

Flowering Plants of Africa

Volume 69

June 2025



Flowering Plants of Africa

Since its inception in 1921, this serial, modelled on the former *Curtis's Botanical Magazine*, has published 2 420 colour plates of African plants prepared by some 80 artists.

The object of the journal is to convey to the reader the beauty and variety of form of the African flora, to stimulate an interest in the study, conservation and cultivation of African plants, and to advance the science of botany as well as botanical art.

We welcome contributions of suitable artistic and scientific merit. Please see *Guide for authors and artists* on page 222.

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(note Afrikaans translation and changes in title)

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The Flowering Plants of South Africa

Volume 25 (1945–1946) to volume 26 (1947):

The Flowering Plants of Africa

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The Flowering Plants of Africa

Die Blomplante van Afrika

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Flowering Plants of Africa

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Flowering Plants of Africa

A peer-reviewed biennial journal containing colour plates with accompanying scientific accounts of flowering plants of Africa and neighbouring islands.

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This volume is dedicated to

NEIL ROBERT CROUCH, Ph.D. (29 January 1967–)

Ethnobotanist, taxonomist, conservationist, and facilitator of biotrade and bioprospecting in South Africa, in recognition of his wide-ranging research outputs and, through his publications, the popularisation of the local flora for which he was earlier awarded the Rudolf Marloth Medal from the Botanical Society of South Africa. In this regard he has co-authored several books on medicinal plants, ferns and succulents of southern Africa. He is commemorated in the species names *Aloe neilcrouchii* (Asphodelaceae) and *Kalanchoe crouchii* (Crassulaceae), both earlier treated in *Flowering Plants of Africa (FPA)* as Plates 2262 and 2366, respectively.



Neil Robert Crouch

His contributions to plant systematics are reflected mostly in taxonomic studies on the large bulbous family Hyacinthaceae, ferns and their allies, aloes and their relatives, and on members of the Crassulaceae, the *plakkies*. As a keen plant photographer he has contributed numerous images to various scientific articles and books produced by others in the region, and to online resources, such as the Flora of Zimbabwe and the Red List of South African Plants. He has also participated in several international biodiversity initiatives, including the Global Plants Initiative, the African Plants Initiative and the World Flora Online.

Neil is a prolific author and has authored or co-authored nearly 370 scientific and other publications over the past three decades. Amongst these he has contributed some 40 species monographs to *FPA*, mostly of southern African succulents and geophytes. He co-authored the texts of two kalanchoes, *K. benbothae* and *K. gideonsmithii*, that are included in this volume.

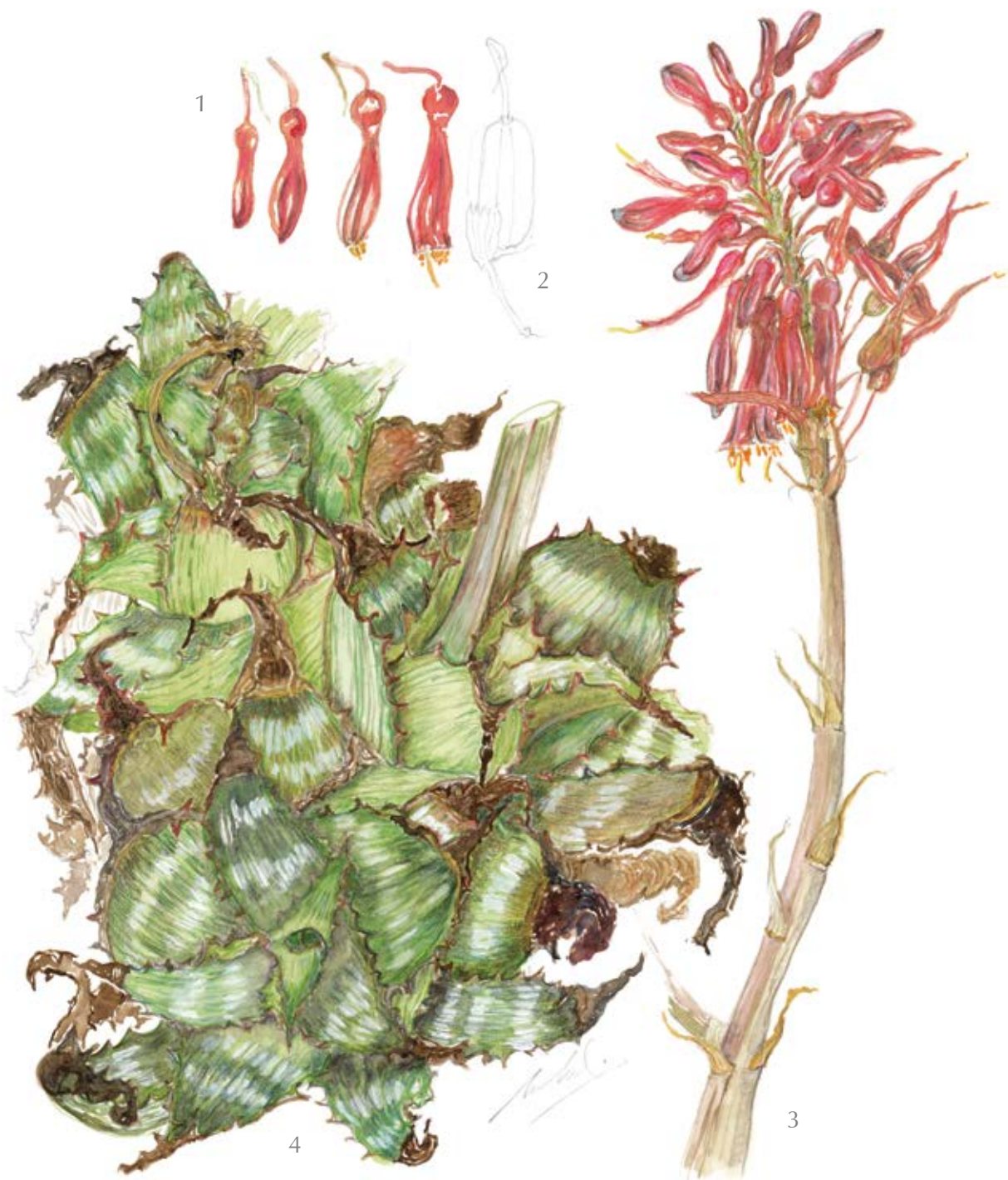


PLATE 2401 *Aloe davyana* var. *magdae*

Aloe davyana var. *magdae*

Asphodelaceae: Aloooideae

South Africa

Aloe davyana Schönland var. **magdae** Gideon F.Sm. in *Phytotaxa* 536(3): 266 (2022).

From 1839 to 1840, following in the wake of the Voortrekkers that left the Cape Colony in the early- and mid-1830s, Carl (Karl) Ludwig Philipp Zeyher (1799–1858) and Joseph Burke (1812–1853) undertook a joint collecting trip to the South African interior to accumulate botanical and other natural history specimens. This was the first expedition during which collections were made in parts of the present-day central and northern provinces of South Africa (Gunn & Codd 1981). In the second half of the 19th century the area through which Zeyher and Burke travelled eventually became the Orange Free State and the Zuid-Afrikaansche Republiek (Z.A.R.), two independent countries. Later still, the Z.A.R., as the Transvaal, and the Orange Free State became provinces of the Union of South Africa, with the Z.A.R. having largely coincided with the present-day North West, Gauteng, Limpopo and Mpumalanga provinces of South Africa.

Some 40 years after Zeyher and Burke collected in the South African interior, the diamond and gold rushes to, respectively, Kimberley (in the Northern Cape), and the Witwatersrand (Gauteng), Pilgrim's Rest and Barberton (both Mpumalanga) areas drew many prospectors and business people to the South African interior. Some of them, like George Thorncroft (1857–1934) (Bornman 1995), were interested in botany, and specimens from the South African hinterland were soon sent to John Medley Wood (1827–1915) in Durban, KwaZulu-Natal, and also to the Royal Botanical Gardens, Kew, in the United Kingdom, for identification. At first, collecting in what is today northern South Africa was patchy and of necessity not systematic, given the challenges of, for example, transport in the African bush (Figueiredo & Smith 2023). In addition, people who settled in the interior had other concerns, such as the First Anglo-Boer War (1880–1881) and, later, the Second Anglo-Boer War (1899–1902), also referred to as the South African War, to contend with. It was only after hostilities in the Second Anglo-Boer War came to an end in 1902, which led to the eventual creation of the Union of South Africa in 1910, that conditions became conducive for the establishment, in 1903, of what is today the National Herbarium (PRE) of South Africa, which is based in Pretoria, the administrative capital of the country (Smith & Willis 1999).

Unsurprisingly, many indigenous species that are common in what was successively the Z.A.R. and later the Transvaal province of South Africa, escaped documentation until the early 1900s. One such species is *Aloe davyana* Schönland (Figure 1), which is arguably the most common aloe – but certainly the most common maculate aloe – north of the Vaal River, which forms the present-day southern border of the Gauteng and the northern

PLATE 2401.—1, flowering sequence from bud (left) to completed anthesis (right), $\times 0.75$; 2, fruit, $\times 0.75$; 3, inflorescence $\times 0.6$; 4, two rosettes, $\times 0.5$. Voucher specimen: G.F. Smith 1160 in H.G.W.J. Schweickhardt Herbarium (PRU), Pretoria. Artist: Magda Nel.



FIGURE 1.—This is how *Aloe davyana* var. *davyana* is often encountered in the winter veld, with only the flowers, which vary in colour from flesh pink to dull brick red, visible above grasses and forbs under which the rosettes are well hidden. Photograph: G.F. Smith.

border of the Free State provinces of South Africa. After *A. davyana* was included under *A. greatheadii*, as *A. greatheadii* var. *davyana* (Schönland) Glen & D.S.Hardy by Glen & Hardy (1987), *A. davyana* was recently reinstated at the rank of species (Smith et al. 2020). At the same time, Smith et al. (2020) also recognised the more northern element, *A. greatheadii* (Figure 2), as an accepted species. *Aloe davyana* belongs in *A. sect. Pictae* Salm-Dyck, an infrageneric group in *Aloe* referred to in the vernacular as the ‘maculate aloes’ (Van Wyk & Smith 2014).

Aloe davyana was only described in 1905 by Selmar Schönland (1860–1940) (Figure 3) while he was based in Grahamstown; in that year he was appointed as the first Professor of Botany in the newly established Rhodes University College (Hewitt & Bolus 1940; De Moor & Lubke 2021; Lubke et al. 2021). Schönland had more than a passing interest in the genus *Aloe* L. (see for example Schönland 1903, 1904, 1905, 1907), and in succulents in general – he, inter alia, contributed the treatment of the Crassulaceae to *Die natürlichen Pflanzenfamilien* (Schönland 1891). Schönland, the spelling of his surname he eventually preferred (Gunn & Codd 1981), is commemorated in the aloe names *A. ×schoenlandii* Baker, as ‘*Schönlandi*’, pro sp. [*A. maculata* All. × *A. striata* Haw.], which is a synonym of *A. ×schimperi* Tod. pro sp. (Figueiredo & Smith 2016), and more recently in *A. ×selmarii* Gideon F.Sm. & Klopper (Smith & Klopper 2021a) [*A. davyana* × *A. parvibracteata* Schönland]. Twenty-four years after *A. davyana* was described, a plate of the species, executed by the accomplished South African-born botanical artist Cythna Lindenberg Letty (1895–1985), was featured in *The Flowering Plants of South Africa* (Phillips 1929), as this series was then known.



FIGURE 2.—In comparison to *Aloe davyana*, *A. greatheadii*, shown here, has a more northerly natural geographical distribution range in the dry subtropics of northern South Africa and southern south-tropical Africa. Photograph: G.F. Smith.



FIGURE 3.—Professor Selmar Schönland (1860–1940) described *Aloe davyana* in 1905 while he was based in Grahamstown at the then newly established Rhodes University College. Photographer unknown. Photograph provided by Tony Dold and copyright of the Selmar Schönland Herbarium, Albany Museum, Makhanda, South Africa.

The following decade, the 1930s, turned out to be the heyday of aloe discovery and description in South Africa, with people like Louisa Bolus (1877–1970), Ben Groenewald (1905–1976), Neville Pillans (1884–1964), Illyd Pole Evans (1879–1968) and Gilbert Reynolds (1895–1967) contributing to our knowledge of the genus (Klopper et al. 2013). Of this group, Groenewald had an especially strong interest in the maculate aloes (Groenewald 1941; Anonymous 2010; Klopper et al. 2013; Smith & Klopper 2021b; Smith et al. 2023) and so, based on material collected by Frederick Z. van der Merwe (1894–1968) near Pienaarsrivier in the Limpopo province of today, Groenewald described the first non-autonymic variety, *Aloe davyana* var. *subolifera* Groenew., recognised in *A. davyana* (Groenewald 1939). *Aloe davyana* var. *subolifera* was accepted by all aloe researchers until it was placed in the synonymy of a broadened concept of *A. greatheadii* var. *davyana* (Glen & Hardy 1987), a view that was not followed by Smith et al. (2021). *Aloe davyana* var. *subolifera* generally differs from *A. davyana* var. *davyana* by the plants forming large, suckering clumps of up to 20 attached rosettes – two to four in the case of *A. davyana* var. *davyana* – while the light pink to almost white flowers of *A. davyana* var. *subolifera* (Figure 4) are generally lighter coloured than the flesh-pink to dull brick-red ones of *A. davyana* var. *davyana*.



FIGURE 4.—The flowers of *Aloe davyana* var. *subolifera*, here growing near Pienaarsrivier in Limpopo, in a patch of recently burned veld, are lighter in colour than those of *A. davyana* var. *davyana*, to the extent that they are often nearly white. Photograph: G.F. Smith.



FIGURE 5.—In the cold winter months on the climatically severe inland escarpment, winter temperatures often drop to well below freezing, to turn the grass yellow in the tree-dotted landscape. Against this drab yellow background the bright orange-red to bright red flowers of *Aloe davyana* var. *magdae* provide a vivid contrast. Note the somewhat cylindrical inflorescences of this aloe. Photograph: G.F. Smith.

More than 80 years after Groenewald described *Aloe davyana* var. *subolifera*, a second non-autonymic variety, *A. davyana* var. *magdae*, the subject of this contribution, was described in *A. davyana* (Smith 2022) (Figure 5). Unlike *A. davyana* var. *subolifera*, which has its main centre of distribution about 50 km north of Pretoria in Limpopo, South Africa, *A. davyana* var. *magdae* is a more southern element that occurs from south of Johannesburg in the vicinity of Ennerdale, Walkerville, Sebokeng and Vanderbijlpark in Gauteng, southward to around Parys and Heilbron in the Free State (Figure 6).

Aloe davyana var. *magdae* was named for Magda Nel (1957–), who has a longstanding interest in aloes and, until recently, was employed as herbarium technician in the H.G.W.J. Schweickerdt Herbarium (PRU) of the Department of Plant and Soil Sciences, University of Pretoria. Her responsibilities included maintenance of the preserved plant collection, capturing data from specimen labels and undertaking plant identifications. Magda is also an accomplished graphic artist and in this, the 69th volume of *Flowering Plants of Africa*, is introduced to the readership of the journal as a botanical artist. In this regard she joins Cythna Letty as one of the few artists that, in this journal, illustrated a taxon – *A. lettyae* Reyn. in the case of Letty – that was named for them (Reynolds 1940; Reynolds 1950).

Like the autonymic *Aloe davyana* var. *davyana* (Figure 1), *A. davyana* var. *magdae* can also develop clusters of up to four rosettes, but often grows as solitary specimens. However, unlike *A. davyana* var. *subolifera* it never develops the large number of connected rosettes found in the latter variety (Figure 4). The rosettes of *A. davyana* var. *magdae* can consist of up to 30 leaves – unlike the fewer than 15 often found in the rosettes of *A. davyana* var. *davyana* and *A. davyana* var. *subolifera* – so generally yielding larger and taller plants. The shape of the rosettes of *A. davyana* var. *magdae* additionally takes on an upwards-tapering, near-triangular appearance.

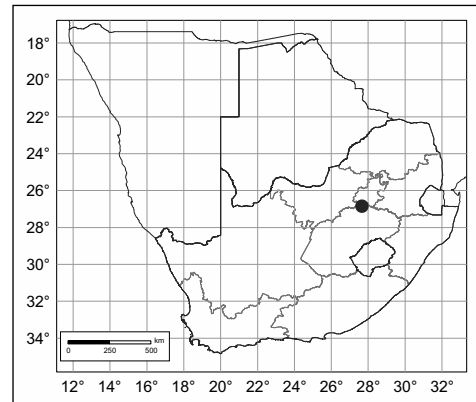


FIGURE 6.—Known natural geographical distribution range of *Aloe davyana* var. *magdae* in South Africa.

At reproductive maturity plants of *Aloe davyana* var. *magdae* usually produce up to three inflorescences simultaneously or successively, as in the case of the other two varieties recognised in the species (Figure 7). However, *A. davyana* var. *magdae* occurs naturally in the climatically severe southern Gauteng and northern Free State and, depending on the rather regular occurrence of severe frosts, only one or, more rarely, none, of the inflorescences



FIGURE 7.—*Aloe davyana* var. *magdae* often grows as solitary specimens, but also form small clumps of up to four rosettes. In the cold winter months the leaves die back to yield small, squat rosettes that are triangular in outline. Photograph: G.F. Smith.



FIGURE 8.—These flowers of *Aloe davyana* var. *magdae* succumbed to the very low temperatures experienced during a cold snap in late-winter 2021. Photograph: G.F. Smith.



FIGURE 9.—The flowers of *Aloe davyana* var. *magdae* are bright orange-red to bright red, while, those of *A. davyana* var. *davyana* vary from pale flesh-pink to dull brick-red, with greenish to greyish, longitudinal stripes. Photograph: G.F. Smith.

will bear flowers that reach anthesis (Figure 8). The racemes of *A. davyana* var. *magdae* are more or less cylindrical, while those of *A. davyana* var. *davyana* and *A. davyana* var. *subolifera* can best be described as broadly conical.

The flowers of *Aloe davyana* var. *magdae* are distinctively bright orange-red to bright red (Figure 9), while, in contrast, those of *A. davyana* var. *davyana* vary from pale flesh-pink to dull brick-red with greenish to greyish, longitudinal stripes. A characteristic feature of the flowers of *A. davyana* var. *subolifera*, on the other hand, is that its flowers are generally lighter pinkish in colour to often almost white.

The perianths of virtually all the maculate aloes have a bulb-like swollen base. In the case of the flowers of *Aloe davyana* var. *magdae* the bulbous swelling is slightly smaller than that found in *A. davyana* var. *davyana* and *A. davyana* var. *subolifera*. This makes the flowers of *A. davyana* var. *magdae* to some degree reminiscent of those of *A. grandidentata* Salm-Dyck, which, although possessing perianths with a rather small basal bulbous swelling (Figure 10), has distinctly clavate flowers. *Aloe grandidentata* also occurs on the climatically severe inland escarpment of South Africa but unlike the winter-flowering *A. davyana*, including *A. davyana* var. *magdae*, flowers rather in spring in the southern hemisphere, from September to October, when temperatures are on the increase (Smith & Figueiredo 2019).

Description.—Plants small, low-growing, solitary or suckering to form groups of 2–4, rosettes often turned sideways, up to 160(–180) mm tall. Stem $\pm$ absent to very short, thickened lower down if present, clothed in persistent, twisted, dried leaves. Leaves very densely rosulate, at first erect, then horizontally spreading, 50–150 mm long,



FIGURE 10.—The flowers of *Aloe grandidentata* have a rather small basal bulbous swelling and are distinctly clavate. Photograph: G.F. Smith.

50–70 mm wide at base, mid-green, usually purplish-infused, smooth textured, deltoid-lanceolate; adaxially white-spotted, white spots $\pm$ oblong to H-shaped, sometimes arranged in interrupted, wavy transverse bands; abaxially pale milky green, green-dotted, longitudinally darker green-lined, lines narrow, not confluent; exudate clear, drying purplish; margins shiny orange-brown to shiny dark brown or shiny concolorous, armed with prominent, short, very pungent, deltoid, shiny brown, yellowish-tipped teeth, $\pm$ 4–6 mm long, 4–5(–8) mm apart, straight variously or more rarely curved towards leaf base. *Inflorescence* 1 to 3 per rosette, simultaneous or consecutively, some often destroyed by frost, 0.7–1.0 m tall, erect, 3- to 7-branched from below middle, branches ascending at narrow angle from peduncle; peduncle rather stout, lacking sterile bracts below racemes, panicle branches subtended by prominent fertile bracts of $\pm$ 30–50 mm long, drying rapidly, dull light brown to creamy white, irregularly deltoid to lanceolate-triangular, indistinctly longitudinally dark brown lined. *Racemes* $\pm$ cylindrical, erect, somewhat tapering upwards, equally densely flowered above and below, (90–)150–200 $\times$ 70–80 mm where flowers are at anthesis, usually rather densely flowered; buds erect to erectly spreading, flowers nodding or pendulous at anthesis. *Floral bracts* $\pm$ 15–25 mm long, conspicuous, $\pm$ as long as pedicels, drying rapidly, light brown to creamy white, narrowly lanceolate, variously twisted, much narrower than fertile bracts. *Pedicels* 20–25 mm long, orange to reddish orange when young, remaining so with age. *Flowers* with perianth buds bright orange-red to bright red, dark-tipped; open flowers bright orange-red to bright red, alternately whitish and darker striped in apical half, 32–35 mm long, 5 mm across ovary, narrowed above ovary to yield small subglobose bulbous base, distinctly enlarged towards mouth, apical half ventricose

below, tips of segments very slightly flared, outer segments free for half of their length; tips slightly spreading; stamens with filiform-flattened filaments, uniformly light yellowish white, exerted for up to 2–4(–6) mm; ovary 7–8 mm long, 2–3 mm in diameter, light green; style well-exserted, uniformly light yellow; stigma tiny, very slightly capitate, yellowish. *Fruit* a loculicidal capsule, 25–30 × 12–15 mm, dull mid-green to purplish green, dry remains of perigone soon shed. Seed 3.5–4.5 × 2–3 mm, dark brown to black, ± irregularly D-shaped, angled. *Chromosome number*: unknown. Plate 2401.

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Agapanthus coddii

Agapanthaceae

South Africa

Agapanthus coddii F.M.Leight. in Journal of South African Botany, suppl. 4: 36 (1965); Letty et al.: 21 (1962) [as *Agapanthus* sp.]; Retief & Herman: 86 (1997); Snoeijer: 120 (2004); Duncan: 198 (2021); Kremer-Köhne: 218 (2021); Wadley et al.: 32 (2021).

Species of *Agapanthus* L'Hér. are renowned as ornamental plants, widely used in pots, as cut flowers and in landscaping projects (Duncan 2003, 2004; Zhang et al. 2015). Members of the genus *Agapanthus* have been cultivated in Europe since the 17th century, with records of cultivation in the Netherlands as early as 1683 and in the Royal Garden at Hampton Court, England, in 1692 (Letty et al. 1962). It was only about a century later that the genus *Agapanthus* was formally established by L'Héritier de Brutelle (1789). Through selection and hybridisation, hundreds of cultivars have been developed and named (Snoeijer 2004; Duncan 2021). '*Agapanthus*, South Africa's Flower' was the title of an article (Leonard 1967) describing members of this genus, indigenous to South Africa, now cultivated in gardens worldwide. It is remarkable that the genus is naturally confined to southern Africa (Eswatini, Lesotho, Mozambique, South Africa), despite being globally cultivated. New cultivars continue to appear annually in nurseries worldwide (Figure 1).

The generic name *Agapanthus* is derived from the Greek words *agape* (love) and *anthos* (flower), possibly meaning 'lovely flower' or 'flower of love' (Singh & Baijnath 2018), though the precise origin of the name remains unclear. The specific epithet, *coddii*, honours Dr L.E.W. Codd (1908–1999), a South African botanist and former director of the Botanical Research Institute from 1963 to 1973 (now the South African National Biodiversity Institute) (Gunn & Codd 1981; Glen & Germishuizen 2010).

Since the establishment of the genus, *Agapanthus* has been classified under various related families, including Liliaceae (Duncan 1985), Alliaceae (Dahlgren et al. 1985; IPNI 2024) and Amaryllidaceae (Fay & Chase 1996), and at the subfamily level (Agapanthoideae) within Amaryllidaceae (Chase et al. 2009). Currently, in the South Africa National Plant Family Classification (Klopper 2024), it is placed in its own family, Agapanthaceae (see also Kubitzki 1998; Meerow et al. 1999; Koekemoer et al. 2023), although other sources still contribute it to Amaryllidaceae following APG IV (Angiosperm Phylogeny Group 2016; POWO 2024).

The Agapanthaceae family is monogeneric, containing only the genus *Agapanthus*, which comprises eight species, some with various infraspecific taxa (Kubitzki 1998; Duncan 2021; Koekemoer et al. 2023). The most recent addition to the genus is *A. pondoensis* F.M.Leight. ex G.D.Duncan (Duncan 2021). The native range of the genus (and family)

PLATE 2402.—1, scape with umbel of flowers in full anthesis, $\times 0.7$; 2, habit, $\times 0.25$; 3, umbel just starting to flower showing the bracts covering the head before it opens, $\times 0.7$. Voucher specimen: Bester & De Smidt 20516 in National Herbarium (PRE), Pretoria. Artist: Gail Irene de Smidt.



Paul de Jode

PLATE 2402 *Agapanthus coddii*



FIGURE 1.—Trademarked *Agapanthus* cultivars currently available at local nurseries in Pretoria, Gauteng: a, b, Twist Again; c, d, Buccaneer; e, f, Bingo White. Photographs: a–f, S.P. Bester.

extends from the Western Cape along the eastern parts of the subcontinent, including Lesotho and Eswatini, into Limpopo in South Africa, and further north into Mozambique (Duncan 2003, 2005; Koekemoer et al. 2023). Members of this family are cultivated globally and have become naturalised in Australia, the United Kingdom, New Zealand, the United States of America, Mexico, Jamaica, Ethiopia and Eritrea (Chawla et al. 2022). In some of these countries, *Agapanthus* species have become noxious weeds.

Due to the lack of distinguishing characteristics and extreme variability within and between species, it has been suggested that all species should be attributed to a single taxon (Letty et al. 1962). However, eight species are currently recognised (SANBI 2024). The very first plant featured in the initial volume of this series (then known as *The Flowering Plants of South Africa*) was *Agapanthus umbellatus* L'Hér. (Pole Evans 1921), now a synonym of *A. africanus* (L.) Hoffmanns. Subsequent publications in this series included *A. praecox* Willd. subsp. *orientalis* (F.M.Leight.) F.M.Leight. (Dyer 1966a); *A. campanulatus* F.M.Leight. subsp. *patens* (F.M.Leight.) F.M.Leight. (Dyer 1966b), now subsumed under *A. campanulatus* F.M.Leight.; *A. inapertus* Beauverd subsp. *inapertus* (Dyer 1966c); *A. inapertus* subsp.

pendulus (L.Bolus) F.M.Leight. (Dyer 1966d); *A. walshii* L.Bolus (Rourke 1973); and *A. dyeri* F.M.Leight. (Duncan 1993), now a synonym of *A. inapertus* subsp. *intermedius* F.M.Leight.

Based on an investigation of genome size using nuclear DNA content and pollen characteristics, *Agapanthus coddii* is closely related to *A. caulescens* Spreng. and *A. campanulatus*, all of which have lilac pollen grains, leaves with a purple base and deciduous growth (Zonneveld & Duncan 2003). In most species pollen grains are yellow or light brown, only in *A. walshii* is it dark brown and in the three species, *A. coddii*, *A. campanulatus* and *A. caulescens*, is it lilac (Duncan 2021). Morphologically, however, Leighton (1965) considers *A. coddii* to be most closely related to *A. campanulatus*, whereas Duncan (2021) regards *A. caulescens* as the closest ally to *A. coddii*. The differences between these taxa are summarised in Table 1.

In the protologue of *Agapanthus coddii* (Leighton 1965), the holotype is cited as the specimen *Erens & Codd 2081* at the National Herbarium (PRE) (barcode PRE0112952-0), with two isotypes cited from the Compton Herbarium (NBC) (namely *NBG 145/55* and *NBG 768/54*). The specimen labels of the presumed isotypes also contain the collector details as *Erens & Codd 2081*, with *NBG 145/55* marked as 'isotype'. The *NBG 145/55* and the *NBG 768/54* specimens consist of two sheets each (barcodes NBG0018221-1 and NBG0018221-2 labelled as 'Sheet I' and 'Sheet II', and barcodes NBG1561112-0 and NBG1561113-0 labelled as 'Sheet I' and 'Sheet II' respectively). However, the holotype material was collected on 27 January 1960 (<https://plants.jstor.org/stable/viewer/10.5555/al.ap.specimen.pre0794039-0>) and the presumed isotypes more than a year earlier: the *NBG 145/55* material on 18 January 1959 (<https://plants.jstor.org/stable/viewer/10.5555/al.ap.specimen.nbg0018221-1> and <https://plants.jstor.org/stable/viewer/10.5555/al.ap.specimen.nbg0018221-2>) and the *NBG 768/54* material two days later on 20 January 1959 (South African National Biodiversity Institute 2024). The holotype also bears the number *NBG 145/55*. The material preserved as the holotype and presumed isotypes (especially that of *NBG 145/55*) may have originated from the same collecting event at the same locality (Kranskop) but they were cultivated at Kirstenbosch National Botanical Garden under different accession numbers and were pressed as specimens on different dates. Therefore, according to Article 8.2 of the *International Code of Nomenclature for algae, fungi, and plants* (the *Code*, Turland et al. 2018), these specimens represent three different gatherings and the NBC specimens (cited as 'isotype' by Leighton 1965), although being original material, cannot be considered type material. It is worth noting that the *Code* provides guidelines for the selection and designation of type specimens but does not specifically address cases where specimens indicated as 'isotypes' are collected or prepared at different times from the holotype. The rules and examples of Article 8 imply how such cases should be treated. Any discrepancies between the collection dates of presumed type material must be carefully documented and treatment of specimens as type (or not) must be justified by taxonomists to ensure the accuracy and stability of botanical nomenclature.

To lawfully collect material in South Africa from any plant species, especially those of conservation concern, collectors must first obtain written permission from the landowners, then a collecting permit from the provincial authority, and, in some cases, a transport permit for moving the specimens. A voucher specimen is then made from this material as a pressed specimen, which, along with habitat information and collecting details, is later

Table 1. Characters distinguishing *Agapanthus coddii* from *A. campanulatus* and *A. caulescens*. Adapted from key and descriptions in Duncan (2021)

Character	<i>A. coddii</i>	<i>A. campanulatus</i>	<i>A. caulescens</i>
Flower size	Larger flowered	Small-flowered	Larger flowered
Tepals	Spreading, usually widely, never reflexed; 25–28 mm long, pale blue	Spreading to 90° from axis, sometimes reflexed; 10–20 mm long, pale to bright blue to deep blue, rarely white	Spreading, suberect or nodding, radiate more than 30° from axis; 20–35 mm long, bright blue or violet-blue
Perianth shape	Widely funnel-shaped	Widely or narrowly funnel-shaped	Widely funnel-shaped
Perianth length	35–40 mm long	20–35 mm long	15–25 mm long
Perianth tube	Relatively long, 8–12 mm long	Relatively short, 5–10 mm long	Relatively long, 15–25 mm long
Leaf width	30–55 mm broad	6–25 mm broad	20–60 mm broad
Leaf apex	Obtuse, rarely sub-acute	Sub-acute	Obtuse, sub-acute or acute
Leaves	Green; in erect or sub-erect fans	Green or glaucous; in arching erect or sub-erect fans	Light to bright green, dark green or intensely glaucous; in strongly arching, erect or sub-erect fans
Pollen	Lilac	Lilac	Lilac
Scape	Stout, to 0.6–1.5 m long	Slender, 0.4–0.7(–1.0) m long	Robust or gracile, 0.6–1.5 m long
Pedicels	Spreading, 30–60 mm long	Erect, suberect or spreading, 22–70 mm long	Radiating, straight, 30–90 mm long
Distribution	Western Limpopo (Waterberg)	Eastern parts of Eastern Cape to southwestern Limpopo	Central parts of Eastern Cape to northern Limpopo (Soutpansberg) and western Limpopo (Waterberg)
Habitat	Steep montane grassland slopes below cliffs in permanently moist seepage areas	Seepage areas in montane grassland amongst rocks in fertile black soils	Wide range: open grassland on rocky mountain and hill slopes, shaded gullies, below cliffs, along wooded streams, on sheer rock faces, in marshy or black turf soils

deposited in a herbarium. Accordingly, the Trustees of Welgevonden Game Reserve (representing the landowner) were officially requested to grant permission to remove plants for illustration purposes. The voucher specimen (*Bester & De Smidt 20516*) is lodged in the National Herbarium (PRE) of South Africa in Pretoria.

From 2021 to 2025 a Foundational Biodiversity Information Programme (FBIP) project, funded by the National Research Foundation (NRF) and known as the Waterberg Mountain Complex Biodiversity Project (WMCBP), was conducted throughout the Waterberg region,

and a collection permit was obtained from the Limpopo Economic Development, Environment and Tourism Department (LEDET), the permit-issuing authority in Limpopo, South Africa. The permit issued for the WMCBP was used for the collection and transport of material of *Agapanthus coddii* to Gauteng, where PRE and the artist's studio are located.

The artist's engagement with Codd's agapanthus began when a friend and fellow botanical artist, Gillian Condry, invited her to contribute a painting of *Agapanthus coddii* for this series. This rare *Agapanthus* is known to grow in a mountainous area of the Welgevonden Game Reserve. The reserve, in which the big five (lion, leopard, rhinoceros, elephant and buffalo) occur, required that a guide accompany the team of volunteers who collected material for the illustration (Figure 2, 3). Permission to remove the plant for painting was obtained, and the CEO of the reserve joined the search for this elusive floral beauty. Several blooming plants were spotted at the base of a cliff and two specimens were collected (Figure 4).

At the reserve lodge, the collected plants were photographed, roughly sketched, and colour samples for the plate were prepared. Upon returning to Johannesburg, where the artist resides, the painting was completed with the flowering scape lasting long enough for the artist to finalise the plate. For the artist, and all others involved, it was a truly memorable excursion in search of a special plant.

Agapanthus coddii is one of the lesser-known *Agapanthus* taxa due to its limited distribution range. It is deciduous, shedding all its leaves in autumn, remaining dormant during winter, and producing new leaves in spring (Notten 2002). Also known as the *Waterberg blouelie* in Afrikaans, it grows along stream banks and steep, moist, rocky mountainsides (Retief & Herman 1997) and has been recorded at altitudes from 1 432 to 1 829 m a.s.l. The species flowers from December to February, peaking from middle to late January depending on environmental conditions, such as the onset of spring rains. The plant figured here was found in a narrow pocket of humus-rich soil, approximately 2–3 m long, located on the side of a stream directly below a steep rocky slope.

Codd's agapanthus is indigenous to South Africa and endemic to the western Waterberg region of Limpopo (Figure 5). It has been Red List assessed as Rare due to its restricted distribution range. The species mostly occurs in inaccessible habitats, with many known populations located within private conservancies and the Marakele National Park. Consequently, the species is not considered threatened (Von Staden 2004).

In Africa, *Agapanthus* species hold cultural significance as both magical and medicinal plants. The Zulu people use it to treat various ailments, including heart disease, paralysis, coughs, colds and chest pains, as well as during pregnancy (Hutchings et al. 1996). These plants are also widely used elsewhere, particularly against reproductive and central nervous system disorders, but also for medicinal applications such as anti-inflammatory, antioxidant, antibacterial, antifungal, uterotonic and anti-hypertensive effects (Younis et al. 2022). Despite the widespread use of *Agapanthus* in traditional medicine for its pharmacological properties, there is very little literature on any of the uses or even on basic biological aspects of *A. coddii*. At the very least, full phytochemical investigations of *A. coddii*, which currently remain limited, need to be conducted (Younis et al. 2022).



FIGURE 2.—*Agapanthus coddii* in habitat: a, upper section of drainage line where plants grow at the base of vertical cliffs at Welgevonden Game Reserve, Limpopo, 20 January 2024; b, amongst dense vegetation at Welgevonden Game Reserve, Limpopo, 20 January 2024; c, sprouting leaves from rhizome (note purple leaf bases) at Hartbeesfontein farm, 19 October 2021; d, remains of inflorescence with some remaining capsules at Hartbeesfontein farm, 19 October 2021. Photographs: a, G.I. de Smidt; b, I. van Zyl; c, d, R. Heydenrych.

Agapanthus coddii is deciduous and frost-hardy, thriving in humic, well-drained soil enriched with compost and ample water during summer (Du Plessis & Duncan 1989; Duncan 1998; Notten 2002). It tolerates irrigation during its winter dormant period and flourishes in the winter-rainfall areas of the Western Cape, notably in the Kirstenbosch National Botanical Garden (Notten 2002). Waterberg blue lilies are suitable for mass displays in large gardens or containers, with their umbels making excellent cut flowers. *Agapanthus coddii* is generally resistant to pests and diseases (Notten 2002). Species like

A. africanus, capable of resprouting from thick, fleshy roots, have adapted to the frequent fires of the fynbos region of South Africa, often blooming profusely after fires. This adaptation is likely present in other species as well and can be a useful character in cultivation, as it will likely also protect plants against frost. Genes responsible for such traits may be useful in some areas, for example, those regions that have harsh winter conditions, when plants



FIGURE 3.—Collection of material for illustration of *Agapanthus coddii* at Welgevonden Game Reserve and the collection team: a, Issy van Zyl with a collection of inflorescences to be illustrated by the artist; b, artist assistant, Issy van Zyl, with Simon Bjaloane, a ranger from Welgevonden Game Reserve, explaining why the material is gathered; c, team members Simon Bjaloane (left) and Kobus van Zyl (right) carefully lifting the rhizomatous rootstocks, from which the voucher was made, to transport it to the artist's studio in a clay pot; d, team members Andre Burger (left, CEO of Welgevonden Game Reserve) and Peter de Smidt (right, vice CEO of Welgevonden Game Reserve) supporting the collection expedition. Photographs: a–d, G.I. de Smidt.



FIGURE 4.—The artist, Gail de Smidt: a, a thoroughly pleased Gail de Smidt with Andre Burger, after receiving the material to illustrate; b. Gail de Smidt at her studio, busy painting the depicted plate of *Agapanthus coddii*. Photographs: a, b, P. de Smidt.

die back, but resprout again when conditions favour aerial growth once more.

In their natural habitat, *Agapanthus* species are pollinated by long-proboscid flies, bees and sunbirds (Duncan 2021), with seed dispersal facilitated by wind. Observations of *Agapanthus coddii* in Kirstenbosch National Botanical Garden have confirmed bee pollination, with the open flowers providing suitable perches for these insects (Notten 2002).

The lack of biological or observational data for *Agapanthus coddii* underscores a broader gap in knowledge concerning many indigenous plant species in South Africa. This presents scope for research in especially the pollination and general biology of such taxa.

Description (adapted from Leighton [1965] and Duncan [2021]).—Robust, deciduous summer-growing perennial, 0.8–1.3 m high. *Rootstock* a subterranean rhizome (often vertical in depicted plants), 30–60 × 18–25 mm, with perennial fleshy roots. *Pseudostem* strongly caulescent, 120–180 × 25–30 mm, purple or greenish-white flushed purple. *Leaves* upright, ± 10 per shoot, clearly caulescent, strap-shaped, broad, 50–450 × 30–50 mm, erect, with obtuse to rarely subacute apices, slightly narrowing towards base, bright green, not glaucous, not shiny. *Inflorescence* globose, 30–50-flowered, fairly dense, 0.6–1.5 m tall.

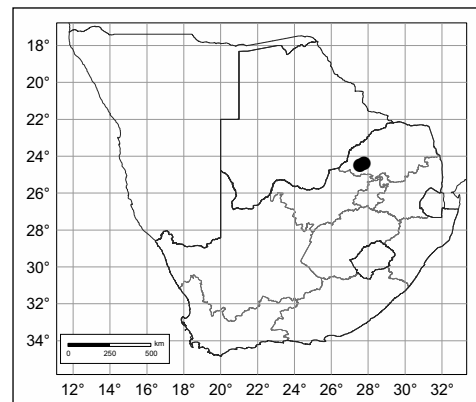


FIGURE 5.—Known distribution of *Agapanthus coddii* from BODATSA records at South African National Biodiversity Institute herbaria (NBC, NH, PRE).

Spathe bracts ovate, 65–135 × 50 mm, green, flushed purple in bud, prominent early in anthesis. *Peduncle* up to 1 m tall, relatively stout. *Pedicels* stiff, spreading, 30–60 mm long. *Perianth* widely funnel-shaped; tube 8–12 mm long, deep blue at base; tepals 35–40 mm long, pale blue to mauve, with darker margins and central vein; spreading segments usually wide but never reflexing, with obtuse often emarginate apices; outer segments 9–11 mm broad, inner segments 10–13 mm broad. *Stamens* included, filaments 19–23 mm long, lower parts fused to the length of tube of tepals; pollen lilac. *Ovary* obovoid, light green. *Style* included, 17–21 mm long. *Capsule* broadly ellipsoid, 20–30 × 13–17 mm, apex truncate. *Seed* obovate, 5–7 × 4–5 mm, laterally compressed, black; wing 7–9 × 4–5 mm, black. Plate 2402.

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PLATE 2403 *Gloriosa rigidifolia*

Gloriosa rigidifolia

Colchicaceae: Colchiceae

South Africa

Gloriosa rigidifolia (Bredell) J.C.Manning & Vinn. in Vinnersten & Manning in Taxon 56: 178 (2007); Wadley et al.: 31 (2021). *Littonia rigidifolia* Bredell: 495 (1936); Retief & Herman: 103 (1997).

The genus *Gloriosa* L. was initially established by Linnaeus (1753) with only one taxon, *G. superba* L. Recently, the genus was expanded to include *Littonia* Hook. and now comprises a total of eight species, with *G. modesta* (Hook.) J.C.Manning & Vinn. and *G. rigidifolia* the only taxa endemic to southern Africa (Vinnersten & Manning 2007). The primary reason for incorporating *Littonia* into *Gloriosa* was due to the discovery of a species, *G. sessiliflora* Nordal & Bingham, showing traits intermediate between the distinguishing characteristics of the two genera (Nordal & Bingham 1998; see also Manning & Ebrahim 2022). This was corroborated by subsequent molecular phylogenetic analysis conducted by Vinnersten & Manning (2007), leading to the formal assimilation of *Littonia* into *Gloriosa*. Moreover, the molecular phylogenetic analysis identified *Gloriosa* as the earliest diverging lineage within the Colchicaceae. *Gloriosa* is characterised by tendrils on the tips of the leaves that are, in most species, used for climbing, and nectaries that are situated in the middle of tepals, as opposed to being fused to the ovary or absent (Angiosperm Phylogeny Group 2016).

From the molecular phylogenetic analysis of Vinnersten & Manning (2007), *Gloriosa rigidifolia* and *G. modesta* are considered to be more closely related to each other than to other members of the genus and, for a considerable period, *G. rigidifolia* was considered a non-twining form of *G. modesta*. Summarised from the key in Manning & Ebrahim (2022), the major differences between these two species are listed in Table 1.

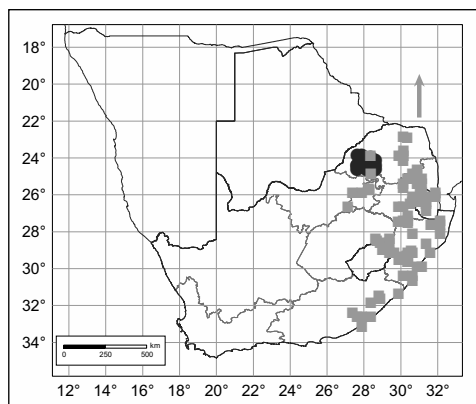
Often referred to as Waterberg bells because of their typically drooping flowers, individuals of *Gloriosa rigidifolia* are found to be widely dispersed, never in dense populations, but confined to the Waterberg Plateau (Figure 1). Plants usually grow in rocky grassland and open savanna, and were observed at altitudes ranging from 1 000 to 1 770 m a.s.l. The species flowers between December and January with the fruit developing and bursting open about a month later.

In herbaria, specimens of narrow-leaved forms of *Gloriosa modesta* have been confused with the Waterberg endemic, *G. rigidifolia*, which typically has shorter, erect stems that are mostly less than 0.5 m tall, and lacks a conspicuous leafy sterile portion above the flowers. In addition to the similarity in nectaries of *G. modesta* and *G. rigidifolia*, which

PLATE 2403.—1, flowering stem, × 1; 2, angled frontal view of a single flower showing anthers and gynoecium, × 1; 3, fruiting stem with fruit at various stages of development, note dried brown petals which are somewhat persistent, × 1; 4, two-toed or y-shaped subterranean tuber, × 1. Vouchers: 1, 2, Condyl 422; 3, 4, Bester 20617, in National Herbarium (PRE), Pretoria. Artist: Gillian Condyl.

TABLE 1.—Characteristics separating *Gloriosa rigidifolia* and *G. modesta*

Character	<i>G. rigidifolia</i>	<i>G. modesta</i>
Leaf shape	Linear	Linear to lanceolate
Leaf width	2–6(–8) mm wide	6–30 mm wide
Stem	Flowering portion of stem not overtopped by a distinct sterile leafy portion	Flowering portion of stem overtopped by a distinct sterile leafy portion
Flowers	Usually 8–20 per stem	Usually > 7 (rarely up to 15) per stem
Corolla colour	Pale green	Yellow to orange (rarely pale green)
Corolla tube length	± 5 mm long	1–3 mm long
Corolla lobe length	13–15 mm long	20–40 mm long
Style length	Much longer than ovary, connate part 7–8 mm long	As long as ovary, connate part 3–4 mm long

FIGURE 1.—Known distribution of *Gloriosa rigidifolia* (black dots) and *G. modesta* (grey squares) based on records from specimens housed at PRE, NH and NBG.

are distinctive for having the distal edge of the flanking ridges developed into a conspicuous auriculate or oblong lobe, both species also have foliage mostly in whorls of three or four. *Gloriosa rigidifolia* can be easily distinguished from *G. modesta* by the following diagnostic characters: plants are generally floriferous, with 8–20 nodding, cup-shaped flowers that are not conspicuously overtopped by sterile foliage at anthesis; erect stems that do not become twining (one of us, SPB, has observed that plants may grow among other supporting plants, like *Dichrostachys cinerea* (L.) Wight & Arn., but despite the presence of tendrils at the ends of leaves, these are not used to attach to supporting plants, thus not exhibiting a climbing habit); the leaves are linear and cirrhose, up to 26 mm wide; the greenish

tepals are connate at the base in a shallow cup, approximately 5 mm deep, with 13–15 mm long ovate-lanceolate lobes; the relatively long, erect style is about twice as long as the ovary, with the connate portion 7–8 mm long; and the flowers are rather open, with the tepals spreading distally to expose the stamens and style (Table 1; variously illustrated in Figures 2–7).

