



***Gabonius* gen. nov. (Leguminosae, Caesalpinioideae, Detarieae), a distant cousin of *Hymenostegia* endemic to Gabon**

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Abstract

A new genus, *Gabonius* is described to accommodate a single species, *Gabonius ngouniensis* which was previously misplaced in *Hymenostegia sensu lato*. *Gabonius ngouniensis* is a widespread Gabonese endemic of evergreen forest. We assess *G. ngouniensis* as Least Concern (LC) according to IUCN criteria. A distribution map of *Gabonius* is presented, as is a table comparing the morphology of *Gabonius*, the closely related, possibly sister genus *Micklethwaitia* and *Hymenostegia sensu stricto* from which *G. ngouniensis* has been excluded. The previously unreported seedling morphology is discussed.

Key words: Amherstieae, Conservation, Fabaceae, New genus, Taxonomy, Tropical Africa

Introduction

The Legumes are one of the most important plant families in the world, both in terms of species richness (third largest family after composites and orchids) and in economic importance where they are arguably as valuable as the grasses (Lewis *et al.* 2005). Subfamily Caesalpinioideae has its widest generic diversification in Africa. The main source of this diversification is found in one of the earliest branches of the family, the Detarieae, a tribe that consists solely of woody plants, the majority trees (Mackinder 2005). Detarieae are considered an important ecological component of both rain forest and woodland systems in Africa. In the wettest forests of Africa, especially those on phosphorus-poor soils, Detarieae species dominate the canopy layer, with up to 60% of the trees belonging to this tribe, a phenomenon commonly attributed to the ectomycorrhizal symbioses of these trees (Newbery *et al.* 1997, Wieringa 1999, Ba *et al.* 2012). One widespread African woodland type, Miombo woodland, is a formation dominated by *Brachystegia* Benth. in Bentham & Hooker (1865: 582) alone or together with species of *Julbernardia* Pellegrin (1943: 297) or *Isoberlinia* Craib & Stapf ex Holland (1911: 266–267). All three genera are members of Detarieae.

From a taxonomic point of view, one of the most problematic areas of the Detarieae is the genus *Cynometra* Linné (1753: 382–383) and some of the genera that have been derived from it in the past, such as *Plagiosiphon* Harms in Engler & Prantl (1897: 194), *Scorodophloeus* Harms (1901: 77), *Talbotiella* Baker f. (1914: 2), *Lebruni dendron* Léonard (1951: 421) and in particular *Hymenostegia* Harms in Engler & Prantl (1897: 193). While *Cynometra* is a pantropical genus, *Hymenostegia* as currently circumscribed, is endemic to Africa, and is under the scrutiny of the first two authors using a combined morphological and molecular approach. Prior to our studies 16 species were recognised in the genus, 15 by Léonard (1951) with one

addition by Aubréville (1970). Since then one species has been removed to *Talbotiella* (Mackinder *et al.* 2011) and three species new to science have been added (Mackinder & Wieringa 2013a, Wieringa & Mackinder 2012) bringing the current total to 18 species. However, we consider eight of these species not to be congeneric with *H. floribunda* (Bentham, 1866: 318) Harms in Engler & Prantl (1897: 193), the type species of *Hymenostegia*. Those species which do not belong in the genus need to be fostered in existing genera or in genera newly described to accommodate them. This paper deals with one such transfer, that of *H. ngouniensis* Pellegrin (1942: 247) to a new genus: *Gabonius*. Together with the transfer of 2 species to *Annea* Mackinder & Wieringa (2013b) this brings the total number of species recognised in *Hymenostegia* to 15, of which still five await further data and analyses before they can be placed and assigned to other genera.

