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Two new species of *Zygotritonia* Mildbr. (Iridaceae: Crocoideae) from eastern tropical Africa with notes on the morphology of the genus



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ABSTRACT

The tropical African genus *Zygotritonia* Mildbr., now with six species, extends from the Fouta Djallon highlands of Guinea in West Africa to southern South Sudan, southern Congo, northern Malawi, Tanzania, Zambia, and western Ethiopia. Two new species are described: *Zygotritonia benishangula* Goldblatt & Sebsebe from western Ethiopia has a basal foliose leaf clasping the stem up to the base of the spike or first branch, with a short, closely pleated-foliose blade that differs from the simply pleated blades of most other species; *Zygotritonia teretifolia* Goldblatt & J.C. Manning from the Uzondo Plateau, Mpanda District, Tanzania, is distinguished by its narrow, compressed-terete leaves and short stature, up to 200 mm high. Flowers of both *Z. benishangula* and *Z. teretifolia* conform to those of other species of the genus in their small size, bilateral symmetry with large hooded dorsal tepal and much shorter, spooned lower tepals. The style in both species ultimately divides into three short branches, not undivided as has been described for other species of *Zygotritonia*.

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1. Introduction

Zygotritonia Mildbr. (1923) was described for the South Sudan species, *Zygotritonia bongensis*, and the south tropical African species, *Zygotritonia nyassana*, but a later revision of the genus (Goldblatt, 1989) recognised an additional two species. One of 10 genera of Watsonieae Klatt (subfam. Crocoideae Burnett), a tribe of predominantly southern African distribution (Goldblatt et al., 2006; Goldblatt and Manning, in press). *Zygotritonia* is recognised by the bilaterally symmetric flower with spatulate tepals that are spooned at the tips, an enlarged, hooded dorsal tepal, and a style apparently entire or divided into three short branches less than 0.4 mm long, this feature unique in Crocoideae. The ± globose corm, as in all Watsonieae (Goldblatt et al., 2004, 2006), is axillary in origin with fibrous corm tunics that form a dense shaggy coat, and in most species the leaf blades are pleated. The genus extends from the highlands of the Fouta Djallon of Guinea and Senegal to Nigeria and Central African Republic in West Africa [*Zygotritonia praecox* Stapf], across Ghana, northern Nigeria to Cameroon, northern Congo and southern South Sudan [*Z. bongensis* (Pax) Mildbr.] to southern Congo, adjacent Zambia and southwestern Tanzania and northern Malawi [*Z. nyassana* Mildbr.]. One species, *Zygotritonia hysteranthera* Goldblatt, is restricted to Central African

Republic. New collections of the genus from western Ethiopia first reported by Sebsebe Demissew et al. (2003) as *Z. praecox* significantly extended the range of the genus, and our examination of the Ethiopian collections shows that they represent an unknown species, described here as *Zygotritonia benishangula* Goldblatt & Sebsebe. A second new species has been recorded on the Uzondo Plateau in the Mpanda District of west-central Tanzania, and we describe that here as *Zygotritonia teretifolia* Goldblatt & J.C. Manning. We also provide a new key to *Zygotritonia*, now comprising six species.

2. Materials and methods

The new species were described from herbarium material at ETH, K, and MO (herbarium abbreviations from Holmgren et al., 1990).

Leaf anatomy was examined by rehydrating a tissue fragment in 30% ethanol to which a drop of commercial detergent had been added, fixing in FAA, dehydrating through an ethanol series, and embedding in paraffin wax following standard anatomical (Rudall, 1995).

