



Cyathula guineensis (Amaranthaceae), a new and endangered species from the Republic of Guinea

Iain Darbyshire¹, Camille Rieder^{2,3}, Pepe M. Haba^{4,5}, Charlotte Couch^{1,6}, Moussa Camara³ & Martin Cheek^{1,6}

Summary. The new species *Cyathula guineensis* (Amaranthaceae), from Faranah and Kankan Regions of northern and central Guinea, is described and illustrated. This new species is assessed as globally Endangered, as it faces a range of threats at its two known locations and is estimated to have a small global population size, with fewer than 250 mature individuals within each of its two known sub-populations. Its taxonomic affinities are discussed, in particular with regard to the sympatric *Cyathula pobeguinii* Jacq.-Fél. and with *C. mollis* C.C.Towns. from the Central African Republic, both of which share with the new species modified sterile flowers that are not hooked or spiny, these instead are tepal-like or bracteolate. The generic placement of these species is discussed in light of recent molecular phylogenetic evidence that resolves *Cyathula* as being polyphyletic within the “achyranthoid” clade of Amaranthaceae and which has resulted in a proposal to modify and expand the circumscription of the genus. Finally, the role of the modified, sterile flowers in aiding epizoochory in *Cyathula guineensis* is discussed.

Key Words. Conservation, IUCN Red List, new species, taxonomy.

Introduction

With over 3,500 indigenous species recorded (Gosline *et al.* 2023), the Republic of Guinea — henceforth Guinea — is amongst the most species-rich countries for vascular plants in Africa west of the Dahomey Gap, and has the highest rate of plant endemism within that region (Sosef *et al.* 2017). Furthermore, its known flora continues to grow significantly as previously unbotanised areas are surveyed for the first time, through the documentation of both new records for the country and species new to science. Indeed, the recently published national checklist of vascular plants by Gosline *et al.* (2023) increased the known indigenous flora by 26% compared to the most recent floristic account of Guinea by Lisowski (2009). Some of these novelties are particularly noteworthy. For example, of the nearly 50 new species described from Guinea (some also extending into neighbouring countries) since the publication of Lisowski’s Flora, two represent new, endemic, monospecific genera, namely *Benna* Burt & Ver.-Lib. (Melastomataceae) and *Kindia* Cheek (Rubiaceae) (Cheek *et al.* 2018; Burt *et al.* 2022), demonstrating the potential for further exciting new discoveries in this floristically important country.

The Moyen-Bafing National Park (PNMB) is situated in north-central Guinea on the northern side of the Fouta Djallon highlands. It occupies an area of 6,767 km², protecting a mosaic landscape of savanna

grasslands and woodlands, areas of lateritic (bauxite) bowal and gallery forests. The site was gazetted as a National Park in 2021 and is famed for having the largest continuous population in West Africa of more than 4,600 chimpanzees (Boesch *et al.* 2020). The Park was identified as an Important Plant Area (IPA) on the basis of the presence of 19 threatened species and two threatened habitats, and for its exceptional richness in range-restricted species, hence this important site qualifies under all three IPA criteria (Couch *et al.* 2019; <https://tipas.kew.org/site/proposed-moyen-bafing-national-park/>). However, since this publication, our understanding of the plant diversity of the site has grown significantly and the number of threatened species that are known to be present has increased to over 30 (C. Rieder *et al.*, unpubl. data). It is particularly important as the only site in which two Guinean endemic species — the Critically Endangered *Barleria asterotricha* Benoist (Acanthaceae) and Endangered *Argyrella* (formerly *Dissotis*) *linearis* (Jacq.-Fél.) Ver.-Lib. & G.Kadereit (Melastomataceae) — are known from recent extant populations. It also holds important populations of five threatened species of Podostemaceae (Couch *et al.* 2019) mainly at the Koukoutamba falls on the Bafing River, including the point endemic Critically Endangered *Inversodiocraea koukoutamba* Cheek (Cheek *et al.* 2019) and only the second global location for the monotypic, Critically

Accepted for publication 7 April 2025. Published online: 24 February 2026

¹ Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AE, UK. e-mail: i.darbyshire@kew.org

² Institute of Earth Surface Dynamics, Faculty of Geosciences and Environment, University of Lausanne (UNIL), Lausanne, Switzerland

³ Wild Chimpanzee Foundation, Guinean section, Conakry, Guinea

⁴ Guinea Biodiversity, Conakry, Guinea

⁵ Société des Mines de Mandiana (SMM), Tri-K Project, Kankan, Guinea

⁶ West Africa Plant Red List Authority, IUCN Species Survival Commission, Rue Mauverney 28, 1196 Gland, Switzerland

Endangered genus *Lebbiea* Cheek (Cheek & Lebbie 2018). However, large areas of this extensive site have not been botanised to date, and the potential for further discoveries of significant botanical interest is high. Indeed, the globally Critically Endangered *Calophyllum africanum* Cheek & Q.Luke (Clusiaceae), recently described from neighbouring southwest Mali and the only native species of its genus in Africa (Cheek & Luke 2016), was found in Moyen-Bafing in 2022 (C. Rieder 42, 170 & 276). Further, the globally Endangered *Barleria maclaudii* Benoist (Acanthaceae) was found within PNMB for the first time in 2021, the first record of the species in Guinea for 86 years (Rieder *et al.* 2024). Couch *et al.* (2019) also report on the presence of four potential new species to science, which are yet to be described, whilst a species of Acanthaceae believed to be new to science and not yet placed to genus has since been recorded from there (C. Rieder & I. Darbyshire, unpubl. data).

