Taxonomic revision of the threatened African genus *Pseudohydrosme* Engl. (Araceae), with *P. ebo*, a new, critically endangered species from Ebo, Cameroon

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This is the first revision in more than 100 years of the African genus *Pseudohydrosme*, formerly considered endemic to Gabon. Closely related to *Anchomanes*, *Pseudohydrosme* is distinct from *Anchomanes* because of its 2-3-locular ovary (vs. unilocular), peduncle concealed by cataphylls at anthesis and far shorter than the spathe (vs. exposed, far exceeding the spathe), stipitate fruits and viviparous (asexually reproductive) roots (vs. sessile, roots non-viviparous), lack of laticifers (vs. laticifers present) and differences in spadix: spathe proportions and presentation. However, it is possible that a well sampled molecular phylogenetic analysis might show that one of these genera is nested inside the other. In this case the synonymisation of *Pseudohydrosme* will be required. Three species, one new to science, are recognised, in two sections. Although doubt has previously been cast on the value of recognising *Pseudohydrosme buettneri,* of Gabon, it is here accepted and maintained as a distinct species in the monotypic section, *Zyganthera*. However, it is considered to be probably globally extinct. *Pseudohydrosme gabunensis*, type species of the genus, also Gabonese but probably extending to Congo, is maintained in Sect. *Pseudohydrosme* together with *Pseudohydrosme ebo sp.nov.* of the Ebo Forest, Littoral Region, Cameroon, the first addition to the genus since the nineteenth century, and which extends the range of the genus 450 km north from Gabon, into the Cross-Sanaga biogeographic area. The discovery of *Pseudohydrosme ebo* resulted from a series of surveys for conservation management in Cameroon, and triggered this paper. All three species are morphologically characterised, their habitat and biogeography discussed, and their extinction risks are respectively assessed as Critically Endangered (Possibly Extinct), Endangered and Critically Endangered using the IUCN standard. Clearance of forest habitat for logging, followed by agriculture or urbanisation are major threats. *Pseudohydrosme gabunensis* may occur in a formally protected area and is also cultivated widely but

infrequently in Europe, Australia and the USA for its spectacular inflorescences.

Taxonomic revision of the threatened African genus *Pseudohydrosme* Engl. (Araceae), with *P. ebo,* a new, Critically Endangered species from Ebo, Cameroon.

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51 **ABSTRACT**
52

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54 considered endemic to Gabon. Closely related to *Anchomanes*, *Pseudohydrosme* is distinct from
55 *Anchomanes* because of its 2-3-locular ovary (vs. unilocular), peduncle concealed by cataphylls
56 at anthesis and far shorter than the spathe (vs. exposed, far exceeding the spathe), stipitate fruits
57 and viviparous (asexually reproductive) roots (vs. sessile, roots non-viviparous), lack of laticifers
58 (vs. laticifers present) and differences in spadix: spathe proportions and presentation. However,
59 it is possible that a well sampled molecular phylogenetic analysis might show that one of these
60 genera is nested inside the other. In this case the synonymisation of *Pseudohydrosme* will be
61 required.
62 Three species, one new to science, are recognised, in two sections. Although doubt has
63 previously been cast on the value of recognising *Pseudohydrosme buettneri,* of Gabon, it is here
64 accepted and maintained as a distinct species in the monotypic section, *Zyganthera*. However, it
65 is considered to be probably globally extinct. *Pseudohydrosme gabunensis*, type species of the
66 genus, also Gabonese but probably extending to Congo, is maintained in Sect. *Pseudohydrosme*
67 together with *Pseudohydrosme ebo sp.nov.* of the Ebo Forest, Littoral Region, Cameroon, the
68 first addition to the genus since the nineteenth century, and which extends the range of the genus
69 450 km north from Gabon, into the Cross-Sanaga biogeographic area.
70 The discovery of *Pseudohydrosme ebo* resulted from a series of surveys for conservation
71 management in Cameroon, and triggered this paper. All three species are morphologically
72 characterised, their habitat and biogeography discussed, and their extinction risks are
73 respectively assessed as Critically Endangered (Possibly Extinct), Endangered and Critically
74 Endangered using the IUCN standard. Clearance of forest habitat for logging, followed by
75 agriculture or urbanisation are major threats. *Pseudohydrosme gabunensis* may occur in a
76 formally protected area and is also cultivated widely but infrequently in Europe, Australia and
77 the USA for its spectacular inflorescences.
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INTRODUCTION

The new species reported in this monograph was discovered as a result of a long-running survey
of plants in Cameroon to support improved conservation management. The survey is led by
botanists from the Royal Botanic Gardens, Kew and the National Herbarium of Cameroon-IRAD
(Institute for Research in Agronomic Development), Yaoundé. This study has focussed on the
Cross-Sanaga interval (*Cheek et al., 2001*) which contains the area with the highest species
diversity per degree square in tropical Africa (*Barthlott et al., 1996*). The herbarium specimens
collected in these surveys formed the foundations for a series of Conservation Checklists (see
below). So far, they have resulted in the discovery and publication of over 100 new species and
several new genera, the recognition of new protected areas and the production of scientific data
for the Cameroon Important Plant Area programme (https://www.kew.org/science/our-science/projects/tropical-important-plant-areas-cameroon).

 In October 2015 the last two authors found two leafless, flowering plants of a spectacular aroid
in the Ebo Forest of Littoral Region, Cameroon (*van der Burgt* 1888, Fig. 1). Since these had
prickles on the peduncle they were provisionally identified as *Anchomanes* Schott.

110   In late 2018 the herbarium specimen of this collection was redetermined by the first author as
111   *Pseudohydrosme* Engl., an erstwhile Gabonese genus previously unknown from Cameroon.
112   *Pseudohydrosme* is distinguished from *Anchomanes* by a peduncle much shorter than the spathe
113   (vs.far longer) and by 2–3-locular (vs.unilocular) ovaries (*Mayo et al. 1997*). *Van der Burgt*
114   *1888* was suspected of representing a species new to science since it differed in several
115   characters from the two known species of *Pseudohydrosme*. In addition, Ebo in Cameroon is
116   geographically 450 km distant from the range of those two previously known species in Gabon,
117   and is in a different biogeographic zone. In order to obtain the missing stages of fruit and leaf to
118   complement *van der Burgt* 1888, it was decided to revisit the collection site at the next available
119   opportunity. Hence, in December 2019 leaves, although not fruits, and additional field data were
120   obtained (*van der Burgt* 2377, Fig. 2) including from a further site. Additional characters
121   separating the Ebo taxon from other members of the genus were discovered in the newly
122   collected material. Early in 2020 a previously overlooked flowering specimen, *Morgan* 25 came
123   to light.
124
125   *Pseudohydrosme* was described by A. Engler with two species, *P. gabunensis* Engl. based on
126   *Soyaux* 299 (B) collected 13 Oct. 1881, and *P. buettneri* Engl. based on *Büttner* (Buettner) 519
127   (B) collected in Sept. 1884, both from forest at Sibang, formerly near and now largely subsumed
128   by, Libreville, the capital and principal city of Gabon (*Engler 1892, Bogner 1981*).
129
130   In 1973 the renowned aroid specialist Josef Bogner visited Gabon and rediscovered two plants of
131   *P. gabunensis*. Tubers were taken to Germany and cultivated allowing description of the leaves
132   of *Pseudohydrosme* for the first time (*Bogner, 1981*).
133
134   The second species of the genus, *P. buettneri* has never been refound. It differs so greatly from
135   the first in the structure of its inflorescence (see key and species account below) that the noted
136   aroid specialist N.E. Brown erected a separate genus, *Zyganthera* N.E. Brown for it (*Thistleton-*
137   *Dyer, 1901*). *Engler* (*1911*) reduced *Zyganthera* to sectional rank within *Pseudohydrosme*.
138
139   In their monumental account 'The Genera of Araceae', *Mayo et al.* (1997) placed *Nephthytis*
140   Schott as sister to *Pseudohydrosme* + *Anchomanes*, in the tribe Nephthytideae Engl. Molecular
141   phylogenetic analysis has subsequently supported the close relationship of *Pseudohydrosme* and
142   *Anchomanes*, but since each were represented by only a single taxon, it was not possible to test
143   their monophyly or sister relationship (*Cabrera et al., 2008*; *Cusimano et al. 2011; Nauheimer et*
144   *al.,2012*). In presenting new data on *Pseudohydrosme gabunensis* based on successful
145   pollination of flowers and fruit production on plants in cultivation in the Netherlands,
146   *Hetterscheid & Bogner* (2013) questioned the distinction of *Pseudohydrosme* and *Anchomanes*.
147   They considered the only difference to be the locularity of the ovaries (2–3 versus 1) and set
148   aside the difference in peduncle: spathe proportions maintained in *Mayo et al.* (*1997*). However,
149   later in their paper *Hetterscheid & Bogner* (*2013*) then brought to light two new characters that
150   further support the distinction of *Pseudohydrosme* from both *Anchomanes* and from all other
151   aroids (see discussion below). *Hetterscheid & Bogner* (*2013*) made the case to extend the range
152   of *Pseudohydrosme gabunensis* from Gabon southwards into the Republic of Congo (Congo-
153   Brazzaville) citing photos and a specimen deposited at WAG by Ralf Becker. However, we have
154   not been able to access the material in order to verify this statement (see methods). Despite this,

155 we accept this record since it is confirmed by Alistair Hay (*in litt.*) who has seen it in flower and
156 confirms that it conforms to *Pseudohydrosme gabunensis* in spathe shape and colour.
157
158 In this paper we describe the Cameroon material from Ebo Forest as a new species to science,
159 *Pseudohydrosme ebo* Cheek, in the context of a revision of the genus, last revised over 100 years
160 ago (*Engler 1911*).
161

MATERIALS & METHODS

163 *The electronic version of this article in Portable Document Format (PDF) will represent a*
164 *published work according to the International Code of Nomenclature for algae, fungi, and plants*
165 *(ICN), and hence the new names contained in the electronic version are effectively published*
166 *under that Code from the electronic edition alone. In addition, new names contained in this work*
167 *which have been issued with identifiers by IPNI will eventually be made available to the Global*
168 *Names Index. The IPNI LSIDs can be resolved and the associated information viewed through*
169 *any standard web browser by appending the LSID contained in this publication to the prefix*
170 *"http://ipni.org/". The online version of this work is archived and available from the following*
171 *digital repositories: PeerJ, PubMed Central, and CLOCKSS.*
172
173 The fieldwork in Cameroon was conducted under the terms of the Memorandum of
174 Collaboration between IRAD-Herbier National de Cameroun and Royal Botanic Gardens, Kew
175 that is valid until 5ᵗʰ Sept. 2021. The research permit number for the last author in 2019 was
176 000146/MINRESI/B00/C00/C10/C12 (issued 28 Nov 2019), and the export permit number was
177 098/IRAD/DG/CRRA-NK/SSRB/12/2019 (issued 19 Dec 2019). In 2015 the respective numbers
178 were: 00076/MINRESI/B00/C00/C10/C14 (issued 25 Aug 2015) and 103/IRAD/DG/CRRA-
179 NK/SSRB-HN/10/2015 (issued 23 Oct 2015). Fieldwork was approved by the Institutional
180 Review Board of the Royal Botanic Gardens, Kew entitled the Overseas Fieldwork Committee
181 (OFC) under the registration numbers OFC 673-1 (2015) and OFC 807-3 (2019). The most
182 complete set of duplicates for all specimens made was deposited at YA, the remainder exported
183 to K for identification and distribution following standard practice (*Cheek & Cable, 1997*).

