

Monanthotaxis bali (Annonaceae) a new Critically Endangered (possibly extinct) montane forest treelet from Bali Ngemba, Cameroon

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Summary. *Monanthotaxis bali* is the only known, solely montane (occurring solely above 2000 m alt.) species of the genus. It joins *Monanthotaxis orophila* (Rwanda) and *M. discolor* (Tanzania), two other species that can also occur above 2000 m alt. *Monanthotaxis bali* is an addition to the small number (28) of the tree species of the surviving montane forests of the Cameroon Highlands of which only eight other species are endemic.

Due to its supra-axillary inflorescences, and petals arranged in one whorl but with the outer petals overlapping the inner petals distally, and rounded flower buds, the new species is placed in Hoekstra's clade B of *Monanthotaxis*. The new species is unusual in being a treelet in a predominantly lianescent genus, and in lacking the glaucous underside of the leaf-blades that usually characterises the genus. *Monanthotaxis bali* takes the number of continental African species of the genus to 80, and makes Cameroon, with 30 species, the most species-diverse country for the genus.

Monanthotaxis bali is known only from the Bali Ngemba Forest Reserve, a forest remnant under pressure of degradation and clearance in the Bamenda Highlands of Cameroon. It may already be extinct due to logging and agricultural activities. Here it is described, illustrated, mapped and assessed as Critically Endangered (Possibly Extinct) using the IUCN 2012 criteria.

Key words. Conservation; extinction crisis; leaf glands; supra-axillary; Tropical Important Plant Areas.

Introduction

In Jan. 2022, whilst examining herbarium specimens collected for the Conservation Checklist of the Plants of Bali-Ngamba, Cameroon (Harvey *et al.* 2004) but which had by oversight not been identified, an unknown taxon of Annonaceae was encountered. *Darbyshire 375* was collected 11 April 2004 (YA, K) at 2110 m alt. This is an extremely high altitude for a member of Annonaceae to occur in the Cameroon Highlands. On the higher mountains, Mt Cameroon (4095 m alt) and Mt Oku (3011 m alt.), the highest recorded occurrences of Annonaceae are respectively at 1400 m (*Uvari dendron fuscum* (Benth.) R.E. Fries and 1500 m alt. *Monan thotaxis vulcanica* P.H. Hoekstra (as *M. littoralis* (Bagsh. & Bak.f.) Verdc. (Cable & Cheek 1998; Cheek *et al.* 2000).

Darbyshire 375 was identified as a *Monan thotaxis* Baill. in the pantropical tribe Uvarieae, despite being a treelet with leaf-blades yellow-brown on the abaxial surface, when this genus is recognised by its lianescent habit and glaucous lower side of the leaves (Hoekstra *et al.* 2021). Pointers to placement in *Monan thotaxis* are the presence of a bract midway along the pedicel, the supra-axillary inflorescences and above all, the presence of dark coloured, gland-like structures at the base of the leaf blade, a feature almost exclusively present in *Monan thotaxis* and not found in other Annonaceae (Hoekstra *et al.* 2021).

The Annonaceae is a pantropical family largely restricted to tropical rainforest habitats. The characteristic often showy flowers and fruit help make it widely collected and studied (Chatrou *et al.* 2012; Couvreur *et al.* (in press)). Annonaceae are well known for species producing edible fruits (bullocks heart, soursop, custard apple), and for the fragrant ylang-ylang (*Cananga odorata* (Lam.) Hook.f. & Thomson) used in perfumes. The Annonaceae is a basal angiosperm family in the order Magnoliales (Heywood *et al.* 2007). It comprises c. 2400 species and c. 107 genera of trees, shrubs and lianas (Guo *et al.* 2017a). Within the subfamily Annonoideae comprising over 1500 species, the pantropical tribe Uvarieae is composed of 15 genera and 474 species (Guo *et al.* 2017a).

New Annonaceae taxa are continually being discovered in Africa, including new genera to science e.g. *Lukea* Cheek & Gosline in E Africa (Cheek *et al.* in press) and new species, e.g. of *Uvari dendron* (Dagallier *et al.* 2021) also in E Africa, and in Cameroon, new species such as *Uvariopsis dicaprio* Cheek & Gosline (Gosline *et al.* 2022), *U. etugeana* Dagallier & Couvreur (Couvreur *et al.* in press) and *Xylophia monticola* D.M. Johnson & N. A. Murray (Johnson & Murray 2018)

The genus *Monan thotaxis* is confined to subsaharan continental Africa (79 species), the Comores and Madagascar (Hoekstra *et al.* 2021). The numbers of species have been recently increased by the description of about 20 new species to science (Hoekstra *et al.* 2014; 2016; 2021) and the subsumation of the African species of the genera *Friesodielsia* Steenis, *Exellia* Boutique and *Gilbertiella* Boutique (Guo *et al.* 2017b). Earlier, Verdcourt (1971) had subsumed the African species of *Popowia* Endl. and *Enneastemon* Exell into *Monan thotaxis*, recognising 55 species in the last genus.

HERB. HORT. KEW



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K000593350

Flora of Cameroon
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~~Annonaceae~~
Annonaceae
Monanthotaxis sp. nov. ined.
Det. CHEEK
Jan 2022

Cameroon
West Region
Mezam
Bali Ngemba F.R.
Lat/Long: 5° 48' 31.0" N, 10° 5' 48.0" E Alt: 2110 m
Ridge at top of reserve, from Ntanyam Trail.
Open forest edge.
Treelet to 3m. leaves distichous, zig-zagging stem. Buds obovate, brown, puberulent.

Darbyshire, I. 375

Fig. 1 *Monanthotaxis bali* The type specimen Darbyshire 375 (holotype K, barcode K000593350).

Monanthotaxis species are mainly confined to rainforest, with only a few species occurring in woodland, notably the widespread *M. buchananii* (Engl.) Verdc. In continental Africa species extend from Senegal in the north, and west to Somalia in the east, and as far south as the Eastern Cape Province of South Africa (Hoekstra *et al.* 2021).

