

1 The Critically Endangered narrowly endemic plant species of the Ebo Forest, Cameroon, with
2 *Uvariopsis dicaprio* (Annonaceae) a new tree species.

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17

18 **Abstract**

19 **Background.** The Ebo Forest area is a highly threatened centre of diversity in the Littoral
20 Region of Cameroon, globally important for conservation with many threatened species
21 including 68 threatened species of plant, yet not formally protected. The tropical African
22 evergreen forest tree genus *Uvariopsis* Engl. & Diels (Annonaceae) is characterised by
23 unisexual, usually cauliflorous flowers with a uniseriate corolla of four petals, and two sepals.
24 Cameroon is the centre of diversity of the genus with 14 of the 19 known species.

25 **Methods.** The herbarium collection *MacKinnon 51* from Ebo is hypothesized to represent a
26 new species to science of *Uvariopsis*. This hypothesis is tested by the study of herbarium
27 specimens from a number of herbaria known to hold important collections from Cameroon
28 and surrounding countries.

29 **Results.** We test the hypothesis that *MacKinnon 51* represents a new species to science, using
30 the most recent dichotomous identification key, and comparing it morphologically with
31 reference material of all known species of the genus. We make a detailed comparative
32 morphological study focussing on three other Cameroonian species, *Uvariopsis solheidii*, *U.*
33 *korupensis* and the sympatric *U. submontana*,

34 In the context of a review of the pollination biology of *Uvariopsis*, we speculate that in a
35 genus otherwise with species with dull, flesh-coloured (pink, red to brown) flowers pollinated
36 (where known) by diptera, orthoptera and blattodea (flies, crickets and cockroaches), the
37 glossy, pale yellow-green flowers of *Uvariopsis dicaprio*, with additional traits unique in the
38 genus, may be pollinated by nocturnal moths.

39 Based on *MacKinnon 51*, we formally name *Uvariopsis dicaprio* Cheek & Gosline
40 (Annonaceae) as new to science, and we describe, illustrate, and map it.

41 Restricted so far to a single site in evergreen forest in the Ebo Forest, Littoral Region,
42 Cameroon, *Uvariopsis dicaprio* is provisionally assessed as Critically Endangered using the
43 IUCN 2012 standard because the forest habitat of this species remains unprotected, and there
44 exist imminent threats of logging and conversion to plantations.

45 **Discussion** We show that the highest density of species of the genus (12), and of narrow
46 endemics (5), is found in the Cross-Sanaga Interval of SE Nigeria and Western Cameroon. A
47 revised key to the 14 Cameroonian species of *Uvariopsis* is presented.

48 We review the other seven narrowly endemic and threatened species unique to the Ebo forest
49 of Cameroon and discuss the phytogeographic affinities of the area.

50 **Conclusions** *Uvariopsis dicaprio* adds to the growing list of species threatened with
51 extinction at Ebo Forest due to current anthropogenic pressures.

52
53 **Key Words:** cauliflorous, conservation, Cross-Sanaga Interval, moth-pollination, threatened
54 species.

55
56 **Introduction**

57 The new species reported in this paper was discovered as a result of a long-running survey of
58 plants in Cameroon to support improved conservation management. The survey is led by
59 botanists from the Royal Botanic Gardens, Kew and IRAD (Institute of Agricultural Research
60 for Development)-National Herbarium of Cameroon, Yaoundé. The study has focussed on
61 the Cross-Sanaga interval (Cheek *et al.*, 2001, 2006) which contains the area with the highest
62 plant species and generic diversity per degree square in tropical Africa (Barthlott *et al.*, 1996,
63 Dagallier *et al.*, 2020). The herbarium specimens collected in these surveys formed the
64 foundations for a series of Conservation Checklists (see below). So far, over 100 new species
65 and several new genera have been discovered and published, new protected areas have been
66 recognised and the results of analysis are feeding into the Cameroon Important Plant Area

67 programme ([https://www.kew.org/science/our-science/projects/tropical-important-plant-](https://www.kew.org/science/our-science/projects/tropical-important-plant-areas-cameroon)
68 [areas-cameroon](https://www.kew.org/science/our-science/projects/tropical-important-plant-areas-cameroon)), based on the categories and criteria of Darbyshire *et al.*, (2017).

69
70 In connection with preparation of a Conservation Checklist of the plants of the Ebo Forest,
71 Littoral Region, Lorna MacKinnon, a volunteer botanical assistant, made a plant collecting
72 expedition to the Ebo Forest in 2008. Among the plant specimens and photographs that she
73 made, we identified an *Uvariopsis* Engl. & Diels (*MacKinnon* 51, Fig. 1 – 3) which
74 resembled no other species known in the genus. In this paper we test the hypothesis that it is a
75 new species to science and name the new species as *Uvariopsis dicaprio*.

76
77 *Uvariopsis* (Annonaceae) is a highly distinctive and easily recognised genus, since most of its
78 species have unisexual flowers, a calyx with two basally connate sepals, and the petals in a
79 single whorl of four (very rarely three, see below). Annonaceae are otherwise characterised
80 by bisexual flowers with trimerous perianths. Most species of the genus are cauliflorous small
81 trees, the flowers being produced from the trunk, although some species are ramiflorous or
82 bear axillary flowers (Kenfack *et al.*, 2003, Couvreur *et al.*, 2021).

