Phytotaxa 518 (3): 223–230
https://www.mapress.com/j/pt/

Article

ISSN 1179-3155 (print edition)
PHYTOTAXA
ISSN 1179-3163 (online edition)

https://doi.org/10.11646/phytotaxa.518.3.4

A new species of *Crassula* (Crassulaceae subfam. Crassuloideae), *C. stylesii*, from the Maputaland-Pondoland Region of Endemism in KwaZulu-Natal, South Africa

GIDEON F. SMITH[1] & NEIL R. CROUCH[2,3*]

[1] *Department of Botany, Nelson Mandela University, P.O. Box 77000 Gqeberha [Port Elizabeth], 6031 South Africa.*
smithgideon1@gmail.com; https://orcid.org/0000-0002-5417-9208

[2] *Biodiversity Research and Monitoring Directorate, South African National Biodiversity Institute, P.O. Box 52099, Berea Road, Durban, 4007 South Africa.*

[3] *School of Chemistry & Physics, University of KwaZulu-Natal, Durban, 4041 South Africa.*
N.Crouch@sanbi.org.za; https://orcid.org/0000-0002-4938-5840

**Author for correspondence*

Abstract

A new species of *Crassula* (Crassulaceae subfam. Crassuloideae), *C. stylesii* that belongs in *C.* sect. *Rosulares*, is described from the Maputaland-Pondoland Region of Endemism in KwaZulu-Natal in southeastern South Africa. *Crassula stylesii* shows similarities with the autonymic varieties of *C. setulosa* and *C. obovata*. However, it grows taller than both these species, and pseudo-rosettes do not develop basally in the case of *C. stylesii*, but are characteristically present in both *C. setulosa* and *C. obovata*, particularly the former. *Crassula stylesii* is illustrated and differences among the three species are tabulated.

Keywords: *Crassula obovata*; *Crassula* sect. *Rosulares*; *Crassula setulosa*

Introduction

The Crassulaceae is one of the largest and best known succulent plant families globally, including in southern Africa (Smith *et al.* 1997). One of its more speciose genera, *Crassula* Linnaeus (1753a: 282), has a natural geographical distribution range predominantly in the southern hemisphere, and contains about 200 species. Of these, 150 have been recorded from southern Africa, which accordingly is a significant centre of present-day diversity for the genus (Tölken 1977a, b, 1985).

To facilitate identification of, and to reflect relationships among, *Crassula* species, the genus has been divided into numerous sections (see 'Key to the species, subspecies and varieties' in Tölken 1985: 78–100). One of these, *Crassula* sect. *Rosulares* Haworth (1821: 13) contains about two dozen species that are characterised by having leafy rosettes that remain compact and more or less basally disposed until flowering initiates, at which time the flowering stem elongates (Tölken 1985: 163–189).

Here we describe a further species of *Crassula*, *C. stylesii* Gideon F.Sm. & N.R.Crouch (Fig. 1A–D), which is presently best placed in *C.* sect. *Rosulares*.

Materials and methods

The description of *C. stylesii* is based on detailed morphological studies of living material of individuals of *C. stylesii* in the field, with the new species compared to two superficially similar species in *C.* sect. *Rosulares*, *C. obovata* Haworth (1819: 18) (Fig. 2A–B, D) and *C. setulosa* Harvey (1862: 347) (Fig. 2C). Character information for the two sister species was sourced from living material and the most recent taxonomic treatments of *Crassula* by Tölken (1977a, b, 1985) and Van Jaarsveld (2003).

