A synopsis of the African genus *Whitfieldia* (Acanthaceae: Whitfieldieae) and a key to the species

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Summary. We present a synopsis and an identification key for the 13 species and one subspecies of the African genus *Whitfieldia* Hook. (Acanthaceae: Acanthoideae: Whitfieldieae). This work is based on the observation and analysis of morphological data from herbarium specimens and photographs of *Whitfieldia* species, and the study of all the relevant literature on the genus. *Whitfieldia latiflos* C.B. Clarke ex Stapf from Liberia is reinstated as an accepted species and a full description and illustration are provided. A new subspecies, *W. colorata* C.B. Clarke ex Stapf subsp. *tigrina* A. Grall & I. Darbysh., also from Liberia, is described. In addition, *W. arnoldiana* De Wild. & T. Durand and *W. letestui* Benoist are treated as synonyms of *W. laurentii* (Lindau) C.B. Clarke and *W. preussii* (Lindau) C.B. Clarke respectively for the first time. Eleven names in *Whitfieldia* are lectotypified. Reference specimens, relevant literature, habitat notes, distribution maps, taxonomic notes and a preliminary assessment of the conservation status and extinction risk are provided for each taxon. Four species are considered to be threatened of which two (*W. latiflos* and *W. rutilans* Heine) are assessed as Endangered (EN) while two others (*W. purpurata* (Benoist) Heine and *W. thollonii* (Baill.) Benoist) are placed in the Vulnerable (VU) category. In addition, two taxa are assessed as Near Threatened (NT) and one is currently considered to be Data Deficient (DD).

Key Words. Africa, conservation, East African forests, Guineo-Congolian forests, systematics, taxonomy.

Introduction

Wild plants belonging to the genus *Whitfieldia* Hook. (Hooker 1845: t.4155) (Acanthaceae: Acanthoideae: Whitfieldieae) grow in the forests of tropical continental Africa from Guinea in the west to Ethiopia in the east, and south to Angola, Zambia and Mozambique, with highest diversity in the Guineo-Congolian phytogeographical region (Vollesen 2008). The genus is perhaps best known for the striking large white-flowered species *W. elongata* (P. Beauv.) De Wild. & T. Durand (“white candles”), which is widely cultivated and has a range of uses from medicine to extraction of dye (Burkill 1985), but many of the species are highly attractive and have horticultural potential. Current literature and taxonomic databases record 12 (Vollesen 2008 & 2013; Burrows *et al.* 2018) to 14 accepted species of *Whitfieldia* (African Plants Database 2020; POWO 2020).

The tribe Whitfieldieae

Based on combined morphological analyses and DNA sequence data, Manktelow *et al.* (2001) recognised the tribe Whitfieldieae of the Acanthaceae to accommodate *Whitfieldia* together with two Afro-Malagasy genera, *Chlamydacanthus* Lindau and *Lankesteria* Lindl. Subsequent molecular phylogenetic studies have

added the Malagasy endemic genera *Camarotea* Scott Elliot, *Forcipella* Baill., *Leandriella* Benoist and *Zygoruellia* Baill. to this tribe (McDade *et al.* 2008; Tripp *et al.* 2013). McDade *et al.* (2008) recognised a core Whitfieldieae clade, comprising *Whitfieldia*, *Chlamydacanthus*, *Camarotea*, *Forcipella* and *Leandriella*, which are monophyletic with strong support. They found *Lankesteria* to be only weakly supported as a basal member of Whitfieldieae s.l.

Manktelow *et al.* (2001) proposed several synapomorphies for Whitfieldieae s.l., notably (1) presence of concentric rings of ridges protruding from the testa of the seeds, and (2) pollen with a densely granular circular area surrounding the pores. Most members of core Whitfieldieae (where known) have biporate pollen grains (Manktelow *et al.* 2001; McDade *et al.* 2008), circular in apertural view and with a pronounced marginal girdle, which is very similar to the gürtepollen of Justicieae: Isoglossinae (Kiel *et al.* 2006; Darbyshire 2009), although this similarity is homoplastic (McDade *et al.* 2008). *Whitfieldia elongata* is the only species of that genus with pantoporate pollen (Manktelow *et al.* 2001) which was otherwise reported in only one other species of Acanthaceae: *Megaskepasma erythrochlamys* by Prieu *et al.* (2017). However, *Megaskepasma*’s pollen has

equatorial apertures only (Kiel *et al.* 2018) and several other genera among Acanthaceae, such as *Louleridium* and *Brunoniella*, do also have pantoporate pollen as defined by Prieu *et al.* 2017 (Tripp *et al.* 2013). Other useful traits for the identification of core Whitfieldieae include left-contort corolla aestivation (Manktelow *et al.* 2001 also record imbricate aestivation in Whitfieldieae but this has not so far been observed by the current authors); an androecium of four stamens or very rarely two stamens and two staminodes with no filament curtain for all species (Manktelow *et al.* 2001; Tripp *et al.* 2013); and each floral or cymose unit being subtended by paired bracts (or bracteoles). These bracts are usually conspicuous and clasping or partially connate and often partially or entirely enclose the calyces. Based on these morphological traits, a further Malagasy genus — *Vindasia* Benoist — is here included within Whitfieldieae for the first time. Core Whitfieldieae therefore contains 7 genera and $\pm$ 26 species, with a further 7 species in *Lankesteria*. Generic delimitation is problematic within the Whitfieldieae, the endemic Malagasy genera being particularly poorly differentiated morphologically (I. Darbyshire, pers. obs.).

Within the wider classification of Acanthaceae, McDade *et al.* (2008) resolved Whitfieldieae as sister to (Andrographideae + Barlerieae) within their “BAWN” clade (i.e. the three tribes Barlerieae, Andrographideae and Whitfieldieae, plus the genus *Neuracanthus* Nees), but noted that this relationship is only weakly supported. This part of the Acanthaceae is in urgent need of phylogenetic studies to resolve relationships within and between the four major lineages (McDade *et al.* 2008; Darbyshire *et al.* 2019).

The genus *Whitfieldia* Hook.

Whitfieldia itself is readily identified by having the combination of well-developed racemes, spikes or panicles; each cymose unit being pedunculate and single-flowered; and the calyces being large and showy, exceeding 9 mm in length. The calyces usually extend beyond or are subequal in length to the bracteoles and are often of a similar colour tone to the corolla, although they can also be green. *Chlamydacanthus* can also have racemose inflorescences but in that genus the cymose units are often 2 – 3-flowered and the calyces are small (up to 8 mm long but usually shorter) and hidden within the bracteoles and are not similar in colour to the corolla. The other genera of core Whitfieldieae have fasciculate, glomerulate or shortly umbellate inflorescences.

On a molecular level, studies by Manktelow *et al.* (2001) and McDade *et al.* (2008) included only two species of *Whitfieldia* (*W. elongata* and *W. “stuhlmannii”*, the latter almost certainly referring to *W. orientalis* Vollesen considering the geographic location [east of

the Usambara Mountains, west of Kwani Forest reserve] of the specimen sampled, Iversen *et al.* 87520, n.v.). Both of the species sequenced were of East African origin. Further molecular work, with the addition of species from west and central Africa (where, based on the current work, c. 70% of the species are found) is needed to test the monophyly of the genus and biogeographical hypotheses regarding its diversification in Africa. This work is currently underway at Kew, using targeted sequencing of nuclear genes from herbarium specimens, as detailed in Brewer *et al.* (2019).

Aims of the present study

Several regional taxonomic treatments of *Whitfieldia* are available, including for central Africa (Heine 1966; Evrard & Demillecamps 1992), eastern Africa (Vollesen 2004, 2008) and southern tropical Africa (Vollesen 2013). However, there is no modern global treatment of the genus. In particular, western African species occurring from Guinea to Cameroon are missing from all these recent regional studies and their identification remains problematic. Apart from *W. elongata* which can tolerate disturbed habitats, most species of *Whitfieldia* can be indicators of good quality forests (I. Darbyshire, pers. obs.), and several species are range-restricted, hence they are of significant conservation concern. To help identify and protect the species that are most at risk, a comprehensive taxonomic treatment, including identification tools and information on the distribution and ecology is needed.

So the present work aims to provide an identification key to species within the genus and a synoptic account of the recognised taxa, including distribution maps, notes on habitat requirements, citation of voucher specimens and, where available, illustrations to help in the identification of this fascinating group.

Material and Methods

Material studied and cited

This study is based primarily on the examination of herbarium specimens held at BM, BR, K, P and PRE, together with additional material digitised at BRLU, G, LISC, MO and WAG, now transferred to L (herbarium codes follow Thiers, [continuously updated](#)). For the more common species (*Whitfieldia elongata*, *W. lateritia* Hook., *W. laurentii* (Lindau) C.B. Clarke), we cite a selection of specimens for each country where the species is found. For all other species, all specimens seen are cited. For most collections, at least one duplicate has been seen by the authors, indicated by an exclamation mark “!”. When only a photograph has been seen, the herbarium code is followed by an asterisk “*”. When only a field photograph of the

collection has been seen by the authors, the collector and collection number are followed by two asterisks “**”. Unseen specimens are only included where the authors have reasonable confidence that the identification is correct. An indication of the phenology (“fl.” or “fr.”, respectively for flowering or fruiting) has been added before the collection date to aid future phenological studies or targeted collection efforts.

Photographs of species of *Whitfieldia* in the field, most of them communicated by authors which are listed in the acknowledgements section, but also from Hawthorne & Jongkind (2006) and Burrows *et al.* (2018), were studied where available to assist in the comparison of floral morphology and colour.

Measurements and terms employed

Measurements were made from dry material except for floral dissections, which were made following soaking in Aerosol OT 10% solution. The morphological terms used to describe the species follow Beentje (2016). The palynological terminology follows Manktelow *et al.* (2001) and McDade *et al.* (2008).

Typification

Wherever required and possible, accepted names and synonyms are lectotyped from amongst the original material.

Distribution Mapping

For most species, geographic coordinates were determined from specimen labels. Localities have been georeferenced wherever possible, primarily using online and published gazetteers (notably Fuzzy Gazetteer: <http://dma.jrc.it/services/gazetteer/>) and Google Earth™.

In some cases where species are more widely distributed in Africa and the number of specimens is too large to be manually georeferenced (*Whitfieldia lateritia*, *W. elongata*), data were first imported into GeoCAT (www.geocat.kew.org; Bachman *et al.* 2011) from GBIF (<https://www.gbif.org>) and herbarium specimens were then consulted to add missing points and allow a calculation of global extent of occurrence (EOO). In such cases, potentially anomalous points from GBIF were checked before acceptance. For most species, all coordinates were imported into SimpleMappr (Shorthouse 2010) to produce the distribution maps. For *W. elongata*, a polygon was drawn from the GBIF data and imported into QGIS version 2.14.4 (QGIS Team 2020).

Species Conservation (Extinction Risk) Assessments

The provisional conservation assessments presented here follow the categories and criteria of IUCN (2012). The term ‘location’ defines a geographically or ecologically distinct area in which a single threat-

ening event can rapidly affect all individuals of the taxon present (IUCN 2012). Extent of Occurrence (EOO) was calculated using the GeoCAT tool. Area of Occupancy (AOO) is not used except in specific circumstances where we are confident that we have a good understanding of the number and distribution of localities for a species.

Taxonomic Treatment

Whitfieldia Hook. (Hooker 1845: t.4155); Nees (1847: 220); Clarke (1899: 65); Heine (1963: 398; 1966: 32); Evrard & Demillecamps (1992: 89); Vollesen (2008: 266, 2013:173). Type species: *Whitfieldia lateritia* Hook. *Stylarthropus* Baill. (Baillon 1890a: 437; 1890b: 822).

Type species: *Stylarthropus brazzae* Baill.

Leiophaca Lindau (1911: 307). Type species: *Leiophaca purpurea* Lindau

Pounguia Benoist (1938: 679). Type species: *Pounguia purpurata* Benoist

*Erect or clambering perennial herbs and shrubs. Leaves opposite-decussate, plants evergreen. Cystoliths present, although not always clearly visible on dry material. Inflorescences racemose or paniculate thyrses, terminal or axillary; bracts along inflorescence axis sometimes large but mostly very reduced and/or caducous; bracteoles conspicuous, paired, clasping the base of the flower. Calyx divided into 5 subequal calyx lobes, in most species longer than the bracteoles and clearly visible at anthesis; bracteoles and calyx lobes green or similar in colour to the corolla. Corolla tube campanulate to funnel-shaped with a short to long basal cylindrical portion; limb with 5 lobes, sometimes markedly bilabiate, with 2 upper lobes and 3 lower lobes. Stamens 4, included or exserted from the corolla mouth, subequal or didynamous; filament curtain absent; anthers bithecous, thecae held at an equal height, without appendages. Pollen biporate in all species where data are available except in *W. elongata* where pantoporate (note: pollen morphology is currently unknown for *W. purpurata* only). Ovary 2-locular, with 2 ovules per locule. Capsule stipitate, 2 – 4 seeded; seeds discoid, surfaces with concentric ridges.*

DISTRIBUTION. *Whitfieldia* is native to tropical continental Africa only. It occurs in (from east to west, and north to south) Sierra Leone, Guinea, Liberia, Ivory Coast, Benin, Nigeria, Cameroon, Equatorial Guinea, Gabon, Congo Republic, Central African Republic, Democratic Republic of the Congo (D. R. Congo), South Sudan, Ethiopia, Uganda, Kenya, Tanzania, Rwanda, Angola, Zambia and Mozambique.