83
84 Nineteen species are currently accepted in *Uvariopsis*. Five species have been published in
85 the 21st Century: *Uvariopsis korupensis* Gereau & Kenfack (Gereau & Kenfack 2000), *U.*
86 *submontana* Kenfack, Gosline & Gereau (Kenfack *et al.*, 2003) and *U. etugiana* Dagallier &
87 Couvreur (Couvreur *et al.*, 2021) all from Cameroon, *U. citrata* Couvreur & Niang.
88 (Couvreur & Niangadouma 2016) from Gabon and *U. lovietiana* Couvreur & Q. Luke
89 (Couvreur & Luke 2010) from Tanzania. In addition a sixth species, *Uvariopsis tripetala*
90 (Baker f.) G.E.Schatz, was transferred to the genus from the monotypic *Dennettia* Baker f.
91 (Kenfack *et al.*, 2003). The genus is centred in Cameroon, where 13 of the 19 species occur,
92 followed in species diversity by Gabon, with six species. The most widespread species of the
93 genus is *Uvariopsis congensis* Robyns & Ghesq. which occurs from Cameroon to South
94 Sudan, Zambia and Kenya. Several species are rare, being known from only one or two
95 specimens and have restricted ranges, these include *U. etugiana* (Cameroon endemic) and *U.*
96 *citrata* (Cameroon & Gabon), both known from two specimens, and *U. sessiliflora* (Mildbr.
97 & Diels) Robyns & Ghesq. endemic to Cameroon and known from a single specimen.

98
99 The genus is distributed throughout continental tropical African evergreen forests, from
100 Guinea in the West to Tanzania in the east, and as far south as northern Zambia. The species
101 usually occur at low altitude, exceptions including *U. submontana* and *U. lovietiana* which
102 occur in submontane or cloud forest in Cameroon and Tanzania respectively (Kenfack *et al.*,
103 2003; Couvreur & Luke 2010). Species are usually small trees in high quality, undisturbed
104 forest and appear not to be pioneers. They usually occur at low frequency. For example, in
105 the Mefou Proposed National Park of Central Region Cameroon, only a single mature
106 individual with one juvenile of one species of the genus, *U. solheidii* (De Wild.) Robyns &
107 Ghesq., was found in the course of many weeks of botanical surveys by numerous botanists
108 collecting thousands of specimens (Cheek *et al.*, 2011: 123). However, in rare ecological
109 circumstances, some species can become locally dominant e.g., *U. tripetala* in the
110 understorey of maritime lowland evergreen inselberg forest in Guinea (Couch *et al.*, 2019:
111 41), and also, *U. congensis* locally subdominant in forests in western Uganda where it
112 flowers synchronously and is dispersed by primates (Dominy & Duncan 2005; Gosline pers.
113 obs. March 2016).

114
115

116 Materials & Methods

Comentado [JdCL1]: I suggest to include the current classification of *Uvariopsis* (subfamily Annonoideae, tribe Monodoreae). Please check:

Chatrou *et al.* 2012 - <https://doi.org/10.1111/j.1095-8339.2012.01235.x>

Guo *et al.* 2017 - DOI:10.1038/s41598-017-07252-2

Comentado [JdCL2]: I suggest to increase this section and explaining a little more about the sexual system and the number of petals and sepals in Annonaceae as a whole. Please, check the references below:

van Heusden, E.C.H. 1992. Flowers of Annonaceae: morphology, classification, and evolution. *Blumea Supplement* 7: 1-218.

Saunders, 2010 doi: 10.1111/j.1469-185X.2009.00116.x

117
118 *The electronic version of this article in Portable Document Format (PDF) will represent a*
119 *published work according to the International Code of Nomenclature for algae, fungi, and*
120 *plants (ICN), and hence the new names contained in the electronic version are effectively*
121 *published under that Code from the electronic edition alone. In addition, new names*
122 *contained in this work which have been issued with identifiers by IPNI will eventually be*
123 *made available to the Global Names Index. The IPNI LSIDs can be resolved and the*
124 *associated information viewed through any standard web browser by appending the LSID*
125 *contained in this publication to the prefix "<http://ipni.org/>". The online version of this work is*
126 *archived and available from the following digital repositories: PeerJ, PubMed Central, and*
127 *CLOCKSS.*

128 Fieldwork in Cameroon resulting in the specimens cited in this paper was conducted under
129 the terms of the series of Memoranda of Collaboration between IRAD (Institute for
130 Agronomic Research and Development)-National Herbarium of Cameroon and Royal
131 Botanic Gardens, Kew beginning in 1992, the most recent of which is valid until 5th Sept.
132 2021. The most recent research permit issued for fieldwork under these agreements was
133 000146/MINRESI/B00/C00/C10/C12 (issued 28 Nov 2019), and the export permit number
134 was 098/IRAD/DG/CRRA-NK/SSRB/12/2019 (issued 19 Dec 2019). At the Royal Botanic
135 Gardens, Kew, fieldwork was approved by the Institutional Review Board of Kew entitled
136 the Overseas Fieldwork Committee (OFC) for which the most recent registration number was
137 OFC 807-3 (2019). The most complete set of duplicates for all specimens made was
138 deposited at YA, the remainder exported to K for identification and distribution following
139 standard practice.

