



Trimelopter cordifolium (Hyacinthaceae subfam. Ornithogaloideae), a new species from South Africa

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Abstract

The study of wild and cultivated material of *Trimelopter* from the Northern Cape province of South Africa revealed an undescribed species that shows a unique syndrome of morphological characters. We here describe *Trimelopter cordifolium* based on plants approaching *T. psammophorum* but differing in its small, cordate, psammophorous leaf, shorter inflorescence and pedicels, smaller flowers and bracts, and more prominently sculptured ovary. We provide a complete morphological description as well as data on ecology and distribution. We also report new data and illustrations of *T. psammophorum*, which complement its scarce description in the protologue.

Key words: Distribution, ecology, Asparagaceae, taxonomy, Northern Cape flora, Scilloideae

Introduction

Hyacinthaceae subfam. Ornithogaloideae sensu APG (2003) (= Asparagaceae subfam. Scilloideae tribe Ornithogaleae sensu APG 2009, 2016, Chase *et al.* 2009) includes about 300 species of bulbous plants which are mainly distributed through Europe, Africa and Southwest Asia. Considerable controversy existed in the last decades regarding generic circumscription based on different interpretations of the available phylogenetic evidence. The accepted genera ranged from a single genus *Ornithogalum* Linnaeus (1753: 306), extremely variable in morphology to cover the whole subfamily (Manning *et al.* 2004), four genera, among them *Ornithogalum* and *Albuca* Linnaeus (1762: 438) in a very wide sense (Manning *et al.* 2009), to several smaller genera that are better defined in morphology (Speta 1998a, 1998b). The latest comprehensive study in Ornithogaloideae demonstrates the existence of 20 monophyletic genera (with the inclusion of *Igidia* Speta 1998b: 70) which are characterized by a clear syndrome of morphological characters related to distinct biogeographic patterns (Martínez-Azorín *et al.* 2011), which parallels the study in Urgineoideae, with 31 accepted genera (Martínez-Azorín *et al.* 2023a, 2023b).

Among those genera, *Trimelopter* Rafinesque (1837: 24) currently includes 12 species occurring in South Africa and southern Namibia, related to *T. unifolium* (Retzius 1781: 17) Mart.-Azorín, M.B.Crespo & Juan in Martínez-Azorín *et al.* (2011: 26) (= *Ornithogalum unifolium* Retz.) (the type of the genus). They mostly show 1–2(–3) elliptic to narrowly oblong leaves that are commonly appressed to the ground, although few species show filiform or suberect leaves; the ovary with two usually prominent longitudinal dorsal keels on each carpel, sometimes weakly prominent but always present (the apomorphy of the genus); six lobed or ribbed capsules; and unequally compressed or semi-discoid seeds (cf. Dyer 1931, Leighton 1944, Obermeyer 1978, Martínez-Azorín *et al.* 2011, 2013, 2020).

In 1997, the botanical exploration by G. Paonessa in Namaqualand, Northern Cape Province of South Africa has facilitated the discovery of a population of an undescribed species of *Trimelopter* characterized by a small, cordate,

psammophorous leaf. Few seeds were collected which were reproduced in cultivation since then in Rome, Italy by G. Paonessa. The study of the cultivated material for more than two decades shows plants constantly producing a single, small, cordate, psammophorous leaf, short inflorescence and pedicels, small flowers and bracts, and prominently sculptured ovary; a combination of characters not fitting with any of the known species in that genus (Martínez-Azorín *et al.* 2011, 2013, 2020). Based on this evidence, we here describe *Trimelopter cordifolium*, including a complete description and illustration as well as data on ecology and distribution.

Materials and methods

Detailed morphological studies were undertaken on cultivated and wild specimens following the terminology used for species of Hyacinthaceae in Martínez-Azorín *et al.* (2007, 2009). Herbarium specimens from the herbaria ABH, BOL, GRA, NBG and PRE (acronyms according to Thiers 2023+) were studied. Authors of the cited taxa follow IPNI (2023+). The MMA numbers correspond the Hyacinthaceae collecting number of the first author. Orthography of geographical names and grid-number system follow Leistner & Morris (1976). Measurements of tepals, stamens and ovaries were performed on fresh material.

