



Kupeantha yabassi (Coffeeae-Rubiaceae), a new Critically Endangered shrub species of the Ebo Forest area, Littoral Region, Cameroon

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Summary. A new species to science of evergreen forest shrub, *Kupeantha yabassi* M.G. Alvarez & Cheek (Coffeeae - Rubiaceae), is described, illustrated and compared morphologically with the closely similar species *K. pentamera*. Restricted so far to a single site in evergreen lowland forest near the Ebo Forest, Yabassi, Littoral Region, Cameroon, this species is Critically Endangered using the IUCN 2012 standard due to habitat clearance driven mainly by agriculture, adding to the growing list of threatened species resulting from anthropogenic pressure on Cameroon forests. A revised key to the six species of *Kupeantha* is presented. Two distinct geographical and ecological species groupings within the genus are identified and discussed. Notes are given on other narrowly endemic and threatened species in the Ebo Forest area, a threatened centre of diversity important for conservation in the Littoral Region.

Key Words. Biodiversity, conservation, endemic species, extinction, threatened species.

Introduction

The new species reported in this paper was discovered as a result of a long-running survey of plants in Cameroon to support improved conservation management. The survey is led by botanists from the Royal Botanic Gardens, Kew and IRAD (Institute of Agricultural Research for Development)-National Herbarium of Cameroon, Yaoundé. This study has focussed on the Cross-Sanaga interval (Cheek *et al.* 2001, 2006) which contains the area with the highest plant species diversity per degree square in tropical Africa (Barthlott *et al.* 1996), many of which are narrowly endemic, and also the highest generic diversity per degree square in tropical Africa (Dagallier *et al.* 2020), including endemic genera such as *Medusandra* Brenan (Peridiscaceae, Breteler *et al.* 2015; Soltis *et al.* 2007). The herbarium specimens collected in these surveys formed the foundations for a series of conservation checklists (see below). So far, over 100 new species and several new genera have been discovered and published because of these surveys, new protected areas have been recognised and the results of analysis are feeding into the Cameroon Important Plant Area programme (Cheek *et al.* 2020) based on the categories and criteria of Darbyshire *et al.* (2017).

During completion of a paper erecting the genus *Kupeantha* Cheek (Cheek *et al.* 2018a), it was noted

that a specimen, *Leeuwenberg* 6400 (K), included in the protologue of *K. pentamera* (Sonké & Robbr.) Cheek (originally described as *Calycosiphonia pentamera* Sonké & Robbr. (Sonké *et al.* 2007), was geographically disjunct from all the other 38 specimens known of that species. Further investigation of this specimen, in connection with preparation of a Conservation Checklist of the Plants of the Ebo Forest, Littoral Region, has shown that the points of difference between this specimen and the other specimens of *Kupeantha pentamera* (see Table 1 below), are more than sufficient to warrant to name a new species, the sixth in *Kupeantha*. We propose in this paper to provide evidence to test this hypothesis and to name this species *Kupeantha yabassi*.

Kupeantha (Coffeeae, Rubiaceae) is a recently described genus in the *Argocoffeopsis* clade which also comprises *Argocoffeopsis* Lebrun and *Calycosiphonia* Pierre ex Robbr., the latter being sister to the first two genera. There are no known morphological synapomorphies that unite the three genera (Cheek *et al.* 2018a). In that paper two new species were published (*Kupeantha ebo* M.G. Alvarez & Cheek and *K. kupensis* Cheek & Sonké, while the other three species had previously been described in either *Argocoffeopsis* or *Calycosiphonia*: (*K. fosimondi* (Tchiengué & Cheek) Cheek (Cheek & Tchiengué

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Table 1. Main distinctions between *Kupeantha yabassi* and *K. pentamera*

Character	<i>Kupeantha yabassi</i>	<i>Kupeantha pentamera</i>
Leaf blade colour	drying dark green	drying black
Secondary nerves	deeply impressed, giving a sub-bullate appearance to the leaf surface	flush with surface, the leaf completely flat
Petiole length (mm)	6 – 12	(7 –) 9 – 13
Number of flowers per axil	(2 –) 3 (– 5)	1 (– 2)
Lower calyculus dimensions (mm)	1.2 – 1.5 × 1.2 – 1.5	0.5 – 1 × 0.5 – 1
Upper calyculus dimensions (mm)	2.2 – 3.5 × 1 – 1.5	1 – 1.5 × 1 – 2
Fruit size (dried) (mm)	10 – 13 × 11 – 14	17 – 25 × 13 – 16.5

in Harvey *et al.* 2010), *K. pentamera* (Sonké *et al.* 2008), and *K. spathulata* (A.P.Davis & Sonké) Cheek (Davis & Sonké 2008)). *Kupeantha* is characterised by having supra-axillary buds, distal stem internodes drying dull black, proximal internodes with smooth, white spongy epidermis. The species all occur in Cameroon, with one of the species extending into Rio Muni of Equatorial Guinea. *Kupeantha* are found mainly in primary tropical forest from 100 – 2000 m altitude (Cheek *et al.* 2018a). It is possible that in future the range of the genus might be extended to adjacent Gabon, since over 1000 specimens of Rubiaceae were reported unidentified from that country by Sosef *et al.* (2006).

