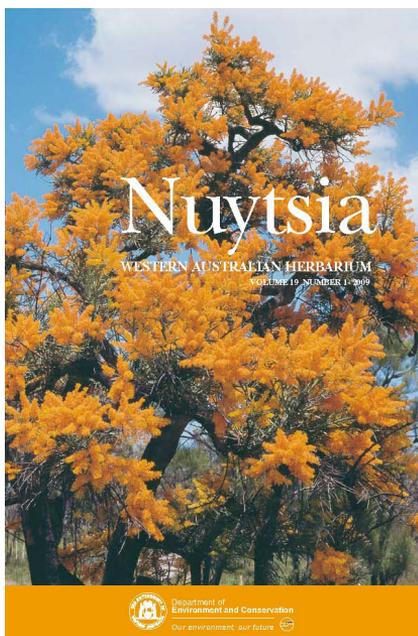


Nuytsia

WESTERN AUSTRALIA'S JOURNAL OF SYSTEMATIC BOTANY

ISSN 0085-4417



Wilkins, C.F. & Whitlock, B.A.

Guichenotia anota and *Guichenotia apetala* (Lasiopetaleae: Byttneriaceae or Malvaceae *s. lat.*) a new and a revised species endemic to the Ravensthorpe Range, south-west Western Australia

Nuytsia 19(1): 181–190 (2009)

All enquiries and manuscripts should be directed to:

The Managing Editor – *NUYTSIA*
Western Australian Herbarium
Dept of Environment and Conservation
Locked Bag 104 Bentley Delivery Centre
Western Australia 6983
AUSTRALIA

Telephone: +61 8 9334 0500
Facsimile: +61 8 9334 0515
Email: nuytsia@dec.wa.gov.au
Web: science.dec.wa.gov.au/nuytsia



Department of
Environment and Conservation
Our environment, our future 

All material in this journal is copyright and may not be reproduced except with the written permission of the publishers.

© Copyright Department of Environment and Conservation

***Guichenotia anota* and *Guichenotia apetalata* (Lasiopetaleae:
Byttneriaceae or Malvaceae s. lat.) a new and a revised species endemic
to the Ravensthorpe Range, south-west Western Australia**

Carolyn F. Wilkins^{1,2,4} and Barbara A. Whitlock³

¹Western Australian Herbarium, Department of Environment and Conservation,
Locked Bag 104, Bentley Delivery Centre, Western Australia 6983

²School of Plant Biology, The University of Western Australia, Stirling Highway, Crawley, Western Australia 6009

³Department of Biology, University of Miami, Coral Gables, Florida 33124, USA

⁴Corresponding author. Email: cwil@plants.uwa.edu.au

Abstract

Wilkins, C.F. & Whitlock, B.A. *Guichenotia anota* and *Guichenotia apetalata* (Lasiopetaleae: Byttneriaceae or Malvaceae s. lat.) a new and a revised species endemic to the Ravensthorpe Range, south-west Western Australia. *Nuytsia* 19(1): 181–190 (2009). *Guichenotia anota* C.F. Wilkins is described as new and *Guichenotia apetalata* A.S. George is revised. Both are endemic to the Ravensthorpe Range in south-west Western Australia. Cladistic analyses of morphological characters, and chloroplast and nuclear DNA sequences (Wilkins & Whitlock in prep.) show these two species to be most closely related to each other, and more closely related to *Lasiopetalum* Sm. than to *Guichenotia* J. Gay. As both are priority species for conservation, in an area with developmental pressures from mining, they require urgent description and revision, and are included here in the latter genus until their generic placement is certain. Anatomical leaf data is presented.

Introduction

Guichenotia apetalata A.S. George and *G. anota* C.F. Wilkins, described herein as new, are restricted to Mt Short and Mt Desmond respectively within the Ravensthorpe Range, south-western Australia. They fall within tribe Lasiopetaleae (Gay 1821) which has traditionally been placed in Sterculiaceae Vent. More recently, this tribe has been included in either the sub-family Byttnerioideae, in a greatly expanded Malvaceae *sensu* Judd and Manchester (1997; see also Alverson *et al.* 1998, 1999; Bayer *et al.* 1999; Bayer & Kubitzki 2003; APG11 2003), or included in the reinstated family Byttneriaceae J. Gay (Heywood *et al.* 2007).

