

## ASTERACEAE

*BERKHEYA CHRYSANTHEMOIDES* AND *HETERORHACHIS HYSTRIX*, TWO NEW SPECIES OF ARCTOTIDEAE–GORTERIINAE FROM THE SOUTHWESTERN CAPE

### **Berkheya**

*Berkheya* Ehrh. (1788), comprising  $\pm$  80 species, is concentrated in southern Africa with four species extending northwards into Angola and tropical East Africa (Roessler 1959; Bremer 1994; Karis *et al.* 2009). The genus is distinguished by the production of latex, a shrubby or perennial habit, spine-tipped or -lobed involucreal bracts that are basally connate, mostly radiate (rarely discoid) capitula with yellow (rarely white or mauve) ray florets that are neuter and often apically four-lobed, a  $\pm$  deeply alveolate receptacle with the walls of the outer and inner cavities uniformly thin-walled, and a pappus of mostly  $\pm$  20 denticulate scales in one or two rows, either short or longer and bristle-like. Most species are herbaceous, sometimes rosulate perennials, and fewer than 20 species are subshrubs or true shrubs. A recent collection of a shrubby taxon from the Bokkeveld Mountains in Northern Cape at the northern limit of the Cape Floral Region represents an undescribed species that is named for the attractive, conspicuously radiate capitula.

***Berkheya chrysanthemoides*** *J.C.Manning & Goldblatt*, sp. nov.

Frutex multiramosa ad 1.7 m alta, foliis alternatis pinnatifidis minute glanduloso-pubescentibus glabrescen-

tibus, primo adpectu maxime simile *Berkheya spinosa* sed foliis profunde lobatis capitulis conspicue radiatis 40–55 mm diam. disco  $\pm$  15 mm diam, radii 18–25  $\times$  4–5 mm.

TYPE.—Northern Cape, 3119 (Calvinia): Nieuwoudtville, Oorlogskloof Nature Reserve, (–AC), 28 September 2000, *Pretorius 540* (NBG, holo.; PRE, iso.).

Much-branched shrub up to 1.7 m high; branches patent, leafy, minutely glandular-pubescent when young and flushed purple, later subglabrous. *Leaves* alternate, sessile, rigid, oblanceolate in outline, (20–)25–40(–50)  $\times$  8–20 mm, apex excurrent in yellowish spine 1–2 mm long, base scarcely narrowed, semi-amplexicaul, blade pinnatifid, 2- or 3-jugate, with smaller, deflexed lobe in distal axil of primary divisions, lobes triangular to narrowly triangular, shorter than, or as long as, width of undivided portion, excurrent in spine similar to apical spine and with smaller, antrorse spines along margins, minutely glandular-pubescent on both surfaces but adaxial surface glabrescent and shining, with some cobwebby hairs in axils. *Capitula* 1–3 in shortly pedunculate corymbs at branch tips, radiate, 40–55 mm across expanded rays; florets yellow. *Involucreal bracts* 3- or 4-seriate, basally connate in involucre  $\pm$  4 mm deep, patent-reflexed, ovate-lanceolate, excurrent in yellowish spine 2–3 mm long, margins with 2 or 3 pairs of pat-

ent spines similar to apical spine, sparsely and minutely glandular-pubescent, glabrescent, outer mostly 5–8 × 2–3 mm, median 10–12 × 3–4 mm, inner narrowly lanceolate, 6–8 × 1.5–2.0 mm. *Receptacle* deeply alveolate, margins irregularly fimbriate with straw-like spinules 1–2 mm long. *Ray florets* 12–14, neuter, tube ± 2.5 mm long, glandular-pubescent, limb oblanceolate, 18–25 × 4–5 mm. *Disc corollas* funnel-shaped, densely glandular-pubescent on tube and more sparsely along lobe margins, 8–9 mm long, tube ± 5 mm long, lobes erect, lanceolate, ± 3 mm long; anthers tailed with lanceolate apical appendage, ± 4.5 mm long; endothelial cells with inner periclinal wall reinforcements displaced towards the connective. *Pappus scales* uniseriate, ± 20, oblong-ovate, obtuse-truncate, denticulate, connate below, ± 0.3 × 0.2 mm. *Immature cypselae* obovoid, 2–3 × 1 mm, angled, densely antrorsely pubescent with short, twin hairs. *Pollen* lophate. *Flowering time*: August–September. Figures 13; 14A–E.

