Chlorophytum delicatulum (Asparagaceae), a newly described species from Zambia

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Summary. Chlorophytum delicatulum Osborne, Vollesen & Bjorå from Zambia is described, illustrated and placed within the context of recent taxonomic and phylogenetic work on Chlorophytum in Africa. This delicate herb has leaf bases furnished with conspicuous dark red setae resembling eyelashes. Its phylogenetic position, ecology, phytogeography and conservation status are discussed. Chlorophytum delicatulum is assessed as being of Least Concern using the categories and criteria of the IUCN Red List.

Key Words. Africa, conservation status, ecology, new species, phylogeny, taxonomy.

Introduction
Chlorophytum Ker Gawl. (Asparagaceae: Agavoideae Anthereiceae) is a genus of approximately 150 species found across the Old World Tropics (Stevens 2001). The genus is particularly diverse in eastern and southern central Africa, with 52 species occurring in the Flora of Tropical East Africa (FTEA) area (Nordal et al. 1997), 57 species in the Flora Zambesiaca (FZ) area (Kativu et al. 2008) and 52 species in the Flore d’Afrique Centrale (FAC) area (Meerts 2015). Molecular analyses of the species of Chlorophytum have shown that they can be divided into subgroups that correlate with morphological characters and number of chromosomes (Bjorå 2008; Bjorå et al. 2017).

Material of the species described here was first collected at Mutinondo Wilderness Area in Eastern Zambia in 2010, and subsequent collections were made in 2015, 2016 and 2019. An earlier collection from 1955 from Serenje, also in the same general part of Zambia, has been referred to the same taxon. When detailed studies were carried out at Kew, this material could not be matched with any known species. It is described here as Chlorophytum delicatulum Osborne, Vollesen & Bjorå.

Materials and Methods
Morphological studies
Specimens were collected and studied by S. Bidgood, L. Merrett, J. Osborne and K. Vollesen at Mutinondo and extensively photographed by L. Merrett. Live specimens were studied in situ at Mutinondo. Herbarium specimens were studied at Royal Botanic Gardens, Kew (K). SEM photographs of seeds from Bidgood et al. 8600 (K) were prepared by Aurelie Grall at Kew.

Conservation status
In order to assess the conservation status of this new species, georeferences were taken or estimated from each herbarium collection, and extent of occurrence was calculated from a minimum convex polygon using the online GeoCAT tool (Bachman et al. 2011). A provisional assessment of conservation status was obtained by applying the categories and criteria of the IUCN Red List (IUCN 2012).

Molecular studies
Sequences from 32 accessions were aligned using MUSCLE v3.8.425 (Edgar 2004) within Geneious Prime v2020.2.4 (Kearse et al. 2012), under default parameter settings. Two datasets were established for the final analyses: (1) ITS1 with 32 accessions; and (2) plastid DNA (rps16 and trnL-F intergenic spacer) with the same 33 accessions. The best-fit model of nucleotide substitution for the alignments was selected using jModelTest v2.1.10 (Guindon et al. 2003; Diego et al. 2012) under the Akaike Information Criterion (AIC). The data were analysed using Maximum Likelihood and Bayesian inference phylogenetic methods. Maximum Likelihood analyses were conducted using the Randomized Accelerated Maximum Likelihood (RAxML) v8.2.11 (Stamatakis 2014) as implemented in Geneious Prime. Rapid Bootstrapping and search

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Fig. 1. Chlorophytum delicatulum. A habit; B distal portion of cataphyll; C proximal part of leaf; D – E leaf surfaces F floral bract; G floral bract, flattened; H flower, outside; J flower, inside; K anther and (right) enlarged surface of anther; L capsule; M open capsule; N seeds. A, F, G, M & N from Bidgood et al 8600; B – E from Merrett 2449; H, J, K & L from photos taken by L. Merrett.

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for best-scoring ML tree algorithms were used, and
bootstrap analyses were performed with 1000 repli-
cates. For the Bayesian phylogenetic analyses, Bayesian
inference was performed using MrBayes v3.2.7a
(Huelsenbeck & Ronquist 2001; Ronquist &
Huelsenbeck 2003). Analyses were started using a
random starting tree and run for four million
generations, sampling every 1000 generations. Two
Markov runs were conducted with four chains per run.
To check whether the Markov Chain had converged
well before finishing the analysis, the standard devia-
tion of split frequencies (SDSF) was monitored to be
below 0.01. The 1000 first generations (25%) were
discarded as burn-in. The remaining trees were used
for calculation of posterior probabilities and building
a 50% majority-rule consensus tree. The trees were
displayed with iTOL (Letunic & Bork 2016) and Keynote v10.0, Apple Inc.