Guichenotia anota is closely related to *G. apetalata*, with the main difference being that the leaves are oblong rather than trilobed. *Guichenotia apetalata* was described in 1968 and placed in *Guichenotia* due to its having the typically ribbed outer surface of the calyx. However, George (1968) also suggested that this species was somewhat anomalous in the genus, as it lacked stipules and petals. The 15 other species currently recognised in *Guichenotia* (Wilkins & Chappill 2003) do have petals; however, there are two more recently described species with stipules always lacking (*G. asteriskos* C.F. Wilkins, *G. basivirida* C.F. Wilkins), and two species with stipules sometimes lacking (*G. impudica* C.F. Wilkins, *G. micrantha* (Steetz) Benth.). Like other *Guichenotia*, *G. apetalata* and *G. anota* have pendulous flowers

and a calyx with prominent external ribs; however, these species share a number of unique features and their exact phylogenetic relationship within *Guichenotia s.str.* is unresolved. As such neither were included in a recent revision of *Guichenotia* (Wilkins & Chappill 2003). *Guichenotia apetala* and *G. anota* differ from other species in the genus in that the outer surface has one central rib and one rib on each lobe fusion line, rather than the more typical 3–5 ribs in the centre of the lobe. Further, the calyx lobes have an obtuse-rounded rather than acute apex; petals are absent; and the ovary has three rather than five cells and the stigmatic tube is wider than the style (Figure 1E), rather than being the same width throughout. Further, the apical stigmatic pore tube is rimmed rather than unrimmed as found in other Lasiopetaleae with poricidal anther dehiscence (e.g. *Guichenotia*, *Lasiopetalum*, *Thomasia* J.Gay and *Lysiosepalum* F.Muell.). In addition, the fruit is oblong-ellipsoid rather than ovoid, obovoid or ellipsoid. Cladistic analyses of morphological characters, and chloroplast and nuclear DNA sequences (Whitlock & Wilkins in prep.) show that *G. anota* and *G. apetala* are more closely related to *Lasiopetalum* than to *Guichenotia*. As these species are designated as Priority One for conservation (Atkins 2008), due to their restricted distributions and because of developmental pressures from mining in the region, it was considered that *G. anota* required urgent description and *G. apetala* should be revised. They are currently placed within *Guichenotia* pending a decision regarding their generic placement, following further DNA analyses.

Methods

Anatomical comparison of fresh plant material of *G. anota* (K.A. Shepherd KS 90) was facilitated by fixing in glutaraldehyde, embedding in GMA resin, sectioning by microtome and staining with Toluidine Blue pH 4.4 (Feder & O'Brien 1968).

Specimens from AD, BRI, CBG, MEL, NSW and PERTH were examined and morphological information was measured and recorded.

The distribution map was produced using Online Map Creation (http://www.aquarius.geomar.de/omc_intro.html) and is based on PERTH specimen data. Localities for species with a conservation listing are withheld for conservation reasons.

Results and Discussion

Anatomy. Transverse leaf sections of *G. anota* show it to be dorsiventral and hypostomatic. Below a thick cuticle the uniseriate epidermis has single cells or groups of cells that are larger than the remaining epidermal cells and stain reddish-purple in toluidine blue. These are considered to be mucilage cells, as their staining properties indicate the presence of polycarboxylic acids, such as alginic and pectic acid (Feder & O'Brien 1968). Mucilage cells and canals are reported as characteristic of Malvaceae *s. lat.* (Metcalf & Chalk 1950). The leaf palisade layer is biseriate, less frequently triseriate and the spongy mesophyll cells are loosely packed. Solitary crystal druses are present as cell inclusions in the spongy mesophyll layer. Cluster crystals of calcium oxalate have been reported as a feature of Malvaceae *s. lat.* with solitary cells less common (Metcalf & Chalk 1950).

There are numerous, green-filled parenchymatous cells (believed to be tannin-filled) below the main vein in the leaf rib. The rib has a tomentum of ferruginous hairs on the outer surface and tannin inclusions in the stellate hair cells possibly account for their brown colour. Tannin has been recorded as abundant in Sterculiaceae leaves (Metcalf & Chalk 1950).

