



Massonia gypsicola (Asparagaceae, Scilloideae), a new species from the Knersvlakte in South Africa

MARIO MARTÍNEZ-AZORÍN^{1*}, MICHAEL PINTER², MANUEL B. CRESPO¹, MARÍA ÁNGELES ALONSO VARGAS¹ & WOLFGANG WETSCHNIG²

¹dCARN (Depto. de Ciencias Ambientales y Recursos Naturales) & CIBIO (Instituto Universitario de la Biodiversidad), Universidad de Alicante, P. O. Box 99, E-03080 Alicante, Spain; e-mail: mmartinez@ua.es

²Institute of Plant Sciences, NAWI Graz, Karl-Franzens-University Graz, Holteigasse 6, A-8010, Graz, Austria.

*author for correspondence

Asparagaceae (subfamily Scilloideae, tribe Hyacintheae) is alternatively regarded as Hyacinthaceae subfam. Hyacinthoideae, an option of our choice. Additional information on generic circumscriptions in Hyacinthoideae can be found in Martínez-Azorín *et al.* (2013, 2014a, 2014b), Pinter *et al.* (2013) and Wetschnig *et al.* (2014).

The genus *Massonia* Houttuyn (1780: 424) occurs in South Africa and in southwestern Namibia and it belongs to subfamily Hyacinthoideae, tribe Massonieae (Speta 1998a, 1998b, Wetschnig *et al.* 2002, Pfosser *et al.* 2003, Manning *et al.* 2004). Originally, this genus was described to include a single species, *Massonia depressa* Houttuyn (1780: 424). However, botanical exploration of South Africa in the nineteenth century led Baker (1897) to accept 33 species in the genus. Recent studies in *Massonia* reduced the number of accepted species to 6 (van der Merwe 2002, Manning & Goldblatt 2003, Summerfield 2004), 8 (Jessop 1976), 12 (Müller-Doblies & Müller-Doblies 1997), or 14 (Species-2000 2017).

Our studies on *Massonia* revealed that the taxonomy of the genus, as accepted in recent revisions, is not satisfactory and several species have been overlooked and misunderstood (Wetschnig *et al.* 2012, 2014, 2016, Martínez-Azorín *et al.* 2013, 2014a, 2014b, 2015a, 2015b, Pinter *et al.* 2013, 2015).

Within the framework of a taxonomic revision of *Massonia*, the study of natural populations, cultivated material as well as herbarium vouchers, revealed existence of some populations of *Massonia* growing on gypcrete outcrops in Knersvlakte (Western Cape Province) that represent a distinct undescribed species based on clear morphological characters, ecology, and biogeography. Therefore, a formal description for this species, named *Massonia gypsicola*, is presented below including data on morphology, habitat, biology and distribution.

Materials and Methods

Detailed morphological studies of *Massonia* were undertaken on natural populations, cultivated specimens and herbarium vouchers, following the terminology used for species of Hyacinthaceae in Martínez-Azorín *et al.* (2007, 2009). Herbarium specimens from the herbaria ABH, B, BLFU, BM, BOL, E, G, GZU, GRA, HAL, K, L, LINN, M, MO, NBG, NU, NY, P, PRE, S, TCD, UPS, WU, Z, ZSS and ZT (acronyms according to Thiers 2017) were studied. Authors of the cited taxa follow IPNI (2017). Orthography of geographical names and grid-number system follows Leistner & Morris (1976). Morphological data given in Table 1 are obtained from living plants and herbarium vouchers (*M. gypsicola*: 18 specimens from 2 populations; *M. pseudoechinata*: 74 specimens from 11 populations; *M. roggeveldensis*: 56 specimens from 6 populations; *M. bakeriana*: 17 specimens from 7 populations; *M. mimetica*: 25 specimens from 5 populations). The WW numbers correspond to the accession numbers of the living plant collection cultivated at the Botanical Garden of the Institute of Plant Sciences of the University of Graz.

TABLE 1. Comparison of main characters of *Massonia gypsicola* and related species. Morphological data are obtained from living plants from the wild and cultivated and also herbarium vouchers as detailed in the Material and Methods section.