Accepted by Ronell R Klopper: 10 Aug. 2021; published: 7 Sept. 2021

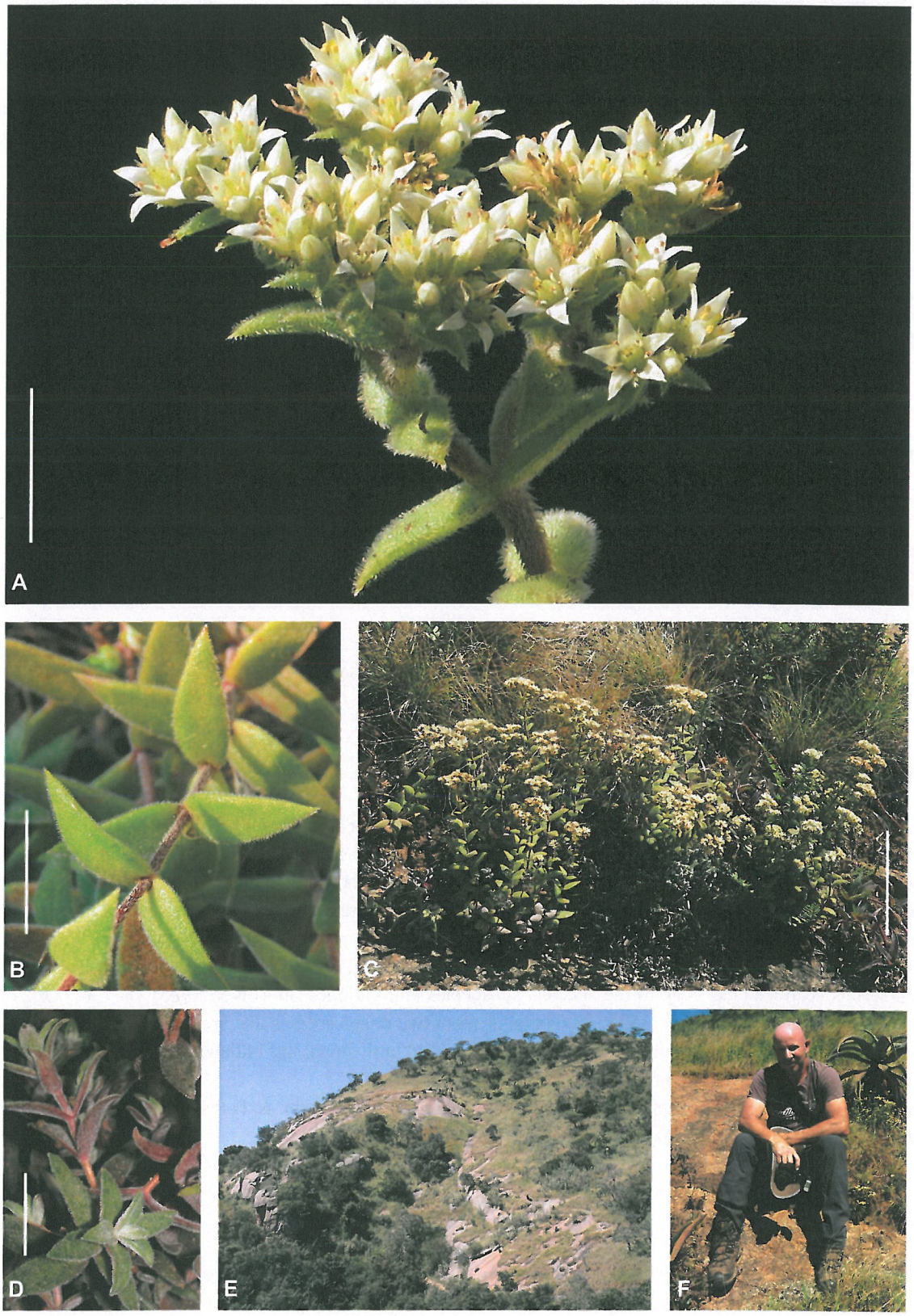

FIGURE 1. *Crassula stylesii* from KwaNyuswa, KwaZulu-Natal province, South Africa. **A.** Inflorescence with white flowers. **B.** Stem section with leaves distinctly 4-ranked in young plants, dorso-lateral view. **C.** Habit. **D.** Shoots with uniformly hairy leaves becoming strongly purple-infused when stressed. **E.** Habitat at type locality. **F.** David Styles (1968–) for whom the species is named. Scale bars: A: 15 mm; B: 17 mm; C: 15 cm; D: 20 mm. Photographs by the authors (A–D, F) and D.G.A. Styles (E).