Results and discussion

Trimelopter cordifolium Mart.-Azorín, Paonessa, Zaalberg, M.B.Crespo & M.Á.Alonso, *sp. nov.* (Figs 1–2).

Trimelopter cordifolium is slightly akin to *T. psammophorum* based on gross leaf features and psammophorous characteristics, but the former species differs by the single, much shorter, cordate leaf; bracts small, smooth and glabrous (not commonly longer, glandulous and psammophorous); smaller tepals and filaments; smaller and more prominently sculptured ovary; and shorter style.

Type:—SOUTH AFRICA. Northern Cape. Hondeklipbaai (2917): ca 35 km W of Steinkopf, ca 5 km S of road R382 on the way to farm Harras (–AD), 320 m elevation, flat sandy soil in quartz field, 30 June 2022 in flower ex hort. in Rome, Italy, G. Paonessa *s.n.* (GRA holotype; ABH, K isotypes).

Deciduous, small, bulbous plants to 5 cm tall. Bulb solitary, hypogeal, ovoid to subglobose, 1.6–2.0 × 1.4–2.0 cm, with soft pale brown outer tunics, usually with longitudinal darker markings, ending in a hypogeal neck, 1–2 cm long. Roots fleshy, branched, white, to 20 mm long. Leaf solitary, cordiform, 10–16 × 8–11 mm, obtuse, appressed to the ground, greyish green on the adaxial side, psammophorous, covered on the adaxial side with small papillae which are arranged longitudinally, giving the appearance of being finely striate, with papillae secreting sticky polysaccharides and adhering sand grains to favour mimicry with the environment, smooth on the abaxial side, starting to wither or withered at the anthesis. Inflorescence an erect raceme with 4–6 flowers, 14–17 mm long; lowermost pedicels 3–4 mm long, erect-patent at anthesis and erect in fruit; peduncle 20–25 mm long; bracts deltoid-lanceolate, brownish-green with membranous, white auriculae, acuminate, 2–2.5 × 1.5–2 mm, equal to shorter than pedicels at anthesis and fruit, glabrous, smooth. Flowers suberect to patent; tepals 6, biseriate, greenish with white margins, with a grey-green median stripe 1–1.5 mm wide associated to the central nerves, slightly fleshy, with minutely glandulous apex; outer tepals oblong, 5.0–5.2 × 2.2–2.3 mm; inner tepals ovate-elliptical, 5.9–6.0 × 2.0–2.1 mm. Stamen 6, biseriate, dimorphic; anthers ca 1 × 0.7 mm after dehiscence; outer filaments narrowly lanceolate, 3.2–3.5 × 0.9–1.0 mm, inner filaments ovate and narrowly tapering along the upper third, 3.3–3.5 × 1.2–1.3 mm. Ovary ovoid, green with white longitudinal keels, 2.0–2.1 × 1.9–2.0 mm, trilobed in section, with two longitudinal keels on each carpel giving a 6-angled section; style narrowly columnar, erect, 1.9–2.0 × 0.4–0.5 mm, stigma undifferentiated, glandulous. Capsule subglobose, ca 4 × 4 mm, trilobed in section, pale-brown when mature, with ca 20 seeds per capsule. Seeds 1.3–1.9 × 0.7–1.0 mm, black, flattened, mostly hemidiscoidal or discoidal, with slightly winged margins.

Etymology:—Named after the heart-shaped morphology of leaves (after combination of the Latin words “*cordus*, -i” (heart) and “*folium*, -i” (leaf).

Phenology and biology:—*Trimelopter cordifolium* produces leaves presumably around June–August in the wild (Fig. 2j). In cultivation, in the Northern Hemisphere (Rome, Italy), *Trimelopter cordifolium* demonstrated to be a robust plant, thriving in typical, mainly all mineral, sandy soil. Leaves appear around September and flowers in June. Capsules are mature at the end of July when the leaves are completely withered.

