

Ternstroemia guineensis (Ternstroemiaceae), a new endangered cloudforest shrub with neotropical affinities from Kounoukan, Guinea, W Africa

Authors: Cheek, Martin, Haba, Pepe M., Konomou, Gbamon, and Van Der Burgt, Xander M.

Source: Willdenowia, 49(3) : 351-360

Published By: Botanic Garden and Botanical Museum Berlin (BGBM)

URL: <https://doi.org/10.3372/wi.49.49306>

BioOne Complete (complete.BioOne.org) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/terms-of-use.

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

MARTIN CHEEK^{1*}, PEPE M. HABA^{2,3}, GBAMON KONOMOU³ & XANDER M. VAN DER BURGT¹

Ternstroemia guineensis (*Ternstroemiaceae*), a new endangered cloudforest shrub with neotropical affinities from Kounounkan, Guinea, W Africa

Version of record first published online on 26 November 2019 ahead of inclusion in December 2019 issue.

Abstract: *Ternstroemia guineensis* is described from a sandstone table mountain at Kounounkan, possibly the last in the Fouta Djallon (Guinea Highlands) to remain largely unimpacted by humans and to have mainly intact natural habitats. It occurs about 2400 km westward of the nearest existing record (Nigeria) of the genus in Africa. It is confined to cloud (submontane) forest in galleries along watercourses. Its conservation status is assessed as Endangered using the IUCN 2012 criteria. The species differs from the other two African highland species, *T. cameroonensis* and *T. polypetala*, in having hermaphrodite flowers with a long subcylindric style and punctiform stigmas, and petals connate at the base into a tube (not dioecious, with a short style and cone-like stigmas, and free petals) resembling in these features the neotropical *Ternstroemia* species, as does also the lowland wetland *T. africana* of Nigeria, Gabon and Angola.

Key words: Amphi-atlantic, conservation, Guinea, Guinea Highlands, Kounounkan, medicinal, new species, *Pentaptylaccaceae*, relic, *Ternstroemia*, *Ternstroemiaceae*, *Theaceae*, West Africa

Article history: Received 22 May 2019; peer-review completed 26 July 2019; received in revised form 2 August 2019; accepted for publication 14 August 2019.

Citation: Cheek M., Haba P. M., Konomou G. & Burt X. M. van der 2019: *Ternstroemia guineensis* (*Ternstroemiaceae*), a new endangered cloudforest shrub with neotropical affinities from Kounounkan, Guinea, W Africa. – Willdenowia 49: 351–360. doi://doi.org/10.3372/wi.49.49306

Introduction

In November 2017, the last three authors were on a botanical survey team seeking to discover the most important surviving areas for plant conservation in Guinea following the criteria of Darbyshire & al. (2017) and Darbyshire (2019+). The object is to evidence Important Plant Areas and to prioritize them for protection. The November 2017 survey was at Kounounkan Forest Reserve, the largest surviving remnant of forest in Fouta Djallon. Among the herbarium specimens collected was one, *Pepe Haba* 1060, which was identified as a *Ternstroemia* Mutis ex L. f. This specimen was collected about 2400 km westward of the nearest existing record of the genus in Africa. It is superficially similar to the recently described *T. cameroonensis* Cheek (Cheek & al. 2017) of Cam-

eroon to the east. Close inspection showed it to be different from all other species of the genus known in Africa by the absence of any visible secondary nerves and from the other African highland species in the leaves arranged in pseudo-verticils and lacking *Terminalia*-branching. Rehydration and dissection of the flowers showed further points of difference (see Table 1). Attempts were made to key out the specimen in the three regional treatments of *Ternstroemia* for the Neotropics (Kobuski 1942a, 1942b, 1943) and it was compared with material of neotropical species at Kew, but no match was found. Accordingly, it is described in this paper as *T. guineensis* Cheek, sp. nov. Additional specimens with fruit developed were collected on a follow-up visit by the three last authors in February 2019, and ripe fruit were observed and seed collected (*Konomou* 691) in May 2019.

1 Science, Royal Botanic Gardens, Kew, TW9 3AE, U.K.; *e-mail: m.cheek@kew.org (author for correspondence).

2 Guinée Biodiversité, Conakry, Guinea.

3 Herbar National de Guinée, Université Gamal Abdel Nasser, Conakry, Guinea.

Ternstroemia

The genus *Ternstroemia* is pantropical, extending into subtropical and temperate areas (Stevens 2001+; Weitzman & al. 2004). Estimates of species numbers range from c. 100 (Stevens 2001+) to 152 (Plants of the World Online 2018+). Of these 152 species, 101 are Neotropical, just three African, with 31 in Malesia (SE Asia), one (*T. cherryi* (F. M. Bailey) Merr. ex J. F. Bailey & C. T. White) extending to N Australia, with 15 species in China, Indo-China, Japan and Tibet, and one species, *T. gymnanthera* (Wight & Arn.) Bedd., extending to India. The genus is absent from Madagascar, the Indian Ocean, all but W Oceania, and from N temperate areas apart from China and Japan. Most of the species are montane and submontane and are absent from lowland habitats apart from some species in swamp forest. The genus is incompletely known, especially in the neotropics: in local Floras, species remain formally unnamed, for example in the Venezuelan Guayana (Berry & Weitzman 2005) and in Guaramacal (Venezuelan Andes) (Dorr & al. 2000: 144).

Several species are used in traditional medicine, for example, in Mexico, *Ternstroemia oocarpa* Melch., *T. pringlei* Standl., *T. sylvatica* Schltld. & Cham., are all used for treating “nervios”, depression and anxiety (Guzmán-Gutiérrez & al. 2014). Phytochemical studies of *Ternstroemia* species have reported the isolation of oleanane- and ursane-type triterpenoids, triterpenoid glycosides, triterpenoid saponins, carotenoids, monoterpenoids, tannins (Balderas-López & al. 2013). Triterpenoid saponins have been reported from the fruits of *T. gymnanthera* (as *T. japonica*) in Asia (Shin & al. 2003). *Ternstroemia cherryi* is used as a fish poison in N. Australia (Williams 2012). In Africa, *T. cameroonensis* has numerous medicinal uses (Cheek & al. 2017).

