Three new species and two new combinations in the Aizoaceae from the Western and Northern Cape of South Africa

C. Klak

Bolus Herbarium, University of Cape Town, 7701 Rondebosch, South Africa

Received 25 September 2009; received in revised form 17 November 2009; accepted 24 November 2009

Abstract

Three new species of Aizoaceae from the Western Cape are described. Octopoma tanquanum Klak and Vlokia montana Klak are dwarf shrubby or mat-forming succulents which belong to the Ruschieae in the Ruschioideae. Mesembryanthemum knolfonteinense Klak of the Mesembryanthemoideae is a geophyte. Octopoma tanquanum inhabits relatively low lying arid areas within the Tanqua Karoo and the Little Karoo and is thought to be closely allied to the two species of Octopoma found in the Little Karoo. Both V. montana and M. knolfonteinense grow at relatively high altitudes within the fynbos biome. In addition, Ruschia littlewoodii L. Bolus is transferred to Phiambolia, and two new combinations are made in Antimima for Ruschia hexamera L. Bolus and Ruschia radicans L. Bolus.

© 2009 SAAB. Published by Elsevier B.V. All rights reserved.

Keywords: Antimima; Aizoaceae; Mesembryanthemum; New species; Octopoma; Phiambolia; Ruschia; South Africa; Taxonomy; Vlokia

1. Introduction

The tribe Ruschieae of Aizoaceae subfamily Ruschioideae incorporates ±1560 species of shrubby succulents (Hartmann, 2001), predominantly found within the Succulent Karoo region of Southern Africa. Although the tribe has diversified extensively in the more arid parts of the winter rainfall region of the Succulent Karoo, there are currently 550 species of Ruschieae listed as occurring in the more mesic Cape Flora (Goldblatt and Manning, 2000). However, within the Cape Flora the majority of the Ruschieae prefer more arid places at lower altitudes, often shales, and only a few species are found at high altitudes in fynbos vegetation, including Esterhuysenia alpina L. Bolus or Vlokia ater S. A. Hammer. These species are frequently covered with snow during the winter.

Subfamily Mesembryanthemoideae, which is sister to the Ruschioideae, comprises the single genus Mesembryanthemum, with 102 species (Klak et al., 2007). Mesembryanthemoideae, in contrast to the Ruschieae, includes annual species as well as perennials, among which nine have evolved a geophytic life form. Of these, eight belong to the Phyllobolus group, with the ninth, M. rapaceum L., in the Psilocaulon group. In this contribution, one new species from the Tanqua Karoo, one from the Swartkoppies Mountains and on the southwestern margin of the Tanqua and a third from the Keeromsberg northeast of Worcester are described. All measurements and observations are based on mature leaves, fresh flowering material and mature capsules. Specimens from BOL and NBG were examined for this study (acronyms follow Holmgren et al., 1990).

2. Species treatments

2.1. Mesembryanthemum knolfonteinense, Klak sp. nov., a M. resurgente, floribus cum staminodeis filamentis, genitalis non occultis, seminibus non cristatis, a M. oubergense planta grandiore et floribus grandioribus, seminibus non cristatis differt

Type: South Africa, Western Cape, Swartkoppies, farm Knolfontein, Grasberg (3219DC), 1180 m, 14 September 2008, Klak 1770 (BOL, holo.).

Deciduous, clump-forming geophyte, 20–45 × 60–120 mm, with carrot-shaped tuber 130–190 × 10–20 mm; stems weakly lignified, very short and not clearly visible. Leaves decussate, slightly alternate in inflorescence, subcylindrical to dorsiventrally flattened, 19–25 × ±3 mm, mesomorphic, bladder cells not prominent. Inflorescence 1(-3)-flowered, pedicels 7–9 mm
long. Flowers with 5 sepals, 35–42 mm diam., petals and filamentous staminodes cream-coloured, reproductive parts exposed. Androecium fused into a tube, pollen yellow. Gynoecium: placentation axile; stigmas 5, long and slender, apically recurved, ±5 mm long, yellowish. Fruits 5-locular, top raised ±4–6 mm tall, lower part shortly funnel-shaped, ±5 mm long, open fruit 18–20 mm diam., closed fruit 9–11 mm diam., valve wings present and inflexed over the valves, without seed pockets. Seeds D-shaped, 1.6–1.8 mm long, without a crest, dark brown, testa scalariform-colliculate.

