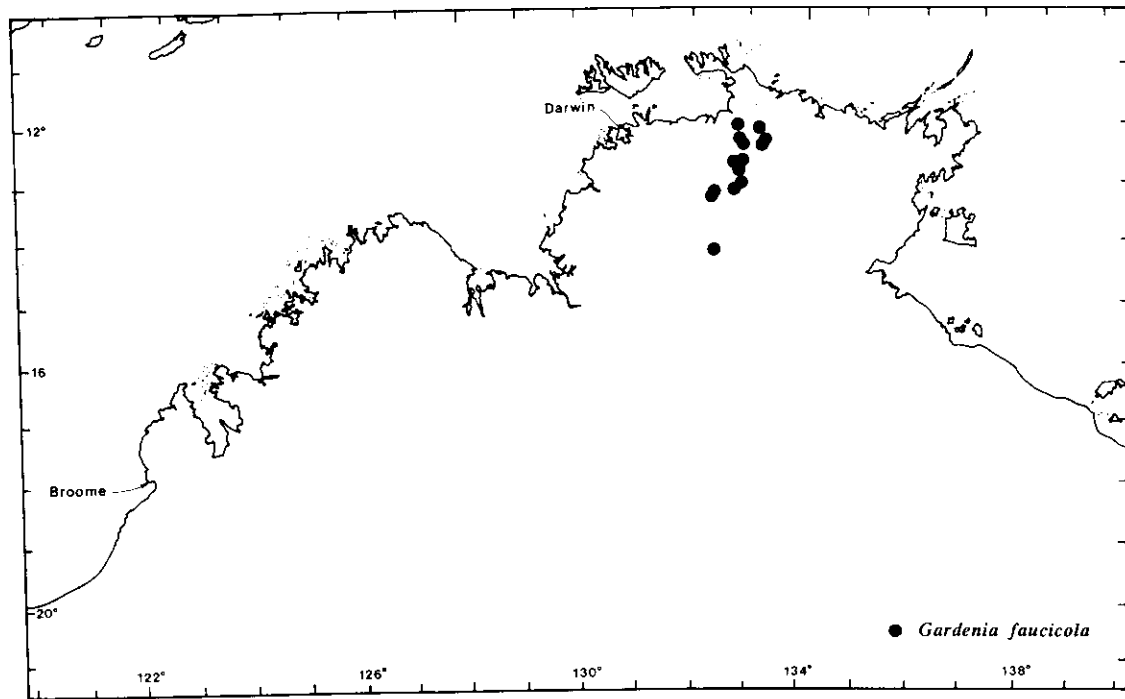


Figure 3. Distribution of *Gardenia faucicola*.