The genus was formerly included in *Theaceae* together with *Ficalhoa* Hiern (now usually placed in *Sladeniaceae*) e.g. in Verdcourt (1962). *Ternstroemia* is now placed in *Ternstroemiaceae* (*Ericales*) together with *Balthasaria* Verdc. (also Tropical Africa) and in Macaronesia *Visnea* L. f. (Weitzman & al. 2004). The remaining nine genera of *Ternstroemiaceae* occur mainly in Tropical Asia, but with two genera restricted to the Neotropics (Weitzman & al. 2004). By some, *Ternstroemiaceae* is merged with *Pentaphylacaceae* where the latter unfortunately takes preference (*nom. cons.*) (Culham 2007; Stevens 2001+). However, the sister relationship of *Ternstroemiaceae* and *Pentaphylacaceae* is uncertain (Stevens pers. comm. 2017).

The number of species described as new to science each year regularly exceeds 2000, adding to the estimated 369 000 already known (Nic Lughadha & al. 2016), although the number of flowering plant species known to science is disputed (Nic Lughadha & al. 2017). Only about 7% of plant species have been assessed and included on the Red List using the IUCN (2012) standard (Bachman & al. 2019), but this number rises to 21–26%

when additional evidence-based assessments are considered, and 30–44% of these assess the species as threatened (Bachman & al. 2018). Newly discovered species such as that reported in this paper are likely to be threatened, since widespread species tend to have been already discovered. There are notable exceptions to this rule (e.g. *Vepris occidentalis* Cheek (Cheek & al. 2019) a species widespread in W Africa from Guinea to Ghana). Generally, it is the more localized, rarer species that remain undiscovered. This makes it all the more urgent to discover, document and protect such species before they become extinct or possibly extinct e.g. as is *Inversodicraea pygmaea* G. Taylor in Guinea (Cheek 2018; Couch & al. 2019), or in the case of another cloud forest tree *Vepris bali* Cheek (Cheek & al. 2018a).

Material and methods

All specimens cited have been seen by the authors. Herbarium citations follow *Index herbariorum* (Thiers 2019+), the *International Code of Nomenclature for algae, fungi, and plants* (Turland & al. 2018) and the *International Plant Names Index* (IPNI 2019+). The conservation assessment was made using the categories and criteria of IUCN (2012). Herbarium material was examined with a Leica Wild M8 dissecting binocular microscope fitted with an eyepiece graticule measuring in units of 0.025 mm at maximum magnification. The drawing was made with the same equipment using Leica 308700 camera lucida attachment.

Results and Discussion

The characters separating *Ternstroemia guineensis* from the other African species of the genus are given in Table 1 and a key to the identification of the African species is also presented.

Key to the African species of *Ternstroemia*

1. Shrubs to 5 m tall, rarely a tree to 9 m tall; secondary nerves not visible on leaves. Guinea (W Africa) *T. guineensis*
- Trees 10–15 m tall (rarely shrubs), secondary, and usually tertiary nerves plainly visible on leaves. C and E Africa (SE Nigeria eastward) **2**
2. Trees (rarely shrubs) of coastal, near sea-level, high-water-table habitats; fruit pendulous, with style 4–6 mm long *T. africana*
- Trees of inland mountains, 1800–2300 m alt., on steep slopes; fruit spreading, style <1 mm long . . . **3**
3. Trees of Tanzania and Malawi; peduncle 20–30 mm long at anthesis; bracts clearly alternate, triangular, as long or longer than wide *T. polypetala*

Table 1. Characters separating *Ternstroemia guineensis* from *T. polypetalata*, *T. cameroonensis* and *T. africana*. Data on *T. polypetalata* from Verdcourt (1962), on *T. cameroonensis* from Cheek & al. (2017) and on *T. africana* from Kobuski (1961).

	<i>T. guineensis</i>	<i>T. polypetalata</i>	<i>T. cameroonensis</i>	<i>T. africana</i>
Altitudinal range	900–1100 m	1800–2300 m	1900–2300 m	0–50 m
Geography	Guinea	Tanzania–Malawi	Cameroon	Nigeria–Angola
Breeding system	hermaphrodite	dioecious	monoecious	hermaphrodite
Leaf dimensions	(2.5–)3.7–6.1(–6.7) × (1.3–)1.6–2.5(–3) cm	4.5–9 × 1.5–2.5 cm	(2.3–)5–7.2(–9) × (0.7–)1.7–2.8 cm	(4–)8–10 × (2–)4–5 cm
Secondary nerves	not visible	conspicuous	conspicuous	visible
Quaternary nerves	not visible	conspicuous, reticulate	not visible	not visible
Petals	5, proximal quarter strongly connate	7–10, free	7 or 8, free	5, lightly connate at base
Stamens	20–25, uniseriate	c. 60, multiseriate	35–40, uniseriate	15–20, uniseriate
Connective appendage	present	present	absent	present
Locule number, placentation	bilocular, axile placentation	bilocular, axile placentation	unilocular apical placentation	bilocular, axile placentation
Style-stigma	stigma punctiform, inconspicuously and minutely bilobed at end of a long style	stigma subsessile, forming a 2(or 3)-lobed dome over ovary	stigma subsessile forming a 2(or 3)-lobed dome over ovary	stigma punctiform at end of a long style

- Trees of Cameroon; peduncle 8–12 mm long at anthesis; bracts opposite, transversely elliptic, broader than long *T. cameroonensis*

Ternstroemia guineensis Cheek, **sp. nov.** – Fig. 1, 2.

Holotype: Guinea, Forécariah Préfecture, S part of Kounoukan Plateau, 09°32'55.5"N, 12°51'35.6"W, 910 m, fl., 26 Nov 2017, P. M. Haba with X. M. van der Burgt, L. Jennings & G. Konomou 1060 (K K001286639; isotypes: HNG, MO, P, US, WAG).