FIGURE 2. A. Inflorescences of *C. obovata* (Cliffdale) (left) and *C. stylesii* (KwaNyuswa) (right). **B.** Flowering plant of *C. obovata* (Cliffdale). **C.** Flowering plant of *C. setulosa* subsp. *setulosa* (Organ Pipes Pass, central Drakensberg). **D.** Flowers of *C. stylesii* (KwaNyuswa) (left) and *C. obovata* (Cliffdale) (right). **E.** Colony of *C. obovata* var. *dregeana* (Mtentu, Eastern Cape province). Scale bars: A: 25 mm; B: 50 mm; C: 30 mm; D: 5 mm; E: 10 mm. Photographs by the authors (A–C, E) and D.G.A. Styles (D).

Measurements were taken by hand using a ruler, except for floral dimensions below 4 mm, which were taken using a Motic SMZ 168 Stereo microscope reticule. Authors of the plant names cited follow IPNI (2021+) although in the notation required by *Phytotaxa*, and herbarium codes follow Thiers (2021 [continuously updated]). Nomenclatural issues accord with the Shenzhen Code (Turland *et al.* 2018).

Results

Vegetatively, *C. stylesii* differs from both *C. obovata* and *C. setulosa* by being a taller plant that can reach a height of 45 cm, while *C. setulosa* usually remains only half as tall and *C. obovata* reaches about 30 cm in height (Table 1). Both *C. obovata* and *C. setulosa* basally produce pseudo-rosettes, while *C. stylesii* does not (Fig. 1C). The leaves of *C. setulosa* are spirally arranged, in contrast to those of *C. stylesii* that are distinctly 4-ranked (Fig. 1B); those of *C. obovata* are more or less 4-ranked.

In terms of reproductive characters *C. stylesii* has shorter sepals than both *C. obovata* and *C. setulosa*. The apex of the elongated-triangular sepals is blunt-tipped in the case of *C. stylesii*, relative to *C. obovata*, in which the apex of the narrowly triangular sepals is acute and drawn into a terminal hair, or *C. setulosa* where the triangular to lanceolate sepals have acute apices. The flowers of all three species are mostly white (Fig. 2A–D), with those of *C. obovata* sometimes being cream and those of *C. setulosa* often red-tinged, while in *C. stylesii* the flowers develop a central light brown stripe with age. The petals of *C. obovata* are longer than those of both *C. stylesii* (Fig. 2D) and *C. setulosa*; those of *C. stylesii* and *C. setulosa* are similar in length, with those of *C. stylesii* sometimes slightly longer. At the Cato Ridge site the plants are generally more gracile although consistent in their vestiture, inflorescence structure, and floral dimensions with those from the type locality at KwaNyuswa.

Crassula stylesii differs from *C. setulosa* and *C. obovata* according to the characters as tabulated (Table 1) and discussed in the 'Diagnosis', below.

TABLE 1. Comparison of selected vegetative and reproductive characters of *Crassula obovata* var. *obovata* (tabulated as *C. obovata*), *C. stylesii*, and *C. setulosa* var. *setulosa* (tabulated as *C. setulosa*).

#	Character	*C. obovata*	*C. stylesii*	*C. setulosa*
A.	Vegetative			
1.	Plant height (cm)	To 30	To 45	To 25
2.	Basal (pseudo-)rosettes	One to several when young	Lacking	Forms cushions of rosettes
3.	Leaf pairs	± 4-ranked	4-ranked	Arranged spirally
B.	Reproductive			
4.	Sepal apex	Acute, drawn into sharp, usually recurved terminal hair	Blunt-tipped	Acute
5.	Sepal length (mm)	3–5	1.5–2.5	1–3
6.	Sepal lobe shape	Narrowly triangular	Elongated-triangular	Triangular to lanceolate
7.	Flower colour	White or cream	White with a faint central light brown stripe with age	White, often tinged red
8.	Petal length (mm)	5–8	3–5	3–4

Taxonomic treatment

Crassula stylesii Gideon F.Sm. & N.R.Crouch, ***spec. nov.*** (Fig. 1A–D)

Type:—SOUTH AFRICA. KwaZulu-Natal province.—2930 (Pietermaritzburg): KwaNyuswa, (–DB), at the edges of shallow soil that overly a granite basolith overlooking the Mngeni River, 14 March 2021, *D.G.A. Styles, N.R. Crouch & A. Heiduk 5898* (holotype BNRH!; isotype NU!).