Thickened yellow reticulate venation on the adaxial leaf surface while not obvious in *Guichenotia*, is a common feature in *Lasiopetalum*, but it is usually much less prominent than seen in *G. anota* and *G. apetala*. Medial leaf transverse sections show that beneath these prominent veins are 2–5 longitudinal rows of thick-walled sclerenchymatous cells with a closed lumen that extend from the adaxial surface to the vein above the abaxial surface

Transverse stem sections of *G. anota* reveal mucilage ducts to be absent from the pith parenchyma. Observed Lasiopetaleae *Guichenotia angustifolia* Turcz., *Keraudrenia velutina* Steetz, *Lysiosepalum involucratum* (Turcz.) Druce, *Thomasia sarotes* Turcz., *T. glabripetala* S.J.Patrick and *Seringia arborescens* (W.T.Aiton) Druce have mucilage ducts as 10–40 % of pith while species of *Hannafordia* F.Muell. have mucilage ducts as 60–70% of the total pith (Wilkins 2000).

Taxonomy

Guichenotia anota C.F.Wilkins, *sp. nov.*

Guichenotiae apetalae affinis sed lamina oblonga vel anguste obovata, non late ovata et subauriculata differt.

Typus: Mount Short, near Ravensthorpe, Western Australia [precise locality withheld for conservation reasons], 24 October 2003, C.F. Wilkins & J.A. Wege 1838 (*holo*: PERTH 07854846; *iso*: AD, BRI, CANB, K, MEL, NSW).

Guichenotia anota ms, in G. Paczkowska & A.R. Chapman, *West. Austral. Fl.: Descr. Cat.* p. 541 (2000).

Dwarf, erect, multistemmed, compact, grey-green, *shrub* 10–40(–100) × 20–40 cm; *young stems* tan-brown, with a tomentum of white, stellate hairs to 0.3 mm diameter, with large, dark brown centres, glabrescent with grey outer surface flaking to reveal red-brown stem with indistinct, irregular, longitudinal ridging. *Stipules* absent. *Leaves* alternate, simple; *petiole* short, 0.5–1.5 mm long; blade oblong to narrowly-obovate, 2–7(–12) × 1.5–2(–3.8) mm; abaxial surface with a prominent rib, with a tomentum of ferruginous, stellate hairs to 0.3 mm diameter, remainder with a tomentum of white, stellate hairs to 0.5 mm diameter; adaxial surface initially with dense, fine, white, stellate hairs to 0.3 mm diameter with brown centres, glabrescent with prominent, yellow, reticulate venation; margin entire, strongly recurved; apex obtuse, mainly recurved or straight. *Inflorescence* a leaf-opposed, monochasial cyme, 15–20 mm long, flowers 3–4(–8), rarely a branched cyme (flowers 5–8). Flowers 5-merous, pendulous. *Peduncle* (3.5–)6–8 mm long. *Pedicel* 1.5–4 mm long. *Peduncle and pedicel* with white, stellate hairs to 0.25 mm diameter, with brown centres, intermixed with abundant, long-stalked, red, clavate glands to 0.5 mm long. *Bracts* 1–2 at base of each pedicel (sometimes absent from terminal flower), 1–2.5 × 0.4–0.5 mm, persistent, sessile, linear-oblong, abaxially tomentose with white, stellate hairs with large, dark-brown centres, adaxially glabrous to densely white-tomentose with stellate hairs. *Epicalyx bracts* 3, free, unilateral, directly below the calyx, 2.3–4.5 × 0.4–0.5 mm, with shape and indumentum as for the inflorescence bracts. *Calyx* petaloid, 5–8 mm long, pale pink becoming medium pink, tube *c.* 3/4 of the total calyx length, with one prominent, central rib on the outer calyx lobe and a rib at the fusion of each lobe; lobes broadly-ovate, erect, 1.3–2.5 × 2.3–3.5 mm, entire; abaxial surface with medium to dense, white, stellate hairs throughout, 0.1–0.3 mm diameter, adaxial surface glabrous at the base, with contrasting darker pink venation, lobes with fine, white, simple or sessile, few-armed,