Fifty four species occur in the Central African forest, with DR Congo and Cameroon both having the highest number of all countries: 29 species. Only a few forest species have wide distributions e.g. *Monanthotaxis laurentii* (De Wild.) Verdc. from Guinea in the west to eastern DR Congo in the east (Hoekstra *et al.* 2021). Hoekstra *et al.* (2021) identify nine different clades, A-I, based on 5 plastid and 2 nuclear DNA markers. Each clade is morphologically characterised. Seed dispersal is mainly recorded to be by primates including humans, gorillas, chimpanzees, mandrills and galagos in continental Africa, and in Madagascar, lemurs. The fruits are juicy, sweet and often brightly coloured red or orange (Hoekstra *et al.* 2021).

Several species are used in traditional medicine including as anti-malarials, and 15 species have been studied for their phytochemistry (Hoekstra *et al.* 2021).

Materials & methods.

The specimen was collected using the patrol method as documented in Cheek & Cable (1997). Unambiguous identification as a new species was largely thanks to the excellent monograph including comprehensive species delimitations and keys, of Hoekstra *et al.* (2021) without which this paper would have been much more difficult to complete so speedily. 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 with a Leica 308700 camera lucida attachment. Specimens, or their high-resolution images, were inspected from the following herbaria: BR, K, P and WAG. All specimens cited have been seen. Names of species and authors follow the International Plant Names Index (IPNI continuously updated). Nomenclature follows Turland *et al.* (2018). Technical terms follow Beentje & Cheek (2003) and Hoekstra *et al.* (2021). The conservation assessment follows the IUCN (2012) categories and criteria. Herbarium codes follow Index Herbariorum (Thiers continuously updated).

Results

Because *Darbyshire* 375 has bisexual flowers, supra-axillary 1 – 2-flowered inflorescences, 7 – 9 carpels, 9 free stamens, no staminodes, inner petals visible between the outer petals in the rounded flower buds, hairy petals, ovules 4 – 6, hairs on young branches yellow-brown, it keys out in Hoekstra *et al.* (2021) to couplet 45 which leads to *Monanthotaxis barteri* (Baill.) Verdc. of West Africa and *M. schweinfurthii* (Eng. & Diels) Verdc. (Central Africa). It differs from these two species in numerous characters (see Table 1 and diagnosis below).

Monanthotaxis barteri and *M. schweinfurthii* are placed in Hoekstra's clade B together with *M. seretii* (De Wild.) P.H. Hoekstra, *M. aestuaria* P.H. Hoekstra, *M. ochroleuca* (Diels) P.H.

Hoekstra, *M. foliosa* (Engl. & Diels) P.H. Hoekstra, *M. capea* (B.G. Camus & A. Camus) Verdc., and *M. biglandulosa* (Boutique) P.H. Hoekstra. This group of species is characterised by rounded flower buds in which the inner petals are exposed between the bases

	<i>Monanthotaxis barteri</i>	<i>Monanthotaxis bali</i>	<i>Monanthotaxis schweinfurthii</i>
Habit	Liana, lianescent shrub, rarely 'a shrub with spreading branches'	Treelet	Liana, lianescent shrub, rarely a shrub
Leaf surfaces & texture	Discolorous, lower surface glaucous white or white-grey, upper surface green or grey-green. Chartaceous or thinly coriaceous	Concolorous, both surfaces pale brown. Coriaceous	Discolorous, lower surface glaucous, upper surface green. Chartaceous or thinly coriaceous
Petiole length (mm)	2.5 – 6	(5 –)6 – 9(– 12)	4 – 9
Flower bud diam. (mm)	2 – 3.5	(5 –)7 – 9	3 – 4.5
Pedicel diam. (mm)	0.25 – 0.3	0.5 – 0.75(– 1.1)	0.3 – 0.4
Inflorescence insertion	Axillary (arising next to the leaf petiole)	Supra-axillary (arising 1 mm above the leaf axil).	Axillary
Stamen length (mm) & indumentum	1.2 – 1.4, hairy	c. 2, glabrous	1 – 1.7, hairy
Anther thecae position & shape of stamen apex	Extrorse, co-adjacent; stamen apex flat.	Latrorse, thecae separated, stamen apex with depression (between the thecae)	Extrorse, co-adjacent; stamen apex flat projecting over the anthers
Outer petals dimensions (mm)	3.2 – 3.6(– 5) x 2.2 – 2.6(– 3.4)	7.3 – 7.6 x 7.1 – 7.3	4 – 4.8 x 2.8 – 4.6
Inner petal dimensions (mm)	2.7 – 3.1(– 4.5) x 1.5 – 2.3	6.7 – 7 x 3.6 – 4	2 – 4.3 x 1 – 3.3
Altitudinal range (m)	0 – 1000	c. 2100	200 – 1290

Table 1. Characters separating *Monanthotaxis barteri* and *M. schweinfurthii* from *M. bali*. Data for the first two species from Hoekstra *et al.* (2021) and herbarium specimens at K.

of the outer petals. They also have a single whorl of both stamens (usually 9) and carpels (usually 6 – 9), are supra-axillary (the inflorescences not arising immediately from the axil but some distance above it) and 1 – 2-flowered. This group, Clade B, equates to the formerly accepted genus *Enneastemon* Exell.

Here we formally describe *Darbyshire 375* as new to science:

***Monanthotaxis bali* Cheek sp. nov.** Type: Cameroon, Northwest Region, Mezam Division, Bali Ngemba Forest Reserve, ridge at top of reserve, from Ntanyam Trail, 2110 m alt., fl. 11 April 2004, *Darbyshire 375* with Nukam, Ronsted, Atem (holotype K, barcode K000593350, isotypes US, YA). (Fig.1 &2)