Moyen-Bafing National Park is also home to many communities who rely on the natural resources of this landscape, with an estimated 36,000 residents (Boesch *et al.* 2020). As a result, some parts of the park face significant threats from a range of human activities, including agriculture and cattle grazing, deliberate setting of wildfires and small-scale mining activities (Couch *et al.* 2019). The need to fully understand and document the biodiversity importance of this site and the unique species that it supports is therefore urgent. This will provide critical data to feed into the management strategy of this newly established protected area and assist the park officials to work with the communities to deliver more sustainable use of its natural resources.

During plant biodiversity surveys in Moyen-Bafing in November 2022, by the second author (C.R.), associated with the Wild Chimpanzee Foundation (WCF; manager of the park at the time) to better describe the park's natural habitats, a striking species of Amaranthaceae was encountered that did not match any species known in Guinea as per the account of Lisowski (2009) and the updated checklist (Gosline *et al.* 2023). Whilst investigating this collection further, a second, earlier specimen of the same species came to light as a new accession to Kew, collected during an environmental impact study for the Kiniero gold mine west of Kankan in the Haute Guinée Region, in August 2020 by one of the authors (P.M.H.). In contrast to the Moyen-Bafing area, Haute Guinée has seen few other discoveries of new species to science, an exception being the Endangered *Striga magnibracteata* Eb.Fisch. & I.Darbysh. (Orobanchaceae, Fischer *et al.* 2012). On close examination by the first author (I.D.), this Amaranthaceae species was considered best placed in the genus *Cyathula* Blume, as traditionally circumscribed, based on the presence of the following suite of characters: leaves opposite;

flowers held in bracteate dichasial cymules (partial florescences *vide* Acosta *et al.* 2009) comprising one or three fertile flowers plus four to fourteen sterile flowers; tepals and stamens five, the stamens bithecal, basally monadelphous and with alternating pseudostaminodes; ovary uniovulate and capsule indehiscent (Townsend 1993). A wider review of the available literature and online databases did not find a match for this species in tropical Africa and it is, therefore, here described as a new species, *Cyathula guineensis* I.Darbysh. & C.Rieder.

Materials and Methods

Herbarium specimens of the new species and comparable species were analysed at K; the holotype specimen from HNG was requested on loan and studied at K (herbarium abbreviations follow Thiers 2025, updated continuously). Standard herbarium practices were employed. Prior to dissection, cymules and flowers were soaked in Aerosol OT 5% solution; other characters were measured on dry material. All duplicates seen are indicated with an exclamation mark “!”. Other relevant type material was viewed online via JSTOR Global Plants (<https://plants.jstor.org/>).

Relevant taxonomic literature was consulted both to place the species to genus and to check if it was already described (e.g., Keay 1954; Berhaut 1971; Cavaco 1974; Townsend 1985a, 1985b, 1988, 1993, 2000; Lisowski 2009; Gosline *et al.* 2023).

The distribution map was produced in SimpleMappr (Shorthouse 2010). The extinction risk (conservation) assessments for the new species follow the Categories and Criteria of the IUCN Red List (IUCN 2012) and the guidelines for their use (IUCN 2024). Extent of Occurrence (EOO) and Area of Occupancy (AOO) were calculated using the GeoCAT tool (<https://geocat.iucnredlist.org/>; Bachman *et al.* 2011).

Results

Through thorough morphological examination and comparison to other known species of *Cyathula*, the two specimens from northern and central Guinea are confirmed to represent a new species to science that is described as *Cyathula guineensis* I.Darbysh. & C.Rieder. It is morphologically most closely allied to *Cyathula pobeguinii* Jacq.-Fél., a sympatric species from west Africa, and *C. mollis* C.C.Towns. from the Central African Republic.

Taxonomic Treatment

***Cyathula guineensis* I.Darbysh. & C.Rieder sp. nov.**
Type: Guinea, Parc National du Moyen-Bafing, Faranah Region, Dinguiraye Prefecture, Gagnakaly

Sub-Prefecture, Plaine de Lamikouré, 11°39'9.56"N 10°58'54.2"W, 14 Nov. 2022, fl., fr., *C. Rieder* 466 (holotype HNG [HNG0002885]!; isotype K [K000010698]!).

