

The genus *Cola* (Malvaceae) in Cameroon's Korup National Park, with two novelties

David Kenfack^{1,*}, Moses N. Sainge², George B. Chuyong³ & Duncan W. Thomas⁴

¹Center for Tropical Forest Science–Forest Global Earth Observatory (CTFS-ForestGEO), Smithsonian Tropical Research Institute, NMNH - MRC 166, P.O. Box 37012, Washington, DC 20013-7012, U.S.A.

²Tropical Plant Exploration Group (TroPEG), P.O. Box 18 Mundemba, Cameroon

³Department of Botany and Plant Physiology, University of Buea, P.O. Box 63 Buea, Cameroon

⁴Department of Biology, Washington State University, Vancouver WA, U.S.A.

*Author for correspondence: kenfackd@si.edu

Background and aims – *Cola*, the second largest genus of the Malvaceae-Sterculioideae comprises 100–135 small to large tree species confined in nature to African forests, though cultivated elsewhere. Current species distribution ranges show that the genus is highly diverse in the seasonally wet forests along the Nigeria-Cameroon border, including the Korup National Park (KNP). In this paper we examine the diversity and abundance of *Cola* in KNP compared to other forests for which comparable data are available. We also describe two novelties in the genus.

Methods – We used inventory data from a 50-ha permanent plot in southern KNP where all *Cola* trees and saplings down to 1 cm in diameter were tagged, mapped and identified. Additional collections of the genus came from the 11 km trail leading to the plot. Classic herbarium techniques and field observations were used for the morphological identification and description of specimens at MO and YA and from our personal collections. *Cola* species richness and abundance was estimated from the plot data and compared to other African forest sites for which comparable data are available. The evaluation of the conservation status of the two new species described in this paper followed the IUCN Red List Categories and Criteria.

Key results – Twenty-five species of *Cola* were identified in the southern part of the KNP, including four undescribed species, raising the total number of *Cola* species in Cameroon to 46. The abundance of the genus in KNP was three orders of magnitude higher than in the Rabi forest in southwestern Gabon or in the Ituri forest in eastern D.R. Congo. This high species richness and abundance suggests that KNP is part of the center of diversity of the genus. Two new species, *Cola zemagoana* Kenfack & D.W.Thomas and *C. mamboana* Kenfack & Sainge are described and illustrated. Both species are only known from the lowland rainforest of southwestern Cameroon. *Cola zemagoana* is narrow endemic of southern KNP and its conservation status is assessed as Endangered. *Cola mamboana* is confined to the lowland forests of southwestern Cameroon, is locally very abundant in protected areas and is also assigned the conservation status Endangered.

Key words – Cameroon, *Cola*, conservation status, Korup National Park, Malvaceae-Sterculioideae.

INTRODUCTION

Cola Schott & Endl. is an iconic genus, with two species that are cultivated across the tropics for their caffeine-rich nuts and that has given its name to the most popular carbonated beverage in the world. It is the second largest genus of Malvaceae-Sterculioideae (or Sterculiaceae s. str.) after *Sterculia*, comprising 100–135 species of understory to canopy trees widespread in continental Africa from Guinea to Ethiopia and South Africa. Only two species are found in South

Africa, 15 in East Africa (Cheek 2007) and about 14 in West Africa, the majority of the species being confined to a forest belt known as Lower Guinea (White 1979) that stretches from SE Nigeria to the mouth of the Congo River. At least 34 species of *Cola* are now recognized in Gabon (Hallé 1961, Breteler 2014a, 2014b) and 32 in the Democratic republic of Congo (Germain 1963). Nkongmeneck (1982) recognized 30 species of *Cola* in Cameroon and described an additional species three years later (Nkongmeneck 1985). Cheek (2002) recognized 23 species of *Cola* in the Mount Cameroon area

including four new species not reported by Nkongmeneck (1982) and three new species, increasing to 38 the number of *Cola* species in Cameroon. Evaluating the relative importance of *Cola* species and their abundance throughout their distributional range can shed light into their center of diversification.

The 1260 km² Korup National Park (KNP, 4°54' to 5°28'N and 8°42' to 9°16'E) is a rainforest located in Cameroon, in the northwestern corner of the Lower Guinea forest. The Korup area with the adjoining Cross-River forest in the neighbouring Nigeria, is one of the floristically richest areas in Africa (Barthlott et al. 1996, Linder 2001). In recent years, the southern part of the KNP has been the subject of botanical inventories and collecting expeditions that has led to the publication of two dozen new species of angiosperms in 21 genera (e.g. Litt & Cheek 2002, Kenfack et al. 2006, van der Burgt et al. 2012, 2014, Ewango et al. 2016).

In the southern part of the park, we established a 50-ha permanent plot to study how diversity is maintained in this forest (Thomas et al. 2003, Chuyong et al. 2004, Kenfack et al. 2007). The establishment of the plot entailed identifying over 300 000 free-standing plants (including *Cola* species) with diameter at breast height greater than or equal to 1 cm. To better identify and document the species of the plot, an intensive botanical collection was performed in the southern part of the park. This paper is the first account of the genus *Cola* in southern KNP based on field observations and collections gathered during this work.

MATERIAL AND METHODS

As part of a global network of large census plots coordinated by the Center for Tropical Forest Science-Forest Global Earth Observatory (CTFS-ForestGEO) of the Smithsonian Tropical Research Institute, we established a long-term monitoring 50-ha plot in southern KNP. During the establishment of the plot, all *Cola* individuals with dbh \geq 1 cm were measured, mapped, tagged and grouped, mostly based on vegetative characters, into putative species. Fertile specimens of each *Cola* were subsequently collected in the area, especially along a 11 km trail in the southern part of the park, from the Mana Footbridge park entrance to the "Chimpanzee Camp" and in the 50-ha permanent plot. The specimens were identified using existing keys or by comparison to type specimens housed at MO, K, L, WAG and YA, and type scans in JSTOR (<https://www.jstor.org>). *Cola* species richness and abundance within the Korup 50-ha plot was compared to inventory data from other sites (SE Cameroon, SW Gabon and eastern D.R. Congo) that used similar data collection protocols. Comparisons were done using one-hectare (100 \times 100 m) plots. Large plots (\geq 10 ha), were subdivided into equivalent areas of one hectare. The number of species in the Korup area was also compared to sites with well-researched species lists. Two new species were described and illustrated, and their conservation status evaluated using the IUCN Red List Categories and Criteria version 3.1 (IUCN 2012). To estimate the Area Of Occupancy (AOO) and the Extent Of Occurrence (EOO), we used the web Geospatial Conservation Assessment Tool or GeoCAT (Bachman et al. 2011).