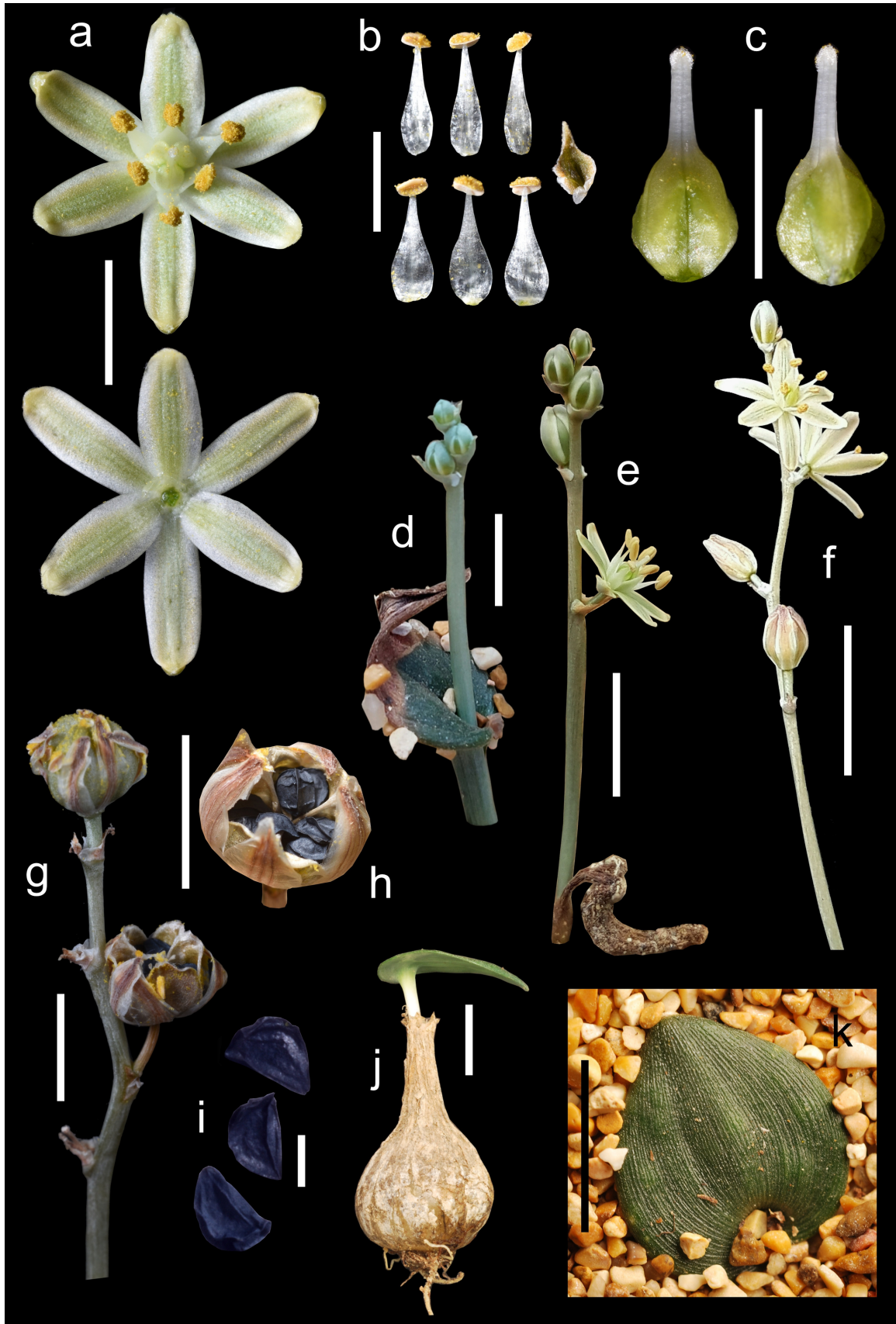


FIGURE 1. *Trimelopter cordifolium* Mart.-Azorín *et al.* from the type locality, west of Steinkopf in South Africa, ex hort. in Rome, Italy. **a.** Flowers in frontal (above) and dorsal (below) views; **b.** Stamens (outers above and inners below) and bract; **c.** Gynoecium in lateral views; **d.** Emergent inflorescence with leaf starting to wither; **e.** Inflorescence with withered leaf; **f.** Inflorescence with immature capsules; **g.** Infructescence; **h.** Dehiscent capsule with seeds; **i.** Seeds; **j.** Bulb with leaf; **k.** Leaf. Scale bars: a, d, g, h = 5 mm; b, c = 3 mm; e, f, j, k = 10 mm; i = 1 mm.



