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Research article

Cladoceras rovumense sp. nov. (Gentianales-Rubiaceae), a new species from southeast Tanzania and northeast Mozambique

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Abstract. Following a review of the circumscription of the genus *Cladoceras* Bremek. (Rubiaceae) in relation to *Tarenna* Gaertn., the new species *Cladoceras rovumense* I.Darbysh., J.E.Burrows & Q.Luke sp. nov. is described from the dry forests of the Rovuma Centre of Plant Endemism (CoE) in southeast Tanzania and northeast Mozambique. This species has previously been known as *Tarenna* sp. 53, following the revision of African *Tarenna* by Jérôme Degreef. A comparison to *Cladoceras subcapitatum* (K.Schum. & K.Krause) Bremek., the only other member of this genus as currently circumscribed, is provided. The new species is assessed as Endangered under the criteria of the IUCN Red List. New records for Mozambique of two further Rovuma CoE endemics are recorded: *Celosia patentiloba* C.C.Towns. (Amaranthaceae) and *Cordia fissistyla* Vollesen (Boraginaceae), both of which are globally threatened.

Keywords. new record, new species, Rovuma, taxonomy, threatened.

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Introduction

The genus *Cladoceras* Bremek. (Rubiaceae Juss.) was described to accommodate the species *C. subcapitatum* (K.Schum. & K.Krause) Bremek., a scandent shrub from coastal Kenya and Tanzania with unusual recurved spines derived from modified branches to aid climbing (Bremekamp 1940; Bridson & Verdcourt 1988). Robbrecht & Bridson (1984) considered the taxonomic position of *Cladoceras* and

placed it with confidence within the tribe Pavetteae Dumort. of subfamily Ixoroideae Bremek. They suggested that it is closely allied to the palaeotropical genus *Tarenna* Gaertn., noting the particular similarity to another eastern African lianescent species, *T. junodii* (Schinz) Bremek. They further noted that, whilst *Tarenna* s. lat. is morphologically diverse with several distinct species groupings recognisable, the group of continental African species that includes *T. junodii* share with *Cladoceras* seeds that are smooth to the naked eye, with a pronounced hilar cavity and entire endosperm, and that the placentation is broadly similar between the two taxa. *Cladoceras subcapitatum* also possesses the same type of exotestal cells on the seeds as present in that same group of continental African species of *Tarenna*, in which the walls are sinuate and so the cells together resemble a jigsaw-puzzle (Robbrecht & Bridson 1984; De Block *et al.* 2015). *Cladoceras subcapitatum* has a corolla with a tube that is markedly longer than the lobes, whilst most African *Tarenna* have the tube shorter than or ± equal to the lobes, but Robbrecht & Bridson (1984) noted the exception of *T. gossweileri* S.Moore, where the tube is distinctly longer than the lobes. However, in that species, both the stamens and the stigma are exserted from the corolla tube, whereas in *C. subcapitatum* the stigma is included well within the corolla tube. De Block *et al.* (2015) also noted that the pollen of *C. subcapitatum* is (3–)4-colporate, whilst it is 3-colporate in continental African *Tarenna*, but they did not consider this to be a significant distinction at the generic rank. Robbrecht & Bridson (1984) chose to maintain *Cladoceras* as a separate genus from *Tarenna*, but that was largely based on the likelihood that *Tarenna* s. lat. would be segregated into several morphologically discrete genera in the future, and so they considered it premature to sink *Cladoceras* at that time.

The anticipated segregation of *Tarenna* has since begun, with the reinstatement of *Coptosperma* Hook.f. (including *Zygoon* Hiern) as an accepted genus with approximately 50 species in Africa and Madagascar, separated from *Tarenna* on the basis of having single-seeded drupes and seeds with ruminate endosperm (De Block *et al.* 2001; Degreef *et al.* 2001). In its current circumscription, *Tarenna*, excluding *Coptosperma*, is a palaeotropical genus of ca 200 species (De Block *et al.* 2015). In the most recent taxonomic account of *Tarenna* in continental Africa, 42 accepted species were documented (Degreef 2006), with two further species added since that publication (Burrows 2009; Cheek *et al.* 2015).

A recent phylogenetic analysis of tribe Pavetteae using *rps16*, *trnT-F* and ITS (De Block *et al.* 2015) revealed that *Tarenna* as currently circumscribed is polyphyletic and that African species of *Tarenna* fall within a lineage together with *Pavetta* L., separated from the Asian lineage to which the type species of *Tarenna* belongs. Further, *Cladoceras subcapitatum* was resolved as nested within the African *Tarenna* clade, sister to *T. pembensis* J.E.Burrows from coastal northeast Mozambique. *Tarenna junodii* was not included in that phylogenetic study, but given the morphological similarities between *T. pembensis* and *T. junodii*, it is considered highly likely that *T. junodii* will belong within the same clade. De Block *et al.* (2015) concluded that African species named *Tarenna* can no longer be included in that genus, and suggested that the name *Cladoceras* could be adopted for at least some of the African clade. However, the renaming of African *Tarenna* is complicated by the fact that monophyletic *Pavetta* arises from within the African taxa of *Tarenna*, thus rendering it paraphyletic. Hence, it is likely that more genera will need to be segregated from African *Tarenna* and the exact delimitation of an expanded *Cladoceras* remains moot. De Block *et al.* (2015: 79) concluded that "further molecular and morphological studies are necessary to clarify the phylogeny of Pavetteae, especially regarding African *Tarenna* species …".