Diagnosis — Similar to *Ternstroemia africana* Melch., differing in the smaller leaves (2.5–)3.7–6.1(–6.7) × (1.3–)1.6–2.5(–3) cm, secondary nerves not visible, (not (4–)8–10 × (2–)4–5 cm, secondary nerves visible, c. 7 pairs); petiole margins entire or with 1–2 setae (not densely glandular denticulate); peduncles 1.4–2.4 cm long (not 3–4.5 cm long).

Description — Hermaphrodite multi-stemmed shrub to 5 m tall (Fig. 2E), rarely a tree to 9 m high and then trunk c. 18 cm in diam. at 1.3 m above ground, glabrous. Trunk and large branches with thick, tessellated, grey bark, tessellations more or less isodiametric, each 2–3 cm in diam., separated by deep fissures (Fig. 2F). *Branches* all erect, leafy branchlets pseudo-verticillate (loose verticils of (2 or)3 or 4 leaves separated by 1.25–3.1 cm of leafless stems (Fig 2B)). Stems grey, subterete, 2–2.5 mm in diam. at lowest leafy node, wrinkled. Apical bud curved, cornute c. 2 × 1 mm, subtended by two unequal scale leaves in dry season (Feb), largest oblong-elliptic 5–5.5 × c. 2 mm, apex acute, with a black conical gland, margins reflexed, each with c. 14 smaller, regularly spaced glands. New shoots probably arising in early wet season

(June–July), from dormant apical bud. First, 2 or 3(or 4) internodes very short (<1 mm long), followed by 2–3 longer internodes (each 5–7 mm long), probably with caducous scale-leaves (not seen), distal part of shoots with 3–4 fully-formed leaves at nodes <1 mm apart (pseudoverticils). *Leaves* with spiral phyllotaxy, persisting for three season's growth: blade coriaceous, surface wrinkled and verrucate, drying green, obovate to obovate-elliptic, length: breadth ratio c. 2:1, (2.5–)3.7–6.1(–6.7) × (1.3–)1.6–2.5(–3) cm, apex rounded or obtuse, base gradually decurrent into slightly winged petiole, margin revolute, with 12–15 inconspicuous dark spots 5–7 mm apart on each side (Fig. 1B, C), remains of marginal glandular setae visible only in young, expanding leaf (Fig. 1D), setae red, patent, c. 0.1 mm long, 1.7–1.8 mm apart; midrib a sunken groove on adaxial surface, on abaxial surface flush with surface, sometimes not extending to apex; secondary, tertiary and quaternary nerves not visible. *Petiole* winged, broadly triangular in transverse section, with a shallow adaxial groove, (0.4–)0.5–0.8(–1) × 0.1–0.18 mm, margin with 2 caducous setae on each side (as in blade); petioles of previous season developing basal articulation. *Stipules* absent. *Pedicels* single, in axils of presumed caducous scale-leaves of first produced (proximal) successive three nodes of current season's growth, each 1.4–2.4 cm long, widening gradually from c. 0.6 mm in diam. at base to c. 1 mm in diam. at apex, patent or slightly nodding. *Bracts* inserted as a pair immediately below calyx; opposite, subequal, ovate or ovate-triangular (2–)2.2–2.8 × 1.5–2.1 mm, midrib raised as a keel, extending beyond obtuse apex as a swollen mucro c. 0.2 mm long, margin with 2 or 3 caducous red setae, as those of leaf. *Flowers* hermaphrodite, 7–9 mm in diam., pendulous. *Sepals* 5, patent, white, quincuncial, slightly