stellate hairs to 0.15 mm long, apex rounded; fruiting calyx persistent, enclosing fruit. *Petals* absent. *Staminal tube* and *staminodes* absent. *Stamens* opposite the petals; *filaments* red, glabrous, *c.* 0.2 mm long; *anthers* ventrifixed, elliptic, touching laterally to form a tube, pink becoming dark red, glabrous, 1.5–1.8 × 0.4–0.9 mm, the thecae fused dorsally and laterally with shallow indentations at fusion lines, introrsely dehiscent by elliptic pores below a truncate apex. *Pollen* white. *Ovary* superior, sessile, 0.5–0.6 × 0.5–0.6 mm; locules three, laterally fused, outer surface with a tomentum of sessile, soft, white, stellate hairs to 0.2 mm long, inner surface glabrous or with a single hair. *Placentation* axile. *Ovules* two per locule, erect, sub-basal. *Style* single, terete with apical 1/3 slightly wider than basal 2/3, with few, white, sessile, stellate hairs at base, remainder glabrous, 3–3.5 mm long. *Stigma* a dry tube with an apical, rimmed stigmatic pore. *Fruit* a sessile, chartaceous, oblong to ellipsoid loculicidal capsule 3.5–4 × 2.5–2.8 mm; outer surface with scattered, stellate hairs. *Seed* one per locule, ellipsoid, *c.* 2 × 1 mm, outer surface dark brown, smooth, with medium dense, sessile, fine, white, stellate hairs. *Aril* cap-like with short lobes (seed voucher *K.A. Shepherd* 126, Wilkins & Chappill 2002a). (Figures 1A–F, 2A & 2B)

Chromosome number. n = 10 (*C.F. Wilkins* 1172, Wilkins & Chappill 2002b).

Flowering period. September to April.

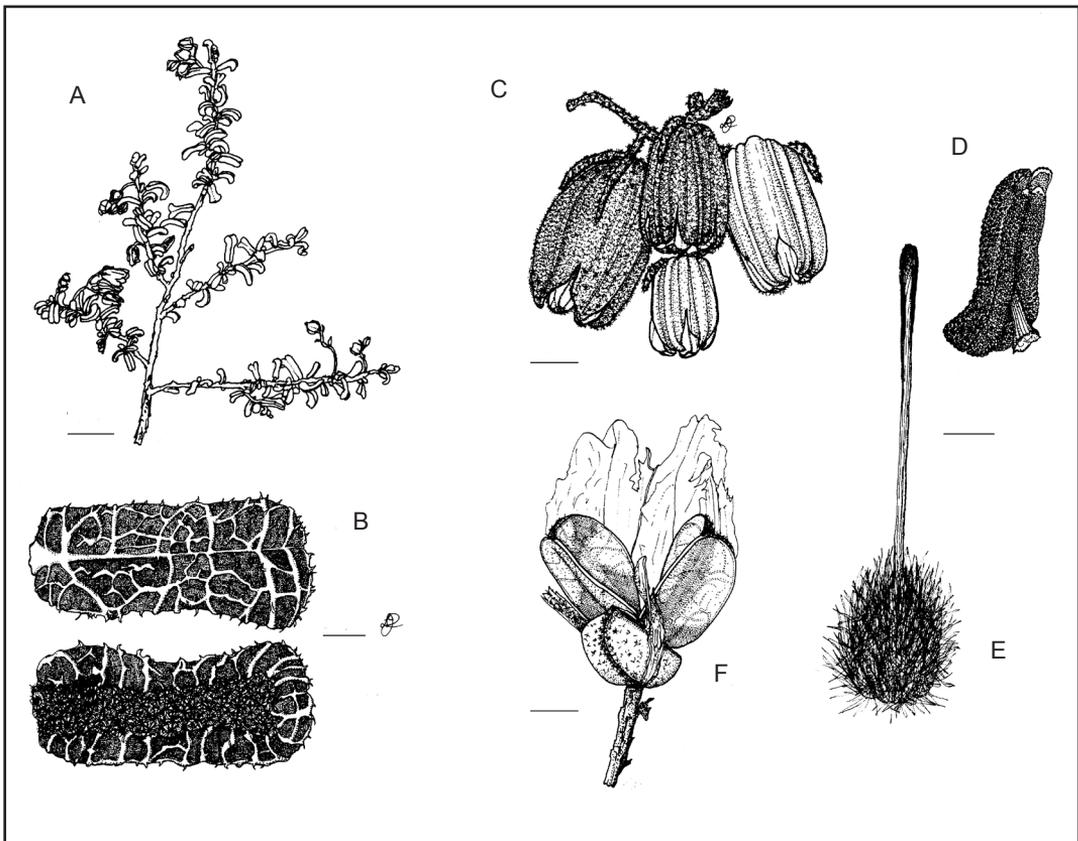


Figure 1. *Guichenotia anota* C.F. Wilkins. A – habit; B – leaf adaxial (above) and abaxial (below) surfaces; C – inflorescence of pendulous flowers; D – anther with poricidal dehiscence; E – ovary and style with stigma broader than style; F – fruit a loculicidal capsule with calyx remains. From *C.F. Wilkins* 1122. Scale bars A & B = 1 cm; C = 0.25 cm; D & E = 0.05 cm; F = 0.1 cm.