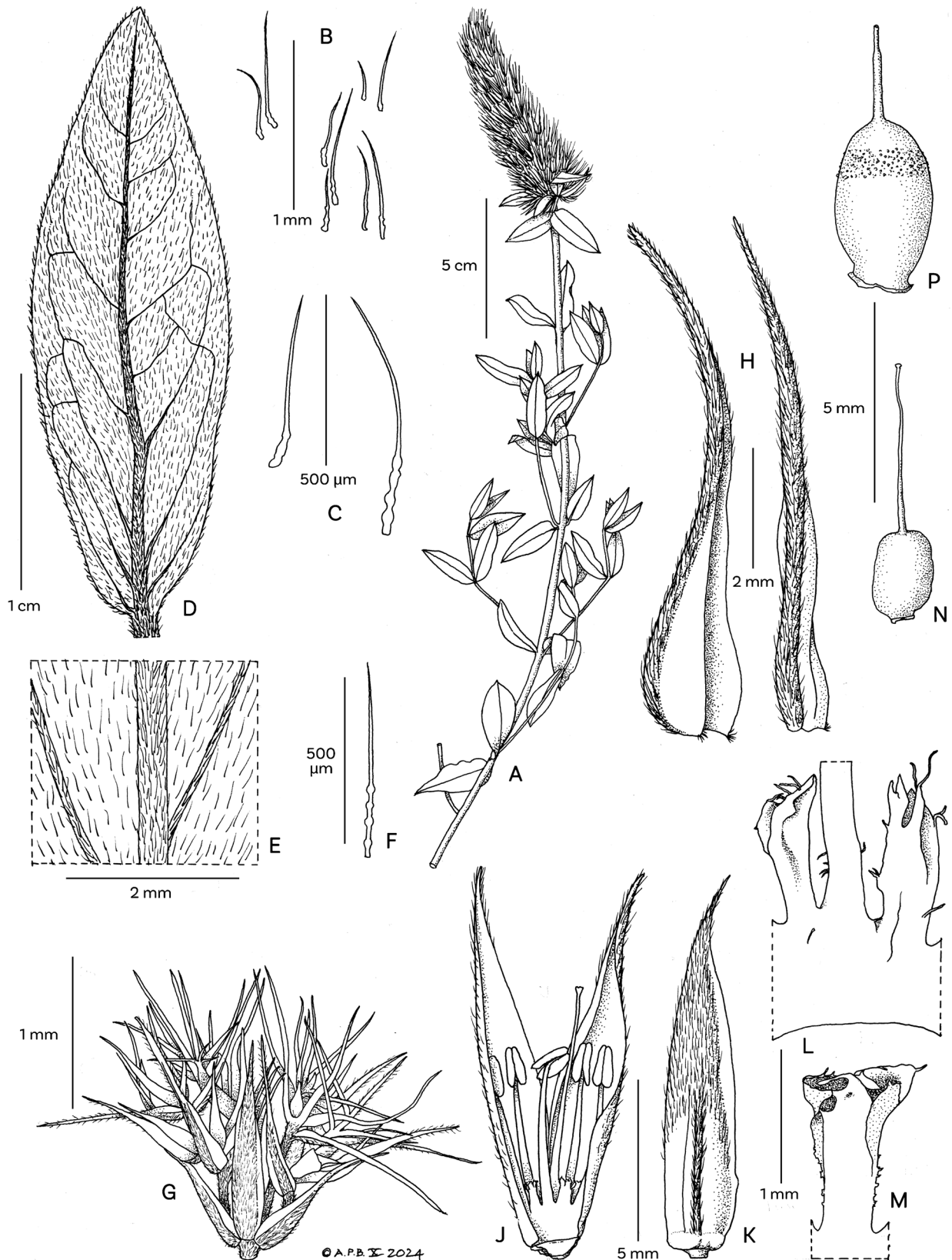
<http://www.ipni.org/urn:lsid:ipni.org:names:77372728-1>

Perennial herb 60 – 80 cm tall. *Stems* erect, arising from a swollen, woody *rootstock* 9 – 13 mm in diameter, several-branched, branches opposite, erect; stems red to dark purplish-brown in dry state, but in live state they appear green with reddish nodes; *young stems* subquadrangular, c. 2 – 2.5 mm in diameter, pubescent with cream-buff ascending to appressed hairs dense throughout or most dense bifariously, hairs variable in length, 0.3 – 1 mm long, with irregular surface giving a granular appearance at high magnification; *mature stems* subterete, 2.5 – 4 mm in diameter, somewhat swollen at nodes, indumentum more sparse; internodes 45 – 70 mm long proximally, 30 – 50 mm long distally. *Leaves* opposite, sessile; blade green with narrow red or whitish margin but can dry dark brown, (oblong-) elliptic to narrowly so, 26 – 38 × 7 – 16 mm (l: w ratio 2.1 – 3.7: 1), base acute to rounded, margin entire, can be somewhat wavy, apex acute and minutely apiculate; surfaces with cream-buff or whitish subappressed hairs throughout, most dense on midvein beneath, hairs 0.5 – 0.9 mm long, hair surfaces as on the stem hairs; lateral veins 4 – 6 per side, can be inconspicuous, midvein prominent beneath. *Inflorescence* terminal, a dense cylindrical spiciform thyse, 65 – 95 × 25 – 35 mm, rachis largely hidden, densely subappressed-pubescent with cream-buff hairs; cymules numerous, each subtended by a rachis bract (which can become largely hidden in fruit), these white with hyaline margins, lanceolate-attenuate, c. 8 – 9 × 2 – 2.5 mm; each cymule comprising a dichasium of 7 (2 orders of branching) or some eventually 15 (3 orders of branching) flowers of which the central (first) flower only or usually the central and first two lateral flowers are fertile, the remaining flowers sterile; first flower subsessile, first order branches at first a maximum of 1.5 mm long but extending to 3.3 – 4 mm long in fruit, second order branches at first largely absent but extending to 4.5 – 5 mm long in fruit, branches curved, indumentum as that of rachis; bracteoles cream-white with hyaline margins and can have a darker, brown midvein, narrowly lanceolate-acuminate, those of first flower 10 – 12 × 2.5 – 3.5 mm when flattened but conduplicate in life with midvein prominent, ascending-pubescent along midvein; bracteoles of ultimate (sterile) flowers of each cymule similar but narrower, 9 – 11.5 × 0.5 – 1 mm. *Fertile flowers* with tepals 5, these green to pink centrally, gradually or

