A new species of *Berkheya* (Asteraceae, Arctotideae) from the Northern Cape, South Africa

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**Introduction**

*Berkheya* Ehrh. (Asteraceae) is the largest genus in Arctotideae subtribe Gorteriinae, the ‘spiny daisies’ of southern Africa. The genus has been shown to be paraphyletic using both molecular (Funk & Chan 2008; Funk, Chan & Keeley 2004) and morphological data (Karis 2006) and changes in generic circumscriptions in the subtribe are anticipated (Karis et al. 2009). Based on current evidence, *Berkheya* consists of approximately 75 species distributed predominantly in South Africa. The genus was last revised by Roessler (1959) and has thus not been treated as a whole for over 50 years, despite several useful regional treatments, including Goldblatt and Manning (2000), Hilliard (1977), Manning and Goldblatt (2012a) and Snijman (2013), and the description of a handful of new species (Hilliard 1977; Hilliard & Burtt 1975; Manning et al. 2010; Manning & Goldblatt 2012b). The prevalent covering of sharp spines makes *Berkheya* species difficult and painful to collect and the genus is poorly known and under-collected, despite forming a prominent component of many plant communities.

*Berkheya* species occur in several bioregions but are concentrated in the Greater Cape Floristic Region, where they are most strongly associated with the winter-rainfall desert (succulent Karoo) vegetation (Verboom et al. in press). Most species are perennial herbs, less commonly shrubs, distinguished from allied genera by the possession of, (1) involucral bracts that are always spiny and basally connate but never hardened into a woody structure, (2) a honeycombed receptacle with the cypselas embedded in alveoli that are all of equal size and (3) a pappus (Roessler 1959).

Roessler (1959) divided *Berkheya* into eight series based on characters of the receptacle alveolar margins, cypselas hair type, pappus arrangement and structure, degree of connation of the involucral bracts, leaf morphology (including degree of division, margin serration and indumentum), leaf arrangement (opposite versus alternate), presence or absence of ray florets and growth form. Additional characters used to define species include hairiness of the stems and leaves, leaf shape and size, form of the leaf margins, size and structure of the leaf spines, arrangement and size of the capitula, ray floret colour and the size and morphology of the involucral bracts.

*Berkheya* material from a localised area in the northern Bokkeveld escarpment in the Calvinia region of the Northern Cape Province (Figure 1) was examined and this could be distinguished from other species in the genus by its tall, shrubby habit, relatively large and broad leaves, small

**Background:** *Berkheya* is a large, mainly southern African genus of approximately 75 species, several of which are poorly known and under-collected. Since revision in 1959, only a few new species have been described. Publication of new taxa facilitates conservation objectives and contributes to a better understanding of the southern African flora.

**Objectives:** The objectives of this study were to describe a new species of *Berkheya*, consider its taxonomic position within the genus and assess its conservation status.

**Methods:** Macro-morphology and micromorphology of the new species were compared with known species.

**Results:** *Berkheya dumicola* N.G.Bergh & Helme was described from two subpopulations from the northern Bokkeveld escarpment, Northern Cape Province, South Africa. The species is a tall shrub with radiate flowerheads, toothed receptacle alveole margins, a uniseriate pappus of small, rounded scales and very short twin-hairs on the cypselas.

**Conclusion:** *Berkheya dumicola* is a new species with a unique combination of features. Based on morphological characteristics, its closest relative within the genus is likely to be the recently described *Berkheya chrysanthemoides* J.C.Manning & Goldblatt. The limited geographic extent and small population size of *B. dumicola* warrant an International Union for Conservation of Nature (IUCN) status of ‘Endangered’.
radiate heads clustered in paniculate groups, very short uniseriate pappus scales and short hairs on the cypselas. This material represents a new species which is described in detail here.

Research method and design

Berkheya specimens from the South African National Biodiversity Institute’s (SANBI) Compton Herbarium in Cape Town (NBG), SANBI’s South African Museum Herbarium in Cape Town (SAM) and the Bolus Herbarium at the University of Cape Town (BOL) were compared with those of the new taxon. Holotype material was collected and dried using standard techniques in October 2013. Type material has been deposited in NBG, BOL and SANBI’s National Herbarium in Pretoria (PRE), Kew Herbarium at the Kew Royal Botanic Gardens, United Kingdom (K) and the Swedish Museum of Natural History Herbarium in Stockholm (S).

Habitat and habit were documented in the field. Morphological structures were examined on dried and rehydrated specimens using a dissecting microscope. Images were captured from the microscopes using an Olympus SC30 digital camera attachment and the software Analysis getIT v. 5.1 (Olympus Soft Imaging Systems, Münster, Germany). Measurements were made on digital images using MeasureIT v. 5.1 from the same company.

