

***Massonia dentata* (Asparagaceae, Scilloideae), a new species from the Nuweveldberge, and typification of the Sneeuwberg endemic *M. calvata* (southern Great Escarpment, South Africa)**

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Abstract

As part of a taxonomic revision of the genus *Massonia* Houtt., a new species, *Massonia dentata* Mart.-Azorín, V.R.Clark, M.Pinter, M.B.Crespo & Wetschnig, is here described from the Nuweveldberge on South Africa's southern Great Escarpment. This new species is, at first sight, related to *M. calvata* Baker and *M. echinata* L.f., but it differs in floral and vegetative characters, such as the dentate perigone segments and bracts, leaves with numerous emergences, each bearing a thickened trichome, as well as in its ecology and distribution. A complete description of the new species and data on its biology, habitat, and distribution are presented. The close relative *Massonia calvata* Baker, an overlooked endemic from the Sneeuwberg Centre of Floristic Endemism in South Africa, is lectotypified.

Key words: Flora of Southern Africa, Hyacinthaceae, Massonieae, Taxonomy.

Introduction

Hyacinthaceae *sensu* APG (2003) comprises ca. 1000 species of bulbous plants distributed through Africa and Europe extending to Asia, with only *Oziroë* Rafinesque (1837: 53) occurring in South America (Speta 1998a, b, APG 2003). Four monophyletic clades are accepted as the subfamilies Hyacinthoideae, Ornithogaloideae, Oziroëoideae and Urgineoideae within Hyacinthaceae (Speta 1998b, Pfosser & Speta 1999, Manning *et al.* 2004, Martínez-Azorín *et al.* 2011). Alternatively Hyacinthaceae is treated as Asparagaceae subfamily Scilloideae, and consequently the former subfamilies are reduced to the tribes Hyacintheae, Ornithogaleae, Oziroëeae and Urgineeae (APG 2009, Chase *et al.* 2009). However, we favour Hyacinthaceae at family rank based on morphological grounds.

As in other groups in Hyacinthaceae, generic circumscription within tribe Massonieae has been a matter of controversy during the last decades (see Wetschnig *et al.* 2014 for a general overview on this point). The taxonomic history of the genus *Massonia* and the species concepts are discussed in Pinter *et al.* (2013) and Martínez-Azorín *et al.* (2013).

Baker (1878) described *Massonia calvata* Baker (1878: 321) (Fig. 1). This species was characterized as follows: “Leaves 2, [...] face when young tuberculato-hispid, when older smooth and glabrous” an uncommon behavior reflected in the specific epithet. A single collection was cited in the original description, *Bolus* 749! from the “Cape Colony, eastern district”. The study of the type collection *Bolus* 749, which was mounted on two herbarium sheets with different labels (K 000257142!, K 000257143!), evidence that it includes plants collected from at least two different localities and at different elevations, and probably collected at different times. Therefore, lectotypification of this species is required, and is effected below.

Massonia calvata has been synonymized into *Massonia echinata* Linnaeus (1782: 193) by Jessop (1976), Van der Merwe (2002) and Summerfield (2004), in which the latter taxon included 24, 17 and 19 names respectively under synonymy. In those concepts, *Massonia echinata* was circumscribed as extremely variable in morphology, including a very large variation on leaf morphology and indumentum, and therefore being very difficult to characterize. Müller-Doblies & Müller-Doblies (1997) circumscribed *M. echinata* in a much narrower sense, citing the following

combination of morphological characters “sigmoid curve at the base of the tepals segments combined with a more or less open throat of the filament tube and with pustulate leaves, bearing one to few short stiff hairs on each pustule”. Moreover, they commented: “It is in fact not easy to tackle the *M. echinata* group. It appears, however, that sufficient discontinuity exists together with geographic evidence to recognize at least three or four further species.” and they cited “We have only found it [*Massonia echinata*] at two localities, Vanrhynspas and the Karoo National Park”. Furthermore, they illustrated flowers from both localities in comparison with the type of *M. echinata*. It is worth mentioning that the drawing of the flower from the Karoo National Park (Müller-Doblies leg n° 84057c; Fig. 5e, pag. 71), shows at least one of the tepals with two teeth, differing from the flower from Vanrhynspas (Müller-Doblies leg n° 77060c; Fig. 5d, pag. 71), in which the perigone segments are entire.

As a result of the field work carried out by Clark (2010) and Clark *et al.* (2011a, b), plants at first sight related to *M. calvata* and *M. echinata* were found growing on rocky places at high elevation in two localities in the Nuweveldberge (Western Cape Province). They show clear morphological and ecological differences which warrant description of a new species, *Massonia dentata* Mart.-Azorín, V.R.Clark, M.Pinter, M.B.Crespo & Wetschnig, as done below.



FIGURE 1. *Massonia calvata* Baker from near the type locality showing immature plants on the left side bearing numerous pustules and hairs and a flowering plant with leaves bearing scarce pustules and almost absent hairs (Eastern Cape, Graaff Reinet, Camdeboo National Park, Valley of Desolation, corresponding to *A.P.Dold 14008* (GRA); Photographed 10 June 2014).