more abruptly changing to white-hyaline margins, lanceolate with attenuate apex, outer 2 tepals usually slightly longer, 12.5 – 13.7 × 2.5 – 3 mm, inner 3 tepals 11.3 – 11.8 × 2 – 2.7 mm; all tepals with external surface appressed-pubescent with cream-coloured hairs except along the margins where glabrous, hairs less dense on inner tepals, internal tepal surfaces glabrous and glossy. *Stamens* 5, monadelphous at base for c. 1 mm in a membranous sheath around the ovary, free portion of filaments very slender, somewhat variable in length, 3.7 – 5.7 mm long, glabrous except proximally where puberulous; with 5 pseudostaminodes alternating with stamens, these oblong, 0.8 – 0.85 mm long, with 3-toothed apex and two apical cavities between the teeth, puberulous; anthers bithecal, thecae narrow, 0.9 – 1.3 mm long, easily detached from filaments. *Ovary* broadly obovoid-ellipsoid, 1.9 – 2.2 × 1.3 – 1.5 mm, glabrous, containing a single ovule, pendulous on an elongate funicle ± 1.3 mm long; style slender, 4 – 5.5 mm long; stigma capitate, 0.1 – 0.2 mm in diameter. *Sterile flowers* with processes tepal-like but reduced in size and more uneven in length, shortest processes typically 1.3 – 5 mm long, longest processes typically 5 – 8 mm long but variable, shorter processes sometimes curving outwards at fruiting stage to reveal the inner surface which can be green, pink or blackish-pink. *Capsule* obovoid-ellipsoid, ± 3.5 × 2.5 mm, glabrous, with persistent style; no mature seeds seen (capsules predated in examples seen). Figs 1 & 2.

RECOGNITION. Resembling *Cyathula pobeguinii* but inflorescence much less densely hairy, with cream (-buff) ascending to appressed hairs on the bracteoles and tepals externally but not obscuring the surfaces (vs inflorescence densely (yellowish-) cream-pilose throughout, appearing woolly and obscuring the surfaces of the bracteoles and tepals in *C. pobeguinii*); bracteoles narrowly lanceolate and long-acuminate, those of first flower 10 – 12 mm long (vs ovate to oblong and shortly acuminate, 5 – 6.7 mm long); tepals of fertile flowers 11.3 – 13.7 mm long (vs 6.7 – 9 mm long); fertile flowers not clearly protruding from the inflorescence, becoming overtopped by the sterile flowers and their bracteoles on lateral cymule branches in fruit (vs fertile flowers protruding from the inflorescence, clearly longer than the adjacent sterile flowers and bracteoles) and leaves smaller, 26 – 38 × 7 – 16 mm, and often proportionately narrower, l: w ratio 2.1 – 3.7: 1 (vs 37 – 61 × 13 – 39 mm, l: w ratio 1.5 – 3.1: 1, usually < 2.5: 1).

DISTRIBUTION & HABITAT. Known from two localities in the Faranah and Kankan Regions of northern and central Guinea, the first from within Moyen-Bafing National Park and the second from west of Kankan



© A.P.B. 2024

◀**Fig. 1.** *Cyathula guineensis* I.Darbysh. & C.Rieder sp. nov. **A** habit, flowering stem; **B** hairs from stem; **C** hairs from **B**, enlargement; **D** leaf, abaxial surface; **E** indumentum of abaxial leaf surface; **F** hair from leaf surface in **E**, enlargement; **G** mature cymule, with partial indication of indumentum; **H** bracteole, lateral view (left) and face view (right); **J** fertile flower with three tepals removed (remaining tepals unrolled to reveal androecium); **K** tepal, external face; **L** monadelphous portion of stamens, showing pseudostaminodes; **M** pseudostaminode, detail showing apical flanges; **N** maturing ovary, with style and stigma; **P** fruit, with indication of surface texture. **A** – **C** and **G** – **M** from *P. M. Haba* 1392; **D** – **F**, **N** and **P** from *C. Rieder* 466. DRAWN BY ANDREW BROWN.

town (Map 1). It may well also occur in higher elevation areas of southwest Mali close to the border with Guinea.

In Moyen-Bafing National Park, this species is found in wooded savanna with a maximum tree height of 12 m, on a seasonally flooded plain at 485 m elevation. It was recorded growing among tall grasses dominated by *Themeda triandra* Forssk., *Hyperthelia dissoluta* (Nees ex Steud.) Clayton and *Diectomis fastigiata* (Sw.) P.Beauv., with *Mitragyna inermis* (Willd.) Kuntze (Rubiaceae) and *Lannea acida* A.Rich. (Anacardiaceae) as the most common trees. Other herbaceous species, such as *Chlorophytum immaculatum* (Hepper) Nordal (Asparagaceae), *Diplacrum africanum* (Benth.) C.B.Clarke, and *Scleria pergracilis* (Nees) Kunth (both Cyperaceae), were also found in this environment but not observed elsewhere in the National Park. Individuals of the *Cyathula* are scattered in slightly more open areas but remain shaded by the grasses. The site faces south with a minimal slope of 1°. The soil is over 40 cm deep, grey-brown, without rock fragments, with a mixed granulometry and is loosely compacted, with a lateritic geological substrate (C. Rieder, pers. obs.). The plain is subject to bushfires, but as of mid-November 2022, the fire had only partially burned the savanna in this area. It is likely that the species' fruits are fire-resistant, similar to *Cyathula pobequinii*, where the fruits are superficially charred without damaging the seeds, although this hypothesis needs further verification.