Degreef (2006) noted a number of incompletely known species of African *Tarenna*, including his sp. 53 for which he had only seen two collections: *S. Bidgood et al. 1357*, a fruiting specimen from the Rondo Plateau of southeast Tanzania, and *Q. Luke 11016*, a specimen with flower buds from the Mueda Plateau of northeast Mozambique. A further collection was made in 2008 from the forests near Quiterajo in Mozambique by one of the current authors (J.E.B.: *J.E. & S.M. Burrows 10748*) during research for the publication *Trees and Shrubs of Mozambique*, but only old, wilted flowers were found at that time

and so the species remained undescribed, and was again listed as *Tarenna* sp. 53 in that publication (Burrows *et al.* 2018). However, fresh flowering material had been collected independently by another of the current authors (Q.L.: *Q. Luke 13883*) on the Mueda Plateau in 2009. With four collections now available, including good flowering and fruiting material, this highly distinctive species can be described. Whilst placed within *Tarenna* in previous literature (Degreef 2006; Timberlake *et al.* 2011; Burrows *et al.* 2018), possible affinity to *Cladoceras* has also been noted on some of the herbarium specimens of this taxon. In particular, the long corolla tube is strikingly similar to that of *C. subcapitatum*. Here, we investigate *Tarenna* sp. 53 of Degreef (2006) as a taxonomic novelty.

The study area

The new species in question is recorded from Lindi Region in southeast Tanzania and Cabo Delgado Province in northeast coastal Mozambique. The sites fall within the proposed Rovuma Centre of Plant Endemism (CoE), which comprises coastal and lowland dry forest, thicket and woodland habitats spanning from east-central Tanzania south to Quelimane in coastal northern Mozambique (Burrows & Timberlake 2011; Darbyshire *et al.* 2019). The core area of this CoE is centred on the Rovuma River, which forms the boundary between Tanzania and Mozambique towards the Indian Ocean coastline. This core area is an expansion of the Lindi Local Centre of Endemism as proposed by Clarke (2001). The extension of this CoE into Mozambique has been confirmed by recent botanical surveys of the coastal dry forests and associated habitats, with a particular focus on Cabo Delgado Province (Timberlake *et al.* 2011; Darbyshire *et al.* 2020). These surveys, together with existing collections, revealed nearly fifty species new to science as well as a large number of new country records for Mozambique across a wide range of plant families (Timberlake *et al.* 2011; Darbyshire *et al.* 2020). In addition to the new species described here, we also report additional new records for Mozambique of species endemic to the Rovuma CoE.

The coastal dry forests and thickets of the Rovuma CoE are particularly rich in species of Rubiaceae, many of which are range-restricted endemics (Timberlake *et al.* 2011; Burrows *et al.* 2018; Darbyshire *et al.* 2019, 2020). This includes the genus *Tarenna*, where two recently described species are of note: *T. bridsoniana* Degreef from Mlinguru in Lindi Region of Tanzania (Degreef 2006) and *T. pembensis* from coastal Cabo Delgado and Nampula Provinces of Mozambique (Burrows 2009). A wide range of other Rubiaceae genera contain localised Rovuma CoE endemics, including *Empogona* Hook.f., *Oxyanthus* DC., *Pavetta*, *Pyrostria* Comm. ex Juss. and *Vangueria* Juss. (Burrows *et al.* 2018; K. Matheka *et al.*, in prep.).

Material and methods

This taxonomic study is based on morphological analyses of herbarium material, primarily using specimens held at the EA, K and BNRH herbaria, with additional study of material at LMA where available (herbarium abbreviations following Thiers, continuously updated). Field photographs of the species in question were also consulted. Measurements were made on dry material except for flowers, which were first rehydrated using Aerosol OT 5% solution, and seeds, which were extracted from a fruit following boiling in water for ca three minutes. At least one duplicate of all cited specimens has been seen by one or more of the authors. Data on distribution, habitat and ecology and phenology were taken from herbarium specimen labels and from field observations made by the authors. Specimen georeference data were imported into SimpleMappr (Shorthouse 2010) to produce a distribution map.

The preliminary conservation (extinction risk) assessment of the new species is based on application of the Categories and Criteria of the IUCN Red List (IUCN 2012; IUCN Standards and Petitions Committee 2019). The online tool GeoCAT (http://geocat.kew.org/, Bachman *et al*. 2011) was used to calculate the area of occupancy (AOO) and extent of occurrence (EOO).

Table 1. The main morphological differences between *Cladoceras subcapitatum* (K.Schum. & K.Krause) Bremek. and *C. rovumense* I.Darbysh., J.E.Burrows & Q.Luke sp. nov.