***Kupeantha yabassi*: its range and other endemic species in the Ebo Forest area**

Abwe & Morgan (2008) and Cheek *et al.* (2018b) characterise the Ebo forest, which is adjacent to the location of *Kupeantha yabassi*, and give overviews of habitats, species and importance for conservation. Sixty-nine globally threatened plant species are currently listed from Ebo on the IUCN Red List website and the number is set to rise rapidly as more of Cameroon's rare species are assessed for their conservation status as part of the Cameroon TIPAs programme. The discovery of a new species to science near the Ebo forest is not unusual. Numerous new species have been published from Ebo in recent years. Examples of other species that, like *Kupeantha yabassi*, appear to be strictly endemic to the Ebo area on current evidence are: *Ardisia ebo* Cheek (Cheek & Xanthos 2012), *Crateranthus cameroonensis* Cheek & Prance (Prance & Jongkind 2015), *Gilbertiodendron ebo* Burgt & Mackinder (van der Burgt *et al.* 2015), *Inversodicraea ebo* Cheek (Cheek *et al.* 2017), *Kupeantha ebo* M.G.Alvarez & Cheek (Cheek *et al.* 2018a), *Palisota ebo* Cheek (Cheek *et al.* 2018b) and *Pseudohydrosme ebo* Cheek (Cheek *et al.* 2021).

Further species described from Ebo have also been found further west, in the Cameroon Highlands, particularly at Mt Kupe and the Bakossi Mts (Cheek *et al.* 2004). Examples are *Myrianthus fosi* Cheek (Cheek & Osborne, in Harvey *et al.* 2010), *Salacia*

nigra Cheek (Gosline & Cheek 2014), *Talbotiella ebo* Mackinder & Wieringa (Mackinder *et al.* 2010).

Additionally, several species formerly thought endemic to Mt Kupe and the Bakossi Mts have subsequently been found at Ebo, e.g., *Coffea montekupensis* Stoff. (Stoffelen *et al.* 1997), *Costus kupensis* Maas & H.Maas (Maas-van der Kamer *et al.* 2016), *Microcos magnifica* Cheek (Cheek 2017), and *Uvariopsis submontana* Kenfack, Gosline & Gereau (Kenfack *et al.* 2003). It is considered likely that additional Kupe species may yet be found at Ebo such as *Brachystephanus kupeensis* I.Darbysh. (Champluvier & Darbyshire 2009), *Impatiens frithii* Cheek (Cheek & Csiba 2002) since new discoveries are still frequently being made in the Ebo Forest area. Therefore, it is possible that *Kupeantha yabassi* might yet also be found in the Cameroon highlands, e.g., at Mt Kupe. However, this is thought to be only a relatively small possibility given the high level of survey effort at Mt Kupe: if it occurred there, it is highly likely that it would have been recorded already.

Materials and Methods

Herbarium citations follow *Index Herbariorum* (Thiers, continuously updated). Specimens were studied online, on loan from, or at BR, K, WAG and YA. All specimens cited have been seen. We also searched JSTOR Global Plants (continuously updated) for additional material, and finally the Global Biodiversity Facility (GBIF, (continuously updated)). Binomial authorities follow the International Plant Names Index (IPNI continuously updated). 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. The terms and format of the description follow the conventions of Cheek *et al.* (2018a). The georeference for *Leeuwenberg* 6400 was obtained from the locality description on the specimen using Google Earth. (https://www.google.com/intl/en_uk/earth/versions/).

Taxonomic Treatment

Kupeantha yabassi can be distinguished from *K. pentamera* to which it is most closely similar, and most easily confused with, using the diagnostic characters presented in Table 1. It can be distinguished

from all other species of the genus using the key. The key is based mainly on vegetative features and fruit, since these are present for all or most (respectively) of the year, and because flowers are unknown in two of the species.

Key to the species of *Kupeantha* (updated from Cheek *et al.* 2018a)

1. Fruit obovoid; acumen spatulate **K. spathulata**
1. Fruit globose or ellipsoid; acumen with apex acute 2
2. 0.5 – 1.5 m tall; tertiary nerves conspicuous, scalariform or forming fine reticulation on lower surface of leaf-blade; secondary nerves (9 –) 10 – 13 on each side of midrib 3
2. 2 – 5 m tall; quaternary nerves absent or inconspicuous, scalariform or fine reticulation absent; secondary nerves < 10 on each side of midrib 4
3. Leaves drying black, secondary nerves flush with adaxial surface; inflorescences 1 (– 2) per axil; fruit 17 – 25 mm long **K. pentamera**
3. Leaves drying green, secondary nerves deeply impressed on adaxial surface; inflorescences (2 –) 3 (– 5) per axil; fruit 10 – 13 mm long **K. yabassi**
4. Fruits ellipsoid, ripening black, with a short stipe & rostrum. SW Region, Mt Kupe **K. kupensis**
4. Fruit globose, ripening orange-red, stipe & rostrum absent or inconspicuous. SW Region, Lebialem or Littoral Region, Ebo 5
5. Fruit 25 – 30 mm diam. Lebialem Highlands of SW Region; 1300 – 1400 m alt. **K. fosimondi**
5. Fruit 10 – 15 mm diam. Ebo Highlands of Littoral Region; 770 – 830 m alt **K. ebo**

Kupeantha yabassi *M.G. Alvarez & Cheek sp. nov.* Type: Cameroon, Littoral Region, 3 km east of km 21 of road Yabassi – Douala, 4°19'12"N, 10°04'09"E, fr, 17 Aug. 1965, *A. J. M. Leeuwenberg* 6400 (holotype K00609212; isotypes BR0000015677594, WAG0114722 (3 sheets), YA).