Whitfieldia elongata is the only species found within the Dahomey gap (*Maesen* 6822 in WAG was collected in Dangbo Forest), the region that separates the phytogeographical regions of Upper Guinea from

Lower Guinea (Salzmann & Hoelzmann 2005). This appears to be an ecological barrier for species within

the genus, which are otherwise recorded on one side or the other of the gap.

Key to species of *Whitfieldia*

1. Proximal, unexpanded portion of corolla tube long and narrowly cylindrical, 3.5 – 5 cm long, corolla pure white; pollen pantoporate **1. *W. elongata***
 Proximal, unexpanded portion of corolla tube rather broad and short, or if narrowly cylindrical then not exceeding 2.2 cm long, corolla variously coloured, rarely pure white; pollen (where known) flattened, biporate 2
2. Corolla tube white, either both lips or only the lower lip abruptly dark purple (not striped) 3
 Corolla without the combination of a white tube and abruptly dark purple lip(s) (if this colour combination exists, the corolla lobes are striped, and the transition is not so abrupt) 4
3. Young branches with floccose stellate hairs; cylindrical portion of corolla tube 0.9 – 1.2 cm long **2. *W. orientalis***
 Young branches finely puberulous with simple hairs; cylindrical portion of corolla tube 1.4 – 1.8 cm long **3. *W. stuhlmannii***
4. Bracteoles and calyx lobes both subulate, c. 1.5 mm wide; flowers white with dark purple stripes on the distal half of the throat only **5. *W. liebrechtsiana***
 Bracteoles and calyx lobes not subulate simultaneously; if corolla with dark stripes, then these present throughout 5
5. Proximal, unexpanded portion of corolla tube short, less than or equal to 4.5 mm long 6
 Proximal, unexpanded portion of corolla tube more than 4.5 mm long 7
6. Distal portion of corolla tube markedly saccate, with a bend of c. 90 degrees above the short proximal portion of the tube, limb weakly 2-lipped, upper lobes fused for less than half their length and held horizontal, lower lobes slightly reflexed but not markedly deflexed; inflorescence unilateral **6. *W. latiflos***
 Distal portion of corolla tube not markedly saccate and without a perpendicular bend above the short proximal tube; limb markedly 2-lipped, the two upper lobes fused for more than half their length and held erect, the three lower lobes deflexed; inflorescence bilateral **7. *W. preussii***
7. Calyx lobes subulate, about as long as the proximal cylindrical portion of the corolla tube, 1.2 – 1.8 cm long **4. *W. laurentii***
 Calyx lobes subulate, oblong, lanceolate or oblanceolate, longer than the proximal portion of the corolla tube, the latter gradually expanding and not exceeding 1 cm long 8
8. Bracteoles chartaceous, broadly ovate to orbicular, 11 – 20 × 7.5 – 17 mm, inserted on a short pedicel up to 8 mm long **8. *W. purpurata***
 Bracteoles membranous or not, ovate, lanceolate or elliptic, usually shorter than 10 mm long, or if longer then membranous and inserted on a longer pedicel (9 –) 11 – 18 (– 25) mm long 9
9. Leaves subtending the inflorescence particularly long, 17 – 28 cm long; terminal inflorescences dense and rather short, up to 8 cm long; flowers orange to red; calyx lobes with yellow stipitate **9. *W. rutilans***
 Leaves subtending the inflorescence shorter than 17 cm long; without the above combination of characters 10
10. Bracteoles 2 – 4.5 mm wide; calyx lobes linear; inflorescences dense, nodes separated by less than 10 mm above the second node **13. *W. colorata***
 Bracteoles 5 – 11 mm wide; calyx lobes linear, oblong or oblanceolate; inflorescences less dense, nodes separated by more than 10 mm above the second node 11
11. Pedicels pubescent; bracteoles chartaceous; sepals puberulent to pubescent; corolla bright orange to salmon pink, (8 –) 9 – 11 mm wide at the throat **12. *W. lateritia***
 Pedicels glabrous; bracteoles membranous; calyx lobes glabrous or with sessile glands; corolla either uniform and light yellow to pale orange or green-yellow with dark purple to brown streaks, 6.5 – 8 (– 10) mm wide at the throat 12
12. Corolla green-yellow with purple to dark brown longitudinal streaks **10. *W. thollonii***
 Corolla pale yellow to light orange, without darker streaks **11. *W. brazzae***

1. *Whitfieldia elongata* (*P.Beauv.*) *De Wild.* & *T.Durand* (in Durand & De Wildeman 1899: 110); Clarke (1899: 66); Durand & Durand (1909: 421); Andrews (1956: 191); Dale & Greenway (1961: 19); White (1962: 383); Heine (1963: 398; 1966: 34); Champluvier (1985: 492); Iversen (1991: 162); Errard & Demillecamps (1992: 90); Beentje (1994: 610); Cheek *et al.* (2011: 120); Agnew (2013: 270);

Lebrun & Stork (1997: 507); Friis & Vollesen (2005: 456); Ensermu Kelbessa (2006: 395); Vollesen (2008: 268; 2013: 175); Bloesch *et al.* (2009: 54); Lejoly *et al.* (2010: 22); Darbyshire *et al.* (2015: 354) ≡ *Ruellia elongata* P.Beauv. (De Beauvois 1804: 46) ≡ *Dipteracanthus elongatus* (P.Beauv.) Nees (1847: 140); Bentham in Hooker & Vogel (1849: 478). Type: Benin, fl., s.d., *Palisot de Beauvois* s.n.

(lectotype G* G00378064, **selected here**; islectotype G* G00378063). Fig. 1A.

Whitfieldia longifolia T.Anderson (1863: 27) *nom. illegit.*; Moore (1880: 229) as “*longiflora*”; Clarke (1899: 66); Hiern (1900: 811); De Wildeman (1910: 267; 1912: 479); Hutchinson & Dalziel (1931: 248); Type: Fernando Po [Bioko], fl., 1860, *Mann* 198 (lectotype K! K001208521, **selected by** Vollesen 2008: 268). Additional syntypes — all from Fernando Po [Bioko]: fl., s.d., *Barter* 2069 (K!); fl., s.d., *Mann* s.n. (K! K000394212); fl. Nov. 1841, *Vogel* 187 (K! K000394210) & *Vogel* 242 (K! K000394211).

Whitfieldia perglabra C.B.Clarke (1899: 66) ≡ *Whitfieldia longifolia* T.Anderson, var. *perglabra* (C.B.Clarke) Hutch. & Dalziel (in Hutchinson & Dalziel 1931: 248). Type: Fernando Po [Bioko], fl., 1861, *Mann* s.n. (holotype K! K000394212).

Whitfieldia subviridis C.B.Clarke (1899: 66). Type: D. R. Congo, Lisha [Lishia], fl. 7 July 1888, *Hens* 343, (lectotype K! K001208522, **selected here**; islectotypes P* P00439326 & P00439327). Additional syntypes: Nigeria, Igbessa, fl. Jan. 1893, *Millen* 141 (K! K001208523); Nigeria, Lagos, fl., s.d., *Millen* 195 (K! K001208524) & *Millen* 181 (n.v.); Nigeria, Old Calabar, *Robb* s.n. (n.v.); Cameroon, Yaunde [Yaounde], *Zenker* 547 (n.v.); Fernando Po [Bioko], fl., 1860, *Mann* 198 (K! K001208521); Angola, Golungo Alto, Rio de Capopa, fl., s.d., *Welwitsch* 5151 (K! K001009241); Kenya, Mombasa, fl. Nov. 1884, *Wakefield* s.n. (K! K001208565).

Whitfieldia elongata (P.Beauv.) De Wild. & T.Durand var. *dewevrei* De Wild. & T.Durand (in Durand & De Wildeman 1899: 111) ≡ *Whitfieldia longifolia* T.Anderson var. *dewevrei* (De Wild. & T.Durand) C.B.Clarke (1900: 511). Type: D. R. Congo, Mobanga, fl. Feb. 1896, *Dewèvre* s.n. (lectotype BR* BR00000013100476, **selected here**; islectotypes BR BR* BR00000013100315 & BR00000013100315).

Whitfieldia tanganyikensis C.B.Clarke (1899: 67). Type: Zambia, Tanganyika Plateau, “Moero Plateau”, fl., 1894, *Carson* 22 (lectotype K! K000394205, **selected here**). Additional syntypes: Uganda, Buddu, fl., 1893, *Scott-Elliot* 7528 (BM! BM013400585, K! K000394206).

Whitfieldia elongata De Wild. & T.Durand var. *abbreviata* Mildbr. (in Robyns 1943: 88). Type: D. R. Congo, Kabasha, fl. 7 Dec. 1934, *de Witte* 2162 (holotype BR* BR00000008740618; isotype BR* BR00000006493547).

For a description of this species see Vollesen (2013: 175).

DISTRIBUTION. This species is found from western and central Africa in Benin, Nigeria, Cameroon, Central African Republic, Equatorial Guinea (Bioko), Gabon,

Congo Republic, D. R. Congo and Rwanda, to eastern Africa in South Sudan, Ethiopia, Uganda, Kenya and Tanzania and southern Africa in Zambia and Angola (Map 1). It is also cultivated in Zimbabwe according to Maroyi (2006).

Whitfieldia elongata is the most widespread and common species in the genus. Many specimens belonging to this species have already been listed in Evrard & Demillecamps (1992) for Central Africa and Vollesen (2008) for East Africa. Additional collections are cited below for each country where it is currently found in the wild, restricted to one citation per country.

SELECTED COLLECTIONS STUDIED. **BENIN.** Ouémé, Dangbo Forest, fl. 12 Nov. 1999, *Maesen* 6822 (WAG* WAG0063277). **NIGERIA.** Abeokuta Prov., Egbado Distr., Ilaro F. R., fl. 17 Dec. 1952, *Onochie* in FHI 31888 (K!). **CAMEROON.** Village de Mebanga, près Mpandang, fl. 21 Feb. 1959, *Letouzey* 1492 (K! K001208564, P* P03590321, YA YA00066833!). **CENTRAL AFRICAN REPUBLIC.** Sangha pref., Ndakan, fl. 2 Jan. 1988, *Harris & Fay* 37 (K!, WAG* WAG.1237268, US* US02856868). **EQUATORIAL GUINEA.** Bioko, Malabo-Baney (along the maritime coast), road km 17, fl. 19 Nov. 1988, *Carvalho* 3718 (K!, MA). **GABON.** Belinga, fl. 8 June 1966, *Hallé* 3769 (K!, P* P03032863). **CONGO REPUBLIC.** R. Alima, fl. Sept. 1887, *Thollon* 952 (P* P03590262). **D.R. CONGO.** Kasai Distr., village of Malela, about 50 – 60 km S of Pania Mutombo, fl. 28 June 1934, *Becquaert* 2 (K!). **RWANDA.** Parc Nat. Kagera, territoire annexe, environs de Kakitumba, fl. 3 July 1957, *Troupin* 3674 (BR* BR00000013100605). **SOUTH SUDAN.** Imatong Mountains, Talanga, fl. 1 Dec. 1980, *Friis & Vollesen* 598 (C, K!). **ETHIOPIA.** Keffa, ridge between swamp 15 mins walk beyond village and c. 2.5 hrs walk W of Mizan Teferi, fl. 15 Jan. 1976, *Gilbert* 4234 (ETH, K!). **UGANDA.** Budongo Forest, fl. Dec. 1934, *Eggeling* 1467 (K!). **KENYA.** Shimba Hills, Pengo Hill, Kidomo, fl. 25 Jan. 1979, *Bamps* 6343 (BR* BR00000020158385, WAG* WAG.1237353). **TANZANIA.** East Usambara, Muheza road below Sigg (Amani), fl. 12 Dec. 2011, *Hemp* 5403 (K!). **ZAMBIA.** nr. Nchelengi, L. Mweru, fl. 26 April 1951, *Bullock* 3843 (K!). **ANGOLA.** Loanda, Canzenço, fl., s.d., *Gossweiler* 4767 (K! K001009240).

HABITAT AND ECOLOGY. This species is found on the forest floor in evergreen forests, often by rivers in gallery forests or along forest tracks or roads. It starts as a shrub and can become scandent reaching up to 3 m. It often occurs in disturbed and secondary forest. It can be found from sea level up to 1650 m a.s.l.

CONSERVATION STATUS. *Whitfieldia elongata* is known from 15 tropical African countries with a large EOO of 6,163,812 km². It is locally common in forest habitat, from evergreen primary forest to more

Fig. 1. Photographs of *Whitfieldia* in the field and in herbaria. **A** *W. elongata*, from Somalomo, at the edge of the Dja National park, Cameroon (collected as *Grall* 117). **B – C** *W. orientalis*: **B** in flower from Lindi Region, Ruawa Forest Reserve, Tanzania (collected as *Suleiman* H.O.S. 5534); **C** detail of stem indumentum, from *Verdcourt & Greenway* 256 (K). **D** *W. stuhlmannii*, from D. R. Congo (collected as *Luke* 7562); **E** *W. laurentii*, from D. R. Congo (collected as *Würsten* 4814A); **F** *W. liebrechtsiana*, bracteoles, calyx and partial corolla from *Gossweiler* 8049 (K); **G** *W. preussii*, from Gabon (collected as *Bidault* 1496). PHOTOS: **A** A. GRALL; **B** I. DARBYSHIRE; **D** Q. LUKE; **E** B. WÜRSTEN; **G** E. BIDAULT.

disturbed areas such as along roads and by villages. Therefore, it is considered to be of **Least Concern (LC)**.