Diagnosis:—*Crassula stylesii* shows similarities with the autonymic varieties of *C. setulosa* and *C. obovata*. However, it can reach a height of 45 cm, which is taller than both *C. setulosa* and *C. obovata*. Pseudo-rosettes do not develop basally in the case of *Crassula stylesii*, but are characteristically present in both *C. setulosa* and *C. obovata*, particularly the former. The white flowers of *C. stylesii* are never red-tinged as in *C. setulosa*, nor cream-coloured as sometimes found in *C. obovata*. The flowers of *C. stylesii* are always shorter than in *C. obovata*, but similar in proportion and size to *C. setulosa*. Additionally, not only are the inflorescences of *C. stylesii* much larger than those of the close relatives compared here, but their structure is characteristically more open and branched. The leaves of *C. stylesii* are always uniformly hairy whilst in *C. obovata* they are variably hairy depending on location, even within the Durban region where plants with either glabrous or hairy laminae may be encountered. *Crassula stylesii* leaves lack the differentiated marginal cilia present in both *C. setulosa* and *C. obovata*.

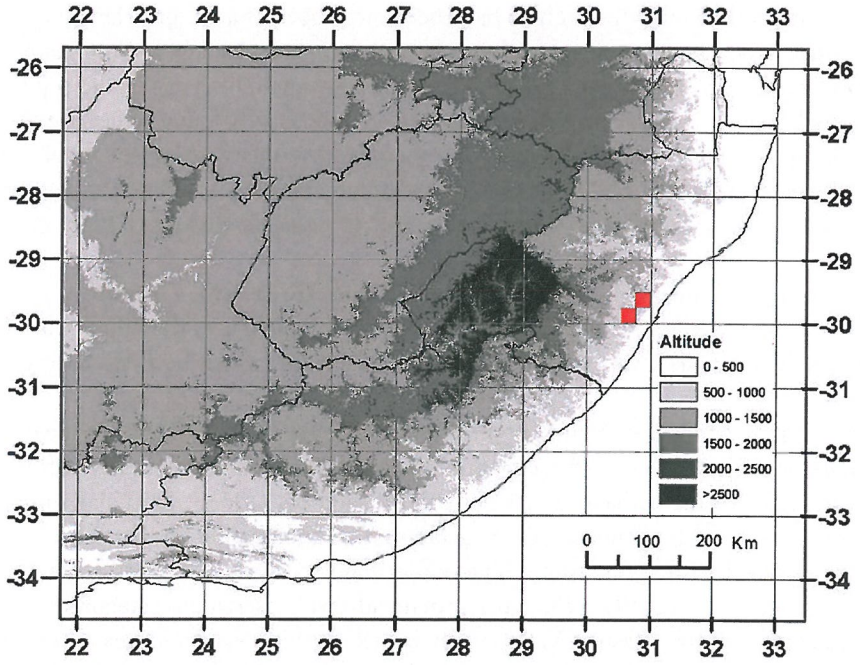

FIGURE 3. Known geographic distribution range of *Crassula stylesii* (■).

Description:—Perennial, small to medium-sized, many-leaved, densely hairy, succulent, sparsely sprouting from base; to 45 cm tall when in flower. *Roots* fibrous. *Stems* erect to leaning, straight or rarely variously curved upwards, purplish brown, hairy; hairs white, 0.3–0.5 mm long, usually pointing down. *Leaves* densely arranged in 4 ranks in young plants, widely spaced as stem elongates when flowering approaches, opposite in pairs, straight to gracefully recurved, succulent, convex above, convex below, very densely hairy, often with soil and plant debris lodged in hairs, dull mid- to light green, strongly purple infused at times of environmental stress; *petiole* absent; *blade* 10–25(–35) × 7–10 mm, lanceolate to shield-shaped, not folded lengthwise, covered in white hairs on both surfaces; *base* narrow; *apex* pointed, dark-tipped; *margins* entire, hairy, without differentiated cilia. *Inflorescence* an erect, few- to many-flowered, flat-topped thyrse consisting of several dichasia, to 20 mm long; *peduncle* an elongation of and hardly distinguishable from stem, leaves and leaf-like bracts smaller upwards. *Flowers* erect to slanted horizontally, white with faint central light brown stripe with age, 3–5 mm long; *pedicels* 2–4 mm long. *Calyx* light green, fleshy, very hairy, contrasting against white corolla; *sepals* 5, 1.5–2.5 mm long, basally adnate, elongated-triangular, hairy, tapering to blunt tip. *Corolla* flared open, more or less cup-like, distinctly shaped like 5-pointed star when viewed from above; *petals* 5, basally fused, 3–5 × 1–2 mm, white with faint central light brown stripe with age, oblong to elongated-triangular, with raised median ridge in distal half, apical half recurved, apiculate, margins flat, persistent after anthesis. *Stamens* attached