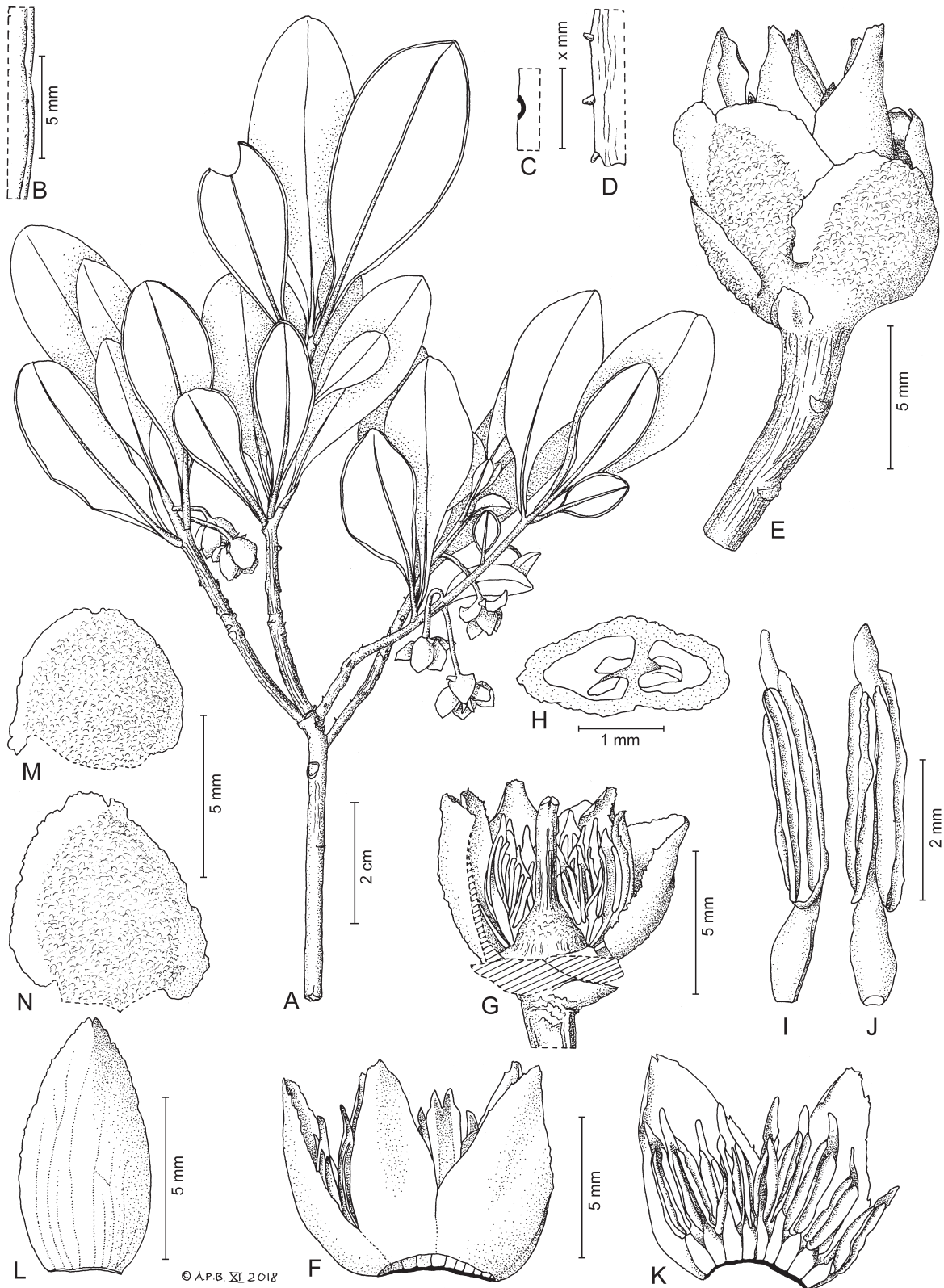


Fig. 1. *Ternstroemia guineensis* – A: habit, flowering leafy stems; B: detail of revolute margin of mature leaf, abaxial view, showing circular scars of fallen marginal setae; C: detail of one seta scar from B; D: detail of margin of immature leaf showing patent setae; E: flower, hydrated, side view; F: connate corolla with staminal ring, as self-detaching after anthesis; G: flower, with pistil exposed by removal of two sepals, two petals and several stamens; H: transverse section of ovary showing intruding placentas in both of two locules; I: side view of stamen, showing inward arching; J: adaxial view of stamen; K: inner view of two adherent petals, with adherent staminal ring; L: petal (flattened), adaxial surface showing slightly lacerate distal margins and longitudinal nerves; M: outer sepal (flattened); N: inner sepal (flattened). – Scale bars: A = 5 cm; B–G, K–N = 5 mm; I, J = 2 mm; H = 1 mm. – All drawn from *Pepe Haba 1060* (K) by Andrew Brown.



Fig. 2. *Ternstroemia guineensis* – A: habitat, submontane gallery forest in sparsely wooded grassland; B: habit; C: flower; D: fruits; E: base of a multi-stemmed shrub; F: bark of a tree, trunk c. 18 cm in diam. – Photos: Republic of Guinea, Kounounkan Massif, Feb 2019, Xander van der Burgt.

concave, thick, leathery, outer surface wrinkled when dry, unequal, outer pair suborbicular, c. 4.5×5.2 mm, leathery, margin scarious, 0.5–1 mm wide, erose, apex rounded or retuse, sometimes with mucro 0.3–0.4 mm long, inserted adaxially below margin; inner sepals ovate, c. 6.5×6 mm, mucro absent, margin as outer sepals. *Petals* 5 (or 6), yellow or yellowish white, together forming a short cylinder enclosing stamens, petals imbricate, connate in basal $\frac{1}{4}$ (for 1.7–2 mm, Fig. 1F, 2C), each nar-

rowly ovate, apex obtuse, sides distally folded in from midrib, base truncate, c. 2.2 mm wide, margin irregularly and minutely lacerate mainly in distal half, longitudinal nerves c. 9 from base, parallel, equally spread, rarely branched, slightly visible in rehydrated material (Fig. 1L). *Stamens* 20–25, uniseriate, adnate to corolla, all falling together as one unit (Fig. 1F), each stamen (4.5–)5.5(–6) mm long, arching inward toward ovary (Fig. 1I), white anther theca inserted along lateral mar-

gins of brown connective, thecae c. $3.2 \times 0.6\text{--}0.7$ mm, anther apex with connective extended as an obtuse apiculus $0.75\text{--}1.3(-1.8) \times (0.2\text{--})0.3\text{--}0.35(-0.4)$ mm, base sagittate, filament crassate, $(1.2\text{--})1.5\text{--}1.8(-2) \times (0.4\text{--})0.5\text{--}0.65(-0.7)$ mm, narrower at base (c. 0.25 mm in diam.) and at junction with connective (c. 0.3 mm in diam.). *Disc* or *torus* absent. *Ovary* conical, 1.75×2.5 mm, subverrucate, bilocular, placentation axile, placentas intruding into locules (Fig. 1H); ovules 2 or 3 per locule; stigma erect, subcylindric, with two opposite longitudinal grooves $5\text{--}5.5 \times 0.7$ mm; stigmas 2, punctiform c. 0.5 mm in diam., separated from each other by a minute cleft (Fig. 1G). *Fruit* on red, non-acrescent pedicels, pendulous, 2–5 per leafy stem, ripening yellow, smooth, glabrous, broadly ovoid to globose $1.1\text{--}1.5 \times 1.1\text{--}1.5$ cm, subtended by appressed, persistent, accrescent, green flushed pink sepals, inner sepals $8\text{--}9 \times$ c. 7 mm; style persistent, accrescent 6–8 mm long, with two subterminal constrictions; dehiscence probably irregular, 4–8-seeded. *Seed* testa epidermis bright orange-red, powdery, underneath yellow, bony, obovate with a central groove, $(0.5\text{--})0.7\text{--}0.9 \times$ c. 0.6 cm, laterally flattened, 0.2–0.3 cm wide.

Phenology — flowering in the dry season from November onward, a few flowers still present in February, when fruits are nearly fully-formed. Fruits ripe in May, as wet season begins. Shoot extension and new leaves are inferred to develop in the wet season (May–October).

Distribution — *Ternstroemia guineensis* is currently only known from the southernmost plateau of the Kounounkan Massif in Forécariah Prefecture, an uninhabited sandstone table mountain, where it is known from gallery forests along four streams.