Treelet c. 3m tall, branches with leafy stems flexuose (zig-zag), terete, 6 – 7 mm diam., dull black with numerous low longitudinal ridges, lenticels conspicuous bright white orbicular (-elliptic) 0.5 – 0.75 x 0.25 – 0.5mm, glabrous. *Leafy stems* distichous, flexuose, terete, 1.5 – 2.5 mm diam., internodes 1.5 – 2.5(– 3) cm long, dark purple-brown, first internode 70 – 80% covered in appressed translucent or slightly yellow simple hairs 0.2 – 0.25 mm long, eventually glabrescent, at second node surface about 50% covered. *Leaves* leathery, drying glossy pale yellow brown above, matt yellow-brown below, not glaucous, elliptic, elliptic-oblong or elliptic-obovate (6 –)9.3 – 13.7(– 15) x (4.0 –)4.4 – 6.8(– 7.3) cm, shortly acuminate or rounded at apex, base obtuse-rounded or rounded and minutely cordate, the lobe margins glossy-black, gland-like, 0.3 – 0.75 x 1mm, midrib and secondary nerves impressed on adaxial surface, raised on the abaxial surface, eucamptodromous, secondary nerves 7 – 11(– 12) on each side of the midrib, arising at 45 – 60° from the midrib, gradually arching upwards, becoming parallel to the margin, percurrent, tertiary nerves inconspicuous abaxially, but with quaternary nerves highly prominent, forming a fine reticulum adaxial surface, with cells 0.25 – 0.5 mm diam., margin slightly revolute, adaxial surface densely white hairy in young leaves, soon glabrescent, then punctate, only the base of the midrib grey-hairy, abaxial surface with persistent appressed translucent or red hairs, scattered evenly covering 20 – 30% of the surface, nerves more sparsely hairy. *Petioles* grey-black, twisted through 90°, distal part canaliculate, gradually becoming terete proximally, (5 –)6 – 9(– 12) x 1.5 mm, sparsely appressed hairy, hairs as stem, articulation sub-basal, leaving an orbicular, cupular scar raised c. 0.5mm above the stem.

Inflorescences supra-axillary, arising c. 1 mm above the leaf axil, 1 or 2-flowered, pedicels drying black, shortly connate, proximally terete, (6 –)8 – 14(– 15) x 0.5 – 0.75(– 1.1) mm, lower bract absent, upper bract inserted slightly below the midpoint, clasping the pedicel for c. 1/3 the circumference, conical (by involution of margins) 0.5 – 1.25 mm long, inclined forward at c. 45° from pedicel axis, densely covered in translucent hairs as stem. Flower buds oblate in bud, brown (0.5 –)7 – 9 mm diam. *Flowers* bisexual, sepals connate, forming a shallowly cupular calyx 0.8mm x 4 mm, lobes not divided, apex rounded, indumentum densely pubescent on outer surface, hairs erect, crisped, translucent, c. 0.1 mm long, inner surface glabrous, drying purple, receptacle c. 3 mm diam., flat; petals brown at anthesis

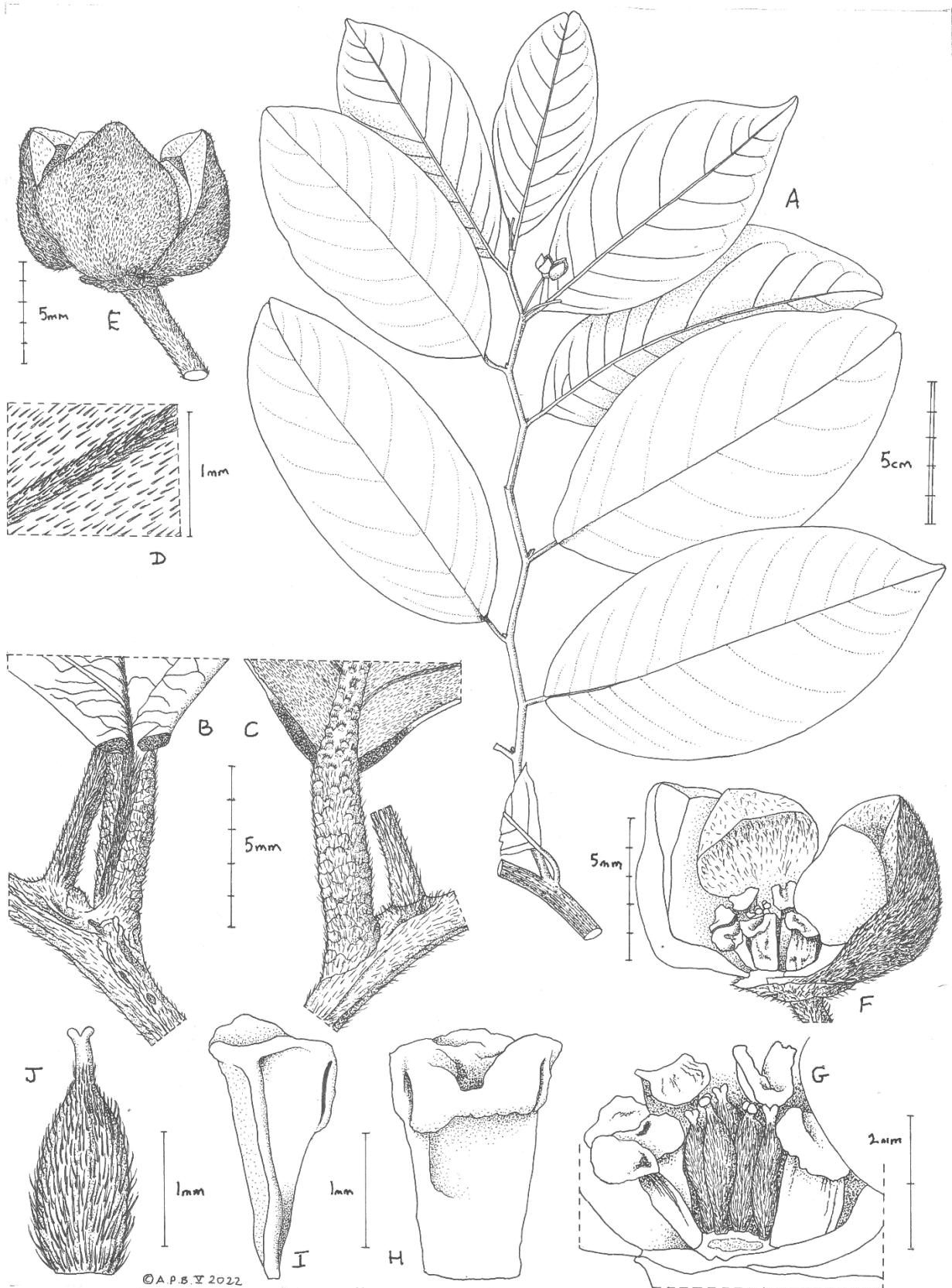


Fig. 1 *Monanthataxis bali* **A** habit, flowering stem; **B** node showing supra-axillary inflorescence base and paired glandular area at base of adaxial leaf blade; **C** as B but abaxial surface of blade; **D** indumentum on abaxial leaf blade surface, including secondary vein; **E**

flower, side view; **F** flower, after removal of an inner and outer petal to show androecium and gynoecium; **G** close-up of F, showing detail of carpels after removal of stamen; **H** stamen outer face, showing the two flanking thecal aperture and central apical depression; **I** stamen as H, but side view, showing absence of hairs; **J** pistil. All drawn from *Darbyshire 375* by ANDREW BROWN.