NOTES. (1) The flowers of *Whitfieldia elongata*, with its pure white corolla and long and narrow basal tube,

look like typical moth-pollinated flowers (Evrard & Demillecamps 1992; A. Giusti, pers. comm.). Although only rarely recorded (*Tanner* 2413 [K!, BR], *Grall* 117 [YA!, K!, P!, WAG!]), the flowers are subtly fragrant. We expect them to open fully at night, as suggested by

Map 1. Distribution of *Whitfieldia elongata* in Africa.

its local name in digo (Kenya, Tanzania) “Mkula usiku” translated as “grow by night” (Pakia 2006).

The pollen of this species is spheroidal with 6 – 9 scattered pores (Manktelow *et al.* 2001) and spinules on its surface. This is an unusual pollen type for this genus as all other species have a flattened, biporate, smooth pollen type (Evrard & Demillecamps 1992; Manktelow *et al.* 2001). While all other *Whitfieldia* species are said to be bee-pollinated (Manktelow *et al.* 2001; D. Notton, pers. comm.), *W. elongata* has a white long tubular corolla with exserted stamens typically associated with moth-pollination (sphingophily) (Faegri & van der Pijl 2013). The unusual pantoporate pollen structure could potentially be the result of the co-evolution of this species with a moth pollinator. However, this still needs to be tested.

(2) When Anderson (1863: 27) published the name *Whitfieldia longifolia*, he cited the collections of Barter, Vogel and Mann from Fernando Po (= Bioko) in the Hooker Herbarium. Subsequently, Clarke (1899: 66) separated those same collections into four species: *W. elongata*, *W. perglabra*, *W. longifolia* and *W. subviridis*. In F.T.E.A, Vollesen (2008: 270) chose the collection Mann 198 (K) as lectotype of *W. longifolia*. However, Mann 198 was also cited by Clarke (1899: 67) as one of the syntypes of *W. subviridis*. For clarity, *W. subviridis* is lectotypified here using one of the other syntypes listed by Clarke, namely *Hens* 343.

(3) The protologue of *Ruellia elongata* P.Beauv. (De Beauvois 1804: 46) describes flowers of a ‘beautiful blue sky colour’ as depicted on the plate associated with the description of the species (De Beauvois 1804: tab. XXVI). However, not only should the flowers in this case have been described as and painted white, but they also should show a

slight bend at the apex of the corolla tube and four longer and fully exserted stamens on the plate (instead of straight corollas with two short stamens). Such inaccuracies in the description and illustration could be justified by the poor state of the original collection (*Palisot de Beauvois* s.n.). However, faulty colouring of some of the plates in De Beauvois’s *Flore d’Oware et de Benin* has first been reported in Marshall (1951). Later, Brenan (1952) described several of those plates as ‘simply products of the imagination and sadly misleading to the botanist’ (p. 194).

2. *Whitfieldia orientalis* Vollesen (2004: 123; 2008: 267; 2013: 173); Burrows *et al.* (2018: 882, 889). Type: Tanzania, Lindi Distr., Rondo Plateau, fl. 10 Feb. 1991, Bidgood *et al.* 1458 (holotype K! K000780517; isotypes C, CAS, DSM, K! K000780518, NHT). Figs 1B – C.

Whitfieldia stuhlmannii sensu Clarke (1900: 68), quoad Heinsen 17, Holst 2673, 3297, Volkens 2396, non Lindau.

For a description of this species see Vollesen (2013: 173).

DISTRIBUTION. This species is known from the East African coast from southern Kenya, Tanzania and northern Mozambique (Map 2).

ADDITIONAL COLLECTIONS STUDIED. KENYA. Mwele Ndogo Forest, Shimba Hills, fl. 6 Jan. 1988, Luke 893B (EA, K!); Kwale, Shimba hills, fl. 12 Sept. 1997, Luke 4729 (EA, K!). **TANZANIA.** Lindi Distr., Sudi, fr. 25 May 1943, Gillman 1460 (K!); Tanga Prov., Mkulumuzi valley near Amboni caves, fl. 8 June 1950, Verdcourt & Greenway 256 (BM!, BR* BR0000020159108, EA, K!, P* P03032899, PRE!); Morogoro Distr., Liwale Valley, Nguru Mts., fl. 27 March 1953, Drummond & Hemsley 1842 (K!, PRE!); Kange Forest, fl. & fr. 27 Aug. 1955, Faulkner 1704 (BR* BR0000020159085, EA, K!, PRE!); Pangani Distr., Msubugwe Forest, fr. 19 June 1956, Tanner 2919 (K!, P* P03032896); Muheza Distr., S of East Usambara Mts, Tongwe F. R., the NE part of the reserve, fl. 2 May 1987, Iversen *et al.* 87166 (K!, UPS); Iringa Distr., Luhega F.R., fl. 24 Feb. 1997, Hørlyck & Jøker TZ387 (K!); Lindi Region, Mtama Distr., Ruawa F.R., off the main road between Lindi and Nangurukuru junction at Kilangala B village, fl. 18 Jan. 2020, Suleiman *et al.* H.O.S.5534 (DSM!, K!, NHT!). **MOZAMBIQUE.** Cabo Delgado Prov., c. 10 km from Nangade on road to Mueda, 23 March 2009, Burrows & Burrows 11315 (BNRH, K! K000787849); 16 km S of Nangade, 23 March 2009, Lotter & Turpin 1764 (K! K000787857).

HABITAT AND ECOLOGY. *Whitfieldia orientalis* is recorded from seasonally moist lowland evergreen or semi-deciduous forest from near sea level to 800 (– 1000) m a.s.l. It occurs mainly in undisturbed forests, although it

Map 2. Distribution of *Whitfieldia orientalis* in Kenya, Tanzania and Mozambique.

can also be found in a more fragmented habitat. Detailed notes on the habitat, ecology and phytogeography of this species are recorded by Vollesen (2004).

CONSERVATION STATUS. This species occurs in forest patches in coastal lowland East Africa. It has an EOO of 194,731 km² and an AOO of 116 km², based upon using the standard recommended grid size of 2 × 2 km². Whilst this calculated AOO is likely to be an underestimate of the true AOO because of incomplete sampling, it is probably not grossly so since the sizes of the extant forest patches within its range are small and declining due to forest clearing for conversion to agriculture, production of charcoal, timber logging, pole cutting and fuelwood gathering (Burgess & Clarke 2000). We have identified 17 to 20 locations for this species, and whilst this number is almost certainly declining, it is not close to meeting the threatened category thresholds under Criterion B. With further research, this taxon might qualify as threatened under Criterion A as some parts of its range have experienced over 30% forest loss of tree cover since 2000. However, in the absence of more information at present, this species is considered to be of **Least Concern (LC)**.

NOTES. Many East African herbarium collections previously identified as *Whitfieldia stuhlmannii* have been redetermined as *W. orientalis*. The latter is easily distinguished from the former by its tufts of floccose stellate hairs (see Fig. 1C) covering the young stems, its shorter basal, cylindrical portion of the corolla tube and its shorter inflorescences (1 – 7 cm long vs 5 – 10 cm). Moreover, the two white upper corolla lobes in *W. orientalis* are almost completely fused, whereas they are clearly divided in *W. stuhlmannii*.

3. *Whitfieldia stuhlmannii* (Lindau) C.B. Clarke (1899: 68); Durand & Durand (1909: 422); Evrard & Demillecamps (1992: 92); Vollesen (2008: 268); Lejoly *et al.* (2010: 23) ≡ *Stylarthropus stuhlmannii* Lindau (1894: 11; 1895: 306). Types: D. R. Congo, Isange-Semliki, fl. 8 Dec. 1891, *Stuhlmann* 2963 (holotype B†); between Bobata and Kamango, fl. Nov. 1939, *Gille* 286, (neotype BR* BR0000008740656, selected by Vollesen 2008). Fig. 1D.

Whitfieldia seretii De Wild. (De Wildeman 1910: 267; 1912: 479). Type: D. R. Congo, road from Duru to Rungu, fl. 7 Jan. 1907, *Seret* 739 (holotype BR* BR0000008510105).

Whitfieldia seretii De Wild. var. *elliptica* De Wild. (De Wildeman 1912: 479). Type: D. R. Congo, dans les forêts autour du poste de Yanga, fl., Jan. 1910, *Jespersen* s.n. (holotype BR* BR0000008512734).

For a description of this species see Vollesen (2008: 268).

DISTRIBUTION. This species is known from the forests of central and western D. R. Congo and in eastern Tanzania. In 2018, it was also found for the first time in Rwanda (*Fischer* 577/2018, see below). It may also occur in western Uganda in the forests of the Semliki National Park, close to the type locality, and might also be found in Burundi, but no collections of *Whitfieldia stuhlmannii* are known from those countries to date (Map 3).

ADDITIONAL COLLECTIONS STUDIED. **D. R. CONGO.** Route Amadi – Suronga, fl. 13 Dec. 1905, *Seret* 350 (BR* BR0000013109189, BR0000008509901 & BR0000013109196); Kamusuku, territoire de Shabunda, fl. & fr. 18 Aug. 1959, *Léonard* 5926 (BR*

Map 3. Distribution of *Whitfieldia stuhlmannii* in D. R. Congo and Tanzania.

BR0000013109219); Maniema prov., Namoya, Explor. Camp to Kibiswa, fl. 10 Aug. 2008, *Luke* 12414 (BR* BR0000015255976, EA, K!, MO); Ituri prov. Mongbwalu, N of Msisi village, fl. 24 Jan. 2011, *Bytebier* 3295 (EA, EPU, BR* BR0000013366476, K!); Haut-Uele prov., Asonga Hill, c. 75 km S of Isiro, fl. 4 Aug. 2011, *Ndjang* 693 (EPU, K! K000683903). **RWANDA.** Western Province, Nyungwe National Park, Cyamudongo Forest, close to road towards Nyakabuye on N-exposed slope, fl. 15 May 2018, *Fischer* 577/2018 (KOB! **). **TANZANIA.** Kigoma Distr., Gombe Stream Reserve, upper Mkenke, fl. 29 April 1992, *Mbango* 1032 (K!); Kigoma Distr., Mt Livandabe [Lubalisi], fl. 3 June 1997, *Bidgood et al.* 4285 (K! 2 sheets); Mpanda Distr., Ntakatta Forest, fl. 14 June 2000, *Bidgood et al.* 4678 (K!).

HABITAT AND ECOLOGY. *Whitfieldia stuhlmannii* grows in wet, undisturbed or somewhat disturbed forest. It is commonly found by streams in riverine forests, and occurs at 750 – 1300 m a.s.l.

CONSERVATION STATUS. This species has been collected in Tanzania and D. R. Congo, with a large EOO of 735,508 km². However, except for three collections, most of the Congolese collections are old with little or outdated locality information, hence not all are mapped. In addition, eastern Congo has been under-collected and so we cannot use the calculated AOO (68 km²) as a suitable measure for this assessment. A decline in the forest cover is ongoing within the range of *Whitfieldia stuhlmannii* due to conflict and mining operations in D. R. Congo (Butsic *et al.* 2015). Of the two known localities in Tanzania, Ntakatta Forest is protected as a Forest Reserve whilst Mount Livandabe is not protected. However, there is still

considerable intact forest cover within the EOO of *W. stuhlmannii* at present. Moreover, even though most collections are from primary forests, a few specimen labels mention that this species can tolerate some disturbance (“forêt secondaire” or “*Hevea*”). Based upon those observations, this species is assessed as of **Least Concern (LC)**.

4. *Whitfieldia laurentii* (Lindau) C.B. Clarke (1899: 68); Evrard & Demillecamps (1992: 98); Lejoly *et al.* (2010: 23) $\equiv$ *Stylarthropus laurentii* Lindau (1897: 317); De Wildeman & Durand (1899: 65, t.32). Type: D. R. Congo, forêts près Stanley falls, fl. 20 Jan. 1896, *Laurent* s.n. (lectotype BR! BR0000008393074, **selected here**; islectotype BR! BR0000006494193). Fig. 1E.

Whitfieldia arnoldiana De Wild. & T. Durand (in Durand & De Wildeman 1899: 116); **synon. nov.**; De Wildeman (1910: 266; 1912: 479) Evrard & Demillecamps (1992: 99); Lejoly *et al.* (2010: 22). Type: D. R. Congo, forêt des environs de Stanleyville, fl. 24 Dec. 1896, *Dewèvre* 1159a (holotype BR! BR000000839340).

Leiophaca purpurea Lindau (in Friedrich 1911: 307). Type: D. R. Congo, Aruwimi, Yambuya, fl. May 1908, *Mildbraed* 3288 (holotype BR* BR000000839501).

For a description of this species see *Whitfieldia arnoldiana* in Evrard & Demillecamps (1992: 99)

DISTRIBUTION. This species is known from the forests of the northeastern equatorial region of D. R. Congo (Map 4).

SELECTED COLLECTIONS STUDIED. D. R. CONGO. Injolo, fl. Oct. 1905, *Laurent* 1423 (BR! BR0000008393678); Chemin de Buta à Banalia, fl. 14 Jan. 1926, *Robyns* 1359 (K!); Plateau entre l'Isalowe et l'Ilongo à l'est de Yangambi, fl. 4 Jan. 1936, *Louis* 936 (K!, P! P03590308, PRE!); Yangambi, fl. 18 Feb. 1957, *Leonard* 158 (BR* BR0000013397098, K!); Yangambi, fl. 28 Dec. 1937, *Louis* 7256 (K!, P! P03590309); Parc National Albert, confluent Djuma/Semliki, fl. 18 Feb. 1948, *de Wilde* 174 (K!); Kibati, terr[itoire] Walikale, fl. 13 June 1957, *Gutzwiller* 1148 (BR* BR0000013396718); Route Kavumu – Walikale, vers km 110, Irangi, réserve IRSAC [Institut pour la Recherche Scientifique en Afrique Centrale], fl. 6 Nov. 1959, *Troupin* 10981 (BR* BR0000013396794); Yangambi, fl. 30 Jan. 1960, *Devred* 4007 (BR* BR0000013397227, K!).