Plants were collected under collecting permit FLORA 02/02/2013 issued to Compton Herbarium staff by the Department of Nature Conservation, Northern Cape Province.

Taxonomic treatment

Berkheya dumicola N.G. Bergh & N.A. Helme, sp. nov.

Type

SOUTH AFRICA. Northern Cape: 3119 (Calvinia): Noord Bokkeveld, top of Die Hel pass, north-west of farm Kookfontein (–AA), 12 Oct. 2013, Helme 7794 (NBG, holo.; BOL, PRE, K, S, iso.).

Description

Well-branched shrub up to 2 m tall, with gnarled woody stem to 120 mm diameter at base, branches leafy towards apices (Figure 2a), thinly (glandular-) tomentose. Leaves: alternate, sessile, oblanceolate in outline, 30 mm – 80 mm × 20 mm – 50 mm, lamina narrowed to slender base ± 2 mm wide, pinnatifid, two-jugetate with five primary lacinia, lacinia increasing in size distally, primary lateral lacinia each with smaller secondary lobe in distal axil, narrowed at base and often with additional slender patent lobes resembling spines, lacinia somewhat concave, triangular to narrowly triangular, shorter than to as long as the width of undivided portion, euradial in apical yellowish spine but lacking spines along margins, margins revolute (Figure 2b), discolorous, adaxial surface thinly woolly when young, glabrescent, abaxial surface densely white-felted. Capitula: shortly pedunculate, 3–10 in loose corymbs at ends of short, slender flowering branches, several branches arranged together in paniculate synflorescences, radiate, 20 mm – 35 mm diameter across expanded ray florets, florets rich yellow. Involucral bracts: 4-seriate (Figure 2c), basally connate in involucre ± 4 mm deep, squarrose, concave, narrowly lanceolate, margins thickened, cartilaginous, yellowish, with apical spine 2 mm – 3 mm long and with 2 or 3 pairs of similar marginal spines, glabrous, outer bracts 5 mm – 8 mm × 2 mm – 3 mm, median 10 mm – 12 mm × 2 mm – 3 mm, inner narrowly lanceolate, 6 mm – 8 mm × 1.5 mm – 2.0 mm. Receptacle: deeply alveolate (Figure 2d), ovaries embedded in fleshy alveolar tissue, alveole margins extended into irregularly serrated cartilaginous teeth 1.0 mm – 2.5 mm long (Figure 3d). Ray florets: 8–10, sterile and lacking pappus, attached to Cypselas: obovoid, 2.0 mm – 3.0 mm × 0.8 mm, angled, distally densely covered with, short, antrorse twin-hairs (Figure 3e). Pappus: of short scales, uniseriate, ± 20, entire, ± 0.3 mm × 0.2 mm, oblong-ovate, apex obtuse-truncate, glabrous (Figures 3e and 3f).

Distribution and habitat

This large, shrubby species has been collected from only one locality in the northern Bokkeveld, north-west of...
Nieuwoudtville, on the very edge of the escarpment (Figure 1). Two subpopulations, each of approximately 30 plants, have been found growing about 800 m apart on steep, southwest-facing slopes amongst large sandstone boulders (Figure 2a). The plants occasionally sprawl over the rocky outcrops. The aspect appears to be important because *B. dumicola* was not seen in otherwise similar habitats along the escarpment edge which generally have a drier, more northerly aspect.

**Ecology**

The species grows in tall, fire-protected thicket vegetation. It is estimated that the habitat has not burnt for at least 80 years. The plants are rooted in deep loamy soils and, because of the steep slope and dense surrounding vegetation, are often partly shaded for part of the day. The thicket vegetation in which they occur includes species such as *Kiggelaria africana* L., *Gymnosporia buxifolia* (L.) Szyszyl., *Lobostemon glaucophyllus* (Jacq.) H.Buek., *Stackys* sp., *Podalyria myrtifolia* (Retz.) Willd. and *Diospyros austro-africana* De Winter. Average annual rainfall in the area is likely to be in the order of 400 mm – 500 mm per year, with pronounced and rapid declines to the east and west of the escarpment edge (Manning & Goldblatt 1997).

**Etymology**

The specific epithet ‘dumicola’ means ‘thicket dweller’ (Stearn 1967) and refers to the rocky, fire-protected vegetation in which this species occurs.