3. Results

3.1. Morphology

3.1.1. Style and stigma

Zygotritonia has been regarded as having an undivided style (Goldblatt, 1993; Goldblatt and Manning, 2008), a character unique in

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Crocoideae. Examination of the two new species described here shows that the style ultimately divides into very short branches, visible under $10\times$ magnification. The style branches are entire and ± 0.3 mm long in *Z. benishangula*, and just under 0.2 mm long in *Z. teretifolia*. After examining a sample of other species of the genus we have found that the style of *Z. hysterantha* when mature is notched apically into three, short lobes. The remaining species appear to have an undivided style but additional specimens should be critically examined for this feature. In the protologue of *Tritonia bongensis* Pax, basionym of *Z. bongensis*, the stigma [i.e. the apex of the style] was described as trilobed (Pax, 1893), a feature we have not been able to confirm. Evidently, the style arms, which comprise the stigmatic surfaces, remain clasped together until late in anthesis and separate, if at all, after the style has arched downward to lie ventral to the stamens. The apparently undivided or shortly divided style with very short, entire branches less than 0.4 mm long remains a distinctive feature of the genus and unusual not only for Crocoideae but especially for tribe Watsonieae, in which most genera and species have well-developed style branches each apically notched or deeply divided.

3.1.2. Leaves

Leaves of *Zygotritonia* species are typically pleated (Goldblatt, 1989) but until now only *Z. nyassana* has been examined anatomically (De Vos, 1982). This species, which has a pleated blade, has the primary bundles alternating and opposed, with a primary bundle at each keel; a pseudomidrib with two pairs of veins, each pair comprising a large bundle and opposed smaller bundle; and thickened leaf margins. Unusually, the vascular bundles are not paired in large portions of the leaf, which contrasts with the usual situation in plicate-leaved Crocoideae, in which the primary bundles are opposed by a smaller bundle (Rudall, 1995). The leaf margin epidermis is of the normal type, as noted for the genus by Goldblatt et al. (2006). The leaves in *Z. benishangula* are sheathing for most of their length with only a short unifacial blade (Fig. 1A). The blade is pleated, with the primary bundles alternating, but is elaborated by the development of foliose extensions or flanges along the keels, identifiable as such by their bifacial nature with a single row of vascular bundles. The primary and secondary bundles have incomplete sclerenchyma sheaths restricted to the phloem pole as caps that extend to the epidermis as girders. The leaf blade in *Z. teretifolia* is terete or compressed-terete and elliptical in section, with a single pair of free, sub-opposite primary veins forming a pseudo-midrib, and several additional secondary bundles around the leaf periphery (Fig. 1B). The primary vascular bundles have a complete, sclerenchyma sheath reaching the epidermis as a girder but in the secondary bundles the

sclerenchyma sheath is restricted to phloem caps, also extending to the epidermis as girders.

3.1.3. Flowers

Flowers of all *Zygotritonia* species are virtually identical in shape and almost so in size and differ, if at all only in quantitative features, including small differences in the length of the upper and lower tepals and stamens. For this reason we have not provided a drawing of flowers of the two new species. Flowers of *Z. bongensis*, *Z. nyassana* and *Z. praecox* are illustrated in Goldblatt (1989, 1993), Goldblatt and Manning (2008: 121), and Mildbraed (1923).

3.2. Key to the species of *Zygotritonia*

1a. Flowering stem bearing sheathing leaves only or leaves with blades shorter than the sheaths (foliage leaves produced after flowering from separate shoots in some species):

2a. Plants usually >300 mm and up to 500 mm tall; flowering stem bearing 2 or 3 sheathing leaves without free blade, sometimes imbricate ... *Z. hysterantha*

2b. Plants rarely exceeding 250 mm; flowering stem bearing 1 or 2 leaves, these sheathing stem for most of their length but with free blade shorter than sheath; always imbricate:

3a. Leaf blade ribbed, mostly 1–3 mm wide; floral bracts dry, 2–3 mm long; upper tepal 6–8 mm long ... *Z. praecox*

3b. Leaf blade pleated and ribbed, 3–5 mm wide; floral bracts green below, ± 3 mm long; upper tepal ± 4.5 mm long ... *Z. benishangula*