The depicted plant originated from the central-northern parts of the Waterberg on the original Welgevonden farm (which was consolidated with a number of other private farms to create the Welgevonden Game Reserve) and was collected on 12 December 2023 when it was in full anthesis (Condy 422 in National Herbarium [PRE], Pretoria). A fruiting stem was

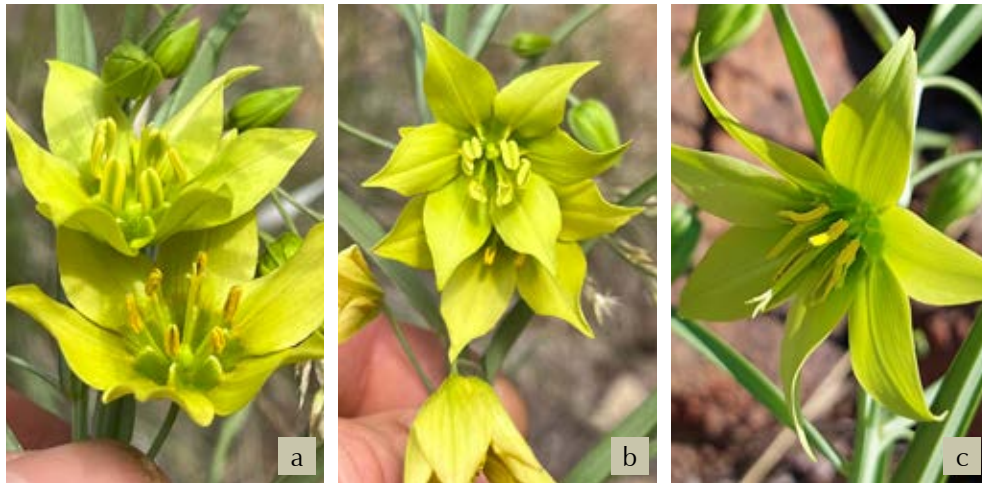


FIGURE 2.—Floral features of *Gloriosa rigidifolia*: a, angled side view showing the nectary flaps at the base of the tepals; b, frontal view of flowers showing the ovate tepals with acute tips; c, angled side view showing the slender style ending in three branches. Photographs: a, b, L. Lindenthal (iNaturalist); c, M. Popp (iNaturalist).

collected on 7 February 2024 at Syringa Sands from the western part of the Waterberg and added to the plate (Bester 20617 in National Herbarium [PRE], Pretoria). These collecting trips formed part of botanical work done in the Waterberg as part of the Waterberg Mountain Complex Biodiversity Project (WMCBP), which primarily aims to document the region's unique biodiversity, which hopefully will also contribute to its conservation. The project is funded by the Foundational Biodiversity Information Programme (FBIP) of the National Research Foundation (NRF), with data collection conducted from 2021 to 2025. This project also seeks to stimulate biodiversity research within the region, encompassing the UNESCO World Heritage site known as the Waterberg Biosphere (McDonald 2021; see also Bester et al. 2025a, b).

Although *Gloriosa rigidifolia* is a restricted endemic of the Waterberg (Figure 1), the species is widely distributed and its distribution range includes extensive protected areas. No major threats have been reported within its distribution range that would cause a population decline or indicate severe fragmentation. Therefore, it has been Red Listed as Least Concern (Foden & Potter 2005; Manning & Ebrahim 2022). Despite the biosynthesis of colchicine (Dubey et al. 2008), increased industrial demand for both wild and cultivated species of *Colchicum* L., *Iphigenia* Kunth and *Gloriosa* (Nordenstam 1998) may eventually also impact populations of *G. rigidifolia* should this source of use become known to, and utilised by, local harvesters in the region where *G. rigidifolia* occurs naturally.

Given the limited specific information on *Gloriosa rigidifolia*, the uses of related genera and species may hint at potentially similar applications. Based on the predictive nature of taxonomy, closely related taxa usually contain similar molecular compounds that act as metabolites for medicinal treatments, not only as traditional medicines but also for extractions used in western medicine. No literature could be found indicating the direct specific



FIGURE 3.—Flower and flowering stem features of *Gloriosa rigidifolia*: a, relative length of ovary to style, with the style being more than twice the length of the ovary; b, tendrils on leaf tips. Photographs: a, b, S.P. Bester.

medicinal use of *G. rigidifolia*, but numerous applications from closely related taxa like *G. superba* exist. These include its use as an antibacterial agent (Kiros et al. 2023) and for the treatment of conditions such as arthritis or gout (Misra et al. 2017), cancer (Mahajan et al. 2024), inflammation and pain (Van Wyk & Gericke 2000), barrenness and impotency (Hutchings et al. 1996), ascites and spasms (Watt & Breyer-Brandwijk 1962) and for its analgesic properties (Ade & Rai 2009). Compounds from *G. modesta* are reportedly used in aphrodisiacs (Gerstner 1939) and emetics (Trease & Evans 1983) amongst others uses.

The alkaloid colchicine is restricted to members of the Colchicaceae (Vinnersten & Larsson 2010; Larsson & Ronsted 2014), especially *Colchicum*, from which the compound's name was derived. Colchicine is also present in *Gloriosa superba* (Nordenstam 1998). Certain derivatives from the plants are very poisonous (Duke 1985; Maroyi & Van der Maesen 2011) and incorrect dosage has caused human deaths (Notten 2015). Not only has the consumption of these plants caused deaths in livestock, it has also been reported as a causal agent in both suicides and homicides (Watt & Breyer-Brandwijk 1962).

The lack of references, for this and many other South African plant taxa, highlights the lack of documented potential uses of *Gloriosa rigidifolia* and underscores the importance of further research and conservation efforts for this species. More studies on *G. rigidifolia* could reveal unique compounds with medicinal properties, contributing to pharmaceutical developments.



FIGURE 4.—Habit and vegetative morphology of *Gloriosa rigidifolia*: a, erect stems, usually solitary, very rarely branched; b, leaves at nodes in whorls of 3–4, clasping the stem; c, sessile leaf bases without any distinct venation apart from the main vein; d, side view of bilobed hypopodial tuber (corm). Photographs: a, d, S.P. Bester; b, J. Kalwij (iNaturalist); c, D. Hoare (iNaturalist).

Colchicum and *Gloriosa* (especially *G. superba*) are well-known horticultural subjects (Nordenstam 1998) and grown in many countries in the world (Notten 2015). The horticultural potential of growing *G. rigidifolia*, with its upright stems and multitude of flowers that last a couple of days with new ones opening successively over weeks, needs further investigation.

The open, rotate flowers of *Gloriosa rigidifolia* are obviously adapted to insect pollination with nectar guides present as keels on the base of the inner side of the tepals

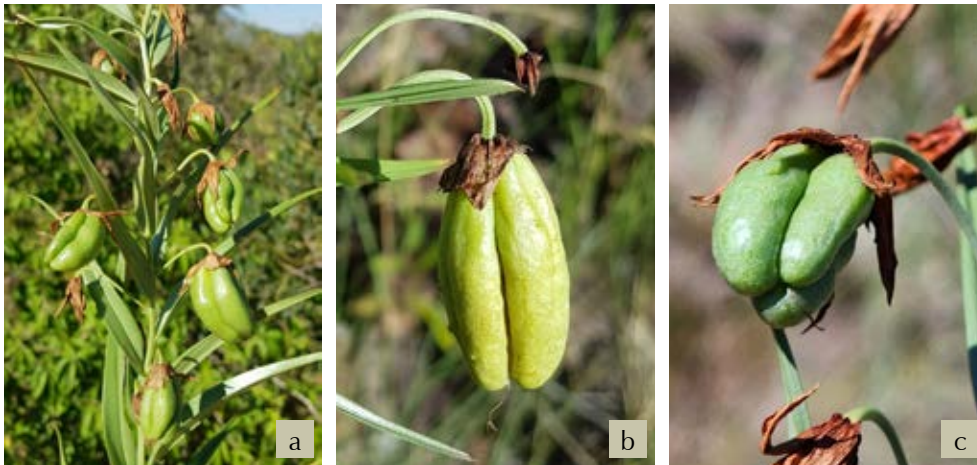


FIGURE 5.—Fruit of *Gloriosa rigidifolia*: a, developing fruit following flowering, with flowers that open successively towards the tip; b, side view of nearly mature fruit showing ovoid shape; c, fruit viewed from apex showing the three locules tightly incised. Photographs: a–c, S.P. Bester.



FIGURE 6.—Morphology of *Gloriosa modesta*: a, frontal view of flower showing deeply divided style branches and faint orange ring at base of tepals, tepals somewhat closed; b, side view of branch showing a green form of this species; c, orange variant in frontal view; d, side view of orange flowers on branch tip; e, dehiscent fruit with red sarcotesta. Photographs: a–d, M. Koekemoer; e, SAPlants@Wikicommons.

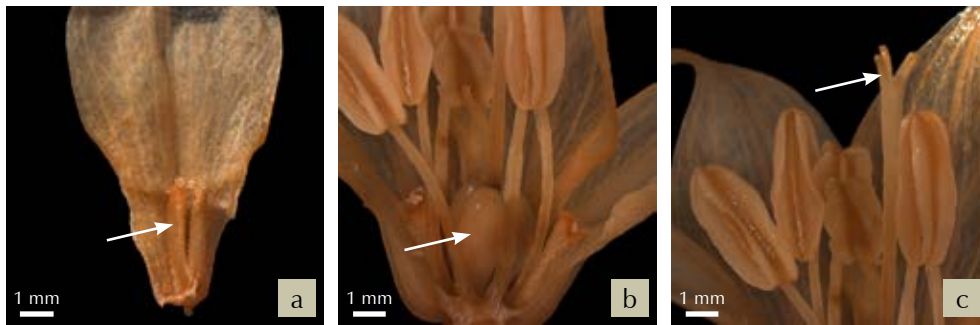


FIGURE 7.—Dissected flower of *Gloriosa rigidifolia*: a, ventral (inner) view of tepal showing the keeled basal nectary (arrow); b, dissected flower base showing the deeply lobed ovary and style, with the latter longer than the ovary; c, dissected flower showing the tip of style branching in three (arrow). Voucher: SP Bester 20617 (PRE). Photographs: a–c, S.P. Bester.

(Nordenstam 1998). The pendent flowers hint at a melittophilous (bee-pollinated) pollination syndrome and occasional visits by pollen-collecting bees from the genus *Lasioglossum* (Halictidae) have been observed by Lyn Wadley (Manning & Ebrahim 2022). Very little is known about the overall biology of *G. rigidifolia*, which leaves ample room for further research (see also Bester et al. 2025a).

Upon maturity, fruits of *Gloriosa rigidifolia* burst open, exposing small, rounded seeds, each with a thin, fleshy, orange testa. Seeds of *G. rigidifolia* resemble those of *G. modesta* (Figure 6e). It is highly likely that seeds are distributed by birds, similar to *Freesia grandiflora* (Baker) Klatt, which occurs in the same habitat as *G. rigidifolia* (Manning & Goldblatt 2010).

The tendrils of *Gloriosa* are described by Rjosk et al. (2017) as features used for climbing. However, in *G. rigidifolia* this seems to be a remnant evolutionary trait, as observations by the first author (SPB) established that plants seemingly do not utilise tendrils for climbing per se.

The habitat and variable corm, also referred to as a bilobed hypopodial tuber (Le Roux & Robbertse 1994), leaf, flower, fruit and other morphological features of *Gloriosa rigidifolia* and *G. modesta* are illustrated in Figures 2–7.

Description.—Perennial herb, resprouting annually. *Corm* (or bilobed hypopodial tuber) fleshy, tunicated, small, 10–20 mm in diameter, lobes 20–40 mm long. *Stem* to 0.2–0.6(–1.2) m long, erect, simple, smooth, leafy upwards, usually with 1 or 2 alternate sheathing leaves towards base. *Leaves* suberect, bifacial, parallel-veined, arranged in whorls of 3–4 towards top, sessile, linear or linear-lanceolate, 30–80 × 2–8 mm; tip acute and tendril-bearing, glabrous; margins involute; midrib conspicuous abaxially. *Flowers* solitary, axillary, pendent, 8–20 in upper $\frac{1}{2}$ – $\frac{1}{3}$ of flowering stems, usually without overtopping sterile leaves. *Pedicels* 6–25 mm long, inserted on one side of leaf base or on internodes. *Corolla* shallowly cup-shaped, basally connate, pale green or dull yellowish green; tepals suberect below becoming spreading towards tips, lobes ovate to ovate-lanceolate, 13–17 × 6–8 mm, tip acuminate, adaxial side of base with oblong nectar cavity, $\pm$ 2 mm long, flanked with 2 keeled ciliate appendages. *Stamens* suberect, $\pm$ $\frac{1}{3}$ of corolla length; filaments 7–8 mm

long; anthers 5–6 mm long, linear-oblong, extorse. Ovary obovoid to oblong, 3-lobed, many-ovuled; style erect, 7–10 mm long, connate portion 7–8 mm long; tip branched in 3, branches $\pm$ 2 mm long, recurving. *Fruit* ovoid to ellipsoid capsule, valves deeply involute, 18–40 $\times$ 10–18 mm at maturity, many seeded. Seed globose, thinly fleshy sarcotesta, $\pm$ 5 mm in diameter, glossy, reddish. Plate 2403.

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Kalanchoe alticola

Crassulaceae: Kalanchooideae

South Africa, Eswatini

Kalanchoe alticola Compton in *Journal of South African Botany* 41: 47 (1975); Compton: 219 (1976); Tölken: 63 (1985); Retief & Herman: 392 (1997); Court: 71 (2000); Descouings: 145 (2003); Court: 92 (2010); Smith et al.: 306 (2017); Smith et al.: 138 (2019).

‘... the sepals of ... *Kalanchoe*, which are united into a tube, retain their form, with scarcely any modification, in each species.’

Hooker & Thompson (1855: 29)

In March 1919, four months after hostilities in World War I came to an end, Professor Robert Harold Compton (Tewkesbury, England, 6 August 1886–11 July 1979, Cape Town, South Africa) (Figure 1), arrived in South Africa to assume duties as the second director of the then National Botanic Garden(s) of the country. At the time, at what is now the University of Cape Town, he was appointed as the Harold Pearson Professor of Botany. Pearson was the first director of the National Botanic Gardens, but died at the young age of 46 (Figueiredo & Smith 2024). After a 34-year career as institutional director and Harold Pearson Professor, Compton retired from these positions.

On his retirement in 1953, Prof. Compton moved to Eswatini, then still known as Swaziland. In this decision to move from Mediterranean-climate Cape Town to the summer-rainfall, subtropical Eswatini, Compton was influenced by Dr (h.c.) Gilbert Westacot Reynolds (Bendigo, Victoria, Australia, 10 October 1895–7 April 1967, Mbabane, Swaziland [Eswatini]). According to Compton (1976), ‘The author’s [Compton’s] interest in Swaziland [Eswatini] was first aroused when he visited the country with Dr. G.W. Reynolds in July 1947.’ Reynolds was by then already the global expert on *Aloe* L. and in 1960 he himself settled in Mbabane, the capital of Eswatini (Gunn & Codd 1981), where he died seven years later. In 1971 Compton returned to Cape Town where he lived until his death in 1979 (Gunn & Codd 1981).

Two years after having settled in Eswatini, Compton was asked by the government of the country to initiate a botanical survey and for this purpose was provided with a technical assistant, a four-wheel drive vehicle and a herbarium building with a small garden attached. Financial assistance for this endeavour came from the British Colonial Development and Welfare Fund (Compton 1976). Starting in 1955, Compton undertook the botanical survey

PLATE 2404.—1, lower portion of the stem-peduncle continuum, $\times 1$; 2, upper portion of the peduncle and the apically-borne inflorescence, $\times 1$; 3, cluster of vegetative branches, $\times 1$; 4, plant that developed from a rhizome, $\times 1$; 5, apical view of corolla lobes, $\times 5$; 6, lateral view of flower, $\times 5$. Voucher specimen: *G.F. Smith 1151* in H.G.W.J. Schweickerdt Herbarium (PRU), Pretoria. Artist: Lesley Deysel.



PLATE 2404 *Kalanchoe alticola*

of Eswatini (Rycroft 1979). He and his colleagues in Eswatini were prolific collectors, with the main set of specimens collected under the auspices of the project consisting of about 8 000 numbers (Gunn & Codd 1981) – 11 000 according to Rourke (1976) and Rycroft (1979) – with these initially kept in Mbabane (Smith & Willis 1997, 1999). The specimens were furnished with labels headed ‘Herbarium of the Botanical Survey of Swaziland’. For the vast majority of specimens collected by Prof. Compton and his assistants (Ben Dlamini and M.C. Karsten) in Eswatini, duplicates were collected and sent to the National Herbarium, Pretoria (PRE) (Gunn & Codd 1981). The Eswatini National Herbarium, now located in Malkerns, Eswatini, was the product of these collection activities; the herbarium initially contained approximately 9 600 specimens, with duplicates also lodged in NBC, the herbarium in Cape Town named for Compton.

After only 13 years, the work on the flora of Eswatini came to initial fruition as an annotated checklist (Compton 1966), and a decade later materialised as a fully fledged Flora (Compton 1976; Rourke 1976). On his own, Compton was also a prolific collector, with the total number of his collections exceeding 35 000 (Gunn & Codd 1981). About 8 750 of Compton’s collections were from Eswatini.

About 10 years after having started collecting in Eswatini in earnest, Compton collected, on 29 May 1964, what would become the type specimen of the name *Kalanchoe alticola*. Compton was evidently not at first convinced that *K. alticola* (Figure 2) was new, for it would be a further more than a decade before he described it as a new species (Compton 1975), just one year before the full Flora of Eswatini appeared in print (Compton 1976).

Kalanchoe alticola is an endemic of the Barberton Centre of Endemism (Van Wyk & Smith 2001), where it occurs in some of the eastern, high-lying parts of southern Africa, in the mountainous grasslands of northwestern Eswatini and in the adjacent Mpumalanga of South Africa, especially around Barberton, but also slightly further north, towards Mbombela (Figure 3). The specific epithet, *alticola*, was derived from the Latin *altus* (high), and *-cola*, (inhabiting), with the species therefore named for its apparent preference for some of the higher elevations in eastern southern Africa.



FIGURE 1.—Professor Robert Harold Compton (1886–1979) was the second director of the then National Botanic Gardens of South Africa, and at the present-day University of Cape Town, appointed as the Harold Pearson Professor of Botany. Compton described *Kalanchoe alticola*, the subject of this paper. Photographer unknown. Copyright: South African National Biodiversity Institute. Reproduced with permission.



FIGURE 2.—*Kalanchoe alticola* is a small-growing species, with elongated, somewhat coin-shaped leaves. Photograph: G.F. Smith.

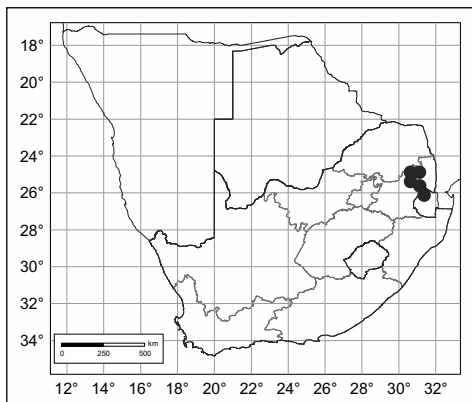


FIGURE 3.—Natural geographical distribution range of *Kalanchoe alticola* in southern Africa.

Compton had more than a passing interest in *Kalanchoe* Adans., as evidenced by his description of a number of new species from the small mountainous Kingdom of Eswatini. In addition to *K. alticola*, he also described *K. decumbens* Compton, which was recently reinstated (Smith et al. 2023), after it was treated as a synonym of *K. rotundifolia* (Haw.) Haw. for about 40 years, from the mid-1980s onwards. *Kalanchoe montana* Compton was also described from Eswatini, with this species too having been recently reinstated, at species rank (Smith et al. 2016), after it was treated as a subspecies of *K. luciae* for many years. When the earlier works that included reference to the flora of Eswatini, such as Burtt Davy & Pott-Leendertz (1912) and

Pott (1920), were published, *K. alticola* had not been collected yet. *Kalanchoe alticola* was included in Kemp (1983), as well as in Braun et al. (2004), a view followed in the *Flora of Southern Africa* volume on the Crassulaceae (Tölken 1985).

Kalanchoe alticola is a small-growing species, with elongated, somewhat coin-shaped leaves (Figure 2), hence its Afrikaans (*pennie-kalanchoe*) and English (coin kalanchoe) vernacular names. The main characters that differentiate it from *K. rotundifolia*, which, in some

respects, has a similar overall vegetative morphology, include the long, thickened, prominent sepals (Figure 4), and the long, lanceolate corolla lobes (Figure 5). As indicated in the quote provided at the start of this paper (Hooker & Thompson 1855), there has been a long awareness that calyx characters, including the length of the tube formed by the basal fusion of the sepals as well as the length of the sepals themselves, are comparatively conservative characters that serve to assist with the delimitation of species in *Kalanchoe* (see also Hance [1870] and as evidenced by the earlier descriptions by Hooker & Thomson [1858] of *kalanchoes* collected in India). At least one other rotundifoliod southern African kalanchoe, *K. waterbergensis* van Jaarsv., has long, thickened sepals in common with *K. alticola*. However, *K. waterbergensis* is a Waterberg endemic and the adaxial surface of the corolla lobes is bright orange-red (Smith & Figueiredo 2021; Smith et al. 2025).

Taxonomically, the so-called ‘rotundifoliod’ kalanchoes are included in *K.* [subg. *Kalanchoe* sect. *Raveta*] ser. *Rotundifoliae* (Smith 2024). The kalanchoes included in this group are all small-growing leaf succulents (Smith et al. 2023). Their leaves are variously shaped and sized but generally round or ovate to obovate and small, straight, flat, rarely longitudinally folded, and rarely slightly recurved. Leaf margins are entire or variously crenate. Flowers are borne erectly at anthesis and the corolla tube is abruptly urceolate and often greenish to strongly greenish infused, glabrous, and lack a white-waxy layer, with the generally lanceolate corolla lobes being various shades of pinkish, red, orange, or yellow, never white, slightly erect, horizontally spreading or recurved.

In a recent review of the conservation status of the indigenous southern Africa kalanchoes (Smith et al. 2022), it was



FIGURE 4.—The most easily observed character that differentiates *Kalanchoe alticola* from *K. rotundifolia*, which has a similar overall vegetative morphology, is the long, thickened, prominent sepals. Photograph: G.F. Smith.



FIGURE 5.—The urceolate, diurnal, ‘rotundifoliod’ flowers of *Kalanchoe alticola* have long, lanceolate corolla lobes that are most often bright yellow. Photograph: G.F. Smith.

determined that 14 grow abundantly in extensive natural geographical distribution ranges and that they are of 'Least Concern'. However, *Kalanchoe alticola* was one of the kalanchoes that was found to be of conservation concern, a situation that has persisted for the past 45 years, since publication of Hall et al. (1980). Work towards the latter pioneering publication, then and still widely referred to as the *Red Data List of southern African plants*, was started in 1974 and in it the conservation status of *K. alticola* was interpreted as 'Rare'. Sixteen years later, Hilton-Taylor (1996) interpreted *K. alticola* as 'Insufficiently known' in Eswatini, as 'Rare' in South Africa and as 'Rare' overall. 'Insufficiently known' was used for taxa that are suspected but not definitely known to be Extinct, Endangered, Vulnerable, Rare or Indeterminate (Hilton-Taylor 1996), while 'Rare' was used for taxa with small world populations that were not at the time Endangered or Vulnerable, but are at risk as some unexpected threat could easily cause a critical decline (Hilton-Taylor 1996).

More recently, the conservation status of *Kalanchoe alticola* was regarded as 'Data Deficient' (Raimondo et al. 2009; Smith et al. 2022), with this category applied to taxonomically well-defined taxa that are too poorly known to allow an assessment of possible extinction risks, either because their distribution and habitat are unknown, or because they are well known and suspected to be in danger of extinction, but relevant data to measure against criteria for the categories of threat do not yet exist (Raimondo et al. 2009).

Alarmingly, Braun (2023) updated the conservation status of *Kalanchoe alticola* to 'Vulnerable', inter alia because the species is '... potentially threatened by livestock overgrazing and burning of its habitat, it has therefore been assessed as 'Vulnerable' ...'.

Given that *Kalanchoe alticola* is rhizomatous (Figure 6), propagation from rhizome cuttings is easy. Such cuttings can be taken at any time of year and will rapidly root if the stems are placed horizontally on the soil surface, covered by a thin layer of soil, and the soil kept moist, at least until roots have developed. Once the cuttings have rooted, plants are easy in cultivation and will grow readily in any soil-based growing medium, even when it is rather clayey. Given the small size of the plants they are best grown in containers that can be placed in dappled shade or even in full sun.

Description.—Perennial, few- to many-leaved, haphazardly, sparsely to multi-branched, glabrous, small, rhizomatous succulent, 0.10–0.25 m tall. *Stems* thin, often leaning and tangled, light green to distinctively pinkish green, several arising from a shallow rootstock near ground level, round in cross-section. *Leaves* opposite-decussate, leaf pairs widely spaced, $\pm$ sessile to hardly petiolate, light green to glaucous, with thin, dull, powdery bloom, shiny in time, succulent, erect to slightly spreading; petiole usually absent, leaves clasping the stem, almost linking with opposite leaf; blade 20–40 $\times$ 9–15 mm, ovate-oblong to oblong, flat; base cuneate; apex rounded, sometimes slightly mucronate; margins entire, often slightly different shade of blade colour, appearing somewhat bony. *Inflorescence* a flat-topped to slightly rounded thyse with several dichasia, erect to leaning, generally sparsely flowered, 20–50 mm in diameter, all parts with a distinct waxy bloom; pedicels 2–3 mm long, slender to slightly thickened. *Flowers* erect at anthesis; calyx consisting of 4 sepals, bluish to slightly purplish green, sepals $\pm$ 5 mm long, elongated-lanceolate, $\pm$ separate, basally fused for $\pm$ 0.5 mm, acute-tipped, clasping basal, swollen portion of



FIGURE 6.—*Kalanchoe alticola* produce rhizomes and plants sometimes grow in small, tangled clusters. The entire leaf margins are often a slightly different shade of the blade colour and then have a somewhat bony appearance. Photograph: G.F. Smith.

corolla, diverging from corolla higher up, succulent, hardly contrasting against bluish green lower part of corolla tube; corolla 9–15 mm long, somewhat inflated, enlarged lower down, twisted apically after anthesis; corolla tube 7–13 mm long, very slightly 4-angled, rounded below and above, light green to light bluish green below, turning light yellow to sulphur yellow to light pinkish orange above; corolla lobes 5–8 × 2–4 mm, light yellow to sulphur yellow to light pinkish orange, lanceolate, spreading to recurved, tapering to an acute at apex, sometimes diurnal. *Stamens* inserted in two or more ranks at and just above middle of corolla tube, well included; filaments 3–4 mm long, yellow; anthers 0.6–0.8 mm long, not to hardly visible at mouth of corolla tube. *Pistil* consisting of 4 carpels; carpels 4–6 mm long, mid-green; styles 1–2 mm long, mid-green to lighter green; stigmas very slightly capitate, yellowish green; nectar scales 2–4 mm long, linear, hair-like, light yellowish, diverging from carpels. *Follicles* 4–6 mm, dull light-green, enveloped in dry, brownish black remains of corolla, eventually dark brown, brittle, grass spikelet-like. Seed 0.50–0.75 mm, dark orange-brown, faintly striated, cylindrical to ellipsoid to somewhat banana-shaped. *Chromosome number*: unknown. Plate 2404.

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Kalanchoe benbothae

Crassulaceae: Kalanchooideae

South Africa

Kalanchoe benbothae Gideon F.Sm. & N.R.Crouch in *Phytotaxa* 521(2): 109 (2021); Smith: 21 (2022a).

As shown elsewhere in this volume of *Flowering Plants of Africa* (FPA) (see the contribution on *Kalanchoe gideonsmithii* N.R.Crouch & Figueiredo, p. 76–85), the name *K. rotundifolia* Haw. for a long time largely served as a catch-all under which virtually all the small-statured southern African kalanchooid material with narrowly urceolate, chromatic (red through orange to yellow) flowers were included (Smith & Figueiredo 2017; Smith et al. 2019a). The same can be said of the taxonomic concept until recently associated with the name *K. luciae* Raym.-Hamet (Smith et al. 2019a, 2023a), with one recently reinstated species (*K. montana* Compton) and three recently described species (*K. winteri* Gideon F.Sm., N.R.Crouch & Mich.Walters; *K. crouchii* Gideon F.Sm. & Figueiredo; and *K. benbothae* Gideon F.Sm. & N.R.Crouch) having vegetative and reproductive morphologies very similar to those of that species. Therefore, as interpreted in the past, *K. luciae* was morphologically very broadly circumscribed and very widely distributed in eastern southern and south-tropical Africa. One of the recent segregates from *K. luciae*, *K. benbothae* (Figure 1), is the subject of this contribution.

The morphology of the *Kalanchoe luciae* lookalikes, including of *K. benbothae*, is visually very different from those of the variable rotundifoliod species. The leaves of *K. luciae* and its relatives are quite large, round to obovoid and are arranged, at least while in the vegetative phase, in what appear to be basal ‘rosettes’ (Figure 2). When the flowering event in these species is initiated and the internodes increase in length and the stem extends into a peduncle, the truly decussate leaf arrangement, as found in the vast majority of kalanchoes, becomes more apparent. Only very few *Kalanchoe* species, such as the Malagasy *K. tomentosa* Baker, have alternately arranged leaves. The shape and, generally, the size of the leaves of the *K. luciae* cluster of species have given rise to them being referred to as being ‘paddle’-leaved. In *Kalanchoe*, a pseudo-rosulate leaf arrangement is not unique to *K. luciae* and its relatives. The Malagasy *K. gastonis-bonnieri* Raym.-Hamet & H.Perrier, similarly, has leaves arranged in what even more closely resembles a rosulate, almost aloe-like (especially at maturity), leaf arrangement, but its leaves, too, are borne decussately. Smith et al. (2023b) recognised all these pseudo-rosulate species as, morphologically, belonging in the non-monophyletic, utilitarian group referred to as ‘Low-growing to medium-sized, pseudo-rosulate plants with robust stems’. In a true rosette the whorled leaves are usually spirally arranged and not decussately so as in *Kalanchoe*.

A further morphological characteristic of *Kalanchoe luciae* and its close relatives is found in the shape of the inflorescence, with the side-branches on the tall-growing, robust

PLATE 2405.—1, middle section of the stem of a flowering specimen, $\times 0.75$; 2, inflorescence, $\times 0.6$; 3, lateral view of flower, $\times 6$; 4, apical view of corolla lobes, $\times 6$. Voucher specimen: G.F. Smith 1152 in H.G.W.J. Schweickerdt Herbarium (PRU), Pretoria. Artist: Lesley Deysel.



PLATE 2405 *Kalanchoe benbothae*

peduncle being very short and densely flowered, conferring the overall structure with a club-shaped outline (Figure 3). All the species with a growth form reminiscent of that of *K. luciae* develop chunky, perennating rootstocks from which, generally, a single stem arises (Figure 4). Under favourable climatic conditions, one or more plants will develop from the base after a stem has flowered. The stem that has transitioned into the reproductive phase will ultimately die, but the plant can persist as a perennial through these basal sprouts.

From a classificatory perspective, *Kalanchoe luciae* and its relatives are included in *K. sect. Raveta* Gideon F.Sm. (Smith 2022a, b, c). At present this section, which is accommodated in the autonymic *K. subg. Kalanchoe*, consists of seven species, all of which have the characteristic round to obovate leaves and tall, densely flowered inflorescences. The species are, in the chronological sequence in which they were described, with an indication of their inclusion in the pages of the variously titled *FPA*, as follows: 1, *K. thyrsiflora* Harv. (illustrated by Cythna Letty, see Phillips 1929); 2, *K. luciae* (illustrated by Gillian Condry, see Smith et al. 2023a); 3, *K. montana*; 4, *K. wildii* Raym.-Hamet ex R.Fern.; 5, *K. winteri* (illustrated by Gillian Condry, see Smith et al. 2019b); 6, *K. crouchii* (illustrated by Angela Beaumont, see Smith et al. 2021); and 7, *K. benbothae*. The latter is accordingly the fifth representative of *K. sect. Raveta* to be illustrated in this series, in this instance by Lesley Deysel.

Plants of *Kalanchoe benbothae* are medium-sized to large, glabrous, densely waxy when young, bi- to triennial to perennial succulents that, morphologically, can be easily separated from *K. luciae*, its closest relative. *Kalanchoe benbothae* is less robust than *K. luciae* in its overall vegetative



FIGURE 1.—At reproductive maturity, the stem of *Kalanchoe benbothae* extends into an inflorescence that can reach a length of 1 m. Photograph: G.F. Smith.



FIGURE 2.—The leaves of *Kalanchoe benbothae*, as well as those of other species included in *K. sect. Raveta*, are quite large, round to obovoid, and are arranged, at least while in the vegetative phase, in what appear to be basal 'rosettes'. Photograph: G.F. Smith.



FIGURE 3.—The tall-growing inflorescences of *Kalanchoe benbothae* carry short and densely flowered side-branches, so giving them a club-shaped outline. Flower disposition varies from erect to semi-erect to pendent. Photograph: G.F. Smith.

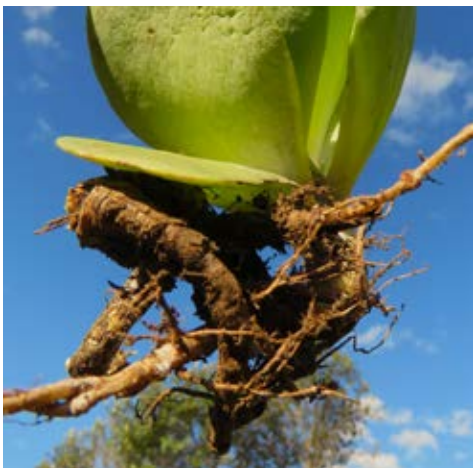


FIGURE 4.—The erect to leaning, unbranched stems of *Kalanchoe benbothae* arise from a sturdy base. One or more plants can develop from the base after a stem has flowered. Photograph: G.F. Smith.

morphology, with especially the leaves of the former not attaining the dimensions of the latter. The flowers of *K. benbothae* are lightly to moderately covered in a waxy bloom (Figure 5, 6), while those of *K. luciae* have a more substantial waxy bloom (Figure 6). The corolla lobes of *K. benbothae* are reddish pink and triangular, while those of *K. luciae* are white to pale yellowish green and oblong (Figure 5, 6). The pistil of *K. benbothae* is narrowly elliptic, whereas that of the latter species is prolate (Figure 7).

Kalanchoe benbothae can be easily propagated from seed and, as the seedlings grow rapidly, these are fit to be transplanted after the first or second season. An additional method of propagation is to remove the whole, albeit small, rosettes that develop from the base of a plant that has flowered and to plant these where they are intended to grow, in containers or in open beds. Like most kalanchoes, plants of *K. benbothae* enter a resting phase once the temperatures drop in autumn and early winter, and the (short-day) flowering season approaches. Plants bloom in the autumn and winter months, from April to August, with a peak from June to July in the southern hemisphere. Although plants can tolerate short periods of exposure to 0°C – *K. benbothae* appears to be slightly more cold-tolerant than *K. luciae* – it will soon show damage if not given some protection against frost.

As far as presently known, *Kalanchoe benbothae* has a narrow, easterly natural geographical distribution range in the Vryheid, Louwsburg and Paulpietersburg districts in the north-central part of KwaZulu-Natal, South Africa (Figure 8). The entire known range of the species falls within the Maputaland-Pondoland Region of Endemism (Van Wyk & Smith 2001). *Kalanchoe benbothae* occurs in shallow soils that overlie dolomitic sheets, in open grassland

at elevations of ca. 1 250 m a.s.l., in Northern KwaZulu-Natal Moist Grassland (Gs4) and Northern Zululand Mistbelt Grassland (Gs 1) (Mucina et al. 2006) (Figure 9, 10). Material of *K. benbothae* was first collected by Inez Verdoorn in 1936 near Louwsburg, the same general area from which *K. albiflora* H.M.L.Forbes was collected and described, a name today subsumed under *K. luciae*.

Kalanchoe benbothae was named for Mr Barend Stapelberg (Ben) Botha (b. 4 September 1961, Elliot, Eastern Cape, South Africa–), nurseryman and succulent specialist. Ben's material of *K. benbothae* formed the basis of the plant description provided here. In 2018, he provided material to GFS, through NRC, and is credited for having recognised it as a distinct species.

Description:—Multiannual to perennial, few- to many-leaved, unbranched at first, pre- and/or post-flowering slowly sprouting from woody base, glabrous, waxy, medium-sized to robust succulent, 0.25–1.00 m tall when in flower. *Stems* light green to reddish-infused, unbranched, arising from sturdy



FIGURE 5.—The corolla lobes of *Kalanchoe benbothae* are reddish pink and triangular, while those of *K. luciae*, which is also included in *K. sect. Raveta*, are white to pale yellowish green and oblong. Photograph: G.F. Smith.



FIGURE 6.—A flower of *Kalanchoe benbothae* (left) and *K. luciae* (right) in lateral view. Flowers of *K. benbothae* are lightly to moderately covered in a waxy bloom, while those of *K. luciae* have a more substantial bloom. Photograph: G.F. Smith.



FIGURE 7.—The stipitate pistil of *Kalanchoe benbothae* (left) is narrowly elliptic, whereas that of *K. luciae* (right) is prolate. The nectar scales of *K. benbothae* are transversely oblong, while they are $\pm$ square in the case of *K. luciae*. Photograph: G.F. Smith.

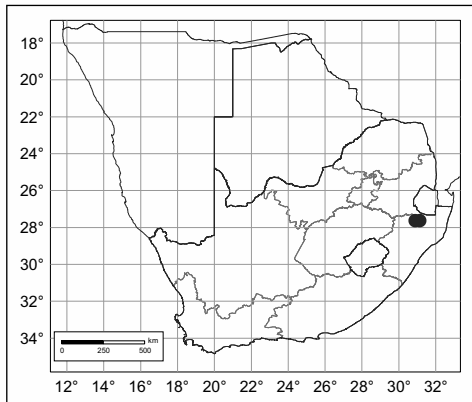


FIGURE 8.—Known natural geographical distribution range of *Kalanchoe benbothae*.

base, erect to leaning, often with few indistinct, lengthwise running ridges. Leaves opposite-decussate, light green, infused with red to purplish red along leaf margins only, succulent, erect to slightly erectly spreading, coriaceous and papery-flimsy on drying; petiole absent, amplexicaul; blade 90–140 × 60–100 mm, obovate to broadly elliptic, somewhat gracefully and slightly folded upwards lengthwise, sometimes very slightly wavy, flat to slightly curved up along margins; base cuneate to narrowly triangular, sometimes very slightly auriculate; apex rounded-obtuse; margins smooth, slightly saucer-like curved upwards. Inflorescence erect to slightly leaning, apically dense, many-flowered, club-shaped to short-branched thyse consisting of several

dichasia terminating in monochasia, flowering portion 100–400(–700) mm long, branches opposite, rarely only one at node, erect to slanted away from main flowering stem at angle of 30°, subtended by leaf-like bracts, very rarely with leafy branchlets in axils, axis light green; pedicels 3–10 mm long, slender. Flowers erectly spreading to slanted horizontally to pendulous at anthesis; calyx light green to lightly reddish-infused, very densely white-waxy covered; sepals 4, $\pm$ 3–4 × 1.5–2.5 mm, narrowly triangular-lanceolate, succulent, clasping corolla tube above, basally fused for 1.0–1.5 mm, acute-tipped, contrasting against light yellowish green corolla tube; corolla 12–14 mm long, enlarged lower down, tapering to mouth, not twisted apically after anthesis; tube 11–13 mm long, light yellowish green,



FIGURE 9.—In the vicinity of Vryheid, KwaZulu-Natal, from near where *Kalanchoe benbothae* is known, the vegetation is a mosaic of grassland and wooded valleys (on the left and right, in the distance). The species is essentially an open grassland element, where it occurs in shallow soils overlying a dolomitic base. Photograph taken in mid-winter – the dry season. Photograph: G.F. Smith.



FIGURE 10.—Near Paulpietersburg, KwaZulu-Natal, the natural grassland vegetation where *Kalanchoe ben-bothae* (foreground and middle ground) is known to occur has been impacted by plantation forestry (background). Photograph taken in mid-winter – the dry season. Photograph: D. Styles.

fading reddish brown when spent, narrowly urceolate, indistinctly 4-angled, round when viewed from below, longitudinally indistinctly fluted above; lobes (3–)5 × 3 mm, pink to reddish with margins often paler, triangular, tapering towards acute apex, margins slightly to distinctly in-folded, erecto-patent, rarely recurved, dark pink to red-tipped in bud. *Stamens* 8, inserted in two ranks, one rank just above middle of corolla tube, other well above middle of corolla tube towards mouth, all 8 slightly exerted to 1 mm, visible at mouth; filaments 2–4 mm long, light greenish white, thin, tapering upwards; anthers 0.5–0.6 mm long, yellow. *Pistil* consisting of 4 carpels, narrowly elliptic; carpels 6–7 mm long, dull mid-green; styles 1.5–2.0 mm long, dull mid-green; stigmas very slightly capitate, whitish green, positioned at mouth; scales ± 1 mm high, ± 2 mm broad, transversely oblong, flat to slightly tooth-like rounded and finely cockscomb-like pointed apically, uniformly light yellow. *Chromosome number*: unknown. Plate 2405.

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PLATE 2406 *Kalanchoe blossfeldiana*

Kalanchoe blossfeldiana

Crassulaceae: Kalanchooideae

Madagascar

Kalanchoe blossfeldiana Poelln. in Repert. Spec. Nov. Regni Veg. 35: 159 (1934); Blossfeld: 36 (1934a); Schweickerdt: t. 9440 + accompanying text (1936); Jacobsen: 818 (1954); Jacobsen: 283 (1977); Van Voorst & Arends: 574 (1982); Jacobsen: 608–609, Fig. 849 (1986); Rauh: 116–117, 148–149 (1995); Descoings: 148 (2003); Smith et al.: 279 (2019); Smith & Figueiredo: 107 (2022). *Kalanchoe globulifera* H.Perrier var. *coccinea* H.Perrier: 26 (1928). *Kalanchoe coccinea* (H.Perrier) Boiteau in Boiteau & Allorge-Boiteau: 188 (1995), *nom. inval.* *Kalanchoe coccinea* (H.Perrier) Boiteau var. *blossfeldiana* (Poelln.) Boiteau in Boiteau & Allorge-Boiteau: 190 (1995), *nom. inval.*

‘My own [Robert C. Blossfeld’s] introduction. A real horticultural sensation and the most valuable winter-flowering pot-plant ever introduced.’

Blossfeld (1936: 46) remarking on *Kalanchoe blossfeldiana*
“Selecta” [No. 2450]

‘[...] of paramount importance was “the necessity of careful choice of parents, as the care and time spent on raising a good batch of seedlings or a bad batch are just the same”.’

Lionel de Rothschild [1882–1942], creator of Exbury Gardens, UK,
quoted in Rothschild et al. (2004: 64)

Based on (often, but not always) accurately dated, georeferenced, preserved plant specimens – typically the holotype and associated original material – held in the world’s herbaria, we today know, in many cases with remarkable certainty, when the plant species that were to become popular in domestic gardening and in industrial-scale landscaping were first collected in the wild, described and given a Latin binomial. For *Kalanchoe blossfeldiana* (Crassulaceae subfam. Kalanchooideae; see Smith & Monro [2022a, b] on the subfamily nomenclature to use, following Turland et al. [2018: Rec. 56A]), the subject of this paper (Figure 1), the situation is no different. We have a good idea of when and where plants of *K. blossfeldiana*, which is known in the vernacular as Flaming Katy, the Florist’s kalanchoe, or as (Malagasy) Widow’s Thrill, were first collected in the wild (in Madagascar); when living material and preserved specimens were sent to Europe (but not with certainty by whom); to which destination in Europe it was sent; and, inevitably, can precisely track its taxonomic history.

Joseph Marie Henri (sometimes spelled ‘Henry’, with ‘Henri’ the name he used) Alfred Perrier de la Bâthie (Chambéry, Savoie, France, 11 August 1873–2 October 1958,

PLATE 2406.—1, flowering stem of *Kalanchoe blossfeldiana* ‘Variegata’, $\times 0.8$; 2, close-up of a flower in lateral view, $\times 6$; 3, apical view of corolla lobes, $\times 6$. Voucher specimen: G.F. Smith 1219 in the H.G.W.J. Schweickerdt Herbarium (PRU), Pretoria. Artist: Gillian Condy.



FIGURE 1.—What the original *Kalanchoe blossfeldiana* likely looked like: a specimen with single, scarlet red flowers. Photograph: G.F. Smith.

Chambéry, Savoie, France) was a prolific French natural history explorer, botanist and mineralogist, as well as an institutional administrator (Leandri 1962). In 1896, the year in which Madagascar became a French colony, he travelled to the island as a gold prospector but after 1906 he focused his attention on natural history exploration. He returned to France during World War I, but after the War returned to Madagascar and continued his natural history work. In the 1910s, from 1912 to 1915, he collaborated on the taxonomy of *Kalanchoe* with fellow Frenchman, Raymond-Hamet (Figure 2), who published the first modern monograph of *Kalanchoe* (Hamet 1907, 1908; Smith 2020). During this period, Perrier de la Bâthie and Raymond-Hamet jointly published the names of 24 new taxa of *Kalanchoe*, mostly at the rank of species. About 10 years later, in the 1920s, Perrier de la Bâthie, as sole author, discussed and described 11 further new taxa in the genus (Perrier de la Bâthie 1923, 1924, 1927, 1928). Perrier de la Bâthie became well acquainted with the flora of Madagascar and his collecting experience and extensive travels on the island enabled the publication of a treatise on the Malagasy vegetation (Perrier de la Bâthie 1921), which at least in part facilitated the later work of, for example, Baena et al. (2007). Leandri (1962), Dorr (1997) and Shtein et al. (2021) provide additional biographical notes on Perrier de la Bâthie, who was recently commemorated in the Malagasy *K. perrieri* Shtein, Gideon F.Sm. & D.-P.Klein. In the early 1930s Perrier de la Bâthie's extensive preserved plant collections were donated to the herbarium of the French National Museum of Natural History (P) in Paris (Dorr 1997).