Materials and Methods

Detailed morphological studies of *Massonia dentata*, *M. calvata* and *M. echinata* were undertaken from natural populations and cultivated specimens as detailed in Martínez-Azorín *et al.* (2007, 2009). Details on number of species, populations and individuals studied in this work are provided in Table 1. Plants were grown and they flowered in Grahamstown, South Africa. Morphological measurements of flower parameters were performed on fresh material from cultivated plants. It has been proved that flowers obtained in a greenhouse keep the size and proportions of in situ flowers, as they are addressed to the fixed size of their pollinators (Müller-Doblies & Müller-Doblies 2002, Wetschnig *et al.* 2012, Martínez-Azorín *et al.* 2013, 2014, Pinter *et al.* 2013). For SEM-micrographs of the leaf-surface, an 8 × 5 mm section of one leaf was fixed in 70% ethanol. After substitution of ethanol by acetone, critical point drying was performed using a Baltec CPD030. The leaf then was mounted on aluminium stubs and coated with gold in an Agar sputter coater. Electron micrographs were obtained with a Philips XL 30 ESEM scanning electron microscope (SEM) operating at 20 kV. Herbarium specimens were studied from the herbaria ABH, GZU, K, GRA, and LI (acronyms according to Thiers 2014). Author names of the cited taxa follow IPNI (2014). *Massonia echinata* L.f. is treated in the sense of Müller-Doblies & Müller-Doblies (1997).

TABLE 1. List of investigated taxa in the present study, with voucher, locality information and number of specimens studied per population. All vouchers are deposited at ABH, GRA and GZU herbaria. Abbreviations: APD = Anthony P. Dold; VRC = V. Ralph Clark; WW = Wolfgang Wetschnig.

Taxon	Voucher	N° of plants studied	Locality
<i>Massonia dentata</i> Mart.-Azorín, V.R.Clark, M.Pinter, M.B.Crespo & Wetschnig.	VRC & Cerros 471 (GRA, NBG)	5	ZAF: Nuweveldberge, Farm Grootvlei
	VRC & Cerros 591 (GRA, NBG)	2	ZAF: Nuweveldberge, Karoo National Park
<i>Massonia calvata</i> Baker	APD 14008 (GRA)	6	ZAF: Sneeuberge, Valley of Desolation
	VRC & McKenzie 459 (GRA)	3	ZAF: Sneeuberge, Pearston, Blinkberg
<i>Massonia echinata</i> L.f.	WW01161 (GZU)	3	ZAF: Nieuwoudtville, Vanrhynspas
	WW03970 (GZU)	6	ZAF: Nieuwoudtville, Vanrhynspas
	WW03974 (GZU)	3	ZAF: Nieuwoudtville, Hantam Bot. Garden
	WW03975 (GZU)	5	ZAF: Nieuwoudtville, Hantam Bot. Garden

Description of the new species

Massonia dentata Mart.-Azorín, V.R.Clark, M.Pinter, M.B.Crespo & Wetschnig, *sp. nov.* (Figs. 2–8)

Ab *M. calvata* et *M. echinata* similis, sed eis et omnibus speciebus generis facile distinguitur et precipue differt segmentis periancticis bracteisque dentatis; foliis semper ad margines ciliis inequalibus munitis atque supra 80–230 pustulis (ca. 0.5 mm diametro) pro cm² obsitis quae minutae sunt et trichomate 100–300 µm longo, suberecto, incrassato, anguste conico ferens; filamentis insuper tubo periantico brevissime connatis (minus quam 1 mm long.).

Type:—SOUTH AFRICA. Western Cape, Beaufort West (3222AB): Nuweveldberge, ca. 20 km NW Beaufort West, Farm Grootvlei 193, ex hort. in Grahamstown on 15 May 2010, *V.R. Clark & R. Cerros 471b* (holotype: GRA!; isotypes: ABH!, GZU!).

Herbaceous perennial plant. Bulb ovoid, 15–18 × 14–16 mm, inner scales fleshy and white, outer tunics papery and brownish. Leaves 2, deciduous, opposite, spreading and appressed to the ground, synanthous, (2.5–)3–6(–6.5) × (2–)2.5–4.5(–5) cm, ovoid to suborbicular with acute to obtuse apex, with a short apiculum 0.5–1 mm long, narrowed into a petiole 10–15 mm long that clasps the peduncle and the inflorescence, green on both sides, all leaves (from first year to mature plants) with 80–230 emergences/cm² and ca. 0.5 mm in diameter only present on the adaxial side, which bear a thickened, suberect to declinate, narrowly conical trichome on top, 100–300 µm long, sometimes bearing 2–3 trichomes when some emergences are placed together, with a narrow membranous margin of 0.2–0.3 mm wide bearing minute papillae on the adaxial side, and short and much longer hairs placed together on the edge. Inflorescence a dense, subcapitate raceme, 1–3 cm long, with (7–)9–16(–20) flowers, shortly overtopping ground level. Bracts membranous, green with a purplish flush and purplish margins in the upper half and white below, translucent after flowering, glabrous with distinctly dentate and denticulate margins, acuminate; lower bracts obovate, 14–17 × 8–10 mm; upper bracts narrowly obovate, 13–16 × 6–10 mm. Pedicels of flowers 2–6 mm long. Flowers tubular. Perigone white, free segments (6–)7–8(–9) × 1.5–2 mm, toothed, greenish at the tip and in the middle longitudinally, first straight and erect, later spreading and finally reflexed and infolded at the base at anthesis, but not strongly rolled in. Perigone-filaments tube 9–13 × 2–4 mm, cylindrical and slightly widening at the upper portion, white. Filaments white, (6–)7–9 mm long, rather fleshy and thickened, suberect to spreading, straight, attenuate, shortly connate at the base for less than 1 mm above the perigone segments, with an hexagonal mouth of the tube with slightly convex sides; anthers 2–2.5 mm long when closed, oblong, dark blue, dorsifixed, with dark blue pollen. Gynoecium cenocarpous-syncarpous. Ovary narrowly oblong, green, 4–5 × 1–1.5 mm, gradually tapering into the style. Style white with purple tip, thickened, gradually tapering to the apex, 15–17 mm long at anthesis, ending about at the same level than the stamens or shortly overtopping them. Capsule and seeds unknown (Figs. 2–8).