1b. Flowering stem bearing foliage leaves with blades at least as long as sheaths or much longer:

4a. Foliage leaf blade \pm terete, <2 mm at widest diameter; plants up to 200 mm tall ... *Z. teretifolia*

4b. Foliage leaf blade pleated or folded with blade at least 3 mm wide; plants 150–500 mm tall:

5a. Uppermost cataphyll with spreading to revolute apex; floral bracts pale green to dry straw-coloured, minutely papillate (using $10\times$ magnification) ... *Z. nyassana*

5b. Uppermost cataphyll straight, sheathing throughout (not revolute); floral bracts dark green, smooth or rugose, not regularly minutely papillate ... *Z. bongensis*

3.3. Taxonomy

3.3.1. *Z. benishangula* Goldblatt & Sebsebe, sp. nov.

Type: Ethiopia, Benishangul-Gumuz Regional State, foot of Enzi Mtn, 2 km from Assosa to Nekemt, *Combretum-Terminalia* woodland, 1610 m, 15 May 2001, Sebsebe Demissew, Herrmann & Tesfaye Awas 5985 (ETH, holo.).

Plants 120–300 mm high. *Corm* 15–18 mm diam., tunics of fine- to medium-textured fibres forming a shaggy cover. *Cataphylls* 2, membranous. *Stem* simple or with 1(2) branches flexed above the sheath of basal leaf. *Foliage leaf* solitary or with additional much smaller leaf, lowermost leaf inserted near base, reaching to base or middle of spike, mostly sheathing, free portion arcuate or falcate with short lanceolate blade $10\text{--}30 \times 3\text{--}6$ mm, blade closely pleated and foliose with longitudinal flanges along the angles, margins slightly thickened, hyaline. *Spike* up to 25-flowered; bracts green below, dry apically, ± 3 mm long, subequal. *Flowers* white, lower tepals flushed purple distally, anthers \pm black; perianth tube ± 3 mm long, widening gradually from base to apex; tepals \pm linear-spathulate, dorsal tepal arcuate in bud but directed forward horizontally at anthesis $\pm 4.5 \times 1.5\text{--}2.0$ mm, lower tepals recurving and twisted loosely after anthesis, $\pm 4.0 \times 1.5$ mm, abruptly expanded and spooned in upper 2 mm. *Stamens* arcuate, reaching apex of dorsal tepal; filaments ± 5 mm long; anthers ± 2 mm long, sagittate, apiculate. *Ovary* subglobose, ± 1.8 mm long; style arching adaxial to stamens, reaching to \pm middle of anthers, curving downward distally

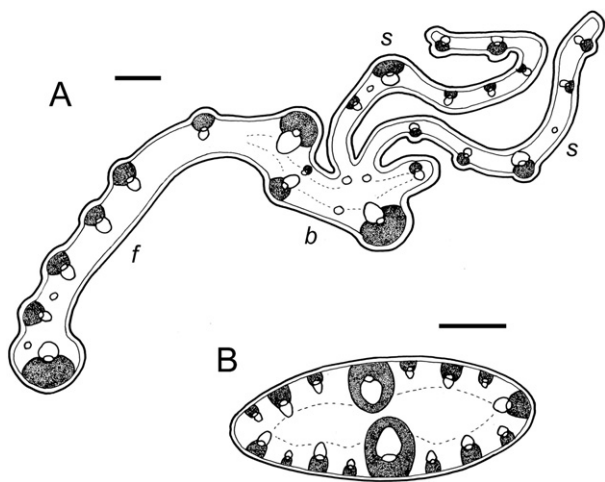


Fig. 1. Leaf tissue plans. A, *Zygotritonia benishangula* (Sebsebe Demissew, Herrmann & Tesfaye Awas 5985, ETH). Scale bar: 100 μm ; B, *Z. teretifolia* (Hoenselaar, Leliyo & Vollesen 5733, DSM, K, MO). Scale bar: 250 μm . b, Blade; f, foliar extension; s, sheath.

when receptive, ultimately divided into 3 short branches ± 0.3 mm long. Capsules and seeds unknown. Flowering time: April to June (Fig. 2).