Material collected and preserved by Perrier de la Bâthie, under his collecting number 17883, was to become the (second-step lecto-)type material of the name *Kalanchoe blossfeldiana*. This multi-specimen [J.M.]H.[A.] Perrier de la Bâthie 17883 gathering is labelled as having originated from the Tsaratanàna Massif, northern Madagascar, at an elevation of 2 000 m a.s.l. (Figure 3), and it is noted that the material collected was eventually cultivated in, and collected for pressing from, Perrier de la Bâthie's garden in Antananarivo (Perrier de la Bâthie 1928). The exact date on which material of *K. blossfeldiana* was collected in the wild was not stated on the specimens. However, Perrier de la Bâthie cultivated material of the autonymic *K. globulifera*, the species in which Perrier de la Bâthie recognised *K. blossfeldiana* as a variety, as *K. globulifera* var. *coccinea*, in his garden in Antananarivo in the years 1925 and 1926. Both *K. globulifera* var. *globulifera* and *K. globulifera* var. *coccinea*, i.e., *K. blossfeldiana*, originated from the Tsaratanàna Massif and it is here speculated that the two taxa were collected together during April/May 1924 because at least one of the *K. globulifera* var. *globulifera* specimens, with barcode P00431201, which is held at P (image available at <http://coldb.mnhn.fr/catalognumber/mnhn/p/p00431201>), carries the date April 1924, written on the sheet as '4/24'.

The collecting label attached to the lectotype specimen of the name *Kalanchoe blossfeldiana* noted that plants of this species almost always grew in 'Silve à Lichens', i.e., in a forest with lichens (on the peaks of the Tsaratanàna Massif), and in isolated stands of never more than four to five plants, at altitudes of between 1 600 and 2 400 m a.s.l. (Smith & Figueiredo 2022). The Réserve Naturelle Intégrale de Tsaratanàna is a strict nature reserve and closed to tourists. Climatically, Tsaratanàna



FIGURE 2.—Raymond-Hamet (1890–1972) was the undisputed global expert on *Kalanchoe* during the 20th century. Image provided by Roy Mottram†, United Kingdom, and digitally enhanced by Ms Elizma Fouché, South African National Biodiversity Institute. Photographer unknown.

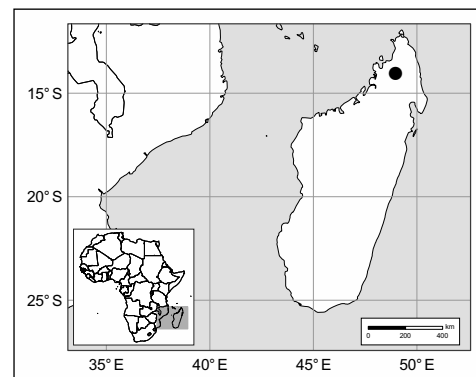


FIGURE 3.—Geographical distribution range of *Kalanchoe blossfeldiana* in northeastern Madagascar based on information included in the protologue of the name, verifiable information held in the Global Biodiversity Information Facility, Boiteau & Allorge-Boiteau (1995: [204] Map 22 [as *K. globulifera*]) and Allorge-Boiteau (1996: 145, Map 23 [still as *K. globulifera*]).

is dominated by the sub-humid climate of northern Madagascar with an annual rainfall of about 1 900 mm. The vegetation is recorded as nearly continuous forest (Goodman et al. 2018). These environmental factors already give an indication of the preferred growing conditions of *K. blossfeldiana*, which is discussed in more detail further on.

However, Perrier de la Bâthie does not appear to have been the first person to have collected material of what we today know as *Kalanchoe blossfeldiana* for deposition in a herbarium. This distinction goes to Aymar Charles d'Alleizette (Paris, France, 23 January 1884–4 July 1967, Clermont-Ferrand, France) who was attached to the French military and also a botanist. He collected material of *K. blossfeldiana* from the Tsaratanàna Massif in October 1909, as A.Ch. d'Alleizette s.n. (see: <https://data.biodiversitydata.nl/naturalis/specimen/L.1860788>), with this specimen today held in the herbarium of the Naturalis Biodiversity Center (L) in Leiden (Dorr 1997).

After d'Alleizette, in 1909, and Henri Perrier de la Bâthie, in April (or perhaps in May) 1924, collected material of *Kalanchoe blossfeldiana*, only one other specimen of the species seems to have been collected in its natural habitat, by Jean-Henri Humbert (1887–1967), in 1937, under his collecting number J.-H. Humbert 18606 (image available at: <http://coldb.mnhn.fr/catalognumber/mnhn/p/p00431200>). This collection was made three years after *K. globulifera* var. *coccinea* was elevated to species rank, as *K. blossfeldiana*, in 1934. The specimen collected by the botanist Raymond Decary (1891–1973) on 17 September 1928, as R. Decary 6767 (P), was prepared from material cultivated in his garden in Antananarivo and not collected in the wild. Decary might have received the material he cultivated from Perrier de la Bâthie.

In summary, a plant of *Kalanchoe blossfeldiana* was first collected for preservation as a herbarium specimen in October 1909 by d'Alleizette but not described at the time. Then, 15 years later, one was recollected by Perrier de la Bâthie in April or in May 1924 and, in February 1928, described as a red-flowered variety of *K. globulifera*, i.e., as *K. globulifera* var. *coccinea*. Six years after the description of *K. globulifera* var. *coccinea* was published, the German botanist Joseph Karl [Carl] Leopold Arndt von Poellnitz (1896–1945) treated this variety as a species and published the name *K. blossfeldiana* for it – the epithet 'coccinea' had already been occupied at species rank in *Kalanchoe* after the name *K. coccinea* Welw. had been published in 1871. Out of more than 700 plant names published by Von Poellnitz, *K. blossfeldiana* was the only *Kalanchoe* species he named. The interpretation that *K. blossfeldiana* should be treated as a variety of *K. globulifera*, i.e., as *K. globulifera* var. *coccinea*, persisted for several decades after Von Poellnitz (1934) recognised it as a separate species (see for example Boiteau [1947]: caption of Figure 2 on page 7, and Raymond-Hamet & Marnier-Lapostolle [1964]: 75 and Planche IC). Raymond-Hamet & Marnier-Lapostolle (1964) stated (translated from the original French): 'The form described above [i.e., on page 75 of Raymond-Hamet & Marnier-Lapostolle (1964)] is that which Perrier de la Bâthie [1928] named *Kalanchoe globulifera* var. *coccinea*.' In addition, in Planche IC of Raymond-Hamet & Marnier-Lapostolle (1964), what is clearly material of *K. blossfeldiana* is illustrated under the name *K. globulifera*. However, these two species are both accepted at present. Julien Marnier-Lapostolle (1902–1976) (Figure 4), who had more than a passing interest in *Kalanchoe*, was the owner of the world-renowned private Jardin Botanique, 'Les Cèdres', on the French Côte d'Azur at Saint-Jean-Cap-Ferrat (Demoly 1999; Smith & Figueiredo 2013).

Those species that are today popular as garden plants, for growing indoors and/or outdoors, in some instances globally so, often originated from far-flung places well away from continental Europe, Great Britain and the USA where much of the plant breeding and cultivar selection took place over the past few centuries. Despite the general, but by no means consistent, existence (and availability, for that matter) of type specimens that establish the application of plant names, for the vast majority of our popular garden plants very little – if any – accurate information is available regarding the dates, even approximately, on which they, often in highly selected or hybrid form, were introduced as living material into the horticultural market and subsequently found favour with the plant-purchasing public. See, for example, Kingsbury (2022: 117) on *Zinnia peruviana* (L.) L. (Asteraceae), the weedy (in southern Africa and elsewhere) *jakobregop*, and Kingsbury (2022: 193) on the parents of hybrids and cultivars of *Petunia* Juss. (Solanaceae). In this regard, *Kalanchoe blossfeldiana* is a notable exception, with a considerable body of information being available on the history of the material in horticultural research and horticulture in general.



FIGURE 4.—Julien Marnier-Lapostolle (1902–1976) had more than a passing interest in *Kalanchoe* and cultivated a large collection of representatives of this genus, and several other mainly but not exclusively succulent plant genera, for that matter, at his world-renowned private Jardin Botanique, ‘Les Cedrés’, on the French Côte d’Azur at Saint-Jean-Cap-Ferrat. Photograph courtesy of Chuck Staples, USA, and digitally enhanced by Ms Elizma Fouché, South African National Biodiversity Institute. Photographer unknown.

According to Van Voorst & Arends (1982), living material of *Kalanchoe blossfeldiana* was received at P as early as in 1927. It could not be determined whether this material – possibly only a single specimen – was received from Perrier de la Bâthie or from Decary, and Van Voorst & Arends (1982) could not find any evidence that either of them dispatched the material to P. For that matter, someone else could have sent living material to the garden at P. The living material of *K. blossfeldiana*, which at that stage had still not been given a scientific name – it was only described as *K. globulifera* var. *coccinea* one year later – flowered shortly after it was received at the botanical garden in Paris. Van Voorst & Arends (1982) record that (likely) seed from this first flowering event in Europe was soon distributed from Paris to botanical gardens in Europe and the USA. Kalanchoes are known to be self-fertile and it would not have been necessary to have had more than only a single specimen flowering in Paris to have ensured seed production (Smith et al. 2021). The material distributed from Paris also reached Rostock, Germany, from where Robert Blossfeld, at the time a nurseryman at Potsdam, near Berlin, acquired seed and/or (less likely) cuttings and started growing it as a pot plant. In 1934, the species was named for Blossfeld.

Robert Carl Blossfeld (1882–27 January 1944 [often given as 1945]) was a German horticulturist and the owner of a seed company based in Potsdam, Germany, from where the business was later moved to Lübeck. The Blossfeld horticultural company specialised in retailing seed of cacti and other succulents, which was sold through well-illustrated trade catalogues. Robert Blossfeld's son, Harry Blossfeld (1913–1986), was a botanist and conducted collecting expeditions, some of which were sponsored by Blossfeld Sr, to cactus habitats in South America (Argentina, Bolivia, Brazil, Paraguay), with his father joining him on a trip to Brazil in ca. 1937 (Staples 2020).

In the 1930 edition of the seed and plant catalogue issued by Blossfeld, no *Kalanchoe* were offered for sale (Blossfeld 1930). However, one year later, in 1931, Blossfeld introduced what was then still known as *Kalanchoe globulifera* var. *coccinea* to the horticultural trade, and two years later, in 1933, noted that, 'My customers claim it to be one of the most wonderful and most valuable winterflowering potplants.' (Blossfeld 1933). By 1933 Blossfeld was offering 1 000 seeds of *K. blossfeldiana* for the princely sum of 7/- (seven shillings, i.e., the purchasing power equivalent of about £32.05 in 2023, 90 years later) (Blossfeld 1933). By then the selection of material with superior horticultural traits had already started and one year later, in 1934, what was referred to as 'Nr. 2450 *Kalanchoe globulifera* var. *coccinea* „Selecta“' was offered for sale (Blossfeld 1934b). Blossfeld stated, 'Since the introduction [of *K. globulifera* var. *coccinea*] in 1931 I always selected a few of the finest plants combining compact growth, floriferousness, large and brilliant coloured flowers with an early flowering-period. In 1933 this strain produced plants with an average of 50 to 60 flower stalks, starting to flower on January 13 th [i.e., in mid-winter in the northern hemisphere].' (Blossfeld 1934b). In language typical of a businessperson he also made the following marketing statement, 'I can confidentially recommend my customers to grow this beautiful winterflowering plant [*K. globulifera* var. *coccinea*, i.e., *K. blossfeldiana*] in quantity. It needs no more trial. It has been tried out in all parts of the world and innumerable delighted testimonials confirm that it is a novelty of real merit and of great commercial value.' (Blossfeld 1934b).

Blossfeld must have been delighted that by 1936 he was able to offer material of 'No. 2450 *Kalanchoe Blossfeldiana* „Selecta“' – no longer of *K. globulifera* var. *coccinea* – for sale in his seed catalogue (Blossfeld 1936), because two years earlier the material that he had so enthusiastically boosted since 1931 was named for him. After the mid-1930s, the desirable characters of *K. blossfeldiana* (Table 1) were increasingly realised and the selection of material from seed-grown *K. blossfeldiana*, as well as from interspecific hybrids of which it is one parent, proceeded rapidly.

Especially differently coloured corolla lobes (orange and yellow, apart from red), but also different leaf morphologies and leaf variegation were soon recorded for *Kalanchoe blossfeldiana* and plants with these traits were in turn used in further breeding trials (selections from the species, as well as from hybrids of which it is one parent) – see Van Voorst & Arends (1982) for a review. Particularly the highly bred material of *K. blossfeldiana* became increasingly popular globally in the horticultural trade as, especially, small- and low-growing container plants (Van Voorst & Arends 1982; Carvalho et al. 2006a–c; Christensen et al. 2008). A selection of other *Kalanchoe*s, such as *K. luciae* Raym.-Hamet, *K. ×estrelae* Gideon F.Sm. and *K. sexangularis* N.E.Br. are increasingly finding favour as outdoor

TABLE 1.—Plant traits (A) that contribute to the attractiveness of *Kalanchoe blossfeldiana* and its derivatives in horticulture, and other factors (B) that add to its popularity and acceptance among plant wholesalers and the plant-acquiring public. ‘Hybrids’ and ‘hybridisation’ refer to material where *K. blossfeldiana* is used as one parent. Over the past ca. 80 years, these hybrids have become very complex and contain genetic material of a range of cytologically compatible (natural or induced) species.

A. Plant traits	
1.	Small, shallow root system
2.	Small, manageable plant size, including of hybrids
3.	Compact vegetative growth form, including of hybrids
4.	Durable, long-lasting, succulent foliage
5.	Symmetrical, decussate phyllotaxis
6.	Leaf surfaces glabrous, glossy and shiny, and easily kept dust-free
7.	Leaves uniformly green or variously chromatically mottled
8.	Dense-flowered inflorescences
9.	Brightly coloured corollas
10.	Predictability of flowering event
11.	Dependably attractive flowers
12.	Longevity of flowers and flowering event
13.	Ease of manipulating timing of flowering event
14.	Ease of hybridisation and widespread interspecific compatibility
15.	Accepting of a range of vegetative and reproductive characters when hybridised
16.	Fertility of hybrids
17.	Possibility of restoring fertility to sterile hybrids
18.	Ease of germinating seed
19.	Rapid maturation to flowering of seedlings
20.	Heterosis often present in hybrids
B. Other factors	
1.	Ease of cultivation, including of hybrids, in lightweight growing media
2.	Ease of indoor cultivation
3.	Reasonable drought-hardiness and efficient use of withdrawable water
4.	Ease of transporting flowering material over long distances
5.	Retention of plant characters under low-light conditions
6.	Often large, durable foliage that obscures low-cost, unattractive plant containers
7.	Predictability of material remaining in flower for extended periods
8.	Ease of maintaining material in flower
9.	Rapid post-flowering decline in plant quality, so ensuring follow-up purchases

landscaping material in mild climate parts of the world (Smith et al. 2019). However, given that most of the breeding of new *Kalanchoe* material for the potted-plant trade has thus far taken place in the often much harsher climate of the northern hemisphere, breeding focus has inevitably been on producing *K. blossfeldiana*-derived material for indoor cultivation (Figure 5), with less emphasis on material suitable for growing outdoors on a large-scale, for example, in industrial, commercial and private landscaping projects.

By the late 1980s *Kalanchoe* material was also considered as a source of cut flowers, given that their blooms can last for up to eight weeks (Kroon et al. 1989; Smith & Hankey 2021; Smith et al. 2023). However, the biggest breakthrough in breeding *Kalanchoes* came in the late 1990s when a double-flowered sport – individual flowers could have over 30 petals – was found in a nursery in Sweden (Rowley 2010, 2017). The material proved to be fertile and so-called ‘Double Flaming Katy’s’ or ‘Rosebud’ selections, globally introduced by the early 2000s, were bred from the offspring. The flowers indeed closely resemble miniature roses and include a wide range of colours, such as crimson red, orange, salmon, yellow, burgundy, pink, purple and white. These plants are today sold worldwide by the millions under the trademark Calandiva® or simply as ‘Rosebud’ selections (Figure 6). By 2018 it was estimated that the global annual trade in *Kalanchoes*, including of ‘Rosebud’ selections, accounted for just short of 100 million plants worth an estimated €67–69 million (Kuang et al. 2021; Smith & Hankey 2021; Smith & Shtein 2021; Kahraman et al. 2022).

Bearing in mind that very possibly only a single living specimen of *Kalanchoe blossfeldiana* was introduced into horticulture via Paris in the late 1920s and the subsequent intensive breeding and selection of horticultural material that took place (Blossfeld 1934a; Jacobsen 1935, 1977, 1986; Schweickerdt 1936; Brown et al. 1939; Smith & Figueiredo 2022), it is today not that easy to establish what ‘typical’ *K. blossfeldiana* looked like, although the (two-dimensional, pressed and dried) type material held at P provides a reasonable idea. Incidentally, it has been suggested that *Hemerocallis fulva* (L.) L., the daylily, also arose and was introduced to the world from a single specimen. Today, the daylily is exceedingly popular in cultivation in domestic gardens and human-influenced landscapes and grown widely across the world in suitable climates (Richmond 2024). However, ‘pure’ *K. blossfeldiana* is not all that commonly available in the horticultural trade, with most of what is simply called ‘*K. blossfeldiana*’ often being hybrids that contain genetic material of a wide range of cytologically compatible species (Izumikawa et al. 2007; Smith 2022a). Even if the offspring of chance or deliberate hybrids produced with *K. blossfeldiana* as one parent prove to be sterile, through appropriate laboratory treatments and techniques, for example by using colchicine, fertility can be restored. In 1937 it had been discovered that treatment with colchicine can lead to the doubling of the number of chromosomes in a cell (Kingsbury 2009; Orton 2019).

From a gross morphological perspective, *Kalanchoe blossfeldiana* shows affinities with a cluster of species, all from Madagascar, which includes, for example, *K. globulifera* H.Perrier and the recently described *K. darainensis* D.-P.Klein & Callm. This group of species fits in *K.* subg. *Kalanchoe* – see Klein et al. (2021) for a discussion.

The material from which the plate that accompanies this text was prepared is therefore deliberately of the variegated variant of *Kalanchoe blossfeldiana* with single, crimson red

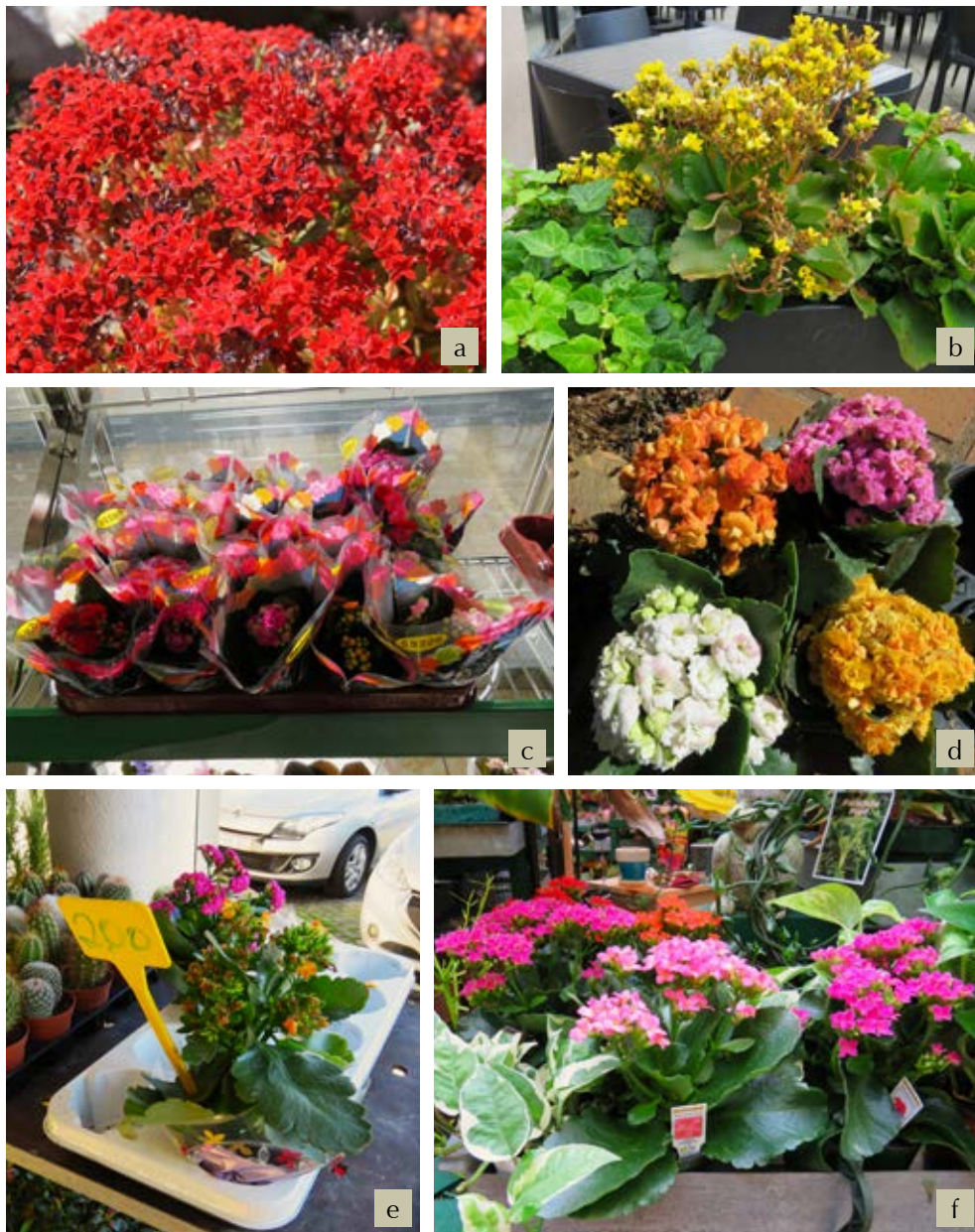


FIGURE 5.—Potted *Kalanchoe blossfeldiana* material is sold globally as part of the indoor horticultural trade: a, bright red, single-flowered variant in full flower in Lubango, southern Angola; b, yellow, single-flowered selection grown along the sidewalk fence of a restaurant in Chicago, Illinois, USA; c, miniature specimens that look like rooted plant tips in full flower are sold as 'Kalanchoe Mini' in a retail store in Alcanena, central Portugal; d, potted, double-flowered specimens sold in a tray in a nursery in Moko-pane, Limpopo, South Africa; e, orange (single-flowered) and bright pink (double-flowered) selections available in the Floral Rua da Saudade, next to the cemetery in Alcanena, central Portugal; f, single-flowered selections sold in the shop of the Missouri Botanical Garden, St Louis, Missouri, USA, with the plant in the centre labelled *Kalanchoe* 'Selena Salmon Pink'. Photographs: a–f, G.F. Smith.



FIGURE 6.—Millions of potted, double-flowered (Rosebud or Roseflower kalanchoes) specimens are annually sold globally under the trademark Calandiva®. Plants are made available in a range of striking colours: a, scarlet red selection with the peduncles extending well above the pseudo-rosettes; b, crimson red selection with very short peduncles; c, bright purple selection; d, pink selection, with the abaxial surface of the unfurling corolla lobes a contrasting creamy colour; e, pink and white flowered selection; f, cream selection, with the centres of the flowers a contrasting pink; g, mustard yellow selection; h, butter yellow selection; i, snow white selection. Photographs: a–f, h, i, G.F. Smith; g, E. Figueiredo.

corolla lobes because with little doubt it is representative of the species. In the horticultural trade this leaf-variegated material is variously available under the monikers *K. blossfeldiana* 'Colour Spoon', *K. blossfeldiana* 'Tricolo[u]r' and *K. blossfeldiana* 'Variegata', with these often presented as cultivar names, or simply as trade designations. The variegated selection flowers less prolifically than non-variegated material, but that is to be expected, given that the leaves inevitably have a lower photosynthetic capacity. With the knowledge of hindsight, the statement of Jacobsen (1977) that, 'Many cvs. [cultivars] have been obtained by selective breeding and crossing', proved to be prophetic and portended what was to come. Apart from listing *K. blossfeldiana* 'Variegata', Shaw (2008) referenced more than 430 cultivars that have been selected from variants of *K. blossfeldiana* or from hybrids that include this species in their parentage. In some instances these greenhouse and nursery selections are, or were, only ephemerally available, but many remain popular, have been widely distributed and are available the world over (Smith et al. 2019). The number of, broadly speaking, *K. blossfeldiana* cultivars or at least of such material with names presented as cultivar names is in fact rather modest – bear in mind that a staggering '[...] some 80,000 [...] cultivars of *Hemerocallis* L. have been registered with the American Daylily Society

alone (Kingsbury 2022). The selection of cultivars from material that includes *K. blossfeldiana* in their genetic makeup continues unabated and at least in terms of interspecific, as well as more complex, multi-taxon hybrids, the *Kalanchoe* horticultural industry continues to rely heavily on natural or induced cytological compatibility between *K. blossfeldiana* and other *Kalanchoe* species, nothospecies and cultivars. A recent introduction is referred to as ‘Else Flower’ and a series of truly spectacular colour variants have been released under this moniker (Figure 7). Other selections, for example material known under monikers such as *K. ‘Katapifa’* and *K. ‘Spider’* (Figure 8), bear little vegetative morphological resemblance to *K. blossfeldiana*, the species. However, florally in this instance, the usually double blooms are distinctly reminiscent of those of the ‘Rosebud’ variants of *K. blossfeldiana* and a range of other cultivars derived from them. This, inter alia, testifies to the broad natural or induced cytological compatibility evident among *Kalanchoe* taxa.

Kalanchoe blossfeldiana thrives under the same environmental conditions (essentially temperature, humidity and light intensity) that humans find agreeable and this has obviously played a role in the domestication of *Kalanchoe*. It is one reason why Flaming Katy plants flourish indoors, for example at temperatures that generally do not drop much below 15°C. Plants purchased in a nursery, general store, or supermarket, which is the most convenient way of obtaining ‘*K. blossfeldiana*’ material, should be watered regularly with care taken not to allow the soil to become completely desiccated before re-watering. However, the soil should also not be waterlogged, which will invariably lead to root rot. Plants grow best in a friable, well-drained soil mixture that ideally contains a substantial amount of decomposed organic material. Plants should also not be exposed to strong, direct sunlight, which will scorch the leaves and likely lead to flowers wilting and dropping prematurely. From shortly after *K. blossfeldiana* was introduced to the horticultural market, it became common knowledge that flowering becomes weaker after the first blooming event. Only one year after *K. blossfeldiana* was described at the rank of species, Jacobsen (1935) noted that vegetative material, presumably including of hybrids of which it is one parent, that has flowered ‘[...] is not worth using as mother plants for cuttings’ (see also Smith & Shtein [2021]). As further noted by Jacobsen (1986), ‘After blooming [of *K. blossfeldiana*], little new growth takes place and cultivation then from cuttings is not worth while [sic].’ As in the case of *K. pumila* Baker (Smith & Figueiredo 2021), the most convenient way in which to obtain healthy, highly floriferous specimens of *K. blossfeldiana* selections and hybrids is to simply purchase a potted specimen from a plant nursery or other outlet that trades, sometimes exclusively online, in these plants.

Kalanchoe blossfeldiana flowers naturally from winter to spring in the southern hemisphere, from July to September. However, flowering can be manipulated by variously exposing plants to short days (long nights), which ensures that blooming material is available at any time of the year – see Smith et al. (2019) for a comprehensive discussion. Brightly lit indoor positions can therefore be decorated with ‘*K. blossfeldiana*’ plants throughout the year.

Description.—Perennial or short-lived multiannuals, usually many-leaved, densely branched, glabrous throughout, small to medium-sized, rounded, succulent shrublets, 0.2–0.4 m tall. Stems green to reddish green, a few arising from a sometimes brittle, corky base, erect to slightly leaning, round in cross-section, rarely with one or two

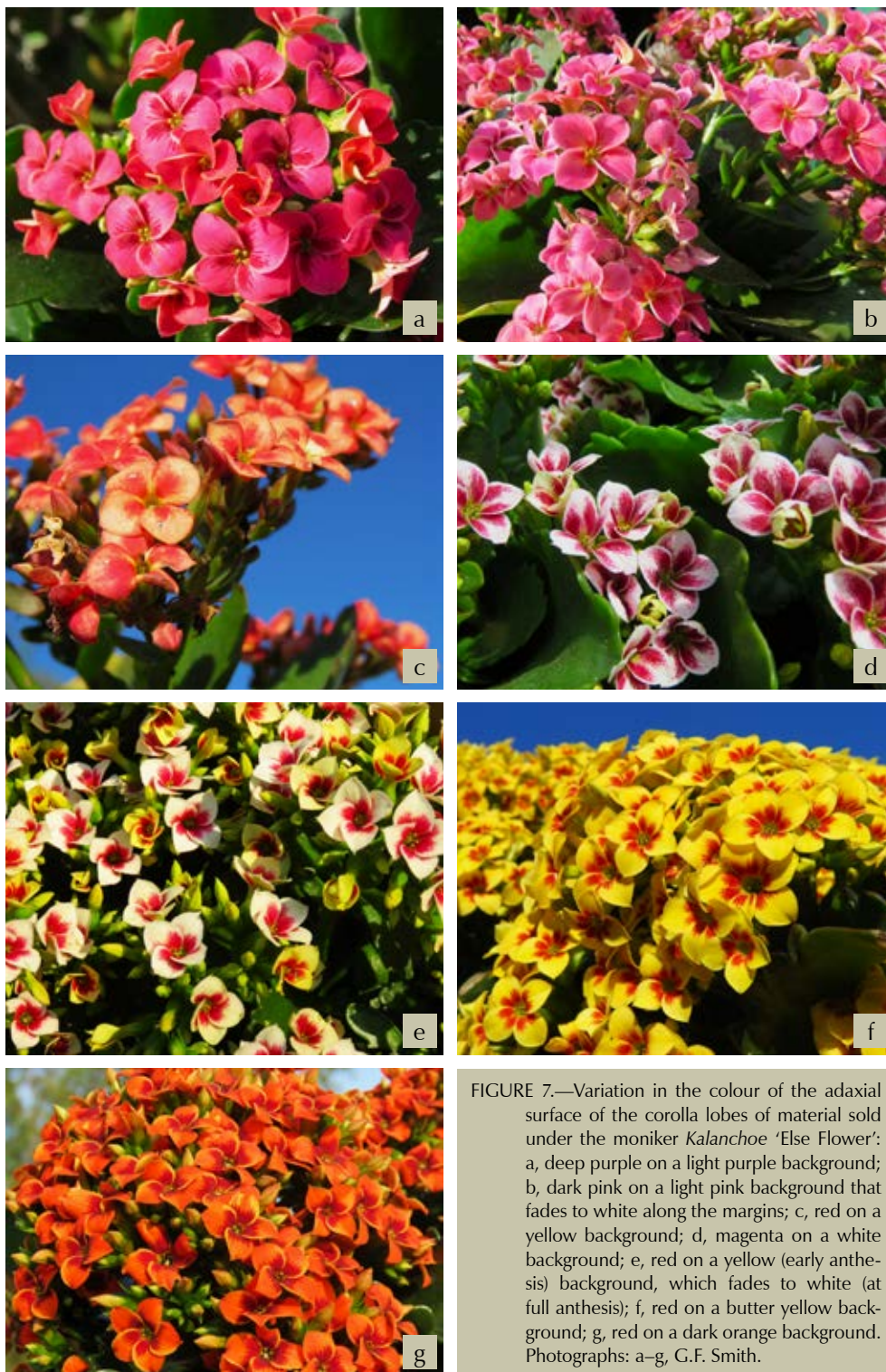


FIGURE 7.—Variation in the colour of the adaxial surface of the corolla lobes of material sold under the moniker *Kalanchoe* 'Else Flower': a, deep purple on a light purple background; b, dark pink on a light pink background that fades to white along the margins; c, red on a yellow background; d, magenta on a white background; e, red on a yellow (early anthesis) background, which fades to white (at full anthesis); f, red on a butter yellow background; g, red on a dark orange background. Photographs: a–g, G.F. Smith.



FIGURE 8.—Miscellaneous horticultural material at least in part derived from, and artificially based on, *Kalanchoe blossfeldiana*: a, *Kalanchoe* Mini Calandiva® Bowl; b, a selection with incompletely developed flowers carried in circinoid inflorescences; c, an orange, double-flowered selection of *Kalanchoe* 'Else Flower'; d, *Kalanchoe* 'Katapifa' with double flowers, as in *Kalanchoe* Calandiva®, but the leaves are narrow and deeply incised; e, f, synthetic *Kalanchoe blossfeldiana* plants manufactured in silk. Photographs: a–f, G.F. Smith.

lengthwise-running ridges. Leaves opposite-decussate, petiolate, mid- to dark green, reddish infused if grown in exposed positions, shiny, somewhat succulent, erectly spreading to spreading, papery on drying; petiole 5–30 mm long, channelled above, leaves not clasping the stem; blade 40–70 × 25–40 mm, ovate-oblong to oblong, flat; base rounded to somewhat cuneate; apex rounded-obtuse; margins coarsely crenate or undulate-crenate into rounded, harmless teeth especially above the middle, often curved upwards, sometimes reddish infused. Inflorescence a flat-topped thyrse, (100–)150–200 mm tall, erect,

apically dense, many-flowered, branches opposite, erect, subtended by leaf-like bracts, leafy branchlets sometimes produced in axils post-flowering, axis green to reddish green to brownish; pedicels 3–4 mm long, slender. *Flowers* erect; calyx consisting of 4 sepals, flared away slightly from corolla tube; sepals 4–6 mm long, shiny reddish green, strongly infused with small red spots especially towards tips and margins, fused for ± 0.5 –1.0 mm, separate above, triangular-lanceolate, acute-tipped, hardly contrasting against corolla tube; corolla 12–13 mm long, somewhat enlarged lower down, not twisted apically after anthesis; tube (7–)10–11(–12) mm long, light green to crimson red to scarlet, 4-angled, rounded to slightly box-shaped-square when viewed from below, slightly longitudinally fluted above; lobes $5\text{--}6 \times 3\text{--}4$ mm, bright crimson to scarlet (selections derived from hybrids include virtually all colours, except black and blue), ovate to oblong-ovate to oblong-deltoid, rounded-acute at apex, mucronate. *Stamens* inserted well above middle of corolla tube, included; filaments 1.0–1.5 mm long, thin, yellow; anthers 0.30–0.75 mm long, rounded to slightly elongated, greenish yellow turning brown. *Pistil* consisting of 4 carpels; carpels 5–6 mm long, bright light green; styles 2–3 mm long; stigmas capitate, whitish yellow, visible at mouth of corolla tube; scales ± 2 mm long, linear, light yellowish green. *Follicles* brittle, grass spikelet-like, enveloped in dry, light brown remains of corolla, dull whitish green, 5–6(–7) mm long. *Seeds* 0.3–0.4 mm long, light brown. *Chromosome number*: $2n = 34$ (Baldwin 1938; Sharma & Ghosh 1967; Friedmann 1971; Van Voorst & Arends 1982; Smith 2022b). (Note that tetraploids, i.e., $2n = 4x = 68$, appeared very early in the breeding of *Kalanchoes*, as reported by Van Voorst & Arends [1982] for what was likely the hybrid between *Kalanchoe blossfeldiana* and *K. glaucescens* Britten, as *K. flammea* Stapf, both of which are diploids, i.e., $2n = 34$; aneuploids are also known in *K. blossfeldiana* hybrids [Rowley 2010, 2017]). Plate 2406.

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PLATE 2407 *Kalanchoe gideonsmithii*

Kalanchoe gideonsmithii

Crassulaceae: Kalanchooideae

South Africa

Kalanchoe gideonsmithii N.R.Crouch & Figueiredo in Phytotaxa 566(2): 234 (2022).

As interpreted in the treatment of *Kalanchoe* Adans. for the *Flora of Southern Africa* series (Namibia, Botswana, Eswatini, Lesotho and South Africa), *K. rotundifolia* (Haw.) Haw. was by far the most variable of the subcontinental species included in the genus (Tölken 1985). *Cotyledon orbiculata* L., like *K. rotundifolia* also a representative of Crassulaceae subfam. Kalanchooideae A.Berger emend. Gideon F.Sm. (see Smith & Monro 2022a, b), is similarly extraordinarily variable; as then circumscribed these two species must jointly hold the distinction of being the most variable of all the species that occur in the flora of southern Africa (see Tölken [1979] and Van Jaarsveld & Koutnik [2004] on *C. orbiculata*; and Figueiredo & Smith [2017], Smith & Figueiredo [2017a], Smith et al. [2019] and Smith & Figueiredo [2022a] on *K. rotundifolia*). In addition, *K. rotundifolia* has an extensive natural geographical distribution range in southern and south-tropical Africa, which stretches much further north into eastern Africa and to the Indian Ocean island of Socotra. This range comfortably outstrips that of *C. orbiculata*, which is an essentially southern and south-tropical African species known to as far north as southern Angola (Van Jaarsveld & Koutnik 2004).

However, with the reinstatement of *Kalanchoe decumbens* Compton (Smith 2021) and *K. stearnii* Raym.-Hamet (Smith 2023a), and the description of *K. waterbergensis* van Jaarsv. (Smith & Figueiredo 2021; Smith et al. 2021), *K. gideonsmithii* (Figures 1 and 2), *K. klop-perae* Gideon F.Sm. & Figueiredo (Smith & Figueiredo 2022b) and *K. krigeae* Gideon F.Sm. & Figueiredo (Smith & Figueiredo 2023), the identification of well-defined segregates from *K. rotundifolia* and their formal recognition at species rank has gained momentum over the past four years.

Geographically, the southern African kalanchoes can be broadly divided into two informal groups: widespread species and narrow-range species, with several of those included in the latter group being additionally restricted to specific regions or centres of endemism recognised by Van Wyk & Smith (2001). Smith & Figueiredo (2021) and Smith (2022) recorded four *Kalanchoe* species (*K. benbothae* Gideon F.Sm. & N.R.Crouch, *K. leblanciae* Raym.-Hamet [Crouch et al. 2016; Smith et al. 2017], *K. longiflora* Schltr. ex J.M.Wood [Smith & Figueiredo 2017b] and *K. neglecta* Toelken [Smith et al. 2019; Smith 2023b]) as local endemics in the Maputaland-Pondoland Region of Endemism (Van Wyk & Smith 2001), with *K. decumbens* Compton being a near-endemic (Smith 2021). A further species, *K. gideonsmithii*, should now be added to this group, so confirming this region to host one of the largest number of southern African *Kalanchoe* endemics (Figure 3).

PLATE 2407.—Flowering specimen of *Kalanchoe gideonsmithii*, $\times 0.75$. Plate prepared on 30 June 2023, i.e., in mid-winter in the southern hemisphere, when plants were in full flower. Voucher specimen: G.F. Smith 1153 in the H.G.W.J. Schweickerdt Herbarium (PRU), Pretoria. Artist: Gillian Condy.



FIGURE 1.—Plants of *Kalanchoe gideonsmithii* are almost throughout infused with a characteristic bluish purple colour. Photograph: G.F. Smith.



FIGURE 2.—The corolla tube of *Kalanchoe gideonsmithii* is distally consistently bright orange-red with a bluish purple infusion, especially around the similarly coloured and distinctly bluish purple-infused ovaries. The corolla lobes are bright orange-red and sometimes somewhat yellowish-infused in the centre. Photograph: G.F. Smith.

Virtually all the plant parts of *Kalanchoe gideonsmithii* are infused with a characteristic bluish purple colour, including young leaves, which with time age to a more uniformly glaucous blue-green to light greenish yellow colour (Figure 4), especially in shaded positions. In contrast, the leaves of *K. rotundifolia* are mid- to light green to somewhat glaucous. The leaves of *K. gideonsmithii* are narrowly oblong-terete to somewhat clavate, rather than round or oblanceolate to obovate as in *K. rotundifolia*. A deep shade of purple also infuses the flowers of *K. gideonsmithii*. Especially at the level of the ovary, the corolla tubes of *K. gideonsmithii* are dark orange-red and purplish-infused, rather than somewhat to strongly green-infused, as in the case of *K. rotundifolia*. Even post-anthesis and when the flowers start to wilt, the purple colour is retained in the papery remains of

the desiccating corolla tube and lobes of *K. gideonsmithii* (Figure 2).

The known southern African *Kalanchoe* species at present taxonomically most closely associated with *K. rotundifolia*, i.e., *K. alticola* Compton, *K. waterbergensis*, *K. gideonsmithii*, *K. klopperiae*, *K. stearnii* and *K. krigeae*, and to a lesser extent *K. decumbens*, differ from other subcontinental taxa by a combination of easily observed characters, inter alia, that they are all rather small-growing and glabrous. The leaves are variously shaped and sized but generally ovate to obovate to cylindrical and small, straight, flat, rarely longitudinally folded and rarely slightly recurved. The inflorescence is a small, dense- or sparse-flowered corymbose cyme, with the flowers invariably borne erectly at anthesis. Flowers are narrowly urceolate and usually abruptly constricted above the upper level of the ovary to present an upwardly tapering corolla tube. In most of these species this tube is often subtly to strongly greenish-infused (in addition to

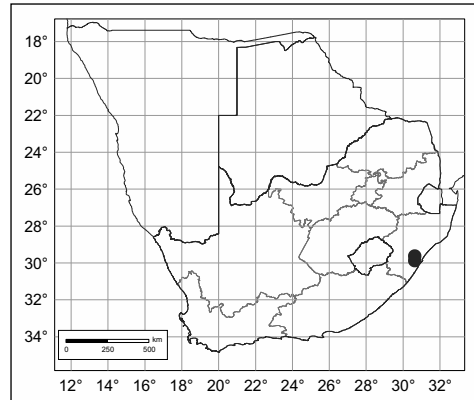


FIGURE 3.—Natural geographical distribution range of *Kalanchoe gideonsmithii* in the Midlands of KwaZulu-Natal in eastern South Africa.



FIGURE 4.—With age, the leaves of *Kalanchoe gideonsmithii* turn a more uniformly glaucous blue-green to light greenish yellow colour. Photograph: G.F. Smith.



FIGURE 5.—The habitat of *Kalanchoe gideonsmithii* at Bishopstowe, in KwaZulu-Natal Hinterland Thornveld (SVs 3) (Rutherford et al. 2006). Photograph: N.R. Crouch.

the bluish purple infusion as found in *K. gideonsmithii*), glabrous and lacks a white-waxy layer. The corolla lobes are various shades of pink, red, orange, yellow or white, slightly erect, horizontally spreading or recurved. In addition, the flowers invariably show diurnal movement, i.e., they close at night, and are distinctly tight-twisted post-anthesis.

Kalanchoe gideonsmithii is most likely to be confused with the much more commonly encountered *K. rotundifolia*, a species that is highly variable, particularly in leaf morphology, and which remains taxonomically complex despite various segregates being recognised in recent years. From *K. rotundifolia*, the subject of this account may be distinguished on account of its bluish purple-infused leaves, rather than mid-green to glaucous ones, being narrowly oblong-terete to somewhat clavate rather than round or oblanceolate to obovate, and by its elliptic rather than lanceolate to subfalcate corolla lobes, among other characters. The distribution of *K. gideonsmithii* is additionally far more limited, as the species is so far known only to occur between Bishopstowe and Cato Ridge in KwaZulu-Natal. In the east of their range plants occur in rocky grassland on sandstone-derived soils at an elevation of ca. 565 m a.s.l., and in the west they form colonies on shallow lithosols overlying a granite outcrop in KwaZulu-Natal Hinterland Thornveld (SVs 3) (Rutherford et al. 2006) at an elevation of 540 m a.s.l. (Figure 5), where they occur fully sympatrically with *K. rotundifolia* yet show no signs of hybridising. Several hundred plants have been observed in the field across its range, but unfortunately much of the extent of occurrence of this newly described species is threatened in the medium term by habitat destruction as the N3 corridor between

Durban and Pietermaritzburg is being transformed for commercial and housing developments. At the type locality at Bishopstowe *K. gideonsmithii* may be observed growing together with other succulent species besides *K. rotundifolia*, including *Aloe candelabrum* A.Berger (Asphodelaceae subfam. Aloioideae), *Kleinia fulgens* Hook.f. (Asteraceae), *Euphorbia tirucalli* L. and *Euphorbia cupularis* Boiss. (both Euphorbiaceae), *Tetradenia riparia* (Hochst.) Codd (Lamiaceae), *Cyanotis robusta* Oberm. (Commelinaceae) and *Cotyledon orbiculata* (Crassulaceae).

One of the defining characters of *Kalanchoe* that separates it from *Cotyledon* L. is that, reproductively, kalanchoes are tetramerous. However, pentamerous flowers, as in *Cotyledon*, and even hexamerous (six-partite) and heptamerous (seven-partite) flowers are sometimes found in *Kalanchoe*. In the case of *K. gideonsmithii*, flowers with five or six corolla lobes and that same number, or a different number, of calyx lobes are sometimes encountered (Smith 2023c) (Figure 6). Such variation in the number of floral parts, even among flowers on the same inflorescence, is also observed in some species of *Crassula* L., such as *C. multicava* Lem. and *C. floribunda* (Friedrich ex Toelken) N.R.Crouch, Gideon F.Sm. & D.Styles (Crouch et al. 2021).



FIGURE 6.—Flowers of *Kalanchoe gideonsmithii* with five (flower on the right) or six (flower on the left) corolla lobes and that same number, or a different number, of calyx lobes are sometimes found. Photograph: G.F. Smith.

Kalanchoe gideonsmithii is easy to propagate from stem cuttings that should ideally be taken at the onset of the growing season (spring in the southern hemisphere) and rooted in a friable, well-drained soil mixture that contains gritty sand. Once rooted, plants are tolerant of a range of soil types and can be transplanted directly to the places that they are intended to grow. If the soil is clayey, care should be taken to not allow the roots to remain in water-logged soil for extended periods. Like all the southern African kalanchoes, in cultivation plants respond well to a summer-rainfall regime, given that they enter a resting phase during winter when they flower.

Although so-called ‘crested’ plants – an often laterally fan-like, flattened abnormality of a regular, usually rather attenuated-growing meristem – is fairly common in the family Crassulaceae, such fasciated plants are almost entirely unknown in *Kalanchoe*, with the cultivar *K. luciae* ‘Oricula’ being a notable exception. However, this condition is here formally recorded for a second species in *Kalanchoe*, *K. gideonsmithii*, some forms of which also show this abnormality (Figure 7).