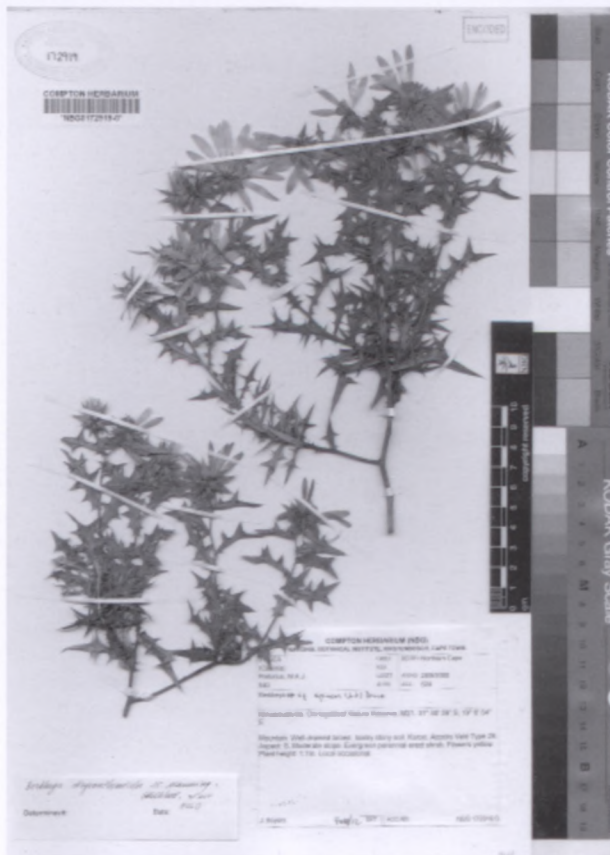


FIGURE 13.—*Berkheya chrysanthemoides*, Pretorius 540 (NBG).

*Ecology and distribution*: apparently endemic to the Bokkeveld Escarpment, where it is known from a single collection made in the Oorlogskloof Nature Reserve near Nieuwoudtville (Figure 15). Plants were recorded as local and occasional on stony, south-trending sandstone slopes.

*Diagnosis and relationships*: *Berkheya chrysanthemoides* is a shrub up to 1.7 m tall with alternate, pinnatifid leaves that, like the young stems, are minutely glandular-pubescent but glabrous with age. It produces few-flowered corymbs of moderately-sized, radiate

capitula 40–55 mm in diameter across the expanded rays, with a relatively small disc, ± 15 mm diam. The alveole margins are conspicuously fimbriate. The young cypselae are densely puberulous, with small, obtuse pappus scales, ± 0.3 mm long (Figure 14B, D).

In its subglabrous, shrubby habit and broad leaves, *Berkheya chrysanthemoides* is superficially most similar to *B. spinosa* (L.f.) Druce but is readily distinguished from that species by the deeply lobed leaves and conspicuously radiate heads with rays 18–25 × 4–5 mm. The leaves of *B. spinosa* are toothed rather than lobed, with the teeth mostly less than half as wide as the undivided portion of the blade, the rays are almost linear and 10–15 × 1.5–2 mm, with a proportionally larger disc 15–25 mm in diameter, the alveole margins are ± entire or denticulate, and the cypselae are densely silky with a biseriate pappus of linear-subulate scales 3–7 mm long (Figure 14F). Other shrubby members of the genus with similar broad, toothed or pinnatifid leaves, notably *B. canescens* DC., *B. coriacea* Harv., *B. cuneata* (Thunb.) Willd. and *B. fruticosa* (L.) Ehrh., all have partially or completely tomentose or felted leaves and, like *B. spinosa*, silky ovaries and cypselae with a biseriate pappus of lanceolate to subulate, acute scales, 1.5 mm or more long. In these species the endothelial cells have the inner periclinal wall reinforcements regularly distributed, and not displaced towards the connective, as found in *Berkheya chrysanthemoides* and also in the species of *Berkheya* series *Rigidae*.