RESULTS

Taxonomy

A total of 28 species of *Cola* occur in southern part of the Korup National Park, of which 23 are found in the 50-ha plot (Thomas et al. 2003). Twenty-one of the species were keyed to previously described species while four were new to science. Two of the four novelties are described in this paper while two more will remain inedited because of the insufficient material for their full description. The remaining three species, still awaiting collection of fertile material, are considered as imperfectly known and are not treated herein. We have constructed a key for use in the field in the Korup area. This vegetative key to the 25 species is provided in this paper.

Cola zemagoana Kenfack & D.W.Thomas, sp. nov.

Diagnosis – *Cola zemagoana* resembles *C. mayimbensis* Pellegr. in the distichous leaves, the black and shortly-puberulent leafy branches, the short petioles and the articulated flower pedicels. It differs from the latter by the larger leaves (15–30 \times 5–12.5 cm vs. 5.5–12 \times 1.7–4.5 in *C. mayimbensis*), the longer flower pedicels (15–25 mm vs. 5–10 mm in *C. mayimbensis*) and the sparsely stellate-hairy androgynophore (glabrous in *C. mayimbensis*). – Type: Cameroon, Korup National Park, about 4 km from Mana Footbridge, 05°02'22"N, 08°48'21"E, fl., 2 Apr. 1997, D. Kenfack 607 (holo-: MO; iso-: K, P, YA).

Small tree to 12 m tall, 20 cm diameter, densely stellate-hairy, internodes up to 3.5 cm long. Leafy-branches black, 4–6 mm diam, shortly and densely puberulent, with mostly simple hairs, young branchlet and petioles woolly brown. Leaves simple, alternate distichous; petiole (0.6–)1–2.2 \times 0.1–0.35 cm, pulvinate at the distal end, pulvini visible only on fresh specimens, c. 2 mm diameter, densely and shortly puberulous; leaf-blade oblong-elliptic to obovate, glabrous on both surfaces, (11.5–)15–30(–35) \times (3.5–)5–12.5 cm, margin slightly undulate, apex caudate to gradually acuminate, 1.2–2.5 cm long, base broadly cuneate to obtuse, midrib prominent on both surfaces, secondary veins (11–)13–17 pairs, glabrous, prominent on both surfaces, anastomosing about 2–3 mm from the margin, lower order veins prominent on both surfaces. Stipules narrowly triangular, 10–18 mm long, silky on both sides. Flowers in dense fascicles borne on leaf axils or on stem below the leaves, each fascicle with 2–5 flowers and buds in different stages of development; basal bracts up to 8, elliptic to ovate, scabrous to pubescent, 2 cm long, upper bracts linear to subulate, ciliate; pedicel 15–25 mm long, hirsute, articulated slightly below its middle, articulation very inconspicuous; perianth divided about 3/4 of its length into 4 lobes, lobes 4–6 \times 2–4 mm, densely hirsute, with 5–7-armed stellate hairs, glabrous, densely papillate. Staminate flowers with androgynophore 0.5–1 mm long, sparsely stellate-hairy; anthers 4, uniseriate, bilocular, 1 mm long. Carpellate flowers with 4 uniseriate bilocular anthers around the base of the ovary; ovary 4(–5)-carpellate, globose to ovoid, densely hirsute, 2 \times 1.5 mm, locules 5-ovulate; stigma 4(–5), sessile muciculate, generally recurved. Fruit yellow-green to brownish, turning red when mature, with 4