Figure 2. *Guichenotia anota* C.F. Wilkins. A – habit; B – flowering branchlet. (C. Wilkins 1838). Photographs by J.A. Wege.

Selected specimens. WESTERN AUSTRALIA: [precise localities withheld for conservation reasons] 16 Nov. 2004, *S. Barrett* 1281 (PERTH); 6 Apr. 2006, *S. Barrett* 1514 (PERTH); 5 Jan. 2001, *J.A. Cochrane* 3851 (PERTH); 21 Mar. 2000, *G.F. Craig* 5176 (PERTH); 24 Nov. 1985, *D.B. Foreman* 1206 (AD, CANB, NSW, PERTH); *s.dat.*, *Gardner* 14835 (PERTH 04205928); 16 Oct. 1964, *R. Hill* 1471 (AD); 11 Nov. 1986, *P.M. Olde* 1156 (NSW); 16 Dec. 1992, *C.J. Robinson* 1046 (PERTH); 10 Sep. 1994, *K.A. Shepherd, J.A. Chappill & J.A. Wege* 90 (PERTH); 17 Sep. 1995 *C.F. Wilkins, R. Orifici & J.A. Chappill* 1122 (PERTH); 13 Sep. 2000, *E. Tink* 496 (PERTH); 25 Sep. 1997, *C.F. Wilkins, J. Wege & R. Butcher* CW 1373 (PERTH); 13 Jan. 2002, *C.F., J.A. & G.C. Wilkins* 1502 (PERTH).

Distribution and habitat. This species is restricted to the vicinity of Mt Short near Ravensthorpe in Western Australia in red-brown clay on laterite, in open, mallee scrubland or heath, mainly on ridge tops and absent in swales, often associated with *Thomasia microphylla*. (Figure 3)

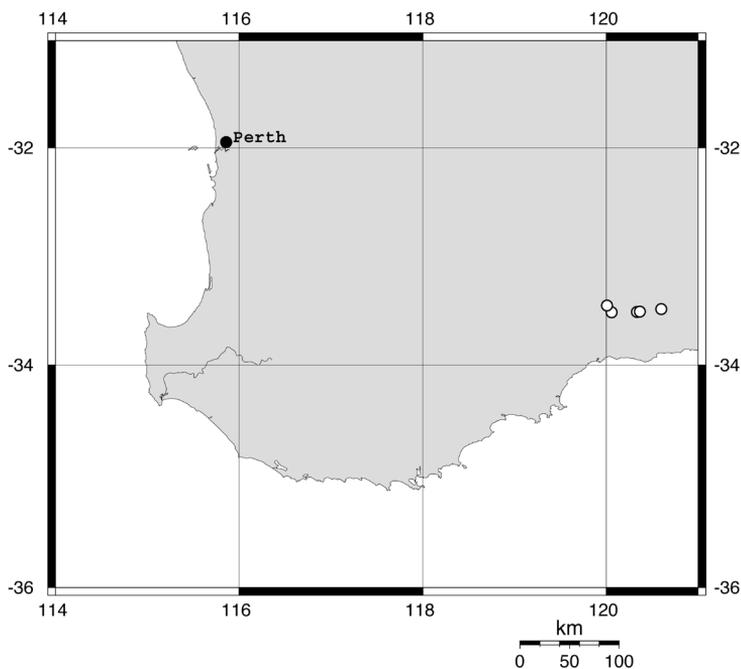


Figure 3. Distribution of *Guichenotia anota* C.F. Wilkins.

Relationships. *Guichenotia anota* is closest to *G. apetala*, differing in having leaves that are oblong with a recurved apex, rather than ovate and sub-auriculate with a straight apex, by having longer leaf petioles, longer peduncles, more glandular mature pedicels and peduncles, and a pink calyx rather than a paler pinkish-white calyx.

Etymology. The specific epithet is derived from Latin *an* (without) and *ota* (ears), referring to the oblong leaves of this species which lack the sub-auriculate lobes present on the leaf base of its closest ally *G. apetala*.

Conservation status. Due to a restricted distribution at Mt Short, *G. anota* has been allocated a conservation status of Priority One by the Department of Environment and Conservation (DEC), Western Australia (Atkins 2008).

