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Cheiridopsis alba-oculata (Aizoaceae: Ruschioideae, Ruschieae) — A new quartz-endemic from southern Namaqualand, South Africa

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ABSTRACT

Cheiridopsis alba-oculata Klak & N.A. Helme is a new species known from two populations in the Garies region of southern Namaqualand, where it appears to be restricted to patches of quartz-gravel. The species belongs to the *Cheiridopsis–Odontophorus* alliance because of its papillate leaves and the 9- or 10-locular fruits with large closing bodies. The isophylly and globose fruits with raised tops suggest that it is closely related to *C.* subg. *Odontophoroides* and *Odontophorus*. *C. alba-oculata* is geographically isolated in this group, whose other members are restricted to northern Namaqualand. *C. alba-oculata* resembles *Cheiridopsis ponderosa* and *Cheiridopsis pilosula* in its densely papillate leaves but is distinguished from them by its strongly keeled, apically toothed leaves.

1. Introduction

Cheiridopsis N.E.Br., *Ihlenfeldtia* H.E.K. Hartmann and *Odontophorus* N.E.Br. are closely related genera in the *Conophytum* clade (Klak et al., 2013). They are all highly succulent, compact, caespitose perennials, only occasionally with longer shoots. Monographs exist for all three genera (Hartmann, 1976, 1992; Hartmann and Dehn, 1987) but several new species and subspecies have been described subsequently in *Odontophorus* and *Cheiridopsis*. In *Odontophorus*, Hartmann (1976) recognised *Odontophorus angustifolius* L. Bolus, *Odontophorus marlothii* N.E.Br. and *Odontophorus nanus* L. Bolus. Subsequently, *O. angustifolius* subsp. *protoparcoides* S.A. Hammer (Hammer, 1994) and *Odontophorus pusillus* S.A. Hammer were described (Hammer, 1996). *Cheiridopsis* currently includes 32 species, including the insufficiently known *Cheiridopsis nelii* Schwantes (Hartmann, 2001) in three subgenera, *C.* subg. *Cheiridopsis*, *C.* subg. *Aequifoliae* H.E.K. Hartmann and *C.* subg. *Odontophoroides* H.E.K. Hartmann (Hartmann and Dehn, 1987). On the basis of differences in fruit structure, *Cheiridopsis excavata* L. Bolus and *Cheiridopsis vanzylii* L. Bolus were moved into a new genus, *Ihlenfeldtia* (Hartmann, 1992). According to Hartmann (1992), the structure of the fruit of *Ihlenfeldtia* suggested a close relationship with *Aloinopsis* Schwantes, *Tanquana* H.E.K. Hartmann and *Vanheerdia* L. Bolus ex H.E.K. Hartmann. This was not supported by molecular results (Klak et al., 2013), which re-affirmed the previous position of *Ihlenfeldtia* close to *Cheiridopsis*, corresponding to the similar anatomy of their leaves (Hartmann, 1992).

Odontophorus shares many characteristics with *Cheiridopsis*. These include the papillate epidermis of the leaves and the large, almost globose fruits. The toothed keels and margins of the leaves are common to *Odontophorus* and some species of *Cheiridopsis* subg. *Odontophoroides* (Hartmann, 2001). *Odontophorus* was distinguished from *Cheiridopsis* (Hartmann, 2001) by the much narrower valve wings (as opposed to the broader valve wings in *Cheiridopsis*). However, in the key to the subgenera of *Cheiridopsis* (Hartmann, 2001), "always narrow valve wings" distinguish *Cheiridopsis* subg. *Aequifoliae* from *C.* subg. *Odontophoroides* (with valve wings as broad as expanding keels or broader). There is therefore considerable overlap in the width of the valve wings between *Cheiridopsis* and *Odontophorus*, rendering the current distinction between the two genera unclear. Similarly, the considerable homoplasy among characters of the fruit revealed for the first time in Klak et al. (2013) makes it doubtful whether *Ihlenfeldtia* is distinct from *Cheiridopsis*.