Kalanchoe gideonsmithii is useful for attracting wildlife to a garden, especially butterflies that feed on the nectar of the flowers that are produced mainly during the winter months,



FIGURE 7.—A 'crested' specimen of *Kalanchoe gideonsmithii*. Crested plants show fasciation, an often laterally fan-like, flattened abnormality of a regular, usually rather attenuated-growing meristem. Photograph: G.F. Smith.



FIGURE 8.—A Leopard Magpie Moth, *Zerenopsis lepida* (Walker, 1854), family Geometridae, perched on a plant of *Kalanchoe gideonsmithii*. The caterpillars are obligatory on cycads in the first three instars (Hermann Staude, pers. comm.). Photograph: G.F. Smith.

from May to August. The Leopard Magpie Moth, *Zerenopsis lepida* (Walker, 1854), family Geometridae, also visits the species (Figure 8).

Description.—Perennial, few- to many-leaved, sparsely to densely branched from the base, glabrous, low-growing small to medium-sized succulent, with creeping stems 0.2–1.0 m long when in flower. *Stems* one to few arising from the rootstock, green to strongly bluish purple-infused, usually simple or sometimes producing obovate-leaved branchlets near the base, main stems very rarely branched higher up; thin, erect or leaning to creeping, rooting along the way. *Leaves* 50–75(–80) × (4.0–)5.0–7.5 mm, pale bluish green to pale light green, with slight to distinct bloom, finely purple-dotted in distal quarter and towards base, opposite-decussate, sessile, erect, uniformly densely carried throughout; petiole absent; blade succulent, spatulate when

young, narrowly oblong-terete to somewhat clavate at maturity, often involute when desiccated, then appearing grooved above, sometimes slightly recurved or incurved in distal third to half; apex rounded to obtuse, slightly pointed; base gradually tapering to a narrow slightly thickened insertion on the stem; margins entire. *Inflorescence* a corymbose cyme, 100–300(–400) mm tall, with leaf-like bracts at nodes, floriferous only at top, erect or leaning, apically sparsely branched, few- to many-flowered, rather round in outline when viewed from above, branches opposite, subtended by small, persistent leaf-like bracts, leafy branchlets sometimes developing in axils, axis light green to strongly bluish purple-infused with a slight waxy bloom; pedicels slender, 7–9(–11) mm long. *Flowers* 11–14 mm long, erect; calyx dull bluish green, distally red, covered with a slight bloom; sepals 4, $\pm 0.75\text{--}1.00 \times 0.75\text{--}1.00$ mm, $\pm$ separate, basally very slightly fused, deltoid-triangular, acute, somewhat contrasting against basal part of corolla; corolla 10–13 mm long, prominently enlarged basally around carpels, distinctly and tightly anti-clockwise-twisted apically after anthesis; corolla tube 9–12 mm long, distally consistently bright orange-red with bluish purple infusion, bright orange-red to distinctly bluish purple-infused around ovaries, yellowish green basally at level of sepals, terete to 4-angled, narrowly urceolate, strongly globose basally to somewhat cubic when viewed from below, narrowing above carpels; lobes $4\text{--}5 \times 1.5\text{--}2.0$ mm, at $30\text{--}45^\circ$ angle to rarely patent, bright orange-red, sometimes slightly yellowish-infused in the centre, narrowly elliptic, distinctly acute apically, showing diurnal movement. *Stamens* inserted in two ranks just above and just below the middle of the corolla tube, included; filaments 1.0–1.5 mm long, thin, yellow; anthers 0.25–0.30 mm long, yellow. *Pistil* consisting of 4 carpels; carpels 4–5 mm long, mid-green, distinctly purple-infused; styles ± 1 mm long; stigmas yellowish green, very slightly capitate; scales 2.0–2.5 mm long, linear, light yellow. *Follicles* 5–6 mm long, dull mid-green, enveloped in dry, purple to purplish white remains of corolla, eventually brittle, grass spikelet-like. *Seed* 0.75–1.00 mm long, brown, striated, somewhat banana-shaped to ellipsoid. *Chromosome number*: $2n = 34$ (Smith et al. 2023). Plate 2407.

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Kalanchoe × *houghtonii*

Crassulaceae: Kalanchooideae

Madagascar (and widely naturalised globally in mild climates)

Kalanchoe × **houghtonii** D.B.Ward in Cactus & Succulent Journal (US) 78(2): 94 (2006); Guillot Ortiz et al.: 99 (2014); Smith: 84 (2019); Shtein et al.: 237–244 (2021). *Bryophyllum* × *houghtonii* (D.B.Ward) Forster: 383 (2006).

‘As usual in seed-raised strains, some flowers were particularly good and worth saving ..., while others were particularly miserable and malformed and worthy of the bonfire.’

Lloyd (2021: 135)

‘Blame must always be placed on the ignorance or, perhaps, hubris of the humans who first introduced these lovely but tough plants to such luxury.’

Lawrence & Clerc (2024: 178)

Separated by just short of 450 plates, two of the most invasive species of *Kalanchoe* Adans. globally, i.e., *K. delagoensis* Eckl. & Zeyh. (Figure 1) and *K. daigremontiana* Raym.-Hamet & H.Perrier (Figure 2), were previously figured and treated in *Flowering Plants of Africa* (respectively Tölken & Leistner 1986; Smith et al. 2023). Both species use multiple reproductive strategies that have enabled them to colonise natural and human-made habitats and substrates suitable for rooting well beyond their natural geographical distribution ranges in Madagascar (Smith et al. 2021). In this paper the hybrid between these two species, *K. ×houghtonii* D.B.Ward (Figure 3), is treated. Perhaps predictably, given the invasive tendencies of the two parents of *K. ×houghtonii*, at least some of the offspring of the hybrid between them is an even worse offender (Herrando-Moraira et al. 2020). Both parents of *K. ×houghtonii* are included in *K.* subg. *Bryophyllum* (Salisb.) Koorders and, at the rank of section, in the appropriately named *K.* [subg. *Bryophyllum*] sect. *Invasores* Shtein & Gideon F.Sm. (Shtein & Smith 2021).

When Dr Arthur Duvernoix Houghton (8 June 1871–23 January 1938) (Figure 4), crossed *Kalanchoe daigremontiana* and *K. delagoensis* in San Fernando, California, USA in the 1930s, and published the ‘name’ ‘*Bryophyllum tubimontanum*’, albeit not validly, for the offspring (Houghton 1935), he must have regarded the hybrid plants that resulted as ‘... particularly good and worth saving ...’ (see quoted text at the start of this paper). Little could he have predicted that some 70 years later, material with this parentage would be found on all continents except Antarctica (Herrando-Moraira et al. 2020). It is even less likely that he would have

PLATE 2408.—1, inflorescence where the leaf arrangement remained decussate, × 1; 2, inflorescence where the leaf arrangement transitioned to tricussate, × 1; 3, single flower, × 1.25. Voucher specimen: G.F. Smith 1076 in H.G.W.J. Schweickerd Herbarium (PRU), Pretoria. Artist: Gillian Condy.



PLATE 2408 *Kalanchoe xhoughtonii*



FIGURE 1.—*Kalanchoe delagoensis*, naturalised at Porto Covo in the southern province of Baixo Alentejo, along the southwestern coast of Portugal. The flowers of some variants of the species are bright orange, as here. Flower colour is somewhat variable with light orange, red, and bicoloured (orange and yellow) variants also known. Photograph: G.F. Smith.

been able to predict that the plants almost invariably would be unwanted because of their invasive tendencies. Houghton was a medical doctor and horticulturalist, and one of three people that started the Cactus and Succulent Society of America (CSSA) in 1928, of which he was elected as the first president in 1929 (Staples 2024).

When exactly *Kalanchoe delagoensis* was introduced to the USA is not certain. In contrast, we know that *K. daigremontiana* reached that country after it was collected during a joint collecting trip undertaken to Madagascar in 1928 by Prof. Dr Jean Henri Humbert (Paris, France, 24 January 1887–20 October 1967, Yvelines, France) and Dr Charles Fletcher Swingle (College Hill [now Manhattan], Kansas, USA, 13 May 1899–24 November 1978, Manhattan, Kansas, USA). Swingle's participation in the field trip was to, inter alia, obtain living material of



FIGURE 2.—A specimen of *Kalanchoe daigremontiana* that is approaching flowering maturity. Photograph: G.F. Smith.



FIGURE 3.—A dense stand of *Kalanchoe ×houghtonii* growing in Alcanena in the Ribatejo province in central continental Portugal. Photograph: G.F. Smith.



FIGURE 4.—Dr Arthur Duvernoix Houghton (8 June 1871–23 January 1938) crossed *Kalanchoe daigremontiana* and *K. delagoensis* in San Fernando, California, USA in the 1930s, and published the designation '*Bryophyllum tubimontanum*' for the offspring. The nothospecies name *K. ×houghtonii* was eventually published for the material. Photograph unknown; photograph supplied by C.J. Staples.

ornamental plants, with Dorr (1997) recording particularly that, 'Notable among the ornamentals were several species of *Kalanchoe* (Crassulaceae)'. Six years after Swingle visited Madagascar, he published a paper on *K. daigremontiana* in which he referred to it as, 'the easiest plant in the world to propagate' (Swingle 1934). This referenced its multiple reproductive mechanisms and ease of cultivation. Houghton obviously obtained material of *K. daigremontiana*, likely after its introduction by Swingle and, one year after Swingle's paper was published, Houghton had produced the hybrid between *K. delagoensis* and *K. daigremontiana*.

Just more than 70 years after the hybrid between *Kalanchoe daigremontiana* and *K. delagoensis* was produced by Houghton, it finally received a validly published nothospecies name, *K. ×houghtonii*, in 2006, when it was named for Houghton, perhaps appropriately in the *Cactus & Succulent Journal (US)*, a mouthpiece of the CSSA that he co-started (Ward 2006).

Houghton was not the only one – but he was very likely the first one – to have hybridised *Kalanchoe daigremontiana* and *K. delagoensis*. In Portugal, Prof. Dr Flávio Resende (Cinfães, Portugal, 28 February 1907–1 January 1967, Lisbon, Portugal) (Figure 5), working at the University of Lisbon, created the exact same hybrid in the mid-1950s. Resende's work was not primarily aimed at obtaining new horticultural material (Resende & Viana 1965); rather, he studied the cytology and cytotaxonomy of succulents (Resende & Warden 1954), character inheritance in hybrids that he created, as well as genetic factors controlling plant development, and the flowering stimulus in various kalanchoes (Figueiredo et al. 2019; Smith & Silva 2019; Smith et al. 2020; Smith 2022). Resende (1956) reported two different chromosome numbers – sterile triploids and fertile tetraploids – for what he regarded as hybrids between representatives of *Bryophyllum* Salisb., which is today treated as a synonym of *Kalanchoe*, as follows (here citing the names and parentage sequence used by Resende, with the currently accepted names given in square brackets): *B. tubiflorum* Harv. [*K. delagoensis*] × *B. daigremontianum* (Raym.-Hamet & H.Perrier) A.Berger [*K. daigremontiana*], which yielded fertile tetraploids (4x, i.e., $2n = 68$); and, the same hybrid with the parents in reverse, *B. daigremontianum* [*K. daigremontiana*] × *B. tubiflorum* [*K. delagoensis*], which yielded sterile offspring, all triploids (3x, i.e., $2n = 51$). The variable chromosome numbers reported for *K. ×houghtonii* are not surprising given that one of its parents, *K. daigremontiana*, is a diploid ($2n = 34$) and *K. delagoensis*, the other parent, is a tetraploid ($2n = 68$) (Smith 2022).



FIGURE 5.—Professor Dr Flávio Resende (left), Prof. Dr Emil Heitz (centre; University of Hamburg, Germany) and Prof. Dr Fernando Catarino (right) outside a greenhouse in the Jardim Botânico de Lisboa, Portugal, ca. early 1960s. Professor Heitz was promoter of Prof. Resende's Ph.D. Professor Resende produced and studied hybrids between *Kalanchoe daigremontiana* and *K. delagoensis* in Lisbon. Photographer unknown; photograph supplied by and copyright of Prof. Fernando Catarino, and reproduced with his permission.

Based on the variable cytology reported for, and associated morphological variation observed in, *Kalanchoe ×houghtonii*, Shtein et al. (2021) recognised four morphotypes in the nothospecies. Two of these, Morphotypes A and B, are of artificial origin (respectively produced by, at least, Houghton [USA] and Resende [Portugal]), while two other morphotypes, Morphotypes C and D, might represent natural hybrids or transitional variants between *K. delagoensis* and *K. daigremontiana* where their natural geographical distributions abut or overlap. Of these morphotypes, *K. ×houghtonii* Morphotype A represents the invasive, fertile tetraploid, while *K. ×houghtonii* Morphotype B is the sterile triploid (Shtein

et al. 2021). Neither *K. ×houghtonii* Morphotype C nor *K. ×houghtonii* Morphotype D has thus far been reported as naturalised anywhere. In summary, material found to be invasive is therefore virtually invariably representative of *K. ×houghtonii* Morphotype A.

Material of *Kalanchoe ×houghtonii* Morphotype A, which is illustrated here, has comparatively large, triangular-lanceolate leaf blades that are attenuate at first and later basally subpeltate, often only weakly so, especially when plants approach reproductive maturity. Leaves of plants of this group are generally only purplish brown-maculate abaxially and along the petiole. The flowers are rather large, purplish to red and more reminiscent of those of *K. delagoensis* rather than those of *K. daigremontiana* (Shtein et al. 2021). Given the large size of the leaves, plants of naturalised *K. ×houghtonii* have been confused with *K. daigremontiana*, one of its parents, for example in Maire (1977) and in Sajeva & Costanzo (2000: 172, top left image), where material of this nothospecies is illustrated and treated as *K. daigremontiana*.

When Resende (1956) used the genus name *Bryophyllum* for the kalanchoes that he worked on, he followed the classification proposed by Berger (1930), who recognised *Kalanchoe*, *Bryophyllum* and *Kitchingia* Baker as separate genera. Like *Bryophyllum*, *Kitchingia* too is today recognised at the rank of subgenus in *Kalanchoe*, as *K. subg. Kitchingia* (Baker) Gideon F.Sm. & Figueiredo. Since Resende (1956) recognised *Bryophyllum* and *Kalanchoe* as separate genera, he published the nothogeneric name *×Bryokalanchoe* Resende for the hybrids he created between representatives of the two genera – he also crossed *K. blossfeldiana* Poelln. [*K. subg. Kalanchoe*] with *K. daigremontiana* [*K. subg. Bryophyllum*]. In the case of *K. blossfeldiana*, Resende (1956) used what he referred to as '*K. blossfeldiana* var. *feuerblüte* Hort.' as well as, separately, what he referred to as '*K. blossfeldiana* var. «α»'. *×Bryokalanchoe* is today included in the synonymy of *Kalanchoe*.

By the 1950s, material of what is today known as *Kalanchoe ×houghtonii* had reached Germany, or the material might have been produced independently in that country, or elsewhere and then sent to Germany. The not validly published 'name' '*Kalanchoe ×hybrida* HORT.', was proposed for this material (Descoings 2003). As far as could be ascertained, this designation made its first appearance in Jacobsen (1954), where the hybrid was illustrated. On that page, Jacobsen wrote as follows: '***Kalanchoe hybrida*** × HORT. (Abb. 764) (*Bryophyllum hybridum* × HORT.). — Eine in einem Garten entstandene Hybride, deren Eltern noch nicht sicher ermittelt sind.' [Translated as: 'A hybrid created in a garden whose parents have not yet been determined with certainty.'] Jacobsen (1977) also treated (but there did not illustrate) the hybrid, as '***K. cv. Hybrida***'. Therefore, whether the material that Herman Jacobsen had access to had originated from the laboratory of Resende in Portugal (Resende 1956), or from Houghton in the USA, or from elsewhere, is not known.

Kalanchoe delagoensis is well known as one of only a few kalanchoes to have a ternate (tricussate) rather than a decussate leaf arrangement, with the latter being found most often in *Kalanchoe*, including in *K. daigremontiana*. Before plants of *K. ×houghtonii* enter their sexual reproductive phase, their leaf arrangement is most usually decussate, but when flowering maturity approaches, leaf arrangement transitions from decussate through alternate to ternate.

Despite some variation, for example in the degree of leaf maculation – leaves of *Kalanchoe ×houghtonii* are generally only purplish brown-maculate abaxially and along the petiole – plants of this nothospecies are intermediate between their two parents in virtually all vegetative and reproductive morphological characters. Leaf blades hardly vary from being variously lanceolate and somewhat elongated (Figure 6), especially at flowering maturity, or somewhat more narrowly deltoid to broadly lanceolate. In the case of *K. daigremontiana* the leaf blades are broadly deltoid and quite large virtually throughout (Figure 2), while those of *K. delagoensis* are narrowly cylindrical (Figure 1). Slight variation has been observed in the flower colour of *K. ×houghtonii*, which varies from dull pinkish purple, nearly as in *K. daigremontiana*, to darker reddish orange, as found in some forms of *K. delagoensis* (Figures 7 and 8). *Kalanchoe ×houghtonii* flowers in mid- to late winter.

Morphotype A of *Kalanchoe ×houghtonii*, i.e., the material illustrated here, is very invasive and has become naturalised in numerous mild-climate regions around the world, inter alia, because it remains remarkably popular in domestic horticulture (see, for example, Ward 2006, 2008 [southern USA]; Laguna Lumbreras et al. 2014 [Spain]; Silva et al. 2015 and Smith et al. 2015 [Portugal]; Zimer 2015 [New Zealand]; Wang et al. 2016 [China]; González Gutiérrez et al. 2019 [Cuba]; Herrando-Moraira et al. 2020 [global review]; Vargas et al. 2022 [Ecuador]; Smith 2023 [Africa and islands in the Gulf of Guinea]; and Sakhraoui et al. 2024 [Algeria]). As a result of its comparatively long leaves, plants produce a multitude of bulbils along their margins (Figure 9). These vegetative propagules root easily and grow vigorously, often in very flimsy substrates, such as in the thin soils and debris that accumulated on roofs and in cracks in walls (Figure 10). Remarkably, until recently, *K. ×houghtonii* was unknown in southern Africa, a region prone to infestations by a large variety of exotic succulents, including kalanchoes (Walters et al.



FIGURE 6.—In most vegetative and reproductive morphological respects *Kalanchoe ×houghtonii* is intermediate between its two parents, *K. daigremontiana* and *K. delagoensis*. The shape of the leaf blades hardly varies from being variously triangular-lanceolate and somewhat elongated. Note the butterfly larva feeding in the centre of the fourth leaf from the right. Photograph: G.F. Smith.



FIGURE 7.—Close-up of an inflorescence of *Kalanchoe ×houghtonii*. The flowers of *K. ×houghtonii* are dull light pinkish purple to reddish purple and longitudinally faintly infused with yellow in the centre of the petals. Photograph: G.F. Smith.



FIGURE 8.—Comparative morphology (colour, shape and size) of the flowers of *Kalanchoe daigremontiana* (left), *K. ×houghtonii* (centre) and *K. delagoensis* (right). The flower colour of *K. ×houghtonii* is intermediate between that of the two parents. The flowers of *K. daigremontiana* are uniformly quite dull light pinkish purple, while those of *K. delagoensis* show more variation, with some variants, such as this one, being bright orange. The flower in the centre is 30 mm long, excluding the pedicel. Photograph: G.F. Smith.

2011). However, several recent sightings indicate that the nothospecies has indeed arrived in the country (see https://www.inaturalist.org/listed_taxa/57659997).

Interestingly, Resende (1956) found that in hybrid kalanchoes the production of bulbils on their leaf margins is recessive, where only one parent has this reproductive ability (*Kalanchoe daigremontiana*), based on the lack of such propagules developing in the case of the sterile F_1 hybrid between *K. blossfeldiana* var. «α» and *K. daigremontiana* [as *Bryophyllum daigremontianum*]. In contrast, in the case of a hybrid produced from parents that are both bryophyllous, as in representatives of *K.* subg. *Bryophyllum*, i.e., *K. pinnata* (Lam.) Pers. [as *Bryophyllum calycinum* Salisb.] $\times$ *K. daigremontiana* [as *B. daigremontianum*], bulbils were indeed formed on the young leaves. The leaves of several representatives of *K.* subg. *Bryophyllum* have this reproductive ability.

Given its ease of cultivation and the inherent variability often found in interspecific hybrids, numerous cultivars have been selected from *Kalanchoe ×houghtonii*. The cultivars *K. ×houghtonii* 'J.T. Baldwin', *K. ×houghtonii* 'Jaws of Life', as well as *K. ×houghtonii* 'Carbí',

are available in the horticultural trade (Shaw 2008; Guillot Ortiz et al. 2014; Smith et al. 2015) and appear to have been derived from the fertile tetraploid *K. ×houghtonii* Morphotype A (Shtein et al. 2021). In contrast, the cultivars *K. ×houghtonii* 'Hybrida', *K. ×houghtonii* 'Pink Butterflies', *K. ×houghtonii* 'Pink Teeth', *K. ×houghtonii* 'Pink Sparkler' and *K. ×houghtonii* 'Fujicho', were derived from the less invasive, sterile triploid *K. ×houghtonii* Morphotype B (Shtein et al. 2021).

Kalanchoe ×houghtonii is extraordinarily easy in cultivation and will grow in any soil type, no matter how poor, thin, waterlogged, or desiccated. The bulbils produced on the leaf margins become dislodged with great ease and will root where they are deposited. This nothospecies should not be grown in southern Africa and material should be destroyed where encountered.

Description.—Biennial to multiannual shrubs, unbranched or more rarely sparsely branched higher up usually when growing tip damaged, glabrous, small to medium-sized to, rarely, robust succulent, 0.5–0.8 m tall when in flower. *Stem* simple, erect or leaning and then curving upwards, light greenish brown. *Leaves* spreading, ± semi-erect when young, pointed down when old, often shed during flowering, then leaf scars contrasting white, sometimes hardly peltate with basal blade 'wings' at 90° angle to petiole, smooth, petiolate, uniformly light to dark green above, light greyish green to khaki green below and variously spotted with irregular purplish or brownish blotches, spots extending to petiole; petiole not amplexicaul, succulent, slightly grooved above, 25–30 mm long; blade 65–75 × 10–20 mm, lanceolate to somewhat hastate-elongated, folded upwards lengthwise, succulent; base ± cuneate, sometimes forming a 90° angle to petiole; apex attenuated, bluntly rounded; margins irregularly crenate, crenations slanted towards leaf tip, plantlets developing on short gutter-like flanges between the marginal crenations. *Inflorescence* a terminal, apically branched, many-flowered head-shaped thyrse, (50–)100 mm long; youngest buds often not developing, drying, abscising, leaving pedicellate branchlets;



FIGURE 9.—*Kalanchoe ×houghtonii* produces a multitude of bulbils on short, guttered pedicels along its leaf margins. Photograph: G.F. Smith.



FIGURE 10.—Plants of *Kalanchoe ×houghtonii* that struck root in a crack in a wall. Photograph: G.F. Smith.

peduncle 200–500 mm tall, $\pm$ straight, erect, light greenish brown, minutely purple-flecked; pedicels 5–7 mm long, glabrous. *Flowers* 28–32 mm long, pendent, glabrous, subtended by small bracts that soon shrivel, waxy bloom absent, papery when dry; buds twisted, light green, rapidly turning pinkish purple when approaching anthesis; calyx consisting of four sepals, tubular for lower $\pm \frac{1}{4}$ – $\frac{1}{3}$; sepals 9–11 mm long, shiny light to dull green, infused with purple, purple more prominent towards calyx base, sepal tips and margins, purple arranged in faint longitudinal lines, free portion short- to deltoid-triangular, fused for ± 3 –5 mm, acute-tipped, obscuring $\pm \frac{1}{3}$ of corolla tube; corolla tube 20–22 mm long, dull light pinkish purple to reddish purple, longitudinally faintly infused with yellow in centre of petal externally, longitudinally faintly infused with yellow in centre of petal, light green where obscured by calyx, yellowish inside, $\pm$ cylindrical to somewhat campanulate, flared at mouth; corolla lobes ± 9 –10 $\times$ 7–8 mm, dull light pinkish purple to reddish purple, obovate, apically rounded, minutely apiculate. *Stamens* eight, inserted well below middle of corolla tube at $\pm$ upper level of carpels, included or hardly exserted; filaments ± 20 mm long, thin, light purplish red in upper $\frac{3}{4}$, light green lower down; anthers ± 1 mm long, greyish black, hardly exserted. *Pistil* consisting of four carpels; carpels ± 6 mm long, shiny light to mid-green; styles ± 23 –25 mm long; *stigmas* very slightly capitate, creamy white; nectar scales $\pm$ rectangular, free, closely adpressed to base of carpels, apically curved away from carpels, 1 $\times$ 1.5 mm, slightly indented above. *Follicles* not recorded. *Seeds* not recorded. *Chromosome numbers*: $2n = 68$ (fertile tetraploid) (Resende 1956) or $2n = 51$ (sterile triploid) (Baldwin 1949; Resende 1956); the parents have $n = 17$ and $2n = 34$ in the case of *Kalanchoe daigremontiana* (Baldwin 1938, 1949; Sharma & Ghosh 1967) and $2n = 68$ in the case of *K. delagoensis* (Baldwin 1938, 1949 [as *K. verticillata* Scott Elliot]; Sharma & Ghosh 1967 [as *Bryophyllum tubiflorum* Harv.]; Friedmann 1971). Plate 2408.

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Kalanchoe longiflora

Crassulaceae: Kalanchooideae

South Africa

Kalanchoe longiflora Schltr. ex J.M.Wood in *Natal Plants* volume 4, part I: plate 320 (1903); Hamet: 26 [42] (1908); Jacobsen: 833 (1954, Abb. 769); Raymond-Hamet & Marnier-Lapostolle: 79; plate XXVIII, figures 92, 93 (1964); Jacobsen: 286 (1977); Tölken: 69 (1985); Jacobsen: 618 (1986); Descouings: 163 (2003); Smith: 145 (2005); Smith & Crouch: 85 (2009); Court: 91 (2010); Smith & Figueiredo: 124 (2017); Smith et al.: 310 (2017a); Smith et al.: 183–187 (2019); Smith & Van Wyk: 169, 198–199 (2019).

On 15 April 1891 material of *Kalanchoe longiflora* Schltr. ex J.M.Wood was collected for the first time by John Medley Wood (Mansfield, Nottinghamshire, England, 1 December 1827–26 August 1915, Durban, KwaZulu-Natal, South Africa) (Figure 1) between Greytown and Weenen in the present-day KwaZulu-Natal, southeastern South Africa. At the time, Wood was employed as curator, later director, of the Durban Botanic Gardens and earlier had also started what is today the KwaZulu-Natal Herbarium, then the Natal Herbarium (Gunn & Codd 1981; Schrire 1983; McCracken & McCracken 1990). Wood took living plants of *K. longiflora* to the herbarium where the material was cultivated and illustrated with a black-and-white line drawing for the *Natal Plants* serial publication, which appeared in six volumes between 1898 and 1912. The central Tugela River basin whence the material originated is botanically rich and, inter alia, host to a range of diverse vegetation types (Edwards 1967), and is included in the Maputaland-Pondoland Region of Endemism that predominantly falls within the borders of South Africa (Van Wyk & Smith 2001; Steenkamp et al. 2004).

It can be safely claimed that *Kalanchoe longiflora* is one of the most appropriately named southern African kalanchoes: the specific epithet was derived from the Latin words *longus* (= long) and *-florus* (= flowered), so referencing its long flowers (Figure 2). The corolla tubes can reach a length of 18 mm and the flowers themselves can be close to 20 mm long. Two other southern African species of *Kalanchoe* Adans. that have overall vegetative and reproductive morphologies reminiscent of those of *K. longiflora*, i.e., *K. leblanciae* Raym.-Hamet (illustrated for *Flowering Plants of Africa* by botanical artist Gillian Condry, see Smith et al. 2017b) and *K. sexangularis* N.E.Br. (illustrated for *The Flowering Plants of Africa* by botanical artist Rosemary Holcroft, see Tölken 1983), have flowers that, at most, reach a length of 13 mm and 18 mm, respectively. Note though that the flowers of *K. longiflora* are still considerably shorter than those of the East African *K. marmorata* Baker and *K. bentii* C.H.Wright ex Hook.f., both of which have rather dull-coloured, whitish flowers, of up to 125 mm and 40 mm long, respectively.

The comparatively large, colourful flowers of *Kalancho longiflora* – the corolla tubes are shiny, greenish yellow and the adaxial surface of the corolla lobes are bright yellow (Figure 3) – as well as the turquoise, orange- to pinkish-infused leaves (Figure 4) have no



PLATE 2409 *Kalanchoe longiflora*

doubt contributed to the present-day popularity of this species in both domestic gardening and even in industrial-scale landscaping (Smith 2020a, 2021). The common names of *K. longiflora* are derived from its turquoise to sea-green leaf colour (Figure 5); in Afrikaans it is known as *seeplakkie* and in English as turquoise kalanchoe. As in the case of the vast majority of southern African kalanchoes, the flowering of *K. longiflora* peaks in July and August (winter in the southern hemisphere). However, the species has a long flowering season and some clones may start flowering as early as February (late summer) and others produce flowers as late as November (early summer). Notably, in the protologue of the name *K. longiflora*, Wood (1903) stated that plants bear their ‘... flowers profusely during the summer months’. Some variation in the flowering period of this species is therefore evident, making it a useful addition to any garden.



FIGURE 1.—John Medley Wood (1827–1915), doyen of KwaZulu-Natal botany from the early 1880s to mid-1910s, collected material of *Kalanchoe longiflora* on 15 April 1891 between Greytown and Weenen. Photographer unknown. Photograph © of the South African National Biodiversity Institute. Reproduced with permission.

After Wood collected material of *Kalanchoe longiflora* in 1891, the name eventually appeared in print 12 years later, along with the undated line drawing prepared for *Natal Plants*. The drawing, which was published as Plate 320, was done by Millicent Franks (1888–1961), who signed her artwork as ‘M.F.’ (Gunn & Codd 1981). In 1901 the then 13-year-old Franks (later Flanders) was appointed as assistant to Wood (Figueiredo & Smith 2021). In 1903, when she was 15 years old, she became contributing artist to *Natal Plants*. In this role she succeeded Wanda Marie Frieda Lauth (later Floyd) (1879–1949) who had been appointed as assistant to Wood in the Natal Herbarium when she was 16 years old. Despite the description of *K. longiflora* having been accompanied by a well-executed drawing – at the time not many authors of plant names could afford the services of an artist – the identity of *K. longiflora* remained obscure for several decades. It was to be a further more than 60 years before Raymond-Hamet & Marnier-Lapostolle (1964) substantially described and illustrated *K. longiflora* (with black-and-white photographs). Raymond-Hamet was the undisputed global expert on *Kalanchoe* during the 20th century (Smith 2020b). Eight years later Ross (1972) recorded the species in his *Flora of Natal* (now the KwaZulu-Natal province of South Africa).

For most of the 20th century, the subject of this treatment was often taxonomically confused with what is now known to be *Kalanchoe sexangularis* (Figueiredo et al. 2016), the name of which was also overlooked for a long time, until Fernandes (1982, 1983) drew attention to it. Especially through the circulation among collectors of a designation ‘*K. longiflora* Schltr. ex J.M.Wood var. *coccinea* Marn.-Lap.’ (see Smith & Figueiredo 2017: 122, 126), *K. longiflora* was thought to include a red-leaved variant (see, for example, Newton &



FIGURE 2.—The flowers of *Kalanchoe longiflora* are some of the longest in the genus in southern Africa. The inflorescences are borne erectly to leaning and are generally sparsely to subdensely flowered. Photograph: G.F. Smith.



FIGURE 3.—The flowers of *Kalanchoe longiflora* have long, shiny, greenish yellow tubes and yellow lobes. Photograph: G.F. Smith.

Mbugua 1993), which is in fact *K. sexangularis*, a related, but different species. Julien Marnier-Lapostolle (Nice, Alpes-Maritimes, France, 24 May 1902–12 June 1976, Saint-Jean-Cap-Ferrat, Alpes-Maritimes, France) (Anonymous 1976; Demoly 1999) (Figure 6), to whom the designation *K. longiflora* var. *coccinea* is attributed, had more than a passing interest in *Kalanchoe* and cultivated a large collection of this genus and other succulents and bromeliads in his world-renowned private Jardin Botanique, 'Les Cèdres', on the French Côte d'Azur at Saint-Jean-Cap-Ferrat (Smith & Figueiredo 2013) (Figure 7). However, Marnier-Lapostolle is not known to have validly published nomenclatural novelties in *Kalanchoe*. The description included in Jacobsen (1977) for *K. longiflora* var. *coccinea* states: '[L]eaves plicate, margins coarsely dentate, salmon-coloured to scarlet in full sun', and clearly applies to the often intensely red-leaved *K. sexangularis*, and not to *K. longiflora*. The designation *K. longiflora* var. *coccinea*, therefore, is associated with *K. sexangularis* and not with *K. longiflora* (Figueiredo et al. 2016).

A further source of confusion surrounding application of the name *Kalanchoe longiflora* was the appearance of the designation '*K. petitiana* var. *salmonea* Hort.' in print. Jacobsen (1954, 1986) placed this 'name' under *K. longiflora*; however, where the designation might have been validly published before it was included in Jacobsen (1954) could not be traced and it was likely used informally in horticultural circles only. A further designation, '*K. peti-*

tiana Hort.', which was also listed by Jacobsen (1986) under '*K. longiflora* var. *coccinea*', is based on a comment included in Raymond-Hamet & Marnier-Lapostolle (1964) where they refer to a small plant with dense, bright red leaves that was commonly found in florist shops, either as unnamed specimens, or labelled '*K. petitiana*'. However, Raymond-Hamet & Marnier-Lapostolle (1964) concluded that this kalanchoe was not at all related to true *K. petitiana* A.Rich., a very different and accepted East African species (Descoings 2003), and in fact represented *K. longiflora*, or, as *K. longiflora* is presently circumscribed, *K. sexangularis*.



FIGURE 4.—Especially in full sun, the sea-green to turquoise leaves of *Kalanchoe longiflora* are distinctly orange-infused. Photograph: G.F. Smith.

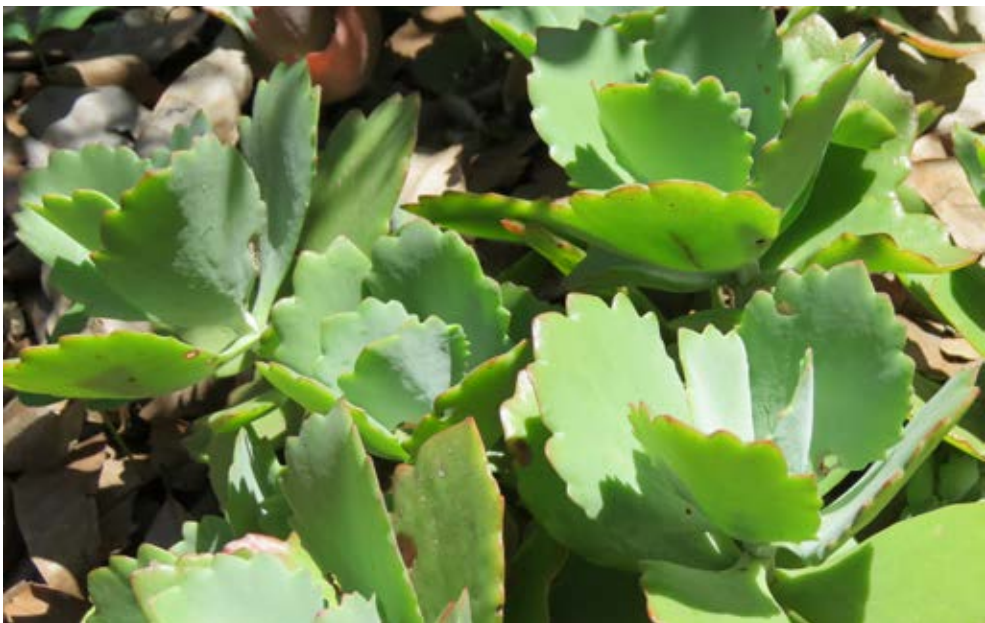


FIGURE 5.—In dappled shade the characteristically sea-green to turquoise leaves of *Kalanchoe longiflora* are less chromatic. The leaf blades are generally not longitudinally folded. Leaf margins are dentate with rounded to harmlessly pointed crenations. Photograph: G.F. Smith.



FIGURE 6.—Julien Marnier-Lapostolle (1902–1976) (right) and Marcel Kroenlein (left), ca. 1974. Marnier-Lapostolle had a strong interest in the genus *Kalanchoe*. Kroenlein (20 April 1928–5 August 1994) was the director of the Jardin Exotique de Monaco from 1969 to 1993. Photograph probably taken by Prof. Dr Werner Rauht. Foto Heritage W. Rauht – © W. Barthlott. Reproduced with permission.

The designation '*Kalanchoe longiflora* var. *genuina* Raym.-Hamet' was not validly published, although it was listed in Ross (1972). Intraspecific names such as '*genuinus*' that aim to indicate the taxon containing the type of the name of the next higher taxon (in this case a species) are not validly published unless they are autonyms (Turland et al. 2018, Art. 24.3). '*Kalanchoe longiflora* var. *genuina*' is therefore not a name in the sense of the *International Code of Nomenclature for algae, fungi and plants* (Turland et al. 2018, Art. 6.3).

In summary, amid all the nomenclatural and taxonomic confusion, *Kalanchoe longiflora*, therefore, does not have any synonyms. This is uncommon in groups of plants, such as succulents, that appeal to collectors. *Kalanchoe* is here regarded as consisting of four subgenera: the geographically widespread, autonymic *K.* subg. *Kalanchoe*; as well as *K.* subg. *Alatae* (Gideon F.Sm.) Gideon F.Sm., *K.* subg. *Bryophyllum* (Salisb.) Koord., *K.* subg. *Kitchingia* (Baker)



FIGURE 7.—Julien Marnier-Lapostolle (1902–1976) cultivated a large collection of kalanchoes in his world-renowned private Jardin Botanique, 'Les Cèdres', on the French Côte d'Azur at Saint-Jean-Cap-Ferrat, France. This is only one of numerous plant-filled greenhouses maintained at 'Les Cèdres'. Photograph: G.F. Smith.

Gideon F.Sm. & Figueiredo, and *K.* subg. *Calophygia* Desc. emend. Gideon F.Sm. (often in the past referred to as the Malagasy ‘woody clade’), all four of which are endemic to Madagascar. *Kalanchoe longiflora*, the subject of this paper, is included in *K.* subg. *Kalanchoe*.

Tölken (1978: 91) noted that: ‘This species [*Kalanchoe rubinea*, i.e., *K. sexangularis*], which is widely used in horticulture, was always confused with *K. longiflora*, an endemic species of central [KwaZulu-] Natal.’ Apart from having similar floral morphologies, both species are more or less low-growing shrublets with often weak, angled stems and more or less flat (*K. longiflora*) or longitudinally folded (*K. sexangularis*) leaves with scalloped margins. While *K. sexangularis* is usually slightly or even significantly taller growing than *K. longiflora*, the latter species is easy to distinguish from *K. sexangularis* given the characteristic sea-green to turquoise leaf colour of *K. longiflora*. In the case of *K. sexangularis* leaf colour ranges from a red-infused and mid-green to intensely, bright wine-red, especially during times of environmental stress, such as low temperatures and water availability. The leaves of *K. longiflora* are obovate to nearly orbicular (Figures 4 and 5), while those of *K. sexangularis* are broadly elliptic or obovate to oblong, and recurved in the upper half. In terms of the range of different growth forms found in *Kalanchoe*, Smith et al. (2023) included both *K. longiflora* and *K. sexangularis* in ‘Group 3. Small to medium-sized, herbaceous shrublets with ‘hard’ stems’.

The natural geographical distribution range of *Kalanchoe longiflora* is restricted to the central Tugela River basin in KwaZulu-Natal (Figure 8), with this limited range in the KwaZulu-Natal Midlands of South Africa having been long established. Although Retief & Herman (1997) listed *K. longiflora* as occurring in the northern provinces of South Africa, this was based on an obvious misidentification (Smith & Figueiredo 2021). From a conservation perspective, *K. longiflora* is included in the ‘Vulnerable’ category (IUCN 2012) and is one of six southern African kalanchoes regarded as of conservation

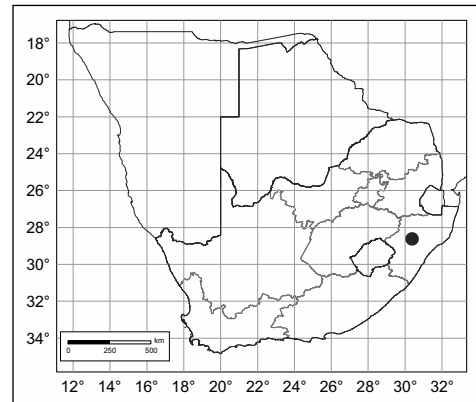


FIGURE 8.—Natural geographical distribution range of *Kalanchoe longiflora* in South Africa.



FIGURE 9.—These rooted cuttings of *Kalanchoe longiflora* have been bulked up in plant containers and are ready for use in large-scale landscaping projects. Photograph: G.F. Smith.



FIGURE 10.—A cluster of low-growing *Kalanchoe longiflora* shrublets planted as a groundcover. Plants of the pale-leaved *Graptopetia* 'Fantome', in the vernacular known as the Mexican snowball, grow in the right foreground. Photograph: G.F. Smith.



FIGURE 11.—The leaves of this variant of *Kalanchoe longiflora* are a light blue, nearly white, colour. The stems of *K. longiflora* are distinctly four-angled, here clearly visible in the plant in the centre. Photograph: G.F. Smith.



FIGURE 12.—A selection of potted kalanchoes, including *Kalanchoe longiflora* (center, left), grown together with other plants in a commercial nursery in Marrakech, Morocco. The red-flowered plants in the right foreground are selections of the horticulturally popular, Malagasy *K. blossfeldiana* Poelln. Photograph: E. Figueiredo.

concern. However, given that *K. longiflora* is very common in cultivation, chances that it will ever become extinct are very slim, but its natural habitat should be monitored to determine any decline in the occurrence of the species (Smith et al. 2022).

Along with *Kalanchoe luciae*, *K. sexangularis* and *K. thyrsiflora*, *K. longiflora* is one of the most commonly cultivated indigenous kalanchoes in southern Africa. *Kalanchoe longiflora* is easy to grow from stem cuttings that root easily in virtually any soil type (Figure 9). The beautiful orange- to pinkish-infused, turquoise to sea-green leaf colour appears at its best in full sun, for example where it is used as a groundcover in exposed beds (Figure 10). However, the species will also thrive in semi- and even in deep shade. Especially in shaded positions a somewhat larger-growing, light blue-leaved variant is perfect for planting in a white garden (Figure 11). When grown in full sun, the fairly short-stemmed plants remain more compact and when planted in dense groups will rapidly form a unicoloured backdrop of even height. Material of *K. longiflora* is today widely available in the horticultural trade in many mild-climate parts of the world (Figure 12).

Description.—Perennial, few-leaved, sparsely branched, glabrous, medium-sized, succulent shrub, 0.2–0.4 m tall. *Stems* few, unbranched or sparsely branched, somewhat brittle, erect to leaning to creeping, distinctly 4-angled, sea-green to turquoise, orange- to pink-infused, surface white-flakey. *Leaves* succulent, opposite, erect, petiolate to subpetiolate to cuneate, sea-green to turquoise, strongly infused with orange or pink, never red; petiole

2–10 mm long when present; blade 40–70 × 40–70 mm, obovate to nearly orbicular, slightly incurved along margins, somewhat spatulate; base cuneate; apex rounded-obtuse; margins scalloped into rounded, harmless, patelliform teeth; teeth becoming smaller to obsolescent towards leaf base. *Inflorescence* an erect, sparsely to sub-densely flowered, ± flat-topped thyrse consisting of several open dichasia, to 500 mm tall; peduncle densely or sparsely covered in large, succulent bract-like leaves the same colour as the leaves; pedicels 10–18 mm long. *Flowers* to 20 mm long, erect; calyx consisting of four sepals; sepals 3–4 mm long, elongated-triangular, acute, succulent, mid-green, sometimes infused with orange towards tip; corolla tube 15–18 mm long, shiny, greenish yellow; elongated-urceolate, cylindrical-quadrangular, enlarged lower down, tapering to the tip, distinctly 4-angled; corolla lobes 4–5 × 4–5 mm, bright yellow, round to broadly obovate, with shallow longitudinal furrow, apiculate. *Stamens* inserted $\frac{3}{4}$ up corolla tube, hardly exserted; filaments 4–5 mm long, greenish yellow, thin; anthers 0.4–0.5 mm long, yellowish brown. *Pistil* consisting of 4 carpels; carpels 10–11 mm long, light green; styles 5–7 mm long; stigmas very slightly capitate, yellowish green; nectar scales ± 4 mm long, linear, yellowish green. *Follicles* 10–11 mm long, brittle, grass spikelet-like, enveloped in dry, reddish brown remains of corolla, drying greyish black. *Seeds* 0.50–0.75 mm long, brown, urceolate to banana-shape-curved. *Chromosome number*: $2n = 34$ (Baldwin 1938; however, this count may refer to *K. sexangularis*, see Smith 2022). Plate 2409.

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PLATE 2410 *Kalanchoe waterbergensis*

Kalanchoe waterbergensis

Crassulaceae: Kalanchooideae

South Africa

Kalanchoe waterbergensis van Jaarsv. in Bradleya 35: 169 (2017); Peckover: 190 (2020); Smith & Figueiredo: 218 (2021); Smith et al.: 175 (2021); Smith et al.: 189 (2022); Wadley et al.: 81 (2021).

By far the majority of the species of *Kalanchoe* Adans. that are indigenous to South Africa occur in the eastern third of the country, east of the Drakensberg massif. This is an essentially mild-climate, summer-rainfall region from which three biomes, Savanna, Grassland and Indian Ocean Coastal Belt, have been recorded (Rutherford et al. 2006d). Structurally, the easiest of these to visually identify are Savanna and Grassland. Savanna – broadly speaking *bosveld* or ‘bushveld’ in the South African vernacular – is the dominant land cover in sub-Saharan Africa, teem with wildlife, and is an essentially tropical vegetation type in which significant components of varying height are comprised of a diverse range of tree, grass and forb species (Scholes & Walker 1993; see also Bond [2019] for a discussion of what are termed ‘open ecosystems’, i.e., non-forested ecosystems; and McKenzie [2022] for a general discussion of the bushveld) (Figure 1). Especially the Savanna Biome, as present in South Africa’s KwaZulu-Natal and Mpumalanga provinces in the east of the country, as well as in neighbouring Eswatini, is host to the highest concentration of indigenous kalanchoes (Smith & Figueiredo 2021; Smith 2022), as well as naturalised ones, for that matter (Walters et al. 2011).