Taxonomic Treatment

Chlorophytum delicatum Osborne, Vollesen & Bjorå
sp. nov. Type: Zambia, Muchinga Province, Mpika
Distr., Mutinondo Wilderness Area, Mayense Camp, 3
May 2016, Bidgood, Merrett & Vollesen 8600 (holotype K!
K000569940; isotypes O!, UZL!).

http://www.ipni.org/urn:lsid:ipni.org:names:77297514-1

Erect, perennial herb, 15 – 55 cm tall, forming small
tufts. Rhizome short, vertical, mostly covered by leaf
bases and fibrous remains of old leaf bases. Roots wiry
with fusiform distal tubers 0.8 – 1.5 × 0.7 – 1 cm.
Cataphylls papery, 1 – 3 cm long, glabrous or apical
part hispid to setose with dark red or white hairs.
Leaves basal, distichous, linear, erect to spreading, 10 –
40 cm long, with distinct setose, sheathing bases.
Leaf bases 2 – 7 × 0.1 – 0.25 cm, with papery margins
and long dark red (occasionally white) setae 1 –
2 mm long along veins and margins. Leaf blades flat
(with in-rolled margins or plicate when dry), 0.5 –
1.5 mm wide, nerves prominent, seven abaxially
and four adaxially, hispid along the nerves with white
hairs or a few red at the leaf tip. Inflorescences
appearing with the leaves, 15 – 50 cm long, solitary
or 2 (– 3) per plant, equal to or taller than the
leaves. Peduncle terete or slightly flattened, longitudi-
inally ridged, 10 – 45 cm tall, glabrous or sparsely
hispid, without sterile bracts. Inflorescence racemose,
0.5 – 5 cm long, with one to four widely spaced nodes; basal internode (1 –) 1.5 – 4 cm long. *Floral bracts* uniformly dark reddish-purple or straw coloured with dark reddish-purple margins and apex, 3 – 6 mm long, ovate or broadly ovate, narrowing abruptly or gradually into a long caudate apex, with 3 – 5 veins, setose along veins and margins, setae 0.5 – 1 mm long, dark reddish-purple, turning whitish. *Flowers* open and star-shaped at anthesis, single or two per node; pedicels 2 – 5 mm long at anthesis, extending to 4 – 8 mm in fruit, articulated below the middle, glabrous. *Tepals* white with pale green 3 – 5-veined central stripes, glabrous; three outer ones linear-lanceolate, 6 – 9 × 1.5 – 2 mm, minutely papillose at apices, three inner ones broadly elliptic, 5 – 8 × 3 – 6 mm. *Filaments* white, glabrous, smooth, c. 1 mm long; anthers yellow, 2 – 3 mm long, papillose. *Ovary* sessile, ellipsoid, 1 × 2 × 0.75 – 1 mm; style 5 – 6.5 mm long, glabrous, bent outwards at anthesis; stigma truncate. *Capsule* partially covered by marcescent tepals when young, sub-globose, 3-locular, c. 5 × 4 mm, truncate to slightly retuse, with dense transverse ridges, style base persistent. *Seeds* black, irregularly folded, 1.7 – 2.5 × 1.5 – 1.7 mm; hilum forming a ridge 0.5 – 0.8 mm long, terminating in a minute acute projection (sometimes the hilum is not clearly visible, depending on how the seed is folded); testa glossy, echinulate-papillose.