Guichenotia apetala A.S. George. *Journal of the Royal Society of Western Australia* 50: 99 (1968).

Type citation: Mt. Desmond, SE of Ravensthorpe, 27 October 1963, T.E.H. Aplin 2693 (*holo*: PERTH 01037773; *iso*: CANB.)

Dwarf, erect, multistemmed, compact, grey-green *shrub*, 10–50 cm high × 10–55 cm diameter; *young stems* dark brown, with a tomentum of white, stellate hairs to 0.3 mm diameter, with large, dark brown centres, glabrescent with grey outer surface flaking to reveal red-brown stem with indistinct, irregular, longitudinal ridging. *Stipules* absent. *Leaves* alternate, simple; *petiole* short, 0.2–0.5 mm long; blade triangular-cordate, sub-auriculate, (1.5–)3.5–4.5 (–5) × (1.5–)3.5–4.5(–5) mm; abaxial surface with a prominent rib with a tomentum of ferruginous, stellate hairs to 0.4 mm diameter, remainder with a tomentum of white, stellate hairs to 0.3 mm diameter; adaxial surface initially with

medium-dense, fine, white, stellate hairs to 0.3 mm diameter with large, brown centres, glabrescent with prominent, yellow, reticulate venation; margin entire, strongly recurved; apex obtuse, straight or scarcely upturned. *Inflorescence* a leaf-opposed, monochasial cyme, 10–40 mm long, with 1–2 (–3) flowers. *Flowers* 5-merous, pendulous. *Peduncle* 1.5–4 mm long. *Pedicel* 1.5–4.5 mm long. *Peduncle and pedicel* tomentose with white, stellate hairs to 0.25 mm diameter, with brown centres, intermixed with scattered, long-stalked, red, clavate glands to 0.4 mm long, or glands absent. *Bracts* 1–2 at base of each pedicel (sometimes absent from terminal flower), $0.8\text{--}2.5 \times c. 0.4$ mm, persistent, sessile, linear-oblong, abaxially tomentose with white, stellate hairs with large, dark-brown centres, adaxially glabrous to densely white-tomentose with stellate hairs. *Epicalyx bracts* 3, free, unilateral, directly below calyx, $2\text{--}4.5 \times 0.3\text{--}0.5$ mm, with shape and indumentum as for inflorescence bracts. *Calyx* petaloid, 5–7 mm long, pinkish-white; tube *c.* 3/4 of total calyx length, with one prominent, central rib on the outer calyx lobe and a rib at the fusion of each lobe; lobes broadly ovate, erect, $1.3\text{--}2 \times 2.3\text{--}3$ mm, entire; abaxial surface with dense, white, stellate hairs throughout, 0.1–0.3 mm diameter; adaxial surface glabrous at the base, venation same colour as surface, lobes with fine, white, simple or sessile few-armed stellate hairs to 0.15 mm long, apex rounded; fruiting calyx persistent, enclosing fruit. *Petals* absent. *Staminal tube* and *staminodes* absent. *Stamens* opposite the petals; *filaments* red, glabrous, almost sessile; *anthers* ventrifixed, elliptic, touching laterally to form a tube, pink becoming dark red, glabrous, $1.5\text{--}1.8 \times 0.4\text{--}0.9$ mm, the thecae fused dorsally and laterally with shallow indentations at fusion lines, introrsely dehiscent by elliptic pores below a truncate apex. *Pollen* white. *Ovary* superior, sessile, $0.5\text{--}0.6 \times 0.5\text{--}0.6$ mm; locules three, laterally fused, outer surface with a tomentum of sessile, soft, white, stellate hairs to 0.2 mm long, inner surface glabrous or with a single hair. *Placentation* axile. *Ovules* two per locule, erect, sub-basal. *Style* single, terete with apical 1/3 slightly wider than basal 2/3, with few, white, sessile, stellate hairs at base, remainder glabrous, 3.5–4 mm long. *Stigma* a dry tube with an apical, rimmed stigmatic pore. *Fruit* a sessile, chartaceous, oblong to ellipsoid loculicidal capsule $3.5\text{--}4 \times 2.5\text{--}3$ mm; outer surface with scattered, stellate hairs.



Figure 4. *Guichenotia apetala* A.S.George – flowering branchlet. From C. Wilkins 419. Scale bar = 1 cm.