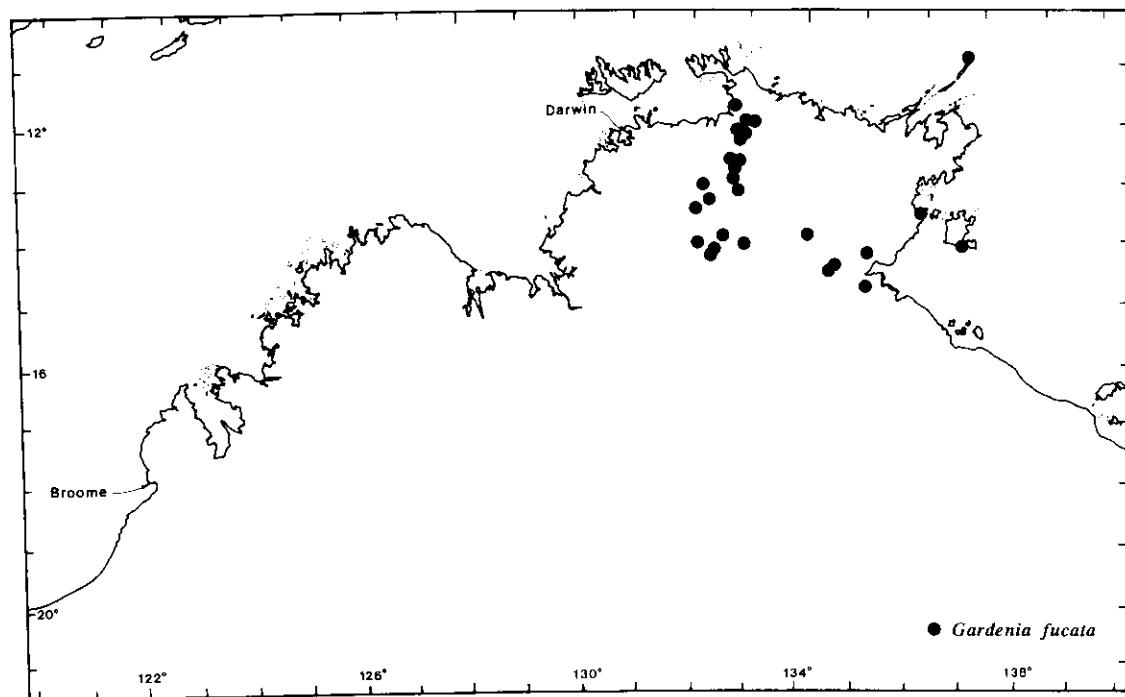


Figure 4. Distribution of *Gardenia fucata*.

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 brevioris, 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 UNSW9044 & A. Murray (holo: NSW; iso: BRL, 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 lobes; lobes linear, 3-5 mm long, not laterally flattened. Corolla tube cylindrical, 8-9 mm long, c. 2 mm diameter, fine retrorse 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 UNSW9184 (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 receptacular 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 upstream 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, *Latzs.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 discoloured 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 & Allens*.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* AE 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 (*vide* Brock 1988).