 Vegetative key to the species of *Cola* in southern Korup National Park

1. Leaves compound, digitate2
 1'. Leaves simple, lamina lobed or entire7
2. Leaflets with undersurface completely hidden by silvery scales, leaflets 3, up to 50 cm long and 30 cm broad, shortly petiolulate..... *C. lepidota* K.Schum.
 2'. Leaflets not scaly or only minutely so, leaflets 5–7(–9), green below.....3
3. Main trunk and old wood without inflorescence scars.....4
 3'. Main trunk and old wood with inflorescence scars.....6
4. Leaflets, at least the central one, deeply lobed, never abruptly acuminate, up to 85 cm long, petiole and midrib beneath almost glabrous or stellate-puberulous5
 4'. Leaflets not lobed, very abruptly long-caudate-acuminate at apex, up to 40 cm long, petiole and midrib beneath puberulous *C. rostrata* K.Schum.
5. Leaflets papery or subcoriaceous, gradually acuminate at apices, up to 55 cm long, almost glabrous beneath*C. digitata* Mast.
 5'. Leaflets thickly coriaceous and rigid, obtuse or hardly acuminate at apices, up to 85 cm long, densely stellate-puberulous beneath..... *C. megalophylla* Brenan & Keay
6. Tertiary veins conspicuous, drying yellowish white, contrasting with the areolar tissue; stipules ligulate, flat, to 1.6 × 0.4 cm *C. pachycarpa* K.Schum.
 6'. Tertiary nerves conspicuous, drying the same color as the areolar tissue; stipules folded along midrib, subulate, to 11 × 1.5 cm *C. chlamydantha* K.Schum.
7. Mature leaves mostly deeply digitately lobed.....8
 7'. Mature leaves entire, sometimes obscurely lobed9
8. Leaves deeply 3-lobed, sometimes with 2 additional basal lobes, the lobes separated by open sinuses, their margins not overlapping*C. flaviflora* Engl. & K.Krause
 8'. Leaves 2–3-lobed, rarely entire, branchlets and petiole shortly stellate pubescent
*C. heterophylla* (P.Beauv.) Schott & Endl.
9. Leaves rosulate or in whorls 10
 9'. Leaves sub-opposite to alternate 11
10. Leaves in whorls of 3 to 4..... *C. verticillata* Stapf ex A.Chev.
 10'. Leaves rosulate, in groups of 6–12, with very short internodes, the groups separated by long internodes; leaf-blade oblanceolate, attenuate at base sessile*C. micrantha* K.Schum.
11. Leaves sub-opposite*C. suboppositifolia* Cheek
 11'. Leaves alternate..... 12
12. Leaves distichous, all short-petiolate (petioles less than 2.5 cm long).....
*Cola zemagoana* Kenfack & D.W.Thomas sp. nov.
 12'. Leaves not distichous, long-petiolate or with both long and short petioles (petiole to 52 cm long) .. 13
- 13'. Leaves with both long and short petioles..... 14
 13'. Leaves all long-petiolate 17
14. Stipules persistent at the stem apex, linear *C. flavo-velutina* K.Schum.
 14'. Stipules caducous, narrowly or broadly triangular 15
15. Leaves narrowed to an obtuse or rounded base, dark-green, midrib puberulent on lower surface, secondary veins 10 to 13 pairs*C. praeacuta* Brenan & Keay
 15'. Leaves cuneate at base, yellow-green, midrib glabrous on lower surface secondary veins less than 10 pairs..... 16
16. Flowers on main stem and on old wood *C. mamboana* Kenfack & Sainge sp. nov.
 16'. Flowers on branches*Cola* sp. ined. 1
17. Stem monopodial or few-branched, leaf-blades more than 30 cm long 18
 17'. Stem much branched, leaf blades less than 30 cm long..... 19
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| | | |
|--|---|----|
| 18. Leaves tri-nerved at base..... | <i>Cola</i> sp. ined. | 2 |
| 18'. Leaves not tri-nerved at base | <i>C. semecarpophylla</i> K.Schum. | |
| 19. Leaves cordate at base..... | | 20 |
| 19'. Leaves cuneate at base | | 21 |
| 20. Leaves hirsute, often with ant pouches, understory tree | <i>C. marsupium</i> K. Schum. | |
| 20'. Leaves glabrous, canopy tree..... | <i>C. lateritia</i> K.Schum. | |
| 21. Understory trees, mature plants not exceeding 10 m tall..... | | 22 |
| 21'. Canopy trees, mature plants up to 15 m tall..... | | 23 |
| 22. Petioles glabrous, lamina glabrous..... | <i>C. nigerica</i> Brenan & Keay | |
| 22'. Petioles glabrescent, lamina pubescent..... | <i>C. gabonensis</i> Mast. | |
| 23. Lamina pubescent at least in young leaves, becoming glabrous..... | <i>C. altissima</i> Engl. | |
| 23'. Lamina glabrous, even in young leaves | | 24 |
| 24. Petioles glabrescent, first pair of lateral veins originating from the base of the lamina and running parallel to the margin at 2–4 mm | <i>C. acuminata</i> (P.Beauv.) Schott & Endl. | |
| 24'. Petioles glabrous, lateral veins not originating from the base | <i>C. griseiflora</i> De Wild. | |

fruitlets; peduncle woody, 1.5–2.5 × 0.1–0.2 cm long, glabrescent, articulated about 1/3 of its length from the base, often with tepal remnants at apex; fruitlets pendent, cylindrical, nearly always recurved, with scattered stelate hairs, 7–10 × 1.5–2 cm, usually with a conspicuous beak 1.5–2.5 cm long, stipe c. 1.5 cm long. Seeds 3–5 per fruitlet, 1–2 × 0.5–2 cm. Figs 1 & 2.

Additional material – **Cameroon:** Korup National Park, 05°03'00"N, 08°48'00"E, st., 28 Feb. 1984, *D.W. Thomas* 3206 (MO, YA); Korup National Park, between Ndiang River at Pamol field 69 and 2.5 km at Transect P, 05°01'00"N, 08°50'00"E, fl., fr., 12 Apr. 1985, *D.W. Thomas* 4712 (MO, YA); Korup National Park, about 4.8 km from Mana Footbridge, 05°02'51"N, 08°52'45"E, fl., 2 Apr. 1997, *D. Kenfack* 609 (MO, YA); Korup National Park, hunters trail about 3 km from Rengo Rock Camp, 05°01'00"N, 08°48'21"E, fl., 17 Feb. 2011, *M.S. Sainge* 2607 (MO, YA); Korup National Park, Chimpanzee Camp trail, about 1.9 km from Mana Footbridge, 05°01'27"N, 08°52'09"E, fl., 29 Apr. 2000, *M.S. Sainge* 459 (MO, YA); 05°02'19"N, 08°52'03"E, fl., 18 Apr. 1998, *D. Kenfack* 1091 (MO, YA); Korup National Park, Near Chimpanzee Camp, 05°02'16"N, 08°51'29"E, fl., 22 Jul. 2000, *D. Kenfack* 1390 (MO, YA); Korup National Park, 7.6 km from Mana bridge on chimpanzee trail, 05°04'06"N, 08°52'43"E, fr., 5 Jun. 2011, *M.S. Sainge* 2647 (MO, YA); Korup National Park, 05°04'06"N, 08°52'07"E, fl., *M.S. Sainge* 2007 (MO, YA); Korup National Park, 05°02'38"N, 08°52'33"E, fr., *M.S. Sainge* 579 (MO, YA).

Distribution – *Cola zemagoana* is so far known only from the southern part of the Korup National Park in Cameroon's Southwest Region. The species has not been found in the adjacent Ilor forest, in the Mount Cameroon area about 90 km to the southeast of the KNP (Cheek 2002) or in the Rumpi Hills Forest Reserve about 20 km east of the KNP (Sainge 2016) despite recent detailed botanical surveys in these areas.

Ecology – *Cola zemagoana* is limited to lowland moist forests with a distinct dry season but very high wet-season rainfall, dominated by *Oubanguia alata* Baker f. and supporting

many other species of *Cola*, on well-drained nutrient-poor sandy soils.

Phenology – Flowering is from February to April and fruiting from June to August.

Affinities – With its distichous alternate leaves, *Cola zemagoana* cannot be mistaken for any other species of *Cola* in the field. In fact, field botanists seldom identify this species at its vegetative stage as belonging to the genus.

Etymology – This species is dedicated to memory of the mother of the first author (DK), Zemago Julienne.