140
141 Herbarium citations follow Index Herbariorum (Thiers *et al.*, 2020). Specimens were viewed
142 at EA, K, P, WAG, and YA. The National Herbarium of Cameroon, YA, was searched for
143 additional material of the new species, but without success. Images for specimens at WAG
144 were studied at <https://bioportal.naturalis.nl/?language=en> and those from P at
145 https://science.mnhn.fr/institution/mnhn/collection/p/item/search/form?lang=en_US. We also
146 searched JSTOR Global Plants (<https://plants.jstor.org/> accessed March 2021)
147 for additional material, and finally the Global Biodiversity Facility (GBIF, www.gbif.org
148 accessed March 2021). We compared our material with reference material of all other species
149 in the genus. Binomial authorities follow the International Plant Names Index (IPNI 2021).
150 The conservation assessment was made using the categories and criteria of IUCN (2012).
151 Herbarium material was examined with a Leica Wild M8 dissecting binocular microscope
152 fitted with an eyepiece graticule measuring in units of 0.025 mm at maximum magnification.
153 The drawing was made with the same equipment using Leica 308700 camera lucida
154 attachment. The botanical terms follow Beentje & Cheek (2003), and format of the
155 description follow the conventions of Kenfack *et al.*, (2003) and Couvreur & Luke (2010).
156 The map was made using QGIS 3.12 (<https://www.qgis.org>).

157 Results

158 Comparative morphology

159 Because it has leaves exceeding 15 cm long, cauliflorous flowers with pedicels exceeding 10
160 mm long, petals free, exceeding 7 mm long, *MacKinnon* 51, described below as *Uvariopsis*
161 *dicaprio*, keys out in the key to the species of *Uvariopsis* by Dagallier in Couvreur *et al.*,
162 (2021) to couplet 12, leading to *U. dioica* (Diels) Robyns & Ghesq. (flower buds globose)
163 and *U. solheidii* (flowers buds conical). Of these two choices, our material is closest to the

Comentado [JdCL3]: The method used for inferring the extent of occurrence and area of occupancy needs to be mentioned here.

Comentado [JdCL4]: I suggest to describe this information in another way, something like this:

The new *Uvariopsis dicaprio* has leaves exceeding 15 cm long, cauliflorous flowers with pedicels exceeding 10 mm long, petals free, exceeding 7 mm long, which grouped it with the other species of *Uvariopsis* in Cameroon (Couvreur *et al.* 2021). *Uvariopsis dicaprio* is similar to *U. solheidii* by the flower buds conical that in *U. dicaprio* can vary from ovoid-conical to pyramidal. The two species can be separated using the differential characters in Table 1 below

165 second of these leads, the buds being ovoid-conical to pyramidal. The two species are
166 somewhat similar but can be separated using the differential characters in Table 1 below.

167
168 However, based on morphology, *Uvariopsis dicaprio* is closely similar to two other species
169 from Cameroon, *Uvariopsis korupensis* and *Uvariopsis submontana*. These four species share
170 the following features: they are all trunciflorous with well-developed (1.5 – 8 cm or more
171 long) pedicels;—All four species share flowers which in bud are ovoid-conic, and more-or-
172 less pyramidal (most strongly so in *Uvariopsis dicaprio* where the angles of the pyramid
173 become wing-like: Fig. 1);— All four species also have similar petal shapes— are more or less
174 ovate-lanceolate, rather than orbicular as in most species of the genus. The four species can
175 be compared and separated from each other using the characters in Table 1.

176
177 The petals of *Uvariopsis dicaprio* do not seem to reflex at anthesis exposing the staminal
178 dome as they do in the other species, rather they open only slightly, concealing the staminal
179 dome (Fig. 1). Moreover, the petals are only thinly leathery in texture, with an inner surface
180 that is smooth, and not thick and fleshy with a tuberculate inner surface as in the other three
181 species. Another difference is ~~The~~ the outer surface of the petals that is mostly naked, with
182 only a very few widely scattered hairs and not appressed-pubescent as in the other species but
183 is mostly naked, with only a very few widely scattered hairs (Fig. 3, Table 1). In leaf-blade
184 dimensions *Uvariopsis dicaprio* fits within the ranges of those of most of the other species,
185 and also in petal dimensions where it fits closest to the ranges of *Uvariopsis korupensis* and
186 *Uvariopsis submontana*. Vegetatively *Uvariopsis dicaprio* differs from all three other species
187 in having a much lower range of secondary nerves (5 to 8 (– 9) versus 8 to 20), and can
188 immediately be distinguished from them by having glabrous young stems, petioles and
189 abaxial midribs (versus appressed pubescent or tomentose) (Table 1).

190
191 *Uvariopsis dicaprio* additionally has several features that appear unique in the genus that are
192 presented in the notes section following the description below.

193
194 The new species can be separated from all other Cameroonian species of *Uvariopsis* using the
195 key presented below, modified from Dagallier in Couvreur *et al.*, (2021).