The second collection, west of Kankan, was recorded in a similar open wooded grassland over lateritic hardpan (or bowal) at 440 m elevation. Here, the main tree species include *Annona senegalensis* Pers. (Annonaceae), whilst *Hyparrhenia* E.Fourn. and *Loudetiopsis* Conert (Poaceae) dominate the grass layer, with *Cochlospermum* Kunth (Bixaceae) and *Tephrosia* Pers. (Fabaceae) species amongst the ground flora (P. M. Haba, pers. obs.).

CONSERVATION STATUS. This species is currently known from only two subpopulations that are here treated as separate locations. A search for this species at other potentially suitable sites within the broad vicinity of

Kankan (for example, at Parc de Diwasi, Tintioulén, Sabadou-Koma and Mandiana) has not uncovered any further subpopulations (P. M. Haba, pers. obs.). This, together with the fact that there are no records of this species prior to 2020, suggests that it is naturally rare and restricted in range. Within the Moyen-Bafing National Park, it has only been observed in a small locality within an area of occupancy (AOO) of under 2 km², supporting fewer than 250 individuals. The species' habitat there faces several human-related threats. First, the plain is used by residents of Keyla and Lamikouré for growing rice and peanuts, so it is regularly cultivated or cleared, although some sections are left fallow, including where the species was found. Second, the fire dynamics are similar to other areas in the park, but this zone is prone to later fires due to its lowland nature and harvesting activities in October–November. While fire may not be inherently harmful to the species' growth, late-season fires are more intense and cause significant damage to trees and soil, which are critical components of the species' habitat. Third, livestock are abundant in the area, though they likely do not prefer this species as forage. Finally, the National Park has a subsoil rich in bauxite and iron, making it a target for potential mining concessions in the coming decades. Currently, no specific management strategy exists to protect this species, though maintaining an open habitat appears necessary. The second location, west of Kankan, supports a low density population over an area of c. 5 ha, with more than 50 individuals. This site is close to the extensive Kiniero gold mine, and is positioned between the mine's processing plant and the airfield near the site access road, hence is likely to be increasingly disturbed. It is also likely to fall within the planned Sabali extension of the mine. Other ongoing threats include gold panning, livestock grazing and bush fires. Therefore, this location is considered to be highly threatened. Given the threats faced by this species at both of the known locations, the highly restricted AOO, and the small number of mature individuals with fewer than 250 in each subpopulation with a projected future decline in this number due to impacts from mining activity at Kiniero, it is reasonable to assess this species, provisionally, as Endangered [EN B2ab(iii); C2a(i)], based on current data. However, more exhaustive surveys in similar habitat across northern and central Guinea and southwestern Mali may well reveal additional sites for this species, at which point it may require reassessment.

ADDITIONAL SPECIMENS EXAMINED. Guinea, Kankan Prefecture, Kiniero Kouroussa à Kankan, 10°24'58.6"N 9°47'1.3"W, 9 Aug. 2020, fl., *P. M. Haba* 1392 (HNG, K! [K001970433]).

ETYMOLOGY. The species is named after the Republic of Guinea, where it is currently believed to be endemic.



Fig. 2. *Cyathula guineensis* I.Darbysh. & C.Rieder sp. nov. in the field in Guinea. **A** habit, flowering plants; **B** inflorescence; **C** detail of inflorescence including open flower; **D** habit, fruiting plants; **E** leaves; **F** detail of inflorescence in fruit, showing the numerous sterile flowers. **A – C** collected as *P. M. Haba* 1392; **D – F** collected as *C. Rieder* 466. PHOTOS: **A – C** P. M. HABA; **D – F** C. RIEDER.

Generic circumscription of *Cyathula* and placement of *Cyathula guineensis*

As traditionally defined, *Cyathula* (e.g., Townsend 1993) comprises species with — among other characters — cymose subunits (cymules) of the inflorescence, that combine hermaphrodite fertile flower(s) with modified sterile flowers (Townsend 1993). The new species of *Cyathula* described here is compared in the diagnosis (Recognition section) to the sympatric *Cyathula pobeguinii* (Jacques-Félix 1950), a range-restricted species that occurs in Guinea, Guinea-Bissau,

Mali and Senegal and is assessed as globally Vulnerable (Couch 2019). *Cyathula pobeguinii* is also to be found in MBNP, although the two species are not known to co-occur. In most species of *Cyathula*, the tepals of the sterile flowers in each cymule are modified into uncinate, straight or glochidiate spines (Townsend 1993). However, in both *C. guineensis* and *C. pobeguinii*, the sterile flowers are not so markedly modified, the processes being non-spinose and remaining tepal-like or bracteolate, although they are variably reduced in size compared to the true tepals and bracteoles. Indeed,



Map 1. Distribution of *Cyathula guineensis* I.Darbysh. & C.Rieder sp. nov. (red dots).

C. pobeguinii was keyed out separately from other members of *Cyathula* in the generic keys of both Keay (1954) and Lisowski (2009) for this reason. The two species are otherwise quite different and are easily separated by the characters listed in the diagnosis. A third species of *Cyathula* with bracteolate, non-spiny sterile flowers is *C. mollis* from the Central African Republic (Townsend 1985b); that species has narrower leaves than *C. pobeguinii* but they are larger than in *C. guineensis* at 35 – 65 mm long, with more prominent venation beneath and are more conspicuously hairy. The inflorescence is also more hairy in *C. mollis* than in *C. guineensis*, the cymules comprise one fertile and two sterile flowers and the tepals of the fertile flowers are shorter, the two external tepals being 8 – 9 mm long (Townsend 1985b) and so more similar to *C. pobeguinii* in that respect.