	<i>M. gypsicola</i>	<i>M. pseudoechinata</i>	<i>M. roggeveldensis</i>	<i>M. bakeriana</i>	<i>M. mimetica</i>
Leaf blade size (cm)	2.5–9 × 1.5–5	3–12 × 2.5–8	2–5 × 2–3.5	4–10 × 5–10	3.5–10 × 3–9
Leaf emergences per cm ²	15–40	1–60	absent	11–42	10–25
Leaf emergences	conical to hemisphaerical, 0.4–0.8 mm in diameter with a trichome on top 0.1–0.8 mm long	cone-like, 0.2–0.4 mm in diameter, with a deflexed, thickened, smooth trichome on top, 0.2–0.5 mm long	absent	symmetrical, cone-like, dark green, with a small apical papilla	slightly asymmetrical, conical, 1–2 mm in diameter, with a short obtuse conical cell on top
Leaf margin	entire to minutely denticulate	denticulate to shortly ciliate-fimbriate	minutely papillose-denticulate	entire to minute papillose	entire
Number of flowers	10–25	9–90	10–40	15–20	12–31
Free perigone segments at anthesis	5–8 × 1.5–2 mm white with a short greenish central band at the tip, reflexed with a slight sigmoid curve at the base but not inrolled	6–10 × 1.5–2 mm, pure white, with a short greenish central band at the tip, strongly reflexed and inrolled with a distinct sigmoid curve at the base	6–10 × 1.5–2 mm pure white sometimes with a short greenish central band at the tip, strongly reflexed with a sigmoid curve at the base at anthesis, but not distinctly inrolled	6–8 × 1.2–2 mm with a short greenish central band at the tip, strongly reflexed with a slight curve at the base	6–9 × 1.5–2 mm, with a green central band, strongly reflexed, inrolled with a distinct sigmoid curve at the base
Perigone-filaments tube	6–7 × 2–3 mm narrowly cylindrical, not widening at the upper portion, with a circular mouth with no gibbosities	10–15 × 2–3 mm narrowly cylindrical, not widening at the upper portion, with a hexagonal mouth showing strongly convex sides, giving the appearance of having 6 gibbosities	14–19 × ca. 2 mm narrowly cylindrical, not widening at the upper portion, with an almost closed mouth enveloping the style	9–13 × 2–4 mm, cylindrical below, funnel-shaped above, bearing a wide open mouth that shows the ovary in apical view	6–15 × 2.5–4 mm, cylindrical or slightly widening at the upper portion, tinged with reddish above the segments insertion, with 6 gibbosities at the mouth of the tube
Free portion of filaments length (mm)	10–15	8–12	8–12	12–18	6–13
Filaments-tube length (mm)	ca. 0.5	ca. 1	ca. 0.5	ca. 0.5	1–2
Anther colour	pale yellow	pale blue	pale blue	violet-purple	pale orange with a red flush or rarely purplish-bluish
Pollen colour	yellow	blue	blue	yellow	yellow
Ovary (mm)	3–4 × 1.5–2 gradually tapering to the style	4–6 × 1.8–2.1 gradually tapering to the style	4–6 × 1.8–2.1 gradually tapering to the style	5–6 × 1.7–2, slightly contracted at the joint with the style	3–4.5 × 2–2.5, gradually tapering to the style
Style length (mm)	10–14	15–17	18–22	16–20	11–20
Capsule (mm)	7–12 × 3–7	10–17 × 4–9	not studied	10–12 × 7–10	6–14 × 4–8
Seed (mm)	1.6–2.0 × 1.5–1.8	1.5–2.1 × 1.3–2	not studied	1.4–1.6 × 1.3–1.6	1.5–1.8 × 1.3–1.6
Distribution	Knersvlakte	Bokkeveld	Roggeveld	Kamiesberg, Bokkeveld, Jan Swartsberge and Slangberge	Surroundings of Platbakkies, Loxton and Victoria West