FIGURE 2. *Massonia dentata* Mart.-Azorin, V.R.Clark, M.Pinter, M.B.Crespo & Wetschnig *in situ*. Above, plant at the type locality at the farm Grootvlei 193, NW of Beaufort West (corresponding to Clark & Cerros 471 GRA); below, eastern-most specimen (corresponding to Clark & Cerros 591 GRA).



FIGURE 3. Bulb with young leaves of *Massonia dentata* Mart.-Azorin. V.R.Clark, M.Pinter, M.B.Crespo & Wetschnig. Scale bar: 1 cm.

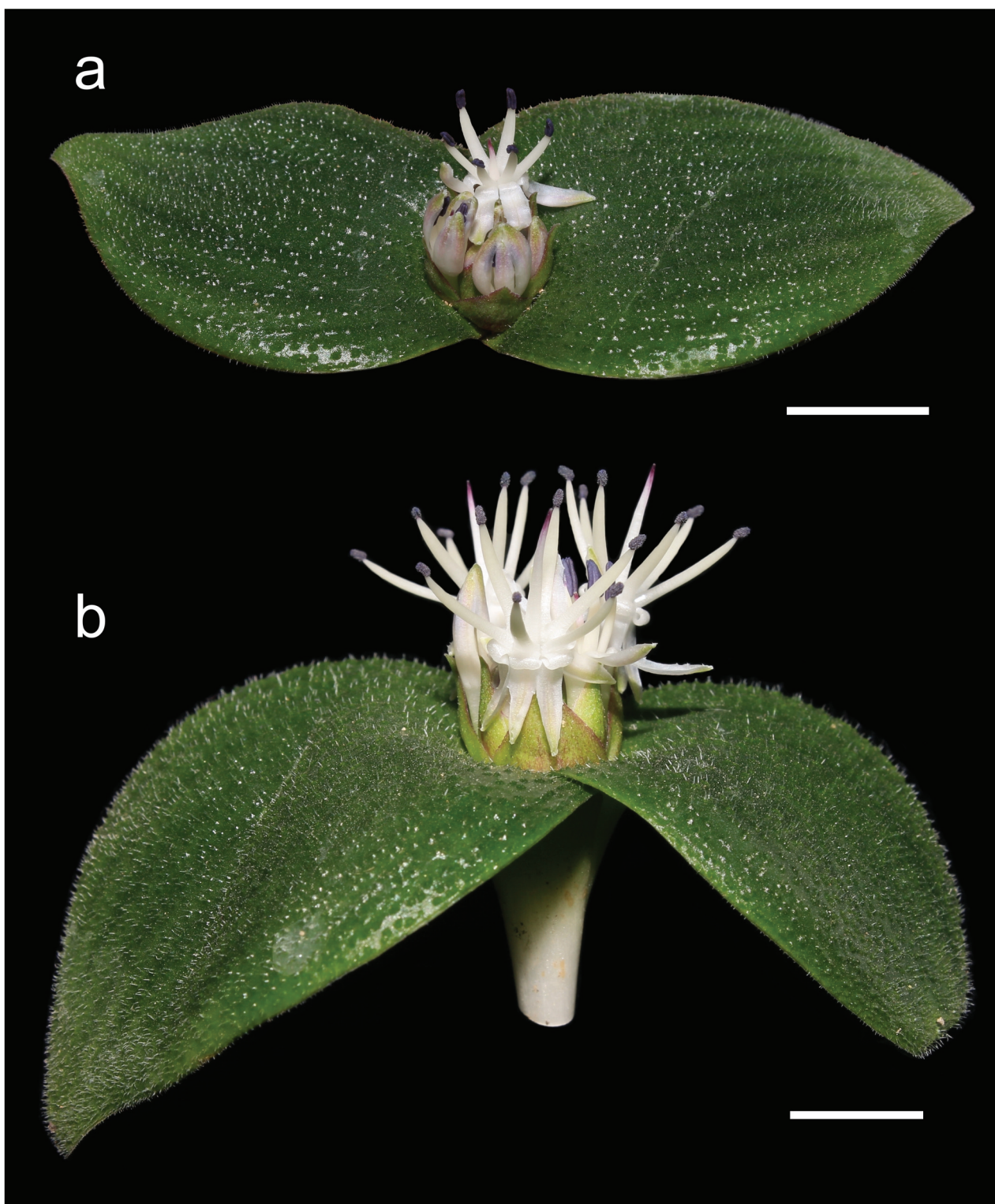


FIGURE 4. *Massonia dentata* Mart.-Azorín. V.R.Clark, M.Pinter, M.B.Crespo & Wetschnig. A. General view; B. Inflorescence and leaves, lateral view. Scale bars: 1 cm.