Character	***Cladoceras subcapitatum***	***Cladoceras rovumense* sp. nov.**
Habit	Scandent shrub with some lateral branches modified to form ± recurved spines	Free-standing tree or shrub, lacking modified spinose lateral branches
Leaf shape and dimensions	Elliptic to oblong-oblanceolate 3.5–12 × 0.9–4.8 cm Length / width ratio 1.85–4 : 1, usually >2 : 1	Obovate or obovate-elliptic 9–17.5 × 5.8–10.5 cm Length / width ratio 1.55–1.9 : 1
Leaf indumentum	Glabrous	Pubescent particularly on veins beneath and midrib above, becoming scabridulous at maturity
Inflorescence position	Borne on lateral branches with one or more pairs of leaves at least at flowering stage, sometimes caducous at fruiting	Borne on leafless lateral branches
Inflorescence form	Subcapitate but usually with some clear branching, 9–15-flowered	Dense, capitate, usually with branching suppressed, with 20+ flowers
Calyx lobes	Acute-triangular to -lanceolate, without toothed margin	Rounded to broadly and convexly triangular, with an irregular, sometimes toothed margin
Corolla tube length	25–35 mm	(30–)38–42 mm
Anther length	2–2.5 mm	2.6–3 mm
Combined length of style + stigma	8–10 mm	17–19 mm

Results

On thorough examination of the available material of "*Tarenna* sp. 53" of Degreef (2006), we confirm that this is a previously undescribed species of Rubiaceae and that its closest ally in morphological terms is *Cladoceras subcapitatum*. It shares with this species in particular a similar floral morphology in which the corolla tube is much longer than the lobes and the stigma is included in the corolla tube and held well below the stamens. The fruit and seed morphology are also a close match for *C. subcapitatum*. However, the two species differ markedly in a number of easily observable characters including growth habit, leaf shape, size and indumentum, inflorescence form, shape of the calyx lobes and flower length (Table 1; Figs 1–2). Given the likelihood that the group of African species currently placed in *Tarenna*, to which *C. subcapitatum* is closely related, will probably be transferred to *Cladoceras* in the future, it is deemed most appropriate here to describe the new species from Mozambique in that latter genus, and so the name *Cladoceras rovumense* I.Darbysh., J.E.Burrows & Q.Luke sp. nov. is validated below.

In addition, two new country records for Mozambique of globally threatened species restricted to the Rovuma CoE and previously known only from Tanzania are recorded here: *Celosia patentiloba* C.C.Towns. (Amaranthaceae Juss.) and *Cordia fissistyla* Vollesen (Boraginaceae Juss.).

Taxonomic treatment

Class Magnoliopsida Brongn.
Order Gentianales Juss. ex Bercht. & J.Presl
Family Rubiaceae Juss.
Genus *Cladoceras* Bremek.

Cladoceras rovumense I.Darbysh., J.E.Burrows & Q.Luke sp. nov.
urn:lsid:ipni.org:names:77302733-1
Figs 1–3

Tarenna sp. 53 sensu Degreef, *Opera Botanica Belgica* 14: 143 (Degreef 2006); Timberlake *et al.*, *Plant Ecology and Evolution* 144: 131 (Timberlake *et al.* 2011); Burrows *et al.*, *Trees and Shrubs Mozambique* (Burrows *et al.* 2018); Darbyshire *et al.*, *Plant Ecology and Evolution* 153: 441 (Darbyshire *et al.* 2020).

Diagnosis

Cladoceras rovumense sp. nov. resembles *C. subcapitatum* in floral and fruit morphology, but differs most markedly in (a) being a free-standing tree or shrub, lacking modified spinose lateral branches (vs a scandent shrub with some lateral branches modified to form ± recurved spines to aid climbing in *C. subcapitatum*); (b) the leaves being obovate or obovate-elliptic, larger, up to 17.5 × 10.5 cm, with surfaces pubescent particularly on the veins beneath and midrib above, becoming scabridulous at maturity (vs leaves elliptic to oblong-oblanceolate, smaller, up to 12 × 4.8 cm, glabrous); (c) the inflorescences being borne on leafless lateral branches (vs inflorescence-bearing branches with one or more pairs of leaves at least in flower, sometimes caducous at fruiting); (d) the inflorescence being dense, capitate and with 20+ flowers (vs less dense and usually with clear branching, 9–15-flowered); (e) the calyx lobes being rounded to broadly and convexly triangular, with an irregular, sometimes toothed margin (vs calyx lobes acute-triangular to -lanceolate); and (f) the style and stigma together measuring 17–19 mm long (vs 8–10 mm long in *C. subcapitatum*); see Table 1.

Etymology

The epithet denotes that this species is endemic to the proposed Rovuma CoE in coastal southern Tanzania and northern Mozambique.

Type

MOZAMBIQUE • Cabo Delgado Prov., Quiterajo, Pt. 463; 11.7676° S, 40.3743° E; alt. 115 m; 24 Nov. 2009; *Q. Luke 13883*; holotype: K [K000787442]; isotypes: EA, LMA, MO, P.

Paratypes

MOZAMBIQUE • Cabo Delgado Prov., Mueda Plateau; 11°20′ S, 39°26′ E; alt. 760 m; 14 Dec. 2003; [*W.R.*]*Q. Luke, O. Kibure & E. Nacamo 10116*; EA, K, LMA, MO, UPS • Cabo Delgado Prov., Namacubi Forest (the Banana), west of Quiterajo; 11°45′55″ S, 40°23′45″ E; alt. 90 m; 25 Nov. 2008; *J.E. & S.M. Burrows 10748*; BNRH, K, LMA.