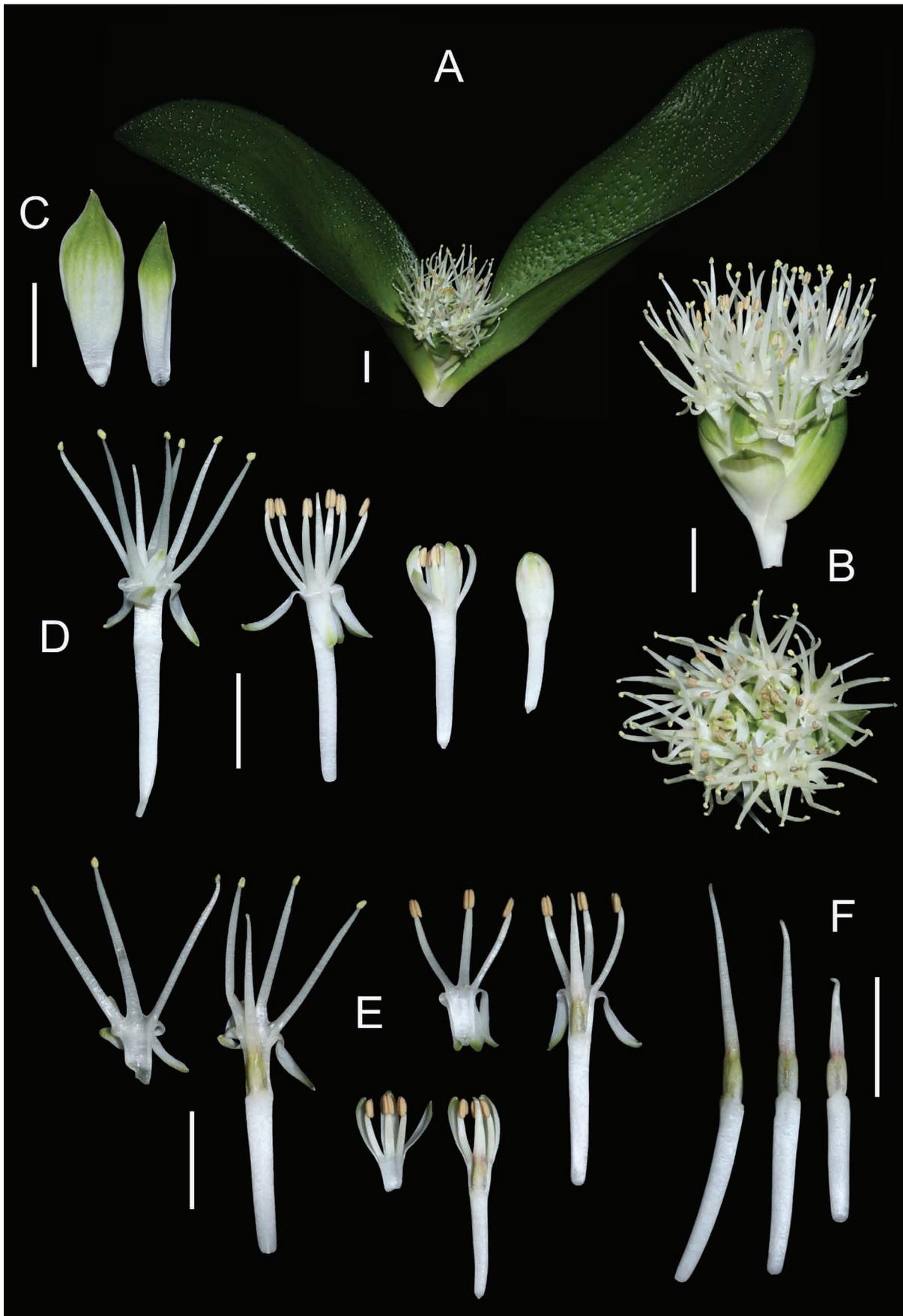


FIGURE 1. *Massonia gypsicola* Mart.-Azorín *et al.* in cultivation from the type locality in Knersvlakte, Western Cape province of South Africa (corresponding to the holotype *MMA1298* pressed on 14/11/2016). **A.** Plant in flower, lateral view; **B.** Inflorescence, lateral and apical views; **C.** Bracts; **D.** Flowers from bud to full anthesis, lateral views; **E.** Dissected flowers, lateral views; **F.** Gynoecia from bud to full anthesis, lateral views. Scale bars 1 cm.



FIGURE 2. Leaf emergences of *Massonia gypsicola* Mart.-Azorín *et al.* Light microscope images. Scale bar: 1 mm.