Conservation status – IUCN Red List category: Endangered [EN D]. The Extent Of Occurrence (EOO) is estimated to be over 35 km² (less than 100 km² upper limit for Critically Endangered status under the criterion B1) and its minimal area of occupancy (AOO) is estimated using a grid cell of 2 by 2 km to be 32 km² (within the limits for Endangered status under the criterion B2), following the IUCN Red List Categories and Criteria version 3.1 (IUCN 2012). The species is under legal protection in Korup National Park and no indication of any direct threats to the species has been observed. Thus, there is no indication of population decline or fragmentation of its range. However, the species is known only from a narrow area in the southern part of the park from individuals close enough to be considered as a single subpopulation. The species is not abundant locally and we estimate its population to have less than 250 mature individuals. We therefore assess *Cola zemagoana* with the preliminary IUCN Red List status of Endangered EN D.

***Cola mamboana* Kenfack & Sainge, sp. nov.**

Diagnosis – *Cola mamboana* with the variable petiole length, the lamina shape, size and the number of secondary veins closely resembles *C. attiensis* Aubrév. & Pellegr., but differs from the latter by the glabrous and articulated flower pedicels, the 5- ovulate locules (vs. 1–2 in *C. attiensis*),

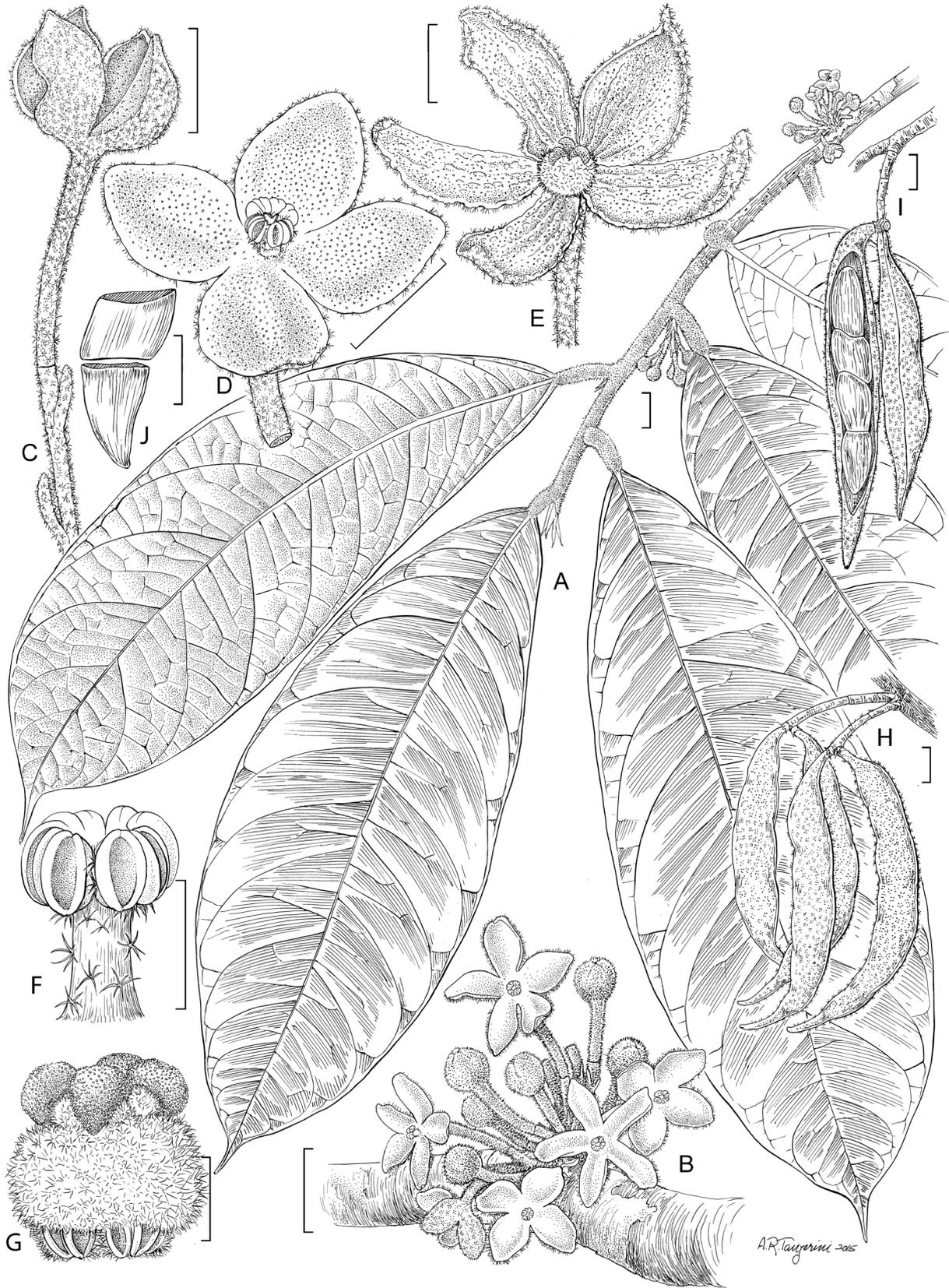


Figure 1 – *Cola zemagoana* : A, leafy twig with flowers; B, inflorescence; C & D, staminate flower; E, carpellate flower; F, androgynophore; G, gynoeccium; H, fruit; I, opened fruit; J, seed. Scale bars: A & H–J = 1 cm, B = 5 mm; C–E = 3 mm; F & G = 1 mm. Drawn by Alice Tangerini. A–D & F from Kenfack 607; E & G from Kenfack 1091; H–J from Sainge 2647.