Distribution: known from several sites in north-western Ethiopia, *Z. benishangula* is evidently endemic to Benishangul–Gumuz Regional State (Welega Floristic Region), in the mountains near Asosa and the surrounding areas (Fig. 4). Plants grow at elevations between 1440

and 1600 m in *Oxythenanthera abyssinica* thicket, *Combretum–Terminalia* woodland, and wooded grassland, and are evidently locally common.

Diagnosis: *Z. benishangula* appears to most closely resemble the West African *Z. praecox*, from which it is distinguished by the prominent, basal foliage leaf, the long sheath of which encloses the stem almost to the base of the spike and remains open for most of the length of the free portion as well, terminating in a short blade $10\text{--}30 \times 3\text{--}6$ mm. The blade appears plane or ribbed when pressed but is plicately folded or pleated, with longitudinal foliose extensions on the angles. The flowers are white or predominantly so with a purple flush at the tips of the tepals, and the darkly coloured, sagittate anthers reach the apex of the dorsal tepal in much the same way as in *Z. nyassana* (see photographs in Geerinck, 2005). *Z. praecox* also has the leaves of the flowering stem largely sheathing but the blades are much narrower, 1–2 mm wide and the lowermost leaf closely sheaths the stem. In *Z. praecox* a foliage leaf is produced after flowering on a separate shoot. Production of a foliage leaf or leaves on separate shoots after flowering is unknown in *Z. benishangula*.



Fig. 2. Scan of type specimen of *Zygotritonia benishangula*.



Fig. 3. Scan of type specimen of *Zygotritonia teretifolia*.

Conservation: *Z. benishangula* is known from at least five sites in the vicinity of Assosa and Bambasa, all comprising relatively large populations in undisturbed vegetation. Plants appeared locally common, thus we see no current threat to the species.

Additional specimens

Ethiopia: Benishangul-Gumuz Regional State (Welega Floristic Region), Assosa, Enzi Mtn, 1600 m, 5 May 2000, 1650 m, 9 Feb. 1997, *Herrmann 81* (ETH); 2 km S of Assosa, 1550 m, 10 June 2001, *Herrmann 228* (ETH); 19 km Assosa towards Komosha, 1510 m, 13 May 2001, *Sebsebe Demissew, Herrmann & Tesfaye Awas 5931* (ETH); 13 km from Bambasi to Tongo towards Keshamando swamp, 1440 m, 16 May 2001, *Sebsebe Demissew, Herrmann & Tesfaye Awas 6008* (ETH); 19 km from Assosa to Kurmuk, Amba 11, 10°11'9.6"N 34°39'10.5"E, 1477 m, 10 June 2013, *Sebsebe Demissew, Nordal & Tesfaye Awas 7144* (ETH); 25.6 km from Assosa (including 4 km from the turn off) at 21.6 km on Min road, Assosa to Gumbi, going east, 9°55'32.7"N 34°41'42.1"E, 1450 m, 10 June 2013, *Sebsebe Demissew, Nordal & Tesfaye Awas 7146* (ETH).

3.3.2. *Z. teretifolia* Goldblatt & J.C. Manning, sp. nov.

Type: Tanzania, Mpanda District, Uzondo Plateau, wet grassland in thin, sandy soil on rock outcrops, 1550 m, 1 May 2003, *Bidgood, Hoenselaar, Leliyo & Vollesen 5733* (K, holo.!; DSM, MO!, NHT, iso.).