Cheiridopsis is fairly widely distributed, from the district of Lüderitz-South in Namibia to the western and central parts of the Western Cape in South Africa (Hartmann and Dehn, 1987). The highest diversity of seven species is found around Steinkopf (Hartmann and Dehn, 1987), where three of the four species of *Odontophorus* also occur (Hartmann, 1976). The southernmost record for *Odontophorus* is 14 km south of Springbok, along the road to Hondeklipbaai (*O. marlothii*). *Ihlenfeldtia* occurs slightly to the east, at the edge of northern Namaqualand and Bushmanland as far east as Pofadder. Although *Cheiridopsis* extends to the southern Cape, the diversity drops to 2 or 3 species per half degree

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square. Most of the "southern species" belong to *C.* subg. *Cheiridopsis* (Hartmann and Dehn, 1987).

With only one species from each of these genera included by Klak et al. (2013) in their molecular analysis, we were unable to conclude whether *Cheiridopsis*, *Ihlenfeldtia* and *Odontophorus* were monophyletic as currently circumscribed and a more detailed molecular study of this group will provide better insight into generic and subgeneric boundaries among them (Powell et al., in prep.).

Recent generic treatments have favoured broader circumscriptions of genera (Klak et al., 2007; Klak and Bruyns, 2012, 2013) due to the high levels of homoplasy among many morphological characters (Klak et al., 2013). Below, we show that the new species could be placed equally well in *Cheiridopsis* subg. *Odontophoroides* or in *Odontophorus*. In view of the many shared morphological similarities between *Cheiridopsis* subg. *Odontophoroides* and *Odontophorus*, we predict that molecular data will lend further support to an enlarged generic concept of *Cheiridopsis*, including both *Odontophorus* and *Ihlenfeldtia*. We therefore describe the new species in *Cheiridopsis* subg. *Odontophoroides*.

2. Materials and methods

Morphological data on the new species came from herbarium material and observations in the field. All measurements are based on mature leaves, fresh flowering material and mature capsules. Collections at BOL, NBG and SAM were consulted.

3. Taxonomic treatment

Cheiridopsis alba-oculata Klak & N.A. Helme, sp. nov. Type: South Africa. Western Cape: Hondeklipbaai (3017), south of Bruinkop farm towards Spioenkop, (–DA), on loam with superficial quartz-gravel, 212 m alt., 26 Sep 2013, *Klak 2308* (BOL, holo.; K, iso.).

Compact, tufted, succulent perennial to 100 × 300 mm, branches to 150 mm long, internodes 5–15 mm long, greyish to ochre, rooting at nodes. *Leaves* all similar in shape, trigonous, widened and thicker subapically, 30–80 × 11–16 mm, connate basally into sheath 10–15 mm long, dull to brownish green, epidermis velvety, keel and margins dentate towards tips. *Flowers* solitary, 60–70 mm diam., pedicels 35 mm long with leaf-like bracts positioned near middle; *calyx*: lobes 5 or 6, subequal; *petaloid staminodes* yellow becoming white towards base, 30.0–33.0 × 1.5 mm, in many rows; *filamentous staminodes* few, slightly overtopping stamens; *stamens* 9 mm long, in many rows, filaments white, anthers yellow, only innermost filaments papillate towards base; *ovary* slightly raised on top, styles 9 or 10, green, 5–6 mm long, plumose on inside, with coilomorphic holonectary. *Fruits* erect, subglobose, 12–16 × 9–11 mm, top rounded with moderately raised rims but lower than basal part, basal part hairy, 9- to 10-locular, closing bodies large, blocking entire exit of locule, covering membranes undulate, sloping downwards towards centre of fruit and dented around middle, rims bent upwards, without additional closing devices below covering membranes, keels dark brown, parallel at base and later diverging apically, valve wing narrow and ending in awns. *Seeds* pear-shaped, 1.5 × 1.0 mm, light brown, smooth but colliculate in micropylar region. *Flowering time*: August–September.

3.1. Distribution and ecology

C. alba-oculata is known from two populations near Garies in southern Namaqualand, where it appears to be restricted to patches of quartz-gravel, in Namaqualand Heuweltjieveld (Mucina et al., 2006) and known colloquially as *Hardeveld*. This is a widespread vegetation type in Namaqualand. The habitat would, however, more correctly be described as an outlier of the Riethuis-Wallekraal Quartz Vygieveld (Mucina et al., 2006), which occurs only 30 km away, as it is structurally and floristically most similar to this unit. However, units smaller than 1 km in width, as is the case for most quartz patches, are typically unmapped in the South African vegetation map due to scale issues.