2.1.1. Ecology and distribution

Mesembryanthemum knolfonteinense (Fig. 1) is so far only known from the top of the Grasberg in the Swartruggens Mountains (Fig. 2), where it was first collected by Ivor Jardine. The plants grow in flat, open patches of shallow ground, between low outcrops of sandstone in arid fynbos, in which other succulent elements such as species of Crassula and members of the Ruschieae also abound. Since they occur at an altitude of nearly 1200 m, the plants may be covered with snow during the winter.

In 2008 plants begun flowering in October and continued to December (Fig. 3). Mature fruits (Fig. 4) were collected at the end of March 2009. By this time all of the leaves had withered, but the fruits remained on the plants.

2.1.2. Discussion

The tuberous root, the seed surface structure and the floral morphology place M. knolfonteinense in the Phyllobolus group of species (Klak et al., 2007). The three species M. knolfonteinense, M. resurgens and M. oubergense are all clump-forming geophytes with very short stems and only the leaves visible above the ground. They cannot be mistaken for any of the other geophytic species of Mesembryanthemum, which have a prostrate to decumbent or scrambling habit (Gerbaulet, 1997). In terms of overall size of the plant, M. knolfonteinense
is most similar to *M. resurgens* (20–45 × 50–110 mm), but differs from that species considerably in its floral morphology. In *M. resurgens* the reproductive parts are hidden by the petaloid staminodes and there are no filamentous staminodes, but in *M. knolfonteinense* the stamens and stigmas are visible and filamentous staminodes are present (Fig. 2). Further distinguishing characters between *M. knolfonteinense* and *M. resurgens* are found in the leaves, which are decussate in *M. knolfonteinense*, but alternate in *M. resurgens*. The third of the clump-forming species, *M. oubergense*, is overall a more delicate plant (10–30 × 25–40 mm). Although similar to *M. knolfonteinense* in floral and leaf morphology, the maximum flower size in *M. oubergense*...
is ±30 mm in diameter (Gerbaulet, 1997) versus 35–42 mm diam. in *M. knolfonteinense*. The seeds of *M. knolfonteinense* also lack the crest that is characteristic of both *M. resurgens* and *M. oubergense* (Gerbaulet, 1997).

In addition, flowering in *M. oubergense* (September) and *M. resurgens* (July to September) begins earlier than in *M. knolfonteinense*, which flowers from October to December.

The relationships among the species of the Phyllobolus group were poorly resolved and supported in the molecular analysis by Klak et al. (2007), and the relationships of the geophytic species to the others within this group remain uncertain.

The distribution of *M. resurgens* is quite extensive and it has been recorded from the Kamiesberg across the Bokkeveld and Roggeveld Escarpments and the Moordenaarskaroo to Matjiesfontein. In the northern part of its range *M. resurgens* occurs in areas receiving relatively high rainfall, whereas in the south-easterly parts of its range the records are from areas with substantially lower rainfall. Whereas the distribution ranges of *M. resurgens* and *M. oubergensis* are mainly found within the Succulent Karoo region (Gerbaulet, 1997), *M. knolfonteinense* is found at the northeastern margin of the Cape Floral Region. All three species are always found on shallow soils.

### 2.1.3. Etymology

The plant has been named after the farm Knolfontein, where it was discovered. The word *knol* means tuber or bulb in Afrikaans and is descriptive of the habit of *M. knolfonteinense* as well as many other species in the area.

*Additional material examined:* South Africa, Western Cape, Knolfontein, top of Grasberg (3219DC), 1 Oct. 2009, Jardine 1184 (NBG).

### 2.2. Octopoma tanquum, Klak sp. nov., an *O. octojugo* *O. quadrisepaloque fructibus cum 6 loculis et alis valvae latioribus differt*

**Type:** South Africa, Western Cape, Tanqua Karoo, 7 km west of Matjiesfontein, Farm Aasvoëlbos (3320BA), 26 May 2007, Bruyns 10797 (BOL, holo.).