196 197 **Key to the species of *Uvariopsis* in Cameroon**

- 198
199
- 200 1. - Crushed leaves emitting a strong citrus scent *U. citrata*
 - 201 - Crushed leaves without citrus scent 2
 - 202 2. - Leaf blades generally \leq 15 cm long; pedicel $<$ 7 mm long and petals \leq 7 mm long 3
 - 203 - Leaf blades generally $>$ 15 cm long, pedicel $>$ 10 mm long and petals $>$ 7 mm long .. 6
 - 204 3. - Flowers cauliflorous, pedicel 0 – 2 mm long *U. sessiliflora*
 - 205 - Flowers ramiflorous, pedicel 0 – 11 mm long, sometimes cauliflorous with pedicel $>$ 3
 - 206 mm long 4
 - 207 4. - Flowers bisexual, petals 3 (but occasionally 4) *U. tripetala*
 - 208 - Flowers unisexual, petals 4 5
 - 209 5. - Young branches glabrous or very sparsely pubescent, petals free *U. congensis*
 - 210 - Young branches and petioles densely to sparsely pubescent, petals basally fused
 - 211 *U. zenkeri*
 - 212 6. - Petals basally fused 7
 - 213 - Petals free 10
 - 214 7. - Flowering pedicels generally \geq 10 cm long; petals 3 *U. congolana*

Comentado [JdCL5]: I suggest including this character in table 1.

Comentado [JdCL6]: I suggest including if this measure refers to \leq or $<$. The same for the other measures that can cause confusion.

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Comentado [JdCL7]: This measure falls in the range of the step above. It would be possible to add more information, something like this (0-)3-11 mm, informing that the 0-2 mm is a rare feature?

Formatado: Realce

- 215 - Flowering pedicels 10 cm long; petals 4 8
 216 8. - Flower buds globose, monocarps verrucose *U. pedunculosa*
 217 - Flower buds conical to pyramidal, monocarps smooth 9
 218 9. - Sepals 5 – 10 mm long, flowers completely covering base of trunk, generally
 219 occurring above 800 m a.s.l. *U. submontana*
 220 - Sepals 2 – 4 mm long, flowers partially covering base of trunk, generally occurring
 221 below 800 m a.s.l. *U. korupensis*
 222 10. - Flowering pedicels 10 mm long 11
 223 - Flowering pedicels 10 mm long 12
 224 11. - Petals linear, 25 – 45 mm long, more than 6 times longer than wide *U. bakeriana*
 225 - Petals elliptic to ovate, 10 – 14 mm long, less than 6 times longer than wide
 226 *U. etugiana*
 227 12. - Flower buds globose *U. dioica*
 228 - Flower buds conical 13
 229 13. - Stems and petioles tomentose, lateral nerves 8 – 13; flowers wine brown . *U. solheidii*
 230 - Stems and petioles glabrous; lateral nerves 5 – 8(– 9) on each side of the midrib;
 231 flowers green-yellow *U. dicaprio*
 232
 233

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234 ***Uvariopsis dicaprio* Cheek & Gosline sp. nov.** Type: Cameroon, Littoral Region, Yabassi,
 235 Ebo Forest, 4° 20' 44" N, 10° 24' 33" E, 849 m alt. Dicam Trail 2000 m from Bekob camp,
 236 male fl. 25 March 2008, *MacKinnon* 51 (holotype K001381842; isotypes MO, YA).

237
 238 Syn. *Uvariopsis ebo* nom. nud. (Gosline *et al.*, 2021: 5).

Comentado [JdCL8]: I would like to understand better what has happened. It is a nomen nudum because the article was available as preprint and not officially published?

239
 240 Diagnosis. Similar to *Uvariopsis solheidii* (De Wild.) Robyns & Ghesq., differing in the
 241 stem, petioles and abaxial midrib glabrous (versus tomentose); number of secondary nerves
 242 on each side of the midrib 5 – 8 (versus 8 – 13); petals yellow-green, (14 –) 16 x (5.5 –) 9
 243 mm (versus wine brown, 7 – 10 x 2.5 – 5 mm). Additional differential characters are given in
 244 Table 1, above.

Comentado [JdCL9]: I think it is not necessary to include this information in the diagnosis once the table is already cited in the text.

245
 246 *Cauliflorous, probably monoecious understory tree* 3 – 4 m tall. Trunk terete, lacking flutes
 247 or prop roots, 1.8 – 2.5 cm diameter at 1.5 m above the ground, bark smooth, dark-brown,
 248 with sparse, longitudinal lines of white lenticels (Fig. 1), the crown sparsely branched (Fig.
 249 2). Leafy stems with 3 – 4 leaves per season's growth, terete, internodes (1.2 –) 1.5 – 2.8 (–
 250 4.3) cm long, 0.15 – 0.2 cm diam., pale yellow-green, later orangish brown, glabrous.
 251 Axillary buds dome-shaped 0.5 – 0.75 × 1 mm, bud-scales numerous, linear, spreading,
 252 densely hairy, hairs simple, appressed hairy c. 0.5 mm long, colourless or red brown. *Leaves*
 253 distichous, held in the horizontal plane, with punctuations (minute translucent glands),
 254 lacking scent when crushed (collection metadata, *MacKinnon* 51), blades oblanceolate 17.7 –
 255 20.2 (– 23) × (6.4 –) 7 – 7.9 cm, acumen narrowly triangular (0.5 –) 1 – 1.3 cm, base
 256 broadly acute with convex edges, minutely cordate, blade mounted above petiole, margins
 257 undulate-sinuous (live & dried), midrib impressed on adaxial surface, inconspicuous, below a
 258 groove; on abaxial surface ~~subcylindrical~~ ~~subcylindrical~~, 1 – 1.2 mm diam., conspicuous;
 259 secondary veins 5 – 8 (– 9) on each side of the midrib, brochidodromous, arising at c. 50°
 260 from the midrib, initially straight, then curving in the outer third, uniting with the secondary
 261 nerve above to form a looping inframarginal nerve, attaining 3 – 4 mm from the margin;
 262 intersecondary nerves sometimes present, tertiary nerves raised, conspicuous, forming a
 263 reticulum with cells 4 – 5 mm long, quaternary nerves inconspicuous; glabrous (except in bud
 264 when densely orange-brown hairy, hairs 0.1 mm long). Petiole stout, shallowly canaliculate,