Description of the new species

Massonia gypsicola Mart.-Azorín, M.Pinter, M.B.Crespo, M.A.Alonso & Wetschnig, *sp. nov.* (Figs. 1, 2)

Species notabilis combinatione propria characterum ab ceteris speciebus Massoniae bene distincta. Folia pustulata pustulis leviter asymmetricis conicis vel hemisphaericis 0.4–0.8 mm diametro plus minusve numerosis (15–40) obsita, quae ad apicem papilla late vel anguste conica et valida 0.1–0.8 mm long. munitas. Flores albidis, ad apicem segmentorum fascia longitudinali viridi instructis; tubo brevi (ad 7 mm long.) et strictissimo, ad faucem egibboso, longitudine ovarium valde occultante; et segmentis perigonii 5–8 × 1.5–2 mm, reflexis sed non revolutis, a basi vix sigmoideo-curvatis. Antherae statu clauso ca. 2 × 1 mm, luteolae; polline luteo subconcoloro. Ovarium conicum vel suboblongum, ca. 3–4 × 1.5–2 mm, in stylo gradualiter desinente. Semina 1.6–2.0 × 1.5–1.8 mm, globosa, nigra, laevia.

Type:—SOUTH AFRICA. Western Cape. Vanrhynsdorp (3118): Knersvlakte, ca. 4 km SW of N7 on the gravel road parallel to the railway, farm Quaggas Kop 215 (-BC), crevices and shallow soil on gypcrete outcrops, 135 m elevation, 14 November 2016 ex hort. in Graz (Austria), *M. Martínez-Azorín, M. Pinter, M.B. Crespo & M.A. Alonso MMA1298* (holotype GRA!; isotypes ABH!, GZU!).

Deciduous geophyte. Bulb ovoid to subglobose, 1.4–4.3 × 0.9–4 cm, hypogeal, with white, fleshy bulb scales covered by pale brown, papery or slightly leathery outer tunics. Leaves 2, synanthous, opposite, appressed to the ground, ovoid, with an acute apex and a short apicule about 2–3 mm long, limb 2.5–9 × 1.5–5 cm (up to 15 cm long in cultivation), with narrow, membranous, entire to minutely denticulate margins; adaxial side green, with 15–40 slightly asymmetrical, conical to hemispherical, emergences per cm², which are 0.4–0.8 mm in diameter, with a conical to elongated and slightly deflexed, thickened, smooth trichome on top, 0.1–0.8 mm long; abaxial side smooth, green; petiole 0.5–2.5 cm long. Inflorescence a dense, subcapitate raceme, up to 2–3 cm long, with 10–25 flowers, shortly overtopping ground level. Bracts narrowly obovate, attenuate at the apex, 15–25 × 5–9 mm, green in the upper half with white membranous margins and base, glabrous, entire. Pedicels at anthesis 8–16 mm long. Flowers pentacyclic, trimerous. Perigone pure white; tepals 6, free segments 5–8 × 1.5–2 mm, entire, with a short greenish central band at the tip, straight and erect in bud, reflexed with a sigmoid curve at the base but not distinctly inrolled at anthesis; perigone-filaments tube 6–7 × 2–3 mm, narrowly cylindrical, not widening in the upper portion, with a circular mouth with no gibbosities, the ovary included in the tube and not visible. Stamens 6, filaments long-attenuate, spreading at anthesis, slightly arcuate, white, 10–15 mm long, shortly connate at the base for ca. 0.5

mm above the perigone segments; anthers oblong, pale yellow, ca. 2×1 mm when closed, dorsifixed, with yellow pollen. Gynoecium obclavate, compound, tricarpetal, with axile placentation. Ovary superior, conical to suboblong, white to pale green with a purple tinge, $3\text{--}4 \times 1.5\text{--}2$ mm, gradually tapering to the style, with 12–14 ovules per locule. Style white, erect, 10–14 mm long at anthesis, narrowly conical, gradually tapering from the ovary to the acute, simple stigma. Capsule ovate in lateral view, trigonous with blunt edges in apical view, $7\text{--}12 \times 3\text{--}7$ mm. Seeds globose, black, $1.6\text{--}2.0 \times 1.5\text{--}1.8$ mm, smooth.