HABITAT AND ECOLOGY. *Whitfieldia laurentii* has often been collected by water in riverine forests, in the shade of primary to more degraded forests and in forests clearings, at 400 – 1650 m a.s.l.

CONSERVATION STATUS. Although restricted to D. R. Congo, this species has an extensive EOO, calculated at 203,528 km². Apart from two recent collections by B. Wursten in 2012, most collections of *Whitfieldia laurentii* were made prior to 1983 and the eastern part of the D. R. Congo where it grows remains under-collected. It is therefore likely that a larger number of populations than those known from herbarium specimens exists in D. R. Congo, hence we are not using the calculated AOO (96 km²) for assessing this species. A decline in the forest cover is ongoing within the range of *W. laurentii* due to conflict and mining operations in eastern D. R. Congo (see Butsic *et al.* 2015). However, forest maps show that extensive

forest cover still exists within this species' range, and it is thought to tolerate some disturbance, as evidenced by specimen labels. Based upon those observations, this species is currently assessed as of **Least Concern (LC)**.

NOTES. Evrard & Demillecamps (1992: 90) distinguished *Whitfieldia laurentii* from *W. arnoldiana* by its “non-coloured” [green] calyx and its yellow and densely pubescent corolla. However, the colour of the calyx for each species is mentioned in neither protologue and on none of the specimen labels of the original material of *W. laurentii*. As for the corolla, we have studied the three collections of *W. laurentii* cited by Evrard & Demillecamps, together with several collections of *W. arnoldiana* and did not find a significant difference in the pubescence. However, we do agree that dried specimens identified as *W. laurentii* have a pale-yellow corolla, distinct from specimens filed under *W. arnoldiana* on which the dark burgundy of the flowers is clear from both our observation of dry material and the original label information. For *W. laurentii*, none of the labels mention the original colour of the corolla and Lindau (1897) did not specify the corolla colour when describing *Stylarthropus laurentii*. The pale colour of the dry material could be due to the drying technique employed by E. Laurent. Alternatively, it could also be that those three specimens are a white-flowered form of a predominantly burgundy-flowered species, i.e. that the pigmentation has been lost, a common occurrence in Acanthaceae (Tripp & Manos 2008). Both *W. laurentii* and *W. arnoldiana* have the same type locality: Stanley Falls, now known as Boyoma Falls, in D. R. Congo. We conclude that separating these two species purely on the hypothesis of a different corolla colour is not justifiable

Map 4. Distribution of *Whitfieldia laurentii* in D. R. Congo.

and so they should be treated as a single species under the earlier name, *W. laurentii*.

Whitfieldia laurentii is also very similar to *W. stuhlmannii* in many respects: inflorescence size, corolla shape and pubescence of the different elements of the flower. Lindau (1894), when describing *W. laurentii*, also noted that these species were very similar but that *W. laurentii* has hairy bracteoles, a character that we have not observed on the dry material of *W. laurentii*. Lindau also added that the inflorescences of *W. laurentii* are pauciflorous and axillary, but this distinction is not obvious from our own observation of the two taxa. However, the flowers of *W. stuhlmannii* always show a very clear colour pattern on the corolla with its distinctive purple lobes contrasting sharply with the pure white tube and throat, and the corollas of *W. stuhlmannii* are generally larger than those of *W. laurentii* (c. 24 – 59 mm long, vs 20 – 25 mm long).

5. *Whitfieldia liebrechtsiana* De Wild & T. Durand (in Durand & De Wildeman 1899: 111); Durand & Durand (1909: 422); Evrard & Demillecamps (1992: 98) Type: D. R. Congo, on the road from Owali to Chiganga, fl. 20 Aug. 1895, *Dewevre* 277 (holotype BR* BR0000008393227). Fig. 1F.

Asystasia striata S. Moore (1930: 133) $\equiv$ *Whitfieldia striata* (S. Moore) Vollesen (in Furness & Vollesen 1991: 731). Type: Angola, Cabinda, Buco Zau, fl. 31 July 1916, *Gossweiler* 6540 (holotype BM! BM000931035).

For a description of this species see Evrard & Demillecamps (1992: 98).

DISTRIBUTION. This species is known from the Mayombe (Mayumba, Mayombe or Maiombe) forests that extend from the south of Gabon, through Congo Republic, the region of Cabinda in Angola and into the western tip of D. R. Congo (Map 5).

ADDITIONAL COLLECTIONS STUDIED. CONGO REPUBLIC. Madingou, Moyen-Congo, fl. July 1950, *Koechlin* 1209 (P! P03032900); Mayume (M. Congo), Boku-n' Situ, fl. 8 Aug. 1951, *Koechlin* 1548 (P! P03032909); Kouilou, Bilala, fl. 21 June 1989, *Dechamps* 13078 (BR* BR0000013442972); Kouilou, Les Sara, fl. 29 June 1989, *Dechamps* 13182 (BR* BR0000013442729). **D. R. CONGO.** Kinjati, près de Lukula, fl. 15 Sept. 1912, *Chevalier* 28436 (P! P03032908); Boma-Sundi (Lukula), fl. 29 Aug. 1913, *Bequaert* 641 (BR* BR0000013109202); **ANGOLA. CABINDA.** Buco Zau, fl. 31 July 1916, *Gossweiler* 6540 (BM! BM000931035); Sera-Subluali-Maiombe, fl. 9 May 1919, *Gossweiler* 8049 (BM! BM000931036, K!, LISC* LISC048221, LISC048221, LISC048223, LISC048224, LISC048225 & LISC048226); entre Buco

Zau e Belize, in bud, 27 Aug. 1958, *Monteiro et al.* 245 (PRE!); Buco Zau, Chiaca, fl. 15 June 1959, *Monteiro & Murta* 16 (PRE!); Maiombe-Chiaca, Buco Zau, fl. 15 July 1959, *M.E.F.A.* 434 (LISC* LISC048227, LISC048228).

HABITAT AND ECOLOGY. *Whitfieldia liebrechtsiana* grows in shade in lowland forests and plantations (banana, cocoa) from near sea level to 180 m a.s.l.

CONSERVATION STATUS. The EOO calculated for *Whitfieldia liebrechtsiana* of 10,702 km² is well below the 20,000 km² threshold for Vulnerable under criterion B1 and only eight locations are recorded. This species is largely an endemic of the Mayombe with one subpopulation in Aubeville (Congo Republic). Widespread logging for timber, construction, firewood and charcoal, and for clearing areas for subsistence agriculture is a serious threat to the biodiversity of the Mayombe Forest. In addition, the impact of slash and burn cultivation practice is a major concern in this region (Ron 2013). Transfrontier Conservation Areas in this region have been designated and could secure the future of Mayombe species, an area known to be of high botanical importance (Romeiras *et al.* 2014). No collections have been made in the area since 1989 and recent observations or collections are needed to confirm its current status in the Mayombe region today. As for the Aubeville area in Congo Republic where the species was collected in 1951, the forest has since suffered from industrial wood exploitation (1953 – 1988), exploitation of goods and services by local communities, and finally, since 1988, strong pressure from slash and burn agriculture (Kimpouni 2008). Currently, *W. liebrechtsiana* is not known from any protected areas (Protected Planet 2020) and considering the small number of locations and the continuing decline in extent and quality of habitat, it is assessed as **Vulnerable** under criterion B: **VU B1ab(iii,v)**.

NOTES. With its long subulate bracteoles (see Fig. 1F), long slender inflorescences and its corolla which is purple in its upper half, becoming striped with purple lines in the middle and then transitioning to cream/white, *Whitfieldia liebrechtsiana* is unlikely to be confused with any other species.

6. *Whitfieldia latiflos* C.B. Clarke *ex Stapf* (1906: 640). Type: Liberia, within 20 miles of Kakatown [Kakata], fl., 1904, *Whyte* s.n. (holotype K! K000394214).

Whitfieldia lateritia sensu Hutchinson & Dalziel (1931: 399), pro parte quoad *Whyte* s.n. ex Liberia.

Shrub, up to 150 cm tall; leafy stems stout, 4 – 5 mm in diam., somewhat 4-angular or becoming terete, swollen above nodes (constricted in dry state), shortly pubescent when young with multicellular spreading

Map 5. Distribution of *Whitfieldia liebrechtsiana* in Congo Republic, Cabinda (Angola) and D. R. Congo.

hairs, later glabrescent. *Leaves* petiolate, petiole 1.5 – 4 cm long, shortly pubescent; blade oblong-elliptic, c. 16.5 – 19 × 6.5 – 8.2 cm, base shortly attenuate then abruptly widened, margin entire, apex shortly acuminate; lateral veins c. 8 – 9 pairs, these and midrib pale and prominent beneath; shortly pubescent on main veins beneath, elsewhere glabrous; cystoliths minute, dot- or shortly rod-shaped, surface beneath also with minute sunken dark glands. *Inflorescences* axillary in distal leaf axils, racemiform, 3.7 – 13 cm long, secund; primary peduncle 9 – 30 mm long, this and spike rachis pubescent with short multicellular hairs, these appearing deflated in dry state; cymes at each inflorescence axil single-flowered, opposite, becoming ± widely spaced at maturity; bracts along rachis green, linear or narrowly lanceolate, (4.5 –) 7 – 13 × 0.6 – 3 mm, shortly pubescent beneath, glabrous above; pedicels of individual cymes 1.5 – 3.5 mm long, densely short-pubescent; bracteole pairs fused towards base, clasping the calyx, each pale yellowish-green, broadly ovate, 7 – 11 × 7 – 8.5 mm, base rounded or shallowly cordate, apex obtuse or shortly and bluntly acuminate, external surface shortly pubescent, internal surface glabrous; flowers sessile above bracteoles. *Calyx* divided to the base into five oblong-oblancheolate lobes, pale yellowish-green but darker towards apices, lobes somewhat unequal in size, posterior lobe largest, 9.5 – 11.7 × 3.6 – 4.5 mm, other four lobes marginally smaller and narrower, each with apex rounded and surface with 3 or 5 subparallel veins, both surfaces glandular-pubescent. *Corolla* reddish-purple, lobes and distal portion of tube speckled purple and with darker

purple veins, ± 21.5 mm long when dissected and flattened, glabrous externally; basal portion of tube somewhat bulbous, 3.7 – 4.5 long and 4.3 – 5 mm in diam., above which tube is slightly constricted and bent through c. 90°, and abruptly expanded into markedly saccate throat 11.5 – 13 mm long and 10 – 13 mm in diam., with few long multicellular hairs on floor within and with a raised ring of dense silky, blunt unicellular hairs at insertion point of stamens; limb of five ovate-triangular lobes in a weak 2+3 configuration, left-contorted in bud, becoming somewhat reflexed at anthesis; adaxial pair of lobes 5.5 – 6.5 × 5.7 – 6.7 mm, slightly asymmetric, fused for 1 – 2.5 mm at base; 3 abaxial lobes 6 – 7.5 × 5.5 – 6.5 mm, apices slightly emarginate. *Stamens* 4, didynamous, held against roof of corolla; filaments sigmoid-shaped, longer pair 10 – 15 mm long, glabrous; anthers included within corolla tube or those of longer pair partially exerted, thecae narrowly oblong, 2.9 – 3.3 mm long, connective pale-puberulous and with few short-stalked glands. *Ovary* 2 – 2.5 mm long, glabrous, within cupular disk 0.8 – 1 mm tall; style markedly curved, held against corolla roof, ± 19 mm long, shortly pubescent in distal half; stigma capitate, 0.5 mm in diam. *Capsule* only seen in immature state, 17 mm long including stipe 6.5 mm long, fertile portion broadly expanded, rounded with obtuse apex, glabrous; seeds not seen. Fig. 2.

DISTRIBUTION. *Whitfieldia latiflos* is only known from two collections in the northwest of Liberia: the type was collected 20 miles from Kakata, and the second

Fig. 2. *Whitfieldia latiflos*. A habit, flowering stem; note leaf at * removed to reveal inflorescences; B petiole, adaxial channelled surface; C detail of pedicel indumentum; D recently opened flower; E detail of the corolla of a recently opened flower showing the sharply angled ventral surface; F bracteoles with detail of indumentum at margin on the right; G calyx with ovary, style and stigma; H indumentum of calyx at margin; J corolla cut and opened flat, dorsal corolla lobe on the right; K detail of anther; L detail of staminode with part of raised ring supporting filaments, with examples of attached hairs. A – F, H – L from Baldwin 10754 from Genna Tanyehun, Liberia; ovary, style and stigma in G from Whyte s.n. from Kakatown, Liberia. DRAWN BY ANDREW BROWN.

specimen was from Genna Tanyehun in Grand Cape Mount County (Map 6).

ADDITIONAL COLLECTION STUDIED. LIBERIA. Grand Cape Mount Co., Genna Tanyehun, fl. 20 Dec. 1947, *Baldwin* 10754 (K!).

HABITAT AND ECOLOGY. Very little of the ecology of *Whitfieldia latiflos* is known: no altitude or habitat information features on the labels of the two known collections. However, given what we know about the localities, it is likely to occur in moist forest.