TANZANIA • Lindi Region, Rondo Plateau, Rondo Forest Reserve; 10°07′ S, 39°13′ E; alt. 750 m; 6 Feb. 1991; *S. Bidgood, R. Abdallah & K. Vollesen 1357*; K (2 sheets), NHT.

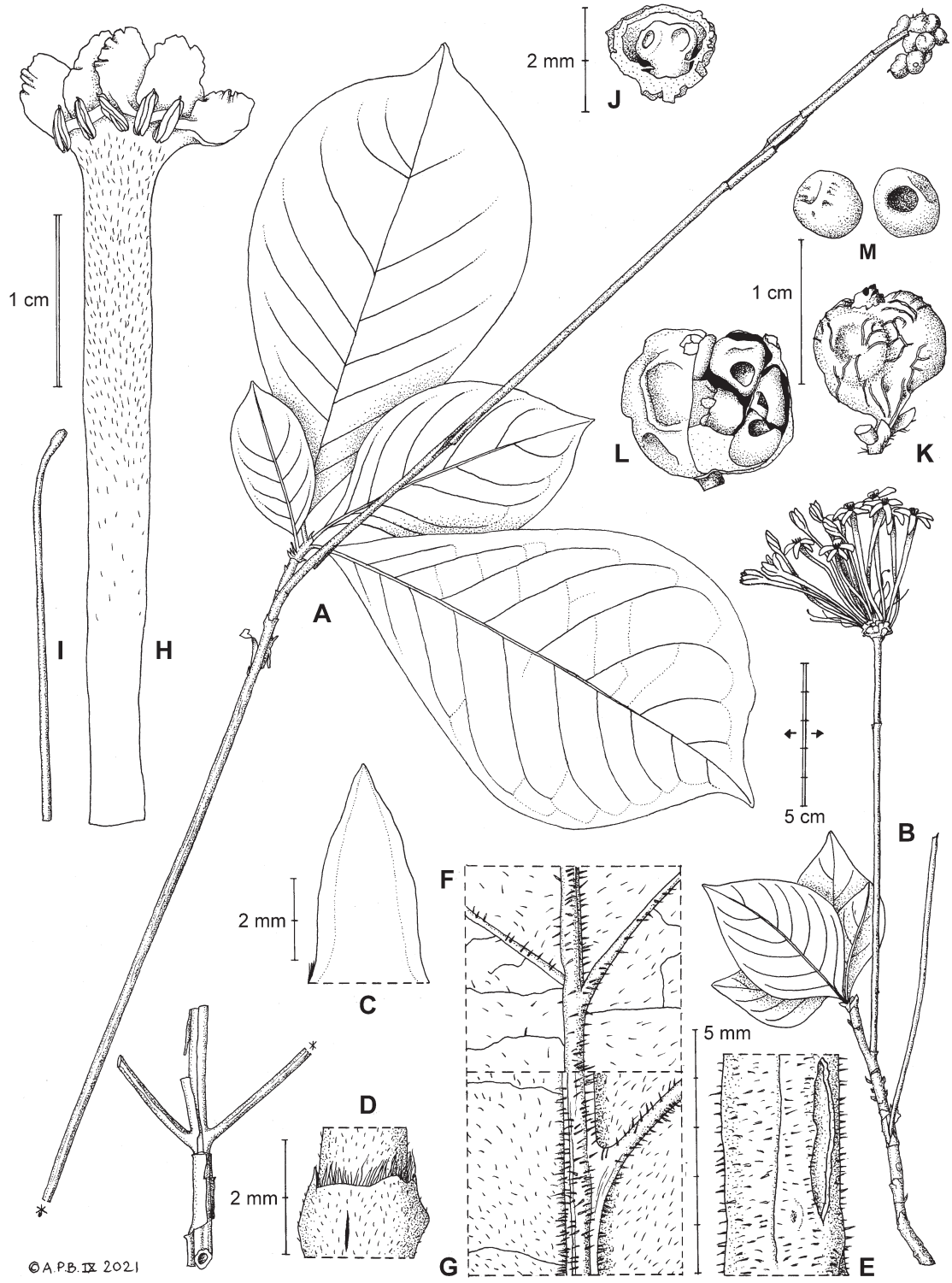

Fig. 1. *Cladoceras rovumense* I.Darbysh., J.E.Burrows & Q.Luke sp. nov. **A**. Habit, fruiting shoot. **B**. Habit, flowering shoot. **C**. Stipule, external face. **D**. Hairs revealed beneath fallen stipule. **E**. Portion of flowering stem showing indumentum. **F**. Leaf, adaxial indumentum. **G**. Leaf, abaxial indumentum. **H**. Dissected corolla with androecium. **I**. Style and stigma. **J**. Longitudinal section of ovary. **K**. Mature fruit. **L**. Fruit, partially dissected to reveal seeds. **M**. Seed in two views. **A**, **E–G**, **K–M** from *S. Bidgood et al. 1357*; **B**, **H**–**I** from *Q. Luke 13883*; **C**–**D**, **J** from *Q. Luke et al. 10116.* Drawn by Andrew Brown.