Based on morphology, *Cyathula guineensis* appears to be a good fit for the genus *Cyathula* as traditionally circumscribed. *Cyathula* cymules typically occur in triads of one fertile and two sterile flowers (Townsend 1993) as in *C. mollis* but in *C. guineensis* there are seven or sometimes ultimately 15 flowers per cymule of which one or usually three are fertile and the remainder are

sterile. However, it should be noted that Jacques-Félix (1950) recorded between two and six sterile flowers associated with a single fertile flower within each cymule in *C. pobeguinii*, hence this character does appear to be variable within the genus.

With these discrepancies in sterile flower form and cymule structure in mind, it would be desirable to confirm the placement of *Cyathula guineensis* (and also *C. pobeguinii* and *C. mollis*) within the classification of Amaranthaceae using molecular phylogenetic evidence. However, generic delimitation within the “achyranthoid” clade of this family, to which *Cyathula* and relatives belong (Müller & Borsch 2005; Di Vincenzo *et al.* 2018, 2024), is in a state of significant flux, with several genera found to be para- or polyphyletic. In the most comprehensive molecular phylogeny of the “achyranthoid” clade to date, Di Vincenzo *et al.* (2018) found that *Cyathula* as currently defined is polyphyletic, with five separate lineages resolved across the “achyranthoid” clade which also contains a range of other, primarily African genera both with and without modified sterile flowers. This confirms some earlier inferences based on morphological evidence. For example, in describing *Cyathula mollis*, Townsend

(1985b) noted that its general aspect is more akin to the East African genus *Sericocomopsis* Schinz than to *Cyathula* but that *Sericocomopsis* differs in lacking sterile flowers, the cymules in that genus comprising solitary or 2–3 fertile flowers only (Townsend 1985a). Townsend also noted that the pollen is virtually identical in these two genera and surmised that they are closely related. Di Vincenzo *et al.* (2018) found that *Sericocomopsis* arises as two separate lineages within a clade comprising most but not all sampled species of *Cyathula* plus some other African genera including the southwest African *Nelsia* Schinz (cymules multi-flowered with both fertile and sterile flowers, the latter bracteoliform and long plumose-pilose) and the single sampled species of the widespread tropical African *Pandiaka* (Moq.) Benth. & Hook.f. (cymules single-flowered, sterile flowers absent). Hence it is clear that both multi-flowered cymules and presence of modified sterile flowers are homoplastic traits in Amaranthaceae that have resulted in problems in generic classification.

Most recently, and published whilst the current paper was under review, Di Vincenzo *et al.* (2024) expanded their taxon and character sampling within their “clade II” of the achyranthoids which includes *Cyathula* s.l. The expanded phylogeny is consistent with their earlier results (Di Vincenzo *et al.* 2018) and led the authors to propose an expanded *Cyathula* that subsumes *Nelsia*, *Pandiaka* and *Sericocomopsis* excluding *S. pallida* S.Moore, which is described as the new genus *Evelynastra* Di Vincenzo, Berends., Wondafr. & Borsch. One species of *Cyathula*, *C. orthacantha* (Hochst. ex Asch.) Schinz, was resolved outside of *Cyathula* s.l. and is also morphologically distinct, hence it was described as the new genus *Sebebea* Di Vincenzo, Berends., Wondafr. & Borsch. *Cyathula guineensis* and allies would fit well within this expanded concept of *Cyathula*.

Epizoochory in *Cyathula guineensis*

The cymules of some Amaranthaceae, including several genera containing sterile flowers such as *Cyathula* and *Sericorema* Lopr., fall wholly or partially at maturity as burr-like units (Townsend 1993; Acosta *et al.* 2009). In this scenario, the development of spinose, often hooked sterile flowers is hypothesised to aid epizoochory, i.e., inadvertent seed dispersal via animals by attaching to their skin or fur using these adhesive structures. This phenomenon occurs in over 80% of the genera in the “achyranthoid” clade (Di Vincenzo *et al.* 2018). The modification of the sterile flowers to being non-spinose in *Cyathula guineensis*, *C. mollis* and *C. pobeguinii* is noteworthy as it might potentially lessen the ability of these species to benefit from epizoochory. In *C. guineensis*, the cymule branches are not well developed at flowering, with the flowers being largely sessile. However, at the fruiting stage, the lateral branches (to 2 or 3 orders)

elongate and curve, such that the fruiting cymule, which can dislodge as a complete unit, is a complex structure with numerous sterile flowers held above the fertile ones and could easily become tangled in animal fur. We hypothesise that it is this complexly branched cymule that aids epizoochory in the case of this species.