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

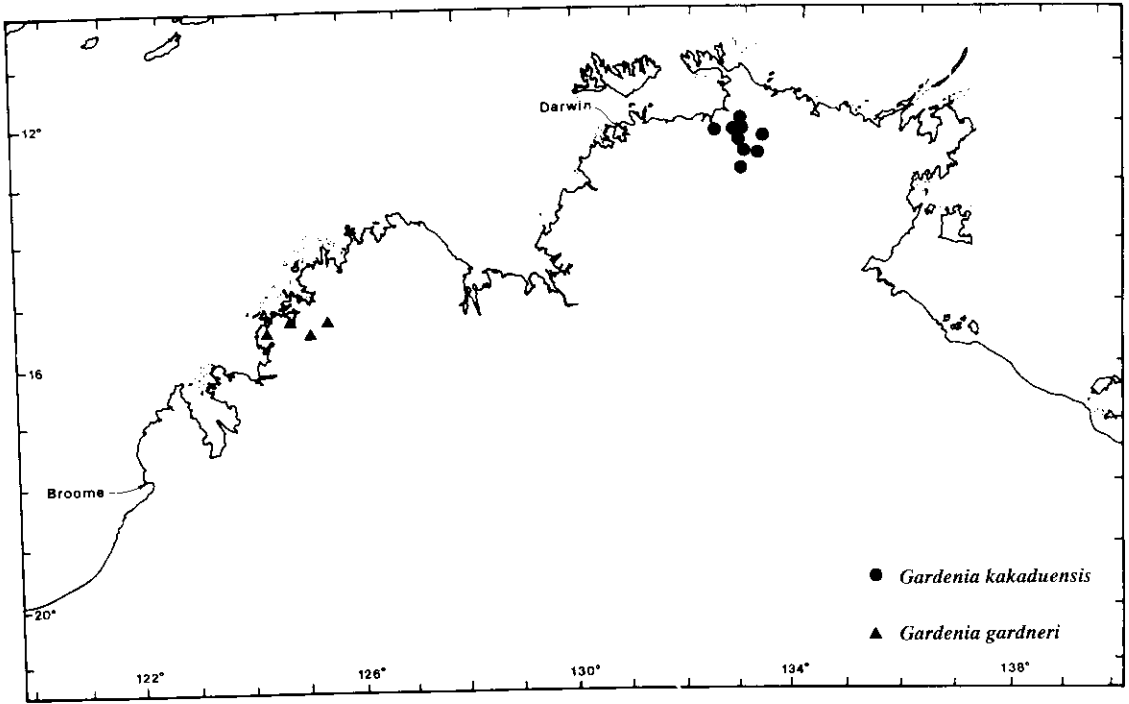


Figure 5. Distribution of *Gardenia gardneri* and *G. kakaduensis*.

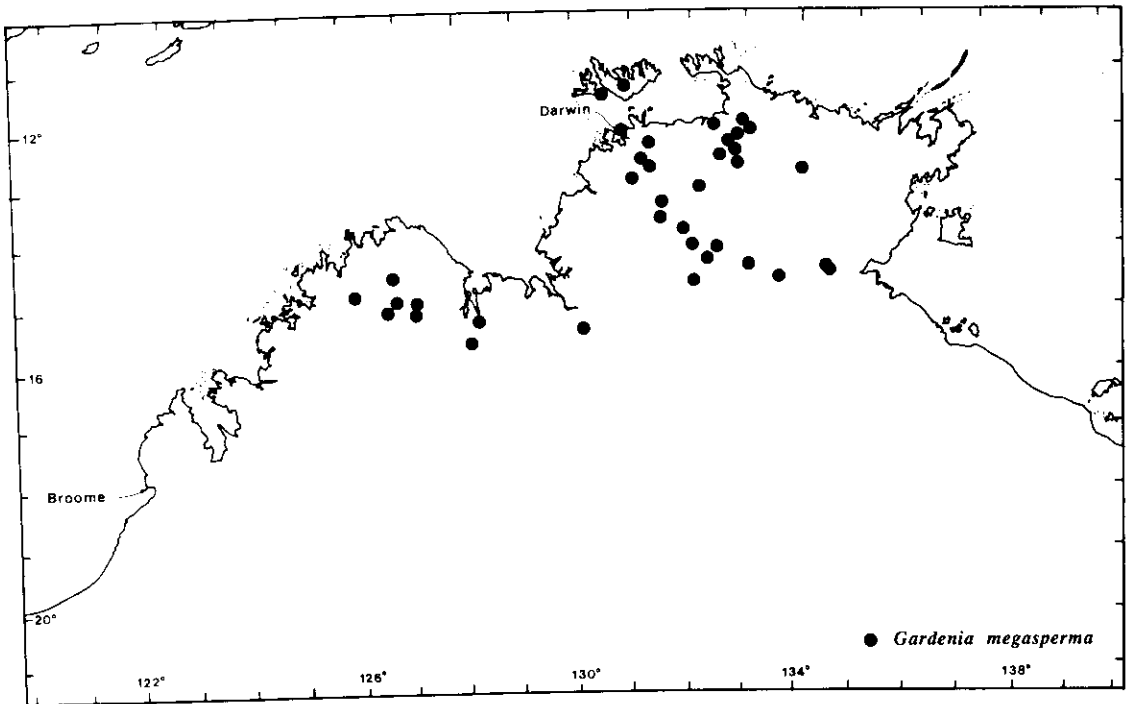


Figure 6. Distribution of *Gardenia megasperma*.