In the diversity of different vegetation units recognised in the Savanna Biome (Rutherford et al. 2006a), kalanchoes, all of which are small to medium-sized at reproductive maturity, tend to grow on rocky outcrops and rock-strewn *koppies*, often in the dappled shade provided by bushveld trees. However, plants can also be found growing in dense shade or in completely exposed positions. These habitats are typically mesic to dry, or the sites are at least locally dry in areas that receive high rainfall.

Some kalanchoes, notably *Kalanchoe thyrsiflora* Harv., which was the first kalanchoe to be illustrated in the then *The Flowering Plants of South Africa* (Phillips 1929), also occur widely in the Grassland Biome, for example on the climatically more severe high lying areas of central and northern South Africa. However, the kalanchooid flora present in grasslands in general is more depauperate than that found in savanna (Smith & Figueiredo 2021; Smith 2022).

Like most kalanchoes, *Kalanchoe waterbergensis*, the subject of this paper, is a typical bushveld species (Figure 2). As its name implies, *K. waterbergensis* occurs naturally in the Waterberge in northern South Africa, to which it is endemic (Figure 3). The Waterberge, an

PLATE 2410.—1, flowering stem, × 1; 2, inflorescence, × 1; 3, cluster of plants, × 1; 4, lateral view of flower, × 3; 5, apical view of corolla lobes (adaxial surface), × 3. Voucher specimen: G.F. Smith & E. Figueiredo 90 in H.G.W.J. Schweickerdt Herbarium (PRU), Pretoria. Artist: Lesley Deysel.



FIGURE 1.—Conservation areas in South Africa's Savanna Biome, including in the Waterberge, teem with wildlife. Photograph: E. Figueiredo.



FIGURE 2.—A stand of *Kalanchoe waterbergensis* at R[h]enosterpoort, Jan Trichardt Pass, in a densely shaded habitat in the Waterberge. At this location the grasses and forbs grow sparsely under the canopies of deciduous trees. Plants of *K. waterbergensis* of various ages are present in this population. Photograph: G.F. Smith.

Afrikaans name that means 'water mountains', was so named for the abundance of water in the area – several rivers, such as Nylstroom, and the Mokolo and Palala rivers, and several springs, such as the famous hot one at Bela Bela, have their sources in the region (Raper et al. 2014). In this contribution the plural, 'Waterberge', is officially used for the region in question to so distinguish it from the 'Waterberg' (singular) used for a plateau in the Otjiwarongo district in Namibia.

Van Wyk & Smith (2001) mentioned and recognised the floristic significance of the Waterberge but did not treat it as a centre of endemism. The Waterberge fall entirely within the Savanna Biome (Rutherford et al. 2006a) and exclusively in the Limpopo province of South Africa. Thus far our species has been recorded from two vegetation units in the Savanna Biome: Central Sandy Bushveld (Rutherford et al. 2006b) and Waterberg Mountain Bushveld (Rutherford et al. 2006c).

The recent reinstatement of *Kalanchoe decumbens* Compton for a distinctive species from Eswatini and northeastern KwaZulu-Natal (Smith 2021), as well as the description of *K. waterbergensis* (Van Jaarsveld 2017), *K. klopperæ* Gideon F.Sm. & Figueiredo (Smith & Figueiredo 2022a), *K. gideonsmithii* N.R.Crouch & Figueiredo (Crouch & Figueiredo 2022) and *K. krigeae* Gideon F.Sm. & Figueiredo (Smith & Figueiredo 2023) have highlighted the need to split *K. rotundifolia* (Haw.) Haw. into discreet, well-defined species. As taxonomically interpreted until recently, *K. rotundifolia* was by far the morphologically most diverse kalanchooid species recognised in South Africa (Figueiredo & Smith 2017; Smith & Figueiredo 2017, 2022b). This exceedingly widespread species occurs from the Eastern Cape province of South Africa northwestwards into Namibia and northeastwards into East Africa and to the island of Socotra off the east coast of Africa. In terms of vegetative morphology, it has an overall leaf shape that varies little from oblong-elliptic to elliptic-obovate. In contrast, while leaf shape in *K. waterbergensis* can also be oblong-elliptic to elliptic-obovate, the leaves of this species tend towards often rather being somewhat rhombic in outline (Figure 2). The leaf margins of *K. rotundifolia* are most often concolorous and only sometimes, for example in the case of material from around Tshwane, adorned with a whitish rim, while the leaf margins of *K. waterbergensis* are commonly white to creamy white (Figure 4). Furthermore, unlike the basally cuneate leaves of *K. rotundifolia*, the leaf bases of *K. waterbergensis* are distinctly auriculate (Figure 5). The leaves of *K. waterbergensis* are arranged in a single plane (Figure 2), a feature only occasionally found in some forms of *K. rotundifolia*, for example in material from near Steytleville in South Africa's Eastern Cape province.

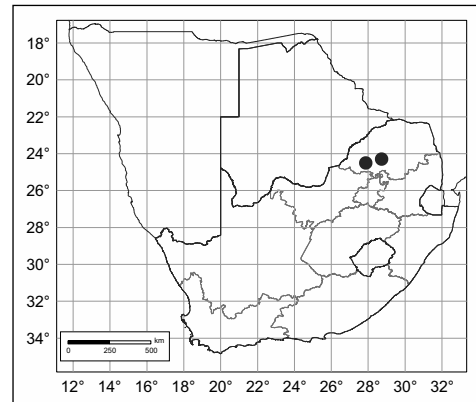


FIGURE 3.—Known geographical distribution range of *Kalanchoe waterbergensis* in South Africa.

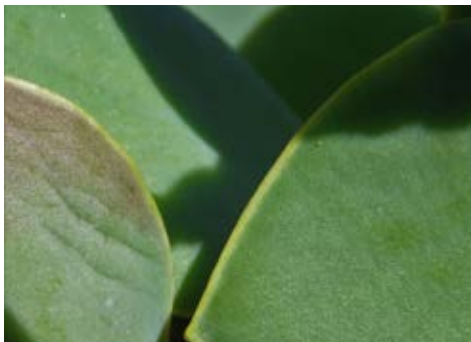


FIGURE 4.—Leaf margins of *Kalanchoe waterbergensis* are adorned with a whitish rim. Photograph: G.F. Smith.



FIGURE 5.—Leaf bases of *Kalanchoe waterbergensis* are distinctly auriculate. Photograph: G.F. Smith.



FIGURE 6.—Flowers of *Kalanchoe waterbergensis* are borne erectly in small clusters. Photograph: G.F. Smith.

Reproductively, *Kalanchoe rotundifolia* has small flowers of which the adaxial surface of the corolla lobes is uniformly red to uniformly dull orange. The flower tubes are abruptly narrowly urceolate above the ovary and the sepals of this species are usually tiny and hardly contrast against the lower portion of the usually green-infused corolla tube. As with *K. rotundifolia*, the flowers of *K. waterbergensis* are borne erectly in small clusters (Figure 6) and, in general morphology, have a very similar urceolate shape (Figure 7). However, the adaxial surface of the corolla lobes of *K. waterbergensis* is bright orange-red (Figure 8), and its sepals are prominent and can reach a length of 7 mm. The sepals are therefore most often as long as, or even slightly longer than, the basally swollen part of the corolla tube at the level of the ovary. Of the ‘rotundifolia’-like species, the yellow-flowered *K. alticola* Compton is thus far the only other one with such prominent sepals.



FIGURE 7.—Comparison of the flowers, in lateral view, of *Kalanchoe rotundifolia* from Kariega in the Eastern Cape, South Africa (left), *K. rotundifolia* from Zingela in KwaZulu-Natal, South Africa (centre), and *K. waterbergensis* (right). Note the length of the sepals in the case of *K. waterbergensis*. Photograph: G.F. Smith.



FIGURE 8.—Comparison of the adaxial surface of the corolla lobes of *Kalanchoe waterbergensis* (left), *K. rotundifolia* from Zingela in KwaZulu-Natal, South Africa (second from left), *K. rotundifolia* from Kariega in the Eastern Cape, South Africa (second from right), and *K. decumbens* (right). *Kalanchoe decumbens* from Eswatini and northeastern KwaZulu-Natal is a further species with a ‘rotundifoliod’ growth form but its corolla lobes tend to be more ovate to elliptic in outline, while those of *K. rotundifolia* and *K. waterbergensis* are usually much narrower and often subfalcate. Photograph: G.F. Smith.

Apart from *Kalanchoe waterbergensis*, seven other *Kalanchoe* species occur in the Waterberge (Smith & Figueiredo 2021). These are *K. brachyloba* Welw. ex Britten, *K. lanceolata* (Forssk.) Pers., *K. luciae* Raym.-Hamet, *K. paniculata* Harv., *K. rotundifolia*, *K. sexangularis* N.E.Br. and *K. thyrsiflora* (Smith & Figueiredo 2021). Both *K. paniculata* and *K. rotundifolia* have been found occurring very closely sympatrically with *K. waterbergensis*, with, in their natural habitat, these three species often growing literally only a few centimetres apart. However, hybrids with *K. waterbergensis* have yet to be recorded. All the *Kalanchoe* species indigenous to South Africa are included in the autonymic *K.* subg. *Kalanchoe* (Smith & Figueiredo 2018; Smith et al. 2019).

Kalanchoe waterbergensis flowers in the comparatively dry autumn and winter months, from March to July, peaking from May to June (southern hemisphere).

Kalanchoe waterbergensis is not threatened and included in the Red List category ‘Least Concern’ (Smith et al. 2022).

Kalanchoe waterbergensis is very easy in cultivation and does well in both containers and in open beds. It is easy to germinate seed by simply shaking the dust-like seed held in dry follicles onto a seedling tray filled with a well-drained soil mixture. Seed also germinate easily and profusely in the natural habitat of the species (Figure 9). Plants can also be propagated by stem cuttings that easily strike root. Again, make sure that the soil mixture in which the cuttings are rooted is well-drained. In the case of several *Kalanchoe* species, the development of roots is not restricted to the nodes as is commonly found in stem succulents. Rather, roots will also develop along the length of the internodes (Figure 10).

Description.—Perennial or biennial, few-leaved, unbranched or sparsely branched, glabrous, small, low-growing succulent, to 0.5 m tall when in flower. Roots thin, fibrous.



FIGURE 9.—In the natural habitat of *Kalanchoe waterbergensis* in the Waterberge seed germinate profusely, especially in niches where shade is initially provided by tuft grasses and fallen leaves. Photograph: G.F. Smith.



FIGURE 10.—A rooting cutting of *Kalanchoe waterbergensis*. Note that roots develop from nodes as well as along the internodes. Photograph: G.F. Smith.

Stems 3–4 mm in diameter, glaucous green with a slight bloom, few, erect, often with sterile, small-leaved branchlets at the base. *Leaves* opposite-decussate, initially subrostrate, uniformly pale glaucous green to purple-infused, covered in a slight bloom, succulent, erect to slightly spreading in a single plane, dense low down on stem and branches, more widely spaced and becoming smaller higher up; petiole absent; blade 45–50 × 26–28 mm, oblong-elliptic to elliptic-obovate, to somewhat rhombic, flat, straight; base cuneate, auriculate; apex ± acute-tipped, minutely mucronate; margins yellowish white, entire. *Inflorescence* a thyrses terminating in several dichasia, 250–350 mm tall, erect, floriferous only apically, sparsely branched, rather few-flowered, round in outline when viewed

from above, branches opposite, subtended by small leaf-like bracts that soon dry, without leafy branchlets in axils; peduncle bluish green; pedicels 3–10 mm long, slender. *Flowers* 8–18 mm long, erect, usually bicoloured; calyx consisting of 4 sepals, covered with a slight to dense bloom; sepals $\pm 4\text{--}7 \times 1.0\text{--}1.5$ mm, bluish green, narrowly elongated-triangular, $\pm$ separate, basally fused for ± 0.5 mm, acute, somewhat contrasting against orange-green lower part of corolla tube, apically cat claw-like incurved; corolla tube 7–16 mm long, bright orange-red in distal $\frac{3}{4}$, usually gradually becoming green in proximal $\frac{1}{4}$, distinctly urceolate, distinctly and strongly globose-enlarged lower down around carpels, rounded-4-angled to somewhat box-shaped-square when viewed from below, longitudinally narrowing above carpels, distinctly and tightly twisted apically before and after anthesis; corolla lobes $5\text{--}6 \times 2.0\text{--}2.5$ mm, bright orange-red, narrowly lanceolate, distinctly acute apically, subfalcate, spreading to distinctly recurved, showing diurnal movement (closing at night). *Stamens* inserted in two ranks at and just below the middle of the corolla tube, included; filaments 3–5 mm long, thin, yellow; anthers 0.3–0.5 mm long, yellow. *Pistil* consisting of 4 carpels; carpels 4–6 mm long, shiny mid-green; styles 1.0–1.5 mm long; stigmas very slightly capitate, yellowish green; scales 2.0–3.5 mm long, linear, light yellowish. *Follicles* (5–)6–8 mm long, light to mid-green at first, later brittle, grass spikelet-like, tightly enveloped in dry, whitish purple remains of corolla. *Seeds* 0.75–0.80 mm long, reddish brown to dark brown, cylindrical to slightly D-shaped, obscurely longitudinally striped. *Chromosome number*: unknown. Plate 2410.

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Senna italica subsp. *arachoides*

Fabaceae: Caesalpinioideae

*Angola, Botswana, Eswatini, Mozambique,
Namibia, South Africa, Zimbabwe*

***Senna italica* Mill. subsp. *arachoides* (Burch.) Lock** in Brummitt et al. *Flora Zambesiaca* 3: 156 (2007). *Cassia arachoides* Burch.: 341 (1822); Harvey: 272 (1862). *Cassia italica* (Mill.) Spreng. subsp. *arachoides* (Burch.) Brenan: 242 (1958). *Cassia obovata* Collad.: t. 15A (1816); Oliver: 277 (1871).

Admired for their clusters of showy yellow flowers and eye-catching foliage and pods, many exotic species of *Cassia* L. and *Senna* Mill. are grown as ornamentals in South Africa (Glen 2002; Johannsmeier 2016). In southern Africa only *Senna italica* subsp. *arachoides* and *S. petersiana* (Bolle) Lock are indigenous, with another 12 species naturalised, seven of which have become invasive in the region (BODATSA 2022).

Both *Cassia* and *Senna* are economically important members of the Fabaceae (also known as the Leguminosae), commonly referred to as the pea family. They belong to the Caesalpinioideae or peacock flower subfamily, which now includes subfamily Mimosoideae and is one of six subfamilies in the Fabaceae (LPWG 2017). The Fabaceae has $\pm$ 770 genera and $\pm$ 19 500 species (LPWG 2017) and it is among the three largest plant families in the world. In its broadest sense, *Cassia* ranked among the 25 largest genera of dicotyledonous plants globally (Acharya et al. 2011) as it contained $\pm$ 600 species, including those in its subgenera *Senna* and *Chamaecrista* (L.) Moench. The three subgenera were circumscribed as genera by Irwin & Barneby (1982), and together make up the subtribe Cassiinae (Irwin & Barneby 1982; Acharya et al. 2011). *Cassia* now has 37 species, *Chamaecrista* 365 species and *Senna* 282 species (POWO 2022). Globally, most *Cassia* species have been transferred to *Senna* by Irwin & Barneby (1981) and Lock (1988) reclassified the species in Africa based on their generic concepts. Lock (1988) features a simplified version of Irwin & Barneby's (1981) key with diagnostic characters for *Cassia* and *Senna*. Of the 12 *Cassia* species indigenous to southern Africa, nine were placed in *Chamaecrista*, two in *Senna* and one species (*Cassia abbreviata* Oliv.) was retained in the new generic concept of *Cassia* (Lock 1988).

Senna and *Chamaecrista* can be broadly separated from *Cassia* by their petioles with nectar glands (seldom absent) and their lowermost filaments that are straight or slightly curved (Frank 2018). In *Cassia* the petioles lack nectar glands and the lowermost filaments are curved in a distinct sigmoid or S-shape. *Senna* can be separated from *Chamaecrista* by the absence of bracteoles, glabrous anthers and ovate-oblong seeds. *Chamaecrista* has two bracteoles, anthers covered with minute hairs and seeds rhombic or sub-rhombic (Irwin & Barneby 1982; Lock 1988).

Senna italica was first described in 1768 by Philip Miller (1691–1771), an English horticulturalist and botanist, famous for his work, *The Gardener's Dictionary*, which was published



PLATE 2411 *Senna italica* subsp. *arachoides*

from 1731 to 1768. Similar to *Flowering Plants of Africa* for African plants, Miller's *Dictionary* 'not only covered methods of cultivation, but also provided a systematic botanical compendium of all wild-growing and cultivated plants in Britain then known'. (JSTOR 2022). Miller (1768) segregated the plants first described by Linnaeus (1753) into *Senna* and *Cassia* based on plants with ten stamens and one style. He also referred to two different forms in *S. italica* – one from Egypt and the other from India. Brenan (1958), 190 years later, split *C. italica* (formerly placed in *Senna*) into three subspecies: *C. italica* subsp. *arachoides*, *C. italica* subsp. *italica* and *C. italica* subsp. *micrantha* (Brenan) Lock based on length of petioles, leaf size, length of racemes, flower size, indumentum and distribution range. The characters used to separate subspecies *italica* and *micrantha* were found to overlap in plants in India, and the character that best distinguishes the two subspecies is the raceme (up to fruiting) that is shorter than the leaves in subsp. *micrantha* (Singh 2001). Subspecies *arachoides* has a short, sparse, spreading indumentum and relatively short petioles. A number of regional African Floras (Brenan 1967; Gordon-Gray 1977; Thulin 1993; Brummitt et al. 2007) followed Brenan's (1958) infraspecific classification of *C. italica*.

Senna is derived from the Arabic word *sana* for plants having laxative leaves and pods (Gledhill 2008) and was used by Linnaeus (1753) for the medicinal species *Cassia senna* L. (now *S. alexandrina* Mill.). The epithet *italica* means 'from Italy' although the species does not occur there naturally and possibly became known through trade by the Roman Empire with Egypt and India. The name *arachoides* is from Burchell's (1822) association of the plant form of *Cassia arachoides* to the legume, *Arachis hypogaea* L. (peanut plant) in his description, where he used *Arachidis hypogaea* instead, which is gender correct for the genus name (Drobnik 2021). He based his description on a specimen (*Burchell 1680* in K), which he collected in Kloof Village on the Asbestos Mountains in Griqualand West (Northern Cape) on 25 September 1811. *Senna italica* subsp. *arachoides* is known as eland's pea although many other names are used in South Africa. It is also referred to as eland's senna, wild senna, Italian senna, and *elandsertjie*, *swartstorm*, *swartstormbossie*, *kalwerbossie*, *grondboontjie* and *wilde ertjies* (Afrikaans) (Kyffhäuser 2020). The Zulu name is *impengu* (Hutchings 1996).

Senna is a genus of trees, shrubs or subshrubs (sometimes referred to as herbaceous) and occurs throughout America, Africa and Australia, as well as the Middle East, Asia and Pacific Islands (Irwin & Barneby 1982). *Senna italica* has a wide distribution range, from South Africa northwards, through Africa and the Middle East to western Asia (Pakistan and India) (Brenan 1958; POWO 2022). It is noted as extinct in Socotra but has been introduced into areas in Columbia, Venezuela and the Caribbean Islands, as well as in Benin, Transcaucasia and Uzbekistan (POWO 2022). The species is identified by its oblong to broadly obovate leaflets and characteristic pods with little crests along the middle of each valve (Brenan 1958; WFO 2023).

On the African continent, *Senna italica* subsp. *italica* occurs in northern Africa while *S. italica* subsp. *micrantha* occurs from northern Botswana and Namibia into central and east Africa. *Senna italica* subsp. *arachoides* has a narrower range, occurring in southern Africa and Angola (Figure 1). In South Africa, the subspecies is common in KwaZulu-Natal, Free State, Gauteng, Limpopo, Northern Cape and North West. It is Red-Listed as Least Concern by Foden & Potter (2005). It is also common in Botswana, Eswatini and Namibia (although absent from Lesotho), and, further north, it enters into southern Angola,

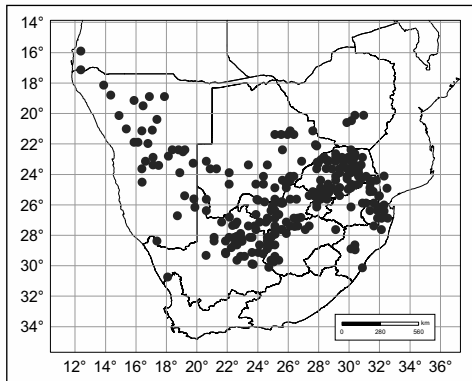


FIGURE 1.—Known geographical distribution of *Senna italica* subsp. *arachoides* in southern Africa, and just entering into Angola (BODATSA 2022).

Mozambique and Zimbabwe. There is some overlap with subspecies *micrantha* in Botswana and Namibia, and one specimen (De Winter & Leistner 5756 in PRE) with intermediate characters suggests hybridisation is possible between the subspecies (Gordon-Gray 1977). A number of herbarium specimens from different countries in Africa are identified as *S. italica* subsp. *arachoides* in BODATSA (2022) and their data lack latitude and longitude coordinates. It is likely that the specimens in countries north of Angola, Botswana, Mozambique and Zimbabwe belong to one of the two other subspecies of *S. italica* and will need to be confirmed through a taxonomic study.

Senna italica subsp. *arachoides* occurs in open areas in the Savanna Biome at altitudes of 45–1 500 m a.s.l. and is also found in exposed, disturbed areas along roadsides and old cultivated fields (BODATSA 2022). It grows in well-drained sandy soil in full sun (Figure 2). The plants of subspecies *arachoides* occur in dry habitats, with some populations displaying modifications in leaflet and indumentum characters for drier habitats in its range of occurrence (Gordon-Gray 1977). Subspecies *arachoides* is very variable and this led Brenan (1958) to recognise four forms within it and Gordon-Gray (1977) segregated the plants into three groups based mainly on differences in indumentum and relatively distinct areas of distribution.



FIGURE 2.—*Senna italica* subsp. *arachoides* in the Tswalu Kalahari Reserve, Northern Cape, South Africa: a, prostrate habit, flowers and pods; b, close up of inflorescences. Photographs: a, b, M. Koekemoer.

The flowers of *Senna* do not produce nectar and are not visited by honey bees, although carpenter bees often collect pollen from them (Johannsmeier 2016). Pollinator studies of *S. italica* by Gess & Gess (2006) in the southern Kalahari and between Rehoboth and Gamsberg Pass in Namibia showed the large carpenter bees, *Apidae* (Latreille, 1802) and *Xylocopa* (Latreille, 1802), *Amegilla atrocincta* (Lepeletier, 1841) and *Anthophora armata* (Friese, 1905) visited the flowers and were the probable pollinators of the species. A year later, Marazzi et al. (2007) reported carpenter bees in the genus *Xylocopa* as pollinators for *Senna* species as they extract pollen through buzz pollination, the efficiency of which is not known. Even though literature is limited on pollinators specific to *S. italica* subsp. *arachoides*, it is likely that all three subspecies of *Senna italica* attract and share similar pollinators.

Senna, well-known as a traditional herbal remedy, has become popular in modern medicine as an over-the-counter stimulant laxative (Khurm et al. 2020). It is used to treat constipation and to empty the bowel in preparation for diagnostic procedures like colonoscopy and abdominal imaging (Ulbricht et al. 2011). The dried leaves and pods of *Senna* are traded for its medicinal uses and the majority of all *Senna* in global trade is now cultivated in India (Brinckmann & Smith 2018). In southern Balochistan (Pakistan), *S. italica* leaves are ground to a paste and applied to the forehead and heels of the feet as a coolant to reduce fever and internal heat (Ghafoor & Goodman 1992). In South Africa, the Pedi people include the roots of *S. italica* with leaves, stems, bulbs or entire plants of other medicinal plant species to produce African Traditional Medicines (ATMs). These are used for treating infertility, stomachache and diarrhoea, and given as a meal to new-born babies to strengthen their immune systems (Mongalo & Makhafola 2018). The Zulu people prepare a milk infusion using the roots of *S. italica* subsp. *arachoides* to treat influenza and they also combine animal fat and powdered root to form a mixture that is used to treat phlegm (Watt & Breyer-Brandwijk 1962; Hutchings 1996).

Senna italica is easily propagated from seed by soaking and scarifying the seeds for high germination success (Okeyo & Bosch 2007). In *S. italica* subsp. *italica*, seeds soaked in sulphuric acid for an hour showed maximum germination while removing the seed coat mechanically resulted in complete germination (Singh 2001). *Senna italica* subsp. *arachoides* is an attractive small plant and, with its many flame-like racemes, will make a good addition to open beds in a garden. Further, being drought-tolerant, the subspecies is suitable for water-wise gardening in southern Africa and should grow well in dry sandy soil and sunny spots.

Description.—Suffrutex (low-growing woody shrub or perennial with woody base), 100–500 mm tall, often prostrate with sprawling stems up to 400 mm long. Stems when young, slightly flattened, 90–120 mm tall, glabrous or with sparse short hairs, without glands. Leaves with petioles 60–100 mm long; stipules linear to ovate triangular, 6–7 mm long; rachis 55–80 mm long, paripinnate with 4–8 pairs of leaflets and a small reddish gland between each leaflet pair; petiolule up to 1 mm long; leaflets oblong to broadly obovate, 35 × 20 mm, base broadly cuneate or rounded, somewhat asymmetric, apex slightly notched, rounded or mucronate, distal pair larger, sparsely hairy or hairless above, more densely hairy on margin and midrib below. Racemes axillary, 70–140(–220) mm long, equal to or longer than subtending leaves, 10–20-flowered. Bracts oblong, 4–7 mm long,

caducous before anthesis. *Flowers* bright yellow, showing brown streaks with age. *Sepals* subequal, broadly elliptic, 8–13 mm long. *Petals* subequal, obovate, 7–12 × 5–7 mm. *Stamens* 10, filaments straight or nearly so, 3 adaxial probably sterile small, $\pm$ 1 mm long, 4 lateral and 1 central-abaxial medium-sized, 2.0–3.3 mm long, 2 lateral-abaxial large, 5–8 mm long, dehiscence porose. *Ovary* flattened, glabrous or covered in short straight, curved or appressed hairs, or in long, slender straight hairs (villous); style 6–7 mm long, terete to apex; stigma hardly wider than style, narrowed again apically into a small $\pm$ circular opening. *Pods* green, matures to brown, oblong, 30–60 × 13–20 mm, somewhat curved, flat with distinct raised crests over the seeds, dehiscent, glabrous or covered in short straight, curved or appressed hairs, or in long, slender straight hairs (villous). *Seeds* ovoid, $\pm$ compressed, 6–7 × 4 mm, 1.25 mm thick, wrinkled, with a small areole 1.00–1.25 × 0.5 mm on each face. *Flowering time*: October to April. Plate 2411.

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PLATE 2412 *Securidaca longepedunculata*

Securidaca longepedunculata

Polygalaceae

Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Chad, Democratic Republic of Congo, Eritrea, Ethiopia, Gambia, Ghana, Guinea, Ivory Coast, Kenya, Malawi, Mali, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, South Sudan, Tanzania, Uganda, Zambia, Zimbabwe

Securidaca longepedunculata Fresen. in Museum Senckenbergianum 2: 275 (1837). *Lophostylis angustifolia* Hochst.: 231 (1842). *Lophostylis oblongifolia* Hochst.: 231 (1842). *Securidaca angustifolia* Miq.: 152 (1848). *Lophostylis pallida* Klotzsch: 115 (1861). *Securidaca oblongifolia* Benth. & Hook.f. ex Harv. & Sond.: 586 (1862). *Securidaca longepedunculata* var. *parvifolia* Oliv.: 134 (1868). *Elsota longipedunculata* (Fresen.) Kuntze: 46 (1891). *Securidaca spinosa* Sim: 14 (1909). *Securidaca longepedunculata* var. *angustifolia* Robyns: 89 (1927).

The family Polygalaceae was first described in 1809 by Hoffmannsegg and Link (Hoffmannsegg & Link 1809; IPNI 2024). It has a cosmopolitan distribution, meaning that it is widespread across the globe, and contains 27 genera and around 1 200 species (Bramley et al. 2023). The species in this family are herbs, shrubs, woody vines or trees, and they are characterised by spiral leaves, their simple zygomorphic flowers with two inner petaloid sepals forming the wings and three (rarely five) petals (Simpson 2010). The flowers are superficially similar to those of the pea family, Fabaceae, but can be distinguished by the presence of a tufted appendage at the tip of the lower keeled petal.

Linnaeus first described the genus *Securidaca* in 1759 (Linnaeus 1759; POWO 2024). The genus contains small trees, shrubs and lianas, all with zygomorphic flowers. It is separated from other genera in the family Polygalaceae by the combination of eight stamens, three petals and a one-locular samara fruit (Johnson 1987). It occurs across the tropics and the subtropics, on the continents of Africa, South America, North America and Asia. The vast majority of the 80 species are found in the Americas with only two species endemic to Africa: *S. longepedunculata* and *S. welwitschii* Oliv. The latter species is a liana, which is indigenous to tropical Africa, but absent from South Africa. It can easily be distinguished from *S. longepedunculata* by its growth form, since *S. longepedunculata* are shrubs or small trees (Figures 1–3) (Johnson 1987). The genus name *Securidaca* means ‘hatchet-shaped’, in reference to the fruit, while the species epithet *longepedunculata* means ‘long flower stalk’.

Securidaca longepedunculata was first collected in Ethiopia by Eduard Rüppell in 1837, thereby making it the first specimen of this genus to be collected in Africa. Rüppell was sent to Ethiopia on an expedition by the Senckenberg Naturforschende Gesellschaft (Senckenberg Nature Research Society) in Frankfurt and he was the first European naturalist to traverse Ethiopia (known as Abyssinia at the time). The type specimen is housed at Herbarium Senckenbergianum in Frankfurt (FR; Johnson 1987). His expedition resulted in the description of about 100 new plant species, despite many of his collections being lost



Figure 1.—*Securidaca longepedunculata* inflorescences from trees growing in the Waterberg, Limpopo, South Africa. Photograph: I. Lingenfelder.

due to the sinking of a ship off the coast of France (Friis 2013). In addition to his plant collections, Rüppell is also well known for his collections of many animals, with 13 mammal, reptile and bird species bearing his name. The first African collection of *Securidaca* was initially placed in a new genus, *Lophostylis*, by Hochstetter (1842) and later moved to its current place in the genus *Securidaca* by Robyns (1927). Common names include violet tree (due to the flowers' sweet, violet-like scent), fibre tree, wild wisteria (English); *krinkhout*, *rooi-peultjie*, *seepbasboom* (Afrikaans); *mpesu* (Tshivenda); *mmaba* (Setswana); *iphuphuma* (isiZulu); *tsatsu*, *mudlandlopfu* (Xitsonga); *saggat* and *alali* (Arabic) (Orwa et al. 2009).

The violet tree has a widespread distribution and is indigenous to almost all African countries (Figure 4). In South Africa, it occurs in the provinces of North West and Limpopo in low densities, which is exacerbated by the traditional use of its roots. Though it is globally listed as Least Concern on the IUCN Red List of Threatened Species (IUCN 2024), it appears on the list of threatened and protected species in the South African National Forests Act (No. 84 of 1998). This means that no part of the tree may be damaged, collected, possessed, transported or sold without a permit in South Africa. The species suffers from

overharvesting (particularly for its roots) due to its plethora of medicinal uses, which has a severe effect on its survival. It occurs in woodland and savanna habitats (Figure 3), as well as in forests, at an altitudinal range from sea level to 1 600 m a.s.l., where annual rainfall ranges from 600 to 1 000 mm (Coates Palgrave 2002; Orwa et al. 2009).

Securidaca longepedunculata is one of the most widely used medicinal plants in the whole of Africa and has been used to treat almost any conceivable ailment (Van Wyk et al. 2013). The primary volatile compound found in the roots is methyl salicylate ($C_8H_8O_3$), also known as wintergreen oil. Leaf, stem and root material contain a wide range of alkaloids, anthraquinones, flavonoids, saponins, steroids, tannins and triterpenoids (Jayasekara et al. 2002; Nguta 2019). The species is traditionally used as male erectile aids, contraceptives, abortifacients, and for the medicinal treatment of various ailments, such as headaches, coughs, chest complaints, toothache, rheumatism, epilepsy, snake bites and even cancer (Orwa et al. 2009). Many of these traditional uses have been further investigated in



Figure 2.—Flowering branches: a–c, close-up photographs of *Securidaca longepedunculata* flowers from trees growing in the Waterberg, Limpopo, South Africa. Flowers provide a valuable nectar source for bees. Photographs: a–c, I. Lingenfelder.

scientific trials, e.g., tests on mice and zebrafish larvae confirmed efficacy in treating epilepsy, convulsions and psychosis (Adeyemi et al. 2010; Moussavi et al. 2024). Strong anti-malarial activity has also been shown in tests on mice, making this a promising avenue to explore for new antimalarial drugs (Nguta 2019). Extracts from root bark show anticancer properties against cultured human breast adenocarcinoma cells (Olaoye et al. 2021).

Other uses include the use of ground roots as a pesticide against beetles in stored grain, while the bark is also used to make soap, ropes, fishing nets, thread and arrow poison (Van Wyk et al. 2013). The use of ground roots as a pesticide against grain pests has been confirmed in multiple studies, showing a reduction in a number of pests for more than nine months after the treatment was applied (Jayasekara et al. 2005; Stevenson et al. 2009). The flowers are very attractive to birds, bees and butterflies. The violet tree forms an important part of apiculture in Eritrea, providing a valuable lowland nectar source for bees (Figures 1, 2) (Orwa et al. 2009). It has also been recommended as a means to increase honey production in Cameroon (Fohouo et al. 2008).

The tree is difficult to cultivate. Seeds do not germinate easily and those that do germinate often die when transplanted. Some success has been achieved when sowing



Figure 3.—A fruiting violet tree, *Securidaca longepedunculata*, in the foreground with smooth grey bark in typical bushveld habitat, Waterberg, Limpopo, South Africa. Photograph: A. Frisby.

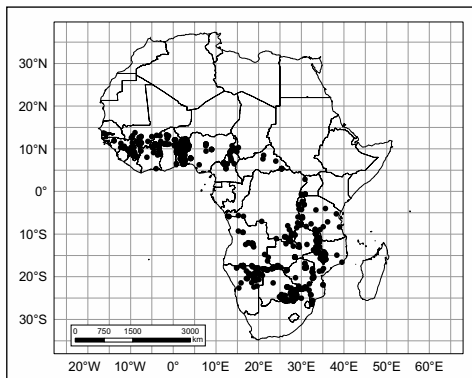


Figure 4.—Distribution map of *Securidaca longepedunculata* in Africa.

soaked seeds directly in sandy soil and then not transplanting seedlings from where they were sowed (Coates Palgrave 2002). Experiments on in vivo germination of the seeds in a laboratory setting at the Royal Botanic Gardens, Kew, London, showed a success rate of 67–90%, and seedlings that were planted out produced roots within four weeks (Zulu et al. 2011). This could be an avenue to explore for future propagation of the species. The difficulty in propagating this species, together with its wide range of local uses and potential in new drug development, may pose a threat to wild populations. Alternative means to produce supplies for medicinal use, for example in vivo propagation of seedlings or synthetic production of compounds, should be investigated to conserve the species in the wild.

Description (based on Johnson [1987] and Paiva [2007]).—Small tree or large shrub, up to 6 m tall. *Bark* smooth, pale grey to white, becoming finely scaly. *Leaves* alternate or clustered towards tips of branches, simple, broadly oblong to narrowly elliptic, $25\text{--}55 \times 5\text{--}20$ mm; petiole 2–10 mm long; adaxial surface sparsely hairy. *Inflorescences* terminal or axillary racemes, 30–150 mm long. *Flowers* in dense flower heads, pea-like, pink to purple, sweetly scented; pedicels 10–18 mm long. *Calyx* with posterior and anterior sepals, $4\text{--}6 \times 3\text{--}5$ mm. *Corolla* with 2 upper petals obovate, $5.0\text{--}7.5 \times 2.5\text{--}4.0$ mm; carina $8\text{--}10 \times 5$ mm. *Filaments* fused into split sheath, 6–7 mm long, free part 4–5 mm long. *Fruit* smooth, reddish to pale brown, almost round, nut with single, hatchet-shaped wing, $50\text{--}70 \times 10\text{--}20$ mm; notched at base; often persistent on tree for many months. *Seed* 8×6 mm in diameter. *Flowering time*: mainly spring and summer, at the beginning of the rainy season (August to November, southern hemisphere). Plate 2412.

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PLATE 2413 *Hibiscus waterbergensis*

Hibiscus waterbergensis

Malvaceae: Malvoideae

South Africa

Hibiscus waterbergensis Exell in Boletim da Sociedade Broteriana 33: 178 (1959); Germishuizen & Fabian: 254, t. 119 f (1997); Retief & Herman: 526 (1997); Wadley et al.: 136 (2021).

The Waterberg Mountain Complex Biodiversity Project (WMCBP) primarily aims to document and conserve the region's unique biodiversity. The project is funded by the Foundational Biodiversity Information Programme (FBIP) of the National Research Foundation (NRF), with baseline biodiversity data collection (mainly distributional and specimens) conducted from 2021 to 2025, which seeks to stimulate biodiversity research within the region, encompassing the UNESCO World Heritage site, the Waterberg Biosphere (McDonald 2021, 2022; Bester 2022). One of the plant species encountered during this project was *Hibiscus waterbergensis* and, through this project, it was possible to obtain material to produce the accompanying colour plate and do some observations on the species.

Members of the genus *Hibiscus* are placed in the Malvaceae family (Fryxell 1968; Hinsley 2002; Koekemoer et al. 2023). Many members of the family characteristically have stamens fused into a tubular column through which the style protrudes at the top. According to the APG IV system, the family is further divided into nine subfamilies, and *Hibiscus* is attributed to the Malvoideae (Stevens 2001). The charismatic genus *Hibiscus*, comprising approximately 300–440 species depending on the authority (Mabberley 1997; Leistner & Bredenkamp 2000; Hanes et al. 2024; POWO 2024), is widely distributed across the tropics and subtropics. Like many Malvaceae, in *Hibiscus*, the stamens are also fused into a tubular column through which the style protrudes at the top. This is one of the characters present in all *Hibiscus* species, another being the presence of a series of inner calyx and outer epicalyx (Letty 1962; Leistner & Bredenkamp 2000). *Hibiscus* is regarded as a medium-sized genus, ranging from annual herbs to large trees, although most species are perennial subshrubs (Pfeil et al. 2002), represented by 57 taxa indigenous to southern Africa (Leistner & Bredenkamp 2000; Germishuizen et al. 2006; SANBI 2024), with 16 taxa endemic to the region (SANBI 2024). Thirty-five taxa are indigenous to the northern provinces of South Africa (North West, Limpopo, Mpumalanga and Gauteng) with the majority (32 taxa) occurring in Limpopo.

Members of *Hibiscus* are commonly cultivated as ornamental plants, particularly in temperate to subtropical regions. *Hibiscus* is regarded as the fifth most popular commercially grown flowering plant genus globally, following roses, azaleas, carnations and orchids (The Gardener Magazine 2024). Several members of the genus are important as fibre crops, e.g., *H. cannabinus* L. (Meeuse 1961; Letty 1962; Bayer & Kubitzki 2003) and *H. tiliaceus* L.,

PLATE 2413.—1, apical portion of stem with flowers and fruit, ants and grasshopper, $\times 1$; 2, side view of flower showing fused column of anther filaments surrounding style, $\times 1$; 3, dehiscent capsule viewed from above showing 5 locules and persistent calyx, $\times 2$; 4, seed with indumentum of long cottony hairs, $\times 2$; 5, abaxial side of leaf showing extrafloral nectary at base of main vein, $\times 6$. Voucher specimen: Condyl 414 in National Herbarium (PRE), Pretoria. Artist: Gillian Condy.

contain tough fibrous bark widely used for rope and twine in construction, sewing mats and general binding (Van Wyk & Gericke 2000). The ripening fruit and calyces of *H. sabdariffa* L. (known as roselle) is cultivated for its fleshy edible calyx, which is rich in vitamin C, and is also becoming more popular as a hibiscus tea (Cheek 1992) and colourant in beverages, with the young leaves eaten as spinach (Van Wyk 2005). Sap from some red-flowered *Hibiscus* species is used in liqueurs and as a dye for hair and eyebrows (Thulaja 2020). Dried flowers of certain species are used medicinally throughout Asia, while in China the flowers are used in pickles and teas. In Hawaii, the flowers are consumed as a remedy for indigestion (The Gardener Magazine 2024). The bioflavonoid gossypin from the petals of *H. vitifolius* L. exhibits anti-inflammatory activity (Parmar & Gosh 1978). Various anti-fertility effects have been reported for *H. rosa-sinensis* L. (Farnsworth et al. 1983). Additionally, various medicinal properties of *Hibiscus* species from KwaZulu-Natal are documented by Hutchings et al. (1996). Yet, no references to the use of *H. waterbergensis* could be traced in literature; probably due to the relative rarity of the plant (being endemic) or very little ethnobotanical research from this region.

Despite their generally large and attractive flowers, few species have been covered in this series. Ten contributions on *Hibiscus* have previously been made in this series (Pole Evans 1933; Dyer 1948, 1953, 1960; Exell 1961; Codd 1966; Cheek 1992; Phillipson 1992) of which *H. praeteritus* R.A.Dyer (Pole Evans 1931) and *H. coddii* Exell subsp. *barnardii* (Exell) Leistner & P.J.D.Winter (Leistner et al. 2005) are the only small, red-flowered (scarlet) taxa. *Hibiscus pusillus* Thunb. (Frylinck & Van Zyl in press) is set to appear in a future volume of this series.

There is much value in observing material in the wild of plants that are illustrated in this series. The plant used to create the accompanying colour plate (*Condy 414* in National Herbarium [PRE], Pretoria) originates from De Draai farm in the northwestern part of the Waterberg Mountain Complex, where it grows in typical open savanna habitat on moderate south- and southwest-facing rocky slopes. The soils are predominantly sandy and the vegetation is classified by Mucina & Rutherford (2006) as Montane Waterberg Bushveld within the Central Bushveld bioregion. While observing the plants in the wild, the artist noted ants running up and down the stem but never visiting the flowers. Closer examination revealed that the ants were attracted to the bases of the leaves' undersides, where they remained briefly before departing (Figure 1a). Researching the species for this contribution, and upon examining the voucher specimens (several duplicates were collected), it became clear what the ants were doing. A conspicuous extrafloral nectary (Figure 2c, d) is located on the main vein (and occasionally on some secondary veins) of the abaxial side of the leaves, appearing as a patch of darker cells, which is more evident in the dried material. These nectaries secrete oils that the ants harvest, resulting in a mutualistic relationship where the plants receive protection against herbivory, as ants will defend the plant from herbivorous insects to protect this resource. This feature is well documented and occurs in many species of Fabaceae (Figure 1b), as well as Malvaceae, including *Hibiscus* (Figure 1a) (Bentley 1977; De la Fuente & Marquis 1999; Rocha & Rodrigues Machado 2009; Marazzi et al. 2019).

In most Malvaceae, the nectary consists of carpets or cushions of multicellular glandular hairs and can be found on various parts of the plant (Stevens 2001; Bayer & Kubitzki 2003;



FIGURE 1.—Ants harvesting compounds from extrafloral nectaries on the leaves: a, *Polyrhachis schistacea* (ant) on leaf of *Hibiscus waterbergensis*; b, *Polyrhachis schistacea* (ant) on leaf of *Chamaecrista* sp. Photographs: a, SAPlants@Wikicommons; b, M.M. le Roux.

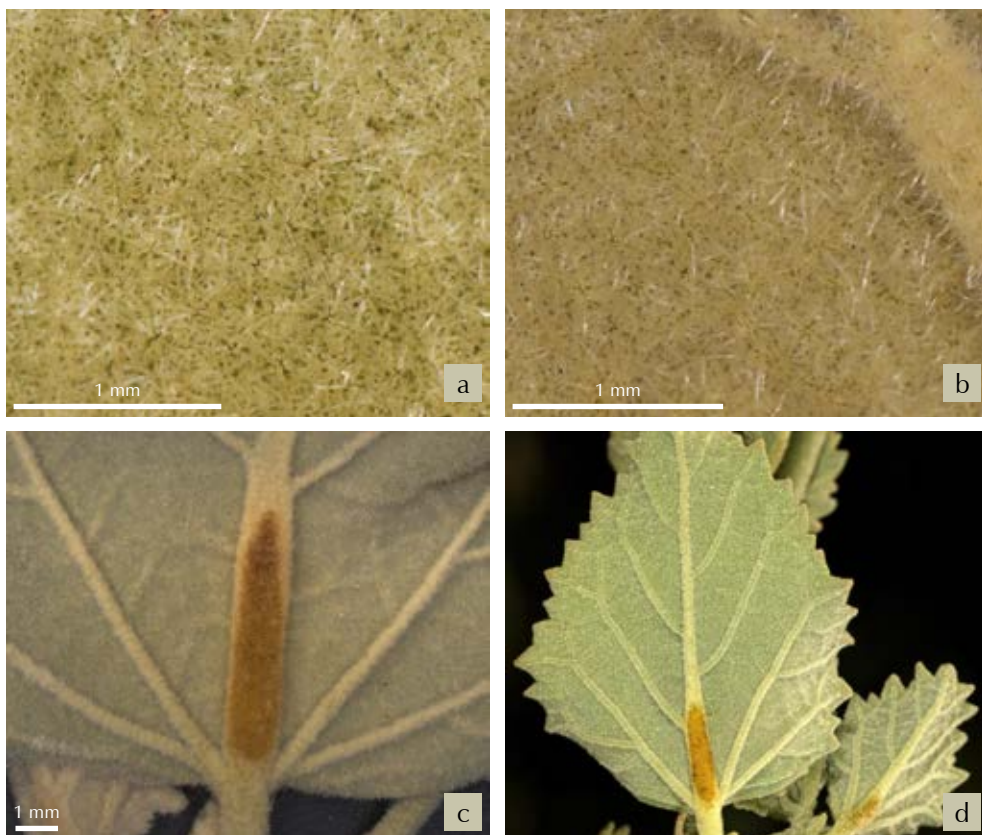


FIGURE 2.—Trichomes and nectary of *Hibiscus waterbergensis*: a, dense indumentum of trichomes consisting of stellate hairs on adaxial side of leaf; b, dense indumentum of trichomes consisting of stellate hairs on abaxial side of leaf; c, extrafloral nectary on base of main vein of leaf (abaxial side) from herbarium specimen; d, extrafloral nectary on base of main vein of leaf (abaxial side) from fresh material. Vouchers: a–c, *Condy 414* in National Herbarium (PRE), Pretoria. Photographs: a–c, S.P. Bester; d, SAPlants@Wikicommons.