The underlying rock-type is gneiss, which has weathered into a sandy loam, overlain by large, white quartz-pebbles. Such patches of quartz occupy less than 2% of the total *Hardeveld*. The slopes may be slightly convex to slightly concave and are north-, west- or south-facing.

Associated common species include *Antimima komkansica* (L. Bolus) H.E.K. Hartmann, *Dicrocaulon ramulosum* (L. Bolus) Ihlenf., *Knersia diversifolia* (L. Bolus) H.E.K. Hartmann & Liede and *Monilaria chrysoleuca* Schwantes (Aizoaceae), *Didelta carnosa* Aiton, *Rhynchopsidium pumilum* DC. (Asteraceae) and *Euphorbia restituta* N.E.Br. (Euphorbiaceae).

C. alba-oculata is locally common and is a conspicuous element of its habitat. Only two other species of *Cheiridopsis*, *Cheiridopsis namaquensis* (Sonder) H.E.K. Hartmann and *Cheiridopsis denticulata* (Haw.) N.E.Br., have been recorded in the same quarter degree square (3017DA) as *C. alba-oculata* (Fig. 1). However, the three species prefer different soils: *C. namaquensis* is mostly found in soils derived from shale, with the northern populations occurring on granites or quartzites, whereas *C. denticulata* prefers gently sloping, gravelly, gneissic soils.

A new species closely related to *Jacobsenia vaginata* was found nearby on more alkaline soils and the Sandveld to the west has yielded several new species, including *Lampranthus procumbens* Klak (Aizoaceae) and *Ferraria ornata* Goldblatt & J.C. Manning (Iridaceae) (Klak, 2003; Goldblatt and Manning, 2011). The nearest extensive quartz-fields are near Riethuis and Wallekraal, some 30 km to the north and near Komkans, some 70 km to the southeast. *Othonna lepidocaulis* Schltr. (Asteraceae), previously known only from Komkans and fields of quartz-gravel and stony hills on the northern Knersvlakte, some 80 km to the southeast, was also noted and the very small, rarely recorded *Crassula multiceps* Harv. (Crassulaceae) also occurs here. Thus, the smaller and more isolated patches of quartz-gravel where *C. alba-oculata* occurs show links to other quartz fields further north and to those further south as well but they include some endemic species such as *C. alba-oculata*.

The unscented flowers are typically open from 10 am to 5 pm and were visited by monkey beetles (Hoplinii), horseflies (Tabanidae) and bee-flies (Bombylidae).

3.2. Diagnostic characters

Cheiridopsis and its sister genera *Odontophorus* and *Ihlenfeldtia* are distinguished from other genera in Ruschieae by papillate leaves and multi-locular fruits (8 to 18 locules) with large or rarely small (*Ihlenfeldtia*) closing bodies (Hartmann and Dehn, 1987).

Similarly, the diagnostic characters to distinguish the three subgenera of *Cheiridopsis* from each other as well as from *Ihlenfeldtia* and *Odontophorus* are mainly found in the leaves and fruits (Hartmann and Dehn, 1987; Hartmann, 1992).

Common to these three genera are the papillate leaves (Hartmann, 2001) which, however, show differences in the shape and density of the papillae (Hartmann and Dehn, 1987). The leaves in *C. alba-oculata* are densely papillate (Fig. 2A), as found in *Cheiridopsis pilosula* and *Cheiridopsis speciosa* of *C.* subg. *Odontophoroides* and also in *Odontophorus*.

C. alba-oculata cannot be confused with any member of *C.* subg. *Cheiridopsis*, since all members of the latter are heterophyllous (the first pair of leaves is shorter than the second pair). The other two subgenera of *Cheiridopsis*, as well as *Odontophorus* and *Ihlenfeldtia*, are isophyllous (both pairs of leaves are of the same length). In addition, the leaves are 30–80 mm long in *C. alba-oculata*, whereas they never exceed 50 mm in *Odontophorus* (Hartmann, 2001). Although the leaves in *C. pilosula* and *Cheiridopsis ponderosa* (both *C.* subg. *Odontophoroides*) may also reach 70–120 mm long (Hartmann, 2001), the leaves of *C. pilosula* lack teeth (Hartmann and Dehn, 1987) and, although the leaves of *C. ponderosa* may have tiny teeth near the apex, the keels are rounded. This contrasts with the leaves of *C. alba-oculata*, which are distinctly keeled with often quite prominent teeth along the keels and