(collection notes), 6, base of inner petals visible in bud, outer petals overlapping at apex. *Outer petals* 3 subrhombic, thick, 7.3 – 7.6 x 7.1 – 7.3 mm, apex obtuse, base slightly united with inner petals, outer and inner surface densely hairy as the sepals, excepting a small glabrous area 2 – 2.5 mm diam. on adaxial surface at base. *Inner petals* 3 cucullate (hooded) in the upper half c. 4 x 4 mm, lower half broadly stipitate c. 3 x 2.5 mm, indumentum as outer petals. Stamens 9, in one whorl, free, 2 x 0.75 – 1.25 mm, filaments centripetally flattened, 1.25 – 1.5 x 0.75 – 1.25 mm, drying yellow, thecae latrorse, separated by a distal depression, connective prolonged horizontally inwards towards the carpels, flat, oblong, apex rounded c. 1.25 x 0.75 mm, glabrous, staminodes absent. Carpels 7 – 9 in one whorl, erect, narrowly ellipsoid c. 2 x 0.75 mm, densely covered in appressed 0.2 – 0.25 mm long simple white or yellow hairs, ovules 3-4, style-stigma erect cylindrical c. 0.5 x 0.08 mm, slightly angled, stigma capitate, glabrous. Fruits not seen.

RECOGNITION. Differing from *Monanthataxis barteri* (Baill.) Verdc. and *M. schweinfurthii* (Engl. & Diels) Verdc. in being a treelet with concolorous leaves, supra-axillary inflorescences and flower buds 7 – 9 mm diam. (vs lianas with blades glaucous below, axillary inflorescences and flower buds 2 – 4.5 mm diam.). Additional diagnostic characters are given in Table 1.

DISTRIBUTION. Cameroon, North West Region (formerly Province), Mezam Division, Bali Ngemba Forest Reserve, only known from remnants of montane forest.

SPECIMENS EXAMINED: CAMEROON: Northwest Region, Mezam Division, Bali Ngemba Forest Reserve, ridge at top of reserve, from Ntanyam Trail, 2110 m alt., fl. 11 April 2004, *Darbyshire 375* with Nukam, Ronsted, Atem (holotype K, barcode K000593346; isotypes US, YA).

HABITAT. Infrequent treelet of montane evergreen forest remnant on basaltic plateau; c. 2110 m alt.

CONSERVATION STATUS. Although within the Bali Ngemba Forest Reserve, *Monanthataxis bali* is not protected because resources for patrolling seem so inadequate that people enter the forest to cut timber and plant food crops with impunity. Much of the montane, upper part of the reserve has been entirely cleared of forest for cultivation (Harvey *et al.* 2004), so it is fortunate that this single plant survived in one of the scraps that remained in 2004. Given continual pressure in the last 18 years it may be that this fragment has also been lost.

This distinctive treelet has not been found in surveys elsewhere in the Cameroon Highlands and adjacent areas (Cheek 1992; Cheek *et al.* 1996; Cable & Cheek 1998; Cheek *et al.* 2000; Maisels *et al.* 2000; Chapman & Chapman 2001; Cheek *et al.* 2004; Harvey *et al.* 2004;

Cheek *et al.* 2006; Cheek *et al.* 2010; Harvey *et al.* 2010; Cheek *et al.* 2011). Therefore, it may be, or have been, endemic to Bali Ngemba. Several other plants of high altitudes in the Cameroon Highlands appear to be point endemics e.g. *Impatiens etindensis* Cheek & Eb. Fisch. (Balsaminaceae, Cheek & Fischer 1999), *Ledermanniella pollardiana* Cheek (Podostemaceae, Cheek & Ameka 2008) and *Kupeantha fosimondi* (Cheek) Cheek (Rubiaceae), Cheek *et al.* 2018a). However, others, originally thought to have been point endemics have since been found at one or more other locations in the highlands of Cameroon, e.g. *Coffea montekupensis* Stoffelen (Rubiaceae, Stoffelen *et al.* 1997) and *Impatiens frithii* Cheek (Balsaminaceae, Cheek & Csiba 2002). It is to be hoped that the second scenario will be the case for *Monanthotaxis bali* and that it will also be found at other locations, although we consider this unlikely.

Bali Ngemba is less than 8 km² in area, and it was relatively well-surveyed by large teams of botanical collectors 2000 – 2004 (Harvey *et al.* 2004). Other new, or rediscovered species from Bali-Ngemba are known from multiple gatherings, sometimes 10 or more e.g. *Leptonychia kamerunensis* Engl. & K. Krause (Byttneriaceae, Cheek *et al.* 2013), *Vepris onanae* Cheek (Cheek *et al.* 2022a). That only a single collection is known for *Monanthotaxis bali*, and that a single plant was reported (*Darbyshire* 375) suggests that the species is genuinely infrequent, if indeed it survives.

Here we assess *Monanthotaxis bali* as Critically Endangered (Possible Extinct), CR (PE) B1+B2ab(iii) +D since only a single individual was reported from a forest scrap, threats are ongoing, and AOO and EOO are estimated as 4 km² using the cells of that size preferred by IUCN. It has been estimated that 96.5% of the former area of the montane and submontane forests of the Bamenda Highlands has been lost to clearance (Cheek *et al.* 2000). The surviving forests of the Bamenda Highlands are extremely fragmented. The indications for seed dispersal in *Monanthotaxis* are that it is conducted by fruit-eating primates (e.g. chimpanzees) (Hoekstra *et al.* 2021) for which traversal of human-created habitat (farmland and secondary grassland) in the Cameroon Highlands is known to be problematic (Cheek *et al.* 2021a).