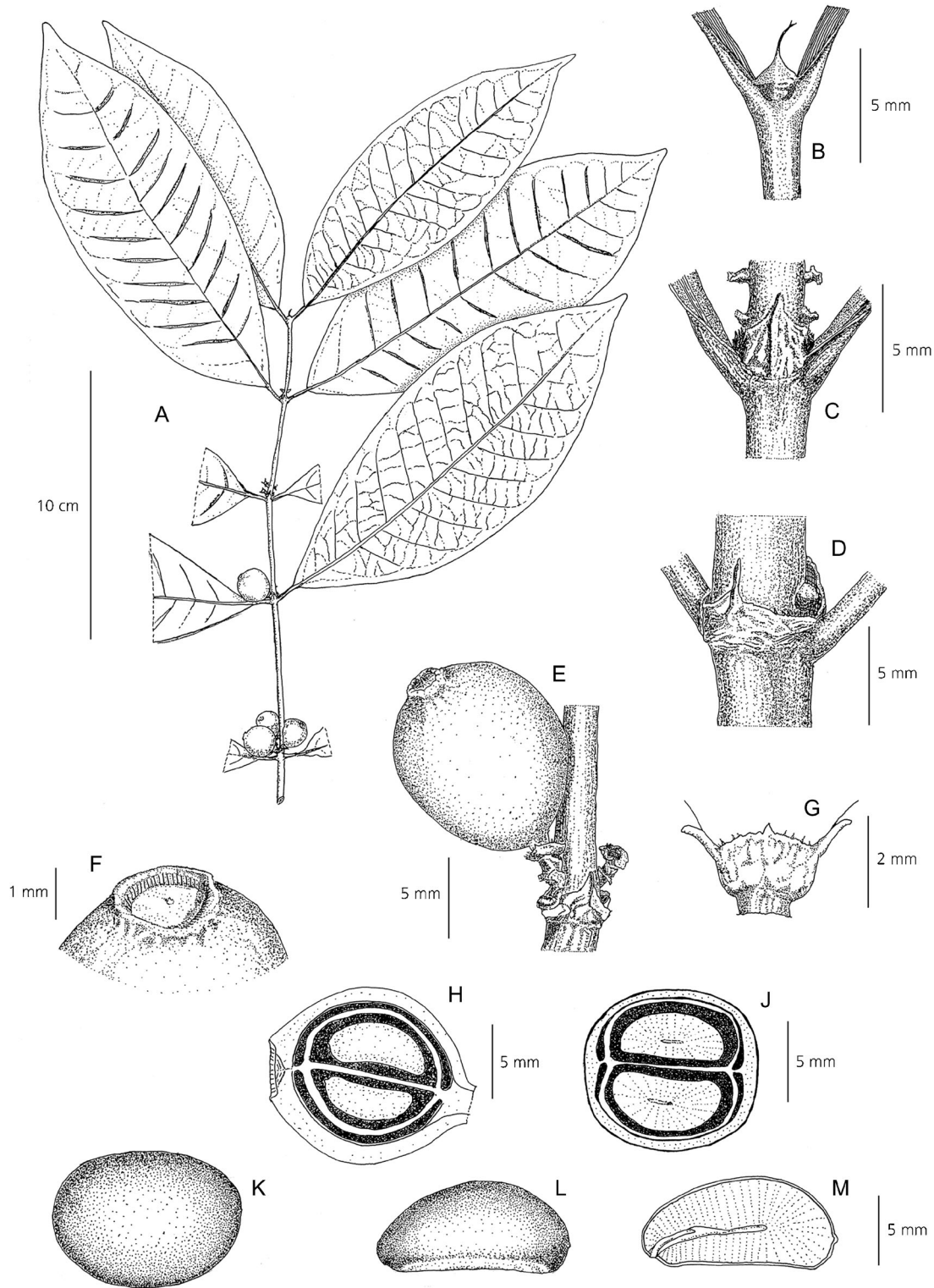
<http://www.ipni.org/urn:lsid:ipni.org:names:77220450-1>

Evergreen shrub 1.50 m tall, erect. Leafy branchlets with distal internodes drying black, black, terete, 2 – 3 mm in diam., internodes 3.8 – 5.5 cm long, glabrous, smooth; epidermis of older branches becoming white, flaking and peeling. Stipules shortly sheathing, subcoriaceous, 2 – 3 × 1.7 – 4 (– 5) mm, broadening with distance from the stem apex, keeled along midline, generally from the base, limb triangular, apex subulate, variable in length, 0.5 – 2 mm long, detaching and falling with age, outer surface glabrous, inner surface with standard colleters (Fig. 1B – D).