Description

Small, slender deciduous tree or shrub 1.5–7 m tall; young stems ± quadrangular, with papery maroon-brown bark that readily exfoliates in strips or patches, at first puberulous with ± patent hairs to 0.35 mm long but soon glabrescent. Stipules soon caducous, triangular, 3.7–7.5 mm long, with a thickened blackish-brown central portion and with paler, somewhat hyaline margins but these often infolded in dry material, glabrous externally, with long pale hairs internally. Leaves clustered towards ends of main and widely divergent lateral branches, ± immature at flowering, subsessile or on puberulent petiole to 7 mm long; blade of mature leaves obovate or obovate-elliptic, 9–17.5 × 5.8–10.5 cm (l/w ratio 1.55–1.9 : 1), base cuneate to somewhat attenuate or some leaves abruptly obtuse at base, apex shortly acuminate or (sub)attenuate, lateral veins 7–11 per side, these and the midrib prominent and often pale beneath, surfaces pubescent with hairs densest and longest on veins beneath and midrib above, conspicuous when young, becoming more sparsely hairy with maturity, the blade then scabridulous; minute pocket-domatia present in axils of lateral veins beneath but inconspicuous. Inflorescences terminating leafless lateral branches 11–28.5 cm long, flowers 20 or more, sessile, crowded in capitate corymbs with highly reduced and thickened branches; bracts subtending the main inflorescence branches maroon at least at apex, triangular with a slender apiculum, 3.2–4.5 × 3–4 mm, those subtending the flower clusters smaller, 1–2.5 mm long. Calyx tube (hypanthium) 1.9–2.7 mm long; calyx lobes pink- to maroon-tinged, rounded to broadly and convexly triangular, ± 1 mm long, with an irregular, sometimes toothed margin, glabrous or margins sparsely ciliate. Corolla white except for yellowish-green tube and central portion

