

Systematic studies in the Acanthaceae: A new species of *Barleria* from Natal

Mandy-Jane Balkwill*, K. Balkwill and P.L.D. Vincent

C.E. Moss Herbarium, Department of Botany, University of the Witwatersrand, P.O. Wits, 2050 Republic of South Africa

Accepted 5 July 1990

A new species, *Barleria greenii* M-J. & K. Balkwill, from Natal, southern Africa, is described. Distribution, habitat, conservation status, floral phenology, pollination biology and the placement of the new species within the genus are discussed.

'n Nuwe spesie, *Barleria greenii* M-J. & K. Balkwill, van Natal, suidelike Afrika, word beskryf. Verspreiding, habitat, bewaring, bestuiwing en die klassifikasie van die spesie in die genus word bespreek.

Keywords: Acanthaceae, *Barleria*, classification, pollination, taxonomy

*To whom correspondences should be addressed

Introduction

Barleria L. is a large, pantropical genus represented by about 70 species in southern Africa. As with many other similar acanthaceous genera of Linnaean description, the generic limits of *Barleria* are somewhat diffuse and the African species have been variously grouped and divided by different authors (Clarke 1900, 1901; Obermeijer 1933). A reappraisal of the delimitation and subdivision of the African representatives of this genus is currently being undertaken. During the course of this research, several very interesting, undescribed species have been discovered and a particularly unusual and attractive one of these is described in this paper. This species was discovered by Mr D.M. Green, a farmer and amateur botanist from the Estcourt district of Natal, and it is in his honour that this remarkable new species is named. Since his initial discovery of the species, Dave Green has spent much time and energy searching for additional populations of the plants. Due to his efforts and careful observation, the species is now known from eight different populations on the farms Van der Merwe's Kraal 972, Selbourne 1311, Bosman Riviers Poort 1386, Braakfontein 1121 and Groote Milie Tuin 1027 in the Weenen and Estcourt districts of the Natal midlands.

Barleria greenii M-J. & K. Balkwill

Species nova propria ab speciebus omnibus aliis combinatione characterum sequentium distinguur: corolla infundibularii, grandii (34.0–)38.9–39.9(–46.0) mm, lobis superis quatuor et lobo infero uno; bracteis acerosis; foliis coriaceis breviter petiolatis cum unciis apicalibus; caulibus bifarium pubescentibus cum basibus ligneissimus; staminibus fertilibus duo et staminodiis tres; stigmatibus capitato brevitate bilobato; capsula non-rostratus; seminibus quatuor.

TYPUS.— Natal, Midlands: Estcourt district, Farm Van der Merwe's Kraal, hill 'Rockleigh', 1 200 m, 31 January 1986, *Green* 625 (J, holotypus; E, K, NH, NU, PRE, isotypi).

Perennial, profusely branched woody shrubs up to 1.8 m high or, if burnt regularly, forming very densely branched suffrutices up to 0.8 m high and 1.2 m in diameter; *branches* very robust and woody at base, bark pale greyish-brown, shallowly fissured; *young stems* less woody, green, slender,

distinctly bifariously pubescent; hairs short, white, eglandular. *Leaves* (25–)29–30(–35) × (6–)8–10(–14) mm, opposite, very shortly petiolate; lamina narrowly ovate or oblong-ovate; base broadly cuneate; apex gradually tapered to acute with pungent, recurved apical hook; surfaces smooth, slightly shiny, glabrous or with a few eglandular trichomes along midrib (especially on abaxial surface), dark green above, yellowish-green below, somewhat thickly-textured, slightly stiff or leathery; margins entire, slightly revolute (markedly so at leaf bases); venation eucamptodromous, one main vein from base, 4–7 pairs of principal laterals, these ending before the margins, not very conspicuous; epidermal cells dense with cystoliths, imparting slightly rough texture to dried specimens; *petiole* (1.0–)1.4–1.6 (–2.0) mm long, pale yellow to yellowish-green, glabrous or with scattered eglandular trichomes. *Inflorescence* an axillary, scorpioid cyme with (3–)4–6(–7) flowers maturing sequentially. *Bracts* 2 per flower, one longer than the other; (15–)20–22(–31) × (2.0–) 3.5–3.7(–6.0) mm, lanceolate to narrowly elliptic, spinous, with a narrow blade, stiff, pale green with reddish-purple tip; midrib conspicuous, pale yellow-green; persistent after leaves and other floral parts fall; abortive inflorescences form in some lower leaf axils with only bracts properly formed giving spiny appearance to plants. *Calyx* of 4 dissimilar lobes, 2 outer, 2 inner; outer adaxial lobe (30–)34–38(–43) × (14–) 18–20(–24) mm; outer abaxial lobe (26–)30–34(–40) × (17–)18–20(–25) mm; both outer lobes very broadly ovate or, rarely, elliptic; bases cordate; apex attenuate, ending in pungent, stiff spine (abaxial lobe sometimes ends in two apical teeth); outer surfaces very finely, shortly and densely pubescent near base, with or without short, stalked, glandular trichomes, upper parts glabrous; inner surfaces shortly pubescent or glandular-pubescent at base, upper parts glabrous; both surfaces very pale green, becoming brown or reddish-brown with age; texture soft and herbaceous initially, becoming chartaceous and stiff with age; margins entire or occasionally irregularly dentate with fine, short spines; venation extremely conspicuous, green when young, becoming red or purplish as flowers mature, (8–)10–11 (–12) main veins from the base, these looping near the margins; reticulate pattern of secondary and tertiary venation clearly visible; inner calyx