The relationships of *Berkheya chrysanthemoides* are somewhat puzzling. The shrubby habit, radiate heads, and relatively broad leaves are consistent with *Berkheya* series *Fruticosae* Roessler but members of this series characteristically have entire or shortly toothed (rarely fringed) alveole margins, densely silky cypselae with the hairs often 1–4 mm long, and a ± biseriate pappus of lanceolate or subulate scales (Roessler 1959). The conspicuously fimbriate alveole margins, short cypselae twin hairs, and uniseriate pappus of short, obtuse scales in *B. chrysanthemoides* are typical of several members of series *Rigidae* Roessler, including *B. rigida* (Thunb.) Bolus & Wolley Dod, *B. heterophylla* (Thunb.) O. Hoffm and *B. viscosa* (DC.) Hutch. Most members of this series, however, are perennial herbs or suffrutices with discoid heads, with a true shrubby habit developed only in *B. cardopatifolia* (DC.) Roessler from the Great and Upper Karoo and in *B. draco* Roessler from the Kwa-Zulu-Natal Drakensberg. Other features characteristic of series *Rigidae* are the lanceolate, subacute apical anther appendages, endothelial thickenings displaced towards the connective, and the lophate pollen. Species of series *Fruticosae*, in contrast, mostly have ovate apical anther appendages, evenly distributed endothelial thickenings, and spinulose pollen. Pending further evidence, we therefore provisionally place *B. chrysanthemoides* in series *Rigidae* based on the characters of the anthers, cypselae and pappus. Its precise relationships remain to be determined but it is significant that the largest molecular phylogenetic analysis of the Arctotideae–Gorteriinae to date (Funk & Chan 2008) segregates a large portion of the sampled representatives of series *Rigidae* in one clade and most species of series *Fruticosae* in another.