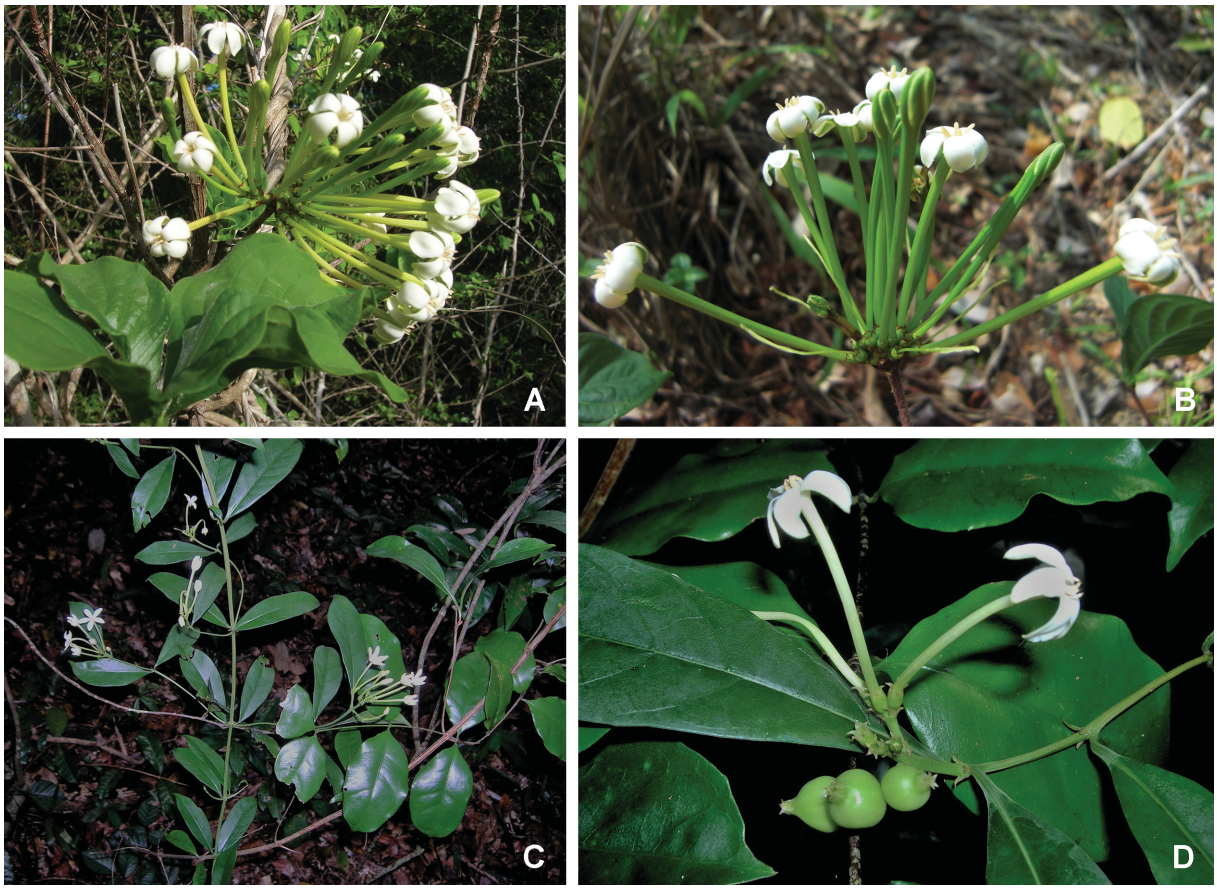

Fig. 2. Species of *Cladoceras* Bremek. in the field. **A**–**B**. *Cladoceras rovumense* I.Darbysh., J.E.Burrows & Q.Luke sp. nov. (photos: **A**. Q. Luke; **B**. P.A. Luke, Mozambique). **C**–**D**. *Cladoceras subcapitatum* (K.Schum. & K.Krause) Bremek. (photos: W.R.Q. Luke, Base Titanium nursery, Kwale County, Kenya).

of lobes externally, glabrous externally; tube narrowly cylindrical, (30–)38–42 × 1.5–2 mm, pilose with long wispy hairs internally mainly in distal half; lobes oblong-elliptic, 5–9 × 3.7–4.2 mm. Stamens with anthers subsessile, held at corolla mouth, 2.6–3 mm long. Ovary bilocular, placentae affixed centrally on septum; style and stigma together 17–19 mm long, glabrous, stigma ± linear, included within corolla tube. Fruit pale green, globose-obovoid, 6–8 mm in diameter, endocarp thin, glabrous, calyx persistent, usually 6–8 seeds per fruit (as few as 2 seeds per fruit reported by Degreef 2006); seeds orange-brown, 4–5 mm in diameter, hemispheric with a slightly angular lower side and a deep circular hilar excavation ca 1.5 mm in diameter, testa smooth and glossy.

Distribution and habitat

Restricted to the proposed Rovuma CoE, known from the Rondo Plateau of Southeast Tanzania and the Mueda Plateau and Namacubi Forest (Quiterajo) in northeast Mozambique (Fig. 3). Occurs in deciduous and semi-evergreen coastal and lowland dry forest and thicket on sandy soils, including areas of secondary woodland/thicket, at 90–760 m altitude. At Quiterajo, it was recorded from *Guibourtia schliebenii* (Harms) J.Léonard dominated dry forest with species of *Memecylon* L., *Warneckea* Gilg and *Strynchnos* L. common in the understorey (*J.E. & S.M. Burrows 10748*). The type specimen from the same site was found growing in close proximity to a number of rare and globally threatened species, i.e., *Xylopia tenuipetala* D.M.Johnson & Goyder (*Q. Luke 13884*), *Vismianthus punctatus* Mildbr. (*Q. Luke 13885*), *Vismia pauciflora* Milne-Redh. (*Q. Luke 13886A*) and *Warneckea cordiformis* R.D.Stone (*Q. Luke 13887*). On the Rondo Plateau, it was noted from within forest of *Milicia excelsa* (Welw.) C.C.Berg, *Dialium* L., *Albizia* Durazz., and *Pteleopsis* Engl. (= *Terminalia* L. according to some authorities).