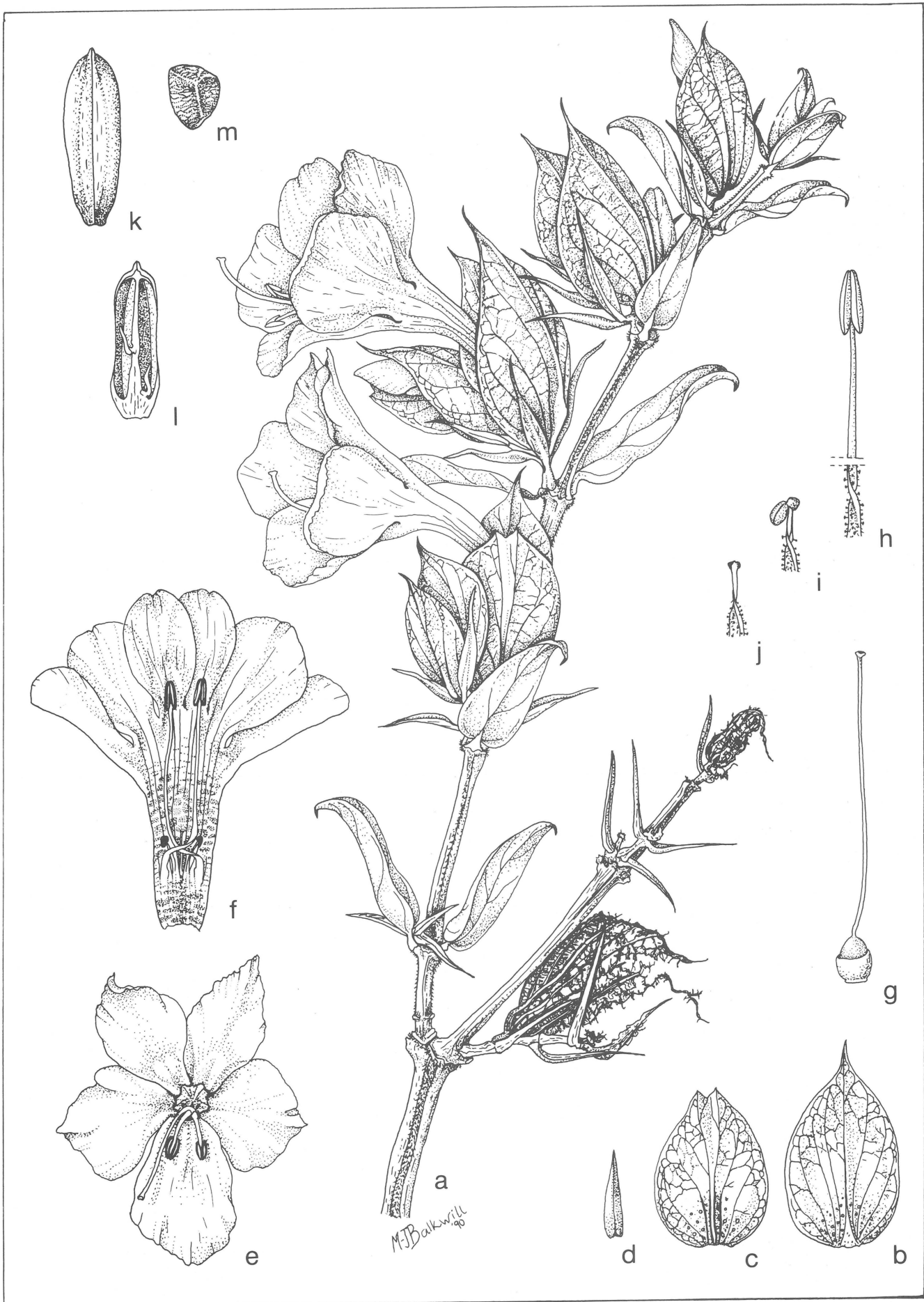


Figure 1 *Barleria greenii*: (a) habit $\times 1$; (b) adaxial outer calyx lobe $\times 1$; (c) abaxial outer calyx lobe $\times 1$; (d) inner calyx lobe $\times 1$; (e) frontal view of flower $\times 1$; (f) opened corolla slit along abaxial corolla lobe $\times 1$; (g) gynoecium $\times 2$; (h) stamen $\times 2$; (i) staminode $\times 2$; (j) staminode $\times 2$; (k) unopened capsule $\times 1.5$; (l) one half of dehiscent capsule $\times 1.5$; (m) seed $\times 2$.

lobes (9.0–)12.3– 12.7(–15.0) × (1.5–)2.1–2.7(–3.0) mm, linear or linear-lanceolate, apex finely pointed; surfaces very densely and finely glandular or glandular-pubescent, very pale green; texture soft, herbaceous initially becoming chartaceous with age; mid-vein conspicuous, projecting on outer surface, green initially becoming red or purple with age. *Flowers* (34–)39–40(–46) mm long, very conspicuous, scented nocturnally, colour ranging from almost pure white with faint pink markings to deep pink with magenta-pink markings on corolla lobes; corolla narrowly funelliform below, unequally 5-lobed above; *tube* narrowly cylindrical near base, gradually inflating as lobes are approached, very gently and convexly curved. *Corolla* obscurely bilabiate; *upper lip* of 4 sub-equal lobes, 2 adaxial lobes narrower and slightly shorter than two lateral lobes; adaxial lobes (19–)22–24(–27) × (8–)16–17(–18), lateral lobes (18–)21–25(–29) × (18–)20–23(–25) mm; all upper lobes elliptic or somewhat obovate to very broadly elliptic or obovate; apex acute, often