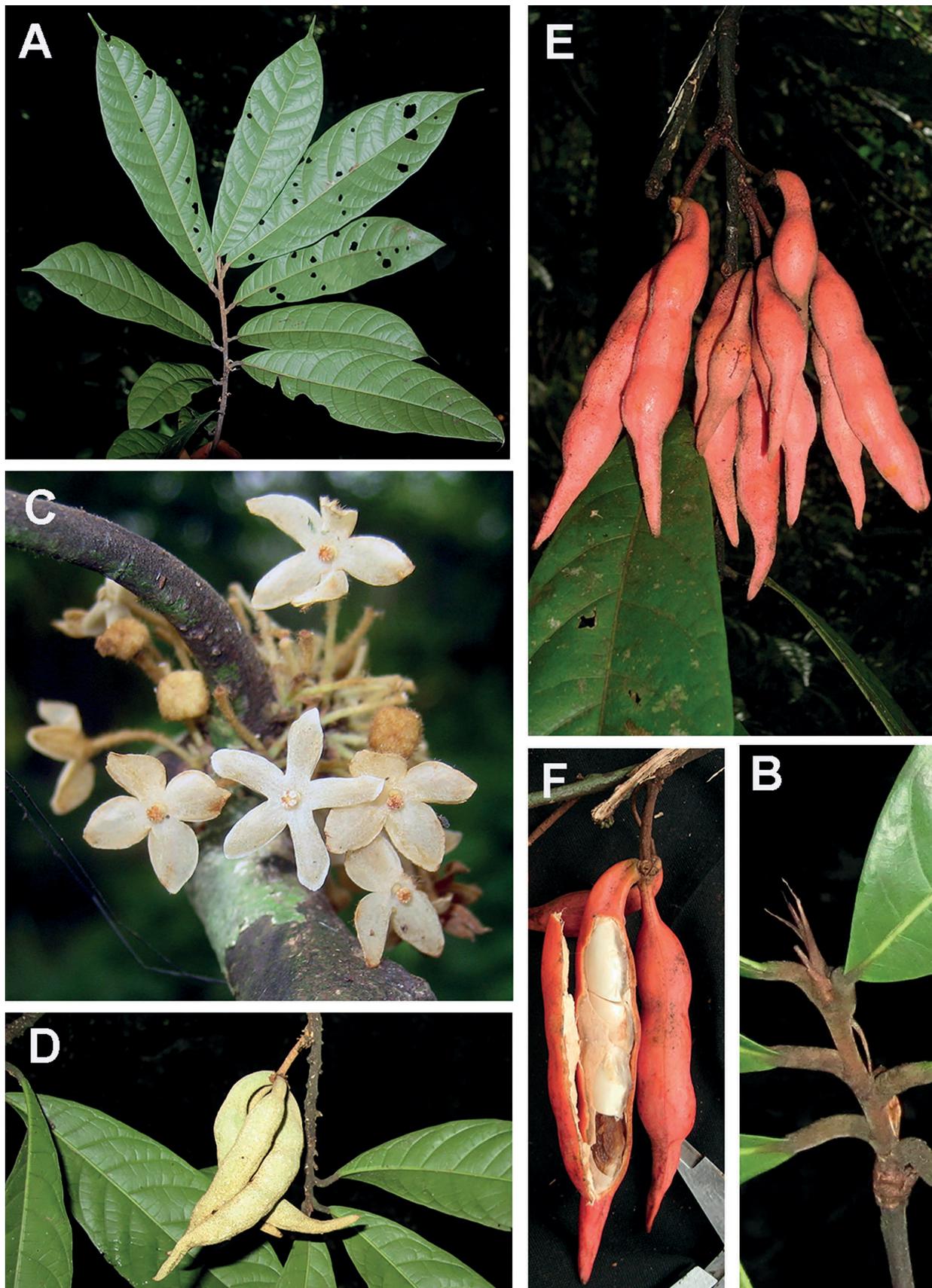


Figure 2 – *Cola zemagoana*: A, leafy twig from below; B, stipules; C, fascicles; D, immature fruit; E, mature fruits (from more than one flower); F, opened fruitlet showing seeds. Photographs: A, B & D by D. Kenfack; C, E & F by M. Sainge.

and the non-apiculate fruitlets. – Type: Cameroon, Southwest Region, Korup National Park, near Chimpanzee Camp, 05°04'09"N, 08°51'36"E, fl., 20 Feb. 1997, *D. Kenfack* 578 (holo-: YA; iso-: MO, K, US).

Small tree to 5 m tall, 9 cm diameter, glabrescent to puberulent, internodes up to 4 cm long. Leafy branches puberulent with mostly simple short hairs. Leaves simple, alternate-spiral; petiole (0.5–)1–3.5 × 0.1–0.15 cm, pulvinate at both ends, 0.1–0.22 mm diameter, shortly puberulent; leaf-blade elliptic, glabrous on both surfaces, (7–)10–27 × (2–)4–12.5 cm, margin slightly undulate, apex caudate to gradually acuminate, 1–2 cm long, base narrowly attenuate-truncate, midrib prominent on both surfaces, secondary veins 7–11 pairs, glabrous, prominent on both surfaces, anastomosing about 3 mm from the margin, lower order veins prominent on both surfaces. Stipules triangular, 7 mm long, glabrous. Flowers in dense fascicles borne mostly on the main trunk and older branches, not axillary, each fascicle with 2–4 flowers; basal bracts up to 9, elliptic to ovate, stellate hairy outside, glabrous inside, 1–2.5 × 0.5–1 cm long, upper bracts absent; pedicel glabrous, 8–15 mm long, articulated about 1/3 of its length from the base; perianth divided 3/4 of its length into 5 lobes, lobes 2.8–3.5 × 1.5–2 mm, glabrous outside, but with scattered reddish stellate hairs towards the apex of the lobes, densely papillate inside. Staminate flowers with androgynophore 0.4–1 mm long, sparsely pubescent; anthers 5, uniseriate, bilocular, 1 mm long. Carpellate flowers with 5 sterile uniseriate bilocular anthers around the base of the ovary; ovary (4–)5-carpellate, globose, densely pubescent, 1.5 × 1.2 mm, locules 5-ovulate; stigma 4, ~1.5 mm long, capitate, muricate, black. Fruit red when ripe with up to 5 fruitlets; peduncle woody, 1.6–3.2 × 0.3–0.6 cm long, glabrous; fruitlets subglobose to oblong, glabrous, 2–6 × 1–5.5 cm, usually not beaked, stipe c. 0.5 cm long. Seeds 2–5 per fruitlet, (0.7–)1–2.7 × (0.4–)0.8–2.4 cm. Figs 3 & 4.