184 Herbarium citations follow Index Herbariorum (*Thiers et al., 2020*). Specimens were viewed at
185 B, BR, K, P, WAG, and YA. *Pseudohydrosme* is centred in Gabon. The national herbarium of
186 Gabon is LBV, but the most comprehensive herbaria for herbarium specimens of that country are
187 P and WAG. The National Herbarium of Cameroon, YA, was also searched for additional
188 material but without success. During the time that this paper was researched, it was not possible
189 to obtain physical access to material at WAG (due to the transfer of WAG to Naturalis, Leiden,
190 subsequent construction work, and covid-19 travel and access restrictions). However, images for
191 WAG specimens were studied at https://bioportal.naturalis.nl/?language=en and those from P at
192 https://science.mnhn.fr/institution/mnhn/collection/p/item/search/form?lang=en_US. We also
193 searched *JStor Global Plants* (*2020*) for additional type material of the genus, and finally the
194 Global Biodiversity Facility (GBIF, www.gbif.org accessed 23 Aug 2020) which lists 28
195 occurrences and 21 images, mainly relating to the holdings (including duplicate herbarium sheets)
196 of WAG, followed by P.
197

198 Binomial authorities follow the International Plant Names Index (*IPNI, 2020*). The conservation
199 assessment was made using the categories and criteria of *IUCN* (*2012*). GeoCAT was used to
200 calculate Red List metrics (*Bachman et al., 2011*). Spirit preserved material was not available.
201 Herbarium material was examined with a Leica Wild M8 dissecting binocular microscope fitted
202 with an eyepiece graticule measuring in units of 0.025 mm at maximum magnification. The
203 drawings were made with the same equipment using Leica 308700 camera lucida attachment.
204 This was used to characterise and measure in particular features of the flowers. The herbarium
205 specimens of the new species described below as *Pseudohydrosme ebo* were soaked in warm
206 water to enable the spathe to be folded back, exposing the spadix and hydrated flowers. The
207 terms and format of the description follow the conventions of *Mayo et al.* (*1997*). Georeferences
208 for specimens lacking latitude and longitude were obtained using Google Earth
209 (https://www.google.com/intl/en_uk/earth/versions/). The map was made using SimpleMappr
210 (https://www.simplemappr.net).
211
212 **RESULTS**

213 **TAXONOMIC TREATMENT**

214 *Pseudohydrosme* is closely related to *Anchomanes* Schott (7–8 species) and the pair are in a
215 sister relationship with *Nephthytis* Schott (6 species). Together these three genera are all tropical
216 Africann (all are absent from Madagascar). However, anomalous *Nephthytis bintuluensis* A.Hay,
217 Bogner & P.C. Boyce occurs in Borneo (*Hay et al,. 1994; Nauheimer et al., 2012*). These three
218 genera comprise the Nephthytideae which is sister to the SE Asian tribe Aglaonemateae Engl.
219 (*Cabrera et al., 2008*), consisting of *Aglaonema* Schott (*Van et al., 2020*). Both groups share
220 adjacent male and female flower zones, free stamens, and collenchyma arranged in threads
221 peripheral to the vascular strands of leaf blades and petioles (with the exception of *Nephthytis*, in
222 which collenchyma can form interrupted bands (*Keating, 2002*; *Cabrera et al., 2008*).
223 Morphological support for Nephthytideae is the well-developed posterior costa, i.e., ± tripartite
224 primary development (*Cusimano et al. 2011*: Table 1)
225 Dracontioid leaf divisions characterise *Pseudohydrosme* and *Anchomanes* but are not present in
226 *Nephthytis*. They derive from complex splitting of a 'simple' and virtually entire blade as the leaf
227 unfurls after emergence, which is why the leaflets at the margin are truncate with two 'tips'. This
228 is unique to *Pseudohydrosme*/*Anchomanes* (*Hay. 2019*: 285). Differences between
229 *Pseudohydrosme* and *Anchomanes* are re-assessed in the discussion below.
230

231 **Pseudohydrosme** Engl. (*Engler 1892*: 455; Brown in *Thistleton-Dyer 1901*: 160; *Engler 1911*:
232 47; *Mayo et al.*, *1997*: 221–222)
233
234 Type species: *Pseudohydrosme gabunensis* Engl. (Lectotypified by N.E.Brown in *Thistleton-*
235 *Dyer 1901*:160).
236
237 *Zyganthera* N.E. Br. (Brown in *Thistleton-Dyer, 1901*:160). Heterotypic synonym.
238 Type and only species: *Pseudohydrosme buettneri* Engl. (*Engler, 1892*).
239
240

241 Large, seasonally dormant, monoecious herbs. Rhizome shallowly subterranean, the growing
242 point at ground level, subglobose or cylindrical with annular leaf scars, and erect to horizontal or
243 obliquely inclined, growing continuously and not renewed with each growing period. Roots
244 fleshy, produced along length of rhizome, sometimes reproductive (the distal ends rising to the
245 surface and producing new plants). Leaf solitary, large, emerging from several cataphylls;
246 petiole cylindrical, erect, long, with minute and sparse prickles, sheath very short and
247 inconspicuous. Blade transitioning from simple, sagittate and entire in seedlings, leaves of older
248 plants developing slits and divisions (see above), in mature plants leaves dracontoid : trisect,
249 primary divisions pinnatisect, distal lobes mostly truncate and bifid, sessile and decurrent,
250 proximal lobes acuminate; primary lateral veins of ultimate lobes pinnate, often forming a
251 regular submarginal collective vein (*P. ebo*) or an irregular collective vein, or veins running into
252 margin (often in *P. gabunensis*), higher order venation reticulate.
253
254 Inflorescence solitary, appearing separately from the leaf. Cataphylls papery-membranous, (3–
255)4–6, proximal ± triangular, small, distal oblong-elliptic, exceeding spathe tube, pink-brown or
256 red-brown, sometimes (*P. gabunensis*) spotted white. Peduncle concealed by cataphylls at
257 anthesis, terete, very short <1/10th the length of the spathe, with minute, sparse, prickles. Spathe
258 large, fornicate, , unconstricted, / very broad, with flaring auriculate margins; tube convolute,
259 fleshy, obconic, with a few sparse prickles on the outer surface proximally. Spadix short, about
260 1/10–1/4 length of spathe, sessile, female zone subcylindric (*P.ebo*) obconic (*P.buettneri*) or
261 gently obconic or conic (*P.gabunensis*), male zone cylindric, obtuse or rounded, subequal to ±
262 twice (±four times in *P. buettneri*) as long as female, completely covered in flowers and fertile to
263 apex (*P. gabunensis*) or with a distal appendix twice as long as the fertile portion and covered in
264 sterile male flowers (*P. buettneri*) or flowers only laxly covering the spadix axis in the female
265 zone and with the distal part of the axis of the female zone completely naked in places (*P. ebo*).
266
267 Flowers unisexual, perigone absent. Male flower 2–5-androus, stamens free, subprismatic,
268 compressed, anthers sessile, connective thick, broad, overtopping thecae, thecae oblong, long,
269 lateral, dehiscing by apical pore. Pollen extruded in strands, inaperturate, ellipsoid-oblong, very
270 large (mean 106 micrometres diam.) exine psilate to slightly scabrous. Sterile male flowers (*P.
271 buettneri*) composed of subprismatic, free staminodes. Female flower ovary globose to broadly
272 ellipsoid, usually prismatic, 2–3-locular, ovules 1 per locule, anatropous, funicle short,
273 placentation axile, at base of septum, stylar region attenuate to cylindric, narrower than ovary,
274 stigma thick, shallowly 2–3-lobed or subdiscoid, concave centrally, wet when receptive.
275
276 Infructescence with slightly accrescent peduncle. Berry at first white, ripening dark purple,
277 fleshy, wrinkled when mature, oblong-ellipsoid, laterally compressed to slightly bilobed, stipitate,
278 large; stigma and style persistent (known only in *P. gabunensis*). Seeds subglobose to broadly
279 ovoid, one side convex, the other slightly flattened, testa thin, whitish, smooth, papery,
280 transparent; embryo large, outer surface green, inner white, endosperm absent, raphe distinct,
281 hilum and micropyle purple, plumule with leaf primordia. Three species.
282 This description is based on that of *Mayo et al.(1997)*, with the addition of descriptions of the
283 fruit, seed and roots of *P. gabunensis,* mainly from (*Hetterscheid & Bogner, 2013*), with novel
284 features of the nervation, spathe and spadix from *P. ebo* (below in this paper)
285
286 **Phenology:** flowering Sept. and Oct. (or March in cultivation in Europe); in leaf Dec.-April.

287 **Distribution & habitat:** Cameroon, Gabon and Congo(Brazzaville), lowland evergreen forest
288 on coastal sediments (Gabon) or inland foothills on basement complex rocks (Cameroon) (Fig. 3).
289 **Etymology:** meaning "false *Hydrosme*", *Hydrosme* Schott is a synonym of *Amorphophallus*.
290 **Local name and uses:** none are documented.
291 **Conservation:** all species are highly infrequent and globally threatened according to IUCN
292 (2012) criteria (see species accounts below), and *P. buettneri* is possibly extinct (not seen for
293 over 100 years, the majority of its former habitat destroyed).
294
295 Pollination in the wild has not been investigated in detail in *Pseudohydrosme,* but is almost
296 certainly by insects as is usual in Araceae. Two different species of flies, and two of beetles were
297 reported to visit *P. gabunensis* (see below). In cultivation the stigmas are reported to be wet and
298 receptive for only two days, and the scent reported to be faint, of lettuce (*Lactuca*) in the same
299 species (see below also). Following successful fertilisation, seed development is reported to take
300 up to 10 months in *P. gabunensis* (see below). Seed dispersal is probably by either ground-
301 dwelling mammals or birds consuming the thinly fleshy purple berries.
302
303 DNA analysis was performed by *Cabrera et al.* (*2008*) for *Pseudohydrosme gabunensis*, using
304 five regions of coding (*rbcL*, *matK*) and noncoding plastid DNA (partial *trnK* intron, *trnL* intron,
305 *trnL – trnF* spacer). These sequences were subsequently used by Cusimano et al (2011) and
306 Nauheimer et al. 2012). The voucher is *Wieringa 3308* (WAG), identified by Hetterschied,
307 GenBank codes are AM905760, AM920582, AM932319 + AM933315.
308
309 Cultivation of one species, *Pseudohydrosme gabunensis* is unknown in Africa yet widespread
310 but infrequent in the tropical glass-house collections of several large extra-African botanical
311 gardens, mainly in Europe, Australia and N. America (see under that species).
312
313 Chromosome numbers are reported of one species, *Pseudohydrosme gabunensis, as* 2n = ca. 40
314 (*Mayo et al.*, *1997*).
315
316 Germination in *Pseudohydrosme gabunensis* is cryptocotylar and takes 3 weeks to 10 months.
317 The large seed embryo remains buried, producing a single hastate seedling leaf (*Hetterscheid &*
318 *Bogner, 2013*). The seedling type is C2 in the classification of *Tillich* (*2014*).
319
320 Medicinal uses, and chemistry is unreported in *Pseudohydrosme.* However, the much more
321 frequent sister genus *Anchomanes*, is harvested as a traditional medicine e.g. in Cameroon, and
322 contains bioactive compounds (*Cheek, 1992*)
323
324
325