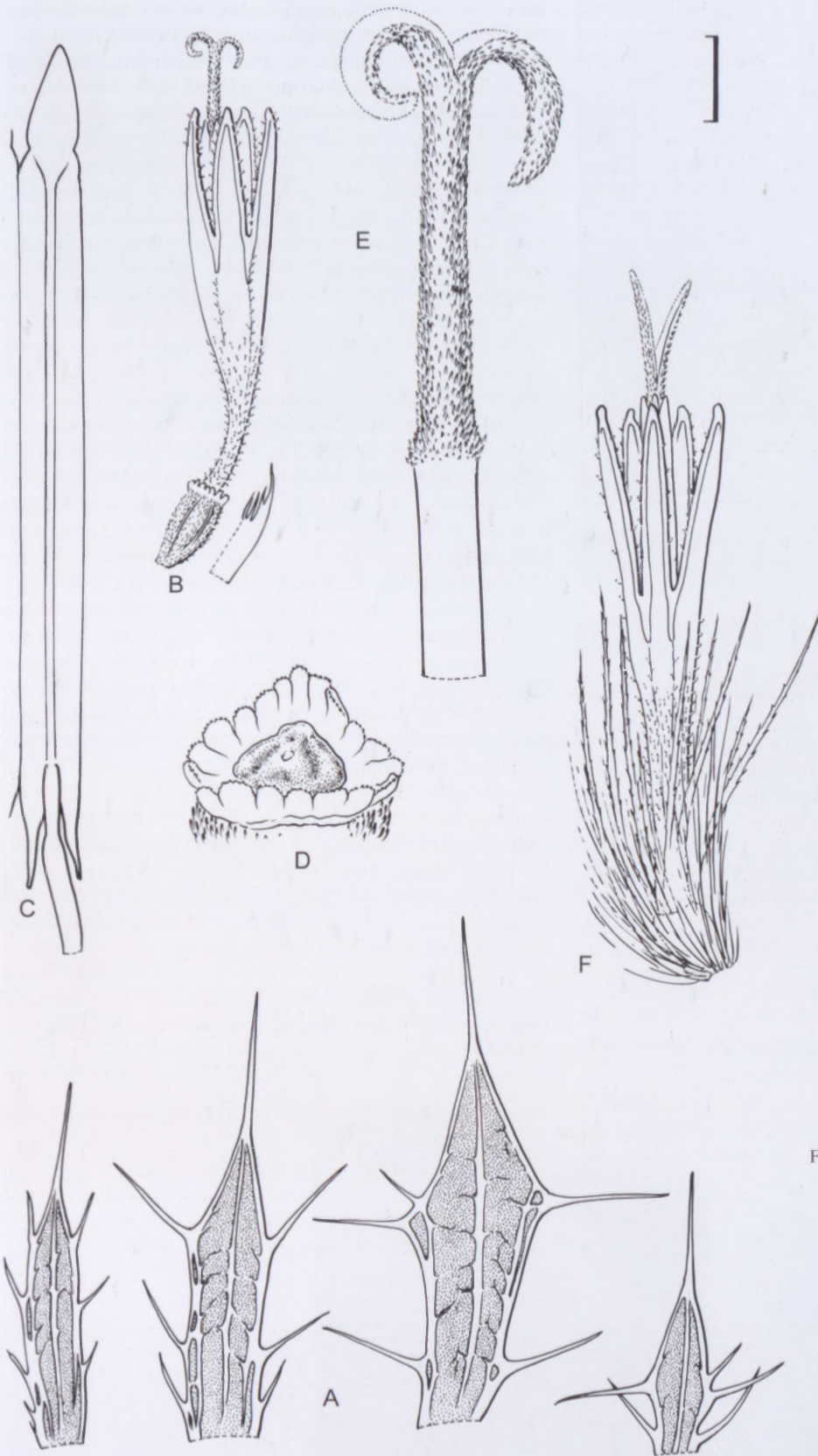


FIGURE 14.—A–E, *Berkheya chrysanthemoides*, Pretorius 540: A, involucre bracts (outermost on left, innermost on right); B, disc floret showing puberulous ovary and coroniform pappus of small, obtuse scales, plus portion of alveole margin; C, anther; D, apex of ovary showing pappus; E, apex of style showing stigma. F, *B. spinosa*: disc floret showing sericeous ovary and bristle-like pappus of subulate scales. Scale bar: A, B, F, 2 mm; C, E, 0.5 mm; D, 1 mm. Artist: John Manning.

**Heterorhachis**

This new species of *Heterorhachis* Sch.Bip. ex Walp., which appears to have been discovered in 1938 by T.M. Salter, has been collected just three times since then. It was overlooked until Goldblatt & Manning (2000)

identified it as a novelty in their conspectus of the Cape Flora as *Heterorhachis* sp. 1. The rediscovery of the species by Cape Town conservationist Nick Helme has enabled us to describe it formally. The epithet *hystrix* (porcupine) alludes to the spiny, greyish leaves on the older stems.

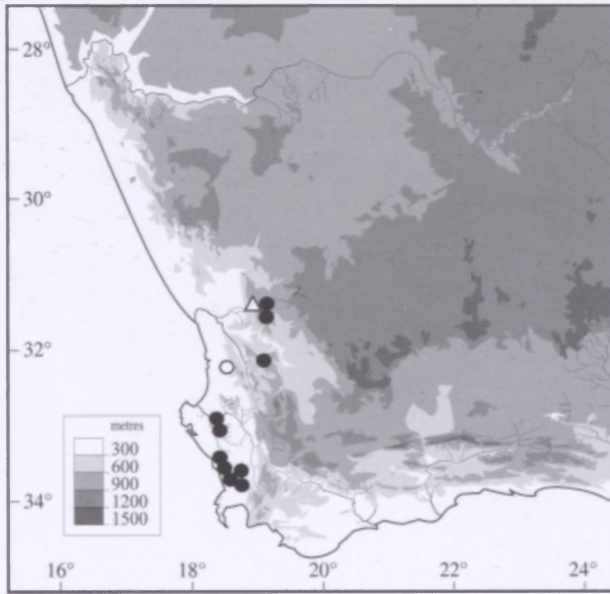


FIGURE 15.—Known distribution of *Berkheya chrysanthemoides*,  $\Delta$ ; *Heterorhachis hystrix*,  $\circ$ ; and *H. aculeata*,  $\bullet$ .

***Heterorhachis hystrix* J.C.Manning & P.O.Karis, sp. nov.**

*Heterorhachis aculeata* (Burm.f.) Roessler valde similis, sed capitulis discoideis, bracteis involucri exterior 3 seriebus ovatis foliaceis integris, a foliis bene dissimilibus, usque ad  $\pm 20 \times 8$  mm, flavo-virentibus pallentibus, cypselis tantum trichomatibus glanduliferis varie longis, et squamis pappis leviter brevibus distinguitur.

TYPE.—Western Cape, 3218 (Clanwilliam): Graafwater, along road towards, Sandberg, close to electric power station,  $32^{\circ} 11.35'S$ ,  $18^{\circ} 36.00'E$ , (–BA), 31 August 2006, *Stångberg & Karis 3* (NBG, holo.; S, iso.).