**RECOGNITION.** *Chlorophytum delicatulum* is easily recognised by the combination of wiry roots with distal tubers, grass-like linear hairy leaves, racemose inflorescence, conspicuous dark red setae (resembling eyelashes) on cataphylls and basal part of the leaf margins, and bracts with long dark reddish-purple setae on veins and margins. It resembles narrow-leaved forms of *C. galpinii* (Baker) Kativu var. *galpinii*, which differ by almost always having a paniculate inflorescence, longer glabrous or very finely ciliate bracts (6 – 15 mm long, 3 – 6 mm long in *C. delicatulum*), and generally larger flowers (tepals 10 – 14 mm long, 5 – 9 mm long in *C. delicatulum*). *Chlorophytum delicatulum* is also similar to narrow-leaved forms of *C. rubribracteatum* (De Wild.) Kativu which typically have a reddish-purple coloration on cataphylls, leaf bases, bracts and tepal apices, and paniculate inflorescences. Some forms of *C. sphagnicolum* Meerts from NW Zambia with racemose inflorescences resemble the new species but differ in having generally broader leaves (1 – 2.5 (– 3) mm wide, 0.5 – 1.5 mm wide in *C. delicatulum*), and longer glabrous or very finely ciliate bracts ((5 –) 7 – 11 mm long, 3 – 6 mm long in *C. delicatulum*). A character matrix illustrates the

| Table 1. Character matrix comparing *Chlorophytum delicatulum* with closely related taxa. |
|-----------------------------------------------|
| Dark red setae | absent | absent | absent | absent | absent | present on cataphylls, leaf bases and bracts |
| Cataphyll colour | purple racemose | green usually branched | green usually branched | green usually branched | green racemose (unbranched) | green racemose (unbranched) |
| Inflorcescence | racemose (unbranched) | branched | branched | branched | branched | (unbranched) |
| Leaf width (mm) | 0.5 – 5 (– 8) | 1 – 5 (– 9) | 1 – 10 | 2 – 7 (– 9) | 1 – 2.5 (– 3) | 0.5 – 1.5 |
| Length of floral bracts (mm) | 5 – 20 (– 30) | 6 – 15 | 5 – 20 (– 25) | 5 – 18 (– 40) | 5 – 7 (– 11) | 3 – 6 |
| Tepal length (mm) | 10 – 17 (– 20) | 10 – 14 | 8 – 15 | 10 – 15 | 5 – 11 | 5 – 9 |
morphological differences between \textit{C. delicatulum}, \textit{C. rubribracteatum}, \textit{C. sphagnicolum} and the varieties of \textit{C. galpinii} (Table 1). These three species also differ from \textit{C. delicatulum} in their ecology. \textit{Chlorophytum delicatulum} grows in pockets of sandy-gravelly or sandy-peaty soils in shallow, seasonally wet depressions on large granite outcrops or in rock crevices, \textit{C. galpinii} and \textit{C. rubribracteatum} are typically open woodland and grassland species, while \textit{C. sphagnicolum} grows in ephemeral wet or swampy grassland pans on ironstone or dolomite soils.

One primary separating character for species groupings within \textit{Chlorophytum} in recent floras (Nordal \textit{et al.} 1997; Kativu \textit{et al.} 2008; Meerts 2015) is the number of flowers per bract (either single or two to several per bract). \textit{Chlorophytum delicatulum} blurs the difference between the groups insofar as the populations studied. For example, \textit{Bidgood 8231} (K) has some individuals with all flowers in an inflorescence being solitary, while others have at least some flowers paired. This variation appears not to be associated with the plants’ vigour.

\textbf{DISTRIBUTION.} \textit{Chlorophytum delicatulum} is endemic to northern-central Zambia, in Mpika and Serenje Districts (Map 1). Due to the close proximity of this area to southern DR Congo (Katanga), it is quite possible that the species will eventually also be found there.

\textbf{SPECIMENS EXAMINED.} \textbf{ZAMBIA}. Central Province: Serenje Dist., Serenje, 23 Jan. 1955, \textit{Fanshawe} 1839 (K!). Muchinga Province: Mpika Dist., Mutinondo Wilderness Area, Mayense Camp, 25 March 2010, \textit{Merrett} 558 (K!) & 16 April 2015, \textit{Bidgood et al.} 8231 (K!) & 3 May 2016, \textit{Bidgood et al.} 8600 (K!, O!, UZL!) & 18 March 2019, \textit{Merrett} 2449 (K!) & Choso Falls, 22 Feb. 2015, \textit{Osborne} 1037 (UZL, K!).