sharply so; *lower lip* of 1 lobe, (18–)21–25(–29) × (18–)21–23(–25) mm, very broadly elliptic or broadly obovate; apex rounded to slightly retuse. *Androecium* comprising 2 fertile stamens and 3 staminodes. *Stamens* (34–)35–36(–40) mm long, epipetalous, exerted when mature; anthers (4.0–)4.6–5.3(–5.5) mm long, bright purple before dehiscence, black or grey after opening; dehiscence introrse, longitudinal; lobes linear, muticous, parallel; filaments white, glabrous except near base where glandular-pubescent, twisted and crossed over near base. *Staminodes* (5.0–)6.6–8.3(–10.0) mm long, epipetalous, adnate to corolla at same level as stamens; 2 staminodes with anther rudiments; filaments twisted but not crossed over near base, glabrous except at base where sparsely glandular-pubescent. *Ovary* superior, ovoid, 2-locular, glabrous; ovules 4; disc nectariferous, deeply cupular, surrounding ovary for three quarters of its length; style terete, white, glabrous, curved in young buds, straight when mature; stigma shortly bilobed. *Fruit* a capsule, (19–)20–22(–25) × (8.0–)8.3–9.7(–11.0) mm, estipitate, spindle-shaped to obtrulloid, flattened, green when young, black when mature, dehiscing explosively; surfaces glabrous, apex tapered but without an apical beak; placental bases inelastic. *Seeds* 4, discoid, (6.0–)6.9–7.3(–7.5) × (5.0–)5.3–5.7(–6.0) mm, discoid, borne on stiff retinacula; surfaces greyish-black, covered in hygroscopic hairs; *hygroscopic hairs* fused to form a continuous layer and kinked to form ridges running the width of the seeds. (Figure 1).