Additional material – **Cameroon:** Korup National Park, 05°02'38"N, 08°51'54"E, fl., *M.S. Sainge* 1869 (MO, YA); Korup National Park, along transect P, 05°01'00"N, 08°51'00"E, st., 16 Feb. 1986, *D.W. Thomas* 5602 (MO, YA); Korup National Park, transect P, 05°01'00"N, 08°51'00"E, fl., 10 Mar. 1986, *D.W. Thomas & H.L. Mcleod* 5813 (MO, YA); Korup National Park, Chimpanzee Camp, 05°04'09"N, 08°51'36"E, fl., 7 Jan. 2000, *M. Sainge & P. Mambo* 227 (MO, YA); Korup National Park, Korup plot, 05°04'26"N, 08°51'07"E, fr., 27 Jun. 2011, *M.S. Sainge* 2747 (MO, YA); Korup National Park, lowland rain forest, 05°01'00"N, 08°50'00"E, fl., 27 Mar. 1985, *D.W. Thomas* 4587 (MO, YA); Korup National Park, along transect P, 05°01'00"N, 08°51'00"E, fl., 16 Feb. 1986, *D.W. Thomas* 5624 (MO, YA); Korup National Park, Korup 50-ha plot, 05°04'26"N, 08°51'07"E, fr., 9 Jun. 2011, *M.S. Sainge* 2719 (MO, YA); Korup National Park, Korup 50-ha plot, 05°04'26"N, 08°51'17"E, fl., 13 Feb. 2010, *M.S. Sainge* 2103 (MO, YA); Korup National Park, around km 4, trail to Chimpanzee Camp, 05°01'01"N, 08°48'21"E, fr., 15 Jun. 1997, *D. Kenfack* 817 (MO, YA); Korup National Park, about 7.4 km from Mana Footbridge to Chimpanzee Camp, 05°04'06"N, 08°52'43"E, fr., 22 Jul. 2000, *D. Kenfack* 1380 (MO, YA); Korup National Park, near Chimpanzee Camp, 05°01'04"N, 08°48'17"E, fl., 12 Mar. 1998, *D. Kenfack* 611 (MO, YA).

Distribution – Rainforests of Cameroon's Southwest Region, in the Ndiian Division.

Ecology – *Cola mamboana* is a dominant understory tree of moist evergreen forests dominated by *Oubanguia alata*

Baker f. and *Dichostemma glaucescens* Pierre. In the Korup plot, this species is found in densities of over 215 individuals/ha in all five topographic habitats (low depressions, low flat, high gullies, slopes and ridge top), with the highest density of 311 individuals/ha attained in high gullies (Chuyong et al. 2011).

Phenology – Flowers were collected from January to March and fruits in June and July.

Note – *Cola mamboana* is often misidentified as *C. attien-sis*. Indeed, the leaves of both species have variable petioles in the same branch, glabrous lamina of comparable size and shape and bare flowers on the main trunk and old wood. The two species however have clear differences in flowering and fruiting material. *C. mamboana* is sympatric with *C. flavovelutina* in the Korup National Park. The leaves of the two species are also very similar. The persistent terminal stipules at the end of the branchlets of *C. flavovelutina* (vs. caducous in *C. mamboana*) is the main discriminating character of these species in their vegetative stage.

Etymology – The species is dedicated to Peter Mambo Ekole in recognition of the immense role that he has played in the field identification of trees and lianas in the 50-ha Korup plot.

Conservation status – IUCN Red List category: Endangered [EN B1ab(iii) + B2ab(iii)]. The Extent Of Occurrence (EOO) of *Cola mamboana* is estimated to be over 157.6 km² (less than 5000 km² upper limit for Endangered status under the criterion B1) and its minimal area of occupancy (AOO) is estimated using a grid cell of 2 by 2 km to be 32 km² (within the limits for Endangered status under the criterion B2), following the IUCN Red List Categories and Criteria Version 3.1 (IUCN 2012). *C. mamboana* is under legal protection in Korup National Park where it is very common. It is the 6th most abundant species in the Korup 50-ha permanent plot (Kenfack et al. 2007), with an average density of 247 individuals per hectare (Chuyong et al. 2011). There is no indication of population decline or fragmentation of its range. Rather, the subpopulation of this species in Korup National Park seem to be very stable. The monitoring of 12 381 individuals (with dbh ≥ 1 cm) within the 50-ha Korup plot showed a net population increase of 556 individuals in a 10.21 years interval. The subpopulation of the Rumpi Hills Forest Reserve is also under protection, but agricultural encroachments occur into the reserve and affect the quality of the habitat of the species. The species is thus known from two locations (Korup and Rumpi Hills). We are therefore assigning *Cola mamboana* the preliminary IUCN Red List status of EN B1ab(iii) + B2ab(iii).

The Colas of Korup National Park and Southwestern Cameroon

Twenty-five species of *Cola* were identified in the southern part of the KNP, including the two new species described here, two still undescribed species, and four additional species not mentioned by previous authors, raising the total number of *Cola* species in Cameroon to 46. The 25 species represent seven of the eight subgenera recognized in the genus (Hallé 1961, 1962), including canopy and understory