Plants 120–200 mm high. *Corm* ± 15 mm diam., tunics of relatively fine-textured fibres forming a shaggy cover. *Cataphyll* evidently solitary, membranous. *Stem* unbranched, flexed above sheath of cauline leaf, with 1 or 2 short, bract-like, sheathing leaves in upper half. *Foliage leaves* 2 or 3, centric, blade arcuate or lightly twisted, terete or compressed-terete with a single main vein and without evident margins, ± 1 mm diam., lowermost leaf ± basal, longest, usually shortly exceeding spike, upper leaves shorter, inserted on stem above ground. *Spike* 6–15-flowered; bracts green below, dry apically, outer ± 3 mm long, inner ± 3.5 mm long. *Flowers* white, lower tepals sometimes pale mauve distally, fading pink, anthers dark purple; perianth tube ± 4 mm long, widening gradually from base to apex; tepals ± linear-spathulate, dorsal tepal arcuate in bud but directed forward horizontally at anthesis, ± 7 × 2 mm, lower tepals recurving and twisted loosely after anthesis, ± 4 × 1 mm long, expanded and spooned in upper 2 mm. *Stamens* arcuate, reaching distal third of dorsal tepal; filaments ± 6 mm long; anthers ± 2.5 mm long, sagittate, apiculate. *Ovary* narrowly obovoid, ± 2 mm long; style arching adaxial to stamens, extending to ± middle of anthers, curving downward distally when receptive, ultimately divided into 3 short branches ± 0.2 mm long. *Capsules* and *seeds* unknown. *Flowering time*: February to May (Fig. 3).

Distribution: known only from the Uzondo Plateau in northeastern Mpanda District of west central Tanzania (Fig. 4). The plants occur on