Acknowledgements

We extend our gratitude to the following members of the Wild Chimpanzee Foundation for their involvement in the fieldwork and financial support: Christophe Boesch (former Foundation President), Pacifique Kizila (Country Director), Patrick Kasangij (former Park Manager), Youssouf Camara (Fieldwork Assistant), Younoussa Diallo (Fieldwork Driver) and everyone else who contributed in any way. Logistical support was offered by OGP NRF and management funds by Guinea Alumina Corporation (GAC) and Compagnie des bauxites de Guinée (CBG). In Haute Guinée, Société des Mines de Mandiana (SMM) and Tri-K Project, a subsidiary of the Managem Group, facilitated access to the second location for the new species and to the internet. We thank Dr Sékou Magas-souba, Head of the National Herbarium of Guinea, and his staff for providing access to the collections at HNG and loaning the holotype specimen of *Cyathula guineensis* and Dr Xander van der Burgt of Royal Botanic Gardens, Kew for facilitating that loan and processing the specimens of C.R. for dispatch to Kew. We are highly grateful to Andrew Brown for providing the illustration of the new species.

Declarations

Conflicts of interests/Competing interests The authors declare no conflicts of interest/competing interests.

Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article’s Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article’s Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

References

- Acosta, J. M., Perreta, M., Amsler, A. & Vegetti, A. C. (2009). The flowering unit in the synflorescences of Amaranthaceae. *Bot. Rev. (Lancaster)* 75: 365 – 376. <https://doi.org/10.1007/s12229-009-9037-9>.
- Bachman, S., Moat, J., Hill, A. W., de la Torre, J. & Scott, B. (2011). Supporting red list threat assessments with GeoCAT: Geospatial conservation assessment tool. *ZooKeys* 150: 117 – 126. <https://doi.org/10.3897/zookeys.150.2109>.
- Berhaut, J. (1971). *Flore illustrée du Sénégal. Tome 1*. Gouvernement du Sénégal, Ministère du Développement Rural, Direction des Eaux et Forêts, Dakar.
- Boesch, C., Gotanegre, A., Hillers, A., Kouassi, J., Boesch, H., Kizila, P. & Normand, E. (2020). Lessons learned while protecting wild chimpanzees in West Africa. *Amer. J. Primatol.* 83 (4): e23209. <https://doi.org/10.1002/ajp.23209>.
- Burgt, X. M. van der, Haba, P. M., Magassouba, S. & Veranso-Libalah, M. C. (2022). *Benna alternifolia* (Melastomataceae: Sonerileae), a new herbaceous genus and species from Guinea, West Africa. *Willdenowia* 52: 25 – 37. <https://doi.org/10.3372/wi.52.52102>.
- Cavaco, A. (1974). *Amaranthacées*. In: A. Aubréville & J.-F. Leroy (eds), *Flore du Cameroun* 17. Muséum National d'Histoire Naturelles, Paris.
- Cheek, M. & Lebbie, A. (2018). *Lebbiea* (Podostemaceae-Podostemoideae), a new, nearly extinct genus with foliose tepals, in Sierra Leone. *PloS One* 13 (10): e0203603. <https://doi.org/10.1371/journal.pone.0203603>.
- & Luke, Q. (2016). *Calophyllum* (Clusiaceae – Guttiferae) in Africa. *Kew Bull.* 71: 20. <https://doi.org/10.1007/s12225-016-9637-6>.
- , Magassouba, S., Howes, M.-J. R., Doré, T., Doumbouya, S., Molmou, D., Grall, A., Couch, C. & Larridon, I. (2018). *Kindia* (Pavetteae, Rubiaceae), a new cliff-dwelling genus with chemically profiled colleter exudate from Mt Gangan, Republic of Guinea. *PeerJ* 6: e4666. <https://doi.org/10.7717/peerj.4666>.
- , Molmou, D., Jennings, L., Magassouba, S. & Burgt, X. van der (2019). *Inversodicraea koukoutamba* and *I. tassing* (Podostemaceae), new waterfall species from Guinea, West Africa. *Blumea* 64: 216 – 224. <https://doi.org/10.3767/blumea.2019.64.03.03>.
- Couch, C. (2019). *Cyathula pobeguinii*. The IUCN Red List of Threatened Species 2019: e.T85724575A85724637. <https://doi.org/10.2305/IUCN.UK.2019-2.RLTS.T85724575A85724637.en> [Accessed 26 April 2024].
- , Cheek, M., Haba, P., Molmou, D., Williams, J., Magassouba, S., Doumbouya, S. & Diallo, M. Y. (2019). *Threatened habitats and Tropical Important Plant Areas (TIPAs) of Guinea, West Africa*. Royal Botanic Gardens, Kew.
- Di Vincenzo, V., Berendsohn, W., Melaku W. & Borsch, T. (2024). Phylogenetics and morphological character evolution in the achyranthoid clade (Amaranthaceae): Evidence to re-circumscribe the genera *Achyranthes* and *Cyathula* and to resurrect a third species of the former genus *Sericocomopsis* in East Africa. *Taxon* 74: 66 – 100. <https://doi.org/10.1002/tax.13284>.
- , Gruenstaedl, M., Nauheimer, L., Melaku W., Kamau, P., Sebsebe D. & Borsch, T. (2018). Evolutionary diversification of the African achyranthoid clade (Amaranthaceae) in the context of sterile flower evolution and epizoochory. *Ann. Bot. (Oxford)* 122: 69 – 85. <https://doi.org/10.1093/aob/mcy055>.
- Fischer, E., Darbyshire, I. & Cheek, M. (2012). *Striga magnibracteata* (Orobanchaceae), a new species from Guinea and Mali. *Kew Bull.* 66: 441 – 445. <https://doi.org/10.1007/s12225-011-9296-6>.
- Gosline, G., Bidault, E., Burgt, X. van der, Cahen, D., Challen, G., Condé, N., Couch, C., Couvreur, T. L. P., Dagallier, L.-P. M. J., Darbyshire, I., Dawson, S., Dorém, T. S., Goyder, D., Grall, A., Haba, P., Haba, P., Harris, D., Hind, D. J. N., Jongkind, C., Konomou, G., Larridon, I., Lewis, G., Ley, A., Lock, M., Lucas, E., Magassouba, S., Mayo, S., Molmou, D., Monro, A., Onana, J. M., Paiva, J., Paton, A., Phillips, S., Prance, G., Quintanar, A., Rokni, S., Shah, T., Schrire, B., Schuiteman, A., Simões, A. R. G., Sosef, M., Stévant, T., Stone, R. D., Utteridge, T., Wilkin, P., Xanthos, M., NicLughadha, E. & Cheek, M. (2023). A taxonomically-verified and vouchered checklist of the vascular plants of the Republic of Guinea. *Sci. Data* 10: 327. <https://doi.org/10.1038/s41597-023-02236-6>.
- IUCN (2012). *IUCN Red List Categories and Criteria*, Version 3.1. Second Edition. Species Survival Commission, International Union for Conservation of Nature, Gland and Cambridge.
- IUCN (2024). *Guidelines for Using the IUCN Red List Categories and Criteria*. Version 16. Available online at: <https://www.iucnredlist.org/resources/redlistguidelines>. Prepared by the Standards and Petitions Committee, International Union for Conservation of Nature Species Survival Commission, Gland and Cambridge. [Accessed Oct. 2024].
- Jacques-Felix, H. (1950). Une nouvelle espèce de *Cyathula* (Amaranthacées) de Guinée française. *Bull. Soc. Bot. France* 96: 196 – 197. <https://doi.org/10.1080/00378941.1949.10837619>.
- Keay, R. W. J. (1954). *Flora of West Tropical Africa*. Volume 1, Part 1. Second Edition. Crown Agents for Oversea Governments and Administrations, London.