Leaves opposite, equal; leaf-blades slightly bicoloured, drying dark green-brown above and grey-green below, papery, narrowly elliptic to oblong, 8 – 17 × 3 – 7 cm; apex acuminate, 8 – 12 mm long; base attenuate to cuneate; midrib slightly raised above and prominent below; secondary nerves deeply impressed above (leaf surface approaching bullate), prominent below, 9 – 12 on each side of the midrib, ascending and uniting to make a looped intramarginal nerve (brochidodromous) 2 – 2.3 mm from the margin;

midrib and secondary nerves drying black on abaxial surface; tertiary nerves scalariform to broadly reticulate on both sides of the leaf (Fig. 1A), glabrous above and below, domatia absent. Petioles drying black to dark brown, plano-convex, 0.6 – 1.1 cm long, 1 mm wide, the adaxial surface flat, glabrous. *Inflorescences* supra-axillary, inserted 2 – 4 mm above the axil, in consecutive nodes (Fig. 1A), (2 –) 3 (– 5) per axil, in opposite axils, 1-flowered, subsessile, peduncle 0.8 – 1.5 mm long. *Calyculi* 2, subsessile, cupuliform, glabrous; the first, proximal, calyculus, closer to the stem, often 4-lobed, 1.2 – 1.5 × 1.2 – 1.5 mm; the second, distal, calyculus, 2.2 – 3.5 × 1 – 1.5 mm, lobes 2, subulate, each 1 mm long (Fig. 1G). *Fruits* berry-like, orange at maturity, shortly ellipsoid to globose, 2 × 1.5 cm when fresh (field notes); 1.1 – 1.4 × 1.0 – 1.3 cm when dried (Fig. 1E); subsessile, glabrous, exocarp drying hard, leathery, dark brown; disc ± circular, flat, 2 mm diam, sunk below calyx rim (Fig. 1F); calyx limbs absent. *Seeds* 2, apparently without seed coat (Fig. 1J), plano-convex, oblate in outline 9 – 12 × 6 – 10 × 2 – 6 mm surface smooth with hilum elliptic, c. 1 mm long on ventral face (Fig. 1L), endosperm entirely cream, striated in longitudinal section, embryo about 0.5 mm long (Fig. 1M). Micropyle not detected.

RECOGNITION. *Kupeantha yabassi* is an evergreen shrub, similar to *K. pentamera*, but differing in the fruits being smaller, 10 – 13 mm long (vs 17 – 25 mm), inflorescences more numerous, (2 –) 3 (– 5) per axil



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Fig. 1. *Kupeantha yabassi* A habit, fruiting branch; B detail of stipules at stem apex; C & D sheathing stipules and supra-axillary buds at subapical nodes; E fruit, showing calyculi; F fruit apex showing disc; G distal (upper) calyculus in young fruit; H fruit, longitudinal section showing the exocarp (dotted), mesocarp (white areas), cavities (dark areas) and at the centre, the seeds; J transverse section of a fruit, showing the exocarp (dotted), mesocarp (white areas), cavities (dark areas) and at the centre, endosperm with embedded embryo; K adaxial view of seed; L lateral view of seed; M longitudinal section of seed showing the endosperm (hatched) and part of embryo. A – M from A. J. M. Leeuwenberg 6400. DRAWN BY MARIA ALVAREZ.

(vs 1 (– 2)), upper calyculus 2.2 – 3.5 mm long (vs 1 – 1.5 mm long), leaf-blade drying green, sub-bullate due to the impressed secondary nerves (not black, surface flat). Additional characters distinguishing *Kupeantha yabassi* from *K. pentamera* are given in Table 1.

DISTRIBUTION. Endemic to Cameroon. Only known from a single collection made in forest near the Ebo Forest in the Littoral Region.

HABITAT. Secondary forest, along the Yabassi-Douala road, with *Lophira alata* Banks ex C.F.Gaertn. (Ochnaceae), *Coula edulis* Baill. (Olacaceae) and *Sacoglottis gabonensis* (Baill.) Urb. (Humiriaceae), 50 – 100 m altitude. The presence of *Lophira alata* and *Sacoglottis gabonensis* in rainforest within c. 50 – 100 km from the coast in Cameroon, indicates that the forest has been cultivated in the past (Letouzey 1957, 1960, 1968, 1985). At Ebo the geology is ancient, highly weathered basement complex, with some ferrallitic areas in foothill areas which are inland, c. 100 km from the coast. The wet season (successive months with cumulative rainfall >100 mm) falls between March and November and is colder than the dry season (Abwe & Morgan 2008).