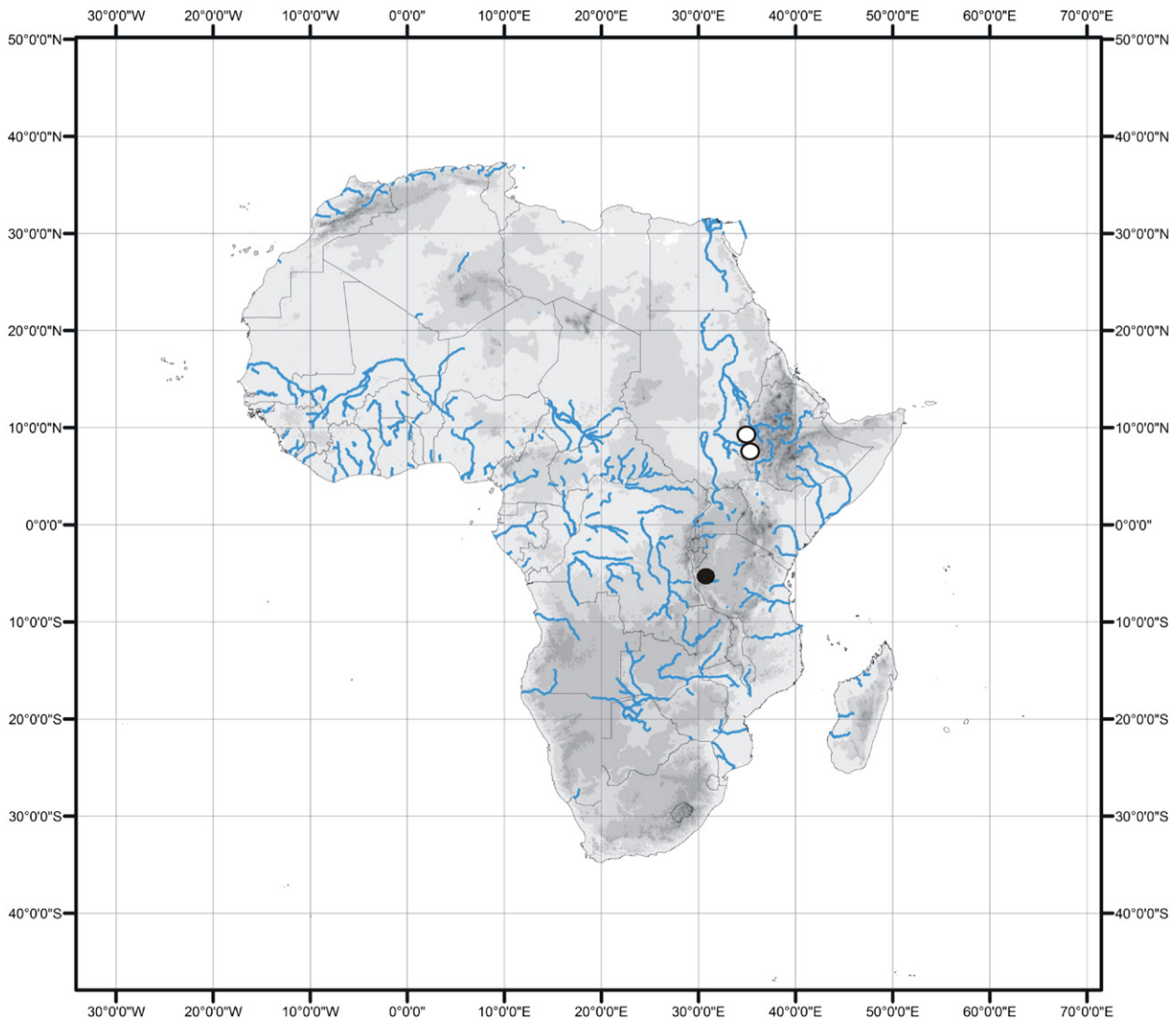


Fig. 4. Distribution of *Zygotritonia benishangula* (○) and *Z. teretifolia* (●).

shallow soil over rock in wet, grassy flushes at elevations of 1600 to 1650 m.

Diagnosis: with flowers typical of *Zygotritonia*, *Z. teretifolia* is a small plant up to 200 mm high and readily recognised by its two or three foliage leaves with narrow, terete or compressed-terete blades up to 1 mm wide, with a single main vein but without thickened margins. The more widespread *Z. nyassana*, which occurs in southwestern Tanzania, northern Malawi, Zambia and southern Congo, is typically a taller plant up to 450 mm high, with one or two, relatively broad foliage leaves (6–)8–14 mm wide with prominently pleated blades. The upper cataphyll in that species is bluntly acute to \pm truncate with dark purple-green revolute margins, unique in the genus, and the outer floral bracts are usually markedly papillate under 10x magnification, a feature lacking in *Z. teretifolia*.

Conservation: very restricted in distribution but with large, healthy populations of 50–100 plants in suitable places at the type locality, i.e. short seasonally inundated grassland on shallow sandy-peaty soil over ironstone pans. This grassland is extremely species rich with about five species of *Utricularia* L., several species of *Xyris* L. and *Eriocaulon* L., numerous sedges and grasses. Newly described species from there include *Blepharis uzondoensis* Vollesen, *Aristida humidicola* S.M. Phillis, *Brachiaria uzondoensis* Sanchez-Ken, *Eragrostis poculiformis* T. Cope, *E. uzondoensis* Sanchez-Ken, *Gladiolus clivorum* Goldblatt & J.C. Manning, *Xyris mallocephala* Lock, *X. mentiensi* Lock, *X. ornithoptera* Lock and *X. porphyrea* Lock.

The Uzondo Plateau is at present uninhabited and ungrazed, and due to its limited agricultural potential there appears to be no reason for this to change significantly. There are thus no immediate threats to this species but due to its limited known distribution it will obviously always be under threat from any sort of disturbance. We suggest a status of potentially threatened (K. Vollesen, pers. com. 2014).

Additional specimens

Tanzania: Mpanda District. Uzondo [Usondo] Plateau, 1650 m, 9 Feb. 1997, Congdon 483 (K, MO); Uzondo Plateau, 5°29'S 30°32'E, 1550 m, 15 Apr. 2006, Bidgood et al. 5484 (K).

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