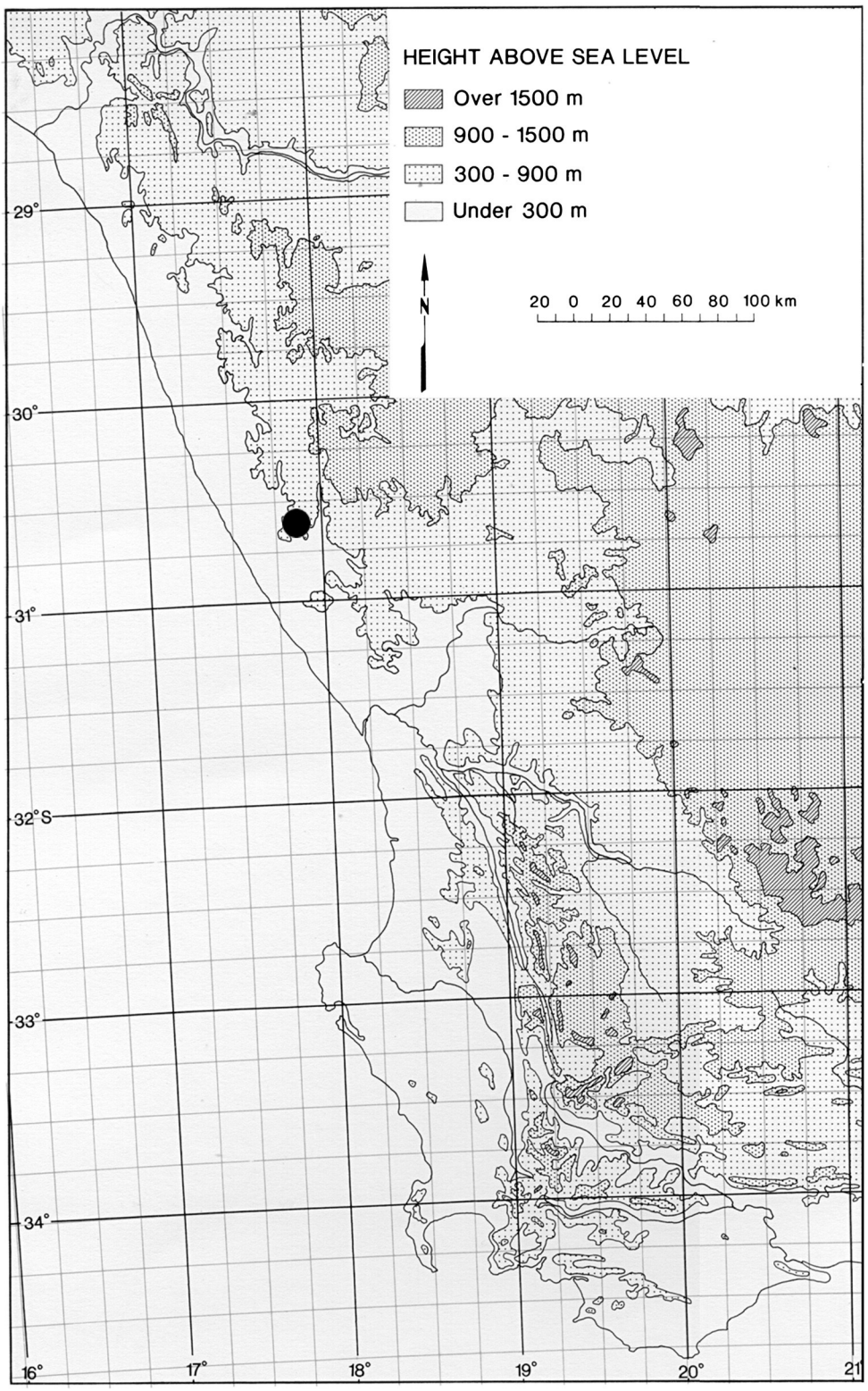

Fig. 1. Distribution of *Cheiridopsis alba-oculata.*

margins towards their tips (Fig. 3A), a feature also found in *C.* subg. *Odontophoroides* and in *Odontophorus*.