Pollination biology and phenology

Flowers of *B. greenii* range from almost pure white with very faint pink markings on the corolla lobes, through to dark pink, with magenta-pink streaks on the lobes. In the darker colour forms, the magenta-pink markings are often flanked by white patches or streaks. Different plants consistently produce flowers of a particular colour form, although there may be slight variation within individuals relating to age.

Scent is produced nocturnally, the strongest fragrance being produced by mature but unopened buds, rather than by the open flowers. The scent is very strong and sweet. Scent-production (by buds or open flowers) commences at nightfall, grows stronger as the night proceeds, and then fades during

the first hours of daylight the following day. The mature buds open during the early morning and at this time, or just prior to anthesis, the stigma is exerted from the flower. The stigma is held beyond the level of the undehisced anthers and the style curves upward just below the stigmatic surface. The flowers of *B. greenii* are protogynous, the maturation and dehiscence of the anthers occurring approximately 12–16 hours after the exertion of the stigma. The anthers are exerted on the lower side of the flower and dehiscence is introrse, such that if an insect settled on the lower lip of the flower, it would be dusted with pollen on its ventral surface. After dehiscence of the anthers, the flowers remain on the plants for a period of one to three days. During this time, scent production is minimal, the colour of the corolla fades and the flowers eventually turn black and fall from the plants.

Copious amounts of very sweet nectar are produced by the flowers of *B. greenii*. Production of nectar is greatest during the first 24-hour period after the buds have opened. Unopened buds do not produce nectar.

The filaments of the fertile stamens are permanently twisted and crossed-over near their bases (approximately 1 to 2 cm above the base of the corolla tube). This arrangement may serve one, or both, of two functions. The fertile stamens are adnate to the abaxial side of the corolla tube. Because the filaments are twisted and crossed-over, the stamens are exerted from the flower on the lower side with the result that visiting insects are dusted with pollen sternotribically. If the filaments were not twisted, the anthers would be held with the lines of dehiscence facing the lower lip of the corolla and pollen would not be effectively transferred to the body of a hovering insect such as a large moth. The second function of the arrangement of the filaments may be to cause a blockage in the narrow part of the corolla tube, thus restricting the nectar to the base of the flower. Consequently, a long proboscis (such as that of a Lepidopteran) would be necessary for an insect to obtain the reward of nectar. For such an insect to be an effective pollinator, it would also need to be large because of the considerable breadth of the flower.

The pale colour, morphology and size of the corollas as well as the nocturnal scent suggests that *B. greenii* is pollinated by large moths with long probosces. During the day, butterflies that have been observed feeding on other flowering plants in the vicinity, do not visit the flowers of *B. greenii*. In contrast, bumblebees are frequent visitors to *B. greenii*, but they remove the nectar from the outside of the flower through a narrow slit which they make in the base of the corolla tube. Hawkmoths have been observed visiting cultivated plants of *B. greenii* at night, although other species of moth active in the area do not appear to be attracted to the *B. greenii* flowers.

Distribution, habitat and conservation status

The first population of *Barleria greenii* was discovered by David Green in 1984 at the type locality on the farm Van der Merwe's Kraal (site 1, see Figure 2), and the plants were known from this single site until 1988 when two additional localities (sites 2 and 3) were discovered (see Figure 2). During the course of fieldwork in January 1990, a further three localities (all within two adjacent quarter-degree squares and on three adjacent farms) were discovered (see