\textbf{HABITAT.} At Mutinondo, \textit{Chlorophytum delicatulum} grows in pockets of sandy-gravelly or sandy-peaty soils in shallow, seasonally wet depressions on large granite outcrops or in rock crevices. Dominant woody associates include \textit{Combretum molle} R.Br. ex G.Don, \textit{Ficus ingens} (Miq.) Miq., \textit{Landolphia parvifolia} K.Schum., \textit{Lannea discolor} (Sond.) Engl., \textit{Myrothamnus flabellifolius} Welw., \textit{Ozoroa insignis} Delile subsp. \textit{reticulata} (Baker f.) J.B.Gillett, \textit{Tetradenia discolor} Phillipson, \textit{Vitex mombassae}
Vatke and Xerophyta trichophylla (Baker) N.L.Menezes. Dominant perennial herbaceous species include Aloe mzimbana I.Verd. & Christian, A. zebrina Baker, Aeollanthus fruticosus Gürke, Coleochloa setifera (Ridl.) Gilly and Cyperus semitriquidus Schrad. A number of grasses are common associates and these include Dictamis fastigiata (Sw.) P.Beauv., Eragrostis welwitschii Rendle, Sporobolus festivus Hochst. ex A.Rich., Stereochloa cameronii (Stapf) Pilg. and Trachypogon chevalieri (Stapf) Jacq.-Fél. Also present are a large number of annual herbs that include Chamaecrista mimosoides (L.) Greene, Commelina subulata Roth, Grona hirta (Guill. & Perr.) H.Ohashi & K.Ohashi, Exochaenium exiguum A.W.Hill (Sebaea minuta Paiva & I.Nogueira) and rare local endemics such as Crepidiodorhaphelon mutinondoensis Eb.Fisch. & I.Darbysh. (Fischer et al. 2014), Euphorbia jubata L.C.Leach and Exochaenium alatum (Paiva & I.Nogueira) Kissling (Sebaea alata Paiva & I.Nogueira). The species has been collected at elevations from 1200 – 1450 m.