*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 faucicola* 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. 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. Kearthland 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 & Careys 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, *Beaglehole* ACB11244 (PERTH); Broome, Apr. 1905, *Fitzgeralds s.n.* (PERTH 133); Broome, Nov. 1922, *Owens 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, *Fitzgeralds.n.* (PERTH 305); Fitzroy River, 18°04'S, 123°53'E, 1883, *Forrests.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 - Wollgorang 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 - Wollgorang 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 July 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



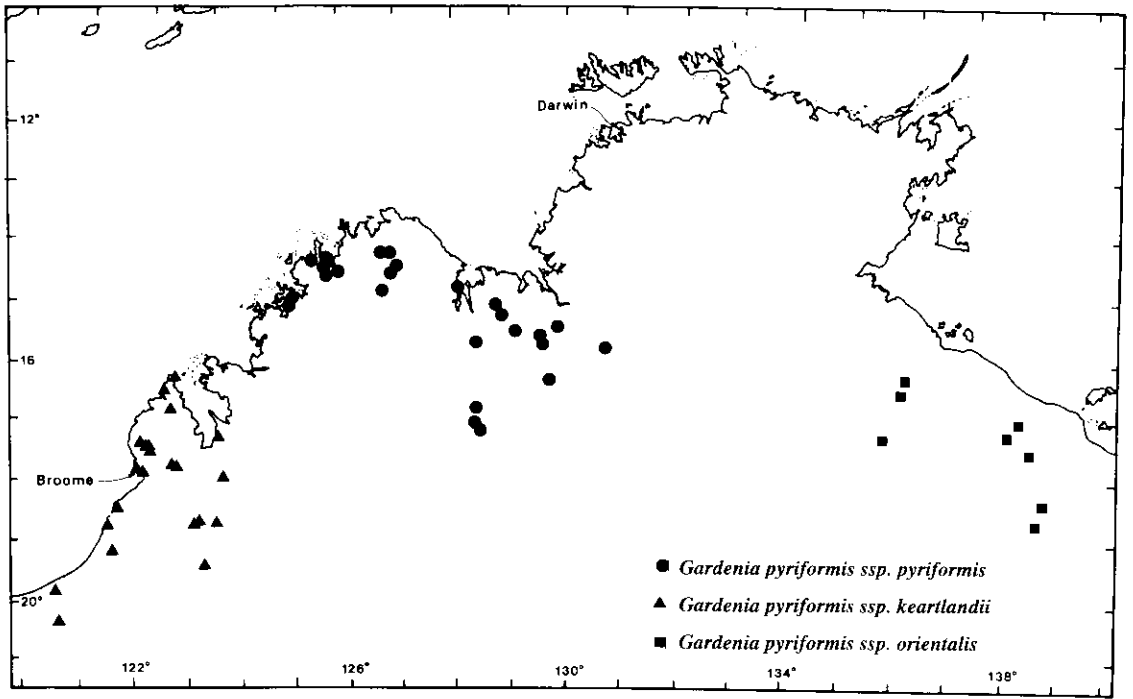


Figure 7. Distribution of *Gardenia pyriformis*.