265 4 (– 5) mm long, 1.9 – 2.1 mm diam., narrowing at base and apex, the adaxial groove
266 shallow, c. 0.5 mm wide, glabrous. *Female inflorescences* unknown. *Male inflorescences*
267 cauliflorous, scattered along the trunk from near ground level to the top of the trunk 2.5 – 3 m
268 above the ground, each 1 – 7-flowered (Fig. 1 & 2). Peduncles patent, c. 2 x 2 mm, pale
269 brown, glabrous, bearing sub-umbellate, radiating, 1-flowered partial-peduncles. Partial-
270 peduncles 0.5 – 2 x 0.9 – 1.2 mm, terminating in 1 – 2 bracts subtending a pedicel. Bracts
271 oblong-elliptic, 1.5 x 0.5 – 0.6 mm, apex acute, outer surface about 50% covered in appressed
272 white hairs c. 0.15 – 0.2 mm long, inner surface glabrous. *Male flowers*. Pedicels 1.8 – 2.5
273 cm long, 0.1 cm diam., articulated with the partial-peduncle, with (0 –) 1 (– 2) scattered,
274 bracteoles in the proximal few mm. Bracteoles similar to the bracts, ovate-oblong, shortly
275 sheathing, (1 –) 1.25 x 1 mm, outer surface with sparse scattered simple appressed translucent
276 hairs 0.05 – 0.2 mm long, buds narrowly ovoid, 16 ~~×~~ 11 mm. *Sepals* 2, opposite, drying pale
277 brown, reflexed, semi-orbicular, 1 – 1.5 mm long, 2.1 – 2.5 mm wide, glabrous. *Petals* 4,
278 uniseriate, free, leathery, pale, glossy, yellow-green when live (Fig. 1), drying black,
279 lanceolate-oblong, (14 –) 16 ~~×~~ (5.5 –) 9 mm, not fleshy but c. 0.25 – 0.3 mm thick, apex
280 rounded, base rounded, outer surface sparsely and inconspicuously hairy, hairs 7 – 9 per mm²
281 (5% of surface covered), simple, translucent, appressed, 0.1 mm long, apices rounded. Inner
282 surface of petals smooth, non-tuberculate, with a shallow elliptic-oblong excavation c. 8 ~~×~~ 5
283 mm, the margin of the excavation raised, the apex with a ridge extending along the midline to
284 the petal apex, glabrous apart from a few scattered erect, minute white hairs 0.05 mm long at
285 the excavation apex. Staminal dome 3.5 – 4 mm long, 3.5 – 4 mm diam., consisting of
286 stamens and a receptacular torus. Stamens shortly cylindrical-angular, 0.5 x 0.1 (– 0.2) mm,
287 connective with two lateral extrorse longitudinal anther cells, each exceeding the connective.
288 Apical connective appendage absent. Female flowers, fruit and seed unknown. Fig. 1 – 3.

289
290 **DISTRIBUTION.** Cameroon (Fig. 4), endemic to the Ebo Forest of the Littoral Region on
291 present evidence.

292 **SPECIMENS EXAMINED.** Cameroon, Littoral Region, Yabassi, Ebo Forest, 4° 20' 44" N,
293 10° 24' 33" E, 849 m alt. Dicam Trail 2000 m from Bekob camp, male fl. 25 March 2008,
294 *MacKinnon* 51 (holotype K001381842; isotypes MO, YA).

295 **HABITAT.** *Uvariopsis dicaprio* is so far only known from lower submontane forest (850 m
296 elev.) below the elevation for the upper montane forest indicator species *Podocarpus*
297 *latifolius* (Thunb.) R.Br. ex Mirb. The geology is ancient, highly weathered basement
298 complex, with some ferrallitic areas in foothill areas which are inland, c. 100 km from the
299 coast. Altitude varies from c. 200 m to 1200 m elevation. The wet season (successive months
300 with cumulative rainfall >100 mm) falls between March and November and is colder than
301 the dry season. Average annual rainfall at Bekob measured 2010 – 2016 is 2336 mm (Abwe,
302 Ebo Forest Research Programme, Cameroon pers. comm., Abwe & Morgan 2008, Cheek *et*
303 *al.*, 2018a).

