BioOne COMPLETE

Vepris bali (Rutaceae), a new critically endangered (possibly extinct) cloud forest tree species from Bali Ngemba, Cameroon

Authors: Cheek, Martin, Gosline, George, and Onana, Jean-Michel

Source: Willdenowia, 48(2) : 285-292

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

URL: https://doi.org/10.3372/wi.48.48207

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.

Downloaded From: https://bioone.org/journals/Willdenowia on 03 Aug 2022
Terms of Use: https://bioone.org/terms-of-use

Willdenowia
Annals of the Botanic Garden and Botanical Museum Berlin

MARTIN CHEEK[1*], GEORGE GOSLINE[1] & JEAN-MICHEL ONANA[2]

Vepris bali (*Rutaceae*), a new critically endangered (possibly extinct) cloud forest tree species from Bali Ngemba, Cameroon

Version of record first published online on 24 August 2018 ahead of inclusion in August 2018 issue.

Abstract: *Vepris bali* is the first known species of *Vepris* in WC Africa with opposite, trifoliolate leaves and is further unusual for its long petiolules. Known only from Bali Ngemba Forest Reserve, a remnant of submontane forest under great pressure of degradation in the Bamenda Highlands of Cameroon, it may already be extinct due to tree cutting and agricultural incursions. Here, *V. bali* is compared with other endemic cloud forest *Vepris* of the Cameroon Highlands and is described, illustrated, mapped and assessed as Critically Endangered (Possibly Extinct) using IUCN 2012 criteria.

Key words: Cameroon, cloud forest, conservation, essential oils, medicinal, new species, *Rutaceae*, *Vepris*

Article history: Received 30 May 2018; peer-review completed 3 July 2018; received in revised form 13 July 2018; accepted for publication 25 July 2018.

Citation: Cheek M., Gosline G. & Onana J.-M. 2018: *Vepris bali* (*Rutaceae*), a new critically endangered (possibly extinct) cloud forest tree species from Bali Ngemba, Cameroon. – Willdenowia 48: 285–292. doi: https://doi.org/10.3372/wi.48.48207

Introduction

Vepris Comm. ex A. Juss. (*Rutaceae–Toddalieae*), is a genus with 86 accepted species, 22 in Madagascar and 65 in Continental Africa with one species extending to Arabia and another endemic to India (Plants of the World Online 2018). Seventeen species were recorded from Cameroon (Onana 2011), rising recently to 20 (Onana & Chevillotte 2015), but several more remain undescribed. *Vepris* are easily recognized in continental Africa. They differ from all other *Rutaceae* in continental Africa because they have digitately (1–)3(–5)-foliolate (not pinnate) leaves, and unarmed (not spiny) stems. However, in Madagascar, the genus *Melicope* J. R. Forst. & G. Forst. also has these features.

The genus *Vepris* consists of evergreen shrubs and trees, predominantly of tropical lowland evergreen forest, but with some species extending into submontane forests and fewer still into drier forests and woodland.

Species of *Vepris* in Africa extend from S Africa, e.g. *V. natalensis* (Sond.) Mziray, to the Guinean woodland in the fringes of the Sahara desert [*V. heterophylla* (Engl.) Letouzey]. Mziray (1992) subsumed the genera *Araliopsis* Engl., *Diphasia* Pierre, *Diphasiopsis* Mendonça, *Oricia* Pierre, *Teclea* Delile and *Toddaliopsis* Engl. into *Vepris*, although several species were only formally transferred subsequently (e.g. Cheek & al. 2009; Onana & Chevillotte 2015). Mziray's conclusions were confirmed by the molecular phylogenetic studies of Morton (2017). She studied about 14 taxa of *Vepris*, mainly those from E Africa.

Vepris species are often indicators of good quality, relatively undisturbed evergreen forest because they are not pioneers (Cheek, Onana pers. obs. 1992–2016). Due to their essential oils, several species are known for their traditional medicinal value (Burkill 1997). Burkill detailed the uses, essential oils and alkaloids known from five species in W Africa: *V. afzelii* (Engl.) Mziray (as

1 Science, Herbarium, Royal Botanic Gardens, Kew, TW9 3AE, U.K.; *e-mail: m.cheek@kew.org (author for correspondence).
2 Faculté des Sciences de l'Université de Yaoundé I, BP 812 Yaoundé, Cameroon.

Downloaded From: https://bioone.org/journals/Willdenowia on 03 Aug 2022
Terms of Use: https://bioone.org/terms-of-use

Teclea afzelii Engl.), *V. heterophylla* (as *T. sudanica* A. Chev.), *V. hiernii* Gereau (as *Diphasia klaineana* Pierre), *V. suaveolens* (Engl.) Mziray (as *T. suaveolens* Engl.) and *V. verdoorniana* (Exell & Mendonça) Mziray (as *T. verdoorniana* Exell & Mendonça), from the *Flora of West Tropical Africa* area (Burkill 1997: 651–653). Research into the characterization and anti-microbial and anti-malarial applications of alkaloid and limonoid compounds in *Vepris* is active and ongoing. Cheplogoi & al. (2008) and Imbenzi & al. (2014) respectively listed 14 and 15 species of *Vepris* that have been studied for such compounds.