Etymology:—Named after the toothed margins of the perigone segments and bracts, a character unknown in any other species of *Massonia*; (*dentatus*, -a, -um = toothed) (Fig. 5–7).

Biology:—Leaves are found in March in wild populations. *Massonia dentata* flowers in May in cultivation in Grahamstown, South Africa.

Habitat:—*Massonia dentata* is confined to the summit plateau of the eastern Nuweveldberge, between 1500 and 1800 m. It occurs in dolerite rock crevices at the base of cliffs, and in rocky doleritic soils alongside seasonal

streams. The vegetation of the eastern Nuweveldberge at these higher elevations is a blend of marginal grassland (forming part of Mucina & Rutherford's 2006 Karoo Escarpment Grassland), Upper Karoo Hardeveld (Nama-Karoo Biome; Mucina & Rutherford 2006), and an unclassified 'Renosterveld'-type of montane shrubland dominated by *Elytropappus rhinocerotis* Lessing (1832: 344) (Fig. 9). This region shows a seasonal rainfall mainly in autumn and summer peaking in March, with a mean of annual rainfall of 250–350 mm (Mucina & Rutherford 2006).



FIGURE 5. *Massonia dentata* Mart.-Azorin. V.R.Clark, M.Pinter, M.B.Crespo & Wetschnig. A. Inflorescence, lateral view; B. Bracts. Scale bars: 1 cm.