very low down in corolla tube, well-exposed between petals, not exceeding petals; *filaments* ± 2 mm long, thin, light greenish white; *anthers* 0.3–0.4 mm long, yellow turning yellowish brown to purplish brown especially when dry. *Pistil* consisting of 5 carpels; *carpels* 1.75–2.00 mm long, light green; *styles* ± 0.65 mm long; *stigmas* very slightly capitate, brown; *squamae* transversely oblong, 0.1 × 0.4 mm, apex indented. *Follicles* 1.75–2.00 mm long, light green, slightly purple-infused towards apex, drying creamy white, soon becoming brittle and disintegrating. *Seeds* 0.25–0.40 mm long, somewhat cylindrical, light creamy white to light brown-infused; weakly self-fertile. *Chromosome number*: unknown.

Distribution:—*Crassula stylesii* has been collected only from KwaZulu-Natal province, South Africa, from where it is known to occur at two sites (17 km distant) within the Mngeni River catchment to the west of Durban. Both localities occur within the Ethekwini Metropolitan area (Fig. 3), which falls entirely within the Maputaland-Pondoland Region of Endemism (Van Wyk & Smith 2001: 82–85).

Habitat:—*Crassula stylesii* occurs on both sandstone and granite, co-occurring with a number of leaf succulent species including *Aloe candelabrum* Berger (1906: 246) (Asphodelaceae), *Huernia hystrix* (Hooker 1869: Tab. 5751) Brown (1876: 795) (Apocynaceae), *Kalanchoe rotundifolia* (Haworth 1824: 188) Haworth (1825: 31) (Crassulaceae subfam. Kalanchooideae), and *Cyanotis robusta* Obermeyer (1981: 438) (Commelinaceae). It occurs at the type locality within Dry Coast Hinterland Grassland (Gs 19) (Jewitt 2018) that has been infiltrated by closely proximate Eastern Valley Bushveld (SVs 6) (Rutherford *et al.* 2006). This site is considered to be relatively transformed and, although a savannah vegetation type, was historically likely to have been more open as a dry grassland mosaic with fewer woody elements. At Cato Ridge it occurs along ridges and exposures within grassland (KwaZulu-Natal Sandstone Sourveld (SVs 5)) (Rutherford *et al.* 2006). Plants occur largely exposed, growing in lithosols on the edges of moderately steep sheets of weathered rock (Fig. 1C), and at the type locality (Fig. 1E) are usually found at the base of stunted specimens of *A. candelabrum*. Plants may be found on northwestern, northern, and northeastern aspects, at elevations of 440–710 m.

Phenology:—Flowers (Fig. 1A, C) late-summer to autumn, peaking in March (southern hemisphere). The flowering periods of *C. stylesii* and *C. obovata* coincide, but *C. setulosa* flowers slightly earlier (mid-summer to autumn).

Eponymy:—This species is named for Mr David G.A. Styles (Bulawayo, Zimbabwe, 7 January 1968–) (Fig. 1F), botanical consultant and explorer who has discovered many novel plant taxa from the KwaZulu-Natal and Eastern Cape provinces of South Africa. His various finds include this species, which he first observed *in situ* on 8 March 2013.