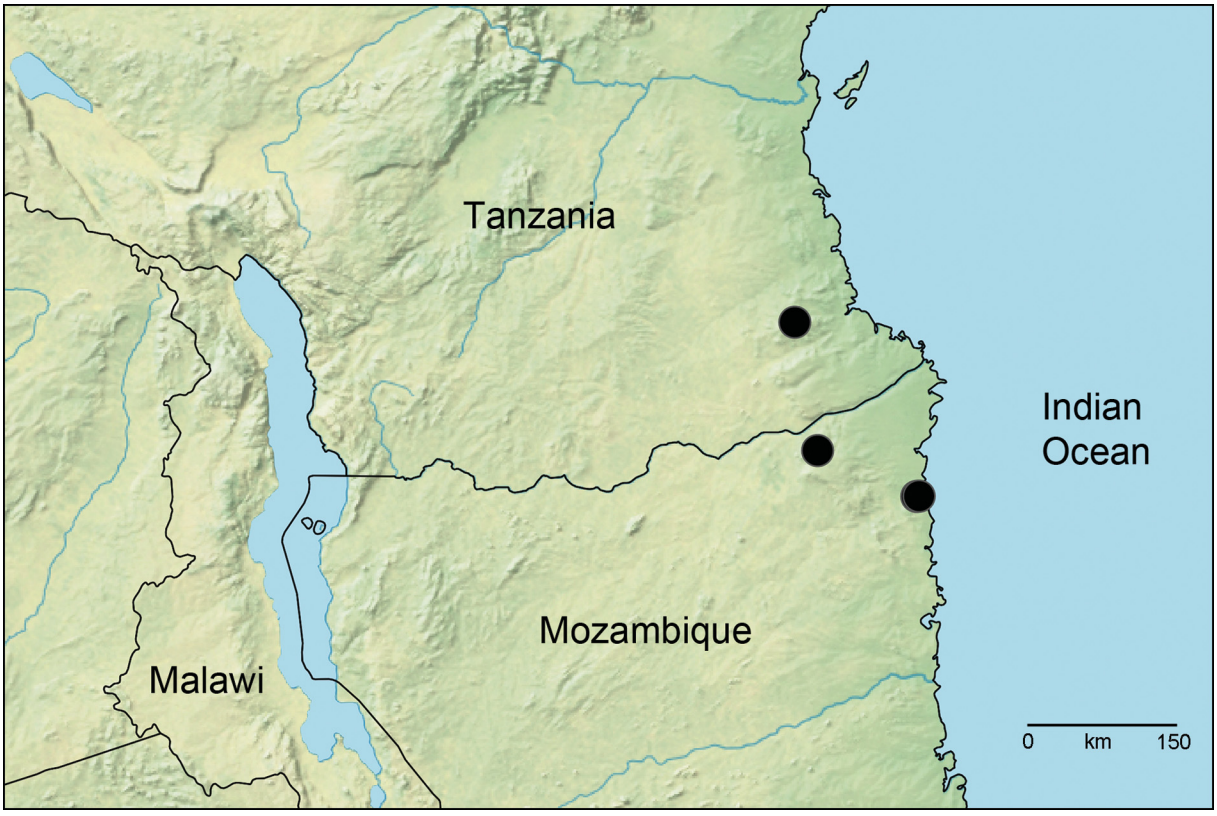

Fig. 3. Distribution of *Cladoceras rovumense* I.Darbysh., J.E.Burrows & Q.Luke sp. nov.

Conservation status

This species is known from three locations and has an extent of occurrence of 6601 km^2 and a calculated area of occupancy of 16 km^2. At Mueda Plateau, there has been an estimated loss of dense woodland and dry forest vegetation cover of over 96%, whilst in the Rio Messalo-Quiterajo area this figure is 71.2% (Timberlake *et al.* 2011). On the Rondo Plateau in Tanzania, 2755 ha of natural forest were cleared during the Rondo Forest Programme in 1952–1978 and replaced by commercial plantation of exotic tree species. Some clearance of natural forest for subsistence agriculture and for fuelwood collection is an ongoing threat at this site (Clarke 2001). However, a sizeable area of forest remains on the western slopes of the plateau, some of which has regenerated since the cessation of forestry. The gazetting of this site as a Nature Forest Reserve in 2016 may hopefully result in increased protection for the biodiversity there (Wabuyele *et al.* 2020). With only three locations and a continuing decline in the extent and quality of habitat at the majority of these sites, this species is provisionally assessed as Endangered – EN B2ab(iii).

Additional new records for Mozambique

Class Magnoliopsida Brongn.
Order Caryophyllales Bercht. & J.Presl
Family Amaranthaceae Juss.
Genus *Celosia* L.

Celosia patentiloba C.C.Towns.

Hooker's Icones Plantarum 38: 41, t. 3732 (Townsend 1975); *Flora of Tropical East Africa*: 13 (Townsend 1985).

Type

TANZANIA • Newala; alt. 670 m [2200 ft]; 9 Apr. 1959; *W. Hay 61*; holotype: K (2 sheets).

Additional collection studied

MOZAMBIQUE • Cabo Delgado Prov., Mueda District; 11°31.822′ S, 39°26.504′ E; alt. 947 m; 10 Sept. 2009; *A. Banze 106*; K, LMA.

Distribution and habitat

Restricted to the Rovuma CoE, known from the Maconde Plateau of Southeast Tanzania and the Mueda Plateau of northeast Mozambique. It occurs in partial or full shade in woodland including in degraded or disturbed areas, at ca 670–950 m a.s.l. elevation.

Conservation status

This species is currently assessed on the IUCN Red List as Critically Endangered – CR B2ab(iii) – and possibly extinct (Howard *et al.* 2020). Whilst the new record from the Mueda Plateau adds a second location, this species could be considered to be severely fragmented given that the two known subpopulations are over 65 km apart, whilst the dispersal potential of this species is likely to be very limited given that it is a small understorey herb. Recolonisation between these isolated subpopulations is, therefore, unlikely to occur. Further, there is very little intact wild habitats still present on both the Maconde and Mueda Plateaux which are highly degraded, with much conversion to agricultural land. At Mueda Plateau, for example, there has been an estimated loss of dense woodland and dry forest vegetation cover of over 96% (Timberlake *et al.* 2011). Whilst this species appears tolerant of some disturbance, it is unlikely to persist in farmlands. Furthermore, as noted by Howard *et al.* (2020), it is

possible that the Maconde subpopulation is no longer extant. Therefore, the assessment of CR B2ab(iii) is upheld here.

Taxonomic notes

Two collections from the Rondo Plateau in southeast Tanzania (*G.P. Clarke 35*; *Q. Luke 12958*; both K) are closely allied to this species but have markedly smaller perianth segments. These collections may represent a further species of Rovuma CoE endemic in *Celosia* or possibly a distinct variant of *C. patentiloba*. Further material is desirable to fully assess the extent of this variation.

Class Magnoliopsida Brongn.
Order Boraginales Bercht. & J.Presl
Family Boraginaceae Juss.
Genus *Cordia* L.

Cordia fissistyla Vollesen

Nordic Journal of Botany 1: 325 (Vollesen 1981).