CONSERVATION STATUS. *Kupeantha yabassi* is known from only a single site along the road parallel to the western boundary of the Ebo Forest. Since 2006, botanical surveys have been mounted almost annually, at different seasons, over many parts of the proposed National Park of Ebo. About 2500 botanical herbarium specimens have been collected, but this species has not yet been seen in the Ebo Forest. However, the area outside the surroundings of the two research camps in the Ebo Forest has not yet been surveyed for plants. While it is likely that the species will be found at additional sites, likely including the Ebo Forest, there is no doubt that it is genuinely range-restricted. Botanical surveys and other plant studies for conservation management in forest areas north, west and east of Ebo resulting in thousands of specimens being collected and identified have failed to find any additional specimens of this species (Cheek *et al.* 1996; Cable & Cheek 1998; Cheek *et al.* 2000; Maisels *et al.* 2000; Harvey *et al.* 2004; Cheek *et al.* 2004; Cheek *et al.* 2010; Harvey *et al.* 2010; Cheek *et al.* 2011). It is possible that the species is truly localised as are all other species of the genus west of the Sanaga (see discussion below). *Kupeantha yabassi* may well be unique to the Ebo Forest area, as are also, on current evidence, at least five other species (see discussion, below). The area of occupation of *Kupeantha yabassi* is estimated as 4 km² using the IUCN preferred cell-size. The extent of occurrence is the same. In February 2020 it was discovered that moves were in place to convert the forest into two logging concessions (e.g. <https://www.globalwildlife.org/blog/ebo-forest-a-stronghold-for-camerouns-wildlife/> and [https://blog.resource shark.com/cameroon-approves-logging-](https://blog.resource shark.com/cameroon-approves-logging-concession-that-will-destroy-ebo-forest-gorilla-habitat/)

[concession-that-will-destroy-ebo-forest-gorilla-habitat/](https://www.globalwildlife.org/blog/ebo-forest-a-stronghold-for-camerouns-wildlife/) both accessed 19 Sept. 2020). Such logging would result in timber extraction that would open up the canopy and remove the intact habitat in which *Kupeantha yabassi* is thought to grow. Additionally, slash and burn agriculture often follows logging trails and would negatively impact the population of this species. Fortunately the logging concession was suspended in August 2020 due to representations to the President of Cameroon on the global importance of the biodiversity of Ebo (<https://www.businesswire.com/news/home/20200817005135/en/Relief-in-the-Forest-Cameroonian-Government-Backtracks-on-the-Ebo-Forest> accessed 19 Sept. 2020). However, the forest habitat of this species remains unprotected and threats of logging and conversion of the habitat to plantations remain. *Kupeantha yabassi* is therefore here assessed, on the basis of the range size given and threats stated as Critically Endangered, CR B1+2ab(iii).

PHENOLOGY. Flowering unknown; fruiting in August.

ETYMOLOGY. *Kupeantha yabassi* is named for the administrative centre nearest to the point where the specimen was collected.

VERNACULAR NAMES. No vernacular names or uses are recorded.

NOTES. Only known from the single collection cited. At Kew the specimen was annotated “indet. not matched in *Tricalysia* etc.”, subsequently loaned to BR in 1983, it was annotated by Robbrecht in 1986 as “unknown to me, I don’t believe it belongs to *Tricalysia*”.

Discussion

Groupings within *Kupeantha*

The former placement of the only known specimen of *Kupeantha yabassi* in *K. pentamera* was understandable due to their morphological similarity. Both species have leaves of similar shape and size, and uniquely in the genus have tertiary nerves which are visible (they are inconspicuous in other species of the genus). They also share fruits of similar shape. The six species of *Kupeantha* can be divided into two groups based on ecology and geography. The groups differ from each other also in sympatry and extent of occurrence. 1) East of the Sanaga river, the only two species present are *Kupeantha spathulata* and *K. pentamera*. Both species are low altitude, predominantly occurring below 800 m (although the last has been recorded as high as 900 m). Both are known from numerous specimens, 21 and 37 respectively, with numerous locations and large extents of occurrence (8100 km², and 52 km² respectively). The two species are often sympatric, indeed have been collected in sequential number series at several of their common locations, in South Region, Cameroon: e.g., Bibondi, 24 Jan. 2005, *Sonké* & *Nguembou* 3783 (*K. pentamera*) and 3784

(*K. spathulata*). Again, at 3 km NNW Ngoyang, 20 Sept. 2005, *Sonké & Djuikouo* 4060 (*K. spathulata*), and 4059 (*K. pentamera*). Similarly, at 2 km NW Mbikililiki, 19 Jan. 2006, *Sonké & Djuikouo* 4286 (*K. pentamera*) and 4285 (*K. spathulata*). These specimens are cited in the protologues of the two species (*Sonké et al.* 2008 and *Davis & Sonké* 2008), they derive from a series of Rubiaceae-focussed surveys that resulted in numerous other discoveries of new Rubiaceae species to science, e.g., *Sonké et al.* 2005, 2006 & 2008). 2) West of the Sanaga River, the four species known, *Kupeantha kupensis*, *K. fosimondi*, *K. ebo* and *K. yabassii* are all upland species, occurring in the 800 – 2000 m altitudinal range (However, *Kupeantha ebo* occurs in the range 770 – 830 m). None are sympatric but allopatric, all are separated from each other by tens of kilometres. Even in the Ebo forest area, *Kupeantha ebo* and *K. yabassi* are physically separated by 20 km. These four species all have much smaller extents of occurrence (c. 8 km² in *K. kupensis*) and are much rarer and more localised (and so more threatened) than those species east of the Sanaga. Despite the separation of these two groups, there is no evidence that they are separated phylogenetically. The two species East of the Sanaga are in fact so dissimilar that they were formerly placed apart from each other in separate genera (*Calycosiphonia* and *Argocoffeopsis*, *Sonké et al.* 2008 and *Davis & Sonké* 2008).