Densely branched dwarf succulent shrublet to ±80 mm tall. *Stems* woody, branching from base, to 5 mm thick, internodes ochre to greyish, 4–6 mm long. *Leaves* basally connate, surface smooth, free parts spreading and somewhat trigonous in cross-section, acute without apical tooth or mucro, keels finely denticulate. *Inflorescence* 1-flowered, bracteoles embracing the base of the flower. *Flowers* to 27 mm diam., petals and filamentous staminodes cream-coloured, inner petals shorter than outer, filamentous staminodes collected into a cylinder around the stamens, all elements epipallate or the inner with few, short papillae. *Fruits* 6-locular, top convex with low rims, base funnel-shaped, closing bodies largish, valve wings broad, broadest at their middle, without additional closing devices below covering

---

Fig. 5. Type of *Octopoma tanquana* Klak, Bruyns 10797 (BOL).
membranes, expanding keels broad and diverging towards top, not ending in awns. Seeds D-shaped, ±0.9 mm long, without a crest, pale, ochre coloured, almost smooth.

2.2.1. Ecology and distribution

*Octopoma tanquanum* (Fig. 5) was first collected by Cape Town succulent expert P.V. Bruyns in May 2002 in the Little Karoo, on the western foot of the Warmwaterberg on the farm Tilney. The species has subsequently been collected several times, mainly in the Tanqua Karoo, extending from a little north of Karoopoort in the west, through Matjiesfontein and into the Little Karoo (Fig. 2). The species prefers flat or gently sloping, slightly gravelly, loamy areas, at altitudes ranging from 750 to 1100 m. It is always associated with Succulent Karoo vegetation.

The distribution ranges of the other two species of *Octopoma* which occur in the Little Karoo are slightly further to the south-east: *O. octojuge* (L.Bolus) N.E.Br. and *Octopoma quadrisepalum* (L.Bolus) H.E.K.Hartmann have been recorded from Eierpoort to Barrydale and Ladysmith, but have not been found growing sympatrically. As in *O. tanquanum* they prefer loamy soils, but usually with plenty of additional quartz pebbles on the surface.

*Octopoma tanquanum* flowers from mid October to November (Fig. 6). Similarly, *O. octojuge* and *O. quadrisepalum* also flower between October and January.

2.2.2. Discussion

*Octopoma* is a genus of eight species and has been subdivided into two groups based on differences in fruit morphology (Hartmann, 1998a). Group 1 (*O. quadrisepalum, O. octojuge* and *O. subglobosum*) is characterized by capsules with narrow valve wings, covering membranes without or with small additional closing devices, and large closing bodies; group 2 (the remaining five species) has capsules without valve wings, covering membranes with distinct closing rodlets, and small closing bodies.

The main characteristics of *Octopoma*, which distinguish it from *Ruschia* and *Leipoldtia*, are the 6- to 8-locular fruits, with no or only narrow valve wings (Hartmann, 1998a). In *Ruschia* the fruits are 5 (rarely 6)-locular, usually with no valve wings, whereas in *Leipoldtia* the fruits are ±10-locular with broad valve wings. *Octopoma tanquanum* exhibits several of the fruit characters of *Octopoma*, including the 6-locular fruits, large closing body, and no additional closing devices below the covering membranes (Fig. 7). The presence of broad valve wings is novel for the genus. On the basis of the fruit morphology *O. tanquanum* should be placed in group 1. Infragenetic variation in fruit morphology has been observed in several genera, most notably in *Drosanthemum* (Hartmann and Bruckmann, 2000). Therefore, the presence of valve wings in the fruits of *O. tanquanum* and their absence in the other species of *Octopoma*, does not exclude a close relationship between them.

In terms of overall habit *O. tanquanum* is most similar to the two species in the Little Karoo. The leaves of *O. tanquanum* show largely the same features as *O. octojuge*, in that the free parts of the leaves are trigonous and spreading. In contrast, in *O. quadrisepalum*, the free parts of the leaves are almost globose. In addition, *O. tanquanum* and *O. octojuge* have white or cream flowers, whereas the flowers are pink in *O. quadrisepalum*.

2.2.3. Etymology

The species has been named after the Tanqua Karoo, where most of the populations have been found.