**CONSERVATION STATUS.** Chlorophytum delicatulum is known from only two sites in northern-central Zambia (Map 1). It has a very restricted distribution with an extent of occurrence of approximately 31 km². The exact locality of the site at Serenje in Central Province, where this species was collected in 1955, is not known but is likely to be one of the hills that surround the town. There is extensive urban development and agricultural land conversion in this area, but the hills currently support natural or semi-natural vegetation and although the vegetation here is to some degree disturbed, Chlorophytum delicatulum may well still occur here. At the Mutinondo Wilderness Area in Muchinga Province, there have been five recent collections dating from 2010 – 2019. The species has been observed to be fairly frequent here and does not appear to be under threat. The almost bare granitic domes where it occurs do not contain any valuable minerals or gemstones and are of no agricultural use. Few of the woody species reach a size where they are of use for firewood and charcoal production. For
Fig. 5. Two 50% majority rule consensus phylograms for species in the genus Chlorophytum from Bayesian analysis of A ITS dataset, B combined plastid DNA dataset. The Bayesian posterior probability values (PP) of at least 0.9 are stated in bold above branches and maximum parsimony jackknife support (JK) of at least 50 % are stated in italics below branches. Multiple accessions of the same taxon are numbered according to Table 2. Bars with names to the right represent informal morphological groups (following Bjorå 2008). Abbreviations: C = Chlorophytum, Con= Dem. Rep. Congo, Eth = Ethiopia, Gab = Gabon, Ken = Kenya, Mal= Malawi, Tan = Tanzania, Zam = Zambia, Zim = Zimbabwe.
| Taxon/Specimen No. | Herb. | Voucher ID | Locality | ITS1 | trnL-F | rps16 |
|--------------------|-------|------------|----------|------|--------|-------|
| *Anthericum rossum L.* | O | Bjorn 855 | Switzerland, Berner Oberland, Schrändli, Zambia, N: Ntumbachusi falls | KU880778 | KU880877 | KU880823 |
| *Chlorophytum affine* Baker | O | Nordal & Bjorn 4552 | Kenya, K3: Near Ngil Gil | EF99985 | EU000019 | KU880890 |
| *C. africannum var. silvaticum* (Dammer) Meerts | O | Nordal & Bjorn 4621 | Gabon, Ngounié | ON000252 | ON012605 | ON053482 |
| *C. asimilofolium* Baker | BR, LB, MO, WAG | Nordal & Bjorn 2515 | Gabon, Ngounié | ON000252 | ON012605 | ON053482 |
| *C. anceps* (Baker) Kativu | K, O, SRGH | Kativu 344 | Zimbabwe, C: Harare, Epworth Mission area | KU880913 | KU880939 | KU880923 |
| *C. andongense* Baker | O | Nordal & Bjorn 5015 | Tanzania, T3: Pare D., SW of N Pare, near Lembeni | EU128950 | EU128940 | EU128960 |
| *C. blepharophyllum* Schweinf. ex Baker | O | Hoell & Nordal 94 | Zambia, N: Ex Lusaka Falls | KU880785 | KU880882 | KU880832 |
| *C. brachystachyum* Baker | O | Bjorn 615 | Zambia, E: Luangwa Valley | KU880915 | KU880933 | KU880925 |
| *C. cameronii* (Baker) Kativu | ETH | Sibbe et al. 0993 | Ethiopia, Benshangul-Gumuz, Gojam | KU880788 | KU880885 | KU880834 |
| *C. colubrinum* (Baker) Engl. | O | Nordal & Bjorn 4535 | Zambia, C: Kasanka | EF999991 | EU000025 | KU880835 |
| *C. comosum* (Thumb.) Jacques | O | Nordal 3162 | Zimbabwe, Cult. in Harare | EF999993 | EU000027 | KU880840 |
| *C. delicatulum* sp. nov. | K, O, UZL | Osborne 1037 | Zambia, N: Mutinondo Wilderness Area | ON008452 | ON012694 | ON055481 |
| *C. filipendulum* Baker | O | Nordal 3219 | Zimbabwe, E: Chipinge D., Kilelo lodge | EU128956 | EU128944 | EU128969 |
| *C. globatense* Schweinf. ex Baker | O | Hoell & Nordal 25 | Zambia, B: LukuLu road | EF999996 | EU000030 | EU128971 |
| *C. galpinii* var. *nov. rindii* (Wein.) Kativu | O | Hoell & Nordal 17 | Zambia, B: Liyoyelo to Mongu | EF999997 | EU000031 | KU893896 |
| *C. galpinii* var. *matabeleense* (Baker) Kativu | SRGH | Chapiano 1879 | Zimbabwe, Makonde | OM127871 | OM212350 | OM212379 |
| *C. geophorum* Peter ex Poelln. | O | Hoell & Nordal 26 | Zambia, B: LukuLu road | EF999998 | EU000032 | EU128972 |
| *C. longifolium* Schweinf. ex Baker | O | Nordal 1507 | Zimbabwe, S: Maswino, near Great Zimbabwe | EU000001 | EU000034 | KU880851 |
| *C. macrocarpum* Poelln. | O | Nordal & Bjorn 4521 | Malawi: Nyika, nr. Zambian border | EU000003 | EU000036 | EU128976 |
| *C. macrosporum* Baker | O | Kativu 255 | Zambia, C: Chegutu | OK572497 | OM174166 | OM212371 |
| *C. pauper* Poelln. | O | Hoell & Nordal 11 | Zambia, B: Mungu | KU880807 | KU880903 | KU880859 |
| *C. pulchellum* Baker | O | Nordal & Bjorn 4561 | Zambia, N: E of Mununga Bridge | EU000007 | EU000040 | EU128979 |
| *C. pusillum* Schweinf. ex Baker | O | Nordal & Bjorn 4567 | Zambia, N: E of Mununga Bridge | EU000007 | EU000040 | EU128979 |
| *C. pygmaeum* (Wein.) Kativu | O | Kativu 384 | Zimbabwe, Nanga Distr. Nyanga National Park, Mare Camp | ON008453 | ON012696 | ON055483 |
| *C. rubribracteatum* (De Wild.) Kativu | O | Bjorn 657 | Zambia, C: 32 km f Chipata to Lusaka | KU880808 | KU880904 | KU880860 |
| *C. sphaeratum var. milaniyanum* (Rendle) Nordal | O | Hoell & Nordal 18 | Zambia, B: Mongu to Mufuwaysa, Loyi | KU880919 | KU880936 | KU880929 |
| *C. sphaeratum* (Baker) Kativu var. *sphaeratum* | O | Hoell & Nordal 2 | Zambia, E: S of Zimba, Monachongwe farm | EU000009 | EU000042 | KU880866 |
| *C. subpetiolatum* (Baker) Kativu (1) | BRLU | Meets 10/31 | D. R. Congo: Luulaba prov. Fungurume | ON000253 | ON012697 | ON055484 |
| *C. subpetiolatum* (2) | O | Hoell & Nordal 15 | Zambia, B: Road to Mongu | EU000011 | EU000044 | KU880867 |
| *C. suffruticosum* Baker (1) | O | Nordal & Bjorn 5014 | Tanzania, T2: North Pare | KU880921 | KU880938 | KU880930 |
| *C. suffruticosum* (2) | O | A. Bjørnsstred 2804 | Kenya K7: Teita Distr., 51 km NW of Vo | EU000010 | EU000043 | KU880868 |
| *C. viridescens* Engl. | O | Nordal & Bjorn 5012 | Tanzania, T2: Moshav-Arusha Rd., Switzerland, Cult. | EU000012 | EU000045 | EU128981 |