ETYMOLOGY. Named for the Bali Ngemba Forest Reserve near the town of Bali.

NOTES. Additional plant taxa unique to Bali Ngemba forest and sometimes also the nearly adjoining and smaller Baba 2 community forest are: *Vepris bali* Cheek (Rutaceae, Cheek *et al.* 2018b), *Psychotria babatwoensis* Cheek (Rubiaceae, Cheek *et al.* 2009), *Magnistipula butayei* subsp. *balingembaensis* Sothers, Prance & B.J.Pollard (Chrysobalanaceae, Pollard *et al.* in Harvey *et al.* 2004). Newly described endangered, tree species from Bali Ngemba include *Tricalysia elmar* Cheek (Rubiaceae, Cheek *et al.* 2020a), *Vepris onanae* Cheek (Cheek *et al.* 2022a) and *Deinbollia onanae* Cheek (Cheek *et al.* 2021a).

Sadly, *Monanthotaxis bali* is not the only seemingly point endemic in the genus in Africa. Eight other species are known from a single collection or location: *Monanthotaxis aquila* P.H. Hoekstra (Ivory Coast), *M. atewensis* P.H. Hoekstra (Ghana), *M. couvreurii* P.H. Hoekstra (Cameroon), *M. filipes* P.H. Hoekstra (Tanzania), *M. glomerulata* (Le Thomas) Verdc. (Gabon, last seen 80 years ago), *M. hexamera* P.H. Hoekstra (Zingui, Cameroon, last

seen 50+ years ago), *M. mortehanii* (De Wild.) Verdc. (DR Congo, last seen >100 years ago) and *M. zenkeri* P.H. Hoekstra (Bipinde, Cameroon, last seen 100 years ago). All of these species, completely logically, are treated as Critically Endangered by Hoekstra *et al.* (2021). *Monanthotaxis bali* of Cameroon occurs within the Cross-Sanaga Interval (Cheek *et al.* 2001) which has the highest species and generic diversity per degree square in tropical Africa (Barthlott *et al.* 1996; Dagallier *et al.* 2020) including endemic genera such as *Medusandra* Brenan (Peridiscaceae, Breteler *et al.* 2015; Soltis *et al.* 2007). Much of this diversity is associated with the Cameroon Highland areas, different highlands each having a species of a genus e.g. as in *Kupeantha* Cheek (Rubiaceae, Cheek *et al.* 2018a). However, unlike for many genera in Africa, such as *Vepris* (Cheek *et al.* 2022a) and *Impatiens* (Cheek *et al.* 2022b), the Cross-Sanaga is not notable as a centre of diversity for the genus *Monanthotaxis*, since it holds only 14 species of the genus, of which three are endemic to the interval, increasing to four with the publication of *Monanthotaxis bali*.

In tropical Africa Annonaceae predominantly occur in lowland evergreen forest. A remarkable feature of *Monanthotaxis* is that 33 of the 79 species documented by Hoekstra *et al.* (2021) can occur over 1000 m alt., while four other species occur only above 1000 m alt, two others occurring sometimes above 2000 m (see introduction).

Discussion and Conclusions.

Monanthotaxis bali joins the growing list of African species considered likely to be extinct. Species considered extinct in Cameroon are *Oxygyne triandra* Schltr., *Afrothismia pachyantha* Schltr. (Cheek & Williams 1999, Cheek *et al.* 2018c, Cheek *et al.* 2019). It seems possible that *Monanthotaxis bali* became extinct before it is formally named scientifically in this paper, as was the case with *Vepris bali*, also of higher altitudes in Bali Ngemba (Cheek *et al.* 2018b). This extinction crisis extends through W. Africa e.g. *Saxicolella deniseae* Cheek, also seemingly extinct before publication (Cheek *et al.* 2022c). Similarly, *Pseudohydrosme bogneri* Cheek & Moxon-Holt and *P. buettneri* Engl. are now considered extinct in neighbouring Gabon (Moxon-Holt & Cheek 2020; Cheek *et al.* 2021b).

About 2000 species of vascular plant have been described as new to science each year for the last fifteen years or more. Cameroon currently has the highest number of new species to science published each year (Cheek *et al.* 2020b), recent examples being published are (Achoundong *et al.* 2021; Aguirre-Alvarez *et al.* 2021; Cheek *et al.* 2021a; 2021b; 2021c; Cheek & Onana 2021; Couvreur *et al.* in press; Gosline *et al.* 2021). While some exceptions exist (Cheek & Etuge 2009; Cheek *et al.* 2019), many, probably most of these species are highly range-restricted, making them especially at risk of habitat destruction, and so likely to be rated as threatened when assessed.

Only 7.2% of the 369,000 flowering plant species (the number is disputed) known to science have been assessed on the IUCN Red List. (Bachman *et al.* 2019; Nic Lughadha *et al.* 2016; 2017). Thanks to the Global Tree Assessment (BGCI 2021) many of the world's tree species have now been assessed. The State of the World's Trees concluded that the highest proportion of threatened tree species is found in Tropical Africa, and that Cameroon has the

highest number (414) of threatened tree species of all tropical African countries (BGCI 2021). This will be further increased by the addition of *Monanthonotaxis bali* and will require the updating of the Red Data Book of Cameroon Plants (Onana & Cheek 2011). However, the vast majority of plant species still lack assessments on the Red List (Nic Lughadha *et al.* 2020).

It is imperative to uncover the existence of previously unknown species as soon as possible and to formally name them. Until this is done, they are invisible to science and the possibility of them being assessed for their conservation status and appearing on the IUCN Red List is greatly reduced (Cheek *et al.* 2020b), limiting the likelihood both that they will be proposed for conservation measures, and that such measures will be accepted.