Shrublet up to 1 m high, branching from near base, with erect to ascending, closely leafy stems. *Stems* densely white-felted when young, later glabrescent. *Leaves* ses-

sile, rigid, semi-amplexicaul, spreading or erect-spreading, becoming declinate, greyish and withering on older stems, blade cuneate in outline,  $30\text{--}60 \times 15\text{--}30$  mm, pinnatisect, 3- or 4-jugate, rachis 3–4 mm wide at base, mostly bifurcate, sometimes trifurcate but median lobe declinate and smaller than laterals, lobes linear-lanceolate to lanceolate, largest  $(10\text{--})20\text{--}50 \times 2\text{--}3\text{--}(5)$  mm, becoming progressively smaller basipetally and reduced to series of spines at base, margins revolute, apex excurrent in yellow spine 2–3 mm long, cobwebbed when young but adaxial surface glabrescent, at length glabrous and shining, abaxial surface persistently white-felted. *Capitula* homogamous, discoid, terminal and axillary in upper axils forming dense, racemose synflorescences, 40–50 mm across involucre bracts. *Involucre* cup-shaped, leathery,  $\pm 8$  mm diam., bracts  $\pm 4$ -seriate, glandular-puberulous on both surfaces, especially abaxially, yellowish green, ovate-lanceolate, apex excurrent in spine 1.0–1.5 mm long, outermost series reflexed, margins lightly recurved thus convex adaxially,  $\pm 15 \times 5$  mm, with 2 or 3 pairs of spines in basal half, second and third series patent to erecto-patent, plane or margins lightly revolute in distal half, second series largest,  $\pm 20 \times 8$  mm, with 1 or 2 pairs of sub-basal spines, third series slightly smaller, with 1 pair of basal spines, innermost series erect and forming collar along involucre margin, oblong,  $4\text{--}7 \times 2\text{--}3$  mm, fimbriate-ciliate. *Receptacle* deeply alveolate with smooth walls, marginal pits very deep with leathery walls, completely enclosing ovary/cypsela and pappus and becoming indurated and woody in fruit, inner pits with thinner, membranous walls remaining papery in fruit, shallower and exposing pappus. *Marginal florets*  $\pm 8$ , disc florets  $\pm 18$ , corolla funnel-shaped, glandular, tube  $\pm 6$  mm long, lobes erect, lanceolate with sclerified margins,  $\pm 3$  mm long; anthers tailed, with lanceolate apical appendages  $\pm 4.5$  mm long; endothelial cells with  $\pm$  entire inner periclinal wall reinforced. *Cypselae* turbinate,  $\pm 2 \times 1$  mm, 10-ribbed, with scattered variously long glandular hairs, pale brown. *Pappus scales* biseriate,  $\pm 10 + 10$ , lanceolate, outer series  $\pm 1$  mm long, inner series  $\pm 1.8$  mm long, with some short glandular hairs, fimbriate with some to many cilia gland-tipped. *Pollen* spinulose. *Flowering time*: August–September. Figures 16; 17A–F.