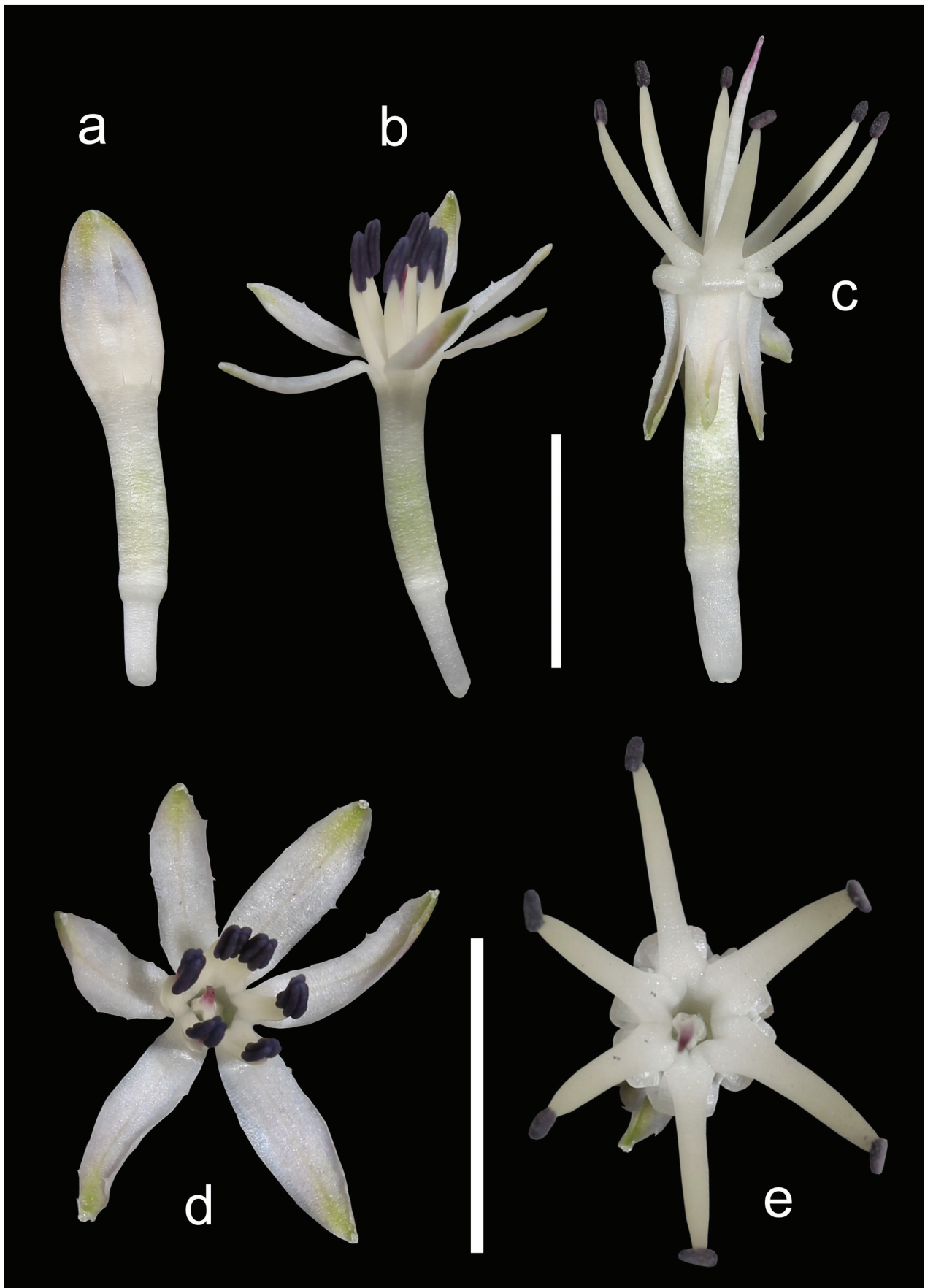


FIGURE 6. Flower morphology and their stages of development in *Massonia dentata* Mart.-Azorín, V.R.Clark, M.Pinter, M.B.Crespo & Wetschnig. A. Flower in bud, lateral view; B. Open flower with spreading perigone segments, lateral view; C. Mature flower with dehiscent anthers and enrolled and sigmoid perigone segments; D. Flower after opening, apical view; E. Mature flower, apical view. Scale bars: 1 cm.



FIGURE 7. Dissected flowers of *Massonia dentata* Mart.-Azorin, V.R.Clark, M.Pinter, M.B.Crespo & Wetschnig. A. Dissected flower after opening, lateral view; B. Dissected mature flower, lateral view. Scale bar: 1 cm.

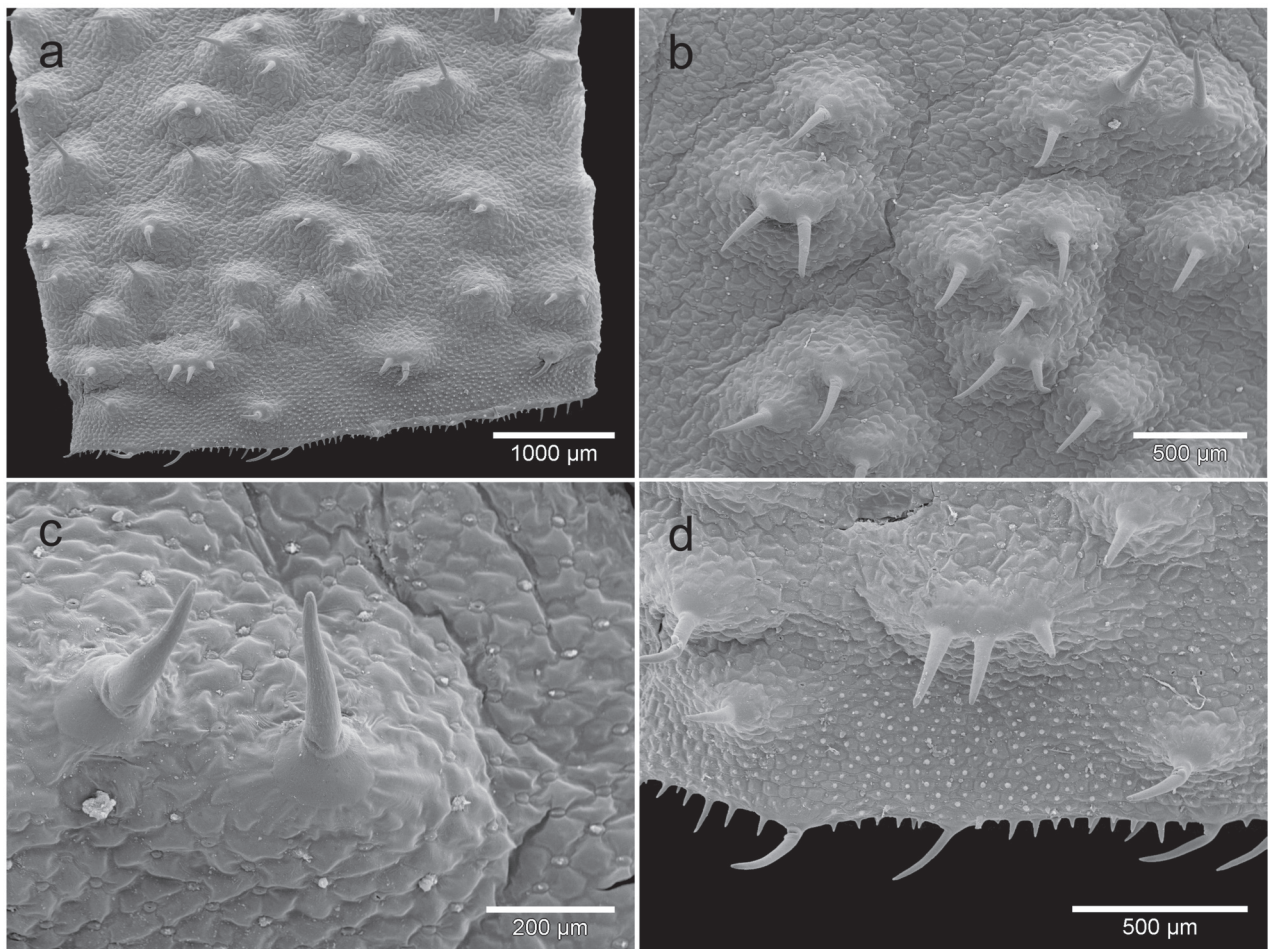


FIGURE 8. SEM image of leaf surface in *Massonia dentata* Mart.-Azorín, V.R.Clark, M.Pinter, M.B.Crespo & Wetschnig. A. Section of a leaf showing leaf emergences with trichomes and leaf margin on the lower edge; B. Detail of several emergences with trichomes; C. Detail of two emergences with trichomes; D. Detail of a leaf margin with minute papillae and hairs of different length.