Cameroon has been highlighted as the top country in tropical Africa for plant species diversity per degree square and has high levels of endemism (*Lachenaud et al.* 2013; *Onana* 2011; *Onana & Cheek* 2011). The inventory of its flora is far from completed, and the few remaining sizable areas of intact forest such as Ebo Forest, in the Littoral Region, are seriously threatened by clearance. Unfortunately, there is an increasing pressure to convert critical areas for biodiversity into oil palm plantations, and logging concessions (*Mahmoud et al.* 2019). The pressure for forest and wildlife resources is a strong driver in the rapid decrease of primary forests and biodiversity. This paper contributes to documenting the rich flora of Cameroon and helps to highlight areas for conservation.

Such discoveries as this new species also underline the urgency for making such further discoveries while it is still possible since in all but one of the cases given, the range extension resulted from discovery of a new species for science with a narrow geographic range and/or very few individuals, and which face threats to their natural habitat, putting these species at high risk of extinction.

About 2000 new species of vascular plant have been discovered each year for the last decade or more. Until species are known to science, they cannot be assessed for their conservation status and the possibility of protecting them is reduced (*Cheek et al.* 2020). Documented

extinctions of plant species are increasing, e.g., *Oxygyne triandra* Schltr. and *Afrothismia pachyantha* Schltr. of South West Region, Cameroon are now known to be globally extinct (*Cheek & Williams* 1999; *Cheek et al.* 2018c; *Cheek et al.* 2019). In some cases, species appear to be extinct even before they are known to science, such as *Vepris bali* Cheek, also from the Cross-Sanaga interval in Cameroon (*Cheek et al.* 2018d) and elsewhere, *Nepenthes maximoides* Cheek (*King & Cheek* 2020). Most of the >800 Cameroonian species in the Red Data Book for the plants of Cameroon are threatened with extinction due to habitat clearance or degradation, especially of forest for small-holder 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 et al.* (2017). This is intended to help avoid the global extinction of additional endemic species such as *Kupeantha yabassi* which we hope will be included in the proposed Ebo Forest IPA.

With only one locality known, *Kupeantha yabassi* represents another narrowly endemic Cameroonian species threatened with extinction due to deforestation for oil palm plantations, small-scale agriculture, mining and logging (*Onana & Cheek* 2011; *Cheek et al.* 2018a).

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References

- Abwe, E. E. & Morgan, B. J. (2008). The Ebo Forest: four years of preliminary research and conservation of the Nigeria-Cameroon chimpanzee (*Pan troglodytes vellerosus*). *Pan Africa News* 15: 26 – 29. <https://doi.org/10.5134/143494>
- Barthlott, W., Lauer, W. & Placke, A. (1996). Global distribution of species diversity in vascular plants: towards a world map of phytodiversity. *Erkunde* 50: 317 – 328 (with supplement and figure).
- Breteler, F. J., Bakker, F. T. & Jongkind, C. C. (2015). A synopsis of *Soyauxia* (Peridiscaceae, formerly Medusandraceae) with a new species from Liberia. *Pl. Ecol. Evol.* 148 (3): 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.
- 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. (2017). *Microcos magnifica* (Sparmanniaceae) a new species of cloudforest tree from Cameroon. *PeerJ* 5:e4137. <https://doi.org/10.7717/peerj.4137>
- ____ & Csiba, L. (2002). A new epiphytic species of *Impatiens* (Balsaminaceae) from western Cameroon. *Kew Bull.* 57 (3): 669 – 674. <https://doi.org/10.2307/4110997>
- ____ & Williams, S. (1999). A Review of African Saprophytic Flowering Plants. In: J. R. Timberlake & S. Katiyu (eds), *African Plants. Biodiversity, Taxonomy & Uses*. Proceedings of the 15th AETFAT Congress at Harare, Zimbabwe, pp. 39 – 49. Royal Botanic Gardens, Kew.
- ____ & Xanthos, M. (2012). *Ardisia ebo* sp. nov. (Myrsinaceae), a creeping forest subshrub of Cameroon and Gabon. *Kew Bull.* 67: 281 – 284. <https://doi.org/10.1007/s12225-012-9362-8>
- ____, Achoundong, G., Onana, J.-M., Pollard, B., Gosline, G., Moat, J. & Harvey, Y. B. (2006). Conservation of the Plant Diversity of Western Cameroon. In: S. A. Ghazanfar & H. J. Beentje (eds), *Taxonomy and ecology of African plants, their conservation and sustainable use*. Proceedings of the 17th AETFAT Congress, Addis Ababa, Ethiopia: pp. 779 – 791. Royal Botanic Gardens, Kew.
- ____, Alvarez-Aguirre, 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 (6): e0199324. <https://doi.org/10.1371/journal.pone.0199324>
- ____, Cable, S., Hepper, F. N., Ndam, N. & Watts, J. (1996). Mapping plant biodiversity on Mt. Cameroon. In: L. J. G. van der Maesen, X. M. van der Burgt & J. M. van Medenbach de Rooy (eds), *The Biodiversity of African Plants* (Proceedings XIV AETFAT Congress), pp. 110 – 120. Kluwer. https://doi.org/10.1007/978-94-009-0285-5_16
- ____, 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 (1): 158 – 164. <https://doi.org/10.3767/blumea.2019.64.02.06>
- ____, Feika, A., Lebbie, A., Goyder, D., Tchiengue, B., Sene, O., Tchouto, P. & van der Burgt, X. (2017). A synoptic revision of *Inversodicraea* (Podostemaceae). *Blumea* 62: 125 – 156. <https://doi.org/10.3767/blumea.2017.62.02.07>
- ____, Gosline, G. & Onana, J.-M. (2018d). *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>
- ____, Harvey, Y. & Onana, J.-M. (2010). *The Plants of Dom, Bamenda Highlands, Cameroon, A Conservation Checklist*. Royal Botanic Gardens, Kew.
- ____, ____ & ____ (2011). *The Plants of Mefou Proposed National Park, Yaoundé, Cameroon, A Conservation Checklist*. Royal Botanic Gardens, Kew.
- ____, 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. <https://doi.org/10.2307/3668742>
- ____, 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. (2020). New scientific discoveries: plants and fungi. *Plants, People Planet* 2: 371 – 388. <https://doi.org/10.1002/ppp3.10148>
- ____, Onana, J.-M. & Pollard, B. J. (2000). *The Plants of Mount Oku and the Ijim Ridge, Cameroon, a Conservation Checklist*. Royal Botanic Gardens, Kew.
- ____, Pollard, B. J., Darbyshire, I., Onana, J.-M. & Wild, C. (2004). *The Plants of Kupe, Mwanenguba and the*