2.3. Vlokia montana, *Klak* sp. nov., a V. atre foliis anguste cymbiformibus, planta tegetes densae formanti differt

Dwarf, mat-forming succulents to 80 mm diam. Stems much reduced, rooting at nodes. Leaves narrowly boat-shaped, back (adaxial surface) rounded but slightly keeled towards apex, fused basally for 2–3 mm, free parts 6–9 × 3.5–5.0 mm, thick, grey-green with minute dark dots. Inflorescence 1-flowered, pedicels short, to 3 mm long. Flowers 22 mm diam., pale pink, filamentous staminodes and stamens conically collected, filamentous staminodes apically recurving with age, white. Stigmas 6, pollen yellow. Nectaries consisting of a crenulate ring. Fruits 6-locular, top only very little raised, rims not raised, lower part half-globose, keels diverging from base and ending in awns, covering membranes without additional closing appendages at their distal ends, valve wings reduced to narrow seams, closing body absent. Seeds 0.7 mm long, brown, minutely rugulose.

2.3.1. Ecology and distribution

Vlokia montana is known from two collections only, i.e. from the Keeromsberg, northeast of Worcester and from Ben Heatlie, which lies ca, 1.8 km NW of the Keeromsberg (Fig. 2). The plants prefer to grow on sandstone pavements in shallow soil at an altitude from 1920 to 2000 m, where they are regularly covered in snow during the winter. Few species of Aizoaceae are found in relatively moist fynbos at these altitudes. As in species of Esterhuysenia, both species of Vlokia grow in rocky places. Vlokia ater and V. montana (Fig. 8) grow on flat expanses of sandstone in shallow pans filled with black soil and covered with fine quartz gravel. Vlokia ater is known from two localities on the Waboomsberg, which are separated by a few kilometres (Hammer, 1994). The Waboomsberg, which is ±12 km north of Montagu, lies some 51 km to the east of Keeromsberg. Thus the two species are geographically well separated. V. montana was first collected by P.V. Bruyns in November 1987. In 2004, N. Helme recollected this species, but no fresh flowering material was available to describe it. Therefore a collection by P.V. Bruyns, made in August 2006, which later flowered in Cape Town, was used to describe the species.

The flowering time of V. montana is from late September to November (Fig. 9). In contrast, V. ater flowers in early spring, from August to September.


2.3.2. Discussion

Vlokia was established fairly recently to accommodate a single species, V. ater (Hammer, 1994). Due to an unusual combination of character states this species had not been possible to place in any of the existing genera. The monotypic genera Didymaotus and Antegibbaeum as well as E. alpina were discussed as possible close relatives to Vlokia (Hammer, 1994). In a molecular analysis of chloroplast and nuclear markers, Vlokia ater was found to belong to a clade with Antegibbaeum, Braunsia vanrensburgii, Hammeria meleagris, Smicrostigma and Zeuxtophyllum (Klak et al., 2003). Unfortunately, neither Didymaotus nor E. alpina was included in the molecular study. However, two other species of Esterhuysenia, E. drepanophylla and E. mucronata that were included, did not belong to the clade into which V. ater and Antegibbaeum fell. Most members of this clade are endemic to the Little Karoo, with outliers in the Tanqua Karoo, although B. vanrensburgii is found between Bredasdorp and the lower Breede River. Morphologically, no characters could be identified which are unique to this group (Klak et al., 2003). One of the few characteristics which they share is the absence of closing bodies in their fruits, which is likely to be a plesiomorphic character state.

Vlokia montana shares many characteristics with V. ater, so that there is no doubt that the two species are closely related. In particular they share similar, 6-locular fruits, without closing bodies and with much reduced or absent valve wings, and an almost flat top and a hemispherical lower part (Fig. 10). Floraically they are also very similar and the main differences between the two species are found in the habit and the shape of the leaves. Plants of V. ater are very sparsely branched and form trailing...
stems, but the stems are much more branched in \textit{V. montana}, forming low and dense mats (Fig. 11). The leaves of both species are roughly boat-shaped, with marked dark spots below the epidermis. However, the leaves of \textit{V. montana} are much narrower and more slender than those of \textit{V. ater}, where the leaves are almost as broad and thick as they are long (usually about 10×8 mm in \textit{V. ater}). In addition, the leaves are much more strongly keeled along the back than in \textit{V. montana}, where the back is mostly rounded and only slightly keeled towards the apex.