326 **Identification key to the sections and species of *Pseudohydrosme***
327
328 1. Spadix with distal half covered in sterile male flowers. **Sect. *Zyganthera***……...**1**. ***P. buettneri***
329
330 1. Spadix lacking sterile flowers, distal part with fertile male flowers only.
331 …………………………………………………………………..**Sect. *Pseudohydrosme***...2
332

333 2. Male and female zones of spadix contiguous; entire spadix covered in flowers densely
334 arranged in both male and female zones; spathe blade inner surface yellow, greenish yellow or
335 white with abrupt transition to a central dark red area;
336 stigmas 2(–3)-lobed. Gabon (probably Congo-Brazzaville)...............................**2. *P. gabunensis***
337
338 2. Male and female areas of spadix incompletely contiguous; female flowers laxly arranged with
339 axis of female zone partly naked especially distally; spathe blade inner surface light reddish
340 brown or pink, with wide green veins, very gradually becoming darker towards the centre;
341 stigmas 3(–2)-lobed.
342 Cameroon…………………………………………………………………………..**3**. *P. ebo*
343
344
345 Sect. ***Zyganthera*** (N.E.Br.) Engl. (*Engler 1911:* 49)
346 Type (and only) species: *Pseudohydrosme buettneri* Engl.
347
348 *Zyganthera* N.E. Br. (Brown in *Thistleton-Dyer, 1901*:160). Basionym
349
350 Male flowers with stamens in pairs; distal half of spadix covered in sterile male flowers; ratio of
351 female:male (including sterile male) spadix portions c.1:4
352
353 **1. *Pseudohydrosme buettneri*** Engl. (*Engler 1892*:456; *Engler 1897*: 59; Brown in *Thistleton-
354 Dyer 1901*: 160; *Engler 1911*: 49). – Fig. 3, 4.
355
356 Holotype: Gabon, Estuaire Province, Libreville "Gabun, Mundagebiet; Sibange-Farm" fl. Sept.
357 1884, *Buettner* 519 (Holotype B destroyed or mislaid).
358
359
360 Terrestrial herb, rhizome vertical, subglobose, 2.5 cm long, 2.5 cm wide, surface tuberculate,
361 roots fleshy, from along the length of the rhizome. Leaf unknown.
362
363 Inflorescence: Cataphylls three or more, 2–13 x 0.9–1 cm; peduncle 3 cm long, colour and
364 indumentum unknown. Spathe 80 cm long, within pale except for the median longitudinal part
365 which is dark purple. Spadix subcylindrical, 7–8 cm long, c. 1.3 cm diam. Female zone obconic
366 1.3 cm long. Fertile male zone 2 cm long. Appendix (of sterile male flowers) 5 cm long, c. 1.5
367 cm diam.
368 Female flowers 4 mm long, ovary globose-ovoid, 3 mm diam., style 1 mm long, slender; stigma
369 bilobed, 1 mm diam., thick; ovules shortly ovoid, solitary in each locule and attached near the
370 base of the septum. Male flowers with stamens 2 mm long, 2 mm wide, usually the two stamens
371 of a flower, appressed to one another, with bilocular subextrorse thecae nearly reaching the
372 stamen apex. Staminodes subprismatic, 4–6 sided, lacking anther thecae and much smaller in
373 diameter than the stamens (description taken from *Engler* (*1892*:456 and tab. XV).
374
375 **Phenology:** flowering in September.
376
377 **Local name and uses**: none are known.
378

379   **Etymology:** named for the collector of the only known, and type specimen, Oscar Alexander
380   Richard Buettner (Büttner) – (1858–1927), traveller and collector.
381
382   **Distribution & ecology:** known only from Sibang in Libreville, coastal lowland evergreen forest
383   dominated by *Aucoumea klaineana* Pierre.
384
385   **Additional specimens:** none are known.
386
387   **Notes:** *Pseudohydrosme buettneri* has the largest inflorescence by far of all known species of the
388   genus, with an 80 cm long spathe (however, 70 cm has been reached for *P. gabunensis* in
389   cultivation in Australia according to Hay *in litt*.). The type specimen had lost the top part of the
390   spathe, but dimensions were given by the collector (*Engler, 1892*).
391
392   The type, and only known specimen was at B, but is reported to be no longer there (Bogner
393   1981). It may have been lost in the allied bombing of Berlin in March 1943, when most of the
394   specimens at B were destroyed. However, the type specimen of *P. gabunensis* (see below) dating
395   from about the same time, and also housed at B, has survived.
396
397   No additional specimens of this species have been found in the 136 years ensuing from
398   collection of the type specimen. *Hetterscheid & Bogner* (*2013*) have questioned whether this
399   species is not just a variant of *P. gabunensis*. However, this seems highly unlikely, because the
400   specimen differs in three independent characters from *P. gabunensis* (and *P. ebo*):
401
402   1) the ratio between the female zone and the male zone (of fertile and sterile flowers) differs
403   greatly between the two. In *P. buettneri* the ratio is 1:4+, while in the other two species it is less
404   than 1:2.
405   2) in *P. buettneri* most of the spadix consists of an appendix of sterile male flowers. No such
406   sterile appendix occurs in the other two species. In fact this character is otherwise unknown in
407   the entire Aglaonemateae/Nephthytideae clade
408   3) in *P. buettneri* the stamens are paired (*Engler 1892*), while in the other two species the
409   stamens are not reliably paired, but also present in an indistinct ring of three to five.
410
411   Additional differences between the species can be seen in the pistil and spadix. The style in *P.*
412   *buettneri* is <1/4 the width of the ovary. In *P. gabunensis* it is ½. The spadix of *P. buettneri* is
413   cylindrical, and unconstructed, while that of *P. gabunensis* shows a pronounced constriction at
414   the junction of female and male zones, and the male zone attains a greater width than the female
415   zone.
416
417   **Conservation.** *Pseudohydrosme buettneri* is here assessed as Critically Endangered (Possibly
418   Extinct). This is because it has only been found once, at a single site, in the "Munda region" at
419   Sibang Farm or Plantation, in 1884. At that time Sibang was far outside Libreville and consisted
420   largely of forest, some of which was exploited to produce forest products such as timber and
421   rubber, and cleared to produce agricultural products by Europeans for international commerce
422   e.g. by the Woermann company (*Cheek et al. 2011*: 45). The Munda is the estuary that forms the
423   eastern edge of the peninsula on which Libreville sits. Tributaries of the Munda drain the Sibang
424   area. Beginning in 1960, the population of Libreville expanded 200-fold, and its footprint

425 expanded. Only a small part of the original forest formerly known as Sibang survived. This part
426 measures about 400 m x 400 m as measured on Google Earth (see further details under *P.*
427 *gabunensis,* below) and is now entitled the 'Sibang Arboretum'. This minute remnant of forest
428 is probably the most visited by botanists in the whole of Gabon because it is immediately
429 adjacent to the site of the current National Herbarium, LBV (Cheek, pers. obs.). In the unlikely
430 although hoped-for rediscovery of *Pseudohydrosme buettneri*, the area of occupancy would be
431 expected to be calculated as 4 km^2 using the IUCN preferred gridcells of this size, and the extent
432 of occurrence of the same size. If it should be found anywhere in the vicinity of Libreville it is
433 likely to be threatened by human pressures since most of the population of Gabon is concentrated
434 here.
435
436 The Libreville region has the highest botanical specimen collection density in Gabon, with 5359
437 specimens recorded in digital format. It also has the highest level of diversity of both plant
438 species overall and of endemics (Sosef 2005). The coastal forests of the Libreville area are
439 known to be especially rich in globally restricted species (*Lachenaud et al. 2013)*. These authors
440 detail 19 species globally restricted to the Libreville area, of which eight have not been seen
441 recently and which are possibly extinct. Among these is *Octoknema klaineana* Pierre, a
442 rainforest tree "only collected in the immediate area of Libreville at the beginning of the 20th
443 century, and only once since." (*Gosline & Malecot, 2011)*. Most of the collections of this
444 possibly extinct species of *Octoknema* were also, as with *Pseudohydrosme buettneri,* from
445 Libreville-Sibang, and were mainly made in the period 1896–1912, during the colonial period,
446 before the city expanded to its current extent. The other seven species recorded as globally
447 restricted to the Libreville area and as possibly extinct by *Lachenaud et al.* (*2013*): are *Ardisia*
448 *pierreana* Taton (*Taton,1979*), *Dinklageella villiersii* Szlach. & Olszewski (*Szlachetko &*
449 *Olszewski, 2001*), *Eugenia librevillensis* Amshoff (*Amshoff, 1958*), *Hunteria hexaloba* (Pichon)
450 Omino (*Omino,1996*), *Pandanus parvicentralis* Huynh (*Huynh, 1986*), *Psychotria gaboonensis*
451 Ruhsam (*Ruhsam et al. 2008*) and *Tristemma vestitum* Jacq.-Fél. (*Jacques-Félix, 1986*). These
452 species have also not been seen in several decades, or more, in the case of the penultimate
453 species, since 1861.
454
455 The explanation for this hotspot of unique species, fast disappearing if not already extinct, at
456 Libreville may be that it has the highest rainfall in Gabon (*Gosline & Malecot, 2011*), with c.2.9
457 m p.a.
458
459 It seems likely that *Pseudohydrosme buettneri* is an additional lost endemic species to the
460 Libreville area, likely rendered extinct by the expansion of the city. Let us hope it is
461 rediscovered in a fragment of forest in the greater Libreville area, although this seems extremely
462 unlikely given that it was the most spectacular species of the genus with by the largest spathe (80
463 cm long) known in the genus, and that as stated above, the Libreville area is the most intensively
464 botanically surveyed part of Gabon (*Sosef et al., 2005).*
465
466
467 Sect. ***Pseudohydrosme***
468
469 *Pseudohydrosme* Engl. Sect. *Chorianthera* Engl. (*Engler, 1911*: 48). Homotypic synonym
470 Type species: *Pseudohydrosme gabunensis* Engl.