**Diagnosis and relationships**

*Berkheya dumicola* is an unusually large, shrubby species in a genus dominated by perennial herbs. The shrubby habit, radiate heads and relatively broad leaves (Figure 2b) are most consistent with *Berkheya* series *Fruticosae* Roessler, but members of this series are characterised by entire or shortly toothed (rarely fringed) receptacle alveolar margins, densely hairy cypselae with the silky hairs often long (up to 4 mm), and a biseriate pappus of lanceolate or subulate scales. The conspicuously fimbriate, serrate-toothed alveolar margins, shortly pubescent cypselae with twin-hairs and uniseriate pappus of short, obtuse scales (Figures 3d–3f) set *B. dumicola* apart from members of series *Fruticosae*. Only one other *Berkheya* species

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FIGURE 2: Macromorphological features and habitat of *Berkheya dumicola*, including, (a) habitat and habit, (b) inflorescence comprising clusters of three to ten heads; large leaves with spines present at the lacinia apices but not along the margins, (c) base of capitulum showing short peduncle and spiny, 4-seriate involucre and (d) deeply alveolate receptacle with irregularly fimbriate alveolar margins (disc florets corollas removed).

Source: Photographs (a) and (b) taken by N. Helme, (c) and (d) taken by N. Bergh, of rehydrated material from the type collection.

FIGURE 3: Micromorphological features of *Berkheya dumicola*, taken from rehydrated material of the type collection, depicting, (a) ray floret and associated receptacular tissue, (b) disc floret, (c) dissected disc floret showing style and anthers, (d) section through receptacle to show embedded cypselae and alveolar margins, (e) dry cypsela and (f) pappus.

Source: Photographs taken by N. Bergh
shares this unusual combination of characters: the recently described *Berkheya crysanthemoides* from the nearby central Bokkeveld. *Berkheya dumicola* differs from *B. chrysanthemoides* in having leaves that are broader (20 mm – 50 mm in *B. dumicola*; 15 mm – 30 mm in *B. chrysanthemoides*), lack marginal spines (both species have spines on the lacinia apices but *B. chrysanthemoides* also possesses smaller antrorse spines along the margins) and are conspicuously tomentose on their abaxial surfaces (contrasting with the abaxially glabrous leaves of *B. chrysanthemoides*). The capitula of *B. dumicola* are smaller (20 mm – 35 mm in *B. dumicola*; 40 mm – 50 mm in *B. chrysanthemoides*) and clustered together in larger groups (three to ten in *B. dumicola*; one to three in *B. chrysanthemoides*).

Manning *et al.* (2010) speculated that *B. chrysanthemoides* may have its closest taxonomic relatives in Roessler’s (1959) series *Rigidae*, the species of which are characterised by similar alveole, pappus and cypsela characters, as well as sharing anther and pollen features. Species in series *Rigidae*, however, are generally herbaceous or suffruticose and lack ray florets. *Berkheya chrysanthemoides*, and now *B. dumicola*, therefore represent unusually large and radiate putative members of this series. It is remarkable that these likely sister-species, both only recently discovered, occur relatively nearby on the Bokkeveld escarpment. Both species are known from only a single locality each and further collections are required to determine their full geographical ranges and morphological variation.

**Conservation status**

The total global population of *B. dumicola* is currently thought to be less than 100 mature plants and the species thus fits the criteria for EN D1 (International Union for Conservation of Nature [IUCN] 2001). No threats to the species are currently known.

**Other material examined**

SOUTH AFRICA. Northern Cape: 3119 (Calvinia): Noord Bokkeveld, top of Die Hel pass, north-west of farm Kookfontein (–AA), 16 Sept. 2006, Helme 4225 (NBG).

**Discussion**

*Berkheya dumicola* is morphologically most similar to *B. chrysanthemoides* and together they form an unusual and geographically proximate subgroup within *Berkheya* (*B. chrysanthemoides* is also from the Bokkeveld plateau, growing in the Oorlogskloof Nature Reserve approximately 50 km to the south of where *B. dumicola* occurs). Of consideration is the fact that both species are known from only very few specimens, so the documented range of within-species variation is small. However, many species do occur naturally in very geographically restricted ranges and with only a small number of individuals. Assessment of natural variation in these cases must, of necessity, be based on a small number of specimens. Careful comparison of morphological differences between *B. chrysanthemoides* and *B. dumicola* revealed a suite of characters, derived from both reproductive and vegetative structures, differing sufficiently and consistently to warrant separating the two taxa.

**Conclusion**

*Berkheya dumicola* is a new, possibly endangered species recently discovered in the northern part of the Bokkeveld plateau in the Northern Cape Province of South Africa.

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**Competing interests**

The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

**Authors’ contributions**

N.A.H. (Nick Helme Botanical Surveys) discovered the plant and recognised it as a new species, as well as contributing to the manuscript and writing the sections on ecology and conservation status. N.G.B. (SANBI Kirstenbosch) performed the dissections and microscope work and wrote the initial taxonomy section and draft manuscript.

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