Distribution:—Known from two localities 10 km apart in the far eastern Nuweveldberge, Western Cape Province, South Africa. This distribution includes the highest elevations of the Karoo National Park (Fig. 10). It is only the seventh endemic plant species known from the drought-prone Nuweveldberge, after the six listed by Clark *et al.* (2011a). It is worth mentioning that Van der Merwe (2002) cited the collection “3320 (Montagu): Mountainview, Karoo National Park, (-BA), *Bruyns* 3358 (BOL!)” under *Massonia pustulata* Jacq. (1791: 177). Although it seems that the quarter degree given was an error, the locality in the Karoo National Park, and the fact that the specimen was included in *M. pustulata* (therefore most probably bearing pustules) points out that it could represent the third known locality of *Massonia dentata*. As the *Massonia* specimens kept at BOL are currently on loan, we were not able to study that specimen and it should be considered in future works.

Taxonomic relationships:—*Massonia dentata* can be easily distinguished from all other species in the genus by the combination of toothed perigone segments and bracts, leaves in all stages with numerous emergences, each bearing a thickened trichome, and margins with hairs of different lengths (Figs. 2–8). Its closest known relative appears to be *M. calvata*, but the latter differs by the leaves in flowering individuals with almost absent or scarce emergences and trichomes, the entire perigone segments and bracts, and the shorter and wider ovary, among other characters (Table 1, Fig. 1). *Massonia echinata* sensu Müller-Doblies & Müller-Doblies (1997) differs from *M. dentata* by the usually larger leaves, with scarce small pustules, the minutely denticulate leaf margin, the entire perigone segments and bracts, the reflexed, infolded and spirally curled in perigone segments, the mouth of the perigone-filaments tube with 6 gibbosities and its different distribution (see Wetschnig *et al.* 2012) (Table 2). Furthermore, remarkable differences exist in the distribution of the cited taxa. *Massonia echinata* appears to be endemic to a small area in the surroundings of Nieuwoudtville and the Vanrhynspas, whilst *M. dentata* is only known from the eastern Nuweveldberge, being more than 300 km apart. Finally, according to our data *Massonia calvata* is endemic to the Sneeuwege, a different mountain range located ca. 150 km to the east of the Nuweveldberge (Fig. 10). As explained before, the collection *Bruyns* 3358 (BOL!) was identified as *Massonia pustulata*, however, the latter species clearly differs from *M. dentata* by distinct characters (Wetschnig *et al.* 2012).