471
472   Male flowers in indistinct clusters of 3-5 or in pairs; distal half of spadix lacking sterile male
473   flowers; ratio of female:male spadix portions 1:2
474
475

476   **2. *Pseudohydrosme gabunensis*** Engl. (*Engler, 1892*:455; *Engler 1897*:59; *Brown, 1907*:161;
477   *Engler, 1911*:48; *Bogner, 1981*:33; *Hetterscheid & Bogner, 2013*:104–113). – Fig. 3, 5.
478
479   **Holotype:** Gabon, Estuaire Province, Libreville, Sibang, "Gabun, Mundagebiet; Sibang-Farm
480   am Ufer des Maveli" fl. 13 October 1881, *Soyaux* 299 (Holotype: B100165306, Herbarium
481   specimen, image!)
482
483   Terrestrial herb, rhizome light brown, ellipsoid or subcylindric, erect or oblique, 9–12 cm diam.
484   to 15 cm long, surface with transverse ridges. Roots fleshy 5–8 mm thick, brownish yellow,
485   sometimes developing new plants at their tips (*Hetterscheid & Bogner, 2013*).
486
487   Leaf 1–1.3(–2.2) m tall, petiole terete, 1–1.4 cm diam. at base, dark green olive and spotted, with
488   small yellowish white points; prickles 1–2 mm long. Blade of youngest seedlings sagittate-
489   elliptic c. 5 cm long, 3–4 cm wide, basal sinus c. 2 cm long, breadth variable (see *Hetterscheid &*
490   *Bogner, 2013*). Successively formed blades developing slits and divisions. Blade of mature
491   leaves dracontoid, primary divisions 30–35 cm long, pinnatisect, lobes in each division 5–8,
492   dimorphic, larger, distal lobes elliptic (4–)8–23 cm long, (2–)3–7(–11) cm, apex truncate, bifid,
493   (0.5–)1–3 cm long; smaller, proximal leaflets ovate, 4.5–8 cm long, 2.5–5 cm wide, apex
494   cuspidate; lateral veins 4–8 on each side of the midrib, conspicuous on abaxial surface, running
495   to the margin or forming an incomplete submarginal nerve, higher order veins reticulate.
496
497   Inflorescence: Cataphylls 4–6 membranous, reddish white or brown-purple, slightly spotted,
498   phyllotaxy spiral, proximal ones subtriangular shorter, distal ones becoming longer and oblong
499   elliptic, towards the spathe 1.5–29 cm long, (1–)2–2.5 cm wide; peduncle (3–)5–9 cm long, 1–
500   1.5 cm diam., colour as petiole, with minute sparse greenish white prickles 1–2 mm long. Spathe
501   (30–)40–55(–70) cm long, fornicate, basal half (20–25 cm long) funnel-shaped to subcylindrical,
502   fleshy and to 5 mm thick, limb comprising the distal half of the spathe, flaring widely and
503   curving forward, the apex obtuse, margin undulate; outer surface uniform bright pale yellow,
504   greenish yellow or yellow white; inner surface of blade mostly pale yellow or yellowish white, in
505   an irregular marginal band, with a dark purple central area separated by an irregular margin
506   down to the base of the tube; mouth facing horizontally, usually orbicular or elliptic. Spadix with
507   "unpleasant smell, but not so strong as some Araceae" (*van der Laan* 7641, WAG) or "faintly of
508   lettuce" (*Hetterscheid and Bogner* (*2013*)) or "of slightly bad cabbage" (David Prehsler,
509   University of Vienna communication to Cheek Nov. 2020), sessile, subcylindrical, (6–)9–12.5
510   cm long, (1.5–)2–2.5 cm diam. Female zone (2–)3.5(–4) cm long, female flowers completely
511   covering the surface of the axis, usually contiguous with but constricted at the junction with the
512   male zone. Male zone (3.5–)6–8.5 cm long, at base abruptly wider than the female zone,
513   tapering to the rounded apex, completely covered in fertile male flowers. Sterile appendix absent.
514
515

516 Male flowers with 2-5 stamens, stamens densely packed, sometimes paired or in groups of 3 or 5,
517 sessile, 4 mm long, in plan view isodiametric, subprismatic, 5–6-faceted, in cross section c. 1.8(–
518 2) mm x 1.2 mm wide, apex convex purple, sides white, anther thecae c. 3mm long, opening by
519 an apical pore, pollen orange or yellow, in strings. Female flowers white with ovary yellowish-
520 white globose or ellipsoid, 2–3 mm diam., 2(–3)-locular; style 1–1.5 mm long, 1.5 mm diam.,
521 stigma black to reddish brown, surface papillose, 2 mm wide, bilobed, lobes with a broad
522 concave area, apex rounded.
523
524 Berry, thinly fleshy, transversely ellipsoid, laterally compressed, rarely globose, 0.8–1.2 cm long,
525 1.5–1.6 cm wide, white, ripening purple-black, surface wrinkled when ripe, style and stigma
526 persistent, (1–)2-seeded, apex rounded-truncate, base stipitate, stipes (2–)3–4 mm long, c. 2 mm
527 diam. Seeds subglobose to broadly ellipsoid, one side flattened, the other convex, 9 mm long, 7
528 mm wide.
529
530 **Phenology:** flowering in the wild mid-Sept.-late Oct.
531
532 **Distribution & ecology:** Gabon, Estuaire, Moyen-Ogooué (probably) and Woleu-Ntem
533 Provinces, known from five sites in lowland rainforest sometimes with *Aucoumea gabonensis*
534 (Burseraceae); 0–100 m alt. Possibly also in Congo (location unknown, see notes below).
535
536 **Etymology:** meaning "coming from Gabon" (formerly, in German "Gabun").
537
538 **Local names & uses:** none known.
539
540 **Additional specimens: Gabon, Woleu-Ntem Province,** c. 15 km NE Asok, 600–700 m alt.,
541 (leg. *Breteler & de Wilde* s.n. 21 Aug. 1978) cult. Wageningen, fl. 13 March 1984, *van der Laan*
542 764 (Bot. Gard. No. 978PTGA550), WAG0351246, WAG0351247 images!); **Estuaire Province,**
543 **Libreville, Sibang:** "Sibang, hinter der Station forêstier; wächst im sandigen Lehmboden im
544 Regenwald, sehr schattig, c. 20 m, fl. 29 Ocktober 1973, *Bogner* 664 (K!, M n.v. US n.v.);
545 Sibang, st. 10 April 1994, *Wieringa & Haegens* 2710 (WAG0181636, WAG0181637 images!);
546 Sibang Forest, st. 1 Dec. 1994, *Wieringa* 3308 (WAG0181631, WAG0181632, WAG 0181633,
547 WAG0181634, WAG0181635 images!); Sibang Arboretum fl. 25 Oct. 2005, *Sosef et al.* 2029
548 (WAG 0223594, WAG0223595 images!, WAG8004057, WAG0108030, WAG.1665445);
549 **Kango,** plantations de Assouko, près de poste de Kango, le Komo (estimated as 0° 10' 41.8" N,
550 10° 06' 45.54"E), fl. 2 Oct. 1912, *Chevalier* 26828 (P02093245 image!); **Forêt de la Mondah**,
551 road from Libreville to Santa Clara, fl. 16 Sept. 1981, *Breteler, Lemmens, Nzabi* 7772
552 (WAG0449339, WAG0449339, WAG0449340 images!)**; St. Clara,** Tussen ± 50–100 m,
553 Linkerkant, Zij-pod naar St. Clara, sterile, no date, *Breteler* s.n. (WAG044938, image!);
554 **Moyen-Ogooué Province:** "Congo français". Ogooué (estimated as 0° 41' 18" S, 10° 13' 55"
555 E), fl. 1894–95, *Leroy* 23 (PO2093240, PO2093241 images! two sheets).
556
557 **Cultivated in Europe exact source unknown**: ex Gabon, probably Sibang, fl. April 2012, leg.
558 *Bogner* 3006 (BR0000019808871, image!).
559
560 Those specimens listed above which are sterile, e.g. *Wieringa* 3308 (voucher for DNA studies of
561 the genus, see above), *Wieringa & Haegens* 2710, are only provisionally identified as *P.*

562 *gabunensis*. It is possible that these specimens might belong to another species of the genus
563 (although unlikely since these specimens were collected at Sibang Arboretum where in recent
564 years only this species of the genus has been collected in flower). Equally they may even
565 represent a species of the genus *Anchomanes*.
566
567
568 **Conservation:** *Pseudohydrosme gabunensis* is possibly extinct at some of its historical
569 locations and is threatened at all of those which remain. At the type location, Sibang, formerly
570 far outside Libreville, at least four gatherings have been made in what is now a small and highly
571 visited forest patch inside Libreville (see notes under *P. buettneri* above). Measured on Google
572 Earth, the forest is approximately a square, c. 470 m N to S, and 420 m W to E, or about 0.25
573 km² (grid reference: 0° 25' 56.05"N, 9° 29' 23.64" E, 49 m alt.). It is now completely
574 surrounded by the dense urban settlement of Libreville which has expanded greatly in the last 60
575 years. In 1960, at independence, the population of Libreville was 32,000. Since then it has
576 expanded 200-fold to, in 2013, 703,904 (https://en.wikipedia.org/wiki/Libreville, accessed 19
577 Sept. 2020) and has a vastly greater footprint. Sibang Arboretum, the surviving patch of forest
578 of a once much greater area, is now known as one of the top two tourist destinations in Libreville.
579
580 At the Cap Santa Clara location, the Forêt de la Mondah, known since 2012 as the Raponda
581 Walker Arboretum (*Walters et al. 2016*), two collections were made, one in 1981 (see additional
582 specimens). Since created as a protected area in 1934, it has been reduced in size, losing 40% of
583 its area in 80 years to habitat clearance and degradation due to its close proximity (c. 15 km) to
584 the metropolis of Libreville which draws upon its trees for timber and firewood (*Walters et al.*
585 *2016*). It is not clear if either of the two specimens from St. Clara were from within the current
586 protected area.
587
588 The species has not been recorded from the Ogouué River since it was collected there by Leroy
589 (1894–1895), despite intensive recent surveys in the lower reaches of the river whence it was
590 probably collected. We have georeferenced the Leroy record on Lambarene since in Leroy's time
591 this was a trading post on the lower reaches of the river and it is credible that he stopped and
592 collected there, but this is uncertain. The historic site on the Komo River at Kango, whence it
593 was collected by Chevalier (26828, P; fl. 2 Oct. 1912) is now on a major transnational route, and
594 on Google Earth shows multiple cleared areas due to development. It is possible that it no longer
595 survives at this location, especially since it has not been recorded here or anywhere near, in a
596 century, despite the peak decades of botanical collection in Gabon having been at the end of the
597 20th century (Sosef *et al.* 2005). *Pseudohydrosme gabunensis* was assessed as Endangered, EN
598 B2ab(ii,iii) by *Lovell & Cheek* (*2020*) since it is or was known from ten specimens at five
599 locations globally, with an area of occupation estimated as 24 km² using the 4 km² cell sizes
600 preferred by IUCN (2012) and the threats detailed above. Threats in the Libreville area have
601 already resulted in the possible global extinction of nine species, including *Pseudohydrosme*
602 *buettneri* (see under that species, above). The extent of occurrence is calculated as 4,150 km². If
603 the identification of the Congolese specimen can be completely confirmed as this species, and
604 the site of its collection discovered, the area of occupation will likely be increased to 28 km², and
605 the extent of occurrence also increased.
606