Ecology — The species was found in species-rich submontane gallery (cloud) forest, on rocky soils, at 900–1100 m altitude.

Conservation status — *Ternstroemia guineensis* is a very rare species, collected only by the last three authors, on a single uninhabited table mountain despite targeted searches on other mountains over three years by our team. We assess *T. guineensis* as Endangered (EN B1+B2ab(ii,iii,v); D) according to the categories and criteria of IUCN (2012) since the species has only been found at the one location, where 169 mature individuals have been observed. The grasslands on parts of the nearby main southern plateau of the Kounounkan Massif are frequently burned in the dry season. These frequent dry-season fires may damage gallery forest edges; the habitat of *T. guineensis*. Continuous decline was observed there in quality of habitat, in the form of burned and fire-killed trees of other species, and continuous decline in number of mature individuals of *T. guineensis* is therefore likely should these frequent fires reach the location of that species.

The species is known from a total of nine sites (four collections and five observations) at one location. The area of occupancy is 16 km², calculated using IUCN-preferred 2 × 2 km cells, and the extent of occurrence slightly larger, estimated at 17 km² to satisfy IUCN preferences, although a minimum convex polygon around the nine sites gives an area of only 4.3 km². Despite searches elsewhere in Guinea, especially in the Kounounkan Massif, the species has not yet been found outside the nine known sites. It has been conjectured that *Ternstroemia guineensis* and other point endemics that occur at the same location (e.g. *Gladiolus mariae* Burgt, Burgt & al. 2019), several of which are also in the process of being described, may be relics, and may once have been much more widespread over the sandstone table mountains of the Fouta Djallon, since these appear so similar in terms of ecology to the *Ternstroemia* location, excepting the presence of humans and the consequent high fire-frequency (Burgt & Haba cited in Couch & al. 2019).

Although the location is unprotected, the immediate threat of farmers or cattle rangers moving in is currently low, due to its inaccessibility. However, this could change rapidly. Currently, there are no paths up to and on the southern plateau. Should a path to the site be constructed, there is a risk that, as with other sandstone table mountains known to us in Guinea, livestock will be introduced for seasonal grazing and as a consequence dry-season fires will be introduced, and as a result submontane gallery forest will be degraded and will decrease in extent. In this event, the assessment should be reviewed and it is likely to become Critically Endangered.

The authors intend to raise public awareness through a poster programme on the importance of protecting this rare species and its habitat, and efforts are being made to obtain seed for seed banking as a safeguard, and to continue to attempt to discover additional locations for *Ternstroemia guineensis*. Given the comparatively large number of rare plant species recorded at the site for this species, and the presence of priority threatened habitats (sandstone cliffs, high altitude bowal, submontane and lowland evergreen forest) the location for *T. guineensis* has been included in the proposed Kounounkan Important Plant Area, for which National Park status is being sought (Couch & al. 2019).

Etymology — The specific epithet *guineensis* signifies from Guinea (Guinea-Conakry or the Republic of Guinea), which holds the only known global location for this species.

Specimens examined — GUINEA: Forécariah Prefecture, southern plateau of Kounounkan Massif, 09°32'58.6"N, 12°51'35.6"W, 920 m, fr., 3 Feb 2019, X. M. van der Burgt 2250 (B, BM, BO, BR, E, FHO, G, HNG, K, LISC, MO, NY, P, PRE, R, SERG, SING, SL, US, WAG); same locality, 09°32'42.5"N, 12°50'36.4"W, 970 m, fl., 4 Feb 2019, X. M. van der Burgt 2258 (BR,

HNG, K, MO, P, PRE, R, SING, WAG); same locality, 09°32'55.5"N, 12°51'35.6"W, 910 m, fl., 26 Nov 2017, *P. M. Haba 1060* (HNG, K, MO, P, WAG, US); same locality, 09°33'08.7"N, 12°50'11.5"W, 1070 m, fr., 5 Feb 2019, *P. M. Haba 1267* (B, BR, G, HNG, K, MO, P, PRE, R, SING, WAG); same locality, fr., May 2019, *Konomou 691* (HNG).

New species from the Guinea Highlands

Ternstroemia guineensis is the most recent of numerous new species to science discovered in the Guinea Highlands in recent years. These are, in alphabetical order:

Brachystephanus oreacanthus Champl. (*Acanthaceae*) (Champluvier & Darbyshire 2009), *Calophyllum africanum* Cheek & Q. Luke (*Calophyllaceae*) (Cheek & Luke 2016),

Eriocaulon cryptocephalum S. M. Phillips & Mesterházy (*Eriocaulaceae*) (Phillips & Mesterházy 2015), *Eriosema triformum* Burgt (*Leguminosae*) (Burgt & al. 2012), *Gymnosiphon samoritourenus* Cheek (*Burmanniaceae*) (Cheek & Burgt (2010), *Inversodicraea pepahabae* Cheek (*Podostemaceae*) (Cheek & Haba 2016), *Isoglossa dispersa* I. Darbysh. & L. J. Pearce (*Acanthaceae*) Darbyshire & al. (2011), *Napoleonaea alata* Jongkind (*Lecythidaceae*) (Prance & Jongkind 2015), *Psychotria samoritourei* Cheek (*Rubiaceae*) (Cheek & Williams 2016), *Striga magnibracteata* Eb. Fisch. & I. Darbysh. (*Orobanchaceae*) (Fischer & al. 2011), *Xysmalobium samoritourei* Goyder (*Apocynaceae*) (Goyder 2009) and the new genus *Karima* Cheek & Riina (*Euphorbiaceae*) (Cheek & al. 2016).

Those recently discovered taxa specific to sandstone substrate in the S part of the Fouta Djallon are *Gladiolus mariae* Burgt (Burgt & al. 2019), *Keetia susu* Cheek (Cheek & al. 2018c), *Kindia gangan* Cheek (Cheek & al. 2018b), *Talbotiella cheekii* Burgt (Burgt & al. 2018) and the resurrected *Mesanthemum tuberosum* Lecomte (Phillips & al. 2018).