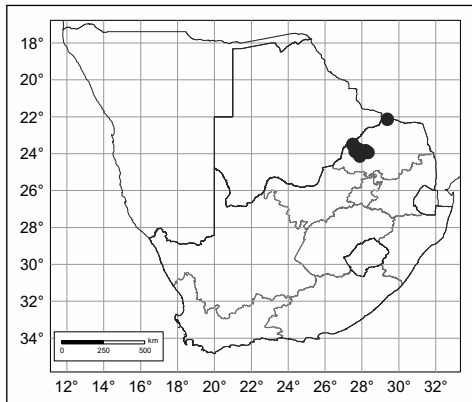


FIGURE 3.—Known distribution of *Hibiscus waterbergensis* based on the herbarium specimens located in PRE, PRU and BLFU.

Leitão et al. 2005). The nectaries that provide rewards for pollinators are commonly found on the inside of the calyx near the base where the corolla is fused to the calyx, and access to the nectar is permitted to a pollinator probing the centre of the flower while simultaneously pollinating the flower (Vogel 2000). Janda (1937) describes extrafloral nectaries in Malvoideae that consist of aggregations of glandular hairs, either abaxially on foliage leaves (as is the case in the Waterberg hibiscus), or on the calyx or at the apex of pedicels. In *Hibiscus waterbergensis*, the morphology of the extrafloral nectaries is quite homogenous, but other genera in the Malvaceae (e.g., *Triumfetta* Plum. ex L.) have variable extrafloral nectaries in the same species (Leitão et al. 2005).

Extrafloral nectar in *H. waterbergensis* accumulates into one or more drops at the dense cushions on the main vein of the abaxial side of the leaf (see accompanying colour plate). This has also been reported for *H. praeteritus* (Pole Evans 1931). It has been proposed that this may function to attract insects, either pollinators or predators of herbivorous insects that may attack the plant (Phillipson 1992), as observed by the artist.

Hibiscus waterbergensis is indigenous to South Africa and the only endemic *Hibiscus* in Limpopo. Specimens (and observations) have mainly been from the Waterberg with a single disjunct distribution in Mapungubwe, northwest of the Soutpansberg (Figure 3). The Red List status of this species is recorded as Least Concern (LC) (Victor 2006), as it is widespread in the Waterberg and the single known location at Mapungubwe results in it having a wide distribution range. The species has been encountered numerous times by the first author (SPB) and no evidence of threat has been observed. The Waterberg region, where this species is found, has numerous protected areas, which help in the conservation of endemic species like *H. waterbergensis*. The various populations in the area are believed to be stable and not declining, hence, the conservation status assessment of LC is justified. Suitable habitats between the Waterberg and Mapungubwe exist, yet no further populations have thus far been collected or observed in the area between these two regions.

Despite the plants being perennial, most of the previous season's growth dies back in winter when the plants become dormant. In the new growing season, plants sprout in response to rainfall, which may vary and, depending on when this occurs, flowering is usually between early summer and autumn (November to April), but mostly during early summer (November to December), with a single collection recorded in July (PRE0286061-0 in PRE).

This species is a herbaceous shrub (Figure 4a, b) that thrives in light shade to full sun, especially on rocky outcrops (Figure 4c) on slopes of varying inclination. It is predominantly found on southern and southwestern aspects of hills and occasionally on streambanks.



FIGURE 4.—*Hibiscus waterbergensis* in habitat: a, b, plants growing among rocks; c, rocky outcrop habitat. Photographs: a, J. Kalwij (iNaturalist); b, M. Popp (iNaturalist); c, M.M. Pienaar.

Herbarium labels indicate that the habitat comprises sandy to loam soils derived from quartzite or sandstone. The reported altitude range is approximately 800–1 200 m a.s.l.

The oldest collection at PRE is by I.B. Pole Evans dating from 1929 (*Pole Evans* 2516). Since then, just over a dozen specimens have been added to the collection at PRE, with none at the KwaZulu-Natal Herbarium (NH) in Durban or Compton Herbarium (NBC) in Cape Town. Only four records could be traced at the Herbarium at Kew (K) (two collection events), and there is an additional single collection at the H.G.W.J. Schweickerdt Herbarium at the University of Pretoria (PRU) and three records from one collection event at the Geo Potts Herbarium at the University of the Free State (BLFU).



FIGURE 5.—Selection of other small, red-flowered (scarlet) *Hibiscus* taxa from southern Africa: a, *H. praeteritus*; b, *H. coddii* subsp. *barnardii*; c, *H. barbosa* Exell; d, *H. rhodanthus* Gürke ex Schinz; e, *H. coddii* subsp. *coddii*. Photographs: a, b, SAPlants@Wikicommons; c, J. Gallagher (iNaturalist); d, G. Jamie (iNaturalist); e, T. van der Merwe (iNaturalist).

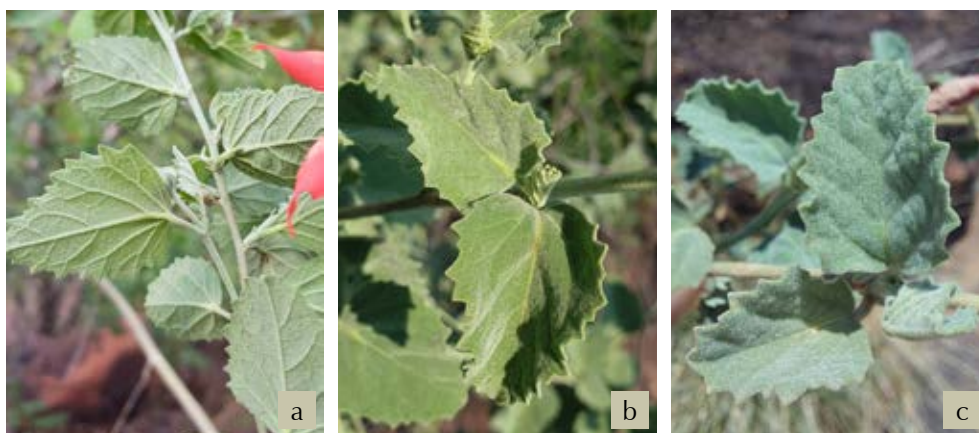


FIGURE 6.—Leaves of *Hibiscus waterbergensis*: a, abaxial side of leaves showing conspicuously raised venation and toothed margins; b, c, adaxial side of leaves with indumentum and relatively indistinct venation compared to abaxial side. Photographs: a, S.P. Bester; b, J. Kalwij (iNaturalist); c, M. Popp (iNaturalist).

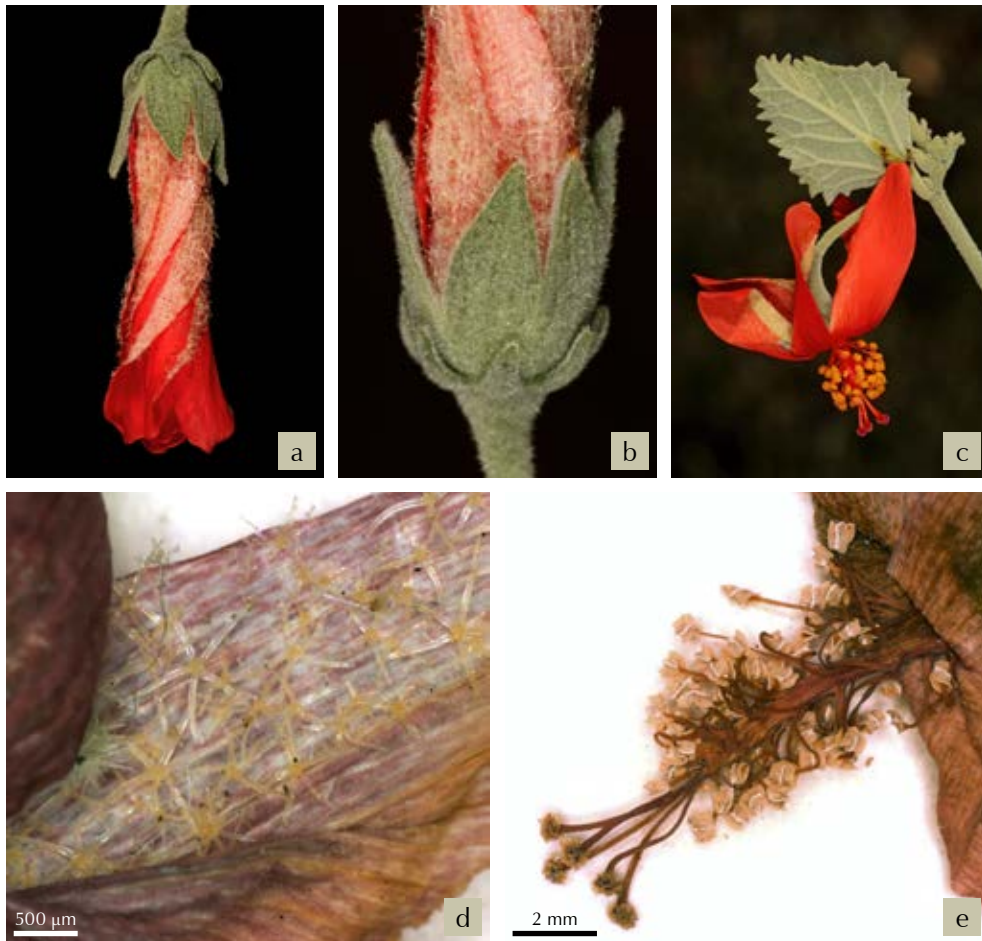


FIGURE 7.—Floral morphology of *Hibiscus waterbergensis*: a, flower bud with twisted corolla lobes unevenly furnished with stellate hairs; b, base of flower bud showing the epicalyx (numerous small bractoid lobes) and calyx (fewer large petaloid lobes); c, side view of flower; d, corolla showing stellate trichomes; e, staminal tube with anthers and branched style. Voucher: a, b, I.B. Pole Evans 2510 in National Herbarium (PRE), Pretoria. Photographs: a–c, SAPlants@Wikicommons; d, e, S.P. Bester.

Other small, red-flowered *Hibiscus* species that may be encountered in the northern provinces of South Africa include *H. praeteritus*, *H. coddii* subsp. *coddii* and *H. coddii* subsp. *barnardii*. A number of these taxa are depicted in Figure 5. *Hibiscus waterbergensis*, however, can easily be distinguished from all others by its nodding flowers with angled pedicels, and dense mat of interwoven stellate hairs on both sides of the leaves and stem. These and various other leaf, flower, fruit and seed morphological features of *H. waterbergensis* are illustrated in Figures 6–9.

Most Malvoideae (one of the nine subfamilies in Malvaceae that includes *Hibiscus*, *Pavonia* Cav. and *Abutilon* Mill. amongst others) are pollinated by birds, bees or other insects (Vogel 1954, 1969; Gottsberger 1972). In some members of the Malvoideae (e.g., *H. trionum* L. and *H. laevis* All.) facultative autogamy has been observed (Buttrose et al.



FIGURE 8.—Floral morphology of *Hibiscus waterbergensis*: a, ventral view of flower showing epicalyx (7 or 8 smaller elongate to triangular-elongate lobes) and calyx (larger elliptic or lanceolate elliptic lobes); b, side view of staminal tube with numerous anthers fused into a column and 5-branched style tip with hirsute stigmatic surface; c, side view of branch with pedicel and flower (note articulation on pedicel close to base of flower); d, ventral view of flower showing streaks on abaxial sides of the corolla (section exposed when in bud) with dense indumentum of stellate trichomes and articulation (bent notch) of pedicel. Photographs: a–c, SAPlants@Wikicommons; d, A. Frisby.

1977). With similar long stylar branches in *H. waterbergensis*, facultative autogamy could easily result in self-fertilisation, and this is another feature of the taxon that could be studied.

Description.—Shrub, subshrub or slender annual herb with few, erect branches, 1–2 m tall, with branchlets densely covered in minute stellate tomentum, becoming nearly glabrescent with age. Leaves ash grey or yellowish, stipulate with subulate stipules 2.5–4.0 mm long, petiolate; petioles 2–10 mm long, stellate-tomentellous; leaf blade chartaceous, ovate to broadly ovate or ovate-elliptic, 15–35 × 10–30 mm, densely covered with minute stellate tomentum on both surfaces, margins serrate (sharply toothed), apex rounded or truncate, 5-veined, midrib slightly prominent adaxially, very prominent abaxially, with veins inconspicuous adaxially and prominent abaxially; extrafloral nectaries abaxially on base of main vein. Flowers solitary, scarlet red, axillary, with pedicel up to 35 mm long, minutely tomentellous, articulated near apex, 7–8 mm long. Epicalyx 7–8, triangular to elongate-triangular, 2.0–2.5 mm long. Calyx 5, with elliptic or lanceolate-elliptic lobes, 7–8 mm long. Petals 5, oblong-elliptic, about 15–20 × 5–6 mm, adaxially stellate-pilose hairs $\frac{1}{4}$ – $\frac{1}{3}$ on sinistrose side of petals at anthesis, glabrous internally. Staminal tube 5 mm long. Filaments free, 2–4 mm long. Style branches 1.5–4.0 mm long, tip deeply 5-lobed, each

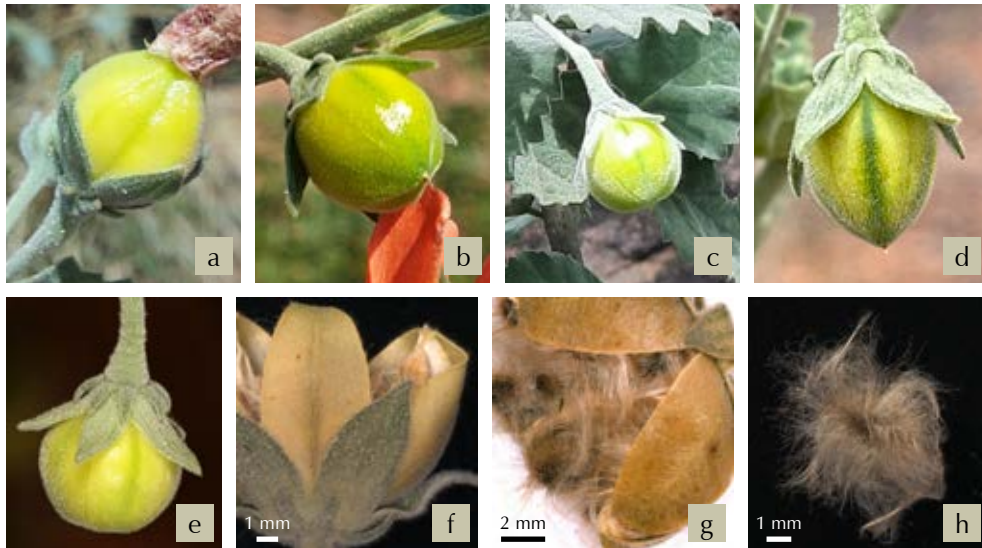


FIGURE 9.—Fruit and seed of *Hibiscus waterbergensis*: a–e, variation of fresh fruit shape, colour and hairiness; f, side view of dehiscent capsule; g, side view of dehiscent capsule containing numerous seeds with cottony fibres; h, seed. Vouchers: f–h, *Condy 414* in National Herbarium (PRE), Pretoria. Photographs: a, M. Popp (iNaturalist); b, J. Kalwij (iNaturalist); c, T. Jaeger (iNaturalist); d, L. Lindenthal (iNaturalist); e, SAPLants@Wikicommons; f–h, S.P. Bester.

branch ending in a globose stigmatic surface. Ovary ellipsoid, 4×3 mm. Fruit a subglobose loculicidal capsule, 12 mm in diameter, minutely pubescent. Seeds kidney-shaped, $2\text{--}3 \times 1.5$ mm, densely covered in 2–5 mm long cottony silky hairs. Plate 2413.

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Cadaba aphylla

Capparaceae

Botswana, Namibia, South Africa, Zimbabwe

Cadaba aphylla (Thunb.) Wild in Flora Zambesiaca 1: 207 (1960); Marsh: 172 (1970); Schmidt et al.: 124 (2002). *Cleome aphylla* Thunb.: 109 (1800).

Cadaba aphylla is a member of the Capparaceae (caper family), which is closely related to, and often included in, the Brassicaceae (cabbage family) in the order Brassicales. The families are related in terms of their chemistry, with members containing mustard oils (Hall et al. 2002). Traditionally, the Capparaceae were circumscribed as two major subfamilies, the Capparoideae and Cleomoideae, and this resulted in a paraphyletic Capparaceae with the Brassicaceae nested within it (Rodman et al. 1993; Hall et al. 2004). These taxa are now accepted as three separate monophyletic families (Iltis et al. 2011), with the Cleomaceae (spider flower family) more closely related to the Brassicaceae than to the Capparaceae (Hall et al. 2002). A comprehensive account of the history of the Capparaceae, from its description in 1789 to recent changes based on DNA analyses, is provided in Mercado-Gómez et al. (2019).

Members of the Capparaceae can be recognised by their woody habit, stamens borne on column-like appendages (androphore), a unilocular ovary with parietal placentation, an indehiscent fruit borne on an elongated stalk (gynophore or androgynophore) and absence of a replum (false septum). Members of the Brassicaceae and Cleomaceae differ from the Capparaceae in their herbaceous (rarely woody) habit and fruit that are mostly dry capsules or siliques that are dehiscent with a replum (Iltis et al. 2011). The flowers of Capparaceae are ecologically versatile and visually pleasing compared to those of the Brassicaceae (Endress 1992). Species of the Capparaceae are generally found in warmer parts of the world, namely the tropics and subtropics, in the Mediterranean (El Karemy 2001), and occur on the continents of (in order of predominance) South America, Africa, North America, Asia, Australia and Europe (GBIF 2022).

The Capparaceae contain 15 genera and 427 species (POWO 2022), all diverse in habit, and flower and fruit morphology (Hall et al. 2002). The largest genus in the Capparaceae is *Capparis* L. with 140 species (eight in southern Africa). This is followed by the genera *Morisonia* L. (87 species, 0 in southern Africa), *Maerua* Forssk. (69 species, 12 in southern Africa), *Boscia* Lam. (30 species, six in southern Africa) and *Cadaba* Forssk. (29 species, three in southern Africa) (BODATSA 2022; POWO 2022). The remaining ten genera each have less than 25 species, five of which have only one species each. Previously, the genus *Cleome* belonged to Capparaceae (Hall et al. 2002; Hosne et al. 2007) and consisted of more than 150 species. Currently, the genus is classified in the Cleomaceae with 202 species (POWO 2022).



PLATE 2414 Cadaba aphylla

The genus *Cadaba* is recognised by its shrubby habit with unarmed or spine-tipped lateral branches. Leaves are entire, rudimentary or absent. The flowers are zygomorphic, solitary or fascicled and have leafless racemes. Members in the genus have two sepals, two to four or no petals and four to eight stamens. The ovary is on an elongated gynophore; fruit are cylindric, indehiscent, or tardily dehiscent by two valves; seeds are many and often embedded in a bright orange or scarlet matrix. The name *Cadaba* is from the Arabic *kad-hab*, the vernacular name for *Cadaba farinosa* Forssk. (Clarke & Charters 2016). The specific epithet *aphylla* is derived from the Latin word *aphyllus*, which translates to ‘without leaves’ or ‘leafless’ (Manning 2013). *Cadaba* is predominantly found in Africa, as well as in Asia and Oceania (Australia, New Zealand and surrounding islands) (GBIF 2022). In southern Africa, there are four species of *Cadaba*, namely *C. aphylla*, *C. natalensis* Sond., *C. schroeppelii* Suess. and *C. termitaria* N.E.Br. Table 1 provides a comparison of the species.

Cadaba aphylla was initially described as *Cleome aphylla* in 1800 by Carl Peter Thunberg (1743–1828). In 1960 Hiram Wild (1917–1982) transferred it to the genus *Cadaba*. The species is known by a number of common names in different regions of southern Africa, the most common being *swartstorm* (Afrikaans for black storm), which has been reported to be a regional variant (Ellis et al. 2021) in the Karoo and makes reference to the strength of the plant. Other names include desert broom, for its ability to adapt and survive harsh desert conditions (Clarke & Charters 2016); *swartstormbos*, *bobbejaanarm*, *rooistormbos*, *doubos*, *douwurbos*, *gifhoutjie* (Afrikaans); *mfitshwana*, *mhitshwana*, *monnamontsho* (Setswana); *tshikuni*, *munnamutswu*, *mudiatsivana* (Tshivenda); *usitorhom* (isiXhosa). In Sepedi, the common name for *Cadaba aphylla* translates into black (*monna*) man (*montsho*) (Rankoana et al. 2016). According to Elovson (1980), the common name, Spanish broom, was given to *C. aphylla* for its smooth, round stems that resemble those of *Spartium junceum* L.

Cadaba aphylla is distributed through southern Africa and present in Botswana, Namibia, South Africa and just enters Zimbabwe in the far south of the country (BODATSA 2022). In terms of conservation status, the species is Red-Listed as Least Concern (Foden & Potter 2005). This small, leafless shrub (Figure 1) occurs in arid and semi-arid regions of southern Africa (Snijman 2013) in mixed scrub, dry bushveld, semi-desert and desert (Coates Palgrave 2002; Retief & Meyer 2017). It is resilient in that it is able to survive drought conditions and can tolerate frost (Voigt 2004). Plants grow on tops of hill slopes in well-drained, rocky (Figure 1), gravelly, sandy loam, limestone and alkaline soils in full sunlight (Van der Spuy 1976; Elovson 1980; Retief & Meyer 2017) along an altitudinal range of 20–1 650 m a.s.l. (BODATSA 2022). In South Africa, the species occurs from the Montagu District in the Western Cape and extends eastwards to Qonce (formerly King William’s Town) in the Eastern Cape, and northwards into the Northern Cape, Free State, North West and Limpopo. Its range continues into southern Zimbabwe, southern and eastern Botswana, and into Namibia where it reaches the Erongo Mountains (BODATSA 2022; GBIF 2022; Hyde et al. 2022) (Figure 2). According to Elovson (1980), the species has been successfully grown on a warm, north-facing rockery in Pretoria and is fairly common in areas surrounding Aberdeen and Beaufort West.

According to a study conducted in the Mountain Zebra National Park (Bezuidenhout & Brown 2008), *Cadaba aphylla* was found growing in plant communities amongst *Diospyros lycioides* Desf., *Atriplex semibaccata* R.Br., *Salsola kali* L., *Cirsium vulgare* (Savi) Ten.,

Table 1.—Comparison of the southern African *Cadaba* species (Marsh 1970)

Notes and characters	<i>C. aphylla</i>	<i>C. natalensis</i>	<i>C. schroepelii</i>	<i>C. termitaria</i>
Specific epithet derivation	without leaves	first collected and described from (KwaZulu-)Natal	named after apothecary Adolf Schroepel	occurs on termite mounds
Common name (English)	leafless wormbush	green-leaved wormbush	silver-leaved wormbush	grey-leaved wormbush
Distribution	Botswana, Namibia, South Africa (Eastern Cape, Free State, Limpopo, Northern Cape, Western Cape), Zimbabwe	Eswatini, Mozambique, South Africa (Eastern Cape, KwaZulu-Natal, Limpopo, Mpumalanga)	Angola, Namibia	Botswana, Eswatini, Mozambique, South Africa (Limpopo, Mpumalanga, North West), Zimbabwe
Leaves	absent, except on young branches	dark green, thin, hairless	grey, densely hoary or papillose-farinose on both surfaces	greyish green, leathery, both surfaces covered in small grey scales
Flowers				
Sepals	red, showy	mauve or purplish with pink nectary guide	greenish grey	green with red nectary guide
Petals	absent	absent	absent	absent
Androgynophore	with hooded nectary at base	not clasping	with basal nectary conspicuous in open flowers	clasping
Flowering time	August–January	June–October	December–February	September–November
Fruit				
Size	50–90 × 6–7 mm	50 × 5 mm	20 × 4 mm	50 × 3–7 mm
Surface	hairless	hairless	covered with greenish white, papillose scales	covered in small grey scales
Fruiting time	November–January	August–November	December	November–January



FIGURE 1.—*Cadaba aphylla* in habitat: a, arrangement of flowers on leafless stems, Eastern Cape; b and c, side view of flowers showing the protruding pedicels and stamens, Western Cape; d, close-up of the gynophore with hairs, Eastern Cape; e, habitat of the plant in rocky areas in Gamkaberg, Western Cape; f, habitat at Fish River Canyon, Namibia. Photographs: a–d, M. Koekemoer; e, D. Euston-Brown; f, B. Fischer.

Lycium oxycarpum Dunal, *Vachellia karroo* (Hayne) Banfi & Galasso, *Chloris virgata* Sw. and *Mesembryanthemum coriarium* Burch. ex N.E.Br., and displayed the highest constancy amongst these species when compared to other plant communities. The shrub is favoured and often eaten by wild animals, and is an important source of nectar for various species of insects and birds (Bezuidenhout & Brown 2008). The red, showy flowers of *C. aphylla*, which bloom from August to January, produce large quantities of diluted nectar and are

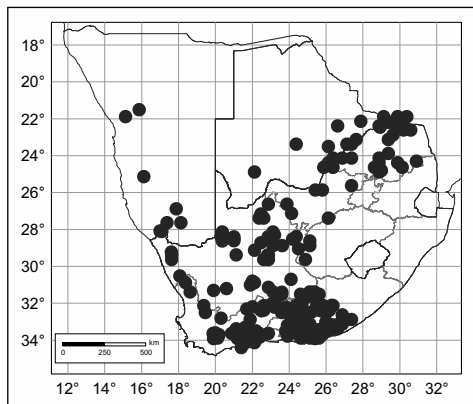


FIGURE 2.—Known distribution of *Cadaba aphylla*, based on data from BODATSA (2022), GBIF (2022) and Hyde et al. (2022).

typical bird flowers (Johannsmeier 2016). This nectar serves as a food source for sugarbirds and ants. The stamens, protruding from the bright red sepals, act as an advertisement to attract pollinators to the plant (Voigt 2004). The plant is pollinated by sunbirds (Manning 2013), such as *Cinnyris chalybeus* (Linnaeus, 1766) (Southern Double-collared Sunbird) (Roberts et al. 2005). The cylindrical fruits appear from November to January (Schmidt et al. 2002; Snijman 2013) and split open into two halves to reveal the seeds. Seeds are embedded in a sticky pulp, which possibly aids in their dispersal by adhering onto birds and mammals that visit the plant or pass by it (Voigt 2004). *Cadaba aphylla* is palatable to wild animals, but not to livestock (Voigt 2004).

Cadaba aphylla is utilised by humans for both medicinal and magical purposes (Magwede et al. 2019). The most common form of use is for the treatment of boils and abscesses, either as a purgative or applied externally; followed by the treatment of stomach ailments (Voigt 2004; Hulley et al. 2016). To work as a purgative, small quantities of the roots are used in a tonic. Larger quantities of roots are known to be poisonous and, when combined with *Boscia oleoides* (Burch. ex DC.) Toelken (Capparaceae), forms a non-purgative tonic (Van Wyk et al. 2008). The roots of *C. aphylla* have also been reported as a treatment for asthma (Rankoana 2016) and, in its powdered form, can be applied as a dressing between layers of gauze to extract boils and abscess fluids (Voigt 2004; Fouché et al. 2008). According to Davids et al. (2016), *C. aphylla* has been documented for its anti-cancer and anti-carcinogenic activity. *Cadaba aphylla* is reportedly sold by street vendors in Gaborone, Botswana, where locals use it as a herbal medicine in the following way (Setshogo & Mberekhi 2011): the roots are heated by fire until they glow and pointed to indicate the area where a boil or abscess is most likely to form; the smoke is then used to permeate the boil or abscess. Furthermore, boiling roots in water followed by oral consumption is a known treatment for headaches. In Sepedi culture *C. aphylla* is used to make protective medicine by grinding dried roots into a powder (Rankoana et al. 2016), while in Xhosa culture the plant is grown around homes, reportedly to ward off evil spirits and lightning (Cocks et al. 2002). Burning stems reportedly banish bad spirits and evil, and make homes safe (Van Wyk et al. 2008). Voigt (2004) stated that, according to local superstition, burning *C. aphylla* wood will make the wind blow.

When it comes to arid or rocky gardens, where water availability is low, temperatures are extreme and sun exposure is high, *Cadaba aphylla* is a perfect addition with its large, showy flowers that are aesthetically pleasing and its ability to withstand extreme climatic conditions (Van der Spuy 1976; Eliovson 1980). It can be grown from root cuttings or seeds. To maintain a compact shape and keep it neat in appearance, the edges be lightly trimmed after flowering (Eliovson 1980; Voigt 2004). This species can be used to complement other species that are suitable for dry gardens, such as *Nymanian capensis* (Thunb.) Lindb. (Chinese

lantern tree), *Rhigozum obovatum* Burch. (wild pomegranate), *Aloe microstigma* Salm-Dyck (spotted aloe), *Tylecodon paniculatus* (L.f.) Toelken (*botterboom*; butter tree), *Schotia afra* (L.) Thunb. var. *angustifolia* (E.Mey.) Harv. (small-leafed Karoo boer-bean), *Lessertia frutescens* (L.) Goldblatt & J.C.Manning subsp. *frutescens* (cancer bush) and *Hermannia cuneifolia* Jacq. var. *cuneifolia* (*agtdaegeneesbos*) (Eliovson 1980; Voigt 2004). When planted among other species, *C. aphylla* grows tall flowering stems that protrude above the other plants (Van der Spuy 1976). Very few pests are known to attack *C. aphylla* and an oil-emulsion insecticide can be used to treat the random outbreaks of scale (Voigt 2004).

Description.—Evergreen, tangled shrub, 2–3 m in height; bark brownish. *Branches* $\pm$ 2 m long, glaucous or purplish, glabrous, slightly flexible and fleshy from woody base; ends spinescent. *Leaves* absent; caducous leaf scales present on seedlings and immature branches. *Inflorescence* short, axillary raceme or corymb on side stems, forming flat-topped heads; peduncle 8–13 mm long, glabrous or glandular-pubescent. *Flowers* showy, yellowish green, orange to reddish purple, maroon, 40–50 mm long; sepals 4, broadly elliptic, 9–17 $\times$ 5–10 mm, lowest larger than rest, free, intersecting, united at base to form shallow receptacle $\pm$ 1 mm in depth; petals absent. *Androgynophore* 20–30 mm long, cup-like with no neck, glabrous, shallowly declinate; hooded nectary at base, $\pm$ 4 mm broad, hidden in open flower, usually persistent on immature fruit. *Stamens* 8; filaments 10 mm long; anthers oblong, 2.3 $\times$ 0.75 mm. *Gynophore* $\pm$ 10 mm long, glabrous or glandular-pubescent; ovary narrowly cylindrical, glabrous or glandular-pubescent; ovules many on 2 placentas; stigma capitate, sessile. *Fruit* cylindrical, semi-torulose, 50–90 $\times$ 6–7 mm, minutely verrucose, smooth or with sticky glands, green when young turning orange-brown when ripe. *Seeds* many, small, subglobose, brownish black, 3 mm in diameter. *Flowering time*: August to January. Plate 2414.

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Sieruela hirta

Cleomaceae

Tropical and southern Africa

Sieruela hirta (Klotzsch) Roalson & J.C.Hall in Systematic Botany 42(4): 935 (2017). *Decastemon hirtus* Klotzsch: 157 (1861). *Cleome hirta* (Klotzsch) Oliv.: 81 (1868); Briq.: 363 (1914); Gilg & Bened.: 162 (1915); Burt Davy: 121 (1926); Bremek. & Oberm.: 414 (1935); Exell & Mendonça: 56 (1937); Hauman & Wilczek: 515 (1951); Wild: 199 (1960); Elffers et al.: 12 (1964); Roessler: 10 (1966); Codd & Kers: 127 (1970); Retief & Herman: 365 (1997). *Polanisia hirta* (Klotzsch) Pax: 14 (1888). *Cleome pulcherrima* Buscal. & Muschl.: 467 (1913). *Cleome scheffleri* Briq.: 363 (1914). *Cleome hildebrandtii* Gilg & Gilg-Ben.: 156 (1915). *Cleome giorgii* De Wild.: 14 (1927). *Cleome bechuanensis* Bremek. & Oberm.: 413 (1935).

The Cleomaceae, previously included in the Capparaceae, is a small family closely related to the Brassicaceae that includes about 18 genera and 270 species (Patchell et al. 2014; Roalson & Hall 2017; Roalson 2021). This classification was mainly based on molecular evidence and supplemented by seed morphology (Iltis et al. 2011). The Angiosperm Phylogeny Group (APG) II (2003) makes provision to include Cleomaceae within the Brassicaceae but the South African National Plant Checklist implements the bracketed families, retaining Cleomaceae as a separate family from the Brassicaceae (Victor et al. 2024).

Cleomaceae is characterised by its herbaceous or suffrutescent nature, palmately compound (rarely simple) leaves, racemose inflorescences with zygomorphic four-merous flowers, petals and stamens curving upwards, the gynoecium with a gynophore and two carpels, stamens on long filaments, dehiscent capsules lacking a septum and seed testa with pronounced invagination (Stevens 2001; Iltis et al. 2011; Patchell et al. 2014; APG IV 2016; Tucker 2020; Messina 2024). Members of the family are distributed throughout the tropics and warm temperate regions across the world (Feodorova et al. 2010; Messina 2024).

Cleomaceae is based on the type genus, *Cleome* L. The name, *cleome*, is of obscure origin, potentially taken from the Greek word 'kleos' referring to glory or named after Kleio (Clio), the Greek muse of history; or paying tribute to the Spartan king, Cleomenes (Messina 2024). *Cleome* was already in use in pre-Linnean times and Linnaeus (1753) formally recognised eight species in his *Species Plantarum*.

Generic boundaries within the Cleomaceae have been in flux and, as a result, most species recognised within the family already have a nomenclatural combination within *Cleome* (Roalson 2021; Thulin 2022). Molecular studies based on nuclear, mitochondrial and chloroplast markers (Hall et al. 2002; Sánchez-Acebo 2005; Hall 2008; Inda et al. 2008; Feodorova et al. 2010; Patchell et al. 2011, 2014; Barrett et al. 2017), and, more recently, a phylogenomics study (Saunders et al. 2024), indicate that *Cleome*, in a narrower sense, is

PLATE 2415.—1, inflorescence with showy pink and yellow flowers and long linear-falcate capsules subtended by foliaceous bracts, the peduncle densely covered with viscid glandular hairs, × 1; 2, frontal view of flower, × 3; 3, side view of flower, × 1.5; 4, mature leaf, × 1. Voucher specimen: Bester & Van Zyl 19451 in National Herbarium (PRE), Pretoria. Artist: Isabelita van Zyl.

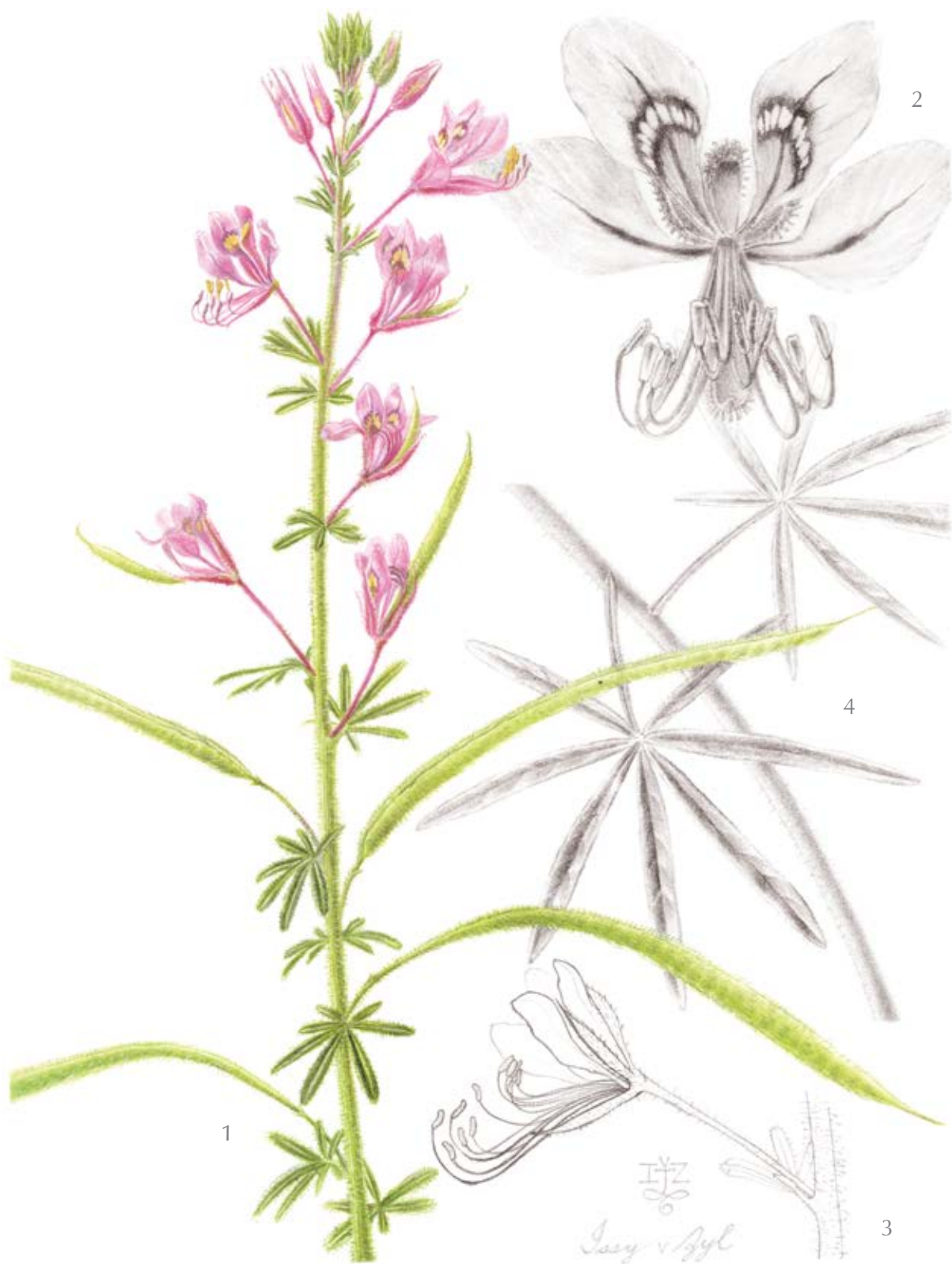


PLATE 2415 *Sieruela hirta*

paraphyletic. Prior to the Saunders et al. (2024) study, there have been three contemporary efforts moving forward in parallel to establish monophyletic genera. Firstly, attempts have been made to establish a monophyletic *Cleome* by breaking the genus into smaller, monophyletic genera using morphologically diagnosable characters (Iltis & Cochrane 2007, 2014; Cochrane & Iltis 2014; Roalson et al. 2015; Barrett et al. 2017; Roalson & Hall 2017; Roalson 2021). The taxonomic revisions are currently ongoing. Secondly, a larger, single genus has been suggested or implemented by various authors (e.g., Gilg & Benedict 1915; Pax & Hoffmann 1936; Iltis 1952; Kers 1973; Mabberley 2017 – excluding *Dipterygium* Decne, see Roalson [2021] for an extensive summary of literature references). Thirdly, Christenhusz et al. (2018) implemented a hybrid system, recognising four monophyletic genera (*Cleome*, *Cleomella* DC., *Peritoma* DC. and *Rorida* J.F.Gmel.). However, Saunders et al. (2024) presents a comprehensive phylogeny with expanded sampling and mostly resolved generic boundaries that supports the first solution.

In southern Africa, *Cleome* in its strict sense includes 22 species (of which two are naturalised or cultivated), two subspecies and five varieties. With the implementation of a narrow and monophyletic concept of *Cleome*, five genera are recognised and the name *Cleome* no longer applies to them. The segregate genera are:

- *Coalisina* Raf. represented by two species – *C. angustifolia* (Forssk.) Raf. and *C. semitetrandra* (Sond.) Roalson & J.C.Hall.
- *Gynandropsis* DC. represented by the monotypic *G. gynandra* (L.) Briq.
- *Kersia* Roalson & J.C.Hall represented by six species – *K. carnosa* (Pax) Roalson & J.C.Hall, *K. foliosa* (Hook.f.) Roalson & J.C.Hall, *K. kalachariensis* (Schinz) Roalson & J.C.Hall, *K. laburnifolia* (Roessler) Roalson & J.C.Hall, *K. paxii* (Schinz) Roalson & J.C.Hall and *K. suffruticosa* (Schinz) Roalson & J.C.Hall.
- *Sieruela* Raf. represented by 11 species – *S. bororensis* (Klotzsch) Roalson & J.C.Hall, *S. conrathii* (Burt Davy) Roalson & J.C.Hall, *S. elegantissima* (Briq.) Roalson & J.C.Hall, *S. hirta* (Klotzsch) Roalson & J.C.Hall, *S. iberidella* (Welw. ex Oliv.) Roalson & J.C.Hall, *S. macrophylla* (Klotzsch) Roalson & J.C.Hall, *S. maculata* (Sond.) Roalson & J.C.Hall, *S. monophylla* (L.) Roalson & J.C.Hall, *S. oxyphylla* (Burch.) Roalson & J.C.Hall, *S. rubella* (Burch.) Roalson & J.C.Hall and *S. schlechteri* (Briq.) Roalson & J.C.Hall.
- The naturalised *Tarenaya* Raf. represented by two species – *T. houtteana* (Schltdl.) Soares Neto & Roalson and *T. spinosa* (Jacq.) Raf.

Both *Sieruela elegantissima* and *S. rubella* are morphologically similar to *S. hirta*, sharing pinkish flowers (with a yellow band or spot on the medial petals in *S. elegantissima* and *S. hirta*, Figure 1b), persistent leaf-like bracts and stems that are sparsely to densely covered by viscid glandular hairs (Codd & Kers 1970). However, *S. hirta* differs from *S. elegantissima* in being a taller plant, up to 1.5(–2.5) m tall, with prominent viscid glandular hairs (as illustrated in the colour plate), filaments covered with glandular hairs from the base upwards to the middle third, and subcircular seeds with rugose ridges and irregularly shaped protuberances (compared to being up to 0.5 m tall, stems subglabrous or less glandular hairy, filaments glabrous, and comma-shaped seeds rugose but lacking protuberances in *S. elegantissima*). *Sieruela hirta* differs from *S. rubella* in being a larger plant (up to 1.5[–2.5] m tall, Figure 1d)



FIGURE 1.—Morphology of *Sieruela hirta*: a, typical palmately digitate leaf; b, a pinkish flower with two yellow spots on the median petals; c, persistent, leaf-like bracts; d, habit, showing its occurrence on a road verge; e, linear capsules. Photographs: a–c, e, R. Fourie (<https://www.inaturalist.org/observations/168094610>); d, Silvia (<https://www.inaturalist.org/photos/216780629>).

while *S. rubella* is consistently smaller (up to 0.4 m tall) in all its components. In *S. hirta*, the median petals have a yellow band, anther filaments are covered with glandular hairs around the base and often also on the lower two thirds, and seeds are subcircular, rugose and with irregular protuberances (Figure 2) while in *S. rubella*, the median petals are pink only, anther filaments glabrous, and the seeds broadly comma-shaped, rugose, but lacking protuberances.

Sieruela hirta occurs from Somalia and Ethiopia in northeast tropical Africa, southwards through east tropical Africa and the eastern parts of west central tropical Africa, southwards through the eastern half of south tropical Africa, southwards into southern Africa. In southern Africa, *S. hirta* is restricted to Namibia, Botswana, Eswatini and the provinces of Limpopo and Mpumalanga in South Africa (Figure 3). It is common in savanna but is also found in grassland. It usually grows in sandy soils and is often collected in disturbed areas, like roadside verges or river beds. Collection next to the road might be biased but *S. hirta* has been reported to be a pioneer, and therefore flourishes in disturbed areas (S.P. Bester, pers. comm.).

While measuring the flower parts on specimens and comparing them with the measurements in descriptions by Wild (1960) for south tropical Africa, Elffers et al. (1964) for east tropical Africa, and Codd & Kers (1970) for southern Africa, it was interesting to note



FIGURE 2.—Seeds of *Sieruela hirta*, showing their subcircular to somewhat oblong shape and diagnostic longitudinal and transverse rugose ridges with irregularly shaped protuberances. Vouchers: a, Levy 35 (PRE); b, Codd & Kers 7613 (PRE); c, Uiras MU746 (PRE). Photographs: a–c, M.M. le Roux & D.M. Ramafalo.

that the length of the gynophore did not match the published descriptions. This could be that the variation observed by others were not present in the specimens studied here. Measurements of the gynophore, ovary and style were explicitly taken for this paper where the flowers were fully open and have reached anthesis but where the ovaries have not yet started developing (i.e., before fertilisation). In mature flowers with undeveloped gynoecia, the gynophores were ± 0.2 to 0.3 mm long. The descriptions by Wild (1960) and Codd & Kers (1970) both noted that the gynophores were 2 mm long, ‘even when young’. Upon closer inspection it was found that flowers on the same inflorescence reach anthesis at different times. On a single inflorescence, some flowers reach reproductive maturity before their petals have fully emerged, while other flowers have synchronised petal emergence and reproductive maturity. In the former, self-fertilisation takes place (Figure 4a), whereas in the latter the opened petals serve as advertisement to attract pollinators, allowing the

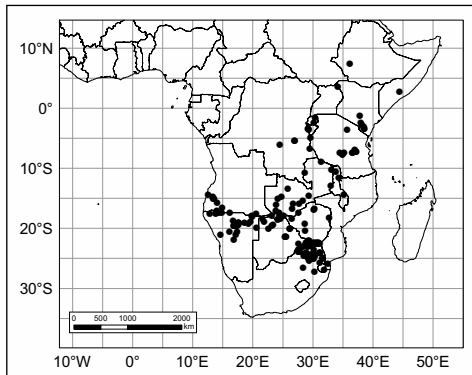


FIGURE 3.—Known geographical distribution of *Sieruela hirta*.

opportunity for cross-pollination (Figure 4b, c). This ensures that cross-pollination can take place in older flowers first, but if pollination does not occur, or if the rate of pollination is too low due to unfavourable conditions, self-pollination will ensure seed set. This reproductive strategy potentially contributes to its success as a pioneer. *Gynandropsis gynandra*, another southern African species, has been reported to cross- and self-pollinate (Raju & Rani 2016).