- Bakossi Mountains, Cameroon: A Conservation Checklist*. Royal Botanic Gardens, Kew.
- _____, Prenner, G., Tchiengué, B. & Faden, R. B. (2018b). Notes on the endemic plant species of the Ebo Forest, Cameroon, and the new, Critically Endangered, *Palisota ebo* (Commelinaceae). *Pl. Ecol. Evol.* 151 (3): 434 – 441. <https://doi.org/10.5091/plecevo.2018.1503>
- _____, Tchiengué, B. & van der Burgt, X. (2021). 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>
- _____, 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>
- Dagallier, L.-P. M. J., Janssens, S. B., Dauby, G., Blach-Oergaard, A., Mackinder, B. A., Droissart, V., Svenning, J.-C., Sosef, M. S. M., Stévant, T., Harris, D. J., Sonké, B., Wieringa, J. J., Hardy, O. J. & Couvreur, T. L. P. (2020). Cradles and museums of generic plant diversity across tropical Africa. *New Phytol.* 225: 2196 – 2213. <https://doi.org/10.1111/nph.16293>
- 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., Saidou, 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. <https://doi.org/10.1007/s10531-017-1336-6>
- Davis, A. P. & Sonké, B. (2008). A new *Argocoffeopsis* (Rubiaceae) from Southern Cameroon: *Argocoffeopsis spathulata*. *Blumea* 53: 527 – 532. <https://doi.org/10.3767/000651908x607486>
- Gosline, G. & Cheek, M. (2014). Two new African species of *Salacia* (Salacioideae, Celastraceae). *Blumea* 59: 26 – 32. <https://doi.org/10.3767/000651914x682026>
- GBIF (continuously updated). Global Biodiversity Information Facility: <https://www.gbif.org/> (Accessed 23 Aug. 2020).
- Harvey, Y., 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.
- _____, Tchiengué, B. & Cheek, M. (2010). *The plants of the Lebialem Highlands, a conservation checklist*. Royal Botanic Gardens, Kew.
- IPNI (continuously updated). *The International Plant Names Index*. Available from: <http://ipni.org/> (Accessed March 2020).
- IUCN (2012). *IUCN red list categories: Version 3.1*. IUCN Species Survival Commission Gland and Cambridge.
- JSTOR Global Plants (continuously updated). <https://plants.jstor.org/> (Accessed March 2021).
- Kenfack, D., Gosline, G., Gereau, R. E. & Schatz, G. (2003). The genus *Uvariopsis* in Tropical Africa, with a recombination and one new species from Cameroon. *Novon* 13: 443 – 449. <https://doi.org/10.2307/3393377>
- King, C. & Cheek, M. (2020). *Nepenthes maximoides* (Nepenthaceae) a new, critically endangered (possibly extinct) species in Sect. *Alatae* from Luzon, Philippines showing striking pitcher convergence with *N. maxima* (Sect. *Regiae*) of Indonesia. *PeerJ* 8:e9899. <https://doi.org/10.7717/peerj.9899>
- Lachenaud, O., Droissart, V., Dessein, S., Stévant, T., Simo-Droissart, M., Lemaire, B., Taedoumg, H. & Sonké, B. (2013). New records for the flora of Cameroon, including a new species of *Psychotria* (Rubiaceae) and range extensions for some rare species. *Pl. Ecol. Evol.* 146: 121 – 133. <https://doi.org/10.5091/plecevo.2013.632>
- Letouzey, R. (1957). La forêt à *Lophira alata* de la zone littorale camerounaise. *Bois Forêts Trop.* 53: 9 – 20.
- _____. (1960). La forêt à *Lophira alata* Banks du littoral camerounais. Hypothèses sur ses origines possibles. *Bull. Inst. Etudes Centrafric.* 19 – 20: 219 – 240.
- _____. (1968). *Etude phytogéographique du Cameroun*. Lechevalier, Paris.
- _____. (1985). Notice de la carte phytogéographique du Cameroun au 1:500000: 4) Domaine de la forêt dense humide toujours verte. Pp. 63 – 142. Institut de la Carte Internationale de la Végétation, Toulouse.
- Mahmoud, I. M., Campbell, M., Sloan, S., Alamgir, M. & Laurance, W. (2019). Land-cover change threatens tropical forests and biodiversity in the Littoral Region, Cameroon. *Oryx* 54: 882 – 891. <https://doi.org/10.1017/S0030605318000881>
- Maas-van de Kamer, H., Maas, P. J. M., Wieringa, J. J. & Specht, C. D. (2016). Monograph of African *Costus*. *Blumea* 61: 280 – 318. <https://doi.org/10.3767/000651916X694445>
- Mackinder, B. A., Wieringa, J. J. & van der Burgt, X. M. (2010). A revision of the genus *Talbotiella* Baker f. (*Caesalpinioideae*, Leguminosae). *Kew Bull.* 65: 401 – 420. <https://doi.org/10.1007/s12225-010-9217-0>
- 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>