Morphological affinities and amphi-Atlantic distributions

The morphological affinities of *Ternstroemia guineensis* are not with the other highland African *Ternstroemia* species, *T. polypetalata* Melch. and *T. cameroonensis*. The last two species both have 7 or more free petals and minute styles bearing large, foliose stigmas that form a cone over the top of the ovary. In contrast, *T. guineensis* and the lowland swamp-dwelling *T. africana* Melchior both have hermaphrodite flowers with 5 petals united at the base, and a cylindrical style that exceeds or equals the ovary in length, bearing two minute, punctiform stigmas. The features of *T. guineensis* and *T. africana* are seen in the Neotropical *Ternstroemia* treated by Kobuski (1942a,

1942b, 1943), while the affinities of *T. polypetalata* (and *T. cameroonensis*) are with the Asian species (e.g. Kobuski 1961). It can be postulated that the ancestors or ancestor of *T. guineensis* and *T. africana* arrived in W Africa as a result of long-distance dispersal from the Neotropics as did *Pitcairnia feliciana* (A. Chev.) Harms & Mildbr. (*Bromeliaceae*) and *Maschalocephalus dinklagei* Gilg & K. Schum. (*Rapataceae*) shown e.g. by Givnish & al. (2004). In the case of the *Pitcairnia* and *Maschalocephalus*, the direction of travel was unambiguously from west to east, since all other members of their families are Neotropical. However, this is not the case with pantropical *Ternstroemia*. Although the species diversity of the genus in the Neotropics, with 101 species, far exceeds that of Africa, now with four species, it cannot be ruled out that the Neotropical *Ternstroemia* may have arisen by dispersal from Africa. In fact, although Africa has by far the lowest species diversity of *Ternstroemia* of all the three major tropical areas, it has the highest level of infra-generic diversity for *Ternstroemia*, containing species with both Asiatic (*T. polypetalata* and *T. cameroonensis*) and American (*T. africana* and *T. guineensis*) morphology. It is even possible that Africa was the crucible in which *Ternstroemia* arose. This hypothesis is supported by the proximity of potential sister genera *Visnea* (Macaronesia) and *Balthasaria* (Albertine Rift and Eastern Arc mountains).

Another group recently discovered to be amphi-atlantic is *Peridiscaceae*, regarded as American until research showing that Cameroonian *Medusandra* Brenan together with WC African *Soyauxia* Oliv., is confamilial (Soltis & al. 2007; Breteler & al. 2015). In this case also, travel from east to west is credible. Morphological and species diversity in *Peridiscaceae* is far higher in Africa than in the Americas.

Acknowledgements

Dr. Sekou Magassouba, Director General, Université Gamal Abdel Nasser de Conakry-Herbier National de Guinée (UGAN-HNG), is thanked for arranging permits and for long term support and collaboration under the Memorandum of Collaboration between UGAN-HNG and the Royal Botanic Gardens, Kew. Mr. Abdoulaye Yéro Baldé, Ministre, Guinean Ministère de l'Enseignement Supérieur et de la Recherche Scientifique, and Dr. Binko Mamady Touré, Secrétaire Général of the same Ministry, are thanked for co-operation. Colonel Namory Keita, Directeur, Direction National des Eaux et Forêts and Mr. Mamadou Bella Diallo, Point Focal CITES, Direction National des Eaux et Forêts authorized the export of the plant and seed specimens; permit numbers GN000053 and GN00018.

This paper was completed under the project "Important Plant Areas in the Republic of Guinea" supported by the Darwin Initiative of the Department of the Environ-

ment Food and Rural Affairs (DEFRA), UK government (project Ref. 23–002, 2016–2019) and by the Ellis Goodman Family Foundation. This supports Kew's Tropical Important Plant Areas (TIPAs) science strategic output. The Garfield Weston Foundation funded the "Global Tree Seed Bank Project" of Kew's Millennium Seed Bank Partnership, enabling five expeditions to Guinea to support the collecting of seeds of numerous rare trees and shrubs, including those in the Kounounkan Massif, as well as in the discovery of some new plant species such as this *Ternstroemia*. Janis Shillito is thanked for typing the manuscript. Ib Friis (C) and an anonymous reviewer are thanked for constructive comments on an earlier draft of this paper.