The common name for *Sieruela hirta* is 'sticky purple cleome' (Drummond & Plowes 1976). The roots are used to treat stomachache (Kokwaro 1976); the leaves to reduce hypertension (Ruffo et al. 2002), treat pneumonia, tuberculosis, fungal skin infection, malaria (Chinsebu 2016) and menstrual pains (Shemdoo et al. 2009); the roots and leaves to treat measles (Ruffo et al. 2002); and the essential oils to ward off ticks and weevils (Ndungu et al. 1999; Ruffo et al. 2002). The young shoots and leaves are also eaten as a vegetable (Ruffo et al. 2002).

Description.—Annual or short-lived perennial herb, up to 1.5(–2.5) m tall. *Stems* striate, (1.8–)2.7–6.6 mm in diameter, covered with viscid glandular hairs, often with smaller axillary leaves present. *Stipules* absent. *Leaves* palmately digitate, (3–)5–9(–11)-foliolate; petiole up to 50(–70) mm long, covered with viscid glandular hairs; leaflets linear to (sometimes) oblanceolate to narrowly elliptic, terminal leaflets 15–50(–70) × 1–5(–6) mm, leaflet apices acute to rounded, cuneate at the base, viscid glandular hairs on both sides. *Inflorescences* terminal racemes with 7–20 flowers that greatly elongate during fruiting. *Bracts*

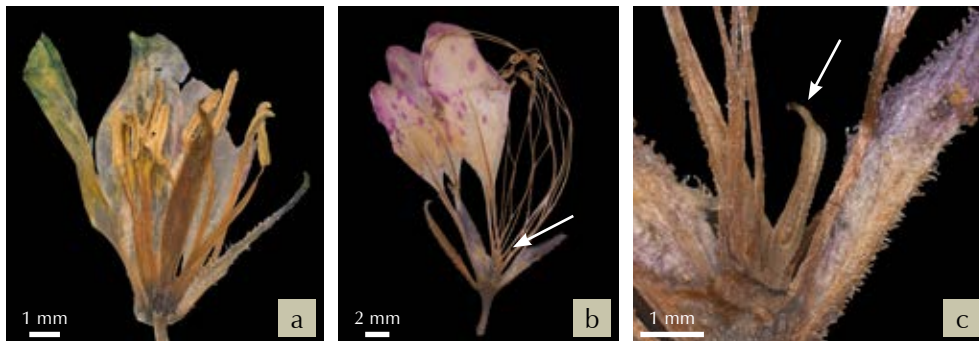


FIGURE 4.—Gynophore of *Sieruela hirta*: a, fertilised ovary in a young flower that has already reached reproductive maturity while the petals are starting to unfold (note the similar lengths of the anther filaments); b, a mature flower that has reached reproductive maturity but that has not yet been fertilised (note the small ovary with short gynoeceum and different lengths of the anther filaments); c, a close-up of the unfertilised gynoeceum. Vouchers: a, Meeuse & Strey 10439 (PRE); b, c, Robson 1609 (PRE). Photographs: a–c, M.M. le Roux & D.M. Ramafalo.

similar to leaves but smaller in size, (1–)3–5-foliolate. *Pedicels* $\pm$ 8–19 mm long. *Sepals* 4, linear, 6.5–10.0(–12.0) mm long, subulate, covered with glandular hairs. *Petals* 4, pink to purple with a yellow band across the 2 median petals, 2 lateral petals lacking a yellow band; oblanceolate, petal claws 4.5–12.0 mm long, petal lamina 8–16 $\times$ 2.0–6.5 mm. *Stamens* 9–12; filaments slender, purple, up to 27(–32) mm long, glandular hairs present from base towards middle $\frac{1}{3}$; anthers linear-oblong, yellow, up to $\pm$ 2.0–2.5 mm long. *Gynoecium* linear, up to 2.5(–5.0) mm long, covered with viscid glandular hairs; gynophore $\pm$ 0.2–0.3 mm long (reported to be 2.0 mm long in tropical African material, even in immature flowers, see Wild [1960]); style 0.6(–2.0) mm long in open, mature but unpollinated flowers. *Capsules* linear to (sometimes) falcate, 60–140(–170) mm long in total length, gynophore 9–12(–15) mm long, striate and covered with glandular hairs. Seeds subcircular to somewhat oblong, light to dark brown, 2.0–2.7 $\times$ 1.5–2.5 mm, covered with longitudinal and transverse rugose ridges and irregularly shaped protuberances, glabrous. Plate 2415.

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*Thesium celatum*Santalaceae: *Psilothersium*

South Africa

***Thesium celatum* N.E.Br.** in A manual of the flowering plants and ferns of the Transvaal with Swaziland, South Africa 2: xxxii, 458, 461 (1932); Lombard & Le Roux: 100 (2023).

Thesium L. is a root hemiparasitic genus in the order Santalales. The Santalales includes 14 families, 151 genera and 1 992 species that are parasitic to various degrees, sucking nutrients from the roots or stems of their hosts via haustoria (Stevens 2001 onwards). *Thesium* forms part of the family Santalaceae R.Br., nom. cons., or Thesiaceae Vest along with 40 other genera, including the well-known mistletoe genus, *Viscum* L. (POWO 2024).

The genus *Thesium* includes about 350 species that occur across the world, except in Antarctica (García et al. 2024). *Thesium* is, however, most prolific in South Africa with about 170 species (Lombard & Le Roux 2023). All species are root parasites that take on various habits, from annual herbs to perennial herbs, subshrubs and shrubs, adjusted to their survival strategies in particular ecologies (García et al. 2024). Vegetative features are rather plastic but other general diagnostic characters include the linear or scale-like leaves lacking petioles and dry, nut-like fruits that often have elaiosomes (Visser et al. 2018; Lombard & Le Roux 2023; García et al. 2024).

Because of their plastic nature, coupled with their inconspicuous and nondescript appearance – e.g., *Thesium davidsoniae* Brenan, *T. inversum* N.E.Br., *T. litoreum* Brenan and *T. subsimile* N.E.Br. – *Thesium* species are often overlooked and under-collected (Hilliard 2006; Visser et al. 2018; García et al. 2024). Some species occur in remote areas or are only known from poor type collections and incomplete protologue descriptions, e.g., *T. procerum* N.E.Br., before its revision by Visser et al. (2018). All of these aspects contribute to the problematic nature and outdated taxonomy of the genus (Hilliard 2006; Visser et al. 2018; García et al. 2024). Occasionally, a collection or observation is made that significantly expands our knowledge of one of these little-known species. *Thesium celatum* N.E.Br. is one of those cases.

Thesium celatum was described in 1932 by N.E. Brown from a single known specimen collected by the British missionary, Frederick Arundel Rogers. The specimen features only two short branches (Figure 1), each about 200 mm long, and does not indicate the size or growth form of the plant. It only has a handful of flowers (containing important diagnostic structures) and no fruit. The type specimen was collected at Zandrivijs Poort in the Waterberg, Limpopo, South Africa, an area now largely transformed by agriculture. Brown (1932) provided only a short description of the species (Figure 2). Although *T. celatum* has not been included in phylogenetic studies (Zhigila et al. 2020; García et al. 2024), it should be placed in subgenus *Psilothersium* based on its flat leaves, bracts surpassing the tops of the flowers and subtropical distribution (Zhigila et al. 2020).

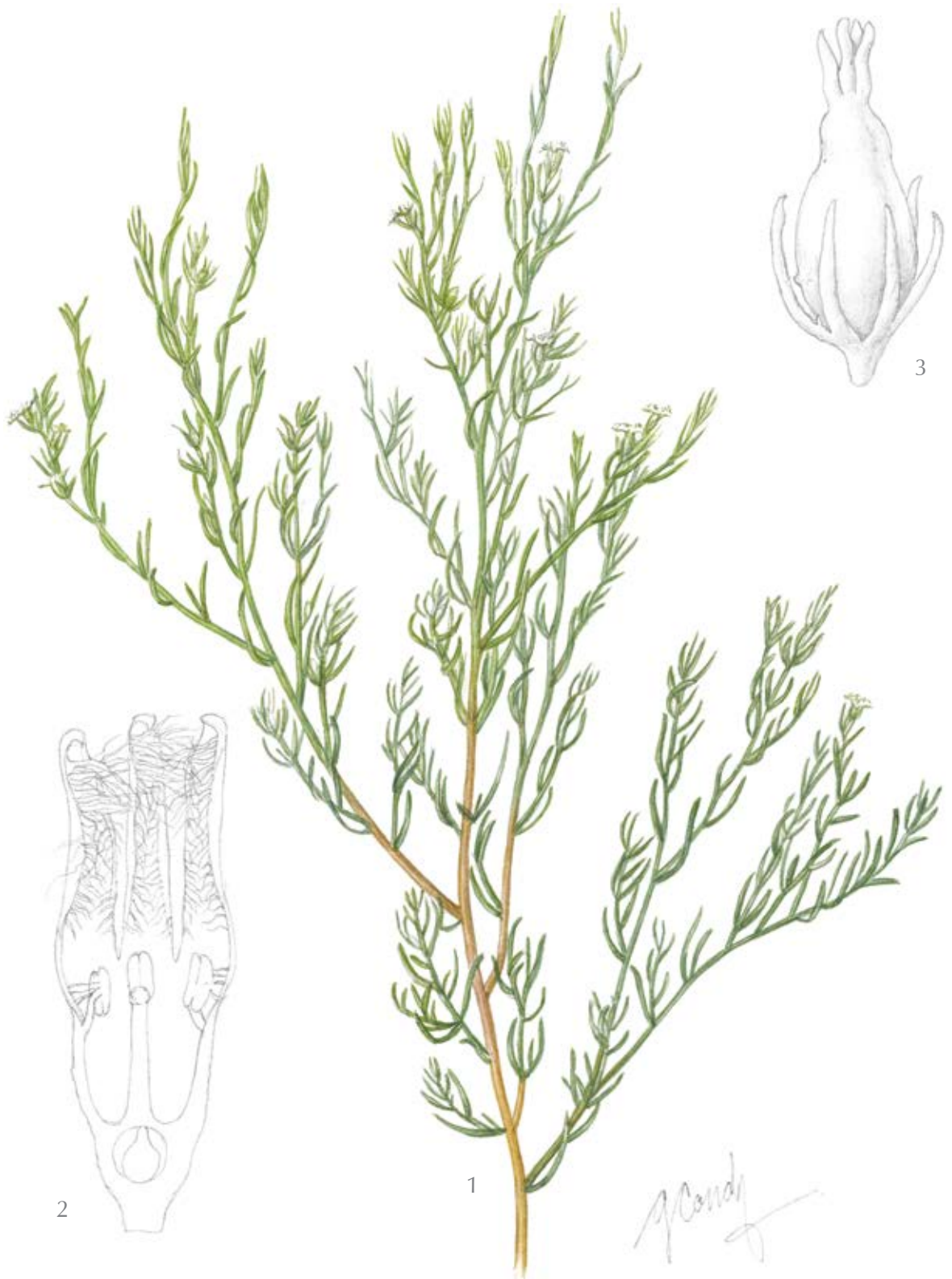


PLATE 2416 *Thesium celatum*



FIGURE 1.—The only known type specimen of *Thesium celatum* (holotype: K000431771). © Board of Trustees of the Royal Botanic Gardens, Kew, England. Available at: <http://specimens.kew.org/herbarium/K000431771>.

127. *T. celatum* N.E. Br., sp. nov. Caules annui 10–15 cm. longi, e caulo lignoso 4 mm. diametro fasciculatim ramosi; folia 8–20 mm. longa, 0.5–1 mm. lata, ascendunt, supra plana, infra convexa, costa inconspicua, marginibus laevibus; flores circiter 3–6-nati, foliis et bracteis occulti, ovario incluso 4–5 mm. longi; bractea et bracteolae floribus maturis 2–3-plo longiores; calycis lobi fere lineares, 2.5 mm. longi vel ultra, basi leviter latiores, tubo duplo longiores, apicem versus barba parva instructi, marginibus minute papillati; stylus calycis tubo aequalis, 1–1.25 mm. longus.—Waterberg Distr., Zandriviers Poort, Rogers 24973! typus.

FIGURE 2.—A scan of the original protologue description of *Thesium celatum*. Taken from Brown (1932), page xxxii.

Recent field studies in the Waterberg area revealed numerous populations of what was determined to be *Thesium celatum* (see Lombard & Le Roux 2023). Lombard & Le Roux (2023) published a detailed description of the species and its known populations. Since then, several more observations of *T. celatum* have been made in the same area, on the iNaturalist platform (see: <https://www.inaturalist.org>). Current data indicates that it is endemic to Limpopo, between Grootwater Nature Reserve, Naboomfontein and Rankin's Pass, with one isolated collection near Brits, North West (Lombard & Le Roux 2023; Figure 3). While it is probable that more populations remain undiscovered, parts of its natural distribution range have been lost to urban expansion and agricultural practices, and the population is considered to be declining. As a result, the threat status of *T. celatum* has been evaluated as Vulnerable (VU) by Lombard & Le Roux (2023).

Little is known about the life history and ecology of *Thesium celatum*. It usually occurs in sandy soils in open grassy savanna or rocky areas between 1 200 and 1 625 m a.s.l. (Lombard & Le Roux 2023; Figure 4). It has been observed in Waterberg Mountain Bushveld, Central Sandy Bushveld and Gold Reef Mountain Bushveld, and may also occur in Moot Plains Bushveld (sensu the vegetation classification of Mucina & Rutherford 2006). It is rare for *Thesium* species to occur in bushveld habitats and, when they do occur there, plants are usually

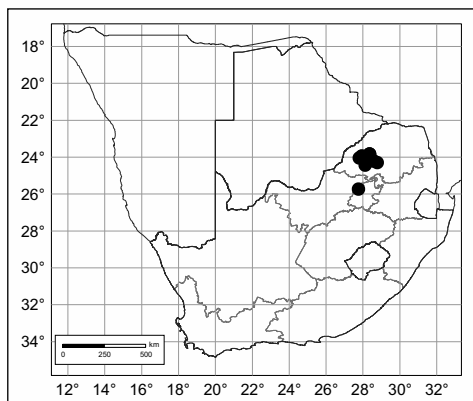


FIGURE 3.—Known geographical distribution of *Thesium celatum*.

restricted to open grassy areas. In total, eight species are recorded from the Waterberg area with five restricted to such grasslands. These include *T. goetzeanum* Engl., *T. magalismontanum* Sond., *T. resedoides* A.W.Hill, *T. resinifolium* N.E.Br. and *T. utile* A.W.Hill. *Thesium celatum*, along with *T. burchellii* A.W.Hill and *T. procerum*, grow in tree-dominated bushveld woodlands in the Waterberg, a less common habitat. These three species share a tall, shrubby, leafy habit, growing up to 1.5 m in height, flowers with lobes bearded on the inner apex, and styles between 0.6 and 1.0 mm long. *Thesium celatum* can be distinguished from *T. burchellii* and *T. procerum* on a number of diagnostic characters that are summarised in Table 1.



FIGURE 4.—Bushveld habitat of *Thesium celatum*: a–e, sandy soils in open grassy savanna and rocky areas between 1 200 and 1 625 m a.s.l. Photographs: a, M. Popp (<https://www.inaturalist.org/observations/105570591>); b, L. Willemse; c–e, S.P. Bester.

Thesium celatum has been observed in flower and fruit in January, February, June, August, September and November, indicating that it likely flowers throughout the year (Lombard & Le Roux 2023), especially in favourable conditions. *Thesium celatum* plants most likely reproduce from seeds. No evidence has been found that they spread via horizontal underground stems like many other summer-rainfall *Thesium* species (e.g., *T. costatum* A.W.Hill and *T. transvaalense* Schltr.). Structures resembling elaiosomes have been observed at the base of some of the nut-like fruits (Figure 5) suggesting that they might be dispersed by ants. Myrmecochory has been confirmed in other *Thesium* species such as the European *T. rostratum* Mert. & W.D.J.Koch (Erbar & Leins 2001) and Asian *T. chinense* Turcz. (Suetsugu 2015).

It is interesting to note that, although many *Thesium* species are highly palatable to a variety of animals, no evidence of grazing has been observed in *T. celatum*. It might be indicative of a less desirable chemical composition. The phytochemistry of many *Thesium* species remains unknown, despite *T. chinense* and *T. viride* A.W.Hill having notable beneficial pharmacological properties, and *T. humile* Vahl, *T. minkwitzianum* B.Fedtsch. and *T. namaquense*

Table 1. Diagnostic characters to distinguish among the three woody *Thesium* species that occur in the bushveld habitat in the Waterberg, Limpopo, South Africa

Characters	<i>T. burchellii</i>	<i>T. celatum</i>	<i>T. procerum</i>
Branching pattern	Erect	Virgate	Intricate
Indumentum	Glabrous	Glabrous to densely verruculose	Glabrous
Leaf length	± 3–10 mm	2–22(–30) mm	3–11 mm
Involucral bracts	Usually present	Usually present	Absent
Bract length	± 3.5–7.0 mm	2–15 mm	4.5–5.5 mm
Inflorescence structure	Flowers solitary or rarely subsolitary	Determinate ‘spike’ or occasional solitary	Determinate ‘raceme’, often with 2- to 3-flowered monochasia or 3-flowered dichasia
Number of flowers in inflorescence	1(–2)	(1)2–6	4–16
Flower length	2.6–3.6 mm	3.5–5.6 mm	2.5–4.0 mm
Flower lobe length	± 1.0–1.5 mm	1.2–2.5 mm	0.9–1.3 mm
Fruit stipe	Not prominent	Not prominent to prominent	Prominent
Fruit dimensions	4.5–6.5 × 2.4–2.9 mm	6.5–8.4 × 2.4–3.2 mm	3.5–5.5 × 2.3–2.8 mm



FIGURE 5.—Fruit of *Thesium celatum* showing the cream-coloured elaiosome-like structures at the base. Photographs: M. Popp (<https://www.inaturalist.org/observations/105570591>, <https://www.inaturalist.org/observations/103889320>).

Schltr. being poisonous (Lombard et al. 2020). Only a few species of *Thesium* have known ethnobotanical uses. Of the 23 species with recorded uses, 17 are present in Africa and 12 in southern Africa. *Thesium* is mostly used as a medicine but is also a functional food and beverage, charm and used in crafts (Lombard et al. 2020). *Thesium utile* is the only species with known uses that occurs in the Waterberg. Its stems are used as brooms or chewed to relieve gastric problems (Lombard et al. 2020). No recorded uses are known for *T. celatum*.

Until now, *Thesium* has been neglected from the *Flowering Plants of Africa* journal, making this treatment of *T. celatum* (Figure 6) the genus' premiere publication and a milestone.

Description (based on Lombard & Le Roux [2023]).—Subshrub or shrub, up to



FIGURE 6.—*Thesium celatum* in the field: a, b, entire plants showing the robust, virgate growth form; c, long, linear leaves; d, example of a plant with a densely verruculose indumentum; e, flower close-up. Photographs: a–e, L. Willemse.

1.2 m in height, with a caudex. *Stems* erect, spreading or virgate, up to 6 mm in diameter, glaucous, glabrous to densely verruculose adaxially only. *Leaves* linear, $2\text{--}22\text{--}(30) \times 0.10\text{--}0.75$ mm, glabrous to variously densely verruculose. *Inflorescences* determinate, spike-like with (1)2–6 flowers, each flower subtended by an involucre of 3–7 bracts, 2–15 mm long. *Flowers* narrowly campanulate, 3.5–5.6 mm long, eglandular and glabrous externally; hypanthium 1.0–1.4 mm long; flower lobes narrowly triangular to linear, 1.2–2.5 mm long, apex slightly cucullate to occasionally cuspidate, inner lobe apices densely bearded with margins fringed. *Stamens* positioned in upper half of hypanthium with anthers either included or occasionally partly exerted from hypanthium; anthers 0.4–0.8 mm long; attached to perianth lobe by hairs. *Gynoecium* with stigma usually positioned below anthers or in lower half of anthers; style 0.6–0.9 mm long; placental column slightly to prominently undulate only (not twisted); ovules (2)3(4). *Fruit* elliptic-globose, $6.5\text{--}8.4 \times 2.4\text{--}3.2$ mm with stipe and

persistent perianth included; stipe (0)0.6–2.2 mm long; perianth 2.4–3.1 mm long; dried fruit striately and reticulately veined, glabrous. *Chromosome number*: unknown. Plate 2416.

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PLATE 2417 *Vangueria triflora*

Vangueria triflora

Rubiaceae

South Africa

Vangueria triflora (Robyns) Lantz in Plant Systematics and Evolution 253(1–4): 181 (2005). *Pachystigma triflorum* Robyns: 184 (1937).

SYNTYPES.—[South Africa, Limpopo], Waterberg Distr., Olifants Poort, 9 miles north of Nylstroom (2428CB), 6 Dec. 1934, *Galpin Herb. No. 13198* (PRE!, BRLU, K, scan!); Zoutpansberg Range; Zoutpansberg District., Jan. 1925, *Smuts s.n.* (PRE 19796), (PRE!).

Robyns (1937) described a new species of *Pachystigma*, namely *P. triflorum* (now *Vangueria triflora*), from the then Northern Transvaal region (now part of Limpopo) of South Africa. This description was based on two syntypes: one collected by E.E. Galpin (*Galpin Herb. No. 13198* [BRLU, K, PRE]) and another by General J.C. Smuts (*Smuts PRE 19796* [PRE]); both specimens have determination labels in Robyns' handwriting. The field labels indicated that these specimens were from the Waterberg and Soutpansberg areas, respectively. According to Robyns (1937), *P. triflorum* is related to *P. macrocalyx* (Sond.) Robyns, a widespread species from the eastern parts of the Flora of southern Africa (FSA) region, based on the habit and the long calyx lobes. However, 'This new species can easily be distinguished by its xerophytic habit, the ashy-coloured leaves, the typical 3-flowered cymes and the form and length of the calyx-lobes' (Robyns 1937: 184) (Figure 1).

The vague locality information on the specimen label of the Smuts syntype, which stated 'District Zoutpansberg' and 'Zoutpansberg Range', has caused uncertainty and necessitates closer examination. If the Smuts specimen was indeed from the Soutpansberg, it would represent the only known record of *Vangueria triflora* from this botanically fairly well-documented mountain range. Norbert Hahn, an expert on the flora of Soutpansberg, included *V. triflora* (as *Pachystigma triflorum*) in his 1994 inventory of Soutpansberg trees with a question mark, indicating uncertainty, but omitted it from a more comprehensive checklist in 2019 (Hahn 1994, 2019). It has also been speculated that the Smuts specimen might be the morphologically very similar-looking *Vangueria dryadum* S.Moore, a common species in the Soutpansberg. Nevertheless, we believe the Smuts specimen, which includes fruit at various stages of development, is indeed *V. triflora*, a species otherwise only known from the Waterberg region (Figure 2).

A critical examination of the Smuts syntype label suggests that the locality information might be misleading or incorrect, as we will argue. The Smuts specimen (PRE 19796) is part of a batch of 82 specimens in the South African National Biodiversity Institute's BODATSA database collected by Smuts (but without collecting numbers), all dated January 1925 and labelled 'District Zoutpansberg', with some additionally marked 'Zoutpansberg Range' (SANBI 2024). The historical Zoutpansberg District was much larger than the Soutpansberg



FIGURE 1.—Flowering stems of *Vangueria triflora*. Photograph: D. Hoare.

Range itself (see, for example, map by Johnston & Johnston 1897). Traveling from Pretoria to the Soutpansberg would have taken Smuts through the Waterberg District and the north-eastern corner of the greater Waterberg region, which at that time was part of the Zoutpansberg District. Although none of these January 1925 specimens mention the Waterberg District as their locality, it is very likely that Smuts collected herbarium specimens in this district on his way to the Soutpansberg. While many of the January 1925 specimens are from the Soutpansberg (based on the distribution of the species represented), the name of this mountain range was likely incorrectly written on the label of *Smuts* PRE 19796, which must have been collected in the Waterberg District, or possibly the Waterberg part of the bordering Zoutpansberg District. This interpretation is supported by the fact that Smuts' January 1925 collections of other typical Waterberg species, often associated with *V. triflora*, were similarly labelled as from the Soutpansberg District/Soutpansberg Range, such as *Kirkia wilmsii* Engl. (*Smuts* PRE 30596), *Strychnos cocculoides* Baker (*Smuts* PRE 49941) and *Vitex pooara* Corbishley (*Smuts* PRE 39777). Note that we have assumed the January 1925 collection date is correct. However, if this date is incorrect, there is a slight possibility that these specimens were collected by Smuts in December 1928 during an expedition with the renowned Kew botanist, John Hutchinson, and others, who travelled from Pretoria to Soutpansberg and the Limpopo River (Hutchinson 1946).

The tribe Vangueriae has been known for its morphologically very similar and poorly defined genera (Robyns 1928; Verdcourt 1958, 1981, 1987; Boshoff 1987; Verdcourt & Bridson 1991; Bridson 1996, 1998). To quote two authorities on Rubiaceae: ‘*Tapiphyllum* is no more than a velvety *Pachystigma* and some South African species are certainly intermediate in character...’ (Verdcourt 1981: 541) and ‘The distinction between *Pachystigma* and *Lagynias* is in need of clarification...’ (Bridson 1996: 346).

In a publication, mainly based on molecular data and a phylogenetic approach towards classification, Lantz & Bremer (2005) concluded that the genera *Ancylanthos*, *Lagynias*, *Pachystigma* and *Tapiphyllum*, and the three species *Fadogia agrestis* Schweinf. ex Hiern, *Rytigynia fuscetulososa* Verdc. and *Rytigynia induta* (Bullock) Verdc. & Bridson, belong to the genus *Vangueria*. According to Lantz & Bremer (2005) the newly and more broadly circumscribed genus *Vangueria* is recognised by a combination of characters, including: domatia rarely present, inflorescences usually borne at nodes from which the leaves have fallen, bracteoles small (usually not more than 1 mm in length), smooth retrorse hairs in the corolla, ovaries with three to five locules, and relatively large fruits (> 10 mm in length).

An interesting feature of the tribe Vangueriae is the presence of a pollen presenter – a modification of the style and stigma to form a structure on which the pollen is deposited (Ladd & Donaldson 1993). The anthers surround and are appressed against the pollen presenter in the flower bud. Just before anthesis, the anthers release pollen which adheres to the pollen presenter and is then exposed during anthesis, presenting the pollen to potential pollinators (Tilney et al. 2014).

Vangueria triflora is endemic to Limpopo, South Africa, and near-endemic to the Waterberg (Figure 2), if the locality of the Smuts specimen is correct. This species is found on rocky mountain slopes, mainly in sandy soils derived from quartzite or sandstone. It is restricted to the Savanna Biome and is found in Waterberg Mountain Bushveld and Central Sandy Bushveld (Mucina & Rutherford 2006). *Vangueria triflora* mainly flowers in summer (October to January) (SANBI 2024) and the flowers are greenish yellow to yellow with strongly reflexed corolla lobes (Figure 1, 3k). Its distribution is sympatric with *V. parvifolia* Sond. (= *Tapiphyllum parvifolium* (Sond.) Robyns) but *V. triflora* could also be confused with morphologically similar species like *V. dryadum* (= *Lagynias dryadum* (S.Moore) Robyns) (both species have strongly reflexed corolla lobes) and *V. macrocalyx* Sond. (= *Pachystigma macrocalyx*) (Figure 3). These four species are all shrubs or small trees with relatively small, velvety leaves. Prior to 2005 these taxa were treated in three different genera (see Robyns 1928). Distinguishing morphological characters can be found in Table 1.

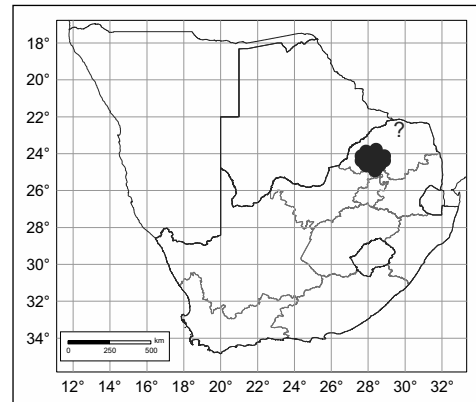


FIGURE 2.—Known geographical distribution of *Vangueria triflora* in southern Africa based on herbarium records; ? depicts the possible locality in the Soutpansberg based on Smuts PRE 19796 (PRE).



FIGURE 3.—A comparison of leaf, flower and fruit morphology: a–c, *Vangueria dryadum*; d–f, *V. macrocalyx*; g–i, *V. parvifolia*; j–l, *V. triflora*. Photographs: a–c, e, f, T. van der Merwe; d, L. Löffler; g–i, H.M. Steyn; j–l, S.P. Bester.

TABLE 1.—Comparison of characters used to distinguish among four southern African *Vangueria* species with small, velvety leaves. (Robyns 1937; Boshoff 1987; Coates Palgrave 2002; Boon 2010; Van Wyk & Van Wyk 2013; Burrows et al. 2018)

Characters	<i>V. dryadum</i>	<i>V. macrocalyx</i>	<i>V. parvifolia</i>	<i>V. triflora</i>
Distribution in FSA region	South Africa (Limpopo)	South Africa (Limpopo, Mpumalanga, KwaZulu-Natal, Eastern Cape), Eswatini	Botswana, South Africa (Limpopo, Gauteng, North West, Mpumalanga)	South Africa (Limpopo)
Habitat	Mixed woodlands, riverine thicket and hillslopes, in rocky places	Grassland or bushveld, on rocky outcrops and mountain slopes	Bushveld, on rocky outcrops	Bushveld, on rocky outcrops/ridges
Leaf colour	Distinctly bicoloured (especially when dry)	Slightly bicoloured	Slightly bicoloured	Slightly bicoloured
Leaf size (mm)	10–40 × 5–20	25–45 × 18–25 (–30)	(10–)15–40 × 10–30	10–20 × 5–10
Leaf shape	Oblong-elliptic, rounded at both ends	Ovate to elliptic, rounded at apex, rounded to tapering at base	Ovate to almost round, shortly tapering at apex, truncate to rounded at base	Narrowly elliptic, rounded at apex, shortly tapering at base
Leaf venation (abaxially)	Secondary veins conspicuous	Secondary veins usually conspicuous	Secondary veins conspicuous	Secondary veins inconspicuous
Petiole length (mm)	2–3	3–7	1(–3)	1.0–1.5
Inflorescences	2- to few-flowered	Few- to many-flowered	3- to 7-flowered	Usually 3-flowered
Peduncle length (mm)	5–8	up to 3	± obsolete	3.5–5.0
Calyx lobes length (mm)	7–10	6–10	1–2	6–7
Calyx lobes (shape)	Oblanceolate, spatulate or narrowly elliptic	Linear to narrowly oblong or oblanceolate	Triangular to oblong	Narrowly elliptic
Corolla tube length (mm)	5–6	4.0–4.5	2	3.0–3.5
Corolla (colour)	Greenish yellow to cream	Greenish yellow to cream	Greenish	Greenish yellow to yellow
Corolla lobes (during anthesis)	Strongly reflexed	Spreading	Spreading	Strongly reflexed
Style exerted (mm)	5–7	2	1.0–1.5	2.0–3.5
Fruit when ripe	Brown, 20–25 mm in diameter (Feb.–Mar.)	Orange-yellow, 20 mm in diameter (Dec.–Feb.)	Brown or reddish, 10–15 mm in diameter (Jan.–Mar.)	Orange-brown, 8–12 mm in diameter (Jan.–May)

The specific epithet, *triflora*, is in reference to the fact that this species typically bear 3-flowered cymes. *Vangueria triflora* is currently listed as Least Concern (LC) on the Red List of South African Plants (Raimondo et al. 2009) and common names listed for the species include Waterberg medlar, Waterberg crowned medlar, and *waterbergkroonmispel*, *waterbergmispel* (Afrikaans) (Van Wyk et al. 2011).

No uses or toxic effects of *Vangueria triflora* have been recorded. However, other members of the genus are widely known for their medicinal properties and magical cultural practices. Some *Vangueria* species (including *V. infausta*, *V. macrocalyx* and *V. parvifolia*) have edible fruit and are used medicinally, as an aphrodisiac or a protective charm (Boon 2010; Van Wyk & Van Wyk 2013; Burrows et al. 2018). The fruit of *V. infausta* contains high levels of vitamin C, calcium and magnesium, while leaves are browsed by wildlife (Boon 2010; Van Wyk & Van Wyk 2013). Medicinal uses to treat malaria, chest troubles and tick bites were reported by Watt & Breyer-Brandwijk (1962), Behr (2004), Van Wyk & Van Wyk (2013) and Maroyi (2018). According to Behr (2004), *V. infausta* is believed to possess evil powers and the wood is not used for fires, as it is believed that it could cause cattle to bear only male offspring. Certain species of *Pachystigma* (now included in *Vangueria*) cause *gousiekte* (quick disease) in ruminants. The majority of animals typically drop dead due to heart failure four to eight weeks after ingestion (Steyn 1927; Watt & Breyer-Brandwijk 1962; Van Wyk et al. 2002; Kellerman et al. 2005).

Description (based on Robyns [1937] and Boshoff [1987]).—Small tree or shrub, deciduous, approximately 5 m tall. Leaves petiolate; petiole 1.0–1.5 mm long, greyish tomentose; lamina narrowly elliptic, 10–20 × 5–10 mm, shortly attenuate at base, apex rounded, often with recurved margins, tomentose on both sides, slightly bicoloured, midrib distinctly prominent on lower surface, secondary veins inconspicuous. *Stipules* 0.5–2.0 mm long, greyish tomentose, eventually deciduous. *Inflorescences* cymes at nodes of usually leafless new branches, typically 3-flowered but often by abortion 2-flowered or even 1-flowered, bracteolate, entirely greyish tomentose, attaining 15–18 mm in length, distinctly pedunculate; peduncle somewhat thickened, 3.5–5.0 mm long. *Flowers* with buds oblong, distinctly apiculate, densely pubescent, pedicellate; calyx lobes somewhat spreading at anthesis, narrowly elliptic, obtuse to acute at apex, 6–7 × 2 mm, tomentose on both sides; corolla tube cylindrical, approximately 3.0–3.5 mm long, densely pubescent externally, with a ring of reflexed hairs inside, lobes lanceolate, apiculate, strongly reflexed, 6–7 mm long of which 1.0–1.5 mm for the apiculus, shortly pubescent externally; anthers subsessile, lanceolate; style slender, 4.5 mm long; pollen presenter cylindrical, 5-lobed, 1.5 mm long, exserted 2.0–3.5 mm; disc annular, smooth; ovary 5-locular. *Fruits* orange-brown when ripe, 8–12 mm in diameter, crowned with persistent calyx lobes. Plate 2417.

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PLATE 2418 *Streptocarpus decipiens*

Streptocarpus decipiens

Gesneriaceae

South Africa

Streptocarpus decipiens Hilliard & B.L.Burt, *Streptocarpus* an African plant study: 388 (1971).

Streptocarpus decipiens is a distinctive miniature species of *Streptocarpus* that bears the smallest flowers (up to 4 mm long) known in the genus, with corollas narrowed towards the mouth. The plants grow to about 70 mm (or rarely 100 mm) tall and bear narrowly elliptic to narrowly obovate opposite to subopposite leaves on upright stems. The species occurs on the edge of the escarpment, north of Graskop in Mpumalanga, and has been listed as one of the endemics of the Limpopo–Mpumalanga–Eswatini Escarpment (Clark et al. 2022).

A very similar taxon grows nearer to Graskop. It has mistakenly been identified as *Streptocarpus decipiens*, as it shares the unique habit of that species, but the corollas are larger and flare out at the mouth. In this manuscript, we document the rediscovery of *S. decipiens sensu stricto* (s. str.) and indicate differences from the, as yet unnamed, Graskop taxon, which thus requires description as a new species.

Hilliard & Burt (1971) named *Streptocarpus decipiens* with the specific epithet meaning ‘deceptive’, alluding to it at first appearing to belong to the subgenus *Streptocarpella*. *Streptocarpella* is characterised by having a stem, no abscission zone in the leaf, no basal meristem in the leaf, the base of the leaf clearly differentiated from the petiole, the inflorescences axillary and a chromosome number of $2n = 30$. Closer examination of the first leaf produced, which is only about 20 mm long, revealed an abscission zone and withered tip, suggesting that it was a phyllomorph rather than a leaf and that it has a basal meristem. The apparent stems are peduncles and the apparent upper leaves are bracts. The phyllomorphs and bracts have attenuate bases and do not have clearly differentiated petioles. The inflorescences are produced at the junction of the ‘petiole’ and the lamina of the phyllomorphs. In addition, the chromosome number is $n = 16$ (Ratter & Milne 1970) or $2n = 32$ (Hilliard & Burt 1971). These characters definitively place *S. decipiens* in subgenus *Streptocarpus*. A phylogenetic study based on the internal transcribed spacers and 5.8S region of nuclear ribosomal DNA places *S. decipiens* in the clade that largely represents subgenus *Streptocarpus* and closest to *S. galpinii* Hook.f. (Möller & Cronk 2001). A later study, including more gene regions and additional taxa, placed *S. decipiens* in a clade with *S. galpinii* and *S. micranthus* C.B.Clarke (Nishii et al. 2015).

On 14 February 2023, two of us (KB and SA) were investigating an undescribed species of *Syncolostemon* E.Mey ex. Benth. near Watervalsspruit in the Blyde River Canyon Nature Reserve, when we found some colonies of a small *Streptocarpus* growing in deep overhangs of large boulders. At first, we, like many others, identified it as *S. decipiens*. However, upon

PLATE 2418.—1, habit, $\times 2$; 2, front view of flower $\times 4$; 3, side view of flower $\times 4$; 4, top view of flower $\times 4$; 5, ovary $\times 6$; 6, stamens $\times 6$; 7, capsule $\times 10$. Voucher specimen: Balkwill & Attwood 14879 in C.E. Moss Herbarium (J), Johannesburg. Artist: Jenny Hyde-Johnson.

further reflection, we were puzzled as to why Hilliard and Burtt had not found the species at this much more accessible site rather than at Hebronberg, the species' type locality. More careful reading of the account of the species (Hilliard & Burtt 1971) and scrutiny of the drawings of the flower (Figure 37: 1a and 1b in Hilliard & Burtt 1971) revealed a significant difference: the most striking feature of the flower of our plant was how the corolla flared out very significantly distally, whereas the drawing showed the corolla narrowing towards the throat. Hilliard & Burtt (1971) had mentioned that the corolla was much swollen at the base, but nothing about it flaring distally. Knowing that Hilliard and Burtt had been given flowering material in spirit, that they had seen the plant in the field and that they were far too meticulous to have made such a mistake, it was decided that the matter needed further investigation. Holotype and syntypes are available on Global Plants (<https://plants.jstor.org/>), however, it is not possible to make a decision based on minute, dry, flattened flowers, and a visit to the type locality was required.

On 9 April 2023, three of us (KB, SA and DO) set off for Mariepskop, with the aim of climbing the Hebronberg the next day. The first specimen of this species, *Miller s.n. sub PRE 30495* in the National Herbarium, Pretoria (PRE), was collected by Victor Miller, a businessman from Polokwane (then Pietersburg), in April 1967 and the locality is noted as 'Mariepskop Forestry Area'. We, like Hilliard and Burtt, assumed this meant that the species occurred somewhere on Mariepskop. Hilliard & Burtt (1971) 'had searched with diligence and backache under the rock outcrops on the top of Mariepskop' with no success and we also had no success in finding the species on Mariepskop over two days in April 2023. Re-examination of the relevant 1:50 000 map (2430DB) (Chief Directorate: Surveys and Mapping 2001) showed that the Mariepskop Forest area included most of the farm Magalieskop and that the northern section of the Hebronberg was on that farm. Thus, with a new understanding, it was surmised that this was possibly where Victor Miller had collected his specimen.

In 1968, while Hilliard and Burtt were staying on Mariepskop, Victor Miller and Clifford 'Potty' Thompson took them up the Hebronberg, stating, 'Mr. Miller and Mr. Thompson joined us there and took us across the valley and up a gully in the cliffs that seem, at a distance, to bar the ascent to Hebronberg from this side' (Hilliard & Burtt 1971). Upon using Google Earth in an attempt to find which gully they had used to ascend the Hebronberg, it was decided on the large gully that divided the Hebronberg from the Mulford Plateau (Figure 1a). Climbing the gully resulted in approximately 620 m of elevation gain over a distance of almost 3 km in very difficult terrain. Upon reaching the mouth of the gully at the base of the cliffs (Figure 1b) it became clear that it would be highly unlikely to gain access to the Hebronberg by that route. In attempts to determine just which gully Miller and Thompson had used, older Google Earth images and old aerial photographs were examined, which led to the discovery that there had been pine plantations just under the cliffs of the Hebronberg and that there had been roads to and through these plantations in the 1960s and 1970s. These would have made access for the Hilliard and Burtt party much easier than currently, as the roads have now been partially washed away and erosion has made the slopes of the now-cleared pine plantations treacherous.

One of us (SA) made several other attempts to reach the type locality via the Mulhuis or Belvedere Creek valley, but these were unsuccessful as the route to ascend the



FIGURE 1.—Hebronberg: a, satellite view showing the Hebronberg (arrow on left), the Mulford Plateau (arrow on right) and the gully between them; b, view from the north of the mouth of the gully that separates the Hebronberg from the Mulford Plateau. Photographs: a, Google Earth; b, K. Balkwill.

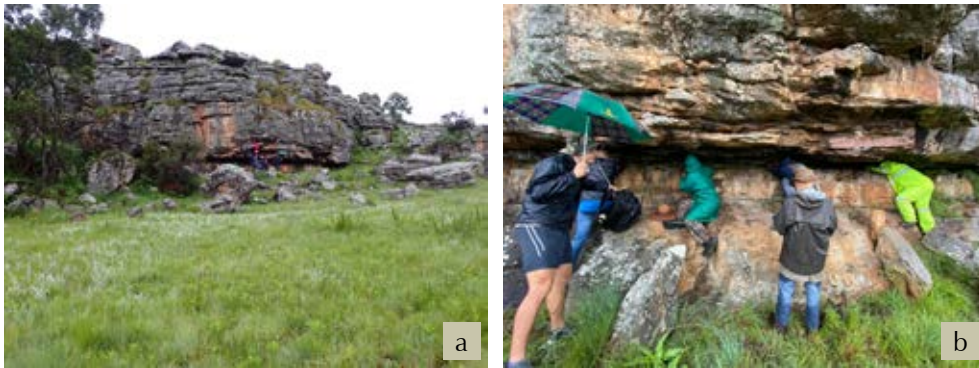


FIGURE 2.—Habitat at Erasmushoop farm: a, the hillside; b, botanists photographing plants in the horizontal fissure. Photographs: a, K. Balkwill; b, S. Attwood.

Hebronberg and Mulford Plateau is much longer and more overgrown from the Belvedere side. During one of these explorations to the farm Op de Berg 429 KT, he found material similar to *Streptocarpus decipiens*, but it had a flared corolla. Hilliard & Burtt (1971) mention that Miller and Thompson indicated that *S. decipiens* occurred at this location. There is a specimen collected by Thompson in PRE with the locality stated as 'Hebron mountain, East of Belvedere Creek'. This specimen has only one flower, partially obscured by mounting tape, so it is not clear whether the corolla flares distally. A conservative estimate of the corolla length is 5.5 mm, so this specimen is more likely the species allied to *S. decipiens* than *S. decipiens s. str.* In December 2023, two of us (SA and KB) revisited the site and were able to locate more plants, all of which had the distally flared corollas and thus do not match *S. decipiens s. str.*

In July 2023, with the aid of Frik Bronkhorst, one of us (SA) found a route up the north-western end of the Hebronberg, however, as he was not at the precise locality and in view of the time of year, no plants of *Streptocarpus decipiens* were found. A return to scale the Hebronberg using this route was planned for January 2024.

On 2 December 2023, one of us (SA) was investigating a rock shelter on the farm Erasmushoop 457 KT for rock paintings (Figure 2) and found plants of *Streptocarpus decipiens s. str.* This was the first sighting of this species in 54 years and was a second locality for the taxon. In January 2024, a party consisting of KB, SA, Carel Fourie and Karabo Mashile scaled the Hebronberg via the northwestern corner in soaking rain and were able to relocate *S. decipiens* at the type locality (Figure 3). The identity was confirmed by matching it to the description and pictures of Hilliard and Burtt (1971) and that it is indeed very different from the material that had been collected mainly from near Graskop in the interim (Figure 4). Looking down the gully above which the plant grew, signs of the old forestry road were visible, not far below. This is thought to be the route that was used by Miller, Thompson, Hilliard and Burtt in 1969.

This species is highly restricted in distribution, occurring at a few localities in and near to the Blyde River Canyon Nature Reserve (Figure 5). These are on the northern edge of



FIGURE 3.—Habitat: a and b, at Hebronberg, the type locality. Photographs: a, S. Attwood; b, K. Balkwill.

the Mulford Plateau of the Hebronberg on the farm Magalieskop 421 KT, on the farm Erasmushoop 457 KT about 1.4 km due east of the farm office near Pirow's Grave, and on the plateau east of the Blyderivierspoort hiking trail on the farms Clearstream 468 KT, Diamond 467 KT and Terpen 466 KT.

The habitat of *Streptocarpus decipiens* is very specific – either in deep horizontal overhangs in rock faces where light and competition are low and water is received from the dripline or splashes from the dripline, or under overhangs of large rocks and boulders where light is low and there is seepage under the rock or boulder. The geology in which it occurs is black reef quartzite, conglomerate and shale formations, where suitable horizontal rock crevices and shelves in open grassland are available. It is only found within 3 km of the escarpment edge, where mist frequently billows in from the east. Plants that often accompany *S. decipiens* are various mosses, *Cheilanthes buchananii* (Baker) Domin, *Chaenostoma debile* (Hutch.) Kornhall, *Crassula alsinoides* (Hook.f.) Engl. and *Oldenlandia muscosa* Bremek. The following species are occasionally present: *Begonia sutherlandii* Hook.f., *Hemionitis nielsii* (W.Jacobsen) Christenh. and *Lobelia trullifolia* Hemsl. subsp. *delicatula* (Compton) Thulin. The northern form of *S. galpinii* (smaller leaves, inflorescences and flowers, and more glabrous leaves often with a thin stipe) often occurs in a similar area to that occupied by



FIGURE 4.—Comparison of *Streptocarpus decipiens* (plant to right with lower flower) from Erasmushoop with *S. sp. nov.* (plant to left with higher flowers) from Berlyn. Photograph: K. Balkwill.