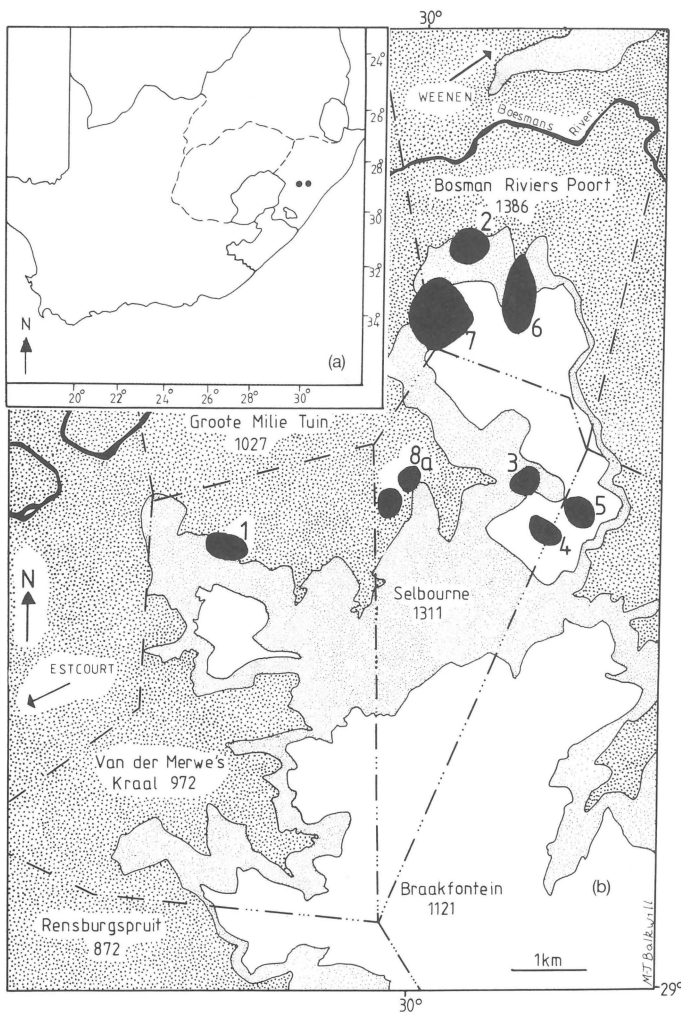


Figure 2 (a) Distribution map of *B. greenii*; (b) enlarged portion of distribution map showing *B. greenii* populations (numbered black patches), farm names and boundaries and altitude (coarse stippling = areas below 1 200 m; fine stippling = areas between 1 200 and 1 240 m contours; white areas = land above 1 240 m contour line).

Figure 2). These sites were all visited on foot and voucher specimens were collected. Because plants of *B. greenii* are large and produce many flowers simultaneously, it was predicted that the plants would be visible from the air. In an attempt to establish the range of *D. greenii*, a low-level flight in a Piper Cherokee aeroplane was made over parts of the quarter-degree squares 2829DD and 2830CC during the flowering period. The plants were found to be very clearly visible from the air, especially when in full flower. During the flight all the known localities were sighted and one additional locality, site 7 (see Figure 2), was discovered. Whilst it is possible that some plants may not have been seen from the aeroplane, it seemed that *B. greenii* did not occur at any other potentially suitable site in the study area. Since the flight was undertaken an additional locality, site 8 (see Figure 2), has been discovered by Dave Green and a voucher specimen has been collected from this population.

At all eight sites, the plants occur in open, rocky areas on moderately sloping north-facing aspects, mostly between the 1 200-m and 1 260-m contours. The soil at all of the

localities is a very heavy, dense black clay strewn with doleritic rock. The plants grow at the interface of grassland and valley bushveld (see Figure 3) occurring in, or along the borders of, seasonal or perennial streams, drainage lines or boggy areas. Most plants grow between the rocks in full sun and those plants that grow in the shade (e.g. under trees) are much less robust and have broader leaves than plants growing in full sun. The growth form of *B. greenii* plants (see Figure 4) can also be affected by the frequency with which the area is burnt. Plants burnt infrequently (such as those at site 1 which are burnt once every four to five years) are extremely robust and woody, attaining heights of almost 2 m. Plants burnt more frequently (i.e. biennially) are less robust, attaining heights of only 0.8 m, but these plants branch far more vigorously and attain a greater diameter than those that are burnt less often. The plants occupy an area of 2–4 ha at each site and, in areas where it is present, *B. greenii* seems to be the dominant species. There is however, a sharp line of discontinuity between where the *B. greenii* plants occur and where they do not and this is particularly noticeable from the air.