Conservation status:—At the KwaNyuswa type locality (Fig. 1E) where plants are locally numerous (*ca.* 250 individuals) the habitat is subjected to over-frequent burning, and grazing and trampling by cattle; this facilitates alien plant invasions by the likes of the herbaceous *Bidens pilosa* Linnaeus (1753b: 832) and shrubby *Lantana camara* Linnaeus (1753b: 627). At the Cato Ridge site the vegetation is in good condition, but plants are sparser with fewer than 100 individuals. KwaZulu-Natal Sandstone Sourveld at the Cato Ridge location is considered an Endangered vegetation type by Skowno *et al.* (2019), although a provincial-level assessment categorises this vegetation unit as Critically Endangered (Jewitt 2018). Eastern Valley Bushveld (SVs 6) is considered Least Concern (Rutherford *et al.* 2006), whereas Dry Coast Hinterland Grassland is assessed as Vulnerable by both Jewitt (2018) and Skowno *et al.* (2019). Altogether, the species occurs within sites of conservation concern, with neither locality formally protected. Using IUCN (2019) criteria the species would be considered Vulnerable (D1).

Discussion:—The closest relatives of *C. stylesii* are *C. obovata* and *C. setulosa*. Apart from the autonymic variety, Tölken (1985: 170–172) recognised four additional varieties in *C. setulosa*. All four of these occur well distant from the location at which *C. stylesii* was collected in KwaZulu-Natal, with: (1) *C. setulosa* var. *jenkinsii* Schonland (1929: 239) known only from north-central South Africa; (2) *C. setulosa* var. *deminuta* Diels (1907: 467) Tölken (1975: 118) from northeastern South Africa; (3) *C. setulosa* var. *rubra* (Brown 1895: 145) Rowley (1978: 53) from the high altitude interior of KwaZulu-Natal, the Free State, Lesotho, and northeastern Cape; and (4) *C. setulosa* var. *longiciliata* Tölken (1975: 119) from northeastern South Africa. None of these varieties have been recorded at the low altitudes and from the area from where *C. stylesii* is known. Therefore, for comparative purposes, only *C. setulosa* var. *setulosa* (Fig. 2C), in this account referred to only as *C. setulosa*, is of concern. *Crassula setulosa* is an altogether more gracile species of higher altitudes than those at which *C. stylesii* is found, and does not occur in the greater Durban area.

In the case of *C. obovata*, Tölken (1985: 179–180) recognised one additional variety apart from the autonymic one. *Crassula obovata* var. *obovata* (Fig. 2B) is widespread in the eastern parts of the Eastern Cape province and southern KwaZulu-Natal, while *C. obovata* var. *dregeana* (Harvey 1862: 346) Tölken (1975: 113) (Fig. 2E) is an edaphic specialist that is restricted to sandstone outcrops in southern KwaZulu-Natal. *Crassula obovata* var. *dregeana* has leaves that are generally arranged in pseudo-rosulate clusters that remain low-growing and is very different from

both *C. obovata* var. *obovata* and *C. stylesii*. Therefore, for comparative purposes, only *C. obovata* var. *obovata*, in this account referred to only as *C. obovata*, is of concern. *Crassula obovata* grows sympatrically with *C. stylesii* at the Cato Ridge locality, but is readily distinguishable there on account of its different habit and relatively large flower size (Fig. 2A, D; Table 1).

Although we consider *C. stylesii* to best be accommodated within *C.* sect. *Rosulares* we note that plants of this species lack a key characteristic of this section, viz. that plants have leaves arranged in basal rosettes or clusters of rosettes in resting or young plants (exampled by Fig. 2C) (Tölken 1985). Pending molecular analyses to refine its position, we tentatively place the species here.

Acknowledgements

Dr Tanza Crouch kindly constructed the accompanying plates and distribution map.