It is uncommon for species of *Cheiridopsis* or *Odontophorus* to have distinctly two-coloured petaloid staminodes (white in the lower third and yellow in the two upper thirds). The flowers in both populations of *C. alba-oculata* are bi-coloured (Fig. 3A). This is otherwise known in *C. pilosula*, *C. denticulata* and *Cheiridopsis caroli-schmidtii* (Dinter & A. Berger) N.E.Br., which all include populations with unicoloured petaloid staminodes.

All 14 species of *Cheiridopsis* subg. *Cheiridopsis* have mostly decumbent capsules. The other two subgenera, as well as *Odontophorus*, have predominantly erect capsules and this is also true of *C. alba-oculata*

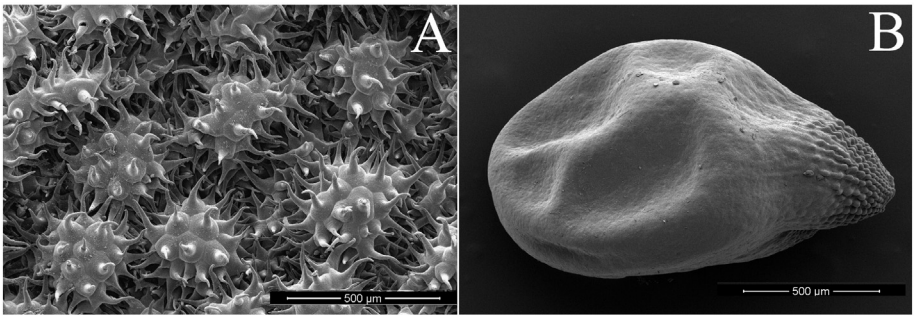

Fig. 2. SEM images of leaf surface and seed testa of *Cheiridopsis alba-oculata*. A. Leaf epidermis, showing the characteristic papillae, *Klak 2308*; B. seed, which has a smooth testa except for the micropylar region where there are convex cells, *Klak 2308*.

(Fig. 3A). The new species shares with *Odontophorus* and *Cheiridopsis* the large closing bodies (Fig. 3B), whereas they are always small in *Ihlenfeldtia* (Hartmann, 1992). In addition, in terms of the shape of the fruits, the almost globose, rounded tops of *C. alba-oculata* (Fig. 3B) are most similar to those of *C.* subg. *Odontophoroides* and of *Odontophorus*. In addition, the lower parts of the fruits are densely hairy. Although Hartmann (1976) suggested that the papillate (hairy) fruits of *Odontophorus* are one of the main characteristics separating this genus from *Cheiridopsis*, similarly hairy fruits are also found in *C. ponderosa* S.A. Hammer and in *C. pilosula* L. Bolus, where the papillae are shorter. Hartmann (2001) also used this character in the key to separate the genera *Cheiridopsis* ("base of capsule rough") from *Odontophorus* ("base of capsule velvety"). However, species with "velvety" fruits such as *C. ponderosa* are nevertheless still included in *Cheiridopsis*. In addition, the terms "velvety" and "rough" are difficult to quantify and intermediates exist, as in the case of *C. pilosula*. The fruits of the new species can only be confused with members of *Odontophorus* or *C.* subg. *Odontophoroides*, but none of these occurs so far to the south.

The seeds are smooth and pear-shaped in the new species (Fig. 2B), characteristics encountered in both *Cheiridopsis* and *Odontophorus*, both of which may also have more papillate seeds (Hartmann and Dehn, 1987; Hartmann, 2001). The papillate seeds in *C. pilosula* (Hartmann and Dehn, 1987) distinguish this species from *C. alba-oculata*.

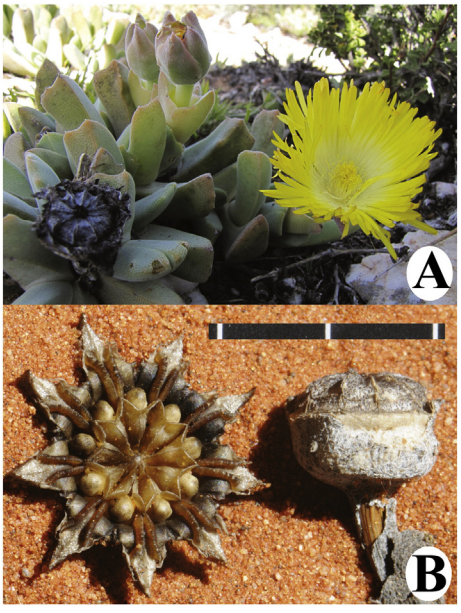

Fig. 3. Habit and fruit morphology of *Cheiridopsis alba-oculata*. A. Habit, *Helme 8058*, at farm Soutfontein, 30 km west of Garies; B. top of open fruit and side view of closed fruit, *Klak 2308*. Scale: distances between white lines indicate 1 cm. (For interpretation of the references to colour in this figure, the reader is referred to the web version of this article.)