Figure 5. *Guichenotia apetalata* A.S.George. A – habit; B – flowering branchlet. (C. Wilkins 1836). Photographs by J.A. Wege.

Seed one per locule, ellipsoid, *c.* 2×1 mm, outer surface dark brown, smooth, with medium-dense, sessile, fine, white, stellate hairs. *Aril* cap-like with short lobes (seed voucher *K. Newbey* 568; Wilkins & Chappill 2002a). (Figures 4, 5A & 5B)

Chromosome number. Unknown.

Flowering period. September to December.

Selected specimens. WESTERN AUSTRALIA: [precise localities withheld for conservation reasons] 18 Sep. 1990, *D.E. Albrecht & B.A. Fuhrer* 4542 (MEL, PERTH); 21 Sep. 2005, *S. Barrett* 1420 (PERTH); 27 Sep. 1985, *M.G. Corrick* 9573 (BRI, MEL); 10 Aug. 1975, *T.C. Daniell* 1 (PERTH); 28 Sep. 2007, *C. Dornan* 227A (PERTH); 20 Oct. 1961, *C.A. Gardner* 13699 (PERTH); 14 Oct.,

A.S. George 1643 (PERTH); 30 Sep. 1999, *J.W. Horn & R. Butcher* 2692 (CANB, DUKE, PERTH); 1963, *F. Humphreys s.n.*, (PERTH); 28 Sep. 1975, *W. Green* 4517 (PERTH); 18 Oct. 1964, *R. Hill* 1477 (AD); 5 Oct. 1966, *T.B. Muir* 4223 (MEL); 21 Oct. 1962, *K. Newbey* 568 (PERTH); 11 Nov. 1986, *P.M. Olde* 1141 (NSW); 15 Dec. 1992, *C.J. Robinson* 1056 (PERTH); 18 Jan. 2002, *C.F., J.A. & G.C. Wilkins* 1510 (PERTH); 18 Nov. 1976, *E. Wittwer* W1889 (PERTH); 27 Oct. 1968, *J.W. Wrigley* 5061 (CANB, PERTH).

Distribution and habitat. This species is restricted to Mt Desmond near Ravensthorpe, Western Australia, mainly on ridges in red lateritic gravel with outcropping laterite, or brown clay over ironstone in open mallee scrubland. (Figure 6)

Relationships. *Guichenotia apetala* is most closely related to *G. anota* but differs in having leaves that are sub-auriculate instead of oblong-obovate, shorter sub-sessile petioles and a fewer-flowered inflorescence.

Conservation status. Due to its restricted distribution at Mt Desmond, *G. apetala* has been allocated a conservation status of Priority One by DEC, Western Australia (Atkins 2008).

Etymology. Named *apetala* for its lack of petals, a feature unique in the genus at the time of description. However, *G. anota* also has no petals.

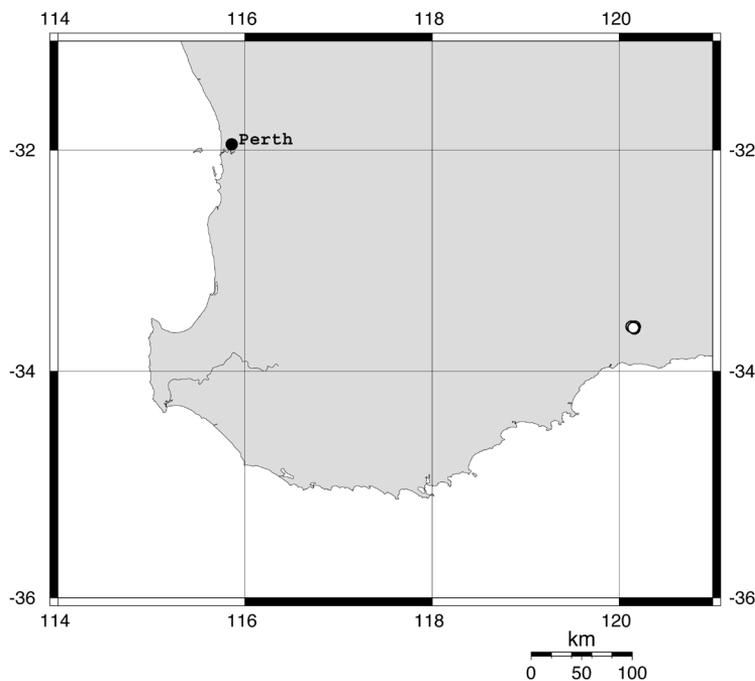


Figure 6. Distribution of *Guichenotia apetala* A.S. George.