Bali Ngemba, while a Forest Reserve, is not formally protected for nature conservation and its natural forest habitat is being encroached for agriculture. Protection of Bali Ngemba, with the support of local communities supported by designation as a TIPA (Darbyshire *et al.* 2017) is essential if the 12 endemic and near-endemic plant species unique (or nearly unique) such as *Monanthonotaxis bali* are not to become extinct globally, and if the 34 threatened species of that forest are not to move closer to extinction.

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References

- Achoundong, G., van der Burgt, X. & Cheek, M. Four new threatened species of *Rinorea* (Violaceae), treelets from the forests of Cameroon. *Kew Bull* **76**, 705–719 (2021). <https://doi.org/10.1007/s12225-021-09987-8>
- Alvarez-Aguirre, M.G., Cheek, M. & Sonké, B. *Kupeantha yabassi* (Coffeeae-Rubiaceae), a new Critically Endangered shrub species of the Ebo Forest area, Littoral Region, Cameroon. *Kew Bull* **76**, 735–743 (2021). <https://doi.org/10.1007/s12225-021-09982-z>
- Bachman, S.P., Field, R., Reader, T., Raimondo, D., Donaldson, J., Schatz, G.E. and Lughadha, E.N. (2019). Progress, challenges and opportunities for Red Listing. *Biological Conservation* 234: 45 – 55. <https://doi.org/10.1016/j.biocon.2019.03.002>

Barthlott, W., Lauer, W. & Placke, A. (1996). Global distribution of species diversity in vascular plants: towards a world map of phytodiversity. *Erdkunde* 50: 317 – 327 <https://doi.org/10.1007/s004250050096>

Beentje, H. & Cheek, M. (2003). Glossary. In: Beentje H (ed), *Flora of Tropical East Africa*. Balkema, Lisse.

BGCI (2021). *State of the World's Trees*. BGCI, Richmond, UK.

Breteler, F.J., Bakker, F.T. & Jongkind, C.C. (2015). A synopsis of *Soyauxia* (Peridiscaceae, formerly Medusandraceae) with a new species from Liberia. *Plant Ecology and Evolution*. 148: 409 – 419. <https://doi.org/10.5091/plecevo.2015.1040>

Cable, S. & Cheek, M. (1998). *The Plants of Mt Cameroon, a Conservation Checklist*. Royal Botanic Gardens, Kew.

Chapman, J. & Chapman, H. (2001). *The Forests of Taraba and Adamawa States, Nigeria an Ecological Account and Plant Species Checklist*. University of Canterbury: Christchurch, New Zealand. pp. 221.

Chatrou, L.W., Erkens, R.H.J., Richardson, J.E., Saunders, R.M.K., Fay, M.F. (2012). The natural history of Annonaceae. *Botanical Journal of the Linnean Society* 169: 1 – 4. <https://doi.org/10.1111/j.1095-8339.2012.01242.x>

Cheek, M. (1992). *A Botanical Inventory of the Mabetia-Moliwe Forest*. Royal Botanic Gardens, Kew.

Cheek, M. & Ameka, G. (2008). *Ledermanniella pollardiana* sp.nov.(Podostemaceae) from western Cameroon. *Nordic. J. Bot.* 26: 214-217. <https://doi.org/10.1111/j.1756-1051.2008.00162.x>

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*, Earthwatch Europe, Oxford.

Cheek, M. & Csiba, L. (2002). A new epiphytic species of *Impatiens* (Balsaminaceae) from western Cameroon. *Kew Bull.* 57: 669 – 674. <https://doi.org/10.2307/4110997>

Cheek, M. & Etuge, M. (2009). A new submontane species of *Deinbollia* (Sapindaceae) from Western Cameroon and adjoining Nigeria. *Kew Bull.* 64: 503 – 508. <https://doi.org/10.1007/s12225-009-9132-4>

Cheek, M. & Fischer, E. (1999) A tuberous and epiphytic new species of *Impatiens* (Balsaminaceae) from Southwest Cameroon. *Kew Bull.* 54: 471 – 475. <https://doi.org/10.2307/4115828>

Cheek, M. & Onana, J.M. (2021). The endemic plant species of Mt Kupe, Cameroon with a new Critically Endangered cloud-forest tree species, *Vepris zapfackii* (Rutaceae). *Kew Bull* 76, 721–734 <https://doi.org/10.1007/s12225-021-09984-x>

Cheek, M. & Williams, S. (1999). A Review of African Saprophytic Flowering Plants. In: Timberlake, Kativu eds. *African Plants. Biodiversity, Taxonomy & Uses. Proceedings of the 15th AETFAT Congress at Harare*. Zimbabwe, 39 – 49.

Cheek, M., Achoundong, G., Onana, J-M., Pollard, B., Gosline, G., Moat, J., Harvey, Y.B. (2006). Conservation of the Plant Diversity of Western Cameroon. In: Ghazanfar SA, H.J. Beentje (eds). *Proceedings of the 17th AETFAT Congress, Addis Ababa*. Ethiopia, 779 – 791.

Cheek, M., Alvarez-Agiurre, M.G., Grall, A., Sonké, B., Howes, M-J.R., Larridon, I. (2018a). *Kupeantha* (Coffeae, Rubiaceae), a new genus from Cameroon and Equatorial Guinea. *PLoS ONE* 13: 20199324. <https://doi.org/10.1371/journal.pone.0199324>

Cheek, M., Arcate, J., Choung, H. S., Herian, K., Corcoran, M., Horwath, A. (2013). Three new or resurrected species of *Leptonychia* (*Sterculiaceae-Byttneriaceae-Malvaceae*) from West-Central Africa. *Kew Bull*. 68. <http://dx.doi.org/10.1007/s12225-013-9469-6>

Cheek, M., Cable, S., Hepper, F.N., Ndam, N., Watts, J. (1996). Mapping plant biodiversity on Mt. Cameroon. In: Maesen, Burgt, Rooy eds. *The Biodiversity of African Plants (Proceedings XIV AETFAT Congress*. Cameroon: Kluwer, 110 – 120. https://doi.org/10.1007/978-94-009-0285-5_16