CONSERVATION STATUS. This species, which has not been collected since 1947, is only known from two localities, hence no EOO could be calculated. It has been collected only twice despite reasonable botanical coverage in Liberia, indicating that it is a rare species. However, the northern collecting site (*Baldwin* 10754) is close to the Gola Forest National Parks (on the Liberia-Sierra Leone border) where the species may be found in the future. The southern collecting site (*Whyte* s.n.) is near Kakata, which today is a highly modified and degraded area due to urban expansion and agriculture. We cannot be sure that this location has been lost but the possibility for this is high. There is a clear need for rediscovery of this species, with efforts focusing in and around the Gola National Parks for conservation purposes. At present, with only two collecting sites known and a clear and ongoing threat to one of these, we assess this species as **Endangered: EN B2ab(iii)**.

NOTES. This species was reduced to synonymy within *Whitfieldia lateritia* by Hutchinson & Dalziel (1931) in the First Edition of *Flora of West Tropical Africa*, whereas

Heine (1963) did not refer at all to *W. latiflos* in the Second Edition. Heine had presumably not seen *Baldwin* 10754 when preparing his treatment of *Whitfieldia* for that publication. The type of *W. latiflos* is a rather depauperate specimen, with the corolla being somewhat immature, but the *Baldwin* collection is a much better specimen, with fully mature corollas that are clearly distinct from both *W. lateritia* and *W. colorata* C.B. Clarke ex Stapf. In fact, *W. latiflos* is more likely to be confused with *W. preussii* (Lindau) C.B. Clarke in the colour and form of the corolla. However, it differs in having an externally glabrous corolla which becomes saccate in its upper part. Moreover, the corolla limb of *W. latiflos* is only weakly 2-lipped whereas in *W. preussii* this is markedly bilabiate (Table 1).

7. *Whitfieldia preussii* (Lindau) C.B. Clarke (1899: 67); Heine (1963: 399); Cheek *et al.* (2004: 142, 231); Onana & Cheek (2011: 76); Velayos *et al.* (2013: 114) ≡ *Stylarthropus preussii* Lindau (1894: 12; 1895: 306 – 307). Type: Cameroon, buschwald ostlich von lake, Barombi, fl. 12 Sept. 1890, *Preuss* 516 (holotype B†; lectotype K! K000029101, **selected here**; isolectotypes K! K000029102, BM!). Fig. 1G.

Whitfieldia letestui Benoist (1928: 671) **synon. nov.**; Heine (1966: 44); Lachenaud *et al.* (2018: 397). Type: Gabon, Yaouri, fl. 30 May 1915, *Le Testu* 2066 (lectotype P! P00439329!, **selected here**; isolectotypes BM! BM000931037!, BR! BR000006294182 & BR000006289836, IFAN* IFAN16582, K! K000394209, P! P00439328, P00439330).

Map 6. Distribution of *Whitfieldia latiflos* in Liberia.

Table 1. Diagnostic characters separating *Whitfieldia latiflos* from *W. preussii*.

Character	<i>W. preussii</i>	<i>W. latiflos</i>
Corolla indumentum	Pubescent externally	Glabrous externally
Corolla limb	Markedly 2-lipped, the two adaxial lobes fused for more than half their length and held erect, three abaxial lobes deflexed	Weakly 2-lipped, adaxial lobes fused for less than half their length, abaxial lobes slightly reflexed but not markedly deflexed
Corolla tube	Throat gradually expanded and curved above the basal tube, not markedly saccate	Throat abruptly expanded above and held at a marked angle to the basal tube and markedly saccate
Calyx indumentum	Minutely glandular- and eglandular-puberulent	Glandular-pubescent
Anthers	All four anthers exerted from corolla tube	Only anthers of longer pair of stamens exerted, or all anthers included within corolla tube
Style	Conspicuously pubescent distally with long white hairs	Shortly pubescent distally
Bracts along inflorescence rachis	Minute, linear-lanceolate, curved, 1.8 – 4 mm long, drying dark brown	Linear or narrowly lanceolate, not curved, (4.5 –) 7 – 13 mm long, drying green
Pedicels of individual flowers (single-flowered inflorescence units)	3 – 12 mm long, puberulent or sparsely so	1.5 – 3.5 mm long, densely pubescent

For a description of this species see *Whitfieldia letestui* in Heine (1966: 44).

DISTRIBUTION. *Whitfieldia preussii* is found in the south-western regions of Cameroon and Gabon as well as on the island of Bioko in Equatorial Guinea (Map 7). We are not aware of any specimens from the continental part of Equatorial Guinea (Río Muni) and from the Congo Republic but it is quite possible that this species also occurs in those countries.

ADDITIONAL COLLECTIONS STUDIED. CAMEROON. Bipindi, fl. 1900, *Zenker* 2229 (BM!, K! K000461084, P! P03032904); Bipindi, fl., 1902, *Zenker* 2461 (BR* BR0000020159122, K! K000461085, P! P03032907 & P03032903, WAG* WAG.1237413); Bipindi, fl., 1913, *Zenker* 4668 (BM!, K! K000461083, P! P03032906); Eseká, fl. 11 Dec. 1967, *Bamps* 1405 (BR* BR0000020159139, YA! YA0061292); 36 km N of Kribi, Edea Falls, fl. 30 Dec. 1969, *Bos* 6017 (WAG* WAG0160822, P! P03032905); Kumba area, fl. 13 Oct. 1984, *Thomas & Nemba* 4050 (MO, K! K000029100, YA); Matoh, fl. 25 Aug. 1986, *Mambo & Thomas* 122 (MO, K! K000029099, YA); Meme Div., Moungo, fl. 24 Oct. 1998, *Etuge* 4321 (BR* BR0000009556447, K! K000109347, MO, P! P04445952, US, WAG* WAG.1237412, YA); Ebo Forest Research station, Bekob drinking stream trail, fl. 27 Oct. 2006, *Osborne* 197 (K! K000634564, WAG* WAG.1237411, YA); Ebo proposed National Park, fl. 10 Nov. 2007, *Fenton* 231 (K! K000616978, YA). **EQUATORIAL GUINEA. BIOKO.** Malabo – Luba, km 42, fl. 2 Dec. 1989, *Carvalho* 4211 (K! K000518533). **GABON.** Rabi-Kounga, fl. 14 May 1992, *Breteler* 11438 (WAG* WAG.1975250); Ogooué-Maritime, Toucan, 14 June 2002, *Bourobou* 746 (LBV); Ngounié, Sindara, 22 June 2011, *Bissiegou et al.* 1439 (WAG* WAG.1975251); Zone de Mabounié, à environ 45 km au sud-est de Lambaréné, rive est de la

Ngounié, fl. 6 May 2012, *Dauby* 2731** (LBV); loc. *ibid.*, fl. 9 May 2014, *Bidault* 1496 (BR! BR0000024389563, BRLU, LBV, MO); loc. *ibid.*, fl. 10 May 2014, *Bidault & Akouangou* 1497 (LBV); loc. *ibid.*, fl. 13 May 2014, *Bidault & Akouangou* 1512** (BRLU, LBV, MO).

HABITAT AND ECOLOGY. *Whitfieldia preussii* often grows along streams in wet forest at 50 – 830 m a.s.l.

CONSERVATION STATUS. Prior to this present study, *Whitfieldia preussii* and *W. letestui* were considered two different species, and a conservation assessment was available for each of them. *Whitfieldia preussii* was assessed as Vulnerable (VU) based upon its previously known distribution in Cameroon and Bioko (Darbyshire 2014). The species then had only eight locations and its threat status was justified by the decline in the extent and quality of its habitat due to agricultural expansion. *Whitfieldia letestui* was assessed as Endangered (EN), being considered endemic to southwest Gabon, with only nine specimens known from eight subpopulations. Of these, four subpopulations occur in a mining concession and two in an oil concession, both of which are experiencing some low-level human pressure including forest clearance, whilst a seventh subpopulation occurs in a selectively logged forest. This led to the conclusion that the quality of habitat of this species is being reduced, with only 4 locations left in total (Stévant *et al.* 2016).

However, these populations are treated here as a single species, and a new location, that of Ebo in Cameroon, has been added. The new EOO is now calculated as 137,816 km² and 13 locations have been identified. Within the EOO, the species still appears to be scarce, with few suitable forests which could host this species. Moreover, as far as Cameroon is concerned, all specimens collected fall outside the range of formally protected areas that are managed for their biodiversity, such as National Parks, although

Map 7. Distribution of *Whitfieldia preussii* in Cameroon, Equatorial Guinea (Bioko), and Gabon.

Ebo was formerly proposed as such. Similarly on Bioko, the single known specimen of this species comes from a non-protected area. It is possible that this species is under-collected due to a short flowering period (Lachenaud *et al.* 2018). However, with few collections known in total and most specimens coming from non-protected areas, the species is now assessed as **Near Threatened: NT B2ab(iii)**.

NOTES. Lachenaud *et al.* (2018) considered *Whitfieldia letestui* to be endemic to southwestern Gabon. However, Heine (1966: 44) had previously noted that this species was very close to *W. preussii*, but the scarcity of the collections prevented him from making taxonomic changes. The characters Heine cited for potentially distinguishing the two species (including the density of the inflorescence, the pilosity of the bracteoles and the length of the flower peduncle) do not clearly discriminate two taxa in the light of the collections available for study today. Consequently, following a thorough review of material identified as *W. letestui* and *W. preussii*, we conclude that these species cannot be distinguished and *W. letestui* is synonymised here.

8. *Whitfieldia purpurata* (Benoist) Heine (1966: 36); Wieringa & MacKinder (2012: 148) $\equiv$ *Pounguia purpurata* Benoist (1938: 679). Type: Gabon, Pongui, région de Lastourville, fl. 20 July 1930, *Le Testu* 8166 (holotype P! P0043933; isotype BM!). Fig. 3A.

For a description of this species see Heine (1966: 36).

DISTRIBUTION. *Whitfieldia purpurata* is endemic to the Bambidie-Lastourville area in Eastern Gabon (Map 8).

ADDITIONAL COLLECTION STUDIED. GABON. Lastourville, fl. 27 April 1929, *Le Testu* 7255 (BM!, BR* BR0000020159160 & BR0000020159177, P! P03032886, P03032889).

HABITAT AND ECOLOGY. Neither the labels for the only two collections known nor the protologue of *Whitfieldia purpurata* give us any indication of its ecology. However, both specimens come from the Lastourville area of Gabon, which supports evergreen humid forest (Escourrou 1988). From Google earth, (www.google.com/earth/index.html), we estimated that *W. purpurata* grows between 260 and 440 m a.s.l.

CONSERVATION STATUS. This species is only known from the Lastourville area, which is currently unprotected. A good forest cover in the area still exists away from the main roads but slash and burn and mining activities are present in the Lastourville area. Much collecting has been conducted in this region, where this species has not been recollected for almost 90 years. However, in the Ogooué-Lolo province more generally, a large part of the forest remains unexplored (Jongkind 2018), and *Whitfieldia purpurata* could well grow in those unexplored areas. As there is currently too little knowledge on the populations of this species, it is assessed as **Data Deficient (DD)**.

NOTES. (1) In *Flore du Gabon*, Heine (1966: 37) noted that the type collection (the only specimen known for

Fig. 3. Photographs of *Whitfieldia* in the field and in herbaria. **A** *W. purpurata*, detail of bracteoles, from *Le Testu* 8166 (P). **B** & **C** *W. rutilans* from Ogooué-lolo, Gabon, collected as *Texier* 840: **B** habit, **C** detail of the inflorescence. **D** *W. thollonii*, detail of an inflorescence, from *Thollon* 210 (P). **E** *W. brazzae* from the Batéké plateaux, Gabon. **F** & **G** *W. lateritia*: **F** from Kindia, Guinea (collected as *van der Burgt* 2184); **G** from Simandou, Guinea (collected as *Haba* 249). **H** & **J** *W. colorata* subsp. *colorata*: **H** inflorescence, **J** flower detail, Dugbe HummingBird site (c. 20 km S of Sapo National Park, c. 50 km E of Greenville), near Tuzon, along the Geebo R., Liberia (collected as *Senterre* 6948). **K** *W. colorata* subsp. *tigrina*, Sapo National Park, Liberia (collected as *Jongkind* 9339). PHOTOS: **B**, **C** N. TEXIER; **E** J. P. VANDE WEGHE; **F**, **G** X. VAN DER BURGT; **H**, **J** B. SENTERRE; **K** C. JONGKIND.

Map 8. Distribution of *Whitfieldia purpurata* in Gabon.

Whitfieldia purpurata at the time, see Note 2) could be an extreme form of *W. brazzae* (Baill.) C.B. Clarke with bracteoles and flowers particularly large and a glabrous inner corolla surface. However, the inflorescences of *W. brazzae* are much more lax. As for the bracteoles, with more collections of *W. brazzae* being available to us today, we observe that even though its bracteoles are wide, they are elliptic to ovate and never fully rounded such as in the type of *W. purpurata* (see Fig. 3A). Moreover, we have not seen any specimen of *W. brazzae* with a purple corolla (the corolla of *W. brazzae* varies from pale yellow to salmon-pink or orange). As for the corolla inner surface, it is often also glabrous in *W. brazzae*, so this character does not help to separate the two species.