References

Berger, A. (1906) III. Neue Aloineen und andere Sukkulenten. *Notizblatt des Königlichen Botanischen Gartens und Museums zu Berlin-Dahlem* 4 (38): 246–249.
https://doi.org/10.2307/3994237

Brown, N.E. (1876) New garden plants. *Huernia hystrix*. *Gardeners' Chronicle* (*London*), new series, 5: 795. [https://www.biodiversitylibrary.org/item/84281#page/813/mode/1up]

Brown, N.E. (1895) 225. *Crassula curta*, N.E. Brown [Crassulaceae]; [*Crassula curta*] var. *rubra* N.E. Brown, pp. 144–145. *In*: CCCCLXIV.—Diagnoses africanæ, VI. *Bulletin of Miscellaneous Information, Royal Gardens, Kew* 1895: 141–153. [https://www.biodiversitylibrary.org/item/127378#page/148/mode/1up]

Diels, L. (1907) *Crassula deminuta* n. sp., p. 467. *In*: A. Engler & L. Diels, Crassulaceae africanae, in A. Engler, Beiträge zur Flora von Afrika. XXX. *Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie* (*Leipzig*) 39 (3 & 4): 462–468. [https://www.biodiversitylibrary.org/item/137011#page/484/mode/1up]

Harvey, W.H. (1862) Order LIII. Crassulaceae, D.C. V. *Crassula*, L. *In*: W.H. Harvey & O.W. Sonder, *Flora capensis* [*being a systematic description of the plants of the Cape Colony, Caffraria, & Port Natal*] 2. L. Reeve & Co., Ltd, Kent, pp. 332–368. [https://www.biodiversitylibrary.org/item/15233#page/340/mode/1up]

Haworth, A.H. (1819) *Supplementum plantarum succulentarum, sistens plantas novas vel nuper introductas, sive omissas, in Synopse plantarum succulentarum : cum observationibus variis anglicanis*. Impensis J. Harding, Londonii, 160 pp.
https://doi.org/10.5962/bhl.title.9314

Haworth, A.H. (1821) *Saxifragëarum enumeratio*. [Accedunt] *Revisiones plantarum succulentarum*. In Ædibus R. et A. Taylor, Londonii, 207 pp.
https://doi.org/10.5962/bhl.title.9670

Haworth, A.H. (1824 [September]) XXXI. Decas novarum Plantarum Succulentarum. ("Mr Haworth's *Decade of new Succulent Plants*."). *The Philosophical Magazine and Journal* 64: 184–191.
https://doi.org/10.1080/14786442408644582

Haworth, A.H. (1825 [06 July]) III. Decas quarta novarum Plantarum Succulentarum ("Mr Haworth's *Fourth Decade of new Succulent Plants*."). *The Philosophical Magazine and Journal* 66: 27–33.
https://doi.org/10.1080/14786442508673917

Hooker, J.D. (1869) *Stapelia hystrix. Botanical Magazine; or, Flower-Garden Displayed* [...] (*London*) 95: Tab. 5751. [https://www.biodiversitylibrary.org/item/14371#page/14/mode/1up]

IPNI. (2021 [continuously updated]) *The International Plant Names Index*. Available from: https://www.ipni.org/ (accessed May 2021)

IUCN Standards and Petitions Committee. (2019) *Guidelines for using the IUCN Red List Categories and Criteria. Version 14*. Prepared by the Standards and Petitions Committee. Available from: http://www.iucnredlist.org/documents/RedListGuidelines.pdf (accessed 7 September 2021)

Jewitt, D. (2018) Vegetation type conservation targets, status and level of protection in KwaZulu-Natal in 2016. *Bothalia* 48 (1): a2294, 10 pp.
https://doi.org/10.4102/abc.v48i1.2294

Linnaeus, C. (1753a) *Species plantarum, exhibentes plantas rite cognitas, ad generarelatas, cum differentiis specificis, nominibus*

trivialibus, synonymis selectis, locis natalibus, secundum systema sexuale digestas. Vol. 1. Salvius, Stockholm, 560 pp. https://doi.org/10.5962/bhl.title.59734

Linnaeus, C. (1753b) *Species plantarum, exhibentes plantas rite cognitas, ad generarelatas, cum differentiis specificis, nominibus trivialibus, synonymis selectis, locis natalibus, secundum systema sexuale digestas*. Vol. 2. Salvius, Stockholm, pp. 561–1200, index pages not numbered. https://doi.org/10.5962/bhl.title.59734

Obermeyer, A.A. (1981) Notes on African plants. Commelinaceae. Two new species of *Cyanotis*. *Bothalia* 13 (3–4): 437–439. https://doi.org/10.4102/abc.v13i3/4.1332

Rowley, G.[D.] (1978) Reviewed work: A revision of the genus *Crassula* in southern Africa. Contributions from the Bolus Herbarium No. 8. 2 vols by H.R. Tölken. *Cactus & Succulent Journal of Great Britain* 40 (2): 53.