Reasons for recognising *Gabonius*: indications from DNA and morphology

DNA. Two published phylogenetic studies of Detarieae, both based on trnL plastid nucleotide sequence data (Bruneau *et al.* 2000, 2001), and a third study based on rbcL data (Mackinder *et al.* 2010) sampled *Gabonius* (as *Hymenostegia ngouniensis*). Each study resolved a well-supported clade containing a core group of *Hymenostegia sensu stricto* species from which *Gabonius* was excluded yet there was no agreement among the studies as to which taxa *Gabonius* was most closely related. The position of *Gabonius* was either unresolved (Bruneau *et al.* 2000), resolved, with weak support as sister to members of the Afzelia clade (Bruneau *et al.* 2001) or resolved with moderate support among members of the Berlinia clade (Mackinder *et al.* 2010). However, a phylogenetic analysis of subfamily Caesalpinioideae based on a combined trnL and matK dataset (Bruneau *et al.* 2008) placed *Gabonius ngouniensis* with very strong support (Bayesian Posterior Probability of 1.00) as sister to a lineage consisting of *Scorodophloeus zenkeri* Harms (1901: 78) and *Annea afzelii* (Oliver 1871: 318) Mackinder & Wieringa (2013b). More recently a phylogenetic analysis was undertaken of the Amherstieae clade which is a large subclade of Detarieae accommodating over 40 genera including all those referred to in the present paper. The Amherstieae clade analysis (Mackinder *et al.* 2013c) was also based on combined trnL and matK data but incorporated species-level sampling additional to that of Bruneau *et al.* (2008). Findings of the Amherstieae clade analysis were consistent with Bruneau *et al.* (2008). *Gabonius* was placed on a separate lineage in a strongly supported clade comprised of seven species grouping into four lineages that we consider genera. In addition to *Gabonius*, the clade included a monophyletic *Scorodophloeus* (3/3 species sampled), a monophyletic *Annea* (both species sampled), and the monotypic genus *Micklethwaitia* Lewis & Schrire (2004: 166) to which *Gabonius* was resolved as sister, albeit with weak support.

Morphology. In a study of vegetative morphology which examined all *Hymenostegia sensu lato* species alongside representatives of several putatively allied genera, *Cynometra*, *Lebruni dendron*, *Plagiosiphon*, *Scorodophloeus* and *Leonardoxa* Aubréville (1968b), *Gabonius* (as *Hymenostegia ngouniensis*) presented a unique combination of key vegetative characters among the wider study group (Mackinder *et al.* 2010) with several differences from *Hymenostegia sensu stricto*. Morphological characters that can be used to distinguish *Gabonius* from *Hymenostegia sensu stricto* and *Micklethwaitia* are presented in Table 1. *Gabonius* also can be readily distinguished from the other genera with which it is considered closely related (Bruneau *et al.* 2008, Mackinder *et al.* 2013c). Compared to *Gabonius*, *Scorodophloeus* has alternate (not opposite) leaflets, caducous (not persistent) bracteoles, 5 (not 3) large petals and pods with winged (not unwinged) upper sutures. *Annea* (compared to *Gabonius*) has fewer leaflet pairs, 1 or 2 (not typically 5 or more pairs), a marked disparity in the size of different leaflets pairs (not subequal), fused stipules (not free), shorter stamens, filaments up to 13 mm (not 20 mm or greater) long, and a shallower hypanthium 2–4 (not 6–9) mm deep. In addition, *Gabonius* has pods that are larger than those of any of these other genera. Within Detarieae, *Gabonius* belongs to a limited group of genera that show 3 large and 2 reduced petals. Next to *Annea* and *Hymenostegia* also *Plagiosiphon*, *Neochevalierodendron* and *Loesenera* share this character. In contrast to *Gabonius*, *Plagiosiphon* has emarginate leaflets and velutinous pods, *Loesenera* white to pink petals and

velutinous pods while *Neochevalierodendron* has an alternate first leaflet pair with a strong marginal vein at base, united stipules, caducous bracteoles and large nearly circular white petals.

TABLE 1. Comparative morphology of *Gabonius*, *Hymenostegia sensu stricto* and *Micklethwaitia*.

Genus Character	<i>Gabonius</i>	<i>Micklethwaitia</i>	<i>Hymenostegia sensu stricto</i>
Number of leaflets	(4) 10–12 (14)	6–8	8–50
Imbricate bud scales	Absent	Absent	Present
Hypanthium depth (mm)	6–9	1.5–2	3–5
Bracteole position on pedicel	Top	Lower half	At or very close to top
Bracteole width	Broad ^a	Narrow ^b	Narrow to broad
Bracteole enclosing the bud before anthesis	Enclosing	Not enclosing	Enclosing
Bracteole persistence	Persistent	Fallen before anthesis	Persistent
No. of well-developed petals	3	4–5	2–3
Petal colour	Blade yellow, claw whitish	White to cream	Commonly white to yellow, rarely green
Pod upper suture wing	Absent	Present	Present or absent

a. Broad defined as: length $1-1.5 \times$ width.

b. Narrow defined as: length $>3 \times$ width

Gabonius Wieringa & Mackinder *gen. nov.*

Type: *Hymenostegia ngouniensis*, for type specimen details see below.