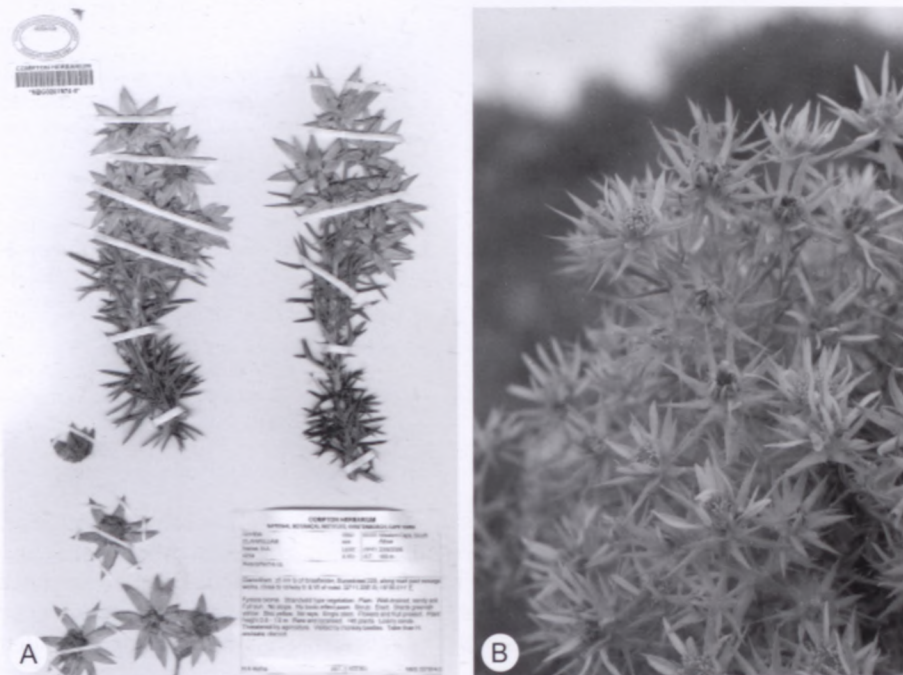


FIGURE 16.—A, *Heterorhachis hystrix*, Helme 4284 (NBG), herbarium specimen. B, *H. aculeata*, Bokkeveld Mountains, no voucher: capitula. Photographer: B, John Manning.