(2) The specimen *Le Testu* 7255, determined by Heine as *Whitfieldia thollonii* (Heine 1966: 40) was also collected in Lastoursville in Gabon. Its corolla (25 × 7.5 mm) is, as in *W. purpurata*, more campanulate than funnel-shaped. The original label describes its colour as “jaune abondamment rayée de brun [yellow heavily streaked with brown]”, confirmed by the observation of the dry specimens, although the stripes are not as neat as in *W. thollonii*. Instead, they resemble the flowers of *W. purpurata*. Indeed, the flowers of *W. purpurata* have been described as purple on the type label but a yellow-green corolla heavily striped with brown (or purplish-brown) lines could also be perceived as purple. Indeed, a similar case has indeed been observed in the description of corollas of *W. colorata* subsp. *tigrina*, described both as “dingy purple” and “yellow with darker red lines”. However, in a dry state, the corollas of that taxon all look similar with thick blurred dark purple stripes on a

cream or yellow background. This is also the case in *W. purpurata*. As for the bracteoles in *Le Testu* 7255, they are not so clearly rounded as in the type of *W. purpurata*; instead, they have a rounded to ovate base with a distinct triangular acumen. However, measurements of the bracteoles at anthesis also exceed the range of bracteoles measured in *W. thollonii* (11 – 11.5 × 7.5 – 8.5 mm vs 9 × 7 mm). Since this collection is the only one so far determined as *W. thollonii* from Gabon, disjunct from the rest of its distribution in the Congo Republic and D. R. Congo, we believe it should be best placed under *W. purpurata* pending further observation of populations in the Lastoursville region.

9. *Whitfieldia rutilans* Heine (1966: 37); Jongkind & Texier (2019: 11). Type: Gabon, Ndanda, fl. 14 June 1931, *Le Testu* 8858 (lectotype P! P00439332, **selected here**; isoelectotypes BM! BM000931034, BR* BR00000006293864 & BR00000006293215, K! K000394207 & K000394208, P! P00439333). Fig. 3B – C.

For a description of this species see Heine (1966: 37).

DISTRIBUTION. *Whitfieldia rutilans* is endemic to Gabon (Map 9).

ADDITIONAL COLLECTIONS STUDIED. GABON. Sacamicanda, fl. 21 July 1930, *Le Testu* 8174 (P! P03032901 & P03032902); Ogooué-lolo, fr. 17 Oct. 2015, *Bidault* 1991** (LBV, MO); Ogooué-lolo, Mount Ngouadi Area, fr. 26 Feb. 2017, *Texier* 349** (BRLU, LBV, MO); Ogooué-lolo, fl. 13 March 2017, *Texier* 840** (LBV, MO).

Map 9. Distribution of *Whitfieldia rutilans* in Gabon.

HABITAT AND ECOLOGY. *Whitfieldia rutilans* is a rare species which grows in evergreen forests including along riverbanks, at 300 – 500 m a.s.l.

CONSERVATION STATUS. This species was first collected by Le Testu in Ndanda and Sacamicanda in the Lastoursville area which, even though unprotected, still has a good forest cover away from major roads. More recently, *Whitfieldia rutilans* was rediscovered by Texier and Bidault in the same area in eastern Gabon, adding three collections from two subpopulations to the ones already known and increasing the EOO of the species to 3,046 km². Those recent collections were made in forest logging concessions. *Texier* 349 and *Bidault* 1991 come from the SEEF concession, where the timber activity was halted in 2017 (Jongkind & Texier 2019) and *Texier* 840 comes from the CEB concession where the exploitation is recent but ongoing and threatening the fourth location for this species (N. Texier, pers. comm.). More generally in this region, even though the forest loss seems low beyond the main roads, timber exploitation in this non-protected area is continuing and is expected to further affect the quality of habitat for this species. It is therefore considered here to be **Endangered** under criterion B: **EN B1ab(iii)+2ab(iii)**. A preliminary assessment was already available online (Stévant *et al.* 2016) with the same conclusion.

NOTES. The flower colour of *Whitfieldia rutilans* was described by Heine (1966) as a bright ochraceous red or deep orange-red, based on the label data of the two Le Testu collections. Since then, the species has been re-collected by Texier and his photos show a pale orange corolla similar to that in some populations of

W. brazzae and *W. lateritia*. However, *W. rutilans* differs from the first species by its short pedicels, dense inflorescence and glandular calyx lobes, and from the latter by its narrower corolla (4.2 – 5.5 mm wide vs 8 – 11 mm). More generally, *W. rutilans* is easily distinguished by its leaves reaching 28 cm in length (see Fig. 3B), which is unusually long for the genus.

10. *Whitfieldia thollonii* (Baill.) Benoist (1928: 671); Evrard & Demillecamps (1992: 96) $\equiv$ *Stylarthropus thollonii* Baill. (Baillon 1890b: 823); Lindau (1895: 306). Type: Congo Republic, bois de Linzolo, fl., s.d., *Thollon* 210 (lectotype P! P00439334, **selected here**; isoelectotype P! P00439335). Fig. 3D.

Whitfieldia gillettii De Wild. (De Wildeman 1905: 316); Durand & Durand (1909: 421) Type: D. R. Congo, environs de Leopoldville [Kinshasa], fl. Aug. 1902, *Gillet* s.n. (holotype BR! BR0000008512413).

Whitfieldia brazzei sensu Clarke (1899: 67), pro parte quoad *Thollon* 210, non (Baill.) C.B. Clarke sensu stricto.

For a description of this species see Evrard & Demillecamps (1992: 96) while considering note (2) below.

DISTRIBUTION. *Whitfieldia thollonii* is found in Congo Republic and D. R. Congo (Map 10).

ADDITIONAL COLLECTIONS STUDIED. CONGO REPUBLIC. Bois de Linzolo, fl. 1883, *Thollon* 210 (P! P00439334, P00439335); au bord du Djoue: fl. May 1888, *Thollon* 970 (P! P03032888) & fl. April 1891, *Thollon* 4053 (K!, P! P03032890, P03032891, P03032892); Kibossi, fl. 20

Map 10. Distribution of *Whitfieldia thollonii* in Congo republic and D. R. Congo.

March 1950, *Koechlin* 857 (P! P03032883); Route de Mayama, fl. 12 Feb. 1954, *Koechlin* 4655 (P! P03032887); Route de la Foulakari le long de la Loufini, fr. 5 Aug. 1964, *Bouquet* 499 (P! P03032884 & P03032885). **D. R. CONGO.** Sanda, fl. 1903, *Oddon* 3339 (BR* BR0000008513076) & *Oddon* 3754 (BR* BR0000013109301); Sanda, fl. May 1915, *Vanderyst* 5467 (BR* BR0000013109356); Litendele, fl. June 1916, *Achten* 482A (BR* BR0000008511751) & *Achten* 482B (BR* BR0000008512086); Kimayala, fl. April 1925, *Vanderyst* 14681 (BR* BR0000013109271) & *Vanderyst* 14682 (BR* BR0000013109332 & BR0000013109333); Goa, fl. 1926, *Vanderyst* 19104 (BR! BR0000013101664); Wutu a Kipako, fl. May 1932, *Vanderyst* 30515 (BR* BR0000008509918); Insiki, fr. 19 July 1953, *Callens* 4164 (BR* BR0000008512741, WAG* WAG0160819); route Zundu-Timansi avant la riviere Mpioka, fl. 21 May 1975, *Breyne* 2500 (BR* BR0000008517524); Kikwit, fl. 10 Aug. 1991, *Masens* 870 (BR* BR0000013109240).

HABITAT AND ECOLOGY. *Whitfieldia thollonii* is recorded from forests, often alongside rivers, but also in palm plantations. The altitude range was not recorded on specimen labels and our knowledge on the ecology of this species is limited.

CONSERVATION STATUS. With all the populations considered, we calculate an EOO of 44,635 km² and between 12 and 15 locations known historically. However, there is a distinct smaller core range (EOO = 7,553 km²) in the vicinity of the two capital cities, Brazzaville and Kinshasa. The collections from there are rather old with the last one from 1975. It is possible that due to deforestation and urban

expansion, those locations do not exist anymore today, at least halving the number of locations. The AOO in this core range is only 48 km², but total AOO is potentially a lot larger for this species as we also need to consider the two outlier locations in Kikwik and Goa in the east. No recent collections of this species have been made so our knowledge on the current population is only estimated. To apply a precautionary approach, we assess it as **Vulnerable VU B2 ab(i,ii,iii,v)** due to the high level of threat in the core of the range and the assumption that fewer than 10 locations are extant. However, the extinction risk would be reduced if further subpopulations are found within its EOO and away from the large conurbations of Brazzaville and Kinshasa.

NOTES. (1) Previously, this species was considered to be also found in Gabon (Heine 1966), based solely on the collection *Le Testu* 7255 from Lastoursville. We believe that this collection is actually referable to *Whitfieldia purpurata* (see Note 2 under *W. purpurata* above).

(2) Previous authors have noted that it is difficult to separate *Whitfieldia thollonii* from *W. brazzae* (Heine 1966: 42; Evrard & Demillecamps 1992: 96). However, Evrard & Demillecamps distinguished these species on the basis of the 10 following characters: a) corolla length; b) corolla length/width ratio; c) bracteole shape; d) density of glands on the calyx; e) colour of the corolla; f) leaf shape; g) position of the calyx in the bracteoles; h) pilosity of the inner corolla; i) pedicel length; and j) pollen morphology. Below, we consider these characters in turn.

(a) According to Evrard & Demillecamps (1992), the corolla length of *Whitfieldia brazzae* can reach

33 mm while *W. thollonii* can reach 34 mm but no range of measurements were given. From our observations, there is no significant difference in corolla length between the two species. (b) We were equally unconvinced by the argument that the length/width ratio (l/w) of the corollas differs in these taxa, as several specimens identified as *W. thollonii* by Evrard & Demillecamps have a l/w ratio which is higher than the supposedly maximum of 2.6 (e.g. *Oddon* 3754, *Achten* 482A), and so within the ratio range that they give for *W. brazzae*. (c) De Wildeman (1905: 317) and Heine (1966) agreed that *W. thollonii* and its synonym *W. gilletii* have elliptic bracteoles while *W. brazzae* and its synonym *W. sylvatica* have ovate bracteoles, whilst Evrard & Demillecamps (1992) argue it is the exact opposite. This disagreement could be explained by different definitions of those shapes by the authors. However, we looked at all specimens cited by those authors, as well as additional material, and we have seen significant variation in the shape of bracteoles ranging from elliptic to ovate with several intermediates, hence not resolving into two well-defined taxa. These differences in bracteole shape are also sometimes visible on a single collection, including on the type specimen for *W. brazzae*, *De Brazza* 165, which has both ovate and elliptic bracteoles. (d) In Evrard & Demillecamps (1992: 96), both species are described as having “a calyx covered with very small white glands” and no difference in the density of glands has been observed by us. (e) The colour of the corolla for *W. brazzae* is described as brown-yellow by Evrard & Demillecamps (1992) but a specimen they cited under that species (*Compère* 1919) was described on the specimen label as pink when fresh and shows clear purple lines when dry. Several specimens from P identified as *W. brazzae* have flowers which are orange (*Farron* 5113) or salmon red (*Pobéguin* 239). For *W. thollonii*, many labels do not indicate the colour of the fresh corolla. However, purple-brown streaks are present on corollas of all dried specimens of *W. thollonii*. Moreover, flower buds for this species tend to show dark purple lobes. Hence, even though the corolla colour for both species is more variable than has previously been described, we agree that dark stripes and dark lobes on the corollas are a good indicator of *W. thollonii*; *W. brazzae* can show stripes but they are faint and regular. (f) For these two species, as in most *Whitfieldia* species, the leaves are variable in size and shape within a species and consequently their measurements cannot be used for identification (the exceptions being *W. rutilans*, where the leaves are exceptionally large [see Fig. 3B], and *W. purpurata* where the leaves are distinctly cuspidate). (g) We did not find a significant difference in the position of the calyx: both taxa can have calyces which are either exerted from or hidden within the bracteoles. This is due partly to variation in the shape of the bracteoles,

which can be markedly acuminate hence covering the calyx lobes, and partly to the maturity of the calyx as it continues to grow post-anthesis. (h) Even though the inner corolla of *W. thollonii* is said by Evrard & Demillecamps (1992) to be pilose, we found several specimens (e.g. *Gillet* s.n. 1903 & 1904) for which it is glabrous as in *W. brazzae*. (i) There is a clear difference in pedicel length when the types of *W. brazzae* (18 – 25 mm long) and *W. thollonii* (4 – 13 mm long) are compared. However, when all specimens are considered together, this character also loses its strength and appears to be clinal. This is illustrated by the specimens *Oddon* 3554, *Achten* 482A and *Achten* 482B from D. R. Congo, which have unusually long pedicels for *W. thollonii* (respectively up to 20 mm, 17.5 mm and 25 mm long). (j) Only minute differences were found in the pollen of *W. thollonii* and *W. brazzae* as published by Evrard & Demillecamps (1992). The addition of the photograph of pollen from another specimen of *W. brazzei* (*Fidao* s.n.) during this study confirmed the similarities.

In conclusion, then, many of the characters previously used to separate *Whitfieldia thollonii* from *W. brazzae* do not hold up when the full range of material is examined and only corolla colour appears to differ consistently between the two. However, whereas *W. brazzae* has been collected multiple times both at the border between southwestern Gabon and Congo Republic and in the Brazzaville-Kinshasa area, *W. thollonii* seems much more confined to the second location only. More field observations and photographs are needed to understand at what rank these taxa should be separated. Only photographs of *W. brazzae* have been seen by the authors (see Fig. 3E), and photographs of *W. thollonii* would enable us to verify if other characters, such as the orientation of the corolla lobes, help distinguish these two taxa better. Additional studies might reveal these species to be better treated as only infraspecifically distinct.