607   **Notes.** The location given in the protologue for the type specimen (see above) is similar to that
608   of *Pseudohydrosme buettneri* but more detailed. The Munda is the estuary that forms the eastern
609   edge of the peninsula on which Libreville sits. Tributaries of the Munda drain the Sibang area,
610   one of which may have been known as the Maveli, on the forested banks of which Soyaux
611   recorded collecting the type of *Pseudohydrosme gabunensis.* Herman Soyaux is reported to have
612   collected herbarium specimens from Loango in Gabon from 1875-1882 (Anon, 1901).
613   The specimens *Leroy* 23 and *Chevalier* 26828 (both P) had been determined as *Amorphophallus*
614   until identified by Bogner (M) as *Pseudohydrosme gabunensis* in Dec. 2012. In contrast,
615   *Wieringa* 4358 (WAG) determined as this species, and cited as such in *Sosef et al.* (*2005*) is in
616   fact an *Amorphophallus*, evident in the larger leaf blade divisions all being acuminate not bifid,
617   and the tuber being described as having the roots from the top (vs.scattered along the length).
618   Similarly, *Wieringa* 3308 (WAG), correctly cited in *Sosef et al.* (*2005*) as *Pseudohydrosme*
619   *gabunensis*, was originally collected as an *Anchomanes* until determined by Hetterscheid in April
620   1996. *Van der Laan* 764 (WAG) had been identified as *Anchomanes nigritianus* Rendle until
621   redetermined by Bogner in Sept. 2012.
622

623   *Pseudohydrosme gabunensis* is the most common and widespread member of the genus.
624   However, it is still extremely rare and with a highly restricted range in the wild. It is sought after
625   by private collectors of aroids and live rootstocks and seed attract high prices on the internet.
626   Fortunately, it is found in several large public botanic gardens including in Australia, Germany,
627   France, Netherlands, U.K. and U.S.A. We believe that plants are probably not collected from the
628   wild (but this cannot be ruled out), rather they are propagated from those already in cultivation,
629   probably from seed derived from the Netherlands.
630

631   The collection reported in *Hetterscheid and Bogner* (*2013*) as from Congo must be treated with
632   caution. Since it is greatly disjunct (at least c. 300 km) from the known range of this species, it
633   may even represent a further new species. We have not been able to view this specimen.
634   However, Hay (in litt.) states that he has seen photographs of flowering material and that it looks
635   extremely like *P. gabunensis* in terms of spathe shape and colouration, therefore this is the most
636   likely identification. The specimen concerned should be located, the spadix studied carefully to
637   determine the species beyond doubt, and an attempt made to rediscover the source population.
638

639   Differences between *Pseudohydrosme gabunensis* and *P. buettneri* are detailed under the last
640   species. There is no doubt that *Pseudohydrosme gabunensis* is much more closely similar to *P.*
641   *ebo* than to *P. buettneri*. However, the larger size of the spathes in *P. gabunensis*, their different
642   colour and patterning, the usually bilobed style and bilocular female flowers densely covering
643   the axis, all serve, together with the vegetative characters, to separate it from *P. ebo* (see also
644   table 1 below).
645

646

647   Floral visitors: *Bogner* (*1981*) collected as inferred pollinators two different flies identified as
648   Diptera: Choridae, Sphaeroceridae, and two different beetles identified as Coleoptera:
649   Scaphidiidae, Staphylinidae in association with *Bogner* 664.
650

651   Reproductive biology: *Hetterscheid & Bogner* (*2013:*106) working with cultivated plants, report
652   that the female flowering phase is indicated by a faint yet clear lettuce-like scent as the spathe

653   opens, at which time, for 2 days, the receptive stigmas are wet and sticky. After this time the
654   stigmas turn darker brown, desiccate and are no longer receptive. Individuals are obligate
655   outcrossers. Fruits take up 10 months to mature (*Hetterscheid & Bogner, 2013*).
656
657   Germination and development: Germination takes 3 weeks to 10 months, producing a single
658   small sagittate, entire leaf from a small rhizome. For several months to two years, new leaves
659   are produced consecutively, usually each larger than its predecessor (*Hetterscheid & Bogner,*
660   *2013*). From the second leaf onwards slits may develop in the blade, and within two years the
661   successively produced blades first becomes divided and finally develop the mature dracontoid
662   pattern (see description). First flowering has occurred in as little as five years from first sowing
663   (*Hetterscheid & Bogner, 2013*). In the wild, the time to maturity is likely to take longer due to
664   predation, competition, and likely lower availability of nutrients
665
666   **3. Pseudohydrosme ebo** Cheek, *sp. nov.* – Fig. 1–3, 6 &7.
667
668   Differing from *Pseudohydrosme gabunensis* Engl. in the ovaries 3-locular, the stigma
669   conspicuously 3-lobed, very rarely 2-locular/lobed (vs. usually 2-locular, 2-lobed, rarely 3-
670   locaular/lobed), the female zone of the spadix only sparsely covered in flowers, the spadix axis
671   visible between the flowers (vs. completely covered in flowers), the spathe at anthesis 24–30(–
672   34.5) cm long, the outer surface dull white with longitudinal brown stripes, inner surface light
673   reddish brown with wide pale green veins (vs.(30–)40–55(-70) cm long, uniformly white, green
674   or yellow on both surfaces, inner surface bicoloured, the mid-limb area dark purple, sharply
675   demarcated from the marginal white/yellow coloured area). Type: *B.J. Morgan* 25 (holotype K!;
676   isotypes B! MO! YA!), Cameroon, Littoral Region, Yabassi-Yingui, Ebo proposed National Park,
677   fl. Sept. 2010.
678
679   Terrestrial herb, to 1.55 m tall. Rhizome cylindric, c. 3 cm diam. obliquely erect to almost
680   parallel to substrate surface, only upper part exposed, surface with transverse ridges (leaf scars)
681   about 2mm deep, 2mm apart. Roots adventitious, thick, fleshy, c. 5 mm diam., scattered along
682   length of rhizome, asexual reproduction not detected.
683
684   Leaf to 1.55 m tall, petiole terete, to 2 cm. diameter at base, green, inconspicuously spotted
685   yellow, mature plants with minute, patent, extremely sparse prickles 0.5 mm long. Blade of
686   youngest seedlings sagittate-elliptic, 5 x 2.5 cm, apex obtuse, basal sinus 1.5 x 1.5 cm, petiole 6–
687   7 cm long. Older seedlings, in successive years with leaves developing first slits and then
688   divisions, becoming triangular in outline with a broad basal sinus. Blade of mature leaves
689   dracontoid, primary division 35–40 x 38–43 cm, pinnatisect, lobes 5–8, dimorphic, larger,
690   mainly distal lobes oblong 12.5–22 x 3.8–6.5 cm, apex acuminate or truncate-bifid (biacuminate),
691   acumen 0.8–1.5 cm long, smaller, mainly proximal lobes ovate c. 8 x 3.5 cm; lateral veins 6–11
692   conspicuous on abaxial surface, on each side of the midrib, uniting to form a regular looping
693   submarginal vein 3–6 mm from the margin, higher order veins reticulate.
694
695   Inflorescence: Cataphylls 4, phyllotaxy spiral, light brown, with light green spots, membranous,
696   successively increasing in size from proximal to distal, the outermost triangular-broadly ovate,
697   amplexicaul 3 x 4 cm, the third in succession narrowly lanceolate-oblong, 12 x 2 cm, the fourth
698   18–19 x 1.5–4 cm; peduncle 3.5–4.5 x 0.6–0.7 cm, with minute, patent, extremely sparse prickles

699 0.5 mm long, colour as petiole. Spathe 24–30(–34.5) x 8 cm long basal 1/2–¾ subcylindric,
700 convolute, funnel-shaped, 1.8–4 cm wide at 2 cm above the peduncle, 6–8 cm wide at 8 cm
701 above the peduncle, and 8–9 cm wide at 15 cm above the peduncle, the distal part (limb), half to
702 one third of the total spathe length, flaring widely and curving forward, hood-like, shielding the
703 spadix, the apex with a triangular acumen 3–4 x 1 cm; outer surface of both tube and limb dull
704 white, with pale brown-red ribs running longitudinally along veins from base of tube to mouth of
705 limb; inner surface of spathe light reddish brown, with wide pale green veins, gradually
706 becoming slightly darker along the midline; mouth facing horizontally, transversely elliptic, 8–
707 10 cm high, 20–25 cm wide, margin entire. Spadix sessile, cylindrical 50 –85 mm long, 10–18
708 mm diam. Female zone 24 mm long, 15–18 mm wide, female flowers sparsely scattered, c. 30,
709 laxly arranged, covering only about half the surface of the spadix axis, the axis visible between
710 the flowers, sometimes not contiguous with the male zone, the axis then naked for up to 10 mm.
711 Male zone 37–55 mm long, 10–14 mm wide, apex rounded, completely covered in densely
712 arranged male flowers, sterile appendix absent.
713
714 Male flowers with 2-5 stamens, sometimes paired or in groups of 3–5, stamens free, sessile,
715 prismatic, 5 mm long, isodiametric in plan-view, 5–6 faceted, (1.5–)2 mm diam., apex convex,
716 minutely papillate; anther thecae lateral, tetrasporangiate (Fig. 6F), oblong-elliptic, running the
717 length of the stamen, with apical pore (Fig. 6E). Female flowers with ovary globose, 4 mm
718 diam., 3-locular (Fig. 6I), very rarely 2-locular, style 1–1.5 mm long, 1 mm diam., stigma pale
719 yellow, 0.5 mm thick, 2–2.25 mm wide, strongly 3-lobed (Fig. 7E), lobes with a narrow midline
720 groove, apex rounded. Berry and seed not seen.
721
722 **Distribution & ecology:** Cameroon, Littoral Region, known only from three sites at one
723 location in the Ebo forest near Yabassi-Yingui, in late secondary and intact, undisturbed lowland
724 evergreen forest on ancient basement complex geology, rainfall c. 3 m p.a., drier season October-
725 March; 300–400 m alt.
726
727 **Conservation**: *Pseudohydrosme ebo* is known from only one location, with three sites along a
728 section of valley 1.3 km long and only 50–100 mature individuals in total have been seen by the
729 collectors (second and third authors). These sites are along former logging roads which have
730 reverted to forest (third author pers. obs. 2019) as well as intact forest. In the fourteen years since
731 2006, botanical surveys have been made almost annually, at different seasons, over many parts
732 of the formerly proposed National Park of Ebo. About 3000 botanical herbarium specimens
733 have been collected, but despite the species being so spectacular in flower, with individual
734 inflorescences lasting potentially two weeks (if they prove to be similar in phenology to those of
735 *P. gabunensis*), this species has been seen nowhere else in the c. 2000 km² of the Ebo Forest.
736 However, much of this area has not been surveyed during the flowering season of the species, or
737 not surveyed at all for plants. While it is likely that the species will be found at additional sites,
738 there is no doubt that it is genuinely range restricted. Botanical surveys for conservation
739 management in forest areas neighbouring Ebo resulting in thousands of specimens being
740 collected and identified have failed to find any specimens of *Pseudohydrosme* (*Cheek et al.*
741 *1996; Cable & Cheek 1998; Cheek et al. 2000; Harvey et al. 2004; Cheek et al. 2004; Cheek et*
742 *al. 2010; Harvey et al. 2010*). It is possible that the species is unique to Ebo and truly localised.
743 The area of occupation of *Pseudohydrosme ebo* is estimated as 4 km² using the IUCN preferred
744 cell-size. The extent of occurrence is the same area. In February 2020 it was discovered that