Type

TANZANIA • Selous Game Reserve, 2 km NW of Kingupira; 8°28′ S, 38°33′ E; alt. 125 m; 9 May 1975; *K. Vollesen in MRC 2283*; holotype: C [C10000406]; isotypes EA, K [K000418662], WAG [WAG0003807].

Additional collection studied

MOZAMBIQUE • Nampula Prov., Monapo; 14°59.023′ S, 40°31.516′ E; 18 Mar. 2009; *E. Schmidt 4762*; Herb. Ernst Schmidt.

Distribution and habitat

Restricted to the proposed Rovuma CoE, known from east-central Tanzania and from Monapo of northeast Mozambique. It occurs in areas of dense thicket including on termitaria, on edges of temporary water holes and edges of riverine thickets, on alkaline soils, at ca 40–125 m a.s.l. elevation.

Conservation status

This species is currently assessed on the IUCN Red List as Vulnerable – VU D2 – as it was previously known from a small range (Extent of Occurrence [EOO] = 366 km^2) and only 2–3 locations within the Selous Game Reserve of Tanzania, and there were some plausible future threats from expansion of camps within the reserve (Beentje *et al.* 2020). Whilst large areas of the Selous Reserve remain intact, it was included by UNESCO (2021) as one of 52 World Heritage sites in danger, and its conservation outlook is listed as "critical" (IUCN World Heritage Outlook 2020). This is due to a number of recent and ongoing developments within the reserve, including the proposed Julius Nyerere Hydropower Project at Stiegler's Gorge on the Rufiji River, current and potential future mineral resource exploitation and high levels of poaching of megafauna which may have an impact on the whole Selous ecosystem (IUCN World Heritage Outlook 2020). The new record from Mozambique extends the EOO of this species considerably, to ca 10 625 km^2, and adds one further location. The area around Monapo and Naguema to the east is heavily populated, with extensive conversion of thicket vegetation to farmland, hence the Mozambique location is considered to be experiencing an ongoing threat. With a continuing decline in extent and quality of habitat and with fewer than five locations known, this species is provisionally reassessed as Endangered under criterion B – EN B2ab(iii).

Taxonomic notes

The single Mozambique collection is from ca 700 km to the south of the nearest previously known records in Tanzania and is in flower bud only, but it is an excellent match for smaller-leaved specimens of *C. fissistyla* (e.g., *K. Vollesen 4493*, Kingupira) and this is a very distinctive species with no close affinity (Verdcourt 1991).

Please note that, other than the type specimen, we only cite the newly seen Mozambique collection in the "Additional collection studied" section here and do not cite the other Tanzanian collections we have seen.

Discussion

The description of *Cladoceras rovumense* sp. nov. doubles the size of the genus *Cladoceras* as it is currently circumscribed, although it is likely to expand further in the future once the African clades of *Tarenna* s. lat. are fully resolved. This new species also broadens the concept of *Cladoceras* to include free-standing shrubs and small trees with unmodified branches as well as scandent shrubs with modified climbing branches.

As noted by De Block *et al.* (2015), whilst it is apparent that the name *Tarenna* should no longer be applied to continental African species, the delimitation of genera within continental African Pavetteae requires further molecular phylogenetic study. Degreef (2006) did not propose an infrageneric classification for *Tarenna*, but did provide notes on potential affinities between continental African species based upon a range of morphological characters. This should help guide a sampling strategy for an expanded phylogenetic study, but ultimately it may require most or all of the continental African species, together with the two species of *Cladoceras* now recognised, to be included in order to circumscribe discrete taxa and enable the identification of diagnostic traits. Given the close relationship between continental African *Tarenna* and *Pavetta*, as revealed by De Block *et al.* (2015), it would be important to also include an enlarged sample of that genus in any future phylogenetic study. To improve support for finer-scale relationships, it would be favourable to use Next Generation Sequencing techniques for such a study; one option would be to use the universal Angiosperm 353 probe set for targeted sequencing of nuclear genes, as employed in a recent order-wide study of the Gentianales where relationships were resolved with strong support (Antonelli *et al.* 2021).

However, the current authors contend that whilst it is ultimately desirable to refine generic delimitation, both in this specific case and more generally across angiosperms, this should not detract from the urgent need to describe range-restricted and potentially threatened species that are new to science, even where there are uncertainties of generic placement. In such cases, formal description of the species can provide much-needed attention and encourage conservation action where it is most urgently required.

In the current study, the documentation of the new species and the new records of Rovuma CoE endemic species from Mozambique will contribute to the documentation of Important Plant Areas (IPAs) in that country (Darbyshire *et al.* 2019; Tropical Important Plant Areas (TIPAs) in Mozambique). Both of the known sites for *Cladoceras rovumense* sp. nov. in Mozambique – Quiterajo and the Mueda Plateau, the latter also being the single known extant site for *Celosia patentiloba* – are currently being designated as IPAs based on the criteria of Darbyshire *et al.* (2017). Indeed, Quiterajo qualifies as an IPA under all three of the criteria, i.e., the presence of threatened species, threatened habitats and exceptional botanical richness, and it is known to contain amongst the highest numbers of rare and threatened species in Mozambique.

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