FIGURE 2. *Trimelepter cordifolium* Mart.-Azorín *et al.* from the type locality, west of Steinkopf in South Africa, ex hort. in Rome, Italy (a–i) and from the wild (j). **a.** Plants with leaf; **b.** Plants with emergent inflorescences and leaves; **c.** Plants with developing inflorescences and leaves starting to wither; **d–h.** Plants in leaf (all to the same scale, vertical side image = 2 cm long); **i.** Leaf surface detail showing the longitudinal ribs covered with tiny papillae; **j.** Leaved plant from the wild showing mimicry and psammophory taken on August 1997 by G. Paonessa.

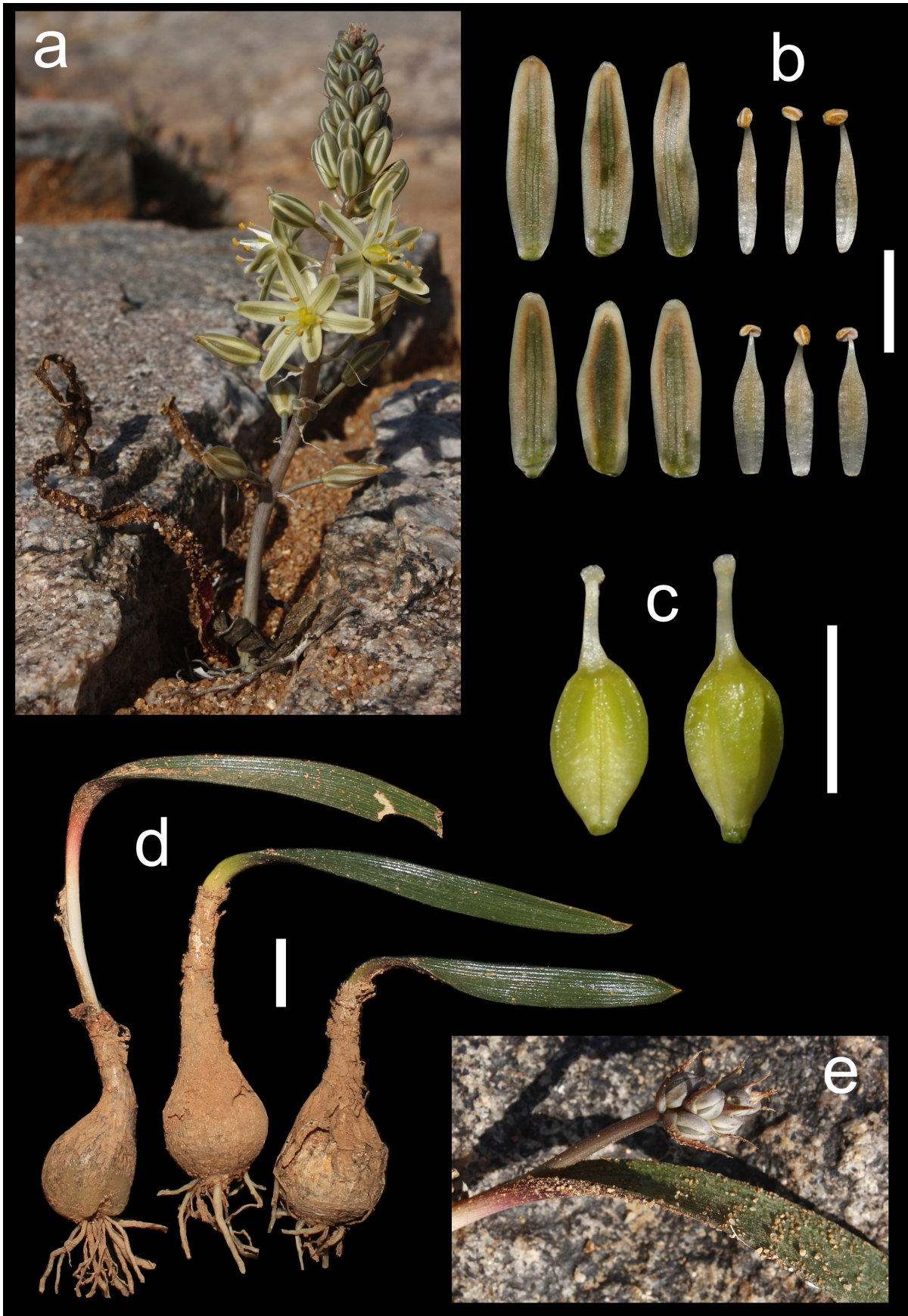


FIGURE 3. *Trimelopter psammophorum* (U.Müll.-Doblies & D. Müll.-Doblies) Mart.-Azorín *et al.* from west of Steinkopf (type locality) in South Africa. **a.** Plant in flower with withered leaf; **b.** Tepals and stamens, outers above and inners below; **c.** Gynoecium, lateral views; **d.** Wild bulbs with leaves; **e.** Detail of young inflorescence with psammophorous bracts and leaf. Scale bars: b–c = 5 mm; d = 1 cm.

As reported by Neinhuis *et al.* (1996), the sand-bearing behaviour is shared by several species occurring in southern Africa, such as in 21 species of Hyacinthaceae, 6 species of Amaryllidaceae, 1 species of Asphodelaceae, 1 species of Anthericaceae and 1 species of Iridaceae. This is achieved by a sticky and viscous secretion, as clear as water and brittle when dry, consisting probably of polysaccharides, which is very slowly soluble in water. In a young stage, the secretion allows the sinking of small particles, adhering sand grains. As for the function of psammophory, mimesis with the environment and protection against herbivores, high insolation and abrasion by sandy winds are argued (Neinhuis *et al.* 1996). Regarding species of Hyacinthaceae, and specially *T. psammophorum* (Müller-Doblies & Müller-Doblies 1996: 482) Mart.