Rutherford, M.C., Mucina, L., Lötter, M.C., Bredenkamp, G.J., Smit, J.H.L., Scott-Shaw, C.R., Hoare, D.B., Goodman, P.S., Bezuidenhout, H., Scott, L., Ellis, F., Powrie, L.W., Siebert, F., Mostert, T.H., Henning, B.J., Venter, C.E., Camp, K.G.T., Siebert, S.J., Matthews, W.S., Burrows, J.E., Dobson, L., Van Rooyen, N., Schmidt, E., Winter, P.J.D., Du Preez, P.J., Ward, R.A., Williamson, S. & Hurter, P.J.H. (2006) Savanna Biome. *In*: Mucina, L. & Rutherford, M.C. (eds.) *The vegetation of South Africa, Lesotho and Swaziland*. Strelitzia 19. South African National Biodiversity Institute, Pretoria, pp. 439–567.

Schonland, S. (1929) Materials for a critical revison of Crassulaceae. *Transcations of the Royal Society of South Africa* 17: 151–293. https://doi.org/10.1080/00359192909519313

Skowno, A.L., Raimondo, D.C., Poole, C.J., Fizzotti, B. & Slingsby, J.A. (eds.) (2019) *South African National Biodiversity Assessment 2018 Technical Report Volume 1: Terrestrial Realm*. South African National Biodiversity Institute, Pretoria, 211 pp. http://hdl.handle.net/20.500.12143/6370

Smith, G.F., Van Jaarsveld, E.J., Arnold, T.H., Steffens, F.E., Dixon, R.D. & Retief, J.A. (eds.) (1997) *List of southern African succulent plants*. Umdaus Press, Pretoria, 175 pp.

Thiers, B. (2021 [continuously updated]) *Index herbariorum: a global directory of public herbaria and associated staff*. New York Botanical Garden's Virtual Herbarium. Available from: http://sweetgum.nybg.org/ih/ (accessed May 2021)

Tölken, H.R. (1975) New taxa and new combinations in *Crassula*. *Journal of South African Botany* 41: 93–124. [https://archive.org/details/journalofsouthaf41unse/page/n101/mode/2up]

Tölken, H.R. (1977a) A revision of the genus *Crassula* in southern Africa. Part 1. *Contributions from the Bolus Herbarium* 8 (1): 1–331.

Tölken, H.R. (1977b) A revision of the genus *Crassula* in southern Africa. Part 2. *Contributions from the Bolus Herbarium* 8 (2): 332–595.

Tölken, H.R. (1985) Crassulaceae. *In*: Leistner, O.A. (ed.) *Flora of southern Africa* 14. Botanical Research Institute, Pretoria, 244 pp.

Turland, N.J., Wiersema, J.H., Barrie, F.R., Greuter, W., Hawksworth, D.L., Herendeen, P.S., Knapp, S., Kusber, W.-H., Li, D.-Z., Marhold, K., May, T.W., McNeill, J., Monro, A.M., Prado, J., Price, M.J. & Smith, G.F. (2018) *International Code of Nomenclature for algae, fungi, and plants (Shenzhen Code) adopted by the Nineteenth International Botanical Congress Shenzhen, China, July 2017*. Koeltz Botanical Books, Oberreifenberg. [Regnum Vegetabile 159]. https://doi.org/10.12705/Code.2018

Van Jaarsveld, E.J. (2003) *Crassula*. *In*: Eggli, U. (ed.) *Illustrated handbook of succulent plants: Crassulaceae*. Springer-Verlag, Berlin, pp. 32–84.

Van Wyk, A.E. & Smith, G.F. (2001) *Regions of floristic endemism in southern Africa. A review with emphasis on succulents*. Umdaus Press, Hatfield, Pretoria, 199 pp.