The shift in flowering time towards late spring in \textit{V. montana} compared to early spring in \textit{V. ater} is a good indication that the two species are reproductively isolated from one another.

2.3.3. Etymology

The epithet “montana” alludes to the montane habitat of this species.

3. New combinations

3.1. A new combination and a new synonym in Phiambolia (Ruschioideae)

\textit{Phiambolia} currently includes ten species, most of which are recorded from the area between Clanwilliam, Ceres and the Tanqua Karoo (Klak, 2008). The main characteristics for recognizing the genus are the xeromorphic, minutely papillate leaves, the 5-locular fruits without closing bodies and the presence of valve wings. Differences and similarities to the closely related genera \textit{Ruschia}, \textit{Lampranthus} and \textit{Amphibolia} were discussed previously (Klak, 2003; p. 113; Table 1). Species placed in this genus are either creeping (\textit{P. hallii} (L.Bolus) Klak, \textit{P. gydouwensis} (L.Bolus) Klak) or form medium to large, erect shrubs to 1 m tall. In addition, species typically prefer soils derived from sandstone and are often associated with arid fynbos. However, the genus has never been fully revised, so that the limits and distributions of the species are still incompletely known.

\textit{Phiambolia stayneri} (L.Bolus) Klak is one of the most unusual species in the genus and may not really belong here (Klak, 2008). Its taxonomic position has been uncertain since its description as \textit{Amphibolia stayneri} L.Bolus (Bolus, 1966), and it has since been transferred into both \textit{Ruschia} and \textit{Lampranthus}. The species differs from all other non-creeping species of \textit{Phiambolia} by having a tuberous rootstock and by
being much smaller, since it reaches a maximum height of 7 cm. In addition, it is found in islands of soil derived from shales which are surrounded by fynbos vegetation as opposed to soils derived from sandstone soils in which the other species of Phiaambolia always occur. It has been collected only rarely. The type collection of P. stayneri was made by F.J. Stayner in 1965 between the Matroosberg and the Theronberg Pass. It was recollected only in 2001, from Klondyke Farm near the base of the Matroosberg. The northernmost collection of this species was made in the Swartruggens on the farm Knolfontein, which is ±60 km NE of Ceres. The south-easternmost collection is from the base of Keeromsberg northeast of Worcester. The plants were found at altitudes ranging from 850 to 1330 m, where they may also be covered by snow during the winter.

A recent study of specimens in the Bolus herbarium revealed that the type of Ruschia littlewoodii L.Bolus is very similar to that of P. stayneri. Ruschia littlewoodii was collected six years earlier than P. stayneri by R. Littlewood, who found the plants 35 miles north of Ceres on the road to Citrusdal at the base of a koppie. Littlewood commented that the plants grow in “the transition stage between Protea veld and Karoo,” which corresponds to the habitat in which P. stayneri is found. Although no fruits are present on the type collection, the species, A. dualis is considered to be conspecific. Since staminodes are present. The two species are therefore considered to be conspecific. Since R. littlewoodii was described earlier, a new combination is necessary.

Phiaambolia littlewoodii (L.Bolus) Klak comb.nov.


Additional specimens examined: South Africa, Western Cape: Swartwuggens, Knolfontein Farm (3219DC), 13 Sep. 2008, Klak 1761 (BOL); Theronberg Pass (3319BC), 22 May 2005, Klak 1148 (BOL); Klondyke Farm (3319BC), 24 Aug. 2001, Klak 714 (BOL); Gydouwberg, Die Erf Farm (3319AB), 16 June 2006, Klak 1209 (BOL); eastern foot of Keeromsberg (3319DA), 27 Aug. 2006, Brahns 10507 (BOL).

3.2. Two new combinations in Antimima (Ruschiioideae)

Brown (1930) described Antimima and placed in it a single species, A. dualis (N.E.Br.) N.E.Br. In a study of the Ruschiinae, Dehn (1989) concluded that about 100 species should be transferred from Ruschia to Antimima. The new combinations were only later formally published by Hartmann (1998b).

Characteristics of Antimima are 5(-6)-locular fruits with large closing bodies, isophyllous or heterophyllous leaves, and 1(-3)-flowered inflorescences (rarely in well developed cymes) (Hartmann, 1998b). In addition, the leaves in species of Antimima often have a papillate epidermal surface, whereas they are typically smooth in Ruschia. Notably, 6-locular fruits are rare in both Ruschia and Antimima.