- Lisowski, S. (2009). Flore (Angiospermes) de la République de Guinée. Première partie (texte). *Scripta Botanica Belgica* 41. Jardin Botanique National de Belgique, Meise.
- Müller, K. & Borsch, T. (2005). Phylogenetics of Amaranthaceae based on *matK/trnK* sequence data — evidence from Parsimony, likelihood, and Bayesian analyses. *Ann. Missouri Bot. Gard.* 92: 66 – 102. <https://www.jstor.org/stable/3298649>
- Rieder, C., Couch, C. & Darbyshire, I. (2024). Rediscovery of *Barleria maclaudii* (Acanthaceae) in Guinea after 86 years. *Oryx* 58 (2): 150. <https://doi.org/10.1017/S0030605323001941>.
- Shorthouse, D. P. (2010). *SimpleMappr, an online tool to produce publication-quality point maps*. Available online at: <http://www.simplemappr.net>. [Accessed 20 Oct. 2024].
- Sosef, M., Dauby, G., Blach-Overgaard, A., Burgt, X., van der, Catarino, L., Damen, T., Deblauwe, V., Dessein, S., Dransfield, J., Droissart, V., Duarte, M. C., Engledow, H., Fadeur, G., Figueira, R., Gereau, R. E., Hardy, O. J., Harris, D. J., de Heij, J., Janssens, S., Klomberg, Y., Ley, A. C., Mackinder, B. A., Meerts, P., Poel, J. L. van de, Sonké, B., Stévant, T., Stoffelen, P., Svenning, J.-C., Sepulchre, P., Zaiss, R., Wieringa, J. J. & Couvreur, T. L. P. (2017). Exploring the floristic diversity of tropical Africa. *B. M. C. Biology* 15: 15. <https://doi.org/10.1186/s12915-017-0356-8>.
- Thiers, B. (2025, updated continuously). *Index Herbariorum: a global directory of public herbaria and associated staff*. New York Botanical Garden's Virtual Herbarium. Available online from: <http://sweetgum.nybg.org/science/ih/>. [Accessed 27 Oct. 2025].
- Townsend, C. C. (1985a). *Amaranthaceae*. In: R. M. Polhill (ed.), *Flora of Tropical East Africa*. A. A. Balkema, Rotterdam, Boston.
- ____ (1985b). A new species of *Cyathula* from the Central African Republic. Notes on Amaranthaceae: XVII. *Kew Bull.* 40: 35 – 37. <https://doi.org/10.2307/4108472>.
- ____ (1988). *Amaranthaceae*. pp. 28 – 133. In: E. Launert (ed.), *Flora Zambesiaca* Vol. 9, Part 1. Flora Zambesiaca Managing Committee, London.
- ____ (1993). *Amaranthaceae*. pp. 70 – 91. In: K. Kubitzki, J. G. Rohwer & V. Bittrich (eds), *The Families and Genera of Vascular Plants. II Flowering Plants: Dicotyledons: Magnoliid, Hamamelid and Caryophyllid families*. Springer-Verlag, Berlin, Heidelberg, New York.
- ____ (2000). *Amaranthaceae*. pp. 299 – 335. In: S. Edwards, Mesfin T., Sebsebe D. & I. Hedberg (eds), *Flora of Ethiopia and Eritrea. Volume 2, Part 1: Magnoliaceae to Flacourtiaceae*. The National Herbarium, Biology Department, Science Faculty, Addis Ababa University, Addis Ababa and The Department of Systematic Botany, Uppsala University, Uppsala.

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.