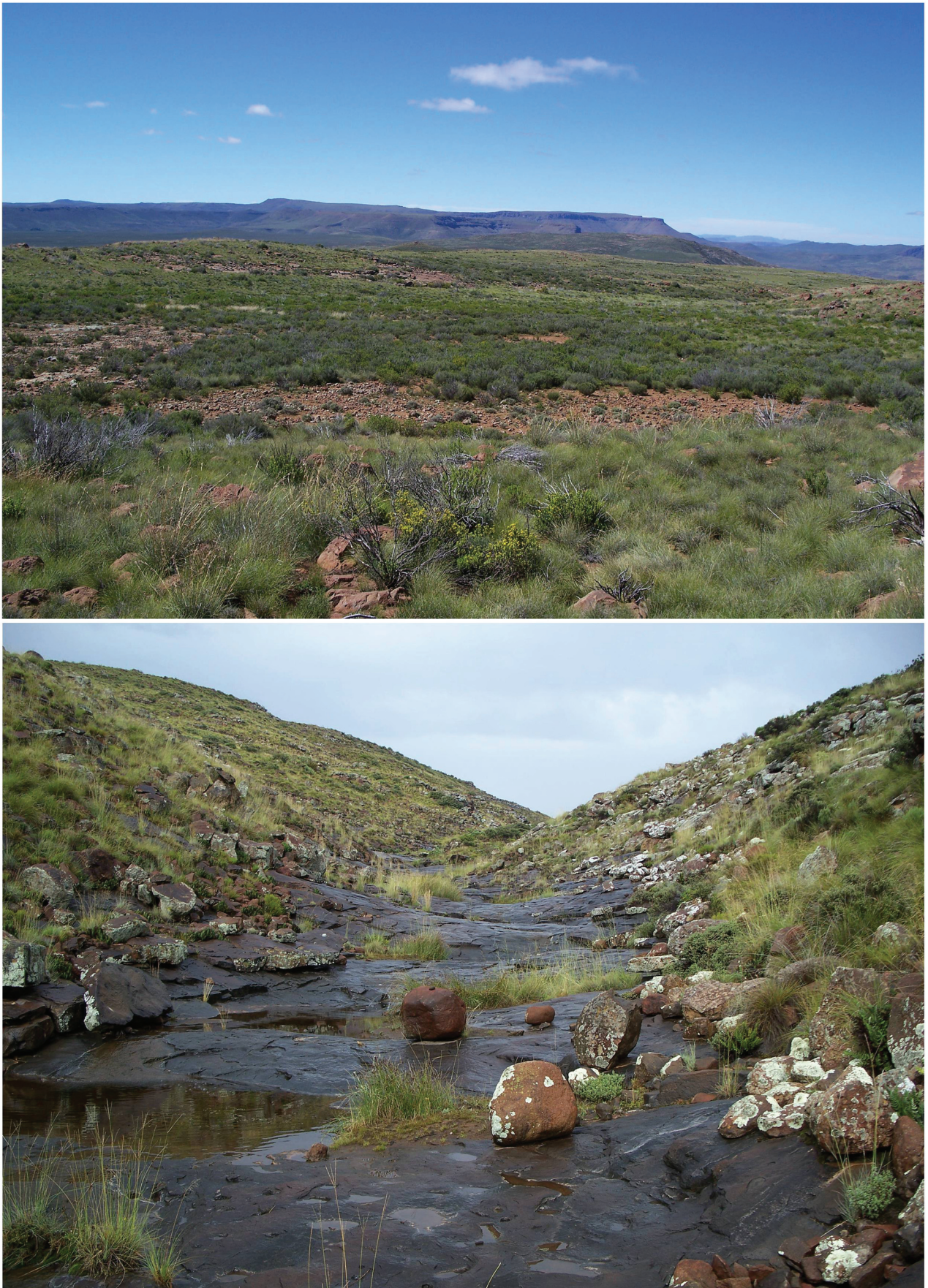


FIGURE 9. Habitat of *Massonia dentata* Mart.-Azorín, V.R.Clark, M.Pinter, M.B.Crespo & Wetschnig. Above, view over the eastern Nuweveldberge plateau in the Karoo National Park, showing the typical combination of Karoo Escarpment Grassland, Upper Karoo Hardeveld and (unnamed) montane renosterveld; below, the seasonal/episodic watercourse on the summit of the Nuweveldberge next to which the type specimen was collected.

Additional specimens studied (paratypes):—South Africa. Western Cape: Beaufort West (3222AB): Nuweveldberge, ca. 20 km NW Beaufort West, Farm Grootvlei 193, alt. 1720 m, 08 March 2008, *V.R. Clark & R. Cerros 471a* (GRA!, NBG!); Beaufort West (3222BA): Nuweveldberge, Karoo National Park, 12 March 2008, alt. 1670 m, SANParks, *V.R. Clark & R. Cerros 591* (GRA!, NBG!).

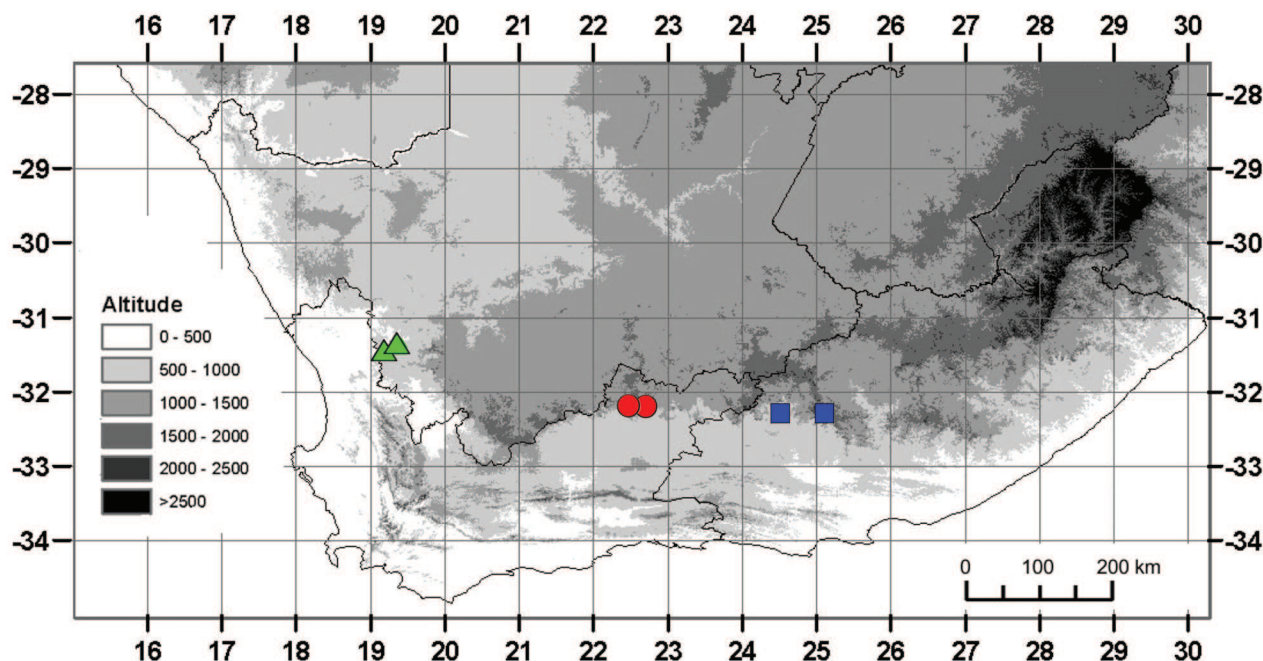


FIGURE 10. Known distribution of *Massonia dentata* Mart.-Azorín, V.R.Clark, M.Pinter, M.B.Crespo & Wetschnig (red circles), *M. calvata* Baker (blue squares) and *M. echinata* L.f. (green triangles) in South Africa.