-Azorín, M.B.Crespo & Juan in Martínez-Azorín *et al.* (2011: 26), secretion is confined to the leaf ribs or rows of papillae, with no secretion in between the ribs, and the stomata not covered by the sticky secretion (Neinhuis *et al.* 1996). This seems to be the pattern of *T. cordifolium* as well. Epicuticular waxes of the primitive unordered type are present on the normal epidermal cells and on the stomata (Neinhuis *et al.* 1996). It is also reported that the sticky secretion is very slowly soluble, even in hot water, and not soluble in organic solvents. Only after one or two hours of incubation in hot water, traceable quantities are dissolved, without allowing, however, the fixed sand grains to fall off (Neinhuis *et al.* 1996). As a possible disadvantage of psammophory, sand grains could function as little lenses and heat up the surface, although the advantage of the sand coat must be very important when the plant must deal with the potentially unfavourable thermal side effects (Neinhuis *et al.* 1996).

Habitat:—*Trimelopter cordifolium* occurs in sandy soil associated to quartz patches (Fig. 2–j), on the Succulent Karoo Biome in SKn4 Namaqualand Heuweltjieveld. It shows a winter-rainfall climate with irregular rain events mostly in the period from May to August and a dry season with almost no rain from November to February. The mean annual precipitation is about 115 mm with dew experienced throughout the winter and the mean annual temperature is quite high and amounts to 17.8° C with frosts hardly occurring (Mucina & Rutherford 2006).

Distribution:—The newly described species is only known from the type locality in northern Namaqualand, ca 35 km west of Steinkopf, on the way to Port Nolloth, in the proximity of Harrasberg, Northern Cape Province of South Africa.