- Onana, J.-M. (2011). *The vascular plants of Cameroon, a taxonomic checklist with IUCN Assessments*. Royal Botanic Gardens, Kew.
- ____ & Cheek, M. (2011). *Red data book of the flowering plants of Cameroon, IUCN global assessments*. Royal Botanic Gardens, Kew.
- Prance, G. T. & Jongkind, C. C. H. (2015). A revision of African Lecythidaceae. *Kew Bull.* 70, 6: 13. <https://doi.org/10.1007/s12225-014-9547-4>
- 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.
- Sonké, B., Dessein, D., Taedoumg, H., Groeninckx, I. & Robbrecht, E. (2008). A new species of *Colletocema* (*Rubiaceae*) from southern Cameroon with a discussion of relationships among basal Rubioideae. *Blumea* 53: 533 – 547. <https://doi.org/10.3767/000651908x607495>
- ____, Djuikouo, M.-N. & Robbrecht, E. (2007) (publ. 2008). *Calycosiphonia pentamera* sp. nov. (afrotropical *Rubiaceae*) from the 'Lower Guinea' area. *Nord. J. Bot.* 25: 275 – 280. <https://doi.org/10.1111/j.0107-055x.2007.00141.x>
- ____, Esono, P., Nguembou, K. C. & Stévar, T. (2005). Une nouvelle espèce de *Bertiera* Aubl. (*Rubiaceae*) du sous-genre *Bertierella* découverte en Guinée Equatoriale et au Cameroun. *Adansonia* sér. 3, 27: 309 – 315.
- ____, Nguembou, K. C. & Davis, A. P. (2006). A new dwarf *Coffea* (*Rubiaceae*) from southern Cameroon. *Bot. J. Linn. Soc.* 151: 425 – 430. <https://doi.org/10.1111/j.1095-8339.2006.00508.x>
- Sosef, M. S. M., Wieringa, J. J., Jongkind, C. C. H., Achoundong, G., Azizet Issembé, Y., Bedigian, D., Van Den Berg, R. G., Breteler, F. J., Cheek, M. & Degreef, J. (2006). Checklist of Gabonese Vascular Plants. *Scripta Bot. Belg.* 35. National Botanic Garden of Belgium.
- Stoffelen, P., Cheek, M., Bridson, D. & Robbrecht, E. (1997). A new species of *Coffea* (*Rubiaceae*) and notes on Mt Kupe (Cameroon). *Kew Bull.* 52 (4): 989 – 994. <https://doi.org/10.2307/4117826>
- Thiers, B. (continuously updated). *Index Herbariorum: A global directory of public herbaria and associated staff*. *New York Botanical Garden's Virtual Herbarium*. Available from: <http://sweetgum.nybg.org/ih/> (Accessed March 2021).
- van der Burgt, X. M., Mackinder, B. A., Wieringa, J. J. & Estrella, M. de la (2015). The *Gilbertiodendron ogoouense* species complex (*Leguminosae: Caesalpinioideae*), Central Africa. *Kew Bull.* 70: 29. <https://doi.org/10.1007/s12225-015-9579-4>

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