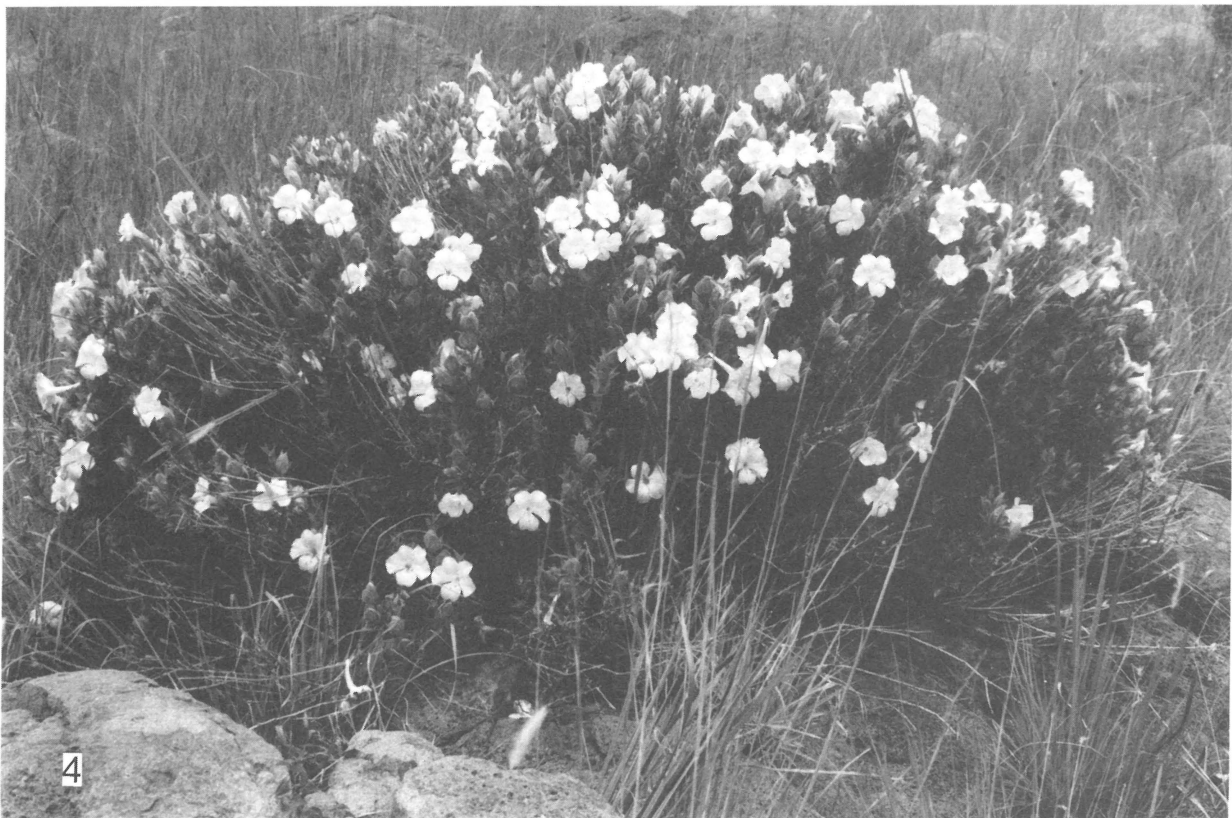
In *B. greenii*, as in many members of the Acanthaceae, dispersal of the seeds occurs ballistically. Dispersal therefore takes place over short distances and this has a profound effect on the distribution of this species. Long-range dispersal to new suitable habitats occurs rather rarely, but, when it does occur, the seedlings mature and by their second year are able to produce offspring which grow close to their bases, and the population thus expands to fill the suitable habitat. Because pollination is most probably achieved by hawkmoths, which are strong fliers, it seems likely that some gene flow takes place between populations by means of pollen transport.

Sites 1, 3 to 5 and 8 (see Figure 2) are included in privately owned cattle farms most of which form part of the Lowlands East Conservancy. The plants are not grazed by cattle (or any of the indigenous fauna), and the sites are unlikely to be developed agriculturally because of the nature of the terrain and the type of soil present in these areas. Sites 2, 6 and 7 have recently been included in the Weenen Nature Reserve (controlled by the Natal Parks, Game and Fish Preservation Board). Therefore, all of the sites at which *B. greenii* is known to occur are well conserved at present, but the conservation status of this species should still be carefully monitored. Although it is locally abundant where it occurs, *B. greenii* is extremely localized and evidently has specific habitat requirements and should therefore be considered a rare species. In this context it is interesting to note that two other species, *B. argillicola* Oberm. and *Kniphofia typhoides* Codd occur at or near the sites where *B. greenii* is found. *Barleria argillicola*, which is rare, is highly localized and is known only from the farms Van der Merwe's Kraal, Rensburg Spruit and Braakfontein (see Figure 2). It grows near the populations of *B. greenii*, but does not grow on the black clay. *Kniphofia typhoides* has previously only been recorded from the northern districts of Natal (where the southernmost limit of its distribution was thought to be at Newcastle), the southern, central and western Transvaal and the north-eastern part of the Orange Free State. It occurs at medium altitudes of 1 216–1 520 m and is almost invariably found on black clay soil in pans or vleis (Codd 1968). We have found *K. typhoides* growing at the edges of the *B.*

greenii populations at six of the eight sites where *B. greenii* grows. The occurrence of *B. argillicola* and *K. typhoides* at or near these sites further suggests that the area provides specialized and unique habitats.