Typification of *Massonia calvata*

The original description of *Massonia calvata* (Baker 1878) includes the following information: “Leaves 2, [...] face when young tuberculato-hispid, when older smooth and glabrous” an uncommon behavior reflected in the specific epithet. Furthermore, the flowers were described as “Perianth white, 1/3 in. long; segments lanceolate, equaling the tube. Filaments as long as the perianth-segments; anthers minute, oblong.” A single herbarium specimen was cited in the protologue, *Bolus 749!* collected in the “Cape Colony, eastern district”. Baker (1897) added further data as follows: “leaves [...] glabrous when mature, slightly tuberculato-hispid when young, [...] perianth white, ½ in. long [...] Central Region: mountains near Graaff Reinet, 4400-5500 ft., *Bolus, 749!*”. The study of the type collection *Bolus 749* (K 000257142!, K 000257143!) provides further information. The label of the herbarium sheet K 000257142! shows: “Rec. 12/70; H. Bolus Austro-Africanæ; N° 749, Flor Junio, Alt. 4400 ped; *Massonia* between *echinata* v *sanguinea*; In montibus prope Graaff Reinet; Foliis junioribus tuberculato-hispidis; *M. calvata* Baker in Journ. Bot. 1878/321”. Moreover, a hand written annotation in pencil reads “4400 ft; large specimens on Sneeuberg (sic.) 5500 ft”. Furthermore, a solid line in pencil separates the much larger plants in the upper part of the sheet from the lower much smaller plants, this agreeing with the information given in pencil about two different collections. A second herbarium sheet exists under the number *Bolus 749* (K 000257143!). The label of this collection says: “*Massonia* cf. *versicolor*; near Graaff Reinet; n° 749 Bolus 7/76; *M. calvata*, Baker”. It is evident therefore that the collection *Bolus 749* includes plants collected from at least two different localities and elevations and most probably collected at different times. According to Art. 40.2 of the ICN (*Melbourne Code*; McNeill & al., 2012), typification of one taxon is achieved “by reference to an entire gathering, or a part thereof, even if it consists of two or more specimens”, and assuming that a specimen is “a gathering, or part of a gathering, of a single species or infraspecific taxon made at one time, disregarding admixtures” (Art. 8.2). Therefore we select below a lectotype among the original material of the species (K 000257142!, K 000257143!). Our selection confirms that this name applies to a previously overlooked species endemic to the Sneeuberg Centre of Floristic Endemism (Clark *et al.* 2009).

Massonia calvata Baker (1878: 321). Type (designated here):—South Africa. Eastern Cape: In montibus prope Graaff Reinet, June, alt. 4400 ped, *Bolus 749* (lectotype, K 000257142!, only the small specimens placed in the lower portion of the sheet separated by a solid pencil line and corresponding to “alt. 4400 ped”).

TABLE 2. Comparison of main characters of *Massonia dentata*, *M. calvata* and *M. echinata* sensu Müller-Doblies & Müller-Doblies (1997).

	<i>M. dentata</i>	<i>M. calvata</i>	<i>M. echinata</i>
Leaf length (cm)	(2.5–)3–6(–6.5)	(4–)5–9	(4–)6–14
Leaf width (cm)	(2–)2.5–4.5(–5)	(2.5–)3.5–6	3–8
Emergences number/cm ² in leaves of immature plants	80–230	30–60	0–30
Emergences number/cm ² in leaves of flowering plants	80–230	0–50	0–30
Emergences diameter (mm)	ca. 0.5	0.1–0.5	0.3–0.4
Leaf trichomes length (µm)	100–300	100–300	100–500
Leaf margin	ciliate, with short and much longer hairs on the edge and minutely papillate on the narrow membranous margin	denticulate in smooth-glabrous leaves or ciliate with short and longer hairs in leaves with emergences and trichomes	minutely denticulate-papillate on margin and edge
Bracts	distinctly dentate and denticulate	denticulate	entire
Free perigone segments	dentate reflexed and infolded at the base at anthesis	entire reflexed, infolded and spirally curled in at the base at anthesis	entire reflexed, infolded and spirally curled in at the base at anthesis
Perigone-filaments tube length (mm)	9–13	8–11	8–14
Perigone-filaments tube width (mm)	2–4	3–3.5	2–4
Filament length (mm)	(6–)7–9	7–10	8–13
Filaments-tube length (mm)	< 1	< 1	0–0.5
Anther length before opening (mm)	2–2.5	2–2.5	2–3
Anther colour	dark blue	dark blue	pale blue-violet
Ovary length (mm)	4–5	3–4	4–5
Ovary width (mm)	1–1.5	(1.5)2–2.5	2
Style length (mm)	15–17	9–16	14–20
Distribution	Nuweveldberge	Sneeuberge	Nieuwoudtville area

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