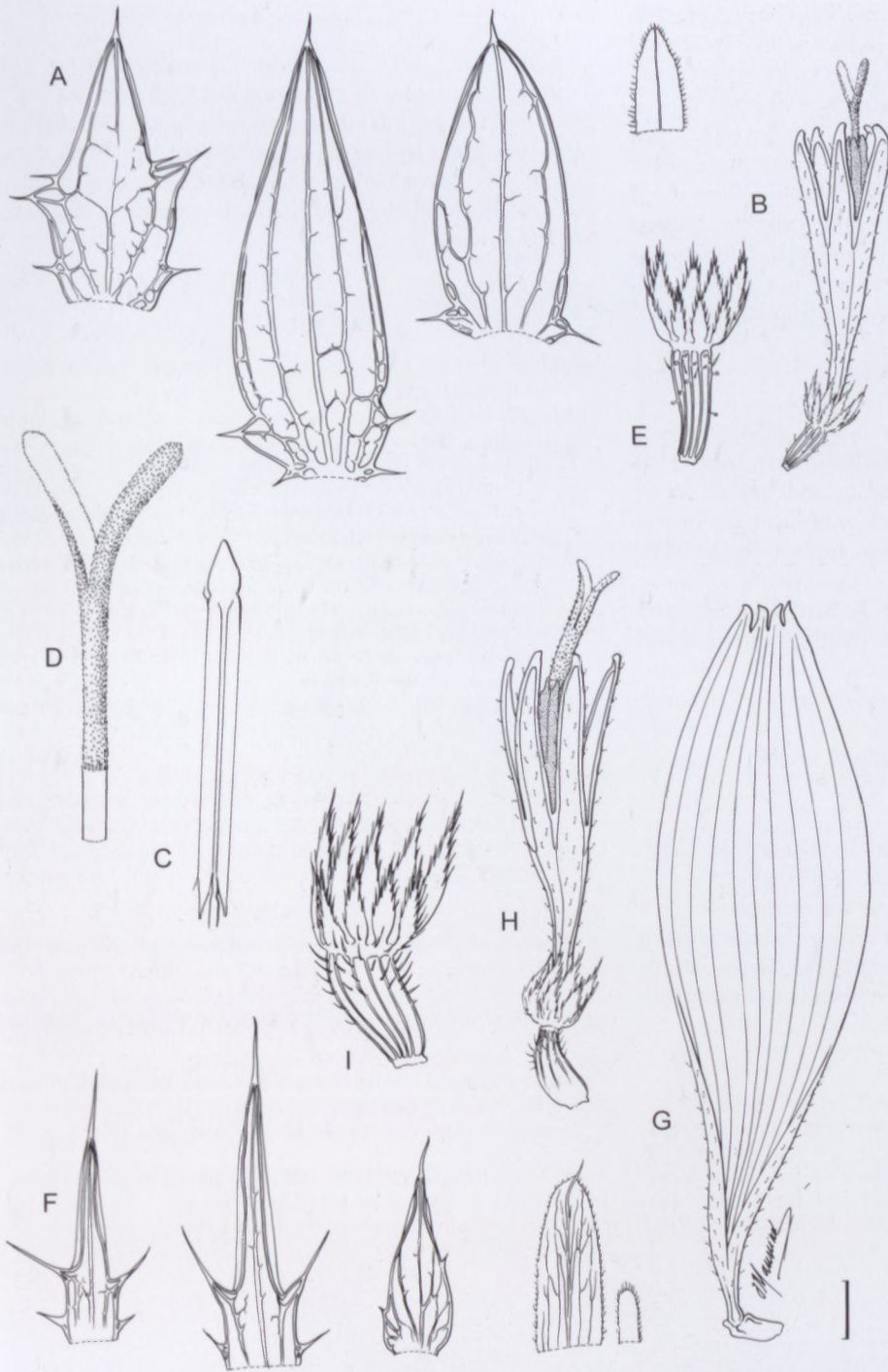


FIGURE 17.—A–E, *Heterorhachis hystrix*, Barker 10421: A, involucre bracts (outermost on left, innermost scale-like bract on right); B, floret; C, anther; D, apex of style showing stigma; E, cypselae. F–I, *H. aculeata*, Low 3750: F, involucre bracts (outermost on left, innermost on right); G, marginal floret; H, disc floret; I, cypselae. Scale bar: A, B, E–I, 2 mm; C, D, 1 mm. Artist: John Manning.

**Distribution and ecology:** known from four collections near the town of Graafwater, west of Clanwilliam (Figure 15). Plants grow in deep sandy soils, and recent observations suggest that there may be fewer than 100 plants extant.

**Diagnosis and relationships:** *Heterorhachis hystrix* is readily distinguished from *H. aculeata* by its discoid capitula with conspicuous, pale yellowish green or cream-coloured involucre bracts. The outer three series of bracts are subsimilar,  $\pm$  foliaceous and ovate, 5–8 mm wide, with plane or only weakly revolute margins, but the bracts of the inner series are much smaller and scale like, forming a distinct collar-like rim protruding 2–3 mm above the preceding series. This collar becomes

indurated and is very conspicuous in fruit after the corollas have abscised. The conspicuous involucre bracts may play an attractive function in the pollination biology of the species analogous to the ray corollas in *H. aculeata*. Both species have pappus scales with scattered glands, including some gland-tipped marginal cilia, a feature thus far unknown in other Arctotideae–Gorteriinae.

The species is very similar in leaf to *Berkheya ferox* O. Hoffm., although the lobes in this species are somewhat wider. However, the involucre bracts are much smaller and less conspicuous than in *Heterorhachis* and the cypselae and pappus scales are devoid of glandular hairs.

The capitula in *Heterorhachis aculeata*, in contrast to those in *H. hystrix*, are distinctly radiate with a relatively inconspicuous involucre concolorous with the leaves and with the outer three series of bracts resembling the foliage, thus narrowly lanceolate, 3–5 mm wide, and with conspicuously revolute margins. The cypselae bear shorter glands throughout as well as some short twin hairs in the upper half, and the pappus is slightly longer, the inner scales  $\pm$  3 mm long. The innermost bracts are oblong and either unarmed or pungent but rather variable in size, with the larger ones typically cucullate.

The two species appear to differ in their habit and ecology. The growth form in *Heterorhachis hystrix* is very characteristic, the plants branching near the base to produce short-lived, erect, rod-like stems up to 1 m tall, which die back after flowering and are replaced by a fresh flush of branches from near the base of the plant. The species, which is known from a single location on the intensively cultivated coastal plain, grows in well-drained, sandy soil with no evident bedrock, and the surrounding vegetation includes both Strandveld and Sand Fynbos elements. This contrasts with the shorter, rounded, bushier habit of *Heterorhachis aculeata*, mostly up to  $\pm$  500 mm high, which favours seasonally damp or waterlogged, loamy sand flats, at altitudes ranging from 100 m to about 800 m.

*Heterorhachis hystrix* has been Red listed as Critically Endangered (Raimondo *et al.* 2009) and although *H. aculeata* is substantially more widespread (Figure 14), at least three of the seven known populations have suffered partial or total loss of habitat in the last thirty years, and it is consequently Red listed as Vulnerable (Raimondo *et al.* 2009).

#### *Other specimens seen*

WESTERN CAPE.—3218 (Clanwilliam): near (east of) Graafwater, (–BA), 2 September 1938, *Salter 7551* (BOL); Graafwater, 18 August 1966, *Barker 10421* (NBG);  $\pm$  5 m S of Graafwater, Buroskraal Farm, 180 m, (–BA), 23 August 2006, *Helme 4284* (NBG). Without precise locality: Clanwilliam Flower Show, 27 August 1998, *Hanekom 3058* (PRE).

#### ACKNOWLEDGEMENTS

BOL, NBG, PRE and SAM, the main herbaria with good representation of collections of Cape species, were consulted for records of the two new species (herbarium acronyms after Holmgren *et al.* 1990). We thank curators of the above herbaria for allowing access to their collections. Michelle Smith kindly prepared the electronic figures.

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