745   moves were in place to convert the forest into two logging concessions (e.g.
746   https://www.globalwildlife.org/blog/ebo-forest-a-stronghold-for-cameroons-wildlife/ and
747   https://blog.resourceshark.com/cameroon-approves-logging-concession-that-will-destroy-ebo-
748   forest-gorilla-habitat/ both accessed 19 Sept. 2020).
749   This would result in logging tracks that would allow access throughout the forest allowing
750   poachers of rare collectable plants such as *Pseudohydrosme*, and timber extraction would open
751   up the canopy and remove the intact habitat in which *Pseudohydrosme* grows. Additionally,
752   slash and burn agriculture often follows logging trails and would negatively impact the
753   populations of this species. Fortunately the logging concession was suspended due to
754   representations to the President of Cameroon on the global importance of the biodiversity of Ebo
755   (https://www.businesswire.com/news/home/20200817005135/en/Relief-in-the-Forest-
756   Cameroonian-Government-Backtracks-on-the-Ebo-Forest accessed 19 Sept. 2020). However, the
757   forest habitat of this species remains unprotected and threats of logging and conversion of the
758   habitat to plantations remain. *Pseudohydrosme ebo* is therefore here assessed, on the basis of the
759   range size given and threats stated as CR B1+2ab(iii), that is Critically Endangered.
760
761   **Additional specimens:** Cameroon, Littoral Region, Ebo proposed National Park, fl. 8 Oct. 2015
762   *van der Burgt* 1888 (K! YA!); ibid., st. (leaves) 9 Dec. 2019 (K!, MO!, P!, WAG!, YA!).
763
764   **Phenology:** flowering in September and early October; leaves early December; fruiting
765   unknown.
766
767   **Etymology:** named as a noun in apposition for the forest of Ebo, in Cameroon's Littoral Region,
768   Yabassi-Yingui Prefecture, to which this spectacular species is globally restricted on current
769   evidence.
770
771   **Local names and uses:** none are known.
772
773   **Notes:** *Pseudohydrosme ebo* came to the attention of the first author in late Aug. 2018 on seeing
774   *van der Burgt* 1888, collected in 2015. Plans were made to revisit the collection site at the next
775   available opportunity, in December 2019, when leaves were found by the third author (*van der*
776   *Burgt* 2377), but unfortunately fruits were not found. At the same time a second site was
777   discovered 1.3 km distant from the site found in 2015. In February 2020 van der Burgt found at
778   Kew an overlooked, additional specimen, *Morgan* 25, which is the earliest known record of the
779   species, dating from 2010, and since it has multiple duplicates, has been selected as type of the
780   new species. The associated collection data previously mislaid was rediscovered in May 2020.
781
782   Alvarez with van der Burgt, and Ngansop, discovered in Dec. 2019 seedlings of the new species,
783   at three different stages, preserved as *van der Burgt* 2377 sheet ¼ (see Fig 7). Clearly the
784   species at this site is reproducing itself. Associated photographs also show plants of different
785   ages.
786
787   *Abwe & Morgan,* (*2008*) and *Cheek et al.* (*2018a*) characterise the Ebo forest, and give
788   overviews of habitats, species and importance for conservation. Fifty-two globally threatened
789   plant species are currently listed from Ebo on the IUCN Red List website and the number is set
790   to rise rapidly. The discovery of a new species to science at the Ebo forest is not unusual. Since

791   numerous new species have been published from Ebo in recent years. Examples of other species
792   that, like *Pseudohydrosme ebo* appear to be strictly endemic to Ebo on current evidence are:
793   *Ardisia ebo* Cheek (*Cheek & Xanthos, 2012*), *Crateranthus cameroonensis* Cheek & Prance
794   (*Prance & Jongkind, 2015*), *Gilbertiodendron ebo* Burgt & Mackinder (*Burgt et al., 2015*),
795   *Inversodicraea ebo* Cheek (*Cheek et al., 2017*), *Kupeantha ebo* M.Alvarez & Cheek (*Cheek et
796   al., 2018b*), *Palisota ebo* Cheek (*Cheek et al., 2018a*).
797
798   Further species described from Ebo have also been found further west, in the Cameroon
799   Highlands, particularly at Mt Kupe and the Bakossi Mts (*Cheek et al., 2004*). Examples are
800   *Myrianthus fosi* Cheek (*Cheek & Osborne, 2010*), *Salacia nigra* Cheek (*Gosline & Cheek, 2014*),
801   *Talbotiella ebo* Mackinder & Wieringa (*Mackinder et al., 2010*)
802
803   Additionally, several species formerly thought endemic to Mt Kupe have subsequently been
804   found at Ebo, e.g. *Coffea montekupensis* Stoff. (*Stoffelen et al., 1997*), *Costus kupensis* Maas &
805   H. Maas (*Maas-van der Kamer et al., 2016*), *Microcos magnifica* Cheek (*Cheek, 2017*), and
806   *Uvariopsis submontana* Kenfack, Gosline & Gereau (*Kenfack et al., 2003*).
807
808   Therefore, it is possible that *Pseudohydrosme ebo* might yet also be found in the Cameroon
809   highlands, e.g. at Mt Kupe, further extending westward the known range of the genus. However,
810   this is thought to be only a relatively small possibility given the spectacular nature of this plant,
811   and the high level of survey effort at e.g. Mt Kupe: if it occurred there it is highly likely that it
812   would have been recorded already.
813
814   Additional characters separating *Pseudohydrosme ebo* from *P. gabunensis* are show in table 1.
815
816   It is to be hoped that further studies of live plants of *P. ebo* will be possible to determine if, like
817   *P. gabunensis* it also reproduces asexually from the root tips.
818
819
820   The biogeography of the Cameroonian *Pseudohydrosme ebo* is very different from that of
821   the two Gabonese species of the genus growing c.450 km to the South. The Gabonese species
822   grow on recently deposited, sandy coastal soils. Although the Gabonese species also experience
823   a wet season of about 3 metres of rainfall per annum, it is differently distributed: the dry season
824   in Libreville occurs from June to September inclusive and is colder than the wet season. In
825   contrast at Ebo the geology at the *Pseudohydrosme* location is ancient, highly weathered
826   basement complex, with some ferralitic areas in foothill areas which are inland, c. 100 km from
827   the coast. The wet season (successive months with cumulative rainfall >100 mm) is almost the
828   inverse of at Libreville, falling between March and November and is colder than the dry season
829   (Abwe & Morgan 2008). In addition, the affinities of Ebo as indicated by shared plant species,
830   seems to be with other parts of the Cross-Sanaga biogeographic area, the Cameroon Highlands,
831   rather than with Gabon (see above).
832

833   **Discussion**

834   The description of *Pseudohydrosme ebo* (this paper) necessitates the modification of the
835   circumscription of *Pseudohydrosme* in two respects. Firstly, in *P. ebo* the flower-bearing male

836 and female portions of the inflorescence are not completely contiguous, the distal region of the
837 female zone shows naked parts of the axis and the female flowers are laxly arranged throughout,
838 while in the other species of *Pseudohydrosme* there is no naked portion and the spadix axis is
839 completely covered in flowers. Thirdly the trilocular ovaries normal in *Pseudohydrosme* ebo are
840 different to those of the other two species which are usually bilocular, and only very rarely
841 otherwise.
842
843 Although indicated as potentially congeneric with *Anchomanes* by *Hetterscheid & Bogner* (*2013*)
844 who cited only the difference in ovary locularity as a basis for maintaining the separation, in fact
845 five other characters support maintaining the separation of these two genera (see table 2
846 below).Two of these characters were discovered for the first time by *Hetterscheid & Bogner*
847 (*2013*) . These are 1) the development in the fruit of a stipe and 2) reproducing asexually from
848 the fleshy roots: producing new plants distant from the parent rhizome. The last character is
849 specifically remarked to be definitively absent from *Anchomanes* species, which have been
850 studied in detail in cultivation (*Hetterscheid, & Bogner 2013*). However, Hay (in litt.) reports
851 anecdotally, that *Anchomanes* can be propagated in cultivation by root cuttings.
852
853 However, there is no doubt that *Anchomanes* and *Pseudohydrosme* are closely related, sharing so
854 many characters. Although the two genera have been stated to have "at least a sister group
855 relationship" (*Hetterscheid, & Bogner 2013*), as those authors pointed out, only one species of
856 each genus was included in the molecular phylogenetic analysis upon which this statement was
857 based (*Cabrera et al., 2008*). We speculate that the differences in inflorescence structure that
858 help distinguish between the two genera (table 2), might be due to two different pollination
859 syndromes being in play. That laticifers were not detected in *Pseudohydrosme* might have been
860 due to insufficient material being available. Resampling might yet discover them. The difference
861 in peduncle character state that currently separates the two genera are encompassed within one
862 genus elsewhere in the family, with intermediates connecting the two states., e.g. in
863 *Amorphophallus*. It cannot be ruled out therefore that one of these genera might be nested inside
864 the other, in which case it might be necessary to sink *Pseudohydrosme* into *Anchomanes*.
865 However further molecular analysis, sampling additional taxa of each genus, is advisable before
866 any such action is needed. It is intended to address this in a future project.
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Conclusions
878
879 The discovery of a new species of *Pseudohydrosme* in Cameroon, far from the border with
880 Gabon, is completely unexpected after nearly 130 years in which no additional taxa have been
881 added to the genus. It is also unexpected because one would not predict from the pre-existing

882   data on the genus that such a new species would be so biogeographically and climatically
883   disjunct from its congeners in the Libreville area of Gabon (see under *Pseudohydrosme ebo*
884   above). However, examples of even more dramatically unexpected African range extensions
885   have occurred recently such as the westward extension by 2400 km of the genus *Ternstroemia*
886   Mutis ex L.f., of *Talbotiella* Baker by 1400 km, and of the genus *Metarungia* Baden by 1200
887   km, or in the other direction, eastwards, 1500 km in *Mischogyne* Exell (*Cheek et al. 2019; van*
888   *der Burgt et al. 2018; Darbyshire et al., 2008; Gosline et al.,2019* respectively). Such
889   discoveries underline how incomplete our knowledge of the geography of African plant genera
890   remains. They also underline the urgency for uncovering such taxa whileit is still possible since
891   in all but one of the cases given, the range extension resulted from finding a new species to
892   science with a narrow geographic range and/or very few individuals, and which face threats to
893   their natural habitat, putting these species at high risk of extinction. About 2000 new species of
894   vascular plants have been discovered each year for the last decade or more. Until species are
895   known to science, they cannot be assessed for their conservation status and the possibility of
896   protecting them is reduced (*Cheek et al., 2020*). Documented extinctions of plant species are
897   increasing, e.g. *Oxygyne triandra* Schltr. of Southwest Region, Cameroon is now known to be
898   globally extinct (*Cheek et al., 2018c*). In some cases species appear to be extinct even before
899   they are known to science, such as *Vepris bali* Cheek, also from the Cross-Sanaga interval in
900   Cameroon (*Cheek et al., 2018d*) and elsewhere, *Nepenthes maximoides* Cheek (*King & Cheek,*
901   *2020*). Most of the >800 Cameroonian species in the Red Data Book for the plants of Cameroon
902   are threatened with extinction due to habitat clearance or degradation, especially of forest for
903   small-holder and plantation agriculture following logging (*Onana & Cheek, 2011*). Efforts are
904   now being made to delimit the highest priority areas in Cameroon for plant conservation as
905   Tropical Important Plant Areas (TIPAs) using the revised IPA criteria set out in *Darbyshire et al.*
906   (*2017*). This is intended to help avoid the global extinction of additional endemic species such as
907   *Pseudohydrosme ebo* which will be included in the proposed Ebo Forest IPA.
908
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925
926
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Figure 1

Pseudohydrosme ebo (*van der Burgt* 1888, K, YA).