304 **CONSERVATION STATUS.** *Uvariopsis dicaprio* is currently known from a single
305 specimen at a single location inside the mid-eastern part of the Ebo Forest (Fig. 4). Less than
306 50 mature individuals have been observed (Bethan Morgan pers. comm. to Cheek, March
307 2021), despite the species being highly conspicuous in flower (Fig. 1) and situated on a major
308 footpath close to a research camp used by many biologists over the last 15 years.
309 Since 2006, botanical surveys have been mounted almost annually, at different seasons, over
310 many parts of the formerly proposed National Park of Ebo. About 2500 botanical herbarium
311 specimens have been collected, but this species has not yet been seen elsewhere in the c. 2000
312 km² of the Ebo Forest. However, the area outside the two research camps, especially the
313 western edge, has not been fully surveyed for plants. While it is likely that the species will be
314 found at additional sites within the Ebo Forest, there is no doubt that it is genuinely range-

315 restricted as are some other species of *Uvariopsis* in Cameroon (see introduction). Botanical
316 surveys and other plant studies for conservation management in forest areas north, west and
317 east of Ebo resulting in tens of thousands of specimens being collected and identified have
318 failed to find any additional specimens of this species (Cheek *et al.*, 1996; Cable & Cheek
319 1998; Cheek *et al.*, 2000; Maisels *et al.*, 2000, Harvey *et al.*, 2004; Cheek *et al.*, 2004; Cheek
320 *et al.*, 2010; Harvey *et al.*, 2010; Cheek *et al.*, 2011).

321
322 The area of occupation of *Uvariopsis dicaprio* is estimated as 4 km² using the IUCN
323 preferred cell-size. The extent of occurrence is the same. In February 2020 it was discovered
324 that moves were in place to convert the forest into two logging concessions (e.g.
325 <https://www.globalwildlife.org/blog/ebo-forest-a-stronghold-for-camerouns-wildlife/> and
326 [https://blog.resourcehawk.com/cameroon-approves-logging-concession-that-will-destroy-](https://blog.resourcehawk.com/cameroon-approves-logging-concession-that-will-destroy-ebo-forest-gorilla-habitat/)
327 [ebo-forest-gorilla-habitat/](https://blog.resourcehawk.com/cameroon-approves-logging-concession-that-will-destroy-ebo-forest-gorilla-habitat/) both accessed 12 April 2021). Such logging would result in timber
328 extraction that would open up the canopy and remove the intact habitat in which *Uvariopsis*
329 *dicaprio* is found. Additionally, slash and burn agriculture often follows logging trails and
330 would negatively impact the population of this species. Fortunately the logging concession
331 was suspended in August 2020 due to representations to the President of Cameroon on the
332 global importance of the biodiversity of Ebo
333 ([https://www.businesswire.com/news/home/20200817005135/en/Relief-in-the-Forest-](https://www.businesswire.com/news/home/20200817005135/en/Relief-in-the-Forest-Cameroonian-Government-Backtracks-on-the-Ebo-Forest)
334 [Cameroonian-Government-Backtracks-on-the-Ebo-Forest](https://www.businesswire.com/news/home/20200817005135/en/Relief-in-the-Forest-Cameroonian-Government-Backtracks-on-the-Ebo-Forest) accessed 12 April 2021). However,
335 the forest habitat of this species remains unprotected and threats of logging and conversion of
336 the habitat to plantations remain, and mining is also a threat. *Uvariopsis dicaprio* is therefore
337 here assessed as Critically Endangered, CR B1+2ab(iii), D.

338 **PHENOLOGY.** Flowering has been observed in late March and early April (Bethan Morgan
339 pers. comm. 2021).

340 **ETYMOLOGY.** This threatened and spectacular tree is named for the American actor and
341 conservationist Leonardo DiCaprio, who, through several months in 2020, lobbied
342 extensively on social media (e.g. https://www.instagram.com/p/B_OLSAhFRue/?hl=en ;
343 <https://twitter.com/leodicaprio/status/1257729388314943490?lang=en> both accessed 12 April
344 2021) to draw attention to threats for the numerous rare Ebo species from the logging
345 concession that had been announced at Ebo earlier that year. The concession was cancelled in
346 August 2020, surely partly due to his efforts.

347 **VERNACULAR NAMES & USES.** None are known.

348 **NOTES.** Unusual and distinctive features of *Uvariopsis dicaprio* within the genus include
349 the colour, shape and texture of the corolla. Bright, glossy, pale yellow-green petals are
350 otherwise unknown in a genus where the petals are otherwise dull shades of pink to purple
351 and brown. Unlike in all other species of the genus known, the petals are not thick and fleshy
352 but thinly leathery. The centre of the proximal half of each petal is concave before anthesis,
353 forming a globose chamber for the staminal dome with the other three petals (Fig. 1). On the
354 inner surface of the petal, the concave area is demarcated by an inverted U-shaped, distinct,
355 raised, broad ridge which seems to be the point of contact with those of the other sepals,
356 sealing the chamber. Such a structure has not been reported or observed in other species of
357 the genus. The distal half of the petals and the margins of the proximal half are flat, wing-like
358 and held against each other (applanate) in bud. In section therefore, the distal part of the
359 corolla will appear cross-shaped (see Fig. 1). This seems to be an extreme form of the petal
360 structure and pyramidal flower bud shape seen in the probably closely related Cameroonian
361 species *Uvariopsis korupensis* and *U. submontana* (see results, above). *Uvariopsis dicaprio* is
362 further distinct from all other species of the genus in that a distinct peduncle is present that
363 bears several branches (partial-peduncles) each of which bears and is articulated with a single
364 pedicel (Fig. 3E). Other cauliflorous species of *Uvariopsis* have few to many-flowered

Comentado [JdCL10]: See comments in the Material & Methods section.