Affinities

It is extremely difficult to ascertain the affinities of *B. greenii* within *Barleria*, as it is a very distinctive and unusual species with an unusual combination of character states. This also



Figures 3 & 4 3. Habitat of *B. greenii* (photograph taken on the farm Braakfontein). 4. Habit of *B. greenii*.

Table 1 A comparison of the characteristic features of the sub-sections of section *Eubarleria* (*sensu* Obermeijer 1933) and *B. greenii*

Feature	Subsection							<i>Barleria greenii</i>
	<i>Pungentes</i>	<i>Aculeatae</i>	<i>Cryptophytæ</i>	<i>Dispermae</i>	<i>Innocuae</i>	<i>Heterotrichae</i>	<i>Thamnotrichae</i>	
Pubescence	Simple hairs	Simple hairs	Simple hairs	Simple hairs	Simple hairs	Simple and complex hairs	Simple and complex hairs	Simple hairs
Spinous bracts	present	present	absent	absent	absent	absent	absent	present
Corolla lobes	2 above 3 below	2 above 3 below	2 above 3 below	4 above 1 below	Subregularly 5-lobed or 4 above, 1 below	2 above 3 below	4 above 1 below	4 above 1 below
Stylar base (pubescence)	with a ring of curly white hairs	glabrous or with a few straight hairs	glabrous or with a few straight hairs	glabrous or with a few straight hairs	glabrous or with a few straight hairs	ring of short curly hair plus long straight hairs	ring of short curly hair and long straight hairs	glabrous
Morphology of stigma	capitate or 1 lobe filiform 1 lobe reduced	1 lobe filiform 1 lobe reduced	subconfluent, capitate	subconfluent, obconical	1 lobe filiform 1 lobe reduced	1 lobe filiform 1 lobe reduced	1 lobe filiform 1 lobe reduced	weakly bilobed, capitate
No. of seeds in capsule	4	4	4	2	2	4	2	4

renders it impossible to place the species satisfactorily in Obermeijer's classification (1933) of the genus. *B. greenii* quite clearly fits into Section 'Eubarleria' (*sensu* Obermeijer 1933), as the capsules are 4-seeded, compressed and narrowed at the base and apex, but without a terminal beak (not 2-seeded, turgid and broad at the base with a long apical beak, as in sections Prionitis and Somalia). However, *B. greenii* does not fit very clearly into any of the sub-sections (*sensu* Obermeijer 1933) of 'Eubarleria' as is shown in Table 1.

The difficulty associated with the placement of *B. greenii* within *Barleria* as a whole underlines the need for a re-appraisal of the current classification of the genus.

Specimens examined

—2829 (Harrismith) Midlands, Estcourt district, Farm Van der Merwe's Kraal 972, hill 'Rockliegh' (–DD), *Green* 396 (NH); *ibidem*, *Green* 499 (BM, J, NH) & *Green* 625 (J, holo.; E, K, NH, NU, PRE, iso.); *ibidem*, *Balkwill & Balkwill* 4020 (CPF, J, M, NH, PRE), 4389 (E, J) & 4390 (J).

—2830 (Dundee): Weenen district, Farm Selbourne 1311 (–CC), *Green* 580 & *Green* 705 (J, NH); *ibidem*, *Balkwill & Balkwill* 4391 (J, MO) & *Balkwill, Balkwill & Green* 5406 (B, E, J, MO); Farm, Braakfontein, *Balkwill, Balkwill & Green* 5404 (B, E, J, MO); Farm

Bosman Riviers Poort, *Balkwill, Balkwill & Green* 5399 (B, E, J, LISC, M, MO).

Acknowledgements

The financial support of the Foundation for Research Development (M-J.B. & K.B.) and the University of the Witwatersrand (Senate Research Grants, M-J.B. & K.B., and Herbarium Programme, K.B.) is gratefully acknowledged. Many thanks are due to Dave and Dorothy Green for their hospitality and to Dave Green and Lou Zonneveld for assistance with field work. We are especially grateful to Mr M.L. Poivesan of Estcourt who kindly flew us over the study site in search of populations of *B. greenii*. His enthusiastic co-operation was very valuable to this study.

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