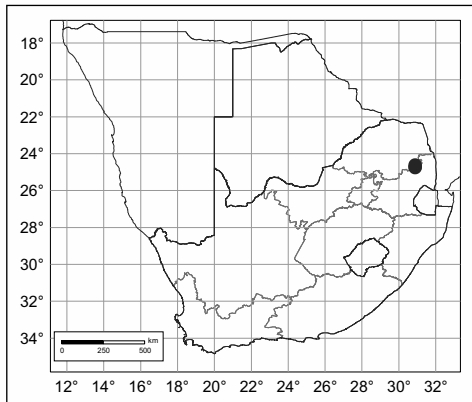


FIGURE 5.—Distribution of *Streptocarpus decipiens* based on herbarium specimens.

S. decipiens, but is much more widespread and common. *Streptocarpus galpinii* sometimes occurs on the same faces as *S. decipiens*, but is seldom found under the same overhangs. The habitat is threatened by woody alien species (most often *Pinus patula* Schiede ex Schltdl. & Cham.) that invade grassland, use up water (reducing seepage) and shade out indigenous plants (Figure 6). Informal mining is taking place close to the habitat of *S. decipiens* and may pose a serious threat in the future. The vegetation type in which *S. decipiens* grows is Northern Escarpment Quartzite Sourveld (Gm 23) (Mucina & Rutherford 2006). It does not occur in forest and will likely be negatively impacted by encroaching pines. Two known localities (including the most populous) are in a nature

reserve and two small subpopulations are on a privately owned farm that is used for timber production. We estimate a few hundred plants on Hebronberg, about a hundred plants on Erasmushoop and thousands of plants on Clearstream, Terpen and Diamond. The extent of occurrence (EOO) is approximately 34 km², but the area of occupancy (AOO) is much smaller (2 km²) due to the very specific habitat requirements of the plant. On the basis of an EOO of less than 5 000 km² and an AOO of less than 10 km², less than five localities, and current threat of habitat invasion by alien woody plants and potential future threat from informal mining, we consider *S. decipiens* to be Endangered B1(a, biii) or B2(1a, biii) (IUCN 2012).

Plants have been collected in flower from December through to April and in fruit from January through to April. Plants can be propagated from seed (C. Fourie, pers. comm.), but due to their small size and exacting requirements are unlikely to be popular in cultivation.

The plant does not currently have a common name, but perhaps a direct translation of the scientific name as ‘deceptive streptocarpus’ is appropriate for various reasons: the



FIGURE 6.—Encroachment of *Pinus* species into the habitat of *Streptocarpus decipiens*: a, on the farm Clearstream; b, on the farm Erasmushoop. Photographs: a, b, S. Attwood.

subgenus to which the species belongs was initially not obvious, the habitat in which it occurs makes it difficult to find, the locality on the first specimen collected suggested that it occurred on Mariepskop rather than the Hebronberg, finding a route up the Hebronberg to find the plant was difficult, and a more common and more easily accessible plant has led to misidentification and confused the identity of the real *Streptocarpus decipiens*.

Description (based on Hilliard & Burtt [1971]).—Slender caulescent perennial herb, up to 70(100) mm tall, whole plant clad with strongly patent, sharply pointed hairs, frequently gland-tipped except on leaves. *Stem* arising from bud on very short petiolode of basal leaf, bearing 1–3 pairs of opposite or subopposite leaves, stem thin, ± 0.75 mm in diameter, rather stiff. *Leaves* with basal and cauline leaves similar, narrowly oblong or very narrowly elliptic, $\pm 20 \times 3$ mm, blunt at apex, gradually attenuate to base; margin entire, slightly sinuate; blade very thin, clad with patent hairs like stem; midrib prominent below, lateral veins 8–10 on each side, very weakly developed, ascending, anastomosing, not prominent below, dark green, sometimes flushed dark purple. *Inflorescences* solitary in axils of all cauline leaves; peduncle 10–15 mm long; bracts minute; pedicels very slender, up to 5 mm long. *Calyx* segments narrowly triangular, 1×0.5 mm, spreading, hairy. *Corolla* 3–4 mm long, white with 5–7 reddish stripes on floor of tube; tube 2–3 mm long, much swollen at base, narrowing towards throat, 2 mm in diameter, translucent, hairy outside, glabrous within; lower lip 1.5 mm long; all lobes rounded, $\pm 1 \times 1$ mm. *Stamens* arising near base of corolla; filaments 2 mm long, curved, gradually swollen upwards, glabrous, white; anther lobes 0.5 mm long; staminodes 3, laterals 1 mm long, posterior one smaller, yellow. *Disc* annular. *Ovary* 1 mm long, conic, rather abruptly narrowed, appressed-hairy; style 1.5 mm long, with a few appressed hairs, white; stigma slightly wider than style, strongly papillose, very faintly grooved. *Capsule* 4–5 mm long, with up to 4 complete twists of the spiral, densely hairy. *Seeds* 0.25 mm long, verruculose. Plate 2418.

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PLATE 2419 *Streptocarpus galpinii*

Streptocarpus galpinii

Gesneriaceae

Eswatini, South Africa

Streptocarpus galpinii Hook.f. in Curtis's Botanical Magazine: t. 7230 (1892); Hooker: 388, 389, t. 76 (1891), manuscript name; Watson: 546 (1891), manuscript name; Watson: 139, t. 24 (1892), manuscript name; Clarke: 439 (1904); Hilliard & Burt: 204 (1971).

Streptocarpus galpinii is a unifoliate to plurifoliate, monocarpic to short-lived perennial herb. It differs from most other species of *Streptocarpus* by its purple corollas with a white floor to the tube, and darker purple inner side walls that appear like two large purple blotches just inside the mouth in the upper section of the throat in front view. Its short campanulate corolla tube differentiates it from many similar species of *Streptocarpus*.

In the molecular phylogeny produced by Nishii et al. (2015), the sister species to *Streptocarpus galpinii* is *S. micranthus* C.B.Clarke, which is sympatric with *S. galpinii* over a large proportion of its range. *Streptocarpus micranthus*, however, differs by having smaller flowers (up to 6 mm long, not 13 to 30 mm long) that are all white (not purple with some white) and face down (rather than facing horizontally). Morphologically similar (not necessarily related) taxa are *S. cooksonii* B.L.Burt, which occurs in KwaZulu-Natal, and *S. denticulatus* Turrill, which has a distribution that overlaps with *S. galpinii*. *Streptocarpus galpinii* differs from *S. cooksonii* by having smaller leaves (up to 150 × 120 mm, not up to 400 × 300 mm), more slender scapes with spreading inflorescences (not stout scapes with compact inflorescences), corollas that broaden rapidly from the base (not gradually), darker markings on the side walls of the corolla (rather than on the floor of the corolla just below the anthers), and anthers that are terminal on the filaments (Figure 1e) and pressed against one another (not subterminal on the filaments and pendent from them). *Streptocarpus galpinii* differs from *S. denticulatus* by having thick-textured (rather than thin-textured) leaves, and corollas that are campanulate and straight (rather than bulbous at the base, then constricted before widening, curved downwards and then directed forwards). The corollas of *S. galpinii* are purple and white rather than pale violet to pinkish red and with the white of the floor of the corolla tube and throat restricted to the central lobe of the lower lip (not extending onto the two lateral lobes as well). *Streptocarpus denticulatus* also has dark speckles in the throat and sometimes yellow on the floor of the throat. *Streptocarpus hilburianus* T.J.Edwards, which occurs in the northern part of the distribution range of *S. galpinii*, was diagnosed against *S. galpinii* on the basis of its cylindrical (rather than campanulate) corolla tube, its shorter pedicels and its spheroidal (rather than prolate) pollen (Edwards 2003).

Streptocarpus galpinii was first collected as seed by E.E. Galpin on a mountain called The Bearded Man, east of Barberton on the border of Mpumalanga and Eswatini. The seed

PLATE 2419.—1, habit, × 1; 2, inflorescence, × 1.5; 3, front view of flower, × 3; 4, side view of flower, × 3; 5, fruit, × 3. Voucher specimen: Oosthuizen et al. 3867 in C.E. Moss Herbarium (J), Johannesburg. Artist: Lesley Deysel.



FIGURE 1.—*Streptocarpus galpinii* flower variation: a, calyx lobes at Ugutugulu Gorge; b, calyx lobes at Mandendeka; c, calyx lobes at The Bearded Man; d, stamen viewed from outside of flower; e, stamens viewed from below, note appressed anthers opening towards one another; f, stigma held in front of anthers towards end of anthesis. Photographs: a, c, K. Balkwill; b, d–f, D. Oosthuizen.

was received at Kew in May 1890, where it was cultivated and, upon flowering in October 1891, the species was figured, but not formally described, in *The journal of horticulture, cottage gardener, and home farmer: a chronicle of country pursuits and country life, including poultry, pigeon and bee-keeping* (Hooker 1891), and then figured and formally described in *Curtis's Botanical Magazine* (Hooker 1892). It has since been included in *Flora capensis* (Clarke 1904) and the book *Streptocarpus, an African plant study* (Hilliard & Burt 1971).

In March 2022, the Mpumalanga Plant Specialist Group held an outing to Ugutugulu Gorge, near Shiyalongubu Dam in South Africa close to the border with Eswatini. A population of *Streptocarpus galpinii* was found among the rocks that differed from the more familiar populations: the plants were more densely hairy on the leaves, had much larger bracts, had longer calyx lobes and dense long hairs on the calyx lobes. iNaturalist (<https://www.inaturalist.org>) photographs represent a wealth of fieldwork where the general morphology, as well as three-dimensional structure and colouration of flowers can be seen. A number of potential forms within *S. galpinii* were observed on iNaturalist, including what is thought to be the typical form, specimens with finer hairs on the leaves and white anthers,



FIGURE 2.—*Streptocarpus galpinii* and *S. denticulatus* flower comparisons: a, Plate 7230 from Curtis's *Botanical Magazine* from copy held by Peter H. Raven Library, Missouri Botanical Garden; b, *S. denticulatus*, front view of flower; c, *S. galpinii*, front view of flower. Photographs: a, Biodiversity Heritage Library; b, D. Oosthuizen; c, K. Balkwill.

specimens where the white area in the corolla extends further into the lobes and has some purple veins in the white area, and specimens where the corolla lobes overlap each other and have a finely undulate margin. A search for type material of '*Streptocarpus galpinii*' on Global Plants (<https://plants.jstor.org>) yielded no results and it was initially thought that, for some reason, the type had not been uploaded. A search for a scan of the original description and accompanying plate yielded a scan from the Peter H. Raven Library, Missouri Botanical Garden (available through Biodiversity Heritage Library, <https://www.biodiversitylibrary.org>) (Figure 2a), which showed some dark veins coming out of the throat and more dark veins on the lobes than in the throat. Like all plates in *Curtis's Botanical Magazine* at the time, the plate had been hand-coloured and the corolla is depicted as lilac to mauve, rather than purple, and there are no dark purple blotches in the upper side of the throat. Thus, the face of the corolla in the plate looks more like that of *S. denticulatus* (Figure 2b) than *S. galpinii* (Figure 2c).

The collections at the National Herbarium (PRE) and C.E. Moss Herbarium (J) were consulted to appraise the variation in *Streptocarpus galpinii*. At the National Herbarium it was

awe-inspiring to note how Olive Hilliard had assembled what appear to be very disparate and sometimes meagre specimens, into a meaningful taxon, but what stood out were the plurifoliate forms from Eswatini. Five specimens from high-lying localities near the Eswatini–Mpumalanga border east of Barberton showed similarly densely hirsute material to those specimens collected at Ugutugulu Gorge. No specimens from the type locality were found.

Because of the unavailability of material from the type locality and given the doubt around the identity of the specimen figured in *Curtis's Botanical Magazine*, it was decided to visit the type locality, The Bearded Man (Figure 3a). The aims were to investigate the



FIGURE 3.—Habitat of *Streptocarpus galpinii*: a, northwest-facing aspect of The Bearded Man; b, sterile plants amongst rocks at The Bearded Man; c, plants in cracks in boulder at Ugutugulu Gorge. Photographs: a–c, K. Balkwill.

morphology and indumentum of the type locality population of *Streptocarpus galpinii* and to see whether *S. denticulatus* also grew at the site. The first *Streptocarpus* plants found on The Bearded Man were located under northwest-facing rocks, on a ridge just above the *Eucalyptus* plantation. These were identified as *S. dunnii* Hook.f.; although most had not yet flowered, one plant was found in fruit and another one in flower. The first plants of *S. galpinii* found were unifoliate and not in flower (Figure 3b). There was an expectation that more *Streptocarpus* plants would be found on the east- and south-facing aspects of The Bearded Man, however, these slopes were found to be very grassy and fires would be too hot for *Streptocarpus* to survive. On the way down from the top of The Bearded Man, near the top of the northwest-facing slope, there were two large boulders with a small cave between them. Shallow soil covered parts of the lower boulder, which was partially under an overhang of the upper boulder (Figure 4). Here



FIGURE 4.—Habitat of *Streptocarpus galpinii* at The Bearded Man. Photograph: K. Balkwill.

a small colony of flowering *S. galpinii* was found growing (Figure 3c). Although within visible range of the Ugutugulu Gorge site, which is only 4.7 km to the west-southwest and about 150 m lower, these plants did not have the large bracts, the long calyx lobes, the long hairs on the calyx lobes nor the dense hairs on the leaves that characterised the plants from Ugutugulu Gorge. In addition, some of the plants in this small colony were plurifoliate. With these observations in mind, the plate was consulted again and it was noted that the profile of the corolla tube in the plate matches the highly characteristic corolla shape of *S. galpinii* (Figure 2a). As there was no material of *S. denticulatus* on The Bearded Man, it was concluded that the plate is definitely of *S. galpinii*, despite previous doubts.

Four weeks after the field trip to The Bearded Man, Mandendeka, 11 km to the east of The Bearded Man and also on the Mpumalanga–Eswatini border, was visited in search of a new *Tephrosia* Pers. species. Here two *Streptocarpus galpinii* plants were found: one at 220 m lower and another at 330 m lower than the type locality. These plants had calyx lobes (Figure 1b) that were intermediate in length and indumentum between the Ugutugulu Gorge population (Figure 1a) and the type locality population (Figure 1c). It was thus concluded that the Ugutugulu Gorge population represents part of the variation that has to be accepted within *S. galpinii*, as so accurately described by Olive Hilliard and Bill Burt in 1971.

Iain Darbyshire at Kew (K) was consulted on obtaining a scan of the type specimen, who advised searching for '*Streptocarpus galpini*' (with a single 'i') on Global Plants. The specimen matches material found on The Bearded Man in terms of the shorter calyx lobes and absence of long hairs on the calyx lobes. No bracts are present in the specimen. The



FIGURE 5.—Side view of flowers at The Bearded Man. Photograph: K. Balkwill.

dried flowers have veining that is very similar to that in the plate – these veins are not visible in fresh material, suggesting that the plate may have been prepared from dried material or modified using dried material. A scan of the original of the plate is also available on Global Plants. This is a mirror image of the plate from the Peter H. Raven Library and the colour is much closer to that of living plants (Figure 5), except that dark blotches in the upper throat are missing. There is also an uncoloured print of the plate available on Global Plants, which was contributed by Kew.

Streptocarpus galpinii occurs along the eastern escarpment of southern Africa, between Lekgalameetse in Limpopo and Hlatikulu in Eswatini (Figure 6). It is one of the Limpopo–Mpumalanga–Eswatini Escarpment endemics (Clark et al. 2022).

Streptocarpus galpinii grows on or amongst rocks in high-lying grassland. Plants grow either where the soil is shallow or sometimes in small cracks and crevices in rocks. They usually grow where there is some shade from overhanging rocks, but away from grass and particularly dense grass, presumably to avoid fires. Unusually, some plants at Ugutugulu Gorge and Mandendeka had their inflorescences and flowers in amongst the grass that grew up to the edge of the rocks. Also unusual, at Ugutugulu Gorge, was that some plants grew on exposed upper surfaces of rocks where there was no shade.

Plants have been collected in flower from November through to May, with a peak in March. Specimens with mature fruits have been collected from November to May, with a peak in March. It is most likely that plants also bear fruits in June.

Filaments are curved gently downwards at the base and then sharply upwards below the anthers (Figure 1d–f). Anthers are firmly pressed against each other and open towards each other (Figure 1e). When upward pressure is applied on filaments, as would be the case when an insect enters the flower, they spread sideways, separating the anthers and tilting their opening downwards to release pollen onto the back of a pollinating visitor. At anthesis, ovary and style lengths are shorter, so that the stigma is behind the anthers and the style is curved, usually to the right, but sometimes to the left. Thus, the stigma is unlikely to make contact with a pollinator. As the flower matures, the style lengthens and straightens until the stigma is in front of the anthers (Figure 1f). This could potentially promote outcrossing.

Hybrids of *Streptocarpus*, especially of perennial species, have been developed and are widely grown and available as pot plants. In South Africa, hybrid single plants sell for

R75.00 each and 25 seeds of a natural species for R19.00. In 2010 the international trade in *Streptocarpus* was estimated to be over US\$30 million (Nishii et al. 2015). Although flowers and growth form of the approximately 160 species of *Streptocarpus* are very diverse and could potentially be highly prized as pot plants, many of them are monocarpic – they grow for a year (sometimes more than one year), flower once, produce seed and die. Plants will grow from leaf cuttings, which may offset this difficulty. Many species of *Streptocarpus* may produce seed without being pollinated (Harrison et al. 1999; Hughes et al. 2006), however, germinating seed and establishing seedlings may not be of interest to many people and cultivation of species is largely left to enthusiasts and specialists. One difficulty in cultivation is that, when the original plants die, seeds are dispersed into other pots, so that plants growing in a pot may be very different from what the label on the pot suggests. Fresh seed will germinate in 10 to 14 days and older seed in up to 30 days (Nichols 2005). Seed and seedlings are vulnerable to fungal attack (Nichols 2005). Plurifoliate forms of *S. galpinii* are likely to be longer living than unifoliate forms and may thus be more suitable for cultivation, although Hilliard & Burtt (1971) regard the different forms to be habitat rather than genetically determined. Plants need to be cultivated out of direct sunlight.

In traditional Zulu medicine, infusions of the leaves of species of *Streptocarpus* are used to ease labour pains (Hutchinson et al. 1996).

The name *Streptocarpus* alludes to the spiralled (or twisted) fruits that characterise the genus; *galpinii* is in reference to E.E. Galpin who collected and sent the seed from which the type specimen was cultivated to Kew. The genus goes by the common names of streptocarpus, streps, gloxinias (Smith 1966) or Cape primrose, the latter due to its similar habit to primroses in England. Species that were previously treated as a separate genus (*Saint-paulia* H.Wendl.), go by the name of African violets. There is no recorded common name for *S. galpinii*.

Description (based on Hilliard & Burtt [1971]).—Monocarpic or short-lived perennial herb. Leaves single or multiple; when single usually sessile, prostrate, broad, up to 150 × 120 mm, cordate or occasionally stalked, vertical, thin textured and cuneate; when multiple stalked, vertical, narrow and cuneate; sparsely to densely hirsute above and below, dark green, light green or plum-coloured below; veins impressed above, markedly raised below. Inflorescence axis upright, sometimes with large bracts at first node, with multiple flowers at each node, glandular and sparsely to densely hirsute with short or long hairs; pedicels spreading in flower, usually reflexed in fruit, 20–90 mm long. Calyx lobes narrowly triangular to linear, spreading or appressed, glandular, short to long sparsely to densely

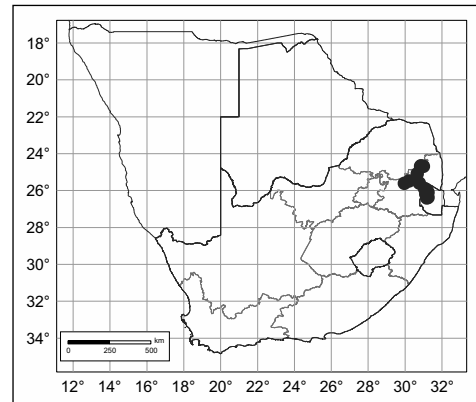


FIGURE 6.—Distribution of *Streptocarpus galpinii* in southern Africa, based on herbarium collections.

hirsute. *Corolla* 13–30 mm long, with stalked glandular hairs on outside and sometimes inside above anthers; tube cylindric or narrowly campanulate below, then campanulate above, sometimes saccate below mouth, up to 11 mm long and 20 mm across, violet to purple, base of tube and lower lips with deltoid white area; upper lip of 2 almost orbicular lobes, up to 10 × 13 mm; lower lip of 3 almost orbicular lobes, up to 13 × 13 mm, sometimes with yellow within. *Stamens* arising near base of corolla; filaments 5 mm long, curved downwards and then upwards, thickened between curves, white, with glandular or eglandular hairs; anthers purple, pressed against and opening towards each other. *Ovary* up to 4 mm long, green, with short gland-tipped hairs; style at first shorter than stamens and curved to left or right, growing through duration of anthesis to exceed and be positioned in front of anthers, terete, glandular-pilose; stigma slightly broader than style. *Capsule* up to 24 mm long, ± 2 mm in diameter. *Seeds* up to 0.7 mm long, reticulate. Plate 2419.

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Jamesbrittenia integerrima

Scrophulariaceae

Namibia, South Africa

Jamesbrittenia integerrima (Benth.) Hilliard in *Edinburgh Journal of Botany* 49: 230 (1992). *Lyperia integerrima* Benth.: 359 (1846). *Sutera integerrima* (Benth.) Hiern: 284 (1904). *Sutera asbestina* Hiern: 285 (1904). *Sutera batlapina* Hiern: 265 (1904). *Lyperia squarrosa* Pilger: 448 (1912).

Jamesbrittenia integerrima belongs to the Limoselleae tribe of the family Scrophulariaceae (Kornhall & Bremer 2004), commonly known as the Figwort family (Koekemoer et al. 2014). Species of the tribe Limoselleae are found in southern Africa (Olmstead 2016).

There are approximately 62 genera and about 1 830 species of Scrophulariaceae worldwide (Angiosperm Phylogeny Group 2016; Christenhusz & Byng 2016). Well-known members of this family include ornamentals such as *Nemesia* Vent., *Diasca* Link & Otto and *Buddleja* L. The family has a cosmopolitan distribution with a high degree of diversity in temperate and tropical mountainous regions of the world (Koekemoer et al. 2014). While the disintegration of the family over the years has reduced the number of species and diversity from over 5 100 species in 269 genera (Hilliard 1994; Fischer 2004), it has provided clear lineages from physiological evidence, morphological traits and molecular evidence (Olmstead et al. 2001; Oxelman et al. 2005), narrowing the circumscription of the family to closely related lineages.

Scrophulariaceae includes annual, biennial and perennial herbs, shrubs, trees and a few climbers (Fischer 2004). Their stems range from erect to prostrate. Their leaves are usually opposite or alternate and entire, while their flowers are hermaphroditic and irregular, often two-lipped, consisting of four to five united petals and two or four stamens, where two are longer and two shorter attached. Stamens attach to the petals. The ovary may be superior and two-chambered. Fruits are usually superior, capsular, septicidal or loculicidal or sometimes both, rarely opening at or near the apex; in some genera they are baccate and indehiscent. Seeds are usually few to numerous, sessile or subsessile (Hiern 1904; Fischer 2004; Koekemoer et al. 2014). Some species formerly placed in this family are now placed in the Linderniaceae, Orobanchaceae, Paulowniaceae, Phrymaceae and Plantaginaceae.

Bentham (1876) was first to recognise the Manuleae tribe within Scrophulariaceae. The tribe included 17 genera and approximately 350 species (Hilliard 1994). The most distinguishing characteristic used to separate Manuleae from its closest related tribe, Selagineae, was their multiple-ovulate ovary, while Selagineae, as then circumscribed, had one ovule per ovary-loculus. However, Selagineae and the genus *Limosella* L. were subsequently incorporated into the tribe Manuleae (Kornhall et al. 2001; Kornhall & Bremer 2004) and, with the inclusion of *Limosella*, led to a name change of the tribe to Limoselleae. This tribe now includes over 635 species in 29 genera (Kornhall et al. 2001; Olmstead et al. 2001;

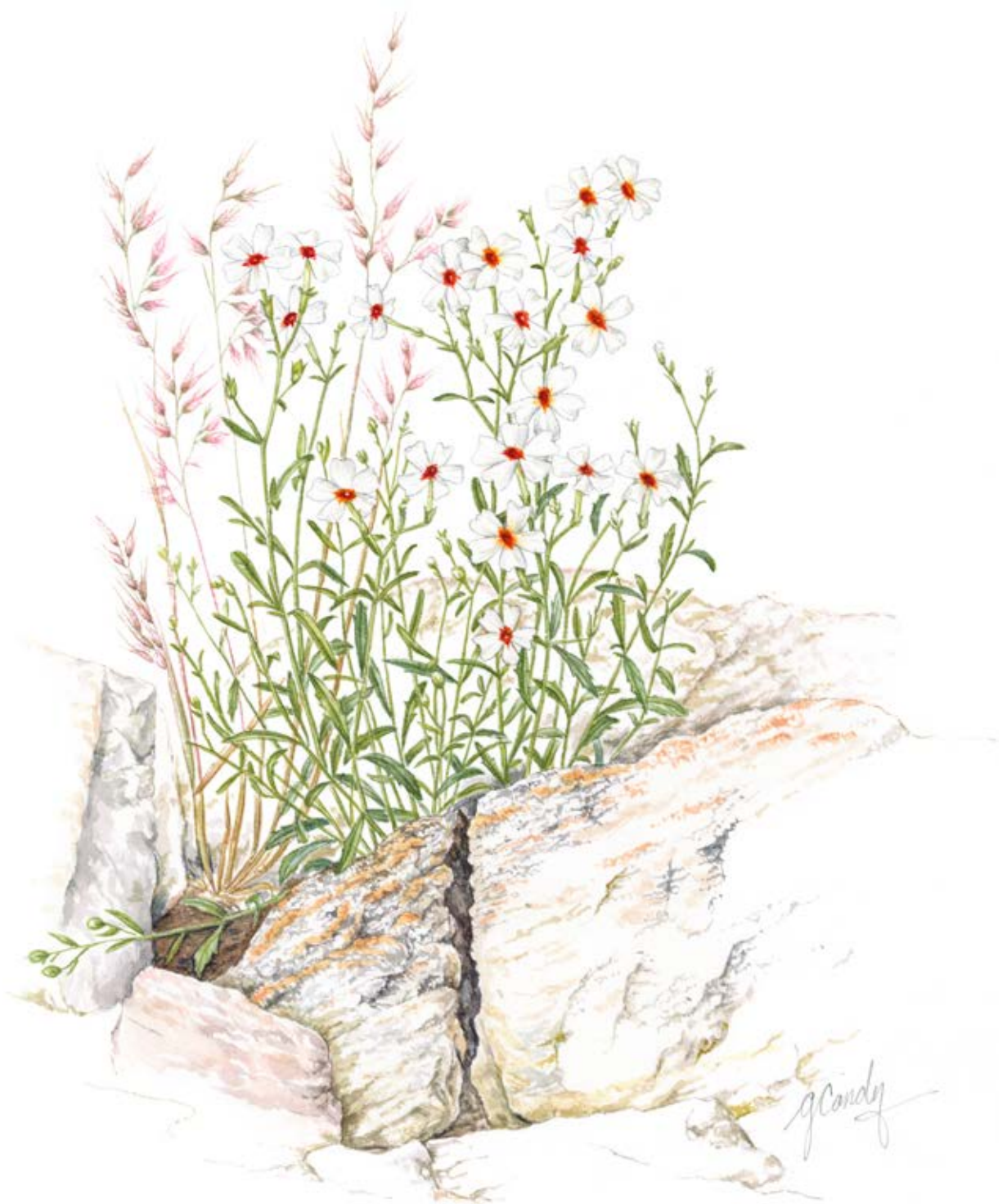


PLATE 2420 *Jamesbrittenia integrerrima*

Kornhall & Bremer 2004; Oxelman et al. 2005; Manning & Goldblatt 2010). Some of the well-known genera comprising Limoselleae include *Lyperia* Benth., *Manulea* L., *Microdon* Choisy, *Sutera* Roth, *Zaluzianskya* F.W.Schmidt and *Jamesbrittenia* Kuntze (Manning & Goldblatt 2010; Olmstead 2016).

Jamesbrittenia – commonly referred to as jaybees – was named by Carl Ernst Otto Kuntze in 1891. Kuntze (1843–1907) was famous for the plant specimens of his private collection, his travels and publications. He was well known within the botanical community after the publication of *Revisio Generum Plantarum* wherein he changed the names of over 30 000 plant species according to the 1867 Paris Code of Botanical Nomenclature (Kuntze 1891, 1893, 1898). He contributed to his private collection between 1874 and 1894 through travels around the world that included Europe, Central America, South America, Asia, Canary Islands, Egypt and southern Africa. After his passing, Kuntze's private plant collection was purchased by the New York Botanical Gardens. Some of his specimens of European origin were, however, sent as a gift to the Charleston Museum in 1913 (Zanoni 1980).

Kuntze named the genus *Jamesbrittenia* after respected botanist, James Britten (1846–1924), who started his botany career at the Kew Gardens Herbarium where he worked as an assistant from 1869 to 1871. In 1871 he was appointed keeper of botany at the British Museum until his retirement in 1909. He upheld the nomenclatural rule of priority and was an editor of the *Journal of Botany* for 45 years. Britten published dictionaries of British plants and botanists throughout his career (Hilliard 1994; Clarke & Charters 2016).

Jamesbrittenia is a large genus with about 84 accepted species, with the most recent species discovered in the genus being *Jamesbrittenia bergae* Lemmer (Lemmer 2003). *Jamesbrittenia* are indigenous to tropical regions of Africa and Asia. In Africa, it is widespread in Angola, Botswana, Egypt, Eswatini, Lesotho, Malawi, Mozambique, Namibia, South Africa, Sudan, Tanzania, Zambia and Zimbabwe (Hilliard 1994), with 82 species occurring in southern Africa (Olmstead 2016).

According to Fischer (2004), *Jamesbrittenia* include annual, perennial or suffrutescent herbs that are glandular pubescent. Their stems are ascending to erect. Their leaves are usually opposite, at least at the base of the stem, but often alternate above; subsessile to petiolate, linear-lanceolate to ovoid, acuminate and entire around the edges. Flowers are borne on pedicels growing from leaf axils, terminal on central stem or cymes, while the calyx has five deep lobes almost to the base and the lobes may overlap. Their corolla is usually creamy white to orange, or blue to violet, while the throat is usually yellow, with the limb nearly regular to distinctly two-lipped; lobes are spreading, orbicular to oblong or ovoid, often entire, sometimes retuse to bilobed. The tube is cylindrical and abruptly expanded near the apex. Four stamens are included, or with the abaxial pair rarely shortly exserted. The ovary is deltate, usually glandular, while their seeds are bothrospermous in two species.

Jamesbrittenia species have become popular among horticultural enthusiasts because of their attractive flowers. Well-known horticultural species include the following: *J. grandiflora* (Galpin) Hilliard, commonly known as wild phlox and sometimes erroneously called

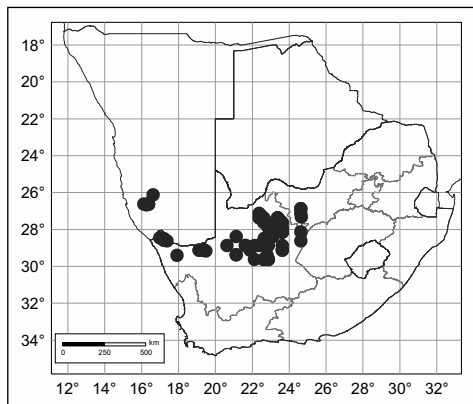


FIGURE 1.—Known distribution of *Jamesbrittenia integerrima* in southern Africa, based on information from POSA (2020).

bacopa (Bergh & Harrower 2007); *J. kraussiana* (Bernh.) Hilliard, also known as *kerriebos* (Afrikaans) or *usikisiki lwehlathi* (Zulu), which is favoured as a pot plant, while its leaves are known to heal dysmenorrhea (Hulme 1954); *J. aurantiaca* (Burch.) Hilliard, commonly referred to as Cape saffron or *saffraanbossie* (Afrikaans) (Van Wyk & Malan 1998); *J. bergae*, known for its crimson red flowers in full bloom; and *J. burkeana* (Benth.) Hilliard, commonly known as *bruinblommetjie* (Afrikaans), is often planted as an ornamental (Van Wyk & Malan 1998; Lemmer 2003). *Jamesbrittenia* species may be propagated using stem cuttings. However, the use of rooting hormones is recommended to expedite rooting (Bergh & Harrower 2007; Harrower 2010).

Jamesbrittenia integerrima was discovered by Bentham in 1846 who first named it *Lyperia integerrima* (Bentham 1846). The specific epithet, *integerrima*, was presumably derived from the Latin word ‘integer’ meaning very entire (as in *Anastrabe integerrima* E.Mey. ex Benth.; Boon 2010) in reference to the leaf margins, which are largely without dentation. Hiern (1904) later placed the species in the genus *Sutera* and described it in two taxa, *S. asbestina* and *S. batlapina*. The latter synonym being named after the place where the type specimen was collected, namely ‘Batlapin Country’, which is believed to be part of what is today known as Botswana. Pilger (1912) later placed the species back in *Lyperia* as *L. squarrosa*. However, Hilliard (1992), in distinguishing *Camptoloma* Benth., *Jamesbrittenia*, *Lyperia* and *Sutera*, presented a new combination of what is still currently known as *J. integerrima*.

Jamesbrittenia integerrima is widely distributed in southern Africa (Figure 1) from the southern half of Namibia to South Africa’s Northern Cape and North West (POSA 2020). This species grows at altitudes between approximately 760 and 1 675 m a.s.l. in dry, elevated areas. *Jamesbrittenia integerrima* is common in mountainous areas, where it is often found growing among rocks and boulders (Figure 2). It is not specific to any particular rock formation or type, with recorded rock formations including banded jasper, dolerite, granite, ironstone, limestone, mica schist, quartzite and sandstone (Hilliard 1994).

Jamesbrittenia integerrima is not well researched in horticulture. With its attractive white flowers, it is a promising subject, especially for indigenous gardens. Furthermore, not much is known about the economic importance of the species. The Red List status of *J. integerrima* in South Africa is Least Concern (Raimondo et al. 2009).

The species can easily be identified by its tubular flowers, the limb of which is usually white with a yellow or orange to orange-brown throat. The leaf blade is narrowly to broadly elliptic, sometimes oblanceolate, and entire, but it is always pubescent on both surfaces



FIGURE 2.—*Jamesbrittenia integerrima* in its natural environment in the Northern Cape, South Africa: a, plant in habitat growing among rocks; b, side view of flowers showing the relatively long, slender corolla tube and characteristic (for the genus) one-sided swelling below the corolla lobes; c, close-up frontal view of a flower. Photographs: a–c, S.P. Bester.

with a mixture of glistening glands and tiny stalked glandular hairs. The capsule and ovaries are densely covered by glistening glands. In Namibian plants, the glistening glands are shorter and smaller compared to specimens from the Northern Cape (including the Richtersveld) and very shortly stalked. Furthermore, the leaves of plants in Namibia are always toothed (Hilliard 1994).

Jamesbrittenia integerrima is usually mistaken for *J. albiflora* (L.Verd.) Hilliard and *J. argentea* (L.f.) Hilliard. The hairiness of leaves can be used to separate it from *J. albiflora*, where the leaf blade is smooth or has glistening glands on the upper side that are few and scattered, whereas the leaves of *J. integerrima* are thickly clad in glistening glands with a few tiny, stalked hairs along the midrib. *Jamesbrittenia integerrima* and *J. argentea* can be distinguished easily: the inflorescence is mostly bracteate in *J. integerrima*, whereas it is leafy in *J. argentea*. *Jamesbrittenia argentea* is restricted to southern Cape coastal districts of the Western Cape and Eastern Cape of South Africa, while *J. albiflora* occurs in the Free State, Northern Cape and North West (Germishuizen & Meyer 2003). The distribution of *J. integerrima* and *J. argentea* overlap in the Northern Cape, which may cause mistaken identification in the field. Although both species have white flowers, those of *J. integerrima* have orange to brown throats, while those of *J. argentea* have yellow throats.

Description (after Hilliard [1994]).—Dwarf shrub or perennial herb; erect, ascending or spreading with parallel, lax branches. Stem leafy at base, $\pm$ 100–600 mm long, 8–15 mm

in diameter at base, covered with glandular fine, soft and short pubescence; hairs $\pm$ 0.1–0.2 mm long or shorter, glistening glands clearly visible when hair is less than 0.1 mm long. Leaves opposite at base becoming alternate upwards, axillary leaf tufts small if present or lacking; primary leaves $\pm$ 7–25 $\times$ 2.5–9.0 mm, elliptic to oblanceolate with apex obtuse to subacute; leaf base narrows to form petiole that is $\frac{1}{3}$ of leaf length; margins entire or with small teeth that form a maximum of four pairs, last pair occasionally up to midway to midrib; glandular to finely pubescent hairs present adaxially and abaxially, hairs up to 0.1–0.2 mm long with glistening glands. Flowers solitary in axils of top leaves; pedicels 7–26 mm long; calyx tube 0.2–0.3 mm long, lobes 2.1–5.0 $\times$ 0.5–1.0 mm, lanceolate-oblong to subspathulate, glandular-puberulous, hairs up to 0.1–0.2 mm long with glistening glands; corolla tube (7.0–)9.5–12.0(–17.0) $\times$ 1.8–2.2 mm in throat, cylindrical, abruptly widened near apex, limb oblique, 8–18 mm wide across lateral lobes, posticous lobes 3.5–8.0 $\times$ 2.7–4.5 mm, anticous lobes 3.0–8.5 $\times$ 2.4–5.0 mm, all lobes cuneate-oblong, $\pm$ truncate to retuse, glandular-puberulous outside, hairs up to 0.15–0.20 mm long, with glistening glands, transverse band of clavate hairs in throat extending briefly onto lower lip, lobes usually white, very rarely cream or yellow, throat yellow to orange, colour sometimes radiating onto base of lobes, these sometimes also marked with a light blueish streak. Stamens posticous filaments $\pm$ 1–2 mm long, anthers 0.8–1.3 mm long; anticous filaments 0.5–1.0 mm long, anthers 0.5–0.8 mm long, all filaments glandular-puberulous. Stigma short, 0.2–0.3 mm long. Style (5–)7–10(–14) mm long. Ovary $\pm$ 2–3 $\times$ 0.8–1.2 mm. Fruit a capsule, 4–9 $\times$ 3.0–3.4 mm, covered with glistening glands, often also with minute glandular hairs. Seeds $\pm$ 0.6–0.7 $\times$ 0.3–0.5 mm long. Flowering time: throughout the year. Plate 2420.

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Guide for authors and artists

INTRODUCTION

Contributions from authors and artists are most welcome. The policy of the editorial committee of *Flowering Plants of Africa (FPA)* is to obtain contributions from as wide a range of authors and artists as possible and to depict a rich and interesting mix of plants from all over Africa. All contributions are assessed by an editorial board and referees. The deadline for submissions for inclusion in volume 70 (2027) is June 2026.

Plates that have already been published in colour in another journal or magazine are generally not acceptable for *FPA*.

Authors and/or artists are advised to contact the editor (Alicia Pretorius) before any work is undertaken with a view to publication in *FPA*: a.grobler@sanbi.org.za.

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Authors intending to have plants illustrated and written up for *FPA* are advised to contact the editor to establish whether a plant has not already been figured for *FPA*.

Authors are expected to supervise the execution of plates to ensure that they are botanically correct. As detailed under the section 'Artists', a write-up and/or plate will not be acceptable unless a voucher specimen is made of the figured specimen and preserved in a recognised herbarium.

Before writing up a text for *FPA*, an author should ascertain whether the plate has been approved by the journal's editorial board, after which the accompanying text can be produced. Approved contributions will be published when space allows. Those in which the names of new taxa are published for the first time usually receive priority.

Manuscripts should be submitted electronically to the editor and should conform to the general style of the most recent issues of *FPA*.

The following serves as a checklist of requirements for an *FPA* text:

1. **Synopsis.** The correct name of the plant together with its author/s and relevant literature (name of publication written out in full) is cited. Put a comma after the author's name if the publication that follows is his/her own; write the word 'in' after the author's name if the publication that follows is a journal or other work edited/compiled by someone else. Following this, are synonyms (listed chronologically) plus their author/s and relevant literature reference/s reflecting only author, page and year of publication, e.g., Boris et al.: 14 (1966). The whole synopsis is in one paragraph. If there are many synonyms and literature references, restrict yourself to the most important ones. References should be arranged in chronological sequence; where

two or more references by the same author are listed in succession, the author's name is repeated with every reference. Author citations of plant names should follow www.ipni.org; for other authors, give full surnames followed by a colon, page number/s and publication date.

2. **Literature references in the text.** Should be cited as follows: 'Jones & Smith (1999) stated ...' or '... (Jones & Smith 1999)' when giving a reference simply as authority for a statement. When more than two authors are involved, use the name of the first author followed by 'et al.' Two or more references should be listed chronologically, e.g., '(Smith 1996, 1998, 2013; Nel 2001; Bester et al. 2007)'. Personal communications are given only in the text, not in the list of references; please include full initials to identify the person more positively. Referencing websites are generally discouraged unless their content is based on reviewed scientific research (e.g., databases of plant names, online Floras, specimen images, Red Lists, etc.) or are otherwise trustworthy and reputable.
3. **List of references.** All publications referred to in the synopsis and the text, but no others, are listed at the end of the manuscript under the heading 'References'. The references are arranged alphabetically according to authors and chronologically under each author, with a, b, c, etc. added to the year if the author has published more than one work in a year. If an author has published both on their own and as senior author with others, solo publications are listed first and after that, in strict alphabetical sequence, those published with one or more co-authors. Author names are typed in capitals. Titles of books and journals are written out in full, in italics. In the case of books, the name of the publisher is followed by a comma and the place of publication. For websites, provide full website name, address and the date when it was accessed in brackets.
4. **Text proper.** Should be written in language and style acceptable to both the scientist and informed lay person. The following features should, as far as possible, be described and discussed in the text:
 - Main diagnostic characters for a brief pen picture of the plant.
 - Affinities: how the taxon differs from its nearest allies; keys or tables may be used to distinguish closely related taxa.
 - History of the taxon, where and when first collected and by whom.
 - Geographical distribution in Africa: a distribution map, which will be handled as a figure, is essential; authors should submit a list of quarter degree grid cells, or GPS coordinates in decimal degrees in two columns (first column for latitude, second column for its corresponding longitude), from which the editor's office will produce the distribution map.
 - Ecology: habitat preferences, etc. It is highly recommended that authors submit a photograph of the plant in habitat or a general habitat image.
 - Phenology: time of flowering, fruiting, etc.
 - Economic importance, edibility, medicinal use, toxicity, etc.
 - Cultivation potential and hints on cultivation.
 - Names: origin of scientific names, common names in various languages, etc.
 - Any other facts of interest.

5. **Description.** This is a formal description of the taxon and not merely of the specimen illustrated. For measurements, use only units of the International System of Units (SI). Use only mm and/or m.
6. **Images and captions.** Supply a caption for the colour plate, indicating the relevant magnifications and/or reductions, and citing the voucher specimen used for the illustration, i.e., collector + number + herbarium where the specimen is housed. The caption ends with the name of the artist. Supply captions for the distribution map and other figures (use scale bars where relevant), making sure that all figures are mentioned in the text. Include names of photographers and ensure photographs are of publishable quality. Figures should be submitted as separate files and planned to fit, after reduction, into a width of either 64 or 130 mm. If a figure is to be published as a composite (a single figure composed of multiple individual images), submit the original, high-resolution images of all individual photographs, naming them a, b, c, etc. Please do not include lettering on the figures. Scale bars can be included on the photo. Provide line drawings electronically as bitmap TIF files at 1 200 dpi.

ARTISTS

1. **Supervision.** All illustrations should be executed under the supervision of the botanist writing the text to ensure botanical accuracy and specific plant details are adequately depicted.
2. **Dimensions.** The dimensions to work to are 160 × 210 mm (width × height of image) or slightly smaller. Illustrations are printed as is, i.e., the same size. Only in exceptional cases are illustrations reduced or enlarged.
3. **Paper.** Paper must be of good quality and as white as possible. Arches or Saunders Waterford (hot-press, 300 gsm) is recommended. The use of board should be avoided.
4. **Watercolours.** The use of good-quality watercolours, e.g., Winsor & Newton (certain pigments fade with time) or Schmincke (colourfast), is essential. The use of black paint is not recommended as it is too harsh and tends to kill colour. Similarly, white paint must be used with caution since it tends to dull adjoining colours and sometimes reproduces as a bluish colour. Its use should be limited to white hairs and certain highlights only. To reflect whiteness, endeavour to use the paper colour itself.
5. **Subject material, composition, voucher, etc.** Subject material should be representative of the species being illustrated and should be in excellent condition. Kindly take note of the following:
 - Drawing from photographs is not recommended, as it's not possible to obtain the same detail from a photograph as from the living plant.
 - Magnifications: all parts should be measured by the artist and magnifications indicated on the back of the plate and the figure(s) where relevant.
 - The plate should not be overcrowded with too many small dissections. These should preferably be inserted as separate figures in the text. Dissections or habit

sketches included on the plate should be in pencil or colour, not ink, whereas dissections or habit sketches to be used as separate text figures should be in ink.

- Vouchers: a voucher specimen, made of material from the plant(s) illustrated, must be preserved, given a collector's number and housed in a recognised herbarium as a permanent record. Without a cited voucher specimen, the plate and write-up will not be accepted.
 - Plant features: clearly show as many features as possible, for example, apical buds, leaf axils, hairs, glands, bracts, stipules, upper and lower surfaces of leaves showing venation, front, side and back view of flowers, mature fruit, habit and where necessary and feasible, the underground parts. The supervising botanist will indicate which features require accentuation.
 - Signature: the artist's signature must be unobtrusive but clearly written so that it will stand reproduction. Numbering of plant parts should be done in light pencil: permanent numbering will be done during layout. No other annotations should appear on the plate. Information such as species name, collector's name and number, date, locality, magnifications, voucher specimen, etc. should be written on the back of the plate.
6. ***Dispatch of plates.*** Plates should be carefully packed, flat, using a sheet of Masonite or similar material to prevent bending, and sent by courier to the editor.

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Flowering Plants of Africa

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