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Table 2. Voucher information (taxon name, herbarium, voucher identification and country of origin) and GenBank accession numbers for DNA sequences used in the present study. *C. = Chlorophytum; Herb. = voucher-holding herbarium.*
these uses, there are better alternatives (e.g. Brachystegia) in nearby woodland habitats. Occasional trees which have died of natural causes may of course be collected for firewood, and some species (e.g. Aloe) are used medicinally. Grazing by wild hares, or possibly bushbuck, has been observed, but in no way represents a threat. Occasional burning, while killing all aerial parts, will not affect the tuberous root system. The Mutinondo Wilderness Area is currently managed for conservation and ecotourism, and Chlorophytum delicatulum is considered to be secure at this site. Because of its small stature and linear grass-like leaves the species is inconspicuous and likely to be overlooked. It may well be more widespread. Chlorophytum delicatulum is provisionally assessed as being of Least Concern (LC).

**Phenology.** At Mutinondo and Serenje, flowering specimens have been observed or collected from the middle of the rainy season to the early dry season from late January to early May. Flowers are noted to close mid to late afternoon. Fruiting specimens have been collected from March to May.

When observed in the field, it is striking that plants of Chlorophytum delicatulum are never seen in groups or aggregations. Plants are always solitary, often occurring some considerable distance from the next plant. The significance of this population structure is not obvious. It could be an adaptation to herbivory (see below) or a strategy to counteract pests. This is a phenomenon also observed in several other species of Chlorophytum at Mutinondo, and here also in other plant families, e.g. in species of several genera in Apocynaceae subfam. Asclepiadoideae.

**Etymology.** The specific epithet refers to the slender and delicate form of the plant.

**Phylogenetic position**

Phylogenetic analyses were performed to place the undescribed species in relation to other species of Chlorophytum. The analyses revealed the same general pattern as reported previously (Bjorå 2008; Bjorå et al. 2017). Thus, the general structure of the phylogenetic tree will not be discussed in detail here. Both in the nuclear (ITS, Fig. 5A) and concatenated chloroplast (Fig. 5B) analyses, C. delicatulum clusters together with species that were formerly included in genus Anthericum (Baker 1899; Kativu & Nordal 1993) and now informally referred to as the “Former African Anthericum group”. This group is highly supported (Fig. 5A & B, PP 1/JK 100) in the molecular phylogeny and by morphology. The species are all characterised by wiry roots with distal tubers, most of them having distichous leaves, and all having shallow dollopicules that are transversely ridged and seeds that are irregularly folded. Species in this group are distributed from Ethiopia, southwards to the Cape, with more species occurring in southern Africa. Within this group, C. delicatulum resolves as sister to C. galpinii var. norlindhië (Weim.) Kativu, C. rubribnacteatum, C. cameronii (Baker) Kativu and C. galpinii var. matabelense (Baker) Kativu (Fig. 5A, PP 0.94/JK 74). This clade is also seen in the chloroplast tree, but without robust support (Fig. 5B).

The molecular analyses do not indicate a single sister species to C. delicatulum. Rather, it resolves as distinct from the “Former African Anthericum group” sister taxa included in the analyses (Fig. 5A & B). Since only a limited number of taxa from the “Former African Anthericum group” were included in the molecular study, further research is required to unravel the relationships among the closely related C. delicatulum, C. sphagnicolium and varieties of C. galpinii.

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**Declarations**

**Conflicts of interest.** The authors declare that they have no conflict of interest.

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