References

- Bachman S. P., Field R., Reader T., Raimondo D., Donaldson J., Schatz G. E. & Nic Lughadha E. M. 2019: Progress, challenges and opportunities for Red Listing. – *Biol. Conservation* **234**: 45–55.
- Bachman S. P., Nic Lughadha E. M. & Rivers M. C. 2018: Quantifying progress toward a conservation assessment for all plants. – *Conservation Biol.* **32**: 516–524.
- Balderas-López J. L., Alfaro-Romero A., Monroy A., López-Villafranco M. E., Rivero-Cruz J. F. & Navarrete A. 2013: Toxic rather than neuropharmacological effect of *Ternstroemia sylvatica* fruits and identification of 28-*O*-[β -L-6-rhamnopyranosyl]-R-barrigenol as a new compound with toxic effects in mice. – *Pharm. Biol.* **51**: 1451–1458.
- Berry P. E. & Weitzman A. L. 2005: *Ternstroemiaceae*. – Pp. 300–308 in: Steyermark J. A., Berry P. E., Yatskievych K. & Holst B. K. (ed.), *Flora of the Venezuelan Guayana*. Volume **9**. *Rutaceae–Zygophyllaceae*. – St. Louis: Missouri Botanical Garden Press.
- Breteler F. J., Bakker F. T. & Jongkind C. H. 2015: A synopsis of *Soyauxia* (*Peridiscaceae*, formerly *Medusandraceae*). – *Plant Ecology and Evolution*. **148**: 409–419.
- Burgt X. M. van der, Haba P. K., Haba P. M. & Goman A. S. 2012: *Eriosema triformum* (*Leguminosae: Papilionoideae*), a new unifoliolate species from Guinea, West Africa. – *Kew Bull.* **67**: 263–271.
- Burgt X. M. van der, Konomou G., Haba P. M. & Magassouba S. 2019: *Gladiolus mariae* (*Iridaceae*), a new species from fire-free shrubland in the Kounounkan Massif, Guinea. – *Willdenowia* **49**: 117–126.
- Burgt X. M. van der, Molmou D., Diallo A., Konomou G., Haba P. M. & Magassouba S. 2018: *Talbotiella cheekii* (*Leguminosae: Detarioideae*), a new tree species from Guinea. – *Kew Bull.* **73**: 26 [1–8].
- Champluvier D. & Darbyshire I. 2009: A revision of the genera *Brachystephanus* and *Oreacanthus* (*Acanthaceae*) in tropical Africa. – *Syst. & Geogr. Pl.* **79**: 115–192.
- Cheek M. 2018: *Inversodicraea pygmaea*. – The IUCN Red List of threatened species 2018: e.T98569037A100439967. – Published at <https://doi.org/10.2305/IUCN.UK.2018-1.RLTS.T98569037A100439967.en> [accessed 8 Jan 2019].
- Cheek M. & Burgt X. van der 2010: *Gymnosiphon samoritourenus* (*Burmanniaceae*) a new species from Guinea, with new records of other achlorophyllous heteromycotrophs. – *Kew Bull.* **65**: 83–88.
- Cheek M., Challen G., Lebbie A., Banks H., Barberá P. & Riina R. 2016: Discovering *Karima* (*Euphorbiaceae*), a new crotonoid genus from west tropical Africa long hidden within *Croton*. – *PLoS ONE* **11**(4): e0152110.
- Cheek M., Gosline G. & Onana J.-M. 2018a: *Vepris bali* (*Rutaceae*), a new critically endangered (possibly extinct) cloud forest tree species from Bali Ngemba, Cameroon. – *Willdenowia* **48**: 285–292.
- Cheek M. & Haba P. M. 2016: *Inversodicraea* Engl. resurrected and *I. pepehabai* [sic] sp. nov. (*Podostemaceae*), a submontane forest species from the Republic of Guinea. – *Kew Bull.* **71**: 55 [1–8].
- Cheek M. & Luke Q. 2016: *Calophyllum* (*Clusiaceae – Guttiferae*) in Africa. – *Kew Bull.* **71**: 20 [1–6].
- Cheek M., Magassouba S., Howes M. R., Doré T., Doumbouya S., Molmou D., Grall A., Couch C. & Larridon I. 2018b: *Kindia* (*Pavetteae, Rubiaceae*), a new cliff-dwelling genus with chemically profiled colleter exudate from Mt Gangan, Republic of Guinea. – *PeerJ* **6**: e4666.
- Cheek M., Magassouba S., Molmou D., Doré T. S., Couch C., Yasuda S., Gore C., Guest A., Grall A., Larridon I., Bousquet I. H., Ganatra B. & Gosline G. 2018c: A key to the species of *Keetia* (*Rubiaceae – Vanguerieae*) in West Africa, with three new, threatened species from Guinea and Ivory Coast. – *Kew Bull.* **73**: 56 [1–15].
- Cheek M., Onana J.-M., Yasuda S., Lawrence P., Ameka G. & Buinovskaja G. 2019: Addressing the *Vepris verdoorniana* complex (*Rutaceae*) in West Africa, with two new species. – *Kew Bull.* **74**: 53 [1–16].
- Cheek M., Tchiengue B. & Tacham W. N. 2017: *Ternstroemia cameroonensis* (*Ternstroemiaceae*), a new medicinally important species of montane tree, nearly extinct in the highlands of Cameroon. – *Blumea* **62**: 53–57.
- Cheek M. & Williams T. 2016: *Psychotria samoritourei* (*Rubiaceae*), a new liana species from Loma-Man in Upper Guinea, West Africa. – *Kew Bull.* **71**: 19 [1–6].
- Couch C., Cheek M., Haba P., Molmou D., Williams J., Magassouba S., Doumbouya S. & Diallo M. Y. 2019: Threatened habitats & Tropical Important Plant Areas (TIPAs) of Guinea, West Africa. – Kew: Royal Botanic Gardens, Kew.
- Culham A. 2007: *Pentaphylacaceae*. – Pp. 248–249 in: Heywood V. H., Brummitt R. K., Culham A. & Seberg O., *Flowering plant families of the world*. – London: Firefly Books.