Etymology:—The specific epithet (*gypsicola*: growing in gypsum substrate) refers to the distinct and unique habitat of this new species; this is so far the only taxon in *Massonia* occurring on gypcrete outcrops.

Phenology:—*Massonia gypsicola* flowers between May and July in the wild and fruits appear from July to August. In cultivation in Graz (Austria) it flowers around November and fruits appear in late December.

Habitat:—*Massonia gypsicola* occurs in crevices and shallow soil on eroding outcrops of gypcrete (deep weathering gypsum rich duripans; see also Francis 2008), rich in calcium sulphate, from 100 to 150 m of elevation. The surrounding vegetation is classified as Knersvlakte Quartz Vygieveld (SKk3) and Central Knersvlakte Vygieveld (SKk2). The region is characterised by winter rainfall peaking from May to August, and dry hot summers, with a mean annual precipitation of 110 mm and rare occurrence of frost (Mucina & Rutherford 2006). Knersvlakte is a worldwide well known area for succulents including many endemic taxa, and this new *Massonia* species increases the value of this region.

Distribution:—The new species is known to us only from two localities west of N7 in Knersvlakte, and appears to be endemic to this area (Fig. 3). Further populations are expected to be found on similar habitats close-by.

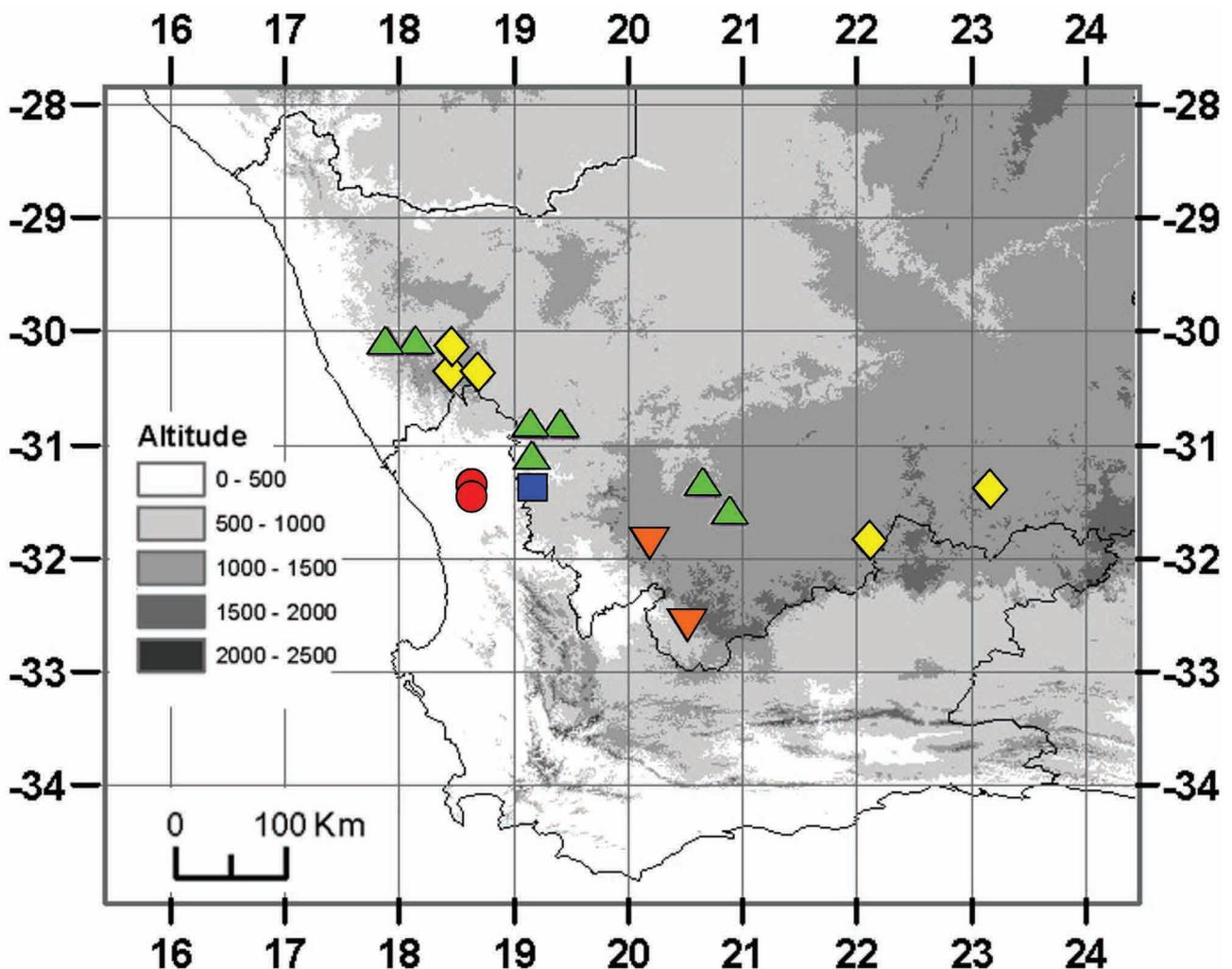


FIGURE 3. Known distribution of *Massonia gypsicola* Mart.-Azorín *et al.* in Knersvlakte in South Africa and related species (red circle: *M. gypsicola*; blue square: *M. pseudoechinata* Mart.-Azorín *et al.*; green triangle: *M. bakeriana* M.Pinter *et al.*; yellow diamond: *M. mimetica* Mart.-Azorín *et al.*, orange triangle: *M. roggeveldensis* Mart.-Azorín *et al.*).

Taxonomic relationships:—*Massonia gypsicola* can be easily distinguished by the leaves covered by distinct conical to hemispherical emergences that usually bear a distinct trichome on top; white flowers with short and narrow perigone-filaments tube; yellow anthers and pollen; and obclavate gynoecium (Table 1). Its morphologically closest relative appears to be *Massonia pseudoechinata* Mart.