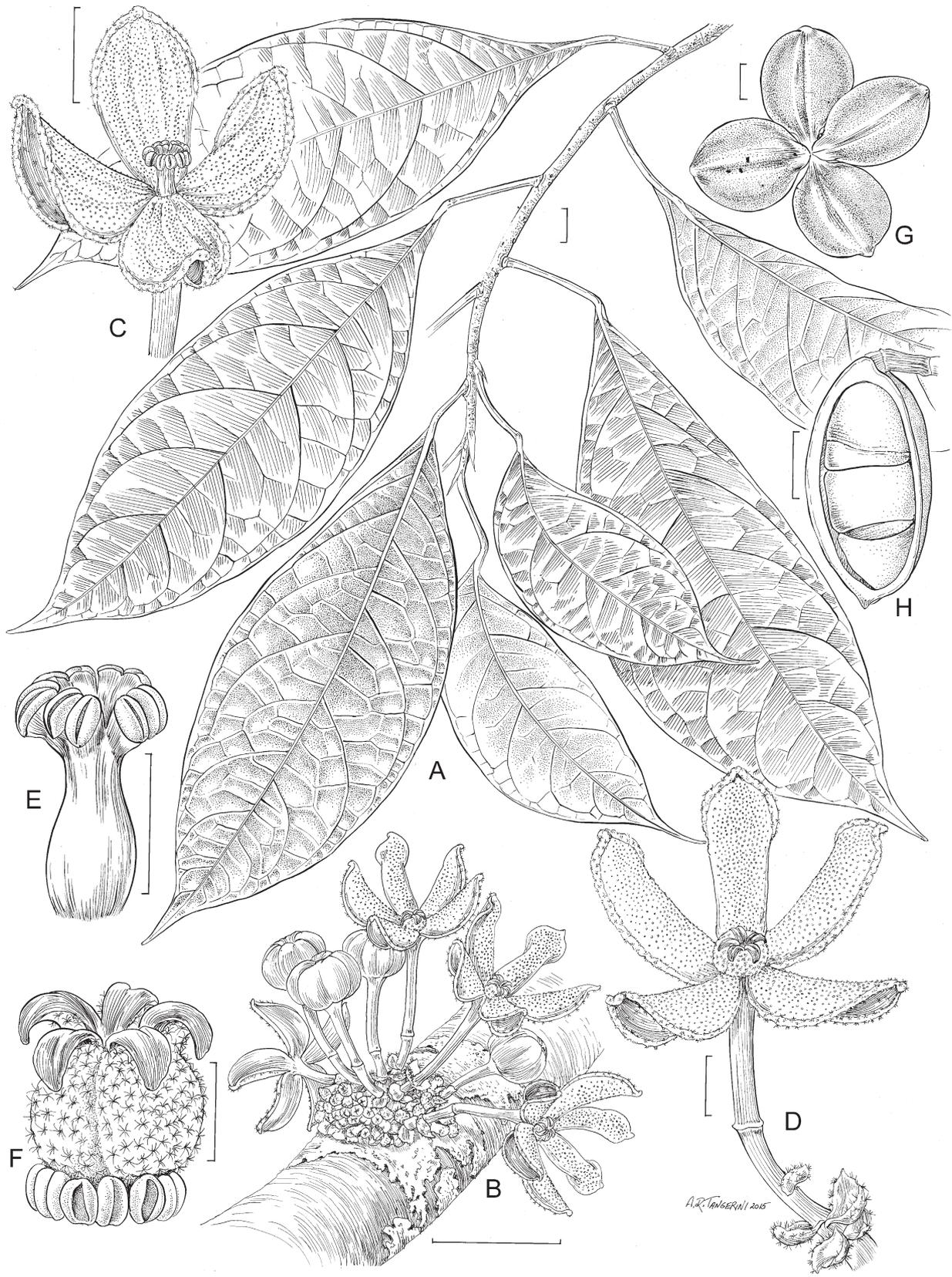


Figure 3 – *Cola mamboana*: A, leafy twig; B, inflorescence; C, staminate flower; D, carpellate flower; E, androgynophore; F, gynoeceum; G, fruit; H, opened fruit. Scale bars: A, B, G & H = 1 cm; C & D = 2 mm; E & F = 1 mm. Drawn by Alice Tangerini. A–C & E from Sainge 1869; D & F from Kenfack 578; G & H from Sainge 2747.

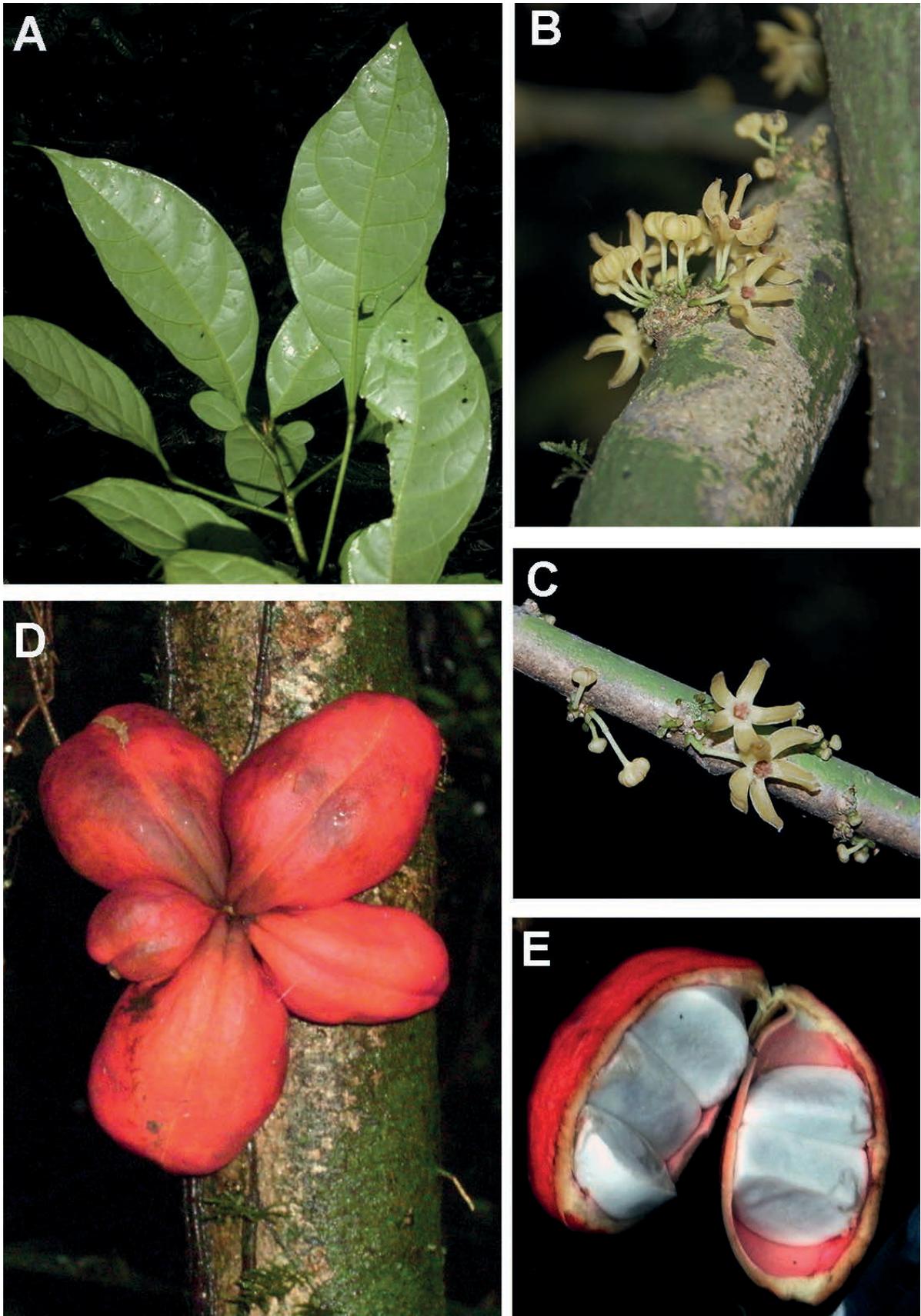


Figure 4 – *Cola mamboana*: A, leafy twig from below; B, dense fascicle; C, lax fascicle; D, mature fruit; E, opened fruitlet showing seeds. Photographs by D. Kenfack.