Notes. Some larger, basal leaves of *G. apetala* rarely have five lobes and palmate venation. This is presumed to be a juvenile leaf characteristic, but juvenile plants have not been observed.

Acknowledgments

We gratefully acknowledge the support and provision of facilities by the Western Australian Herbarium curator and staff, and from the School of Plant Biology of the University of Western Australia. Thanks also to the late Lorraine Cobb for the excellent illustrations; Paul Wilson for preparation of the Latin diagnosis, and to insightful reviewers for excellent comments; ABRIS and NSF grants for research funding; national herbaria for loan of specimens; and Kelly Shepherd, Juliet Wege, Ryonen Butcher, Ainsley Calladine, Raimond Orifici, Jenny Chappill, and John and Genevieve Wilkins for fieldwork assistance and companionship.

References

- Alverson, W.S., Karol, K.G., Baum, D.A., Chase, M.W., Swensen, S.M., McCourt, R. & Sytsma, K.J. (1998). Circumscription of the *Malvales* and relationships to other Rosidae: evidence from *rbcL* sequence data. *American Journal of Botany* 85: 876–887.
- Alverson, W.S., Whitlock, B.A., Nyffeler, R., Bayer, C. & Baum, D.A. (1999). Phylogeny of the core Malvales: evidence from *ndhF* sequence data. *American Journal of Botany* 86: 1474–1486.
- Angiosperm Phylogeny Group (APG) II (2003). An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG II. *Botanical Journal of the Linnean Society* 141: 399–436.
- Atkins, K.J. (2008). *Declared Rare and Priority Flora List for Western Australia*. (Department of Environment and Conservation: Kensington, WA.)
- Bayer, C., Fay, M.F., de Bruijn, A.Y., Savolainen, V., Morton, C.M., Kubitzki, K., Alverson, W.T., & Chase, M.W. (1999). Support for an expanded family concept of Malvaceae within a recircumscribed order Malvales: a combined analysis of plastid *atpB* and *rbcL* DNA sequences. *Botanical Journal of the Linnean Society* 129: 267–295.
- Bayer, C. & Kubitzki, K. (2003). In: Kubitzki, K. & Bayer, C. (eds) *The families and genera of vascular plants. V. Flowering plants. Dicotyledons: Malvales, Capparales and non betalain Caryophyllales*. pp. 225–311. (Springer-Verlag: Berlin.)
- Feder, N. & O'Brien, T.P. (1968). Plant micro techniques: some principles and new methods. *American Journal of Botany* 55: 123–142.
- Gay, J. (1821). Monographie des Cinq Genres de Plantes, Lasiopetalées. *Mémoires de Museum d'Histoire Naturelle* 7: 431–468.
- George, A.S. (1968). Additions to the flora of Western Australia: ten miscellaneous new species. *Journal of the Royal Society of Western Australia* 50: 97–104.
- Heywood, V.H., Brummitt, R.K., Culham, A. & Seberg, O. (2007). *Flowering plant families of the world*. (Royal Botanic Gardens: Kew.)
- Judd, W.S. & Manchester, S.R. (1997). Circumscription of Malvales as determined by a preliminary cladistic analysis of morphological, anatomical, palynological, and chemical characters. *Brittonia* 49: 384–405.
- Metcalfe, C.R. & Chalk, L. (1950). *Anatomy of the dicotyledons* Vol. 1. (Clarendon Press: Oxford.)
- Wilkins, C.F. (2002). *A systematic study of Lasiopetaleae (Malvaceae s.l. or Sterculiaceae)*. PhD thesis. University of Western Australia.
- Wilkins, C.F. & Chappill, J.A. (2002a). Seed and seedling morphology and seed anatomy of Lasiopetaleae (Malvaceae s.l. or Sterculiaceae). *Australian Systematic Botany* 15: 545–563.
- Wilkins, C.F. & Chappill, J.A. (2002b). New chromosome numbers in Lasiopetaleae: Malvaceae s.l. (or Sterculiaceae). *Australian Systematic Botany* 15: 1–8.
- Wilkins, C.F. & Chappill, J.A. (2003). Taxonomic revision of *Guichenotia* (Malvaceae s.l. or Sterculiaceae). *Australian Systematic Botany* 16: 323–360.