11. *Whitfieldia brazzae* (Baill.) C.B. Clarke (1899: 67) as *W. brazzei*, pro parte, excl. syn. *W. thollonii* et *Thollon* 210; Heine (1966: 42); Evrard & Demillecamps (1992: 93); Walters *et al.* (2011: 425) $\equiv$ *Stylarthropus brazzae* Baill. (Baillon 1890a: 283), as *S. brazzei*; Lindau (1895: 306). Type: Congo Republic, bois d’Osika, fl. June 1883, *de Brazza* 165 (lectotype P P00439320!, **selected here; isolectotypes P! P00439321 & P00439322). Fig. 3E.**

Stylarthropus tenuiflora Baill. (Baillon 1890a: 283); Lindau (1895: 306). Type: Congo Republic, dans les bois de Linzolo, fl. May 1885, *de Brazza* 209 (holotype P P00439323!).

Whitfieldia sylvatica de Wild. (De Wildeman 1905: 317). Type: D. R. Congo, Kimuenza, fl. May 1901, *Gillet* 2195 (lectotype BR*

BR0000009858947, **selected here**; isoelectotype BR* BR0000008515964). Additional syntype: environs de Léopoldville, fl. Aug. 1902, *Gillet* s.n. (BR* BR0000013396848)

For a description of this species see Evrard & Demillecamps (1992: 93) while considering note (2) of *Whitfieldia thollonii*.

DISTRIBUTION. *Whitfieldia brazzae* is found in Gabon, Congo Republic and D. R. Congo (Map 11). It is also very likely to occur in the Central African Republic (see Note 2).

ADDITIONAL COLLECTIONS STUDIED. GABON. Leconi road at Souba, fl. 21 June 1989, *Louis* 3107 (LBV, WAG* WAG.1237229); Plateaux Bateke, fl. 8 March 2003, *Niangadouma & Walters* 217 (LBV, MO, K!); Plateaux Bateke, Kalahari sands, Okeli Forest, fl. 6 Oct. 2003, *Walters & Moussavou* 1379 (LBV, MO, WAG* WAG.1237226, BR* BR0000005086061); Plateaux Bateke, Mpassa riparian forest, fl. 30 Jan. 2004, *Niangadouma* 407 (LBV, MO, WAG* WAG.1584056, WAG* WAG.1237416); Haut-Ogoue, Ekouyi village, Okeli forest, fl. 18 July 2006, *Walter* 1819A (LBV, MO, WAG* WAG.1237228); Plateaux Bateke, Bai Djobo, fl. 10 Sept. 2006, *Nguema* 786 (LBV, MO, WAG* WAG.1237227); **CONGO REPUBLIC.** Forêt de Baiki-Oubangui et Boganga, confluent de l'Oubangui et du Congo, fl. Dec. 1916, *Fidao* s.n. (K!, P! P03590298); Moyen Congo, rives du Congo, fl. March 1920, *Pobéguin* 239 (P! P03590299, P03590300); Rive gauche de la Foulakari, fl. 3 Aug. 1964, *Bouquet* 360 (P! P03590303); Plateau des cataractes, route Kinkala-Hamon, forêt de Ngamikole près du village Dzeba, fl. 8 Sept. 1964, *Sita*

1072 (P! P03590293); Forêt de la Djoumouna, fl. 14 April 1966, *Farron* 5113 (P! P03590295, P03590296, P03590297, P03590301); Village de Mbese, terre Ongondza sous prefecture de Boundji, fl. 23 June 1965, *Bouquet* 1460 (P! P03590302, P03590304); Kebara, fl. 1 July 1982, *Audru* 6710 (P! P03564730); Forêt de la Djoumouna, 25 km W Brazzaville, fl. 12 July 1985, *Cusset* 1348 (P! P03071790); on the road to Lefoutou airport and Placong, fl. 25 June 2011, *Mampouya* 128 (IEC, K! K001400005, P! P00948924); N of Lebayi, fl. 31 May 2010, *Kami* 5290 (IEC, K! K000678781); sine loc., s.d., *Thollon* s.n. (P! P03590294); **D.R. CONGO.** Kimuenza, fl. May 1901, *Gillet* 2195 (BR* BR0000008515964 & BR0000009858947); Leopoldville, fl. Aug. 1909, *Claessens* 35 (BR* BR0000013396800); Sanda, fl. 15 June 1915, *Vanderyst* 5553 (BR* BR0000013398989); Mpese, 1919, *Vanderyst* 7614 (BR* BR0000013399023); dans le Benga, fl. June 1925, *Vanderyst* 14934 (BR* BR0000013399061); Kinkoko, fl. 20 April 1960, *Compere* 1919 (BR* BR0000008392916); Manenga, terr. Ngafula, fl. 14 July 1977, *Pauwels* 5850 (WAG* WAG0160820, BR* BR0000013396923); Milu, zone Maluku, fl. 15 May 1982, *Breyne* 4296 (BR* BR0000013396763).

HABITAT AND ECOLOGY. *Whitfieldia brazzae* is found in primary forest and mature secondary forest, often along rivers, at 400 – 600 m a.s.l.

CONSERVATION STATUS. This species is known from many collecting sites and has an EOO of 250,399 km². Several historical collections are from the now heavily degraded Kinshasa-Brazzaville area, where the species is likely to have declined significantly. However, there are still a number of more intact areas where it has been collected. It is protected in the National Park of

Map 11. Distribution of *Whitfieldia brazzae* in Gabon, Congo Republic and D. R. Congo.

the Batéké Plateaux (Protected Planet 2020), where it has been collected several times, including in the last fifteen years. It is therefore considered to be of **Least Concern (LC)**. However, it would be useful to gather more details on current population size, trends and threats. It would be interesting, for example, to assess this species under the criteria A once we have more information on the current rate of decline.

NOTES. (1) Baillon (1890b: 823) and Clarke (1899: 67) have spelt the epithet “brazzei”, the genitive form of “brazzeus”. However, this does not follow the established rules of Latin grammar for botanical nomenclature. Since the species has been named after Pierre Savorgnan de Brazza, the correct epithet should be “brazzae” (Heine 1966; Turland *et al.* 2018, Articles 60.8 and 60.9).

(2) *Whitfieldia brazzae* is very likely present in the Central African Republic and some specimens (e.g. *Fidao* s.n.) have been collected very close to the Congolese border with that country. However, no specimen from that country has been seen by the authors so far.

(3) For separation from the closely allied *Whitfieldia thollonii*, see the Notes section under that species.

12. *Whitfieldia lateritia* Hook. (Hooker 1845: 4155); Clarke (1899: 67); Aké Assi (1961: 199; 1984: 32); Adjanohoun & Guillaumet (1961: 84); Gledhill (1962: 29); Heine (1963: 398); Adam (1975: 1464); Hawthorne & Jongkind (2006: 448); Lisowski (2009: 39); Marshall & Hawthorne (2013: 3, 26). Type: Sierra Leone, sine loc., s.d., *Whitfield* s.n. (lectotype K! K000394216, **selected here**; isolectotype K! K000394219). Fig. 3F – G.

Asystasia amoena Turrill (1920: 26), **synon. nov.** Type: Sierra Leone: round York Pass, fl. & fr. 10 Jan. 1914, *Lane-Poole* 180 (K! K000394215).

For a description of this species see Adam (1975: 1464).

DISTRIBUTION. *Whitfieldia lateritia* is known from West Africa in Guinea, Sierra Leone, Liberia and Ivory Coast (Map 12).

SELECTED COLLECTIONS STUDIED. GUINEA. route Kankan – Macenta, fl. 1 Jan. 1949, *Adam* 2960 (K! K000865123, PRE!); Macenta prefecture, Simandou range, Banko forest, along the stream near the old Conservation International campsite, fl. 9 Nov. 2005, *Tchiengue* 2326 (HNG, K! K000436319, MO, P! P03421016); Macenta prefecture, Mts Ziama, N of Sereidou on road to Macenta, zone Zobroma, Neolemonniera hill, fl. 22 Oct. 2008, *Fofana* 150 (HNG, K! K000615127); Coyah prefecture, near Kouriya, near road from Coyah to Kindia, fl. 11 Oct. 2016, *Goman* 349 (K! K001243785);

Kindia prefecture, forested canyon to Plateau de Tassing above Fossikouré Village, fl. 8 Dec. 2017, *van der Burgt* 2184 (HNG, K! K001286446, P, WAG* WAG.1970626). **SIERRA LEONE:** Yonibana, fl. 30 Dec. 1914, *Thomas* 4018 (K!); York Pass, fl. Dec. 1922, *Dawe* 406 (K!); Jagba hill, N side, fl. 8 Sept. 1958, *Melville & Hooker* 631 (K!); Tonkolili distr., Southern Sula Mts, E of village Farangbaya near Bumbuna, road to Simbili proposed iron ore pit, downstream of the bridge, fl. 27 Nov. 2009, *Tonkolili Plants* 520 (K! K000023633, SL); Gola National Park, central block, fl. 25 Oct. 2013, *Sesay* 98 (HNG, K! K001061894, SL, WAG* WAG.1962815). **LIBERIA.** Gbanga, fl. 8 Sept. 1926, *Linder* 440 (K!); Eastern province, Tappita distr., fl. 15 Aug. 1947, *Baldwin* 9031 (K!); Sanokwele distr., Zolopla, fl. 21 Sept. 1947, *Baldwin* 9390 (K!); Lamco Hq. Camp, fl. 13 Oct. 1964, *Adames* 651 (K!, P! P03032940); Nimba, near Mt Tokadeh, fl. 12 Nov. 2007, *Jongkind* 7984 (K!, WAG* WAG0280090 & WAG0280091, P!, SL). **IVORY COAST.** Man, fl. Sept. – Oct. 1930, *Chevalier* 34190 (P! P03564090); Adioupoumé, réserve botanique, fl. Jan. 1969, *Bamps* 1849 (K!); Mont Toukoui, fl. 7 Dec. 1973, *Aké Assi* 12243 (P! P 03032932 & P03032933); Forêt de Tiapleu, c. 30 km N of Danané, fl. 30 Jan. 1984, *Hepper & Maley* 7906 (K!); Man, fl. 13 Oct. 2001, *Nusbaumer* LN782 (G, P! P04422452).

HABITAT AND ECOLOGY. *Whitfieldia lateritia* is found in disturbed and undisturbed forest, especially near streams, in gullies or canyons, between 190 and 1010 m a.s.l.

CONSERVATION STATUS. This species has a large EOO of 174,821 km² and is known from many collecting sites. It has been collected frequently and it is still today fairly common in suitable forest habitats. According to the notes of past collectors, it also tolerates some disturbance. Nevertheless, it is likely to be declining due to forest loss, although not to such an extent that it would qualify under any of the IUCN threat criteria. This species is therefore assessed as of **Least Concern (LC)**.

NOTE. *Whitfieldia lateritia* is a rather frequently encountered species in surviving forest of Upper Guinea which shows a continuous variation of colour tones in the bracteoles, calyx (green to red) and corolla (from pale orange, brick-coloured, to pink or red, with or without stripes, sometimes dots, see Fig. 3F). A wide and continuous range of bracteole form has also been observed across its range, varying from broadly ovate to lanceolate or suborbicular, with or without an acumen. Moreover, their width ranges from 5 – 12 mm, a rather wide range compared to other species in the genus. The indumentum on the floral parts also varies, with the bracteoles ranging from almost glabrous to pubescent. However, the stem and the pedicels are always villose with multicellular hairs,

Map 12. Distribution of *Whitfieldia lateritia* in Guinea, Sierra Leone, Liberia and Ivory Coast.

which facilitates its distinction from *W. colorata* (glabrous to puberulous) within its distribution range, and from the similar *W. brazzae* (glabrous) in Gabon and the Congos, where *W. lateritia* does not occur.

13. *Whitfieldia colorata* *C.B. Clarke ex Stapf* (1906: 640); Cooper & Record (1931: 117); Gledhill (1962: 29); Heine (1963: 399); Adam (1975: 1464); Aké Assi (1984: 32); Bakayoko *et al.* (2004: 220); Poorter (2004: 385);

Hawthorne & Jongkind (2006: 448 – 449). Type: Liberia, within 20 miles of Kakatown [Kakata], fl., 1904, Whyte s.n. (lectotype K! K000041544, **selected here**; isoelectotypes K! K000041543, K000394213 & K001400070, P! P00439324). Fig. 3H – K.

NOTE FOR SPECIES. *Whitfieldia colorata* is a rather variable species. Two near-allopatric subspecies are recognised here for the first time:

Key to infraspecific taxa of *Whitfieldia colorata*

- Corolla when fresh pink to copper externally with darker regular stripes and no spots, yellow to green internally; corolla in dry state dusky purple with regular darker stripes; calyx salmon pink to bronze-red; l:w ratio of corolla 3.8 – 4.4:1 subsp. **colorata**
- Corolla when fresh yellow to green externally with diffuse dark purple to dark brown stripes, sometimes spots internally, green internally; corolla in dry state dirty yellow with irregular stripes; calyx green; l:w ratio of corolla (3 –) 3.5 – 3.7:1 subsp. **tigrina**

13a. *Whitfieldia colorata* *C.B. Clarke ex Stapf* subsp. **colorata**. Fig. 3H – J.

For this subspecies see a comparative description in Adam (1975: 1464).

DISTRIBUTION. Subsp. *colorata* is found in the south of Sierra Leone, and in the southwest and the southern coast of Liberia. It is likely to occur in the Nimba Mountains in Guinea as well, as noted by Adam (1975: 1464), but no specimen has been seen from there by the authors.