3.3. Etymology

The epithet "*alba-oculata*" is derived from the latin *albus* = white and *oculus* = eye and alludes to the white centre of the flowers.

3.4. Conservation status

The species is known only from two discrete locations, 3 km apart. The two populations cover a total area (area of occupancy; AOO) of less than 5 ha. The total number of plants is estimated at between 500 and 1000. No significant threats were observed and, although the area is grazed by small livestock (mainly sheep), the plants did not appear to be affected by grazing. According to IUCN 3.1 criteria (IUCN, 2001) the species is classified as VU D1.

3.5. Additional specimens seen

South Africa — Northern Cape: 3017 (Hondeklipbaai): 30 km west of Garies, farm Soutfontein 436, along the Outeep River, (–DA), 20 Aug. 2013, on quartz-gravel, 135 m alt., *N.A. Helme 8058* (BOL, NBG).

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References

Goldblatt, P., Manning, J.C., 2011. Systematics and biology of the African genus *Ferraria* (Iridaceae: Irideae). Bothalia 41, 1–40.
Hammer, S., 1994. Macro-observations on *Cheiridopsis* N.E.Br. and *Odontophorus* N.E.Br. (Aizoaceae). Bradleya 11, 75–85.
Hammer, S., 1996. Piante Grasse Speciale 1995. Supplementum to Piante Grasse 15 (4), p. 86.
Hartmann, H.E.K., 1976. Monographie der Gattung *Odontophorus* N.E.Br. (Mesembryanthemaceae Fenzl.). Botanische Jahrbücher für Systematik 97, pp. 161–225.
Hartmann, H.E.K., 1992. *Ihlenfeldtia*, a new genus in Mesembryanthema (Aizoaceae). Botanische Jahrbücher für Systematik 114, pp. 29–50.
Hartmann, H.E.K., 2001. Illustrated Handbook of Succulent Plants, Aizoaceae A–E; F–Z. Springer, Berlin [a. o.].
Hartmann, H.E.K., Dehn, M., 1987. Monographien der Leipoldtiinae. VII. Monographie der Gattung *Cheiridopsis* (Mesembryanthemaceae). Botanische Jahrbücher für Systematik 108, pp. 567–663.
IUCN, 2001. IUCN Red List Categories and Criteria Version 3.1. IUCN Species Survival Commission, Gland, Switzerland and Cambridge, UK.
Klak, C., 2003. New combinations, a new genus and five new species in the Aizoaceae. Bradleya 21, 107–120.
Klak, C., Bruyns, P.V., 2012. Phylogeny of the Dorotheantheae (Aizoaceae), a tribe of succulent annuals. Taxon 61, 293–307.
Klak, C., Bruyns, P.V., 2013. A new infrageneric classification for *Mesembryanthemum* L. (Aizoaceae: Mesembryanthemoideae). Bothalia 43, 197–206.

Klak, C., Bruyns, P.V., Hedderson, T.A.J., 2007. A phylogeny and new classification for Mesembryanthemoideae (Aizoaceae). Taxon 56, 737–756.
Klak, C., Bruyns, P.V., Hanáček, P., 2013. A phylogenetic hypothesis for the recently diversified Ruschieae (Aizoaceae) in southern Africa. Mol. Phylogenet. Evol. 69, 1005–1020.
Mucina, L., Jürgens, N., Le Roux, A., Rutherford, M.C., Schmiedel, U., Esler, K., Powrie, L.W., Desmet, P.G., Milton, S.J., 2006. Succulent Karoo Biome. In: Mucina, L., Rutherford, M.C. (Eds.), The Vegetation of South Africa, Lesotho and SwazilandStrelitzia 19. South African National Biodiversity Institute, Pretoria, pp. 221–299.