- Darbyshire I. 2019+ [continuously updated]: Tropical Important Plant Areas. – Published at <https://www.kew.org/science/our-science/projects/tropical-important-plant-areas> [accessed 8 Nov 2019].
- Darbyshire I., Anderson S., Asatryan A., Byfield A., Cheek M., Clubbe C., Ghrabi Z., Harris T., Heatubun C. D., Kalema J., Magassouba S., McCarthy B., Milliken W., Montmollin B. de, Nic Lughadha E., Onana J. M., Sardou D., Sarbu A., Shrestha K. & Radford E. A. 2017: Important Plant Areas: revised selection criteria for a global approach to plant conservation. – *Biodivers. & Conservation* **26**: 1767–1800.
- Darbyshire I., Pearce L. & Banks H. 2011: The genus *Isoglossa* (Acanthaceae) in west Africa. – *Kew Bull.* **66**: 425–439.
- Dorr L. J., Stergios B., Smith A. R. & Cuello N. L. 2000: Catalogue of the vascular plants of Guaramacal National Park, Portuguesa and Trujillo States, Venezuela. – *Contr. U. S. Natl. Herb.* **40**: 1–155.
- Fischer E., Darbyshire I. & Cheek M. 2011: *Striga magnibracteata* (Orobanchaceae) a new species from Guinée and Mali. – *Kew Bull.* **66**: 441–445.
- Givnish T. J., Millam K. C., Evans T. M., Hall J. C., Pires J. C. & Berry P. E. 2004: Ancient vicariance or recent long-distance dispersal? Inferences about phylogeny and South American–African disjunctions in *Rapateaceae* and *Bromeliaceae* based on *ndhF* sequence data. – *Int. J. Pl. Sci.* **165**(4 Suppl.): S35–S54.
- Goyder D. J. 2009: *Xysmalobium samoritourei* (Apocynaceae: Asclepiadoideae), a new species from the Guinea Highlands of West Africa. – *Kew Bull.* **63**: 473–475.
- Guzmán-Gutiérrez S. L., Reyes-Chilpa R. & Bonilla-Jaime H. 2014: Medicinal plants for the treatment of “nervios”, anxiety, and depression in Mexican Traditional Medicine. – *Revista Brasil. Farmacognosia* **24**: 591–608.
- IPNI 2019+ [continuously updated]: International Plant Names Index. – Published at <https://www.ipni.org/> [accessed 18 May 2019].
- IUCN 2012: IUCN Red List categories and criteria: version 3.1, ed. 2. – Gland & Cambridge: IUCN. – Published at <https://www.iucn.org/content/iucn-red-list-categories-and-criteria-version-3-1-second-edition> [accessed Jan 2019].
- Kobuski C. E. 1942a: Studies in the *Theaceae* – XII. Notes on the South American species of *Ternstroemia*. – *J. Arnold Arbor.* **23**: 298–343.
- Kobuski C. E. 1942b: Studies in the *Theaceae* XIII. Notes on the Mexican and Central American species of *Ternstroemia*. – *J. Arnold Arbor.* **23**: 464–478.
- Kobuski C. E. 1943: Studies in the *Theaceae* XIV. Notes on the West Indian species of *Ternstroemia*. – *J. Arnold Arbor.* **24**: 60–76.
- Kobuski C. E. 1961: Studies in the *Theaceae*. XXXII. A review of the genus *Ternstroemia* in the Philippine Islands. – *J. Arnold Arbor.* **42**: 263–275.
- Nic Lughadha E., Bachman S. P. & Govaerts R. 2017: Plant fates and states: response to Pimm & Raven. – *Trends Ecol. Evol.* **32**: 887–889.
- Nic Lughadha E., Govaerts R., Belyaeva I., Black N., Lindon H., Allkin R., Magill R. E. & Nicolson N. 2016: Counting counts: revised estimates of numbers of accepted species of flowering plants, seed plants, vascular plants and land plants with a review of other recent estimates. – *Phytotaxa* **272**: 82–88.
- Phillips S. M., Fofana F. & Cheek M. 2018: *Mesanthemum tuberosum* Lecomte resurrected from *M. prescottianum* (Bong.) Körn. (*Eriocaulaceae*), variation and lectotypification. – *Kew Bull.* **73**: 13 [1–8].
- Phillips S. M. & Mesterházy A. 2015: Revision of small ephemeral species of *Eriocaulon* (*Eriocaulaceae*) in West Africa with long involucre bracts. – *Kew Bull.* **70**: 5 [1–17].
- Plants of the World Online 2018+ [continuously updated]: *Vepris*. – In: Plants of the World Online. Facilitated by the Royal Botanic Gardens, Kew. – Published at http://www.plantsoftheworldonline.org/?f=accepted_names&q=Vepris [accessed 5 Nov 2018].
- Prance G. T. & Jongkind C. C. H. 2015: A revision of African *Lecythydaceae*. – *Kew Bull.* **70**: 6 [1–68].
- Shin M. H., Kyung W. W., Nam I., Jo Y., Jung J. H. & Im K. S. 2003: Triterpenoid saponins from the fruits of *Ternstroemia japonica*. – *J. Nat. Prod. (Lloydia)* **66**: 1351–1355.
- Soltis D. E., Clayton J. W., Davis C. C., Wurdack K. J., Gitzendanner M. A., Cheek M., Savolainen V., Amorim A. M. & Soltis P. S. 2007: Monophyly and relationships of the enigmatic family *Peridiscaceae*. – *Taxon* **56**: 65–73.
- Stevens P. F. 2001+ [continuously updated]: Angiosperm Phylogeny Website. Version 12, July 2012. – Published at <http://www.mobot.org/MOBOT/research/APweb/> [accessed 18 May 2019].
- Thiers B. 2019+ [continuously updated]: Index herbariorum: a global directory of public herbaria and associated staff. New York Botanical Garden’s virtual herbarium. – Published at <http://sweetgum.nybg.org/science/ih/> [accessed Jan 2019].
- Turland N. J., Wiersema J. H., Barrie F. R., Greuter W., Hawksworth D. L., Herendeen P. S., Knapp S., Kusber W.-H., Li D.-Z., Marhold K., May T. W., McNeill J., Monro A. M., Prado J., Price M. J. & Smith G. F. (ed.) 2018: International Code of Nomenclature for algae, fungi, and plants (Shenzhen Code) adopted by the Nineteenth International Botanical Congress Shenzhen, China, July 2017. – Glashütten: Koeltz Botanical Books. – [Regnum Veg. **159**].
- Verdcourt B. 1962: *Theaceae*. – Pp. 1–8 in: Hubbard C. E. & Milne-Redhead E. (ed.), *Flora of tropical East Africa*. – London: Crown Agents for Overseas Governments & Administrations.
- Weitzmann A. L., Dressler S. & Stevens P. F. 2004: *Ternstroemiaceae*. – Pp. 450–460 in: Kubitzki K. (ed.),

The families and genera of vascular plants **VI**. Flowering plants. Dicotyledons. *Celastrales*, *Oxalidales*, *Rosales*, *Cornales*, *Ericales*. – Berlin, Heidelberg & New York: Springer.

Williams C. J. 2012: Medicinal plants in Australia **3**. Plants, potions and poisons. – Australia: Rosenberg Publishing.

Willdenowia

Open-access online edition bioone.org/journals/willdenowia



Online ISSN 1868-6397 · Print ISSN 0511-9618 · Impact factor 1.156

Published by the Botanic Garden and Botanical Museum Berlin, Freie Universität Berlin

© 2019 The Authors · This open-access article is distributed under the CC BY 4.0 licence