On 6 June 1951, Edwin Ujor of the Nigerian Forestry Service collected a specimen (*Ujor FHI 30422*) of a tree in what, even then, was one of the last remnants of submontane forest (800–2000 m alt.) in the Bamenda Highlands of Cameroon. The specimen was annotated by Ronald Keay as "*Vepris* sp. nov. female flowers and fruits needed". Keay was the originator and director of the botanical inventory programme, then based at Forest Research Institute, Ibadan, Nigeria, which had resulted in the collections by Ujor and others in what was then the British Southern Cameroons, now Southwest and Northwest Regions of the Republic of Cameroon. Keay also revised the first volume of the second edition of the *Flora of West Tropical Africa* (1954–1972), which included *Rutaceae* (Keay 1958). At that time, the segregate genera *Araliopsis*, *Diphasia*, *Oricia*, *Oriciopsis* and *Teclea* were still recognized, Mziray's (1992) excellent work uniting them into a single genus *Vepris* not having been published. Keay did not know in which of the formerly recognized segregate genera to place Ujor's specimen: "Also in this part of the key comes a specimen (*Ujor FHI 30422*) recently received from Bali Ngemba F. R., Bamenda, Br. Cam. The flowers (male) have 8 stamens, but fruit and female flowers are needed to determine the genus; it is perhaps a new species of *Vepris* Commers. ex A. Juss., a genus not otherwise represented in our area, […]" (Keay 1958).

Letouzey, in *Flore du Cameroun* (1963: 117) confused this specimen with *Toddaliopis ebolowensis* Engl. (now *Vepris ebolowensis* (Engl.) Onana). That this was incorrect, and that the specimen was probably a new species, unusual in the genus and especially in Cameroon due to its opposite, rather than alternate leaves, was pointed out by Cheek in Harvey & al. (2004), where it was named as "*Vepris* sp. B" and illustrated. Letouzey's error was confirmed and emphasized by Onana and Chevillotte (2015) in their revision of *Vepris* in Cameroon. Since repeated targeted efforts from 2000–2004 to rediscover the Ujor species have failed (Cheek in Harvey & al. 2004) and since it may be extinct, in the present paper Ujor's specimen is formally described as *V. bali* Cheek sp. nov. It is hoped that naming this species will relaunch efforts to rediscover and protect this species from extinction.

The number of flowering plant species known to science is disputed (Nic Lughadha & al. 2017), but a reasonable estimate is 369 000 (Nic Lughadha & al. 2016), while about 2000 species are described as new to science each year (Kew 2016).

About 5 % of plant species have been assessed for their global extinction risk following the IUCN (2012) categories and criteria. This number rises to 21–26 % when evidence-based assessments beyond those on IUCN's global list are taken into account, and 30–44 % of these assessments consider the species assessed to be threatened (Bachman & al. 2018). Newly discovered species, such as that reported in this paper, are increasingly likely to be threatened, because widespread species tend to be discovered sooner [although there are notable exceptions to this rule, e.g. Cheek & Etuge (2009a)]. Generally, it is the more localized, rarer species that remain undiscovered. This makes it a priority to discover, document and protect such species before they become globally extinct, as is *Oxygyne triandra* Schltr. (Cheek & Onana 2011; Cheek & al. 2018). Most such Cameroonian species threatened with extinction are in that situation as a result of habitat clearance, mainly for smallholder and plantation agriculture following logging (Onana & Cheek 2011). Efforts are now being made to delimit the highest priority areas in Cameroon for plant conservation as Tropical Important Plant Areas (TIPAs) using the revised IPA criteria set out in Darbyshire & al. (2017). This is intended to help avoid the global extinction (where it is not already too late) of more narrowly endemic species such as *Vepris bali*.

Material and methods

This study is based on herbarium specimens. All specimens cited have been seen by the authors, unless indicated otherwise ("n.v."). Herbarium citations follow Index Herbariorum (Thiers & al. 2018+), nomenclature Turland & al. (2018) and author citations IPNI (2018+). Material of the suspected new species was compared morphologically with material of all other African *Vepris*, principally at K, but also using material from BM, P and YA. The methodology used for the surveys in the cloud forest areas of Western Cameroon referred to are given in Cheek & Cable (1997). 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 a Leica 308700 camera lucida attachment.

Results and Discussion

The characters separating *Vepris bali* from *V. ebolowensis* are given in Table 1.

The affinities of *Vepris bali* may lie with the other submontane and montane *Vepris* of Cameroon, all of which

Downloaded From: https://bioone.org/journals/Willdenowia on 03 Aug 2022
Terms of Use: https://bioone.org/terms-of-use

Table 1. Characters distinguishing *Vepris ebolowensis* and *V. bali.*

	Vepris ebolowensis	***Vepris bali***
Habitat	lowland forest near river	submontane forest, well drained
Habit	shrub	tree (trunk. c. 28 cm in diam.)
Leaves	alternate	opposite
Petiole length	c. 10 cm	2–2.8 cm
Petiolule length	nil	9–14 mm
Staminodes in male flowers	present	absent
Ovary hairs	crisped	straight, bristle-like

Table 2. Characters distinguishing the submontane tree species of *Vepris* of Cameroon. Data from Onana & Chevillotte (2015) except for *V. bali*.

	Vepris montisbambutensis Onana	***Vepris bali***	***Vepris adamaouae*** Onana	***Vepris*** sp. aff. ***renieri*** (G. C. C. Gilbert) Mziray
Leaf insertion and lateral leaflet dimensions	alternate, (2–)3–9 × (0.7–)1.5–3 cm	opposite, 6–10.5 × 2.8–4.7 cm	alternate, 22–23.5 × 6.5–7 cm	alternate, 5.5–14 × 1.75–5 cm
Longest petiolule length	2–10 mm	9–14 mm	2–4 mm	c. 0.5 mm
Leaflet apex	shortly acuminate	shortly acuminate	rounded	acute to shortly acuminate
Inflorescence position and length	axillary on leafy stems, c. 8 cm	terminal, c. 10 cm	ramiflorous, filiform, c. 20 cm	axillary on leafy stems, c. 5 cm
Calyx margin indumentum	unknown	long hairy	glabrous	unknown
Pistillode lobing and indumentum	unknown (but fruit bifid, glabrous)	conical-bifid, densely hispid	conical, glabrous	unknown

also occur above 1500 m alt, and are trees with trunks of a diameter of 20 cm or more at 1.5 m above the ground. Table 2 gives diagnostic characters separating these species.

In Onana & Chevillotte (2015), the Ujor specimen keys out as *Vepris heterophylla*. In fact Mziray (1992), in his excellent revision of generic limits of *Vepris* and related genera, cited the *Ujor* specimen as *V.* cf. *heterophylla*. However, *V. heterophylla* is a shrub of Guinean woodland in W Africa ranging from Mali to Cameroon, with the leaves alternate, the leaflet length : width ratio c. 3 : 1, the width of the median leaflets of the flowering stems 2–2.5(–3) cm, and both surfaces showing gland dots, whereas *V. bali* is a tree of submontane forest with opposite leaves, the leaflet length : width ratio c. 2 : 1, the width of the median leaflets of the flowering stems 4.1–5.2 cm, and both surfaces lacking gland dots.

Vepris bali Cheek, **sp. nov.** – Fig. 1.

Holotype: Cameroon, Northwest Region, "Bamenda District, Bali-Ngemba Forest Reserve, in high forest on upper line 'B' in enumeration block at the height of 5,700 ft (=1700m. alt.) with *Uapaca* sp., *Garcinia* sp., and *Aningeria*", male fl., Mar 1951, *Ujor FHI 30422* (K; isotype: FHI n.v.).

– *Toddaliopsis ebolowensis* sensu Letouzey (1963: 108), non Engl. (1917: 305).
– *Vepris* cf. *heterophylla* sensu Mziray (1992: 73), non (Engl.) Letouzey (1966: 246).
– "*Vepris* sp. B" Cheek in Harvey & al. (2004: 55 [fig. 7], 124); Onana & Cheek (2011: 309).

Diagnosis — Differing from *Vepris ebolowensis* (Engl.) Onana in being a submontane tree, with a trunk c. 28 cm in diam. at 1.5 m from ground, leaves opposite, and median petiolules 9–14 mm long (whereas *V. ebolowensis* is a shrub of lowland forest, with leaves alternate, and median petiolules c. 0 mm long).

Description — Tree, dioecious (probably); *trunk* c. 28 cm in diam. at 1.5 m from ground ("3ft. girth"), slash (underbark and sapwood of trunk, exposed by machete cut) "white-grey". *Leafy stems* terete, 2.2–3.5 mm in diam., internodes 3–5 cm long, grey-brown, with longitudinal, winged ridges and lines of raised, white, narrowly elliptic lenticels 0.9–1.5 × 0.2–0.4 mm, epidermal surface minutely patent puberulent, hairs simple, 0.05–0.1 mm long. *Leaves* opposite (or slightly subopposite), trifoliolate; *petiole* terete, 2–2.8 × 0.1–0.15 mm, glabrous;

Downloaded From: https://bioone.org/journals/Willdenowia on 03 Aug 2022
Terms of Use: https://bioone.org/terms-of-use

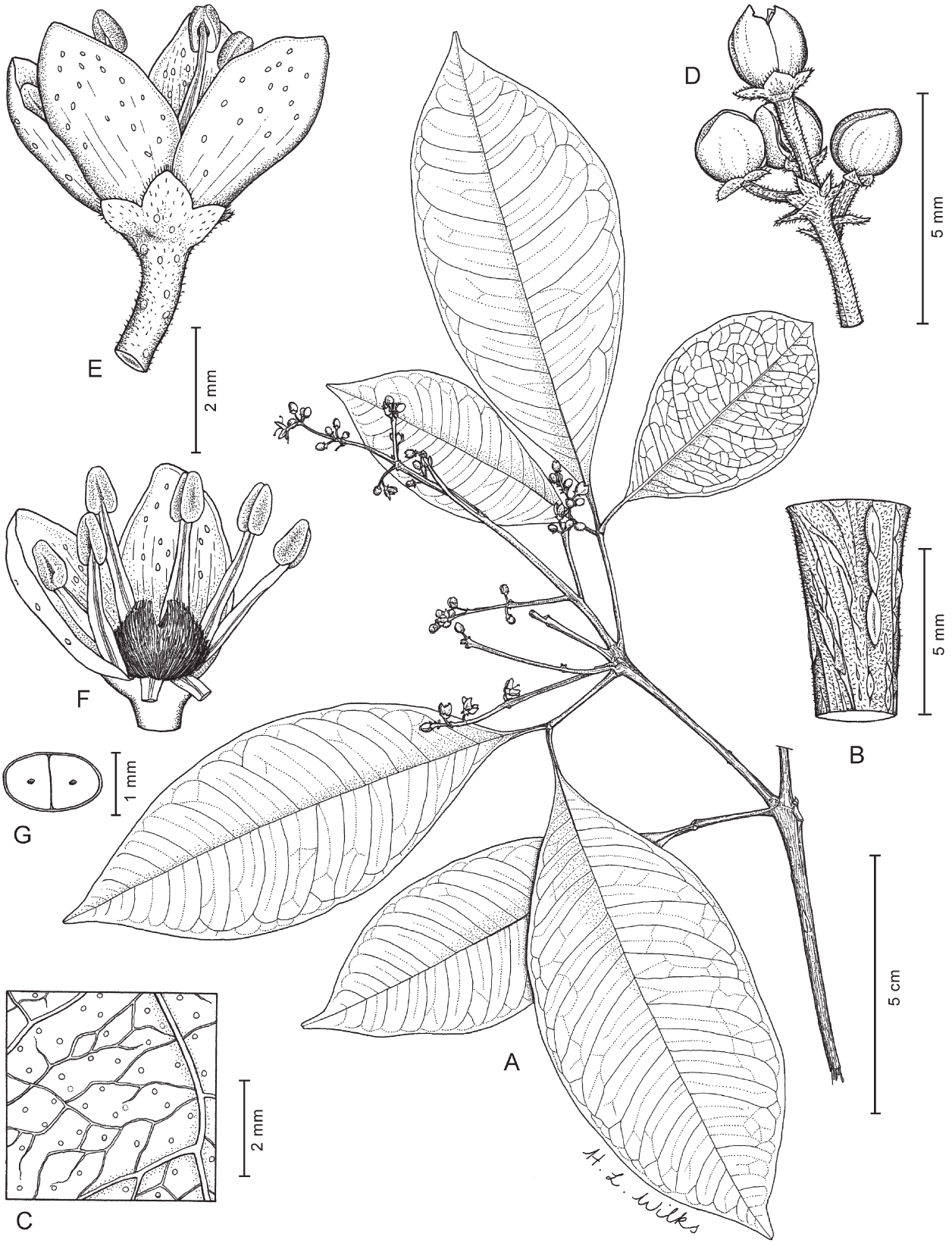


Fig. 1. *Vepris bali* – A: habit, flowering stem with male inflorescence; B: stem detail showing indumentum and lenticels; C: abaxial leaf surface showing oil glands; D: portion of partial-inflorescence showing bracts; E: male flower, side view; F: male flower, 2 sepals and petals removed and staminal filaments truncated; G: cross-section of rudimentary pistil. – Drawn from the holotype, *Ujor FHI 30422* (K), by Hazel Wilks.

Downloaded From: https://bioone.org/journals/Willdenowia on 03 Aug 2022
Terms of Use: https://bioone.org/terms-of-use

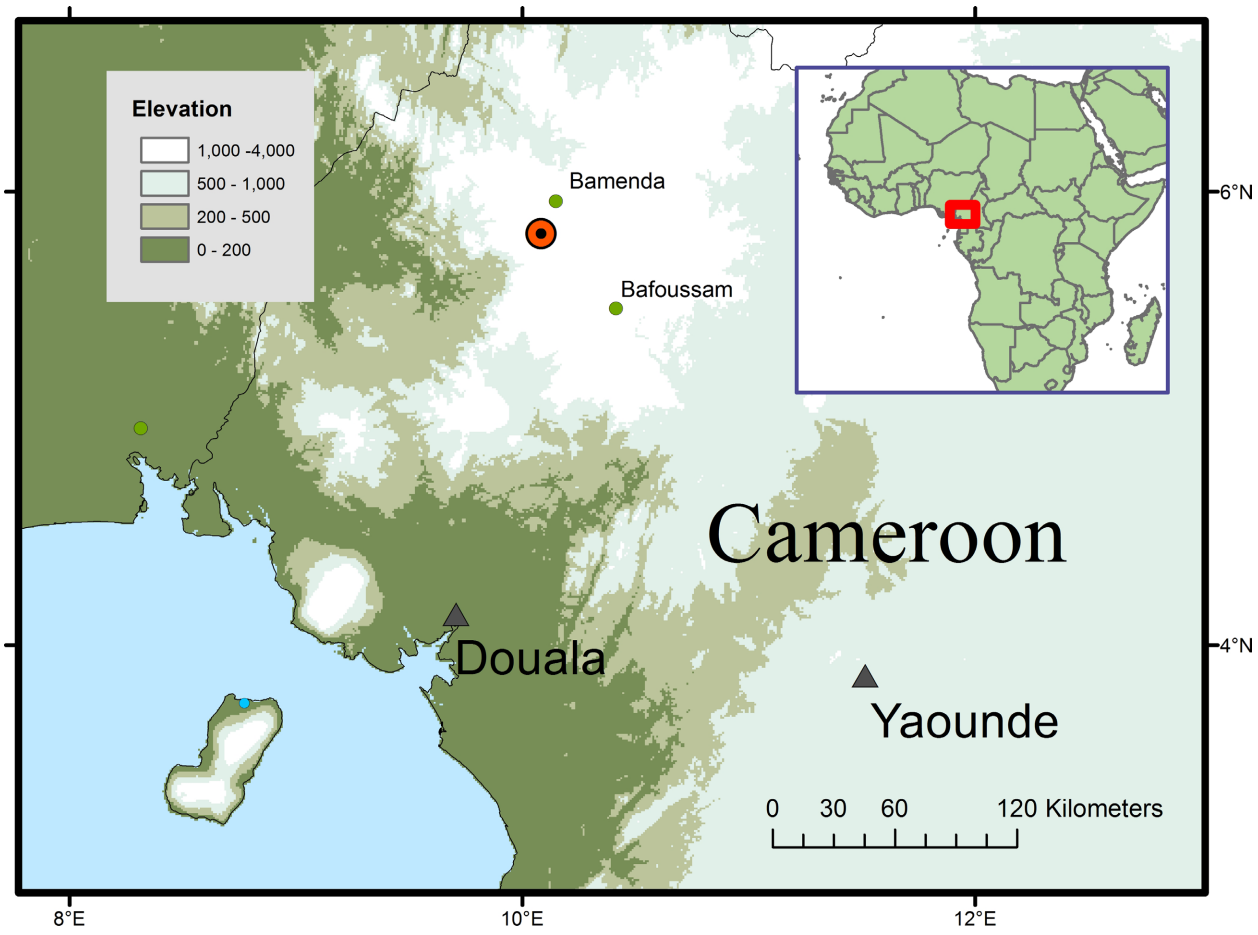


Fig. 2. Global distribution of *Vepris bali* (marked in red).

leaflets subequal; lateral leaflets elliptic, 6–10.5 × 2.8–4.7 cm, c. ½ length and width of obovate median leaflet; median leaflet 10–12.6 × 4.1–5.2 cm, base acute, slightly decurrent into canaliculate, laterally flattened petiolule, acumen 1–3.5 mm long, apex minutely bifid or entire; lateral nerves (6–)8–11 on each side of midrib, arising at c. 70° from midrib and looping toward margin and linking to nerve above (brochidodromous); intersecondary nerves parallel, unbranched or branching only at apex, oil glands 0.15–0.2 mm in diam., c. 180 per cm², appearing colourless in transmitted light, not visible on either surface, both surfaces of leaf blade glabrous; *petiolules* 9–14 mm long. *Inflorescence* (male) terminal, indumentum as stem, extending to calyces, branches 4 from base, racemose, c. 5 cm long (except largest: paniculate, c. 10 cm long), c. 50-flowered; *peduncle* c. 1.5 cm long, internodes 1–2.5 cm long; *partial-inflorescences* opposite or subopposite, to 3.5 cm long, 2–15-flowered; *bracts* caducous or absent on main axis, bracts of partial-inflorescences opposite, boat-shaped to narrowly triangular, c. 1.5 mm long, subtending shorter, flattened bracteoles. *Pedicels* 1.5–2.8 × c. 0.7 mm, surface with scattered oil glands. *Calyx tube* c. 0.6 × 2.5 mm; *lobes* 4, triangular c. 0.7 × 0.8 mm, margin densely pectinate-hairy. *Petals* 4, free, ovate to obovate-elliptic, c. 3.5 × 1.5–2 mm, slightly concave, glabrous, oil glands 15–20, visible on both surfaces, apex rounded to obtuse. *Stamens* 8, equal in length to petals, erect; *filament* dorsiventrally flattened, 2.6–3 × c. 0.3 mm; *anther* ovate-oblong, c. 1 × 0.5 mm, medifixed. *Gynoecium* 2-loculed, depressed ovoid, c. 1.5 × 1.8 mm, surface densely covered in straight, black, bristle-like hairs c. 0.5 mm long, apex retuse, sinus c. 0.5 mm deep. *Female flowers, fruits and seeds* unknown.

Distribution — Cameroon, Northwest Region, Bamenda Highlands, Bali Ngemba Forest Reserve (Fig. 2).

Ecology — Submontane (cloud) forest with *Aningeria*, *Garcinia* and *Uapaca*, altitude c. 1500 m.

Conservation status — Despite targeted searching for this species by numerous botanical teams during surveys for months, over multiple seasons from 2000–2004, "*Vepris* sp. B" was not rediscovered (Harvey & al. 2004: 32) and has not been found subsequently (Onana & Cheek 2011). The higher altitudinal zones from which Ujor collected the type have seen clearance for agriculture by the inhabitants of villages such as Pinyin situated above the forest reserve. It is possible that *V. bali* is already extinct. It has not been found in other patches of submontane forest in

Downloaded From: https://bioone.org/journals/Willdenowia on 03 Aug 2022
Terms of Use: https://bioone.org/terms-of-use

the Cameroon Highlands, such as Mt Cameroon (Cable & Cheek 1998), Mt Oku and the Ijim Ridge (Cheek & al. 2000), Mt Kupe and the Bakossi Mts (Cheek & al. 2004), the Lebialem Highlands (Harvey et al. 2010), nor in the forest of Dom (Cheek & al. 2010).

However, it may yet be refound, as was *Ternstroemia cameroonensis* Cheek, previously also thought to be probably extinct (Cheek & Onana 2011; Cheek & al. 2017). If so, public education, safeguarding live trees, seed collection and banking, development of propagation protocols, and multiplication for reintroduction to safe sites are all strongly urged to help ensure the survival of *Vepris bali*.

Because "*Vepris* sp. B" was not formally published with a species name it has not previously been formally assessed for its conservation status using the IUCN standards. It was anticipated that when published it would be recognized as a threatened species (Cheek in Onana and Cheek 2011: 309).

Here *Vepris bali* is assessed as Critically Endangered using the IUCN (2012) categories and criteria. Under Criterion B, it is assessed as CR B2ab(iii) in view of the threats stated above, and because there is a single location, with an area of occupancy of 4 km² using the grid cells of that size as preferred by IUCN. Under Criterion D, is merits the same level of threat because fewer than 50 mature individuals are known. In fact, only a single individual has been recorded, despite targeted searching over several years. The reality is that *V. bali* may already be extinct.

Local names and uses — None recorded.

Etymology – The specific epithet is a noun in apposition, from the town and people of Bali in the Bamenda Highlands of the Northwest Region of Cameroon, near which, in the Bali Ngemba Forest Reserve, the only known locality for this tree is found.

Remarks — The only other opposite-leaved *Vepris* in W and C Africa is *V. felicis* Breteler of Guinea to Ivory Coast, a Critically Endangered (Cheek 2017a) lowland 1–2 m tall shrub species with unifoliolate leaves, which is therefore unlikely to be confused with *V. bali.*

The discovery of such a distinctive new species in Bali Ngemba, one of the remnant cloud forest areas of the Cameroon Highlands, is not unusual. Among more than one hundred other remarkable and usually globally threatened species discovered in these cloud forests have been: *Coffea montekupensis* Stoff. (Stoffelen & al. 1997), the world's only pink-flowered coffee; *Coleochloa domensis* Muasya & D. A. Simpson (Muasya & al. 2010), the only uniquely epiphytically dwelling sedge globally; *Impatiens etindensis* Cheek & Eb. Fischer (Cheek & Eb. Fischer 1999), the only tuberous epiphytic impatiens W of the Albertine rift; *Kupea martinetugei* Cheek & S. A. Williams (Cheek & al. 2003), a new genus of achlorophyllous mycotroph representing a new tribe of *Triuridaceae*, sister to the rest of the family; and *Ledermanniella pollardiana* Cheek & Ameka (Cheek & Ameka 2008), an unusual *Podostemaceae*.

These cases illustrate the scale at which new discoveries are being made in the highlands of Western Cameroon. These highlands include several Pleistocene refugia and occur in the most species-diverse degree squares documented in tropical Africa (Cheek & al. 2001).

Most of the species listed above are threatened with extinction, because they are narrow endemics with small ranges, restricted to mainly submontane (cloud) forest patches, which are steadily being cleared, mainly for small-scale cultivation of food crops. These species feature in the Red Data Book of Cameroon (Onana & Cheek 2011).

The origin of the Cameroon Highland cloud forest tree *Vepris*

It is remarkable that the cloud forest species of *Vepris* recorded from the Cameroon Highlands (see Table 2) are trees (with trunk diameters of 20 cm or more), and not shrubs 0.5–4 m tall as are the majority of the lowland species in Cameroon (with notable exceptions such as *V. soyauxii* (Engl.) Mziray) and in Africa as a whole. We postulate that the ancestors of the Cameroon Highland species arose from among the more numerous lowland species rather from the submontane species of the Albertine Rift. Phylogenetic analysis is needed to test this speculation because existing studies of this sort sample only 14 of 85 species and do not include the Cameroon Highland species. The results from such a study might elucidate whether or not the Cameroon Highland species arose once or more than once and whether they arose from shrub or tree antecedents.

Bali Ngemba, its importance for conservation and protection

Bali Ngemba Forest Reserve covers 8 km² and an altitudinal range of 1300–2200 m. It is the only formally protected and the largest surviving area of submontane forest in the Bamenda Highlands, an area so denuded of its natural forest vegetation that it is now known in Cameroon as "the grasslands" (Cheek in Harvey & al. 2004). It has been calculated that 96.5 % of the original forest in the Bamenda Highlands above 1500 m alt. has been lost (Cheek in Cheek & al. 2000: 49–50).

The analysis of specimens collected at Bali Ngemba from 2000–2004, together with what little data was available from specimens collected previously, showed that 38 globally threatened plant species are present and that 24 were new, unknown to science. Twelve species are, or were, globally unique to Bali Ngemba (Cheek in Harvey & al. 2004). Among these are: *Allophylus ujori* Cheek (Cheek & Etuge 2009b), *Chassalia laikomensis* Cheek

Downloaded From: https://bioone.org/journals/Willdenowia on 03 Aug 2022
Terms of Use: https://bioone.org/terms-of-use

(Cheek & Csiba 2000), *Oxyanthus okuensis* Cheek & Sonké (Cheek & Sonké 2000), *Psychotria babatwoensis* Cheek (Cheek & al. 2009) and *P. moseskemei* Cheek (Cheek & Csiba 2002).

During our fieldwork from 2000–2004, multiple threats were evident of which the primary was clearance of the forest for agricultural land by local communities at the higher altitudinal range of the forest. Viewing Digital Globe imagery from 2008, now available on Google Earth (viewed 27 May 2018), one can see that the canopy of the forest has become more sparse and the clearance at the forest edges has continued. Nonetheless, if the authorities and communities were to halt this now, it is feasible that the forest could recover and continue to have a national and global role in the conservation of species and natural habitat, even if some species may already have become globally extinct.

Acknowledgements

The botanical surveys in Cameroon that resulted in this paper were mainly supported by Earthwatch (1993–2005) and by the Darwin Initiative of the U.K. Government through the Plant Conservation of Western Cameroon and Red Data Book of Cameroon projects, both led by the Royal Botanic Gardens, Kew, working with the IRAD-National Herbarium of Cameroon. Gaston Achoundong, former head of the National Herbarium of Cameroon (YA) and his successor Marie Florence Ngo Ngwe are thanked for their collaboration and support over the years. We also thank Hans-Joachim Esser (M) and an anonymous reviewer for their comments on an earlier version of this paper.

References

Bachman S. P., Nic Lughadha E. M. & Rivers M. C. 2018: Quantifying progress towards a conservation assessment for all plants. – Conservation Biol. **32:** 516–524.

Burkill H. N. 1997: The useful plants of West Tropical Africa **4.** Families M–R. – Kew: Royal Botanic Gardens.

Cable S. & Cheek M. 1998: The plants of Mount Cameroon. A conservation checklist. – Kew: Royal Botanic Gardens.

Cheek M. 2017a: *Vepris felicis*. The IUCN Red List of threatened species 2017: e.T65064584A65064590. – Published at https://doi.org/10.2305/IUCN.UK.2017-3.RLTS.T65064584A65064590.en [accessed 26 May 2018].

Cheek M. & Ameka G. 2008: *Ledermanniella pollardiana* sp. nov. (*Podostemaceae*) from western Cameroon. – Nordic J. Bot. **26:** 214–217.

Cheek M. & Cable S. 1997: Plant inventory for conservation management: the Kew-Earthwatch programme in western Cameroon, 1993–96. – Pp. 29–38 in: Doolan S. (ed.), African rainforests and the conservation of biodiversity. – Oxford: Earthwatch Europe.

Cheek M., Corcoran M. & Horwath A. 2009: Four new submontane species of *Psychotria* (*Rubiaceae*) with bacterial nodules from western Cameroon. – Kew Bull. **63:** 405–418.

Cheek M. & Csiba L. 2000: A new species and new combination in *Chassalia* (*Rubiaceae*) of western Cameroon. – Kew Bull. **55:** 883–888.

Cheek M. & Csiba L. 2002: A revision of the *Psychotria chalconeura* complex (*Rubiaceae*) in Guineo-Congolian Africa. – Kew Bull. **57:** 375–387.

Cheek M. & Etuge M. 2009a: A new submontane species of *Deinbollia* (*Sapindaceae*) from western Cameroon and adjoining Nigeria. – Kew Bull. **64:** 503–508.

Cheek M. & Etuge M. 2009b: *Allophylus conraui* (*Sapindaceae*) reassessed and *Allophylus ujori* described from western Cameroon. – Kew Bull. **64:** 495–502.

Cheek M. & Fischer E. 1999: A tuberous and epiphytic new species of *Impatiens* (*Balsaminaceae*) from southwest Cameroon. – Kew Bull. **54:** 471–475.

Cheek M., Harvey Y. & Onana J.-M. 2010: The plants of Dom, Bamenda Highlands, Cameroon. A conservation checklist. – Kew: Royal Botanic Gardens.

Cheek M., Mackinder B., Gosline G., Onana J.-M. & Achoundong G. 2001: The phytogeography and flora of western Cameroon and the Cross River-Sanaga River interval. – Syst. & Geogr. Pl. **71:** 1097–1100.

Cheek M., Oben B. & Heller T. 2009: The identity of the West-Central African *Oricia lecomteana* Pierre, with a new combination in *Vepris* (*Rutaceae*). – Kew Bull. **64:** 509–512.

Cheek M. & Onana, J.-M. 2011: Red Data species in Cameroon, a guide for secondary school teachers. – Kew: Royal Botanic Gardens.

Cheek M., Onana J.-M. & Pollard B. J. 2000: The plants of Mount Oku and the Ijim Ridge, Cameroon. A conservation checklist. – Kew: Royal Botanic Gardens.

Cheek M., Pollard B. J., Darbyshire I., Onana J.-M. & Wild C. 2004: The plants of Kupe, Mwanenguba and the Bakossi Mountains, Cameroon. A conservation checklist. – Kew: Royal Botanic Gardens.

Cheek M. & Sonké B. 2000: A new species of *Oxyanthus* (*Rubiaceae-Gardeniinae*) from western Cameroon. – Kew Bull. **55:** 889–893.

Cheek M. & Sonké B. 2005: Two further new species of *Psychotria* (*Rubiaceae*) from western Cameroon. – Kew Bull. **60:** 293–300.

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., Tsukaya H., Rudall P. J. & Suetsugu K. 2018: Taxonomic monograph of *Oxygyne* (*Thismiaceae*), rare achlorophyllous mycoheterotrophs with strongly disjunct distribution. – PeerJ **6:** e4828

Downloaded From: https://bioone.org/journals/Willdenowia on 03 Aug 2022
Terms of Use: https://bioone.org/terms-of-use

Cheek M., Williams, S. & Etuge, M. 2003: *Kupea martinetugei*, a new genus and species of *Triuridaceae* from western Cameroon. – Kew Bull. **58:** 225–228.

Cheplogoi P. K., Mulholland D. A., Coombes P. H. & Randrianarivelojosia M. 2008: An azole, an amide and a limonoid from *Vepris uguenensis* (*Rutaceae*). – Phytochemistry **69:** 1384–1388.

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., Saıdou D., Sarbu A., Shrestha K. & Radford E. A. 2017: Important Plant Areas: revised selection criteria for a global approach to plant conservation. – Biodivers. Conserv. **26:** 1767–1800.

Engler A. 1917: *Rutaceae* africanae. V. – Bot. Jahrb. Syst. **54:** 297–308.

Harvey Y. H., Pollard B. J., Darbyshire I., Onana J.-M. & Cheek M. 2004: The plants of Bali Ngemba Forest Reserve, Cameroon. A conservation checklist. – Kew: Royal Botanic Gardens.

Harvey Y. H., Tchiengue B. & Cheek M. 2010: The plants of the Lebialem Highlands. A conservation checklist. – Kew: Royal Botanic Gardens.

Imbenzi P. S., Osoro E. K., Aboud N. S., Ombito J. O. & Cheplogoi P. K. 2014: A review on chemistry of some species of genus *Vepris* (*Rutaceae* family). – J. Sci. Innovative Res. **3:** 357–362

IPNI 2018+ [continuously updated]: The International Plant Names Index. – Published at http://www.ipni.org/ [accessed 2 Apr 2018].

IUCN 2012: IUCN Red List categories and criteria: version 3.1, ed. 2. – Gland & Cambridge: IUCN. – Published at http://www.iucnredlist.org/ [accessed Jan 2017].

Keay R. W. J. 1958: *Rutaceae*. Pp. 683–689 in: Keay (ed.), Flora of West Tropical Africa **1.** – London: Crown Agents.

Kew 2016: The state of the world's plants report – 2016. – Kew: Royal Botanic Gardens.

Letouzey R. 1963: *Rutaceae*. Flore du Cameroun **1.** – Paris: Muséum National d'Histoire Naturelle.

Letouzey R. 1966: *Vepris heterophylla* R. Let. stat. nov. pour le «Kinkéliba de Boulouli» (Rutacée Toddaliée d'Afrique occidentale et du Cameroun). – Adansonia, sér. 2, **6:** 243–246.

Mackinder B. & Cheek M. 2003: A new species of *Newtonia* (*Leguminosae–Mimosoideae*) from Cameroon. – Kew Bull. **58:** 447–452.

Morton C. M. 2017: Phylogenetic relationships of *Vepris* (*Rutaceae*) inferred from chloroplast, nuclear, and morphological data. – PLoS ONE **12:** e0172708.

Muasya A., Harvey Y. H., Cheek M., Tah K. & Simpson D. A. 2010: A new species of epiphytic *Coleochloa* (*Cyperaceae*) from Cameroon. – Kew Bull. **65:** 1–3.

Mziray W. 1992: Taxonomic studies in *Toddalieae* Hook. F. (*Rutaceae*) in Africa. – Symb. Bot. Upsal. **30:** 1–95.

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.

Onana J.-M. 2011: The vascular plants of Cameroon. A taxonomic checklist with IUCN assessments. Flore du Cameroun **39.** – Yaoundé: Ministry of Scientific Research and Innovation.

Onana J.-M. & Cheek M. 2011: Red Data Book of the flowering plants of Cameroon. – Kew: Royal Botanic Gardens.

Onana J.-M. & Chevillotte H. 2015: Taxonomie des *Rutaceae – Toddalieae* du Cameroun revisitée: découverte de quatre espèces nouvelles, validation d'une combinaison nouvelle et véritable identité de deux autres espèces de *Vepris* Comm. ex A. Juss. – Adansonia, sér. 3, **37:** 103–129.

Plants of the World Online 2018: *Vepris*. – Published at http://www.plantsoftheworldonline.org/?f=accepted_names&q=Vepris [accessed 25 May 2018].

Stoffelen P., Cheek M., Bridson D. & Robbrecht E. 1997: A new species of *Coffea (Rubiaceae)* and notes on Mt Kupe (Cameroon). – Kew Bull. **52:** 989–994.

Thiers B. 2018+ [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 2018].

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**].

Willdenowia

Open-access online edition www.bioone.org/loi/will

Online ISSN 1868-6397 · Print ISSN 0511-9618 · Impact factor 1.500

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

© 2018 The Authors · This open-access article is distributed under the CC BY 4.0 licence

Downloaded From: https://bioone.org/journals/Willdenowia on 03 Aug 2022
Terms of Use: https://bioone.org/terms-of-use