Diagnostic characters and taxonomic relationships:—*Trimelopter cordifolium* is easily identified by the solitary leaf which is small, cordate, finely longitudinally striate and psammophorous; the short inflorescence and pedicels, bearing small flowers and bracts; and the prominently sculptured ovary (Fig. 1a,c). The morphologically closest relative of *Trimelopter cordifolium* appears to be *T. psammophorum* based on the finely longitudinally striate, psammophorous leaf (Fig. 3), but *Trimelopter cordifolium* differs by the much shorter, cordate leaf, 10–16 × 8–11 mm (not (50–)60–120 × (8)10–25 mm), bracts small (2–2.5 mm long), smooth and glabrous (not commonly longer (6–9 mm long), glandulous and psammophorous), smaller tepals 5.0–6.0 × 2.0–2.3 mm (not 8.0–10.0 × 2.1–2.8 mm), smaller filaments 3.2–3.5 × 0.9–1.3 mm (not 5.7–7.0 × 0.8–1.5 mm), more prominently sculptured smaller ovary 2.0–2.1 × 1.9–2.0 mm (not 4.0–5.0 × 2.8–3.0 mm) and shorter style ca 1.9 mm long (not 2.7–3.0 mm long).

Trimelopter psammophorum was briefly described as *Ornithogalum psammophorum* Müller-Doblies & Müller-Doblies (1996: 482) from Kosies entry, ca 9 km west of Steinkopf, Northern Cape Province of South Africa, and was diagnosed by its psammophorous leaf and the only slightly or not sculptured ovary in relation to *T. unifolium*. The protologue did not include a full morphological description of the species and only an illustration of a bulb with a psammophorous leaf, plus comments on its distribution and a list of herbarium collections were provided. It was said that the species is mostly distributed near Steinkopf, with two outside localities in the Kamiesberg and the Knersvlakte, in the southern Namaqualand territories. Moreover, Müller-Doblies & Müller-Doblies (1996) indicated an herbarium collection at PRE as the holotype and further collections as isotypes deposited in 15 additional herbaria. As it occurs with most Hyacinthaceae species described by those authors, type collections have not been deposited in the cited herbaria so far, which, together with the scarce information given in the protologues, make understanding of their species very difficult. Our field work in South Africa in the last decades has facilitated knowledge improvement of their species, and we here present an illustration of *Trimelopter psammophorum* (Fig. 3) from near Steinkopf, including reproductive characters. Based on our field experience, we agree that *T. psammophorum* is mostly restricted to the territories around Steinkopf, and we have documented about ten further populations in the area (MMA312, MMA315, MMA373, MMA375, MMA385; MMA389, MMA412, MMA417, MMA1230, MMA1250; herbarium vouchers deposited at ABH and GRA). The population from the Knersvlakte differs by the more sculptured ovary but retain the elongated leaf and larger flowers of this species. Further studies are necessary to ascertain their taxonomic placement. Furthermore, the collection *A. Harrower 3607* (NBG0216613-0!) from quartz flats east of Nuwerus, includes a photograph of a plant in leaf that resembles *T. cordifolium* in overall morphology, but differs by the more succulent, convex leaf with non-convolute base, and the larger flowers. This probably represents an undescribed species in the genus, but fresh material is necessary to decide about its taxonomic placement. The remaining known *Trimelopter*

species show very different leaf morphology regarding *T. cordifolium*, being much longer and never psammophorous. A sample of *T. cordifolium* was included in our unpublished extended phylogenetic study on Ornithogaloideae based on plastid and nuclear DNA regions and confirms its inclusion in *Trimelopter*, which constantly represents a well-supported clade. All those facts point out to acceptance of *Trimelopter* at genus rank, and its independence from *Albuca* s.str., which shows a highly specialized flower morphology (Johnson *et al.* 2012).

Some northern Namaqualand species of *Coilonox* Rafinesque (1837: 28), which is a phylogenetically close related genus to *Trimelopter* (cf. Martinez-Azorin *et al.* 2011), share with *T. cordifolium* the distinctly longitudinally striate or ribbed, psammophorous leaves, such as *Coilonox scabrocostatum* (Müller-Doblies & Müller-Doblies 1996: 516) Speta (2001: 175) and *C. karachabpoortense* (Müller-Doblies & Müller-Doblies 1996: 517) Speta (2001: 175), but both latter species clearly differ in overall leaf morphology (being distinctly elongated and with different surface), and most notably by their flowers, based on their gynoecium with ovate-oblong ovary (which is subcylindrical-trigonous in transversal section and lacking dorsal keels), and the elongated, thin, deflexed style ending in a distinctly glandulous-papillose stigma, easily characterizing *Coilonox* as a distinct genus.

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