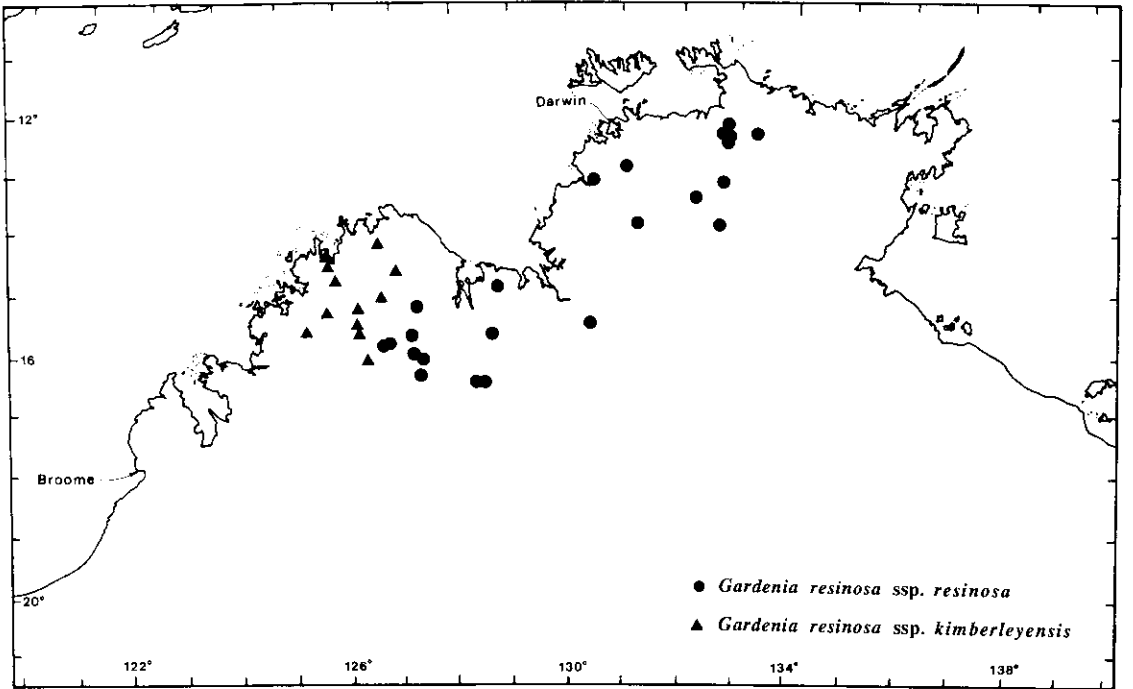


Figure 8. Distribution of *Gardenia resinosa*.

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, furfureaceous 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.

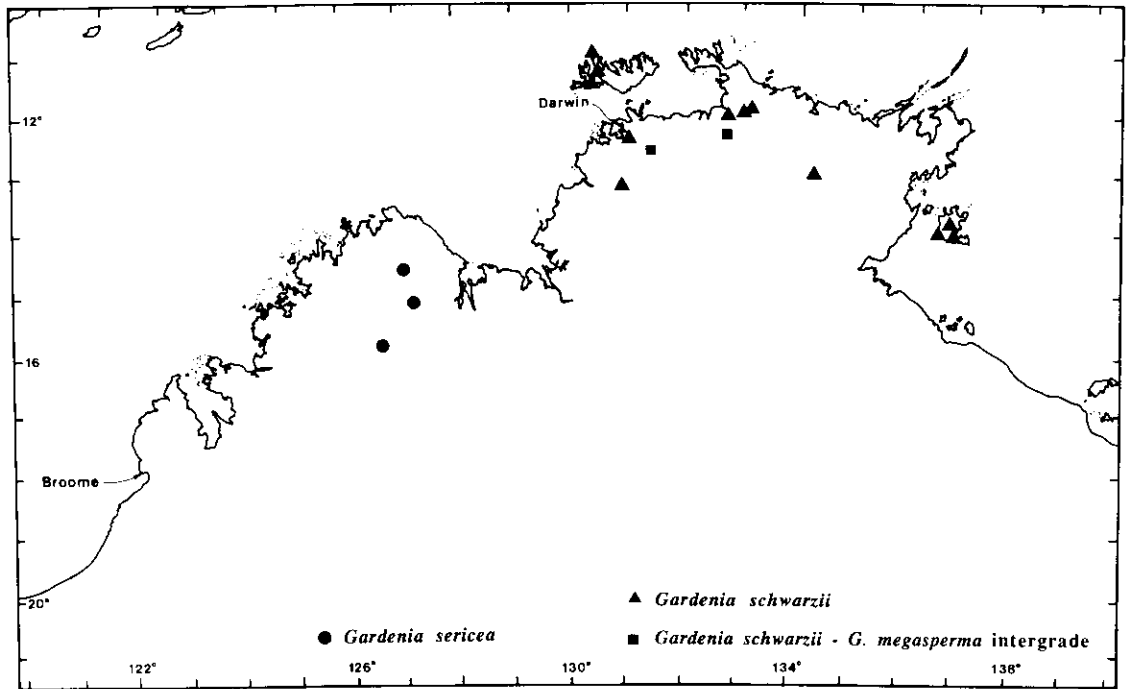


Figure 9. Distribution of *Gardenia schwarzii* and *G. sericea*.

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