Comentado [JdCL11]: I suggest to include the nomenclatural issue with the nomen nudum *Uvariopsis ebo* in this sections, since it is part of the taxonomy of this new species and a important information.

365 fasciculate inflorescences, a peduncle not being observed, the pedicels arising directly from a
366 perennial woody burr. In non-cauliflorous species of *Uvariopsis* the inflorescences consist of
367 a single, axillary flower.
368

369 Discussion

370 Pollination biology in *Uvariopsis* and *Uvariopsis dicaprio*.

371 A striking feature of *Uvariopsis dicaprio* is the presentation and colour of the flowers.- Of the
372 14 species of the genus in Cameroon, 11 are cauliflorous. All of these except *U. dicaprio*
373 have petals which are shades of pink, red, purple to brown. Cauliflorous *Uvariopsis* species
374 present their flowers more or less perpendicular to the trunk; the flowers of *U. dicaprio* are
375 pendant and with the corolla opening only slightly (see results), and facing the ground (Fig.
376 1). All species of *Uvariopsis* other than *U. bisexualis* Verdc. and *U. tripetala* are monoecious.
377 The majority of Annonaceae species are protogynous hermaphrodites, most often beetle
378 pollinated, some exhibiting thermogenesis (Gottsberger, 2012). In the monoecious *U.*
379 *bakeriana* (Hutch. & Dalziel) Robyns & Ghesq. and *U. congolana* (De Wild.) R.E.Fr. the
380 female flowers mature before the male (Gottsberger, Meinke & Porembski, 2011), and our
381 evidence for *U. dicaprio* suggests the same sequence. In *U. submontana*, *U. korupensis*, *U.*
382 *congolana*, *U. dioica*, and *U. pedunculosa*, the male flowers are higher on the trunk, with the
383 female flowers clustered towards the base of the trunk. In *U. dioica* and *U. korupensis* the
384 female pedicels are generally less than 10 cm long and in *U. korupensis* the fleshy fruits
385 mature in dense concentrations at the base of the trunk where they can attract ground-
386 dwelling animals.

387 In *Uvariopsis congolana*, (Diels) Robyns & Ghesq. and *U. pedunculosa* (Diels) Robyns &
388 Ghesq. the female globular flowers are born on slender pedicels to c. 50 cm long embedded
389 in the leaf litter. This habit is also exhibited by *Isolona cauliflora* Verdc. Gottsberger,
390 Meinke & Porembski (2011) studied the visitors to *U. congolana* and concluded that
391 pollination likely was by small litter-flies (not beetles). "It is suspected that this
392 predominantly sapromyiophilous species has a pollination system mimicking fungi and/or
393 carcass, and that the pollinating flies normally live on fungi and/or carcass." They also
394 conclude that *U. bakeriana* is pollinated by dung-flies. Mertens *et al.*, (2018) studied *U.*
395 *dioica* and found minimal visitation by Lepidoptera but more by nocturnal crickets and
396 cockroaches. In all three species of *Uvariopsis* where pollination studies have been done, the
397 researchers have described the pollinators as scarce and unpredictable, and thermogenesis has
398 not been observed.

399 In this context, it seems likely that *U. dicaprio* has found a different pollinator from its sister
400 taxa. The bright pale yellow-green flowers suggest nocturnal pollinators. The similarly
401 glossy, yellow-green flowers of the Asian, widely cultivated ylang-ylang, *Cananga odorata*
402 (Lam.) Hook.f. & Thomson are pollinated by nocturnal moths and small beetles (Parrotta,
403 2014). We speculate that the flowers of *Uvariopsis dicaprio*, unique in the genus, may also be
404 adapted for moth pollination, otherwise unrecorded in indigenous African Annonaceae
405 (Gottsberger 2012). Concerted field monitoring to observe pollinators is needed during the
406 flowering season of *Uvariopsis dicaprio* to test this hypothesis.
407

408 The centre of diversity of *Uvariopsis*

409 With the recognition in this paper of *Uvariopsis dicaprio*, 20 species are now accepted in
410 *Uvariopsis* (see introduction). The highest species diversity for any country is found in
411 Cameroon, now with 14 species, and with six of these nationally endemic. However, the
412 biogeographic area with highest species diversity is the much smaller area of the Cross-
413 Sanaga Interval which includes 12 species, of which five are globally endemic including
414 *Uvariopsis dicaprio*. The Cross-Sanaga Interval appears to be the main centre of diversity of

415 *Uvariopsis*. Numerous other plant genera have their centre of diversity in the interval (Cheek
416 *et al.*, 2001) and some are endemic to it, e.g. *Medusandra* Brenan (Peridiscaceae formerly
417 Medusandraceae, Breteler *et al.*, (2015), Soltis *et al.*, (2007)). The fleshy orange-red fruits of
418 *Uvariopsis* are consumed by primates, which are thought to disperse their seeds (Dominy &
419 Duncan, 2005). The high level of endemism of *Uvariopsis* species to the Cross River Interval
420 may therefore be linked to the high number of primate species that are also endemic to the
421 interval, bounded by the rivers Cross and Sanaga that represent barriers to primates. Ten
422 species of primate are confined to the Interval (Kingdon 2015).