-Azorín, M.Pinter & Wetschnig in Martínez-Azorín *et al.* (2015b: 124), but the latter differs by leaves with scarce to numerous small emergences; flowers with much longer perigone-filaments tube; strongly reflexed and inrolled perigone segments; shorter filaments, the blue anthers and pollen; longer ovary and style; and bigger capsules (Table 1; Martínez-Azorín *et al.* 2015b). *Massonia pseudoechinata* grows on top of the Bokkeveld Plateau near Nieuwoudtville and the Vanrhyns Pass, at elevations of about 700–800 m a.s.l. and vegetation classified as Bokkeveld Sandstone Fynbos and Nieuwoudtville Shale Renosterveld (Mucina & Rutherford 2006). The general flower morphology of *M. gypsicola*, especially the obclavate gynoecium, links this species to *M. pseudoechinata*, *M. roggeveldensis* Mart.-Azorín, M.Pinter & Wetschnig in Martínez-Azorín *et al.* (2015b: 122), *M. bakeriana* M.Pinter, Mart.-Azorín & Wetschnig in Pinter *et al.* (2015: 52), *M. mimetica* Mart.-Azorín, M.Pinter, M.B.Crespo & Wetschnig in Martínez-Azorín *et al.* (2013: 191), *M. jasminiflora* Burch. ex Baker (1870: 390) and related species (Table 1; Martínez-Azorín *et al.* 2013, 2014b, 2015b, Pinter *et al.* 2015). However, none of the related species shows the distinct combination of character-states occurring in *Massonia gypsicola* (Table 1).

Additional material studied (paratypes):—SOUTH AFRICA. Western Cape. Vanrhynsdorp (3118): Knersvlakte, ca. 8 km W of N7 from the railway crossing, farm Wolvenest 212 (-BC), gypcrete outcrop south of the gypsum mine, 125 m elevation, 6 June 2015 in flower, *A. Le Roux* (photo!); Vanrhynsdorp (3118): Knersvlakte, ca. 4 km SW of N7 on the gravel road parallel to the railway, farm Quaggas Kop 215 (-BC), 125 m elevation, 7 July 2015 in fruit and in bud, *N. Helme* (iSpot photo!, <https://www.ispotnature.org/node/697552>); a photograph of *M. gypsicola* from the Knersvlakte in flower (as “Kners *Massonia echinata*”) mounted on a herbarium sheet together with a photograph identified as *Brunsvigia radulosa* (NBG!).

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