Shrub or tree, usually small but may attain 35 m tall. Stipules in pairs, free but touching at the base, caducous. Bud scales absent. Leaves paripinnate, leaflets in (2–)5–7 pairs, subsessile, narrowly elliptic to elliptic, ovate to sub-rhombate, adaxial surface glabrous, abaxial surface glabrous or with sparse indumentum, crater-like glands present, visible at $\times 10$ or higher magnification. Inflorescence a terminal or axillary raceme, axes puberulous, bracts caducous, bracteoles persistent, opposite, petaloid, conspicuous, adaxial surfaces touching along margins prior to anthesis. Petals 5, adaxial and lateral petals large, yellow and white, similar in size, abaxial petals smaller, white. Stamens 10. Ovary stipitate, the stipe fused along most of its length to the adaxial sidewall of the hypanthium, densely hairy along the margins, stigma peltate. Pod compressed, glabrous, trapeziform, broadest at about one-third distance from the apex, dehiscent. Seeds 1–2, discoid.

Etymology:—This new, so far monotypic genus is named after Gabon, a country where it is not only endemic to, but in which it also occurs over a large extent; the known distribution seems to fit that country very well, and a species distribution model of the species (see below) predicts it is more or less confined to this country as well. Although Gabon has a large number of endemics, c. 500 species are recorded as endemic and another 100 as near endemic (Sosef *et al.* 2006), only a few of these species have such a large distribution within the country. *Gabonius* has the male gender.

Note:—The only slightly similar name that exists is *Gabunia* Stapf (1902: 136), but that name differs in several letters and is a synonym of *Tabernaemontana* Linné (1753: 210–211) (Apocynaceae) with no current use, so we do not foresee any possibilities for confusion between these two.

Gabonius ngouniensis (Pellegr.) Wieringa & Mackinder *comb. nov.* (Fig. 1)

Hymenostegia ngouniensis Pellegrin (1942: 247). Type:—GABON. Ngounié: between Dibwangui and Issala, *Le Testu* 5284 (lectotype P!, isolectotype: B!, BR, IFAN!, K!), lectotype selected by Léonard (1951: 441).



FIGURE 1. Flowering branch of *Gabonius ngouniensis* (photographs by L.J.G. van der Maesen) with close up of inflorescence (upper) to show petal development, shape and colour in an opened flower.

Shrub, or more commonly a tree 1–20 (–35) m tall, dbh 25 cm (12 m tree)–40 cm (20 m tree); bark yellowish grey, or greenish brown, peeling (*J.J. de Wilde 9328*) with lenticels. Slash yellow to ochre, rather fibrous, up to 12 mm thick. Sapwood cream-coloured. Twigs reddish brown to dark brown, sparsely to moderately golden-brown puberulous, hairs hooked (only visible at $\times 100$ or greater magnification), lenticels pale. Stipules in pairs, free but touching at base (intrapetiolar), caducous, triangular to ovate, $1\text{--}4.5 \times 0.5\text{--}1.5$ mm, golden-brown to white tomentose, especially over the midvein, lateral areas less dense to glabrous, but margin pubescent again, apex acute. Bud scales absent. Leaves paripinnate, (2–)5–7-jugate, most commonly with 5 or 6 leaflet pairs spaced widely along the rachis, the distance between nodes exceeding the width of the leaflets borne at the nodes, lower pairs smaller than upper pairs, distal or penultimate pair the largest; petiole 0.6–2.1 cm long, rachis 1.7–12.8 cm long, striate, moderately golden-brown puberulous, hairs hooked (only visible at $\times 100$ or greater magnification), leaflets subsessile, narrowly elliptic to elliptic, ovate to sub-rhombate, falcate, upper leaflet pair $3.1\text{--}12.2 \times 1.4\text{--}5.6$ cm, adaxial surface glabrous, abaxial surface mostly glabrous or sparsely hairy, patch of hairs sometimes present at the base, margins often ciliate towards the base, mid-vein sub-central, the proximal half of the leaflet slightly larger, distal margin sometimes angular, proximal margin usually rounded, apex acuminate, base asymmetric, proximal half with 0–4 glands, distal half with 4–17 glands, the lowest numbers in the basal leaflets. Inflorescence a lax 7