Photo of flowering, leafless plant at Ebo forest, Oct. 2015. Photo by Xander van der Burgt.

Figure 2

Pseudohydrosme ebo (*van der Burgt* 2377, K, YA).

Photo of plant in leaf, in habitat, Ebo forest, December, March 2019. Photo by Xander van der Burgt.

Figure 3

Global distribution of the species of the African genus *Pseudohydrosme*

Red dot = *P. buettneri*; black dots= *P.gabunensis* (location not available for Congo specimen); blue dot = *P. ebo.*

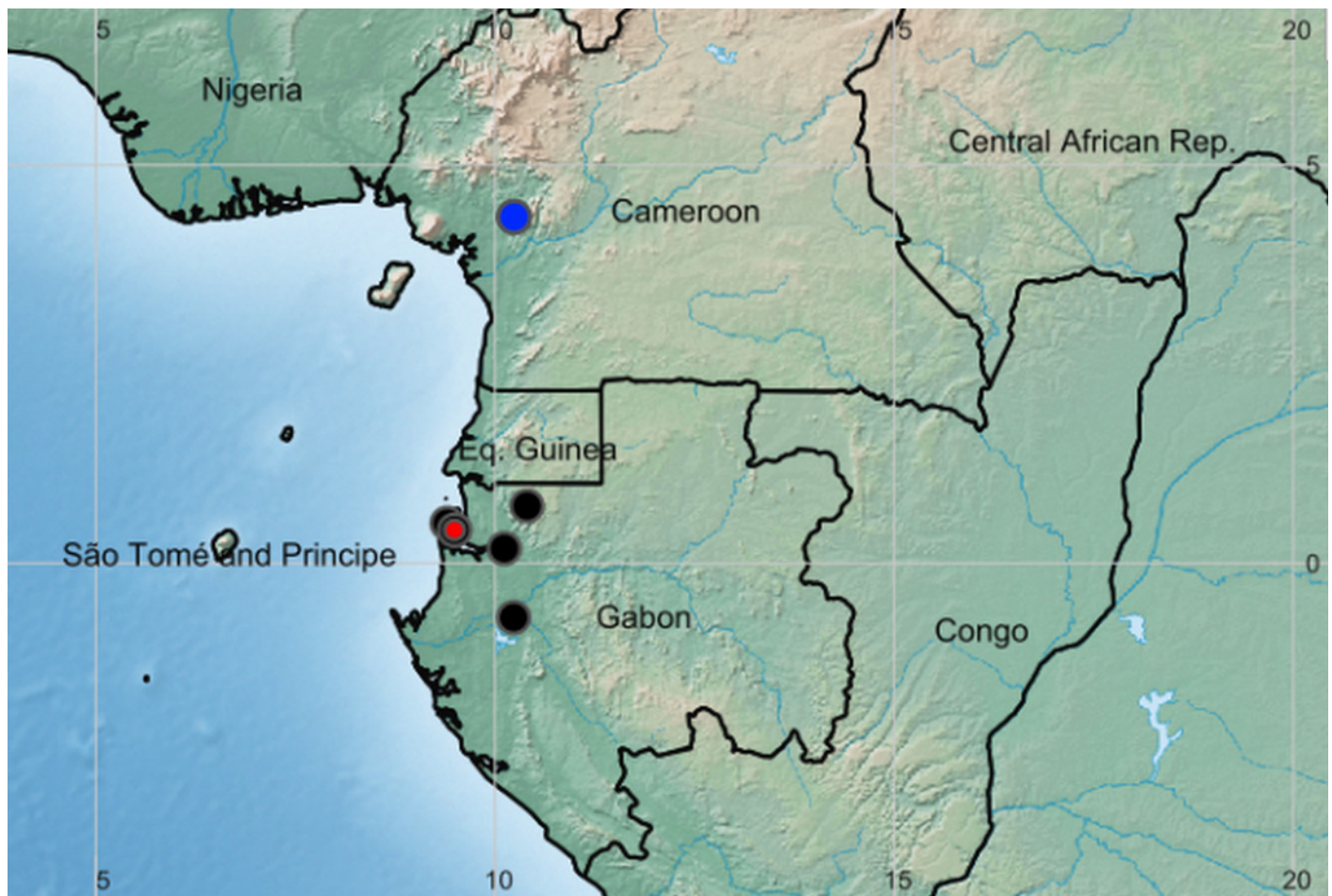



Figure 4

Pseudohydrosme buettneri (*Buettner* 519, B).

Drawing of flowering plant. (A) habit, rhizome and inflorescences; (B) spadix after removal of spathe showing from base to apex, female, male and staminodal flowers; (C & D) paired stamens, side view; (E) paired stamens flowers, transverse section; (F &G) staminodes, sterile male flower; (H) female flower, entire, side view; (J) female flower, longitudinal section. Reproduced from protologue, (*Engler, 1892*: taf. XVII)*. Drawn by Josef Pohl.

Pseudohydrosme Büttneri Engl.

J. Pohl del.

Verlag v. Wilh. Engelmann, Leipzig.

Lith. Anst. Julius Klinkhardt, Leipzig.