Antimima crassifolia (L.Bolus) H.E.K.Hartmann and Antimima pilosula (L.Bolus) H.E.K.Hartmann both have 6-locular fruits and both are known from northern Namaqualand and the Richtersveld. In terms of their fruit morphology, A. pilosula differs from A. crassifolia by having fruits with broad valve wings, whereas valve wings are absent in A. crassifolia. Recent investigations of herbarium material indicate that a specimen collected by Pillans in 1926 in the Richtersveld is conspecific with A. crassifolia. This specimen was described by L.Bolus in 1928 as Ruschia hexamera L.Bolus. The type specimens of both R. hexamera and A. crassifolia possess 6-locular fruits, with closing bodies and both lack valve wings. In addition, the epidermis of the leaves is papillate, the inflorescence is 1-3-flowered and the petaloid and filamentous staminodes are pink to white in both type specimens. Apart from the type specimens, few other collections have been made. Investigations of the fruits of the type specimens have shown that the closing bodies of R. hexamera as well as of A. crassifolia (drawing of a fruit on the type sheet) are not as large as is typical of Antimima, where the closing bodies usually block the entire exit of the locule. However, the relatively long expanding keels and the papillate epidermis in both type specimens are characteristics of species of Antimima. Similar characteristics are also found in Astridia, which mainly differs by having larger flowers that are 30–70 mm diam. and short expanding keels (Hartmann, 2001). Clearly R. hexamera is best placed in Antimima. Since R. hexamera was described much earlier than A. crassifolia, a new combination is made below.

A further species, Ruschia radicans, is here transferred into Antimima based on the study of living and herbarium material. This species has so far remained in Ruschia, since the type lacks fruiting material, which made the placement of this species uncertain. It was collected by Leipoldt in May 1928 at the Doorn River bridge north of Clanwilliam. The re-collection of this species from the type locality allowed the investigation of mature fruit material. The fruits were found to have large closing bodies, which block the exit of the locule and is a characteristic for Antimima.

In the past, this species has been confused with another prostrate species, Antimima granitica (L.Bolus) H.E.K.Hartmann (= A. limba N.E.Br.), which is found in coastal habitats, typically on granitic or gneissic rock slabs from Hondeklipbok to Ganzevleek. Both species have a compact centre and usually form long prostrate branches. In contrast to many other species in Antimima neither of the two species form a protective dry sheath during the resting stage, but the leaves persist throughout the dry summer season. Antimima radicans differs from A. granitica by
having leaves that are distinctly longer than broad, 10–15 × 5 mm. In contrast, the leaves of *A. granitica* are shorter and are only slightly longer, than they are broad and thick, 5–10 × 5–7 × 4–5 mm. In both species the keels often have a red tinge.

Apart from the type locality, the species is also known from Eendekuil. Collections from Vanrhynsdorp were also identified as *A. radicans* but a more detailed study is necessary to assess taxonomic differences between *A. radicans* and *A. watermeyeri* (L.Bolus) H.E.K.Hartmann, which was described from the Vanrhynsdorp area and is thought to differ mainly by the more compact habit (as opposed to the creeping) from *A. radicans*.

For the meantime, *R. radicans* is transferred to *Antimima*.  
*Antimima hexamera* (L.Bolus) Klak comb. nov.

*Ruschia hexamera* L.Bolus, Notes Mesembryanthemum 1: 144 (1928). Type: South Africa, [Northern Cape], hills near Brakfontein, between September and October 1926, *Pillans* 5703 (BOL, holo.!).  


*Antimima radicans* (L.Bolus) Klak, comb. nov.


*Additional material examined:* South Africa, Western Cape: Farm Draaihoek, near Eendekuil (3218DB), 30 June 2002, *Klak 999* (BOL); Eendekuil, Sep. 1933, *L.Bolus sub NBG 1521/33* (BOL).

**Acknowledgements**

This research was supported by the Mesemb Study Group. Gonzalo Aguilar is thanked for the scanning of the figures. P. V.Bruyns translated the Latin diagnoses.

**References**


Edited by JC Manning