Cheek, M., Causon, I., Tchiengue, B. & House, E. (2020a). Notes on the endemic cloud forest plants of the Cameroon Highlands and the new, Endangered, *Tricalysia elmar* (Coffeae-Rubiaceae). *Plant Ecology and Evolution* 153: 167 – 176 <https://doi.org/10.5091/plecevo.2020.1661>

Cheek, M., Corcoran, M. & Horwath, A. (2009b). Four new submontane species of *Psychotria* (*Rubiaceae*) with bacterial nodules from western Cameroon. *Kew Bull*. 63: 405 – 418. <https://doi.org/10.1007/s12225-008-9056-4>

Cheek, M., Darbyshire, I. & Onana, J.M. (2022c). *Impatiens banen* sp. nov. & *I. etugei* sp. nov. (Balsaminaceae), threatened lowland species of the Cross-Sanaga Interval, Cameroon. *bioRxiv* (pre-print) <https://doi.org/10.1101/2022.05.01.490166>

Cheek, M., Etuge, M. & Williams, S. (2019). *Afrothismia kupensis* sp. nov. (Thismiaceae), Critically Endangered, with observations on its pollination and notes on the endemics of Mt Kupe, Cameroon. *Blumea* 64: 158 – 164. <https://doi.org/10.3767/blumea.2019.64.02.06>

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

Cheek, M., Harvey, Y.B., Onana, J-M. (2010). *The Plants of Dom*. Bamenda Highlands, Cameroon: A Conservation Checklist. Royal Botanic Gardens, Kew.

Cheek M, Harvey Y, Onana J-M. (2011). *The Plants of Mefou Proposed National Park*. Yaoundé, Cameroon: A Conservation Checklist. Royal Botanic Gardens, Kew.

Cheek, M., Hatt, S., & Onana, J. M. (2022a). *Vepris onanae* (Rutaceae), a new Critically Endangered cloud-forest tree species, and the endemic plant species of Bali Ngemba Forest Reserve, Bamenda Highlands Cameroon. *Kew Bull.*, 1-15. <https://doi.org/10.1007/s12225-022-10020-9>

Cheek, M., Luke, W.R.Q., Gosline, G. (in press). *Lukea* gen. nov. (Monodoreae-Annonaceae) with two new threatened species of shrub from the forests of the Udzungwas, Tanzania & Kaya Ribe, Kenya. *Kew Bull.*

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. *Systematics and Geography of Plants* 71: 1097 – 1100. <https://doi.org/10.2307/3668742>

Cheek, M., Molmou, D., Magassouba, S., & Ghogue, J. P. (2022c). Taxonomic revision of *Saxicolella* (Podostemaceae), African waterfall plants highly threatened by Hydro-Electric projects. *Kew Bull.*, 1-31. <https://doi.org/10.1007/s12225-022-10019-2>

Cheek, M., Ndam, N., & Budden, A. (2021c). Notes on the threatened lowland forests of Mt Cameroon and their endemics including *Drypetes burnleyae* sp. nov., with a key to species of *Drypetes* sect. *Stipulares* (Putranjivaceae). *Kew Bull.*, 1-12. <https://doi.org/10.1007/s12225-021-09947-2>

Cheek, M., Nic Lughadha, E., Kirk, P., Lindon, H., Carretero, J., Looney, B., Douglas, B., Haelewaters, D., Gaya, E., Llewellyn, T., Ainsworth, M., Gafforov, Y., Hyde, K., Crous, P., Hughes, M., Walker, B.E., Forzza, R.C., Wong, K.M., Niskanen, T. (2020b). New scientific discoveries: plants and fungi. *Plants, People Planet* 2: 371 – 388. <https://doi.org/10.1002/ppp3.10148>

Cheek, M., Onana, J.M., Chapman, H.M. (2021a). The montane trees of the Cameroon Highlands, West-Central Africa, with *Deinbollia onanae* sp. nov. (Sapindaceae), a new primate-dispersed, Endangered species. *PeerJ* 9:e11036 <https://doi.org/10.7717/peerj.11036>

Cheek, M., Onana, J-M., Pollard, B.J. (2000). *The Plants of Mount Oku and the Ijim Ridge, Cameroon, a Conservation Checklist*. Royal Botanic Gardens, Kew.

Cheek, M., Onana, J-M., Yasuda, S., Lawrence, P., Ameka, G., Buinovskaja G. (2019a). Addressing the *Vepris verdoorniana* complex (Rutaceae) in West Africa, with two new species. *Kew Bull.* 74: 53. <https://doi.org/10.1007/S12225-019-9837-Y>

Cheek, M., Pollard, B.J., Darbyshire, I., Onana, J.M. & Wild, C. (2004). *The Plants of Kupe, Mwanenguba and the Bakossi Mts, Cameroon. A Conservation Checklist*. Royal Botanic Gardens, Kew.

Cheek, M., Tchiengué, B., van der Burgt, X. (2021b). Taxonomic revision of the threatened African genus *Pseudohydrosme* Engl. (Araceae), with *P. ebo*, a new, critically endangered species from Ebo, Cameroon. *PeerJ* 9:e10689 <https://doi.org/10.7717/peerj.10689>.

Cheek, M., Tsukaya, H., Rudall, P.J., Suetsugu, K. (2018c). Taxonomic monograph of *Oxygyne* (Thismiaceae), rare achlorophyllous mycoheterotrophs with strongly disjunct distribution. *PeerJ* 6: e4828. <https://doi.org/10.7717/peerj.4828>

Couvreur, T.L.P., Dagallier, L.-P.M.J., Crozier, F., Ghogue, J.-P., Hoekstra, P.H., Kamdem, N.G., Johnson, D.M., Murray, N., Sonké, B. (in press). Flora of Cameroon – Annonaceae. *Phytokeys*

Dagallier, L.P., Janssens, S.B., Dauby, G., Blach-Overgaard, A., Mackinder, B.A., Droissart, V., Svenning, J.C., Sosef, M.S., Stévant, T., Harris, D.J. & Sonké, B. (2020). Cradles and museums of generic plant diversity across tropical Africa. *New Phytologist* 225: 2196 – 2213.