Table 1 – Comparison of *Cola* species richness among forest plots in Africa where all freestanding trees down to 2 cm have been enumerated.

Korup = 50-ha plot in lowland seasonal wet forest in the Korup National Park, Cameroon; Green Valley = six noncontiguous 1-ha plots in the Green Valley logging concession in Semi deciduous forest south of Yokadouma, SE Cameroon; SEFAC (Société d'Exploitation Forestière et Agricole du Cameroun) = four 1-ha plots in the SEFAC logging concession in semi-deciduous forest in SE Yokadouma, also in SE Cameroon; Monts de Crystal = 1-ha plot in the seasonally wet forest in the Monts de Crystal, NW Gabon, Rabi = Rabi 25-ha plot, Gabon; Eodoro1 and Eodoro2 = 10-ha plots in mixed forest in the Ituri Forest Reserve, D.R. Congo; Lenda1 and Lenda2 = 10-ha plots in monodominant forest also in the Ituri Forest Reserve, D.R. Congo. N= total number of individuals, S = total number of *Cola* species in a 1-ha sample, and SD is the standard deviation of the 1-ha samples.

| Plot | Mean S ha ⁻¹ | SD S ha ⁻¹ | Mean N ha ⁻¹ | SD N ha ⁻¹ | % Total stems |
|-------------------------|-------------------------|-----------------------|-------------------------|-----------------------|---------------|
| Korup, Cameroon | 10.2 | 1.5 | 1033.8 | 456.3 | 25.9 |
| Green Valley, Cameroon | 2.8 | 1.8 | 18.8 | 20.5 | 0.6 |
| SEFAC, Cameroon | 2.5 | 1.0 | 10.5 | 4.0 | 0.4 |
| Rabi, Gabon | 2.0 | 0.9 | 30.4 | 54.4 | 0.6 |
| Monts de Crystal, Gabon | 3.0 | – | 15.0 | – | 0.4 |
| Eodoro 1, D.R. Congo | 2.9 | 0.6 | 38.2 | 13.4 | 0.9 |
| Eodoro 2, D.R. Congo | 2.6 | 0.7 | 37.2 | 9.7 | 1.2 |
| Lenda 1, D.R. Congo | 5.0 | 0.9 | 31.9 | 20.6 | 0.9 |
| Lenda 2, D.R. Congo | 4.6 | 0.8 | 28.7 | 7.7 | 0.8 |

trees, species with simple, compound, lobed, alternate, sub-opposite, verticillate and rosulate leaves.

Many *Cola* species in southern KNP occur in strict sympatry. Within the 50-ha plot, there are an average of 11.1 (range 8–17) species of *Cola* per hectare. These species are also very abundant locally. The genus *Cola* represents 20% of the total number of trees in the 50-ha plot, with an average density of 1405 individuals per hectare. The high density of the genus *Cola* in the Korup plot is due to a few species that dominate the forest understory. Four *Colas* (*C. semecarpophylla*, *C. praeacuta*, *C. mamboana* and *C. flavo-velutina*) are among the ten most abundant tree species in the Korup plot (Kenfack et al. 2007). The Korup National Park may correspond to the center of the range of these species since the highest abundance of a species usually occurs towards the center of its range (Brown 1984).

Korup richness in *Cola* species is more than twice as high as the next richest plot for which comparable plot data are available (Lenda 1, a mixed evergreen/semi-evergreen forest in the eastern D.R. Congo, table 1). In terms of abundance, *Cola* is about 25 times more abundant in the Korup plot than in second-ranking plot (Lenda 1 again, table 1). Rather surprisingly, *Cola* in Korup has even higher relative species richness and abundance when compared to the Gabonese plots at Rabi and the Monts de Cristal, all located in the same Lower Guinea forest block (table 1).

A less precise metric for comparing Korup to other forest areas is the number of *Cola* species collected during intensive botanical collecting expeditions. Southern Korup with 25 species can be compared to the forests on and around Mount Cameroon (24 species, Cheek 2002), Kupe, Mwanengumba and Bakossi mountains (23 species, Cheek et al. 2004) and the montane forests of the Mount Oku region, Cameroon (1 cultivated species, Cheek et al. 2000). Korup, Kupe, Mwanengumba, Bakossi and Mount Cameroon are all within 100 km in a more or less continuous block of rain

forest that contains several mountain ranges. This appears to be the approximate area in which a high diversity of *Cola* occurs. Drier forests and montane forests have low *Cola* diversity, even when they are located close to the Bakossi-Kupe Mwanengumba-Korup- Mt. Cameroon area. This area is unique in several ways. It has a series of mountain ranges 1700 m and higher, and it has an unusual pseudoequatorial climate with a short dry season and a long and often heavy wet season, with annual totals that can exceed 5000 mm in Korup (Chuyong et al. 2004). We do not know which of the unique features of the area help to support the very high *Cola* species-richness and abundance of *Cola*.

The forest of Southwestern Cameroon including the Korup National Park and the nearby Mount Cameroon area, with 76% of the Cameroonian species, is one of the areas of highest species-richness of *Cola*. Species in this area exhibit the whole suite of morphological characters of the genus, and include representatives of almost all subgenera recognized in the genus. Southwestern Cameroon also has a significant number of endemic species (12), shares a number of species with the rest of Cameroon (20), with Gabon (16) and the D.R. Congo (4). The high species richness in *Cola* within the forest block between the Cross River in SE Nigeria and the Mungo River in Southwestern Cameroon, including the KNP and the Mount Cameroon area, has already been documented (Cheek 2002). The forests of southwestern Cameroon are likely a major center of diversification for the genus. A molecular phylogeny of *Cola* would be valuable to test this hypothesis.

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