ADDITIONAL COLLECTIONS STUDIED. LIBERIA. Within 6 miles of Monrovia, fr. 4 Jan. 1905, Whyte s.n. (K! K000041549); Urwaldreste zur Cap Mesurado, Monrovia, fl. 20 Jan. 1924, Dinklage 2956 (P! P03590290); along Dukwai [Dukwia] R., Monrovia, fl. Oct. – Nov. 1928, Cooper 34 (K! K000041546), Dukwia R., fr. 4 Feb. 1929, Cooper 152 (K!); sine loc., fl. 1 Jan. 1935, Dinklage 3355 (BM!, BR* BR0000020157845); banks of Farmington R., fl. 23 Dec. 1943, Bequaert 10 (K! K000041545); Central Province, Salala Distr.: Piatah, fl. 2 Dec. 1947, Baldwin 10611 (K!); Western Province, Boporo Distr.: Ba, on Mano R., near border of Grand

Map 13. Distribution of *Whitfieldia colorata* subsp. *colorata* in Sierra Leone and Liberia.

Cape Mount Co., fl. 18 Dec. 1947, *Baldwin* 10700 (K! K000041550); Grand Cape Mount Co.: Genna Tanyehun, fl. 20 Dec. 1947, *Baldwin* 10773 (K! K000041551); Blazie, fl. 27 Nov. 1958, *Adam* 16182 (P! P03590288); Zoka town, fl. 1 Dec. 1958, *Adam* 19248 (P! P03590292); Toué-Tié-Tié, fl. 9 Dec. 1958, *Adam* 16319 (P! P03590289); New University site, ± 35 km from Monrovia, fl. 2 Jan. 1964, *Harten* 228 (K!, WAG* WAG0015130); Gola National Park, E of Bomi hills, access road to school forest, fl. 9 Dec. 1966, *Bos* 2315 (WAG* WAG0015125, WAG0015126); Grand Gedeh, Putuh road, S of Zwedru (Chien, in dark high forest), fr. 18 Jan. 1967, *Bos* 2872 (WAG* WAG0015128, WAG0015127); 4 miles S of Kakata, 6 miles to W, along road, fl. 7 Nov. 1968, *Jansen* 1015 (BR* BR0000020157852, P! P03590291); 10 miles from Tchien, along the road to Cape Palmas, fl. & fr. 22 Jan. 1969, *Jansen* 1298 (K!, WAG* WAG0160524, WAG0015122); 20 miles W of Bomi Hills, road to Mano, fl. 12 Feb. 1969, *Jansen* 1494 (BR* BR0000020157869, WAG* WAG0015120); about 10 miles N of Monrovia, Savanna area, fl. 19 Feb. 1969, *Jansen* 1602 (WAG* WAG0015124); 3 miles N of settlement of MMAL mine company, fl. 12 Feb. 1970, *Jansen* 1799 (K!, WAG* WAG0015121); Montserrado, 8 miles N of Bomi hills, fl. 28 Jan. 1971, *Goll* 68 (WAG* WAG0093391); Grand Cape Mount, c. 5 miles E of Robertspoint in hilly country, fl. 12 Jan. 1978, *Gier* 127 (BR* BR0000020157876, WAG* WAG0093372); Lofa, road from Bopolu to kpelle Nat. Forest, about 15 miles E of Bopolu, fl. 19 Jan. 1978, *Gier* 227 (WAG* WAG0093322); Montserrado, Old Porrobush on Bentol Road, about 5 miles before Bentol, fl. & fr. 9

Feb. 1978, *Gier* 248 (WAG* WAG0093345); Grand Gedeh, along Zwedru-Harper road, south of Tiamia Town, fl. 7 June 2005, *Jongkind* 6663 (WAG* WAG0124407); Grand Cape Mount, Gola Forest, fl. 28 Nov. 2005, *Jongkind* 6927 (BR* BR0000020157906, WAG* WAG0221569, WAG0221568); Gbarpolu, Kpelle Forest, N of Gainkpa, fl. 13 Dec. 2010, *Jongkind* 10102 (BR* BR0000020157920, K! K001400225, WAG* WAG0409410); Grand Cape Mount, Cape Mount, fr. March 2013, *Jongkind* 11787 (BR* BR0000014275708, WAG* WAG.1487950); Dugbe Hummingbird site (c. 20 km S of Sapo National Park, c. 50 km E of Greenville), near Tuzon, along the Geebo R., fl. 24 Dec. 2013, *Senterre* 6948 (BRLU* BRLU0018690).

SIERRA LEONE. Jephun, fl. Dec. 1907, *Smythe* 228 (K! K000041568); Pujehun, fl., 1915, *Thomas* 8663 (K! K000041572); Kenema, fl., 1915, *Thomas* 7967 (K! K000041570); Falaba, fl., s.d., *Burbridge* 471 (K! K000041569); Giewahun, fl. 20 Nov. 1926, *Deighton* 363 (K! K000041573); le Gaura chieftem, near Lalahun, fl. 29 Dec. 1950, *King* 196B (K! K000041574); Gola Forest, fl. 19 March 1952, *Small* 548 (K! K000041575); le Gbanbama, fl., s.d., *Thomas* 9014 (K! K000041571).

HABITAT AND ECOLOGY. *Whitfieldia colorata* subsp. *colorata* is a scandent shrub found in moderate shade in primary and secondary forest. It grows from sea level to 140 m a.s.l.

CONSERVATION STATUS. This subspecies has an EOO of 55,521 km² and occurs at many collecting sites. Some coastal sites where historical collections have been made (such as near Kakata) are currently facing significant loss of forest habitat, in the Gola National Park, where the plant was collected in the last twenty

years, the Bomi Hills are also targets for open cast iron ore mining (Gunn *et al.* 2018). However, the subspecies is also present in areas of good intact forests within the Gola National Parks in both Sierra Leone and Liberia. Consequently, it is assessed as of **Least Concern (LC)**.

13b. *Whitfieldia colorata* subsp. *tigrina* A.Grall & I.Darbysh. subsp. nov. Type: Liberia, Sino, Sapo National Park, fl. 31 Jan. 2010, *Jongkind* 9339 (holotype K! K001400329 isotypes BR! BR0000020157883, COI* COI00092472, E, MA, MO, P! P00886037, WAG* WAG0245449). Fig. 3K.

<http://www.ipni.org/urn:lsid:ipni.org:names:77216479-1>

RECOGNITION. This subspecies differs from subsp. *colorata* in the corolla being green to yellow with red to dark purple stripes slightly blurred towards the lobes (vs pink to red corolla with more regular and darker red veins that are neat up to the lobes); in the calyx being green (vs copper to pink); and in the corollas being generally shorter and proportionally slightly broader, with a l:w ratio (3 – 3.5 – 3.7: 1 (vs elongate and proportionally narrower corolla; l:w ratio 3.8 – 4.4: 1).

DISTRIBUTION. *Whitfieldia colorata* subsp. *tigrina* is recorded from the eastern part of Liberia and western Ivory Coast in the Sassandra region (Map 14).

ADDITIONAL COLLECTIONS STUDIED. LIBERIA. Sinoe Basin, fr. 4 Jan. 1905, Whyte s.n. (K! K000041547); Sino, Sapo National Park, buffer zone, near Sinoe R., fl. 23 Nov. 2002, *Jongkind* 5183 (WAG* WAG0070318);

Grand Bassa, Cestos-Sanguin area, logging concession of the Cooper's, Sudan section, fl. 6 Dec. 2002, *Jongkind* 5661 (BR!, BR0000020157913, G* G00351120, WAG* WAG0070620); Grand Gedeh, Grebo Forest, fl. 8 Dec. 2005, *Jongkind* 7202B (WAG* WAG0221085); Sino, near footpath SW of Jalay's town going to Greenville, fr. 14 March 2009, *Jongkind* 8977 (WAG* WAG0320734); Sino, SW of Togbaville, fl. 29 Nov. 2010, *Jongkind* 9902 (BR! BR0000016836761, WAG* WAG0409472); Sino, Sapo National Park, fl. 31 Jan. 2010, *Jongkind* 9339 (BR! BR0000020157883, P! P00886037, WAG* WAG0245449). **IVORY COAST.** 56 km N of Sassandra, E of Beyo., fl. 17 Dec. 1958, *Leeuwenberg* 2223 (WAG* WAG0005280); 61 km N of Sassandra, W of Niapidou, fl. 18 Jan. 1959, *Leeuwenberg* 2475 (WAG* WAG0005279); 61 km N of Sassandra, W of Niapidou, fr. 19 Feb. 1959, *Leeuwenberg* 2757 (WAG* WAG0005281); entre Bacanda et Tiepo, fl. 13 Jan. 1965, *Aké Assi* 8442 (G* G00394941); Tabou, road to nearby village near the sea, fl. 12 Oct. 1973, *Koning* 2434 (WAG* WAG0060346); Sassandra, P.N. de Taï, entre Djiroutou et le Mont Niénoukoué, fl. 3 Feb. 1999, *Menzies* CC1546 (G* G00394940); Sassandra; Forêt Classée Niégre, E of Keitadougou, fl. & fr. 23 March 2000, *Jongkind* 4665 (WAG* WAG0013344, WAG0013345).

CONSERVATION STATUS. This subspecies has an EOO of 31,278 km² with only 11 locations known. The collections made in Ivory Coast are quite old and there has been significant forest loss in Ivory Coast within its distribution range, mainly due to the development of crops of cocoa, coffee, rubber, bananas, etc. for export, but also slash and burn subsistence agriculture and timber production (Koné

Map 14. Distribution of *Whitfieldia colorata* subsp. *tigrina* in Liberia and Ivory Coast.

et al. 2014). Three specimens were collected in a classified Forest (Forêt de la Niégré: *Jongkind* 4665; *Leeuwenberg* 2475 & 2757), but that area has not been exempt from deforestation since the 1970s and much land in this supposedly protected area has been sold to migrants who converted the forest into cocoa plantations (Eblin *et al.* 2018). Two more Ivorian collections (*Leeuwenberg* 2223; *Breteler* 6063) were made east of the Forêt de la Niégré in the 1950s and the 1960s respectively, and there is now very little forest cover left at that location. Another Ivorian collection was made in Tabou in 1973 (*Konning* 2434) and the area is now heavily urbanised with little forest remaining, so there is little chance that the location still exists. This subspecies was collected in the Taï Forest in 1999 (*Menzies* CC1546). However, the Taï National Park, despite its protected status, has suffered from deforestation due to the expansion of cocoa plantation, illegal timber production, slash and burn agriculture and bush fires (Boissieu *et al.* 2007; Barima *et al.* 2016). One collection was made between Bacanda and Tiepo [Chiepo] in 1965 (*Aké Assi* 8442) in the Go Bodiénuou Classified Forest. Little is known on the protection of that Forest in the last 50 years, and even though some forest is still visible in the area on Google Earth, with the absence of protection (Protected Planet 2020), one can doubt of the presence of *W. colorata* subsp. *tigrina* there today. The locations in the east of Liberia, however, seem much more intact with good forest cover still present. Moreover, several collections were made in the Sapo and Cestos-Senkwen National Parks where the forest is well protected. This portion of Liberia is also largely under-collected and has good suitable habitat for this taxon, hence it is rather difficult to calculate a precise AOO. To conclude, even though the situation for this species is perilous in Ivory Coast, the east of Liberia is much more promising with national parks and a good forest cover in most of the area where the subspecies can be found. We therefore assess this subspecies as **Near Threatened**: NT B1ab(iii,iv,v).

NOTES. The authors contacted Carel Jongkind in 2018 to ask him if he had seen *Whitfieldia latiflos* while conducting fieldwork in Liberia. While he had not, he described interesting plants that he had collected from the Ivory Coast/Liberia border area and which did not key out as either *W. lateritia* or *W. colorata*. Those plants were new to us, and thanks to Carel's observations, a careful combination of morphological observations and mapping led us to conclude that three taxa were indeed present in the area. These are here treated as *W. lateritia*, *W. colorata* subsp. *colorata* and *W. colorata* subsp. *tigrina*. The two latter taxa appear much closer to each other (narrow calyx lobes, dense inflorescence) than to *W. lateritia*, particularly in a dry state, hence they were treated as subspecies in this synopsis. However, additional future collections,

photographs, and observations at the fruiting stage might lead to a re-evaluation of their rank.

CURRENTLY UNPLACED SPECIMENS OF *WHITFIELDIA COLORATA*

The two subspecies cannot be separated at the vegetative or fruiting stage. As a consequence, a few collections with fruits or fallen flowers cannot be assigned to one or the other subspecies with confidence.

One flowering specimen (*Voorhoeven* 134, WAG) is unusual in its dense inflorescence with rather large bracteoles and could not be identified at the subspecies level; it needs further study.

LIBERIA. Grand Bassa Co.: across Cess R., fl. 9 March 1948, *Baldwin* 11294 (K!); Bomi Hills, Yoma Distr. of the Gola Nat. Forest, fl. 23 Nov. 1960, *Voorhoeve* 134 (WAG* WAG0015132); Krahn Bassa Forest, fl. 3 Feb. 1964, *van Harten* 322 (WAG* WAG0015129); Sino, E of Pelloken village, fr. 5 Feb. 2016, *Jongkind* 12970 (WAG* WAG.1943740).

SIERRA LEONE. Pujehun, fr. Feb. 1915, *Thomas* 8451 (K!); loc. *ibid.*, Feb. 1915, *Thomas* 8642 (K!); loc. *ibid.*, Feb. 1915, *Thomas* 8649 (K!).

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