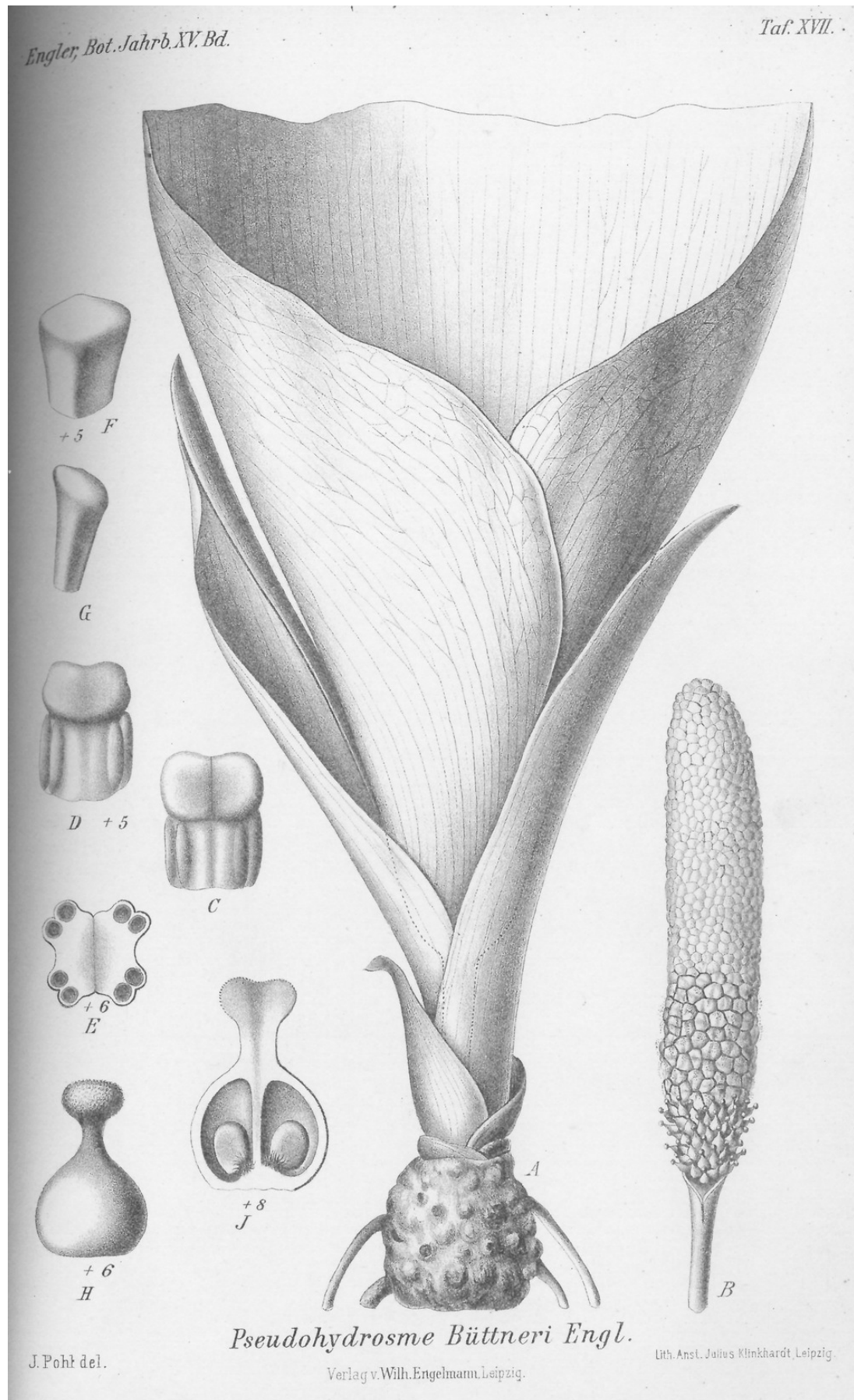



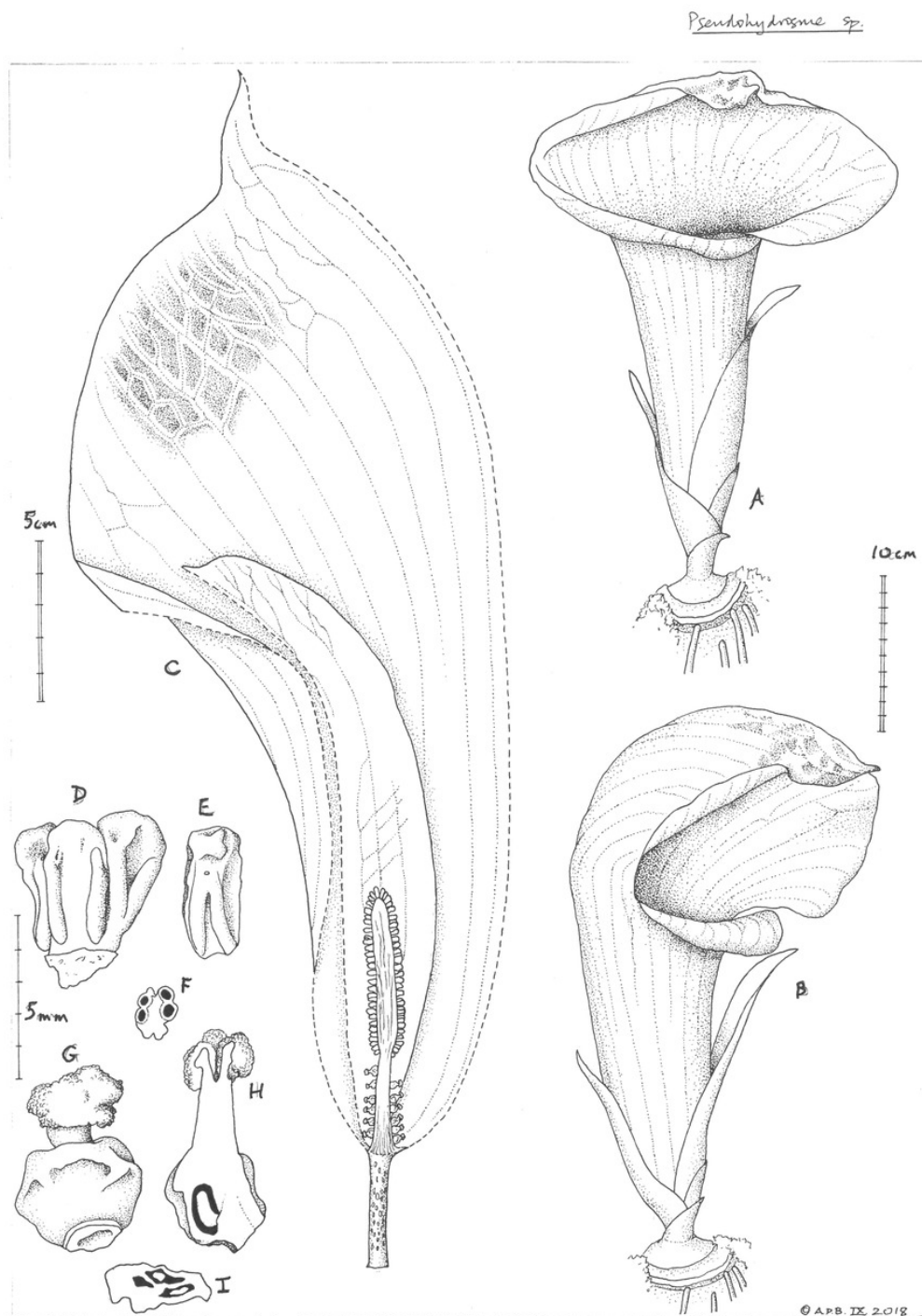
Figure 5

Pseudohydrosme gabunensis

Photo of flowering, leafless plant cultivated at University of Vienna Botanic Garden (courtesy of David Prehsler).

Figure 6

Pseudohydrosme ebo (*van der Burgt* 1888, K, YA).

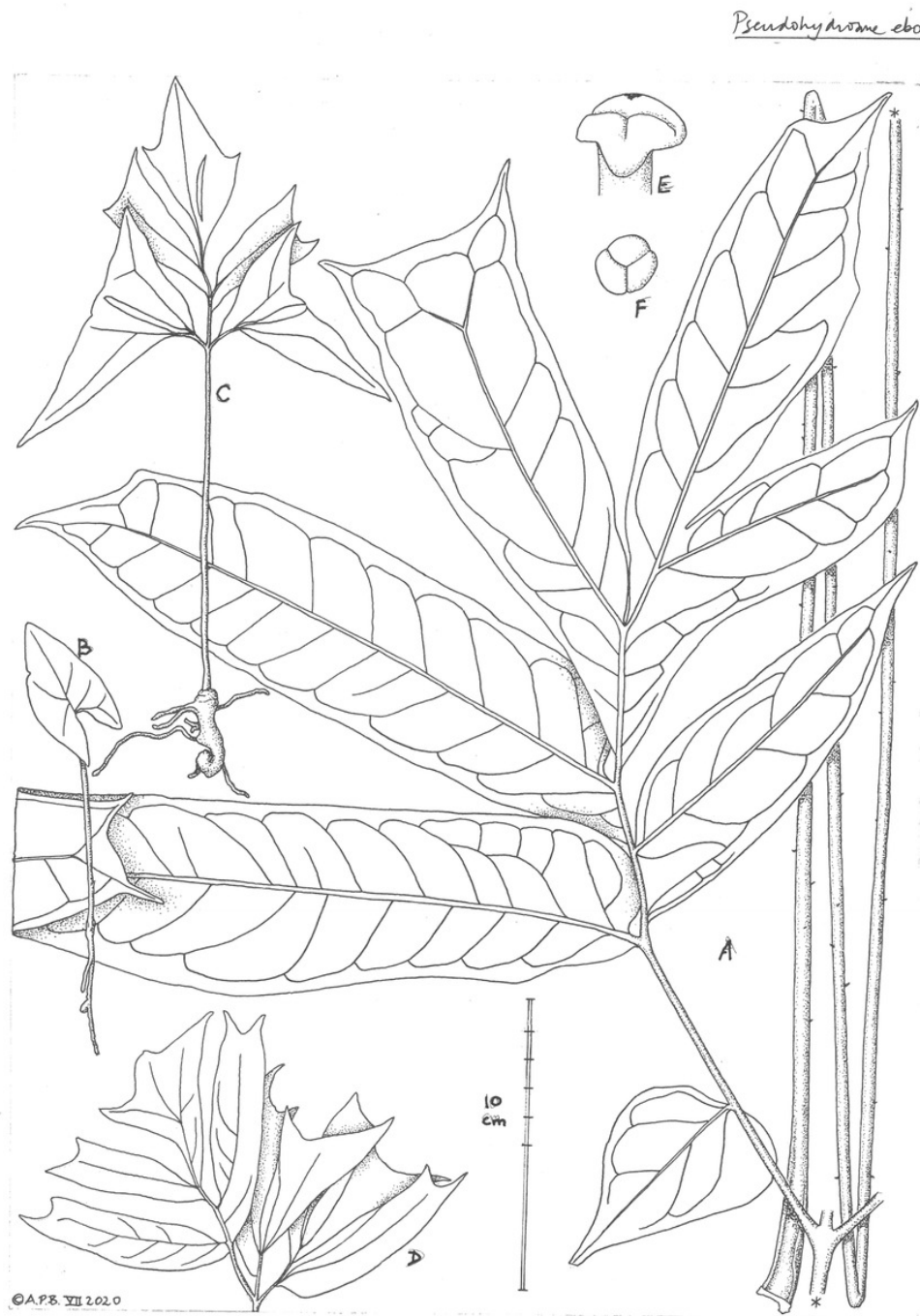
Drawing of flowering plant. (A ventral side view & B oblique side view) habit, rhizome and inflorescences; (C) inflorescence, longitudinal section, showing spadix from base to apex with sparse female flowers, partially naked axis of female zone, separated by naked axis from the densely flowered, male zone; (D) group of three stamens, ventral side view; (E) stamen; (F) stamen, transverse section; (G) female flower, entire, side view; (H) female flower, longitudinal section; (I) ovary, transverse section. Drawn by Andrew Brown.

Pseudohydrosme sp.

Pseudohydrosme sp. del. Andrew Brown September 2018

Figure 7

Pseudohydrosme ebo (A-D from *van der Burgt* 2377, K, YA; E from *Morgan 25,* K,YA).

(A) primary lateral division (one of three divisions) of leaf-blade, with petiole folded, behind; (B) seedling (probably in first year); (C) seedling plant (probably in third or later year); (D) seedling leaf-blade (pre-mature); (E obique view (B) & F from above); trilobed stigma. Drawn by Andrew Brown.

Pseudohydrosme ebo

Pseudohydrosme ebo del. Andrew Brown July 2020

Characters separating *Pseudohydrosme gabunensis* from *Pseudohydrosme ebo*

Data for *Pseudohydrosme gabunensis* from Bogner (1981:33), Hetterscheid & Bogner (2014:104–113), and live material cultivated at Royal Botanic Gardens, Kew.

2 **Table 1:**
3 **Characters separating *Pseudohydrosme gabunensis* from *Pseudohydrosme ebo.***
4
5 Data for *Pseudohydrosme gabunensis* from *Bogner* (*1981*:33), *Hetterscheid & Bogner*
6 (*2013*:104–113), Hay (in litt.*),* and live material cultivated at Royal Botanic Gardens, Kew.
7 Data for *Pseudohydrosme buettneri* from *Engler* (*1892*). Data for *Pseudohydrosme ebo:* this
8 paper.
9
10

	Pseudohydrosme gabunensis	*Pseudohydrosme ebo*	*Pseudohydrosme buettneri*
Leaf lobe posture and surface	Pendulous, surface bullate (convex between nerves)	Horizontal, surface flat	Unknown
Spadix male: female zone width	Base of male zone abruptly wider than female zone below	Male zone about as wide as female zone	Male zone about as wide as female zone
Spathe length (cm)	(30–)40–55(–70)	24–30(–34.5)	80
Spathe tube: colour of outer surface	Uniformly yellow (or white)	Vertical broad pink-brown stripes on white background	Unknown
Spathe blade: colour of inner surface	Yellow or white around margins, central area dark red-purple. Demarcation abrupt	Light reddish brown to pink with pale green veins, gradually slightly darkening in the central area	Unknown
Number of ovary locules & stigma lobes	2 (–3)	(2–) 3	2
Female flower density	Covering completely the female zone spadix axis	Lax (sparse), spadix axis visible between the female flowers	Covering completely the female zone spadix axis
Female and male flower zone contiguity	Female and male zones contiguous, male and female flowers in contact with each other	Female zone separated from male zone by a sort naked portion of spadix axis	Female and male zones contiguous, male and female flowers in contact with each other

Characters separating *Anchomanes* and *Pseudohydrosme*.

Data from *Mayo et al.* (*1997*); *Bogner* (*1981*); *Cusimano et al.* (*2011*); *Hetterscheid & Bogner* (*2014*); this paper

2   **Table 2.**

3   **Characters separating *Anchomanes* and *Pseudohydrosme*.**

4   Data from *Mayo et al.* (*1997*); *Bogner* (*1981*); *Cusimano et al.* (*2011*); *Hetterscheid & Bogner* (*2013*);
5   *Keating* (*2002*)*;* this paper.

	Anchomanes	*Pseudohydrosme*
Spadix: spathe proportions and presentation	Spadix relatively long >1/2–9/10 as long as spathe; conspicuous, projected above the (short) spathe tube	Spadix relatively short, 1/10–1/4 as long as spathe; completely concealed within, and at base of the (long) spathe tube
Peduncle	Peduncle exserted far beyond cataphylls; 2–5 x length of spathe	Completely concealed at anthesis by cataphylls; <1/10 length of spathe
Ovary locularity and stigma lobe number	1	2 or 3
Berries	Sessile	Stipitate (where known)
Laticifers	Present, simple, articulated	Absent (not detected by *Keating*, *2002*)
Reproducing asexually from roots	Absent (but propagation from root cuttings in cultivation reported anecdotally)	Present

8   .