423
424 **The range of *Uvariopsis dicaprio* and other endemic species in the Ebo Forest area.**

425 Abwe & Morgan, (2008) and Cheek *et al.*, (2018a) give overviews of habitats, species and
426 the importance for conservation of the highly threatened Ebo Forest to which *Uvariopsis*
427 *dicaprio* is restricted on current evidence. Sixty-eight globally threatened plant species are
428 currently listed from Ebo on the IUCN Red List website (iucnredlist.org/ accessed 12 April
429 2021) and the number is set to rise rapidly as more of Cameroon's rare species are assessed
430 for their conservation status as part of the Cameroon TIPAs programme (see introduction).
431 The discovery of a new species to science at the Ebo Forest is not unusual. Numerous new
432 plant species have been published from Ebo in recent years. Examples of other species that,
433 like *Uvariopsis dicaprio*, appear to be strictly endemic to the Ebo area on current evidence
434 are presented in Table 2 below:

435
436 With the exception of *Crateranthus cameroonensis* which is widespread over a large part of
437 eastern Ebo, each of the eight species listed have on current evidence, a single small discreet
438 range of no more than 8 km² (usually far smaller) within the Ebo Forest area (see the
439 references cited in Table 2). These species are not concentrated together in one or several
440 spots but are scattered from the far West to the East of the forest, none of the species, apart
441 from the *Crateranthus*, sympatric with any of the others.

442
443 Further species described from Ebo have proved not to be endemic but to have also been
444 found further west, in the Cameroon Highlands, particularly at Mt Kupe and the Bakossi Mts
445 (Cheek *et al.*, 2004). Examples are *Gilbertiodendron_ebo*-Burgt & Mackinder, *Myrianthus*
446 *fosi* Cheek (in Harvey *et al.*, 2010), *Salacia nigra* Cheek (Gosline & Cheek, 2014) and
447 *Talbotiella ebo* Mackinder & Wieringa (Mackinder *et al.*, 2010).

448 Additionally, several species initially thought endemic to Mt Kupe and the Bakossi Mts and
449 adjoining areas in the Cameroon Highlands have subsequently been found at Ebo, e.g. *Coffea*
450 *montekupensis* Stoff. (Stoffelen *et al.*, 1997), *Costus kupensis* Maas & H. Maas (*Maas-van*
451 *der Kamer et al.*, 2016), *Deinbollia oreophila* Cheek (Cheek & Etuge 2009), *Microcos*
452 *magnifica* Cheek (Cheek, 2017), and *Uvariopsis submontana* Kenfack, Gosline & Gereau
453 (Kenfack *et al.*, 2003). It is considered likely that additional Kupe species may yet be found
454 at Ebo such as *Brachystephanus kupeensis* L.Darbysh. (Champluvier & Darbyshire, 2009),
455 and *Impatiens frithii* Cheek (Cheek & Csiba 2002) since new discoveries are still frequently
456 being made in the Ebo Forest. Therefore, it is possible that *Uvariopsis dicaprio* might yet
457 also be found in the Cameroon highlands, e.g., at Mt Kupe. However, this is thought to be
458 only a relatively small possibility given the high level of survey effort at Mt Kupe: if it
459 occurred there, it is highly likely that it would have been recorded already since it is so
460 spectacular when in flower that it would be difficult to overlook.

461 462 **Conclusions**

463 Such discoveries as this new species underline the urgency for making further such
464 discoveries while it is still possible since in all but one of the cases given above, the species

465 have very narrow geographic ranges and/or very few individuals, and face threats to their
466 natural habitat, putting these species at high risk of extinction.

467
468 About 2000 new species of vascular plant have been discovered each year for the last decade
469 or more. Until species are known to science, they cannot be assessed for their conservation
470 status and the possibility of protecting them is reduced (Cheek *et al.*, 2020). Documented
471 extinctions of plant species are increasing, e.g. *Oxygyne triandra* Schltr. and *Afrothismia*
472 *pachyantha* Schltr. of South West Region, Cameroon are now known to be globally extinct
473 (Cheek & Williams 1999, Cheek *et al.*, 2018c, Cheek *et al.*, 2019). In some cases, species
474 appear to be extinct even before they are known to science, such as *Vepris bali* Cheek, also
475 from the Cross-Sanaga interval in Cameroon (Cheek *et al.*, 2018d) and elsewhere, *Nepenthes*
476 *maximoides* Cheek (King & Cheek, 2020). Most of the 815 Cameroonian species in the Red
477 Data Book for the plants of Cameroon are threatened with extinction due to habitat clearance
478 or degradation, especially of forest for small-holder and plantation agriculture following
479 logging (Onana & Cheek, 2011). Efforts are now being made to delimit the highest priority
480 areas in Cameroon for plant conservation as Tropical Important Plant Areas (TIPAs) using
481 the revised IPA criteria set out in Darbyshire *et al.*, (2017). This is intended to help avoid the
482 global extinction of additional endemic species such as *Uvariopsis dicaprio* which will be
483 included in the proposed Ebo Forest IPA.

484 With only one locality known, *Uvariopsis dicaprio* represents another narrowly endemic
485 Cameroonian species threatened with extinction due to deforestation for oil palm plantations,
486 small-scale agriculture, mining and logging, widespread threats posing extinction risks to
487 plant species in Cameroon (Onana & Cheek 2011, Cheek *et al.*, 2018a).

488

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503

504

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