Dagallier, L.-P., Mbago, F.M., Luke, W.R.Q., Couvreur, T.L.P. (2021). Three new species of *Uvariadendron* (Annonaceae) from coastal East Africa in Kenya and Tanzania. *PhytoKeys* 174: 107 – 126. <https://doi.org/10.3897/phytokeys.174.61630>

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., Saïdou, 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. <https://doi.org/10.1007/s10531-017-1336-6>.

Gosline, G., Cheek, M., Onana, J.M., Ngansop Tchatchouang E., van der Burgt, X.M., MacKinnon, L., Dagallier, L.M.J. (2022). *Uvariopsis dicaprio* (Annonaceae) a new tree species with notes on its pollination biology, and the Critically Endangered narrowly endemic plant species of the Ebo Forest, Cameroon. *PeerJ*. 6:9:e12614. <https://doi.org/10.7717/peerj.12614>

Guo, X., Hoekstra, P. H., Tang, C. C., Thomas, D. C., Wieringa, J. J., Chatrou, L. W., & Saunders, R. M. (2017b). Cutting up the climbers: Evidence for extensive polyphyly in *Friesodielsia* (Annonaceae) necessitates generic realignment across the tribe Uvarieae. *Taxon* 66(1), 3-19.

Guo, X., Tang, C.C., Thomas, D.C., Couvreur, T.L.P., Saunders, R.M.K. (2017a). A megaphylogeny of the Annonaceae: Taxonomic placement of five enigmatic genera and support

for a new tribe, Phoeniciantheae. *Scientific Reports* 7: e7323. <https://doi.org/10.1038/s41598-017-07252-2>

Harvey, Y.B., Pollard, B.J., Darbyshire, I., Onana, J.-M., Cheek, M. (2004). *The Plants of Bali Ngemba Forest Reserve. Cameroon: A Conservation Checklist*. Royal Botanic Gardens, Kew.

Harvey, Y.B., Tchiengue, B., Cheek, M. (2010). *The Plants of the Lebiale Highlands, a Conservation Checklist*. Royal Botanic Gardens, Kew.

Heywood, V.H., Brummitt, R. K., Culham, A. & Seburg, O. (eds.) (2007). *Flowering Plant Families of the World*. Royal Botanic Gardens, Kew.

Hoekstra, P. H., Chatrou, L. W., & Wieringa, J. J. (2014). A new species of *Monanthes* from Gabon with a unique inflorescence type for Annonaceae. *Phytotaxa*, 186(2), 106-112. <https://doi.org/10.11646/phytotaxa.186.2.5>

Hoekstra, P.H., Wieringa, J.J., Chatrou, L.W. (2016). A nonet of novel species of *Monanthes* (Annonaceae) from around Africa. *PhytoKeys* 69: 71–103. <https://doi.org/10.3897/phytokeys.69.9292>

Hoekstra, P. H., Wieringa, J. J., Maas, P. J. M., & Chatrou, L. W. (2021). Revision of the African species of *Monanthes* (Annonaceae). *Blumea-Biodiversity, Evolution and Biogeography of Plants* 66(2): 107 – 221. <https://doi.org/10.3767/blumea.2021.66.02.01>

IPNI (continuously updated). *The International Plant Names Index*. <http://ipni.org/> (accessed: 05/2020).

IUCN. (2012). *IUCN Red List Categories and Criteria: Version 3.1*. Second edition. – Gland, Switzerland and Cambridge, UK: IUCN. Available from: <http://www.iucnredlist.org/> (accessed: May 2021).

Johnson, D. M., & Murray, N. A. (2018). A revision of *Xylopia* L.(Annonaceae): the species of Tropical Africa. *PhytoKeys* 97, 1.

Maisels, F.M., Cheek, M., Wild, C. (2000). Rare plants on Mt Oku summit, Cameroon. *Oryx* 34: 136 – 140. <https://doi.org/10.1017/s0030605300031057>.

Moxon-Holt, L. & Cheek, M. (2020). *Pseudohydrosme bogneri* sp. nov. (Araceae), a spectacular Critically Endangered (Possibly Extinct) species from Gabon, long confused with *Anchomanes nigrifolius*. *BioRxiv (pre-print)* <https://doi.org/10.1101/2021.03.25.437040>

Nic Lughadha, E., Bachman, S.P., Leão, T.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona,

L.R., Razanajatovo, H., Reich, P.B., Richards, S.L., Rivers, M.C., Amanda Cooper, A., Iganci, J., Lewis, G.L., Smidt, E.C., Antonelli, A., Mueller, G.M. & Walker, B.E. (2020). Extinction risk and threats to plants and fungi. *Plants, People, Planet* 2: 389 – 408. <https://doi.org/10.1098/rstb.2017.0402>

Nic Lughadha, E., Bachman, S.P., Govaerts, R. (2017). Plant fates and states: Response to Pimm & Raven. *Trends in Ecology and Evolution* 32: 887–889

Onana, J.M. (2011). The Vascular Plants of Cameroon. A taxonomic checklist with IUCN assessments. *Flore du Cameroun* 39 “occasional volume”. IRAD-National Herbarium of Cameroun.

Onana, J.M. (2013). Synopsis des espèces végétales vasculaires endémiques et rares du Cameroun. Check-liste pour la conservation de la biodiversité. *Flore du Cameroun* 40. Ministère de la Recherche Scientifique et de l'Innovation (MINRESI), Yaoundé, Cameroun.

Onana, J.M. & Cheek, M. (2011). *Red Data Book of the Flowering Plants of Cameroon, IUCN Global Assessments*. Royal Botanic Gardens, Kew.

Plants of the World Online (continuously updated). Facilitated by the Royal Botanic Gardens, Kew. http://www.plantsoftheworldonline.org/?f=accepted_names&q=Vepris (downloaded 1 May 2022)

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.

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. <https://doi.org/10.2307/3668527>

Thiers, B. (continuously updated). *Index Herbariorum: A global directory of public herbaria and associated staff*. *New York Botanical Garden's Virtual Herbarium*. <http://sweetgum.nybg.org/ih/> (accessed: Jan. 2021).

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. (1971). Annonaceae in Milne-Redhead and Polhill (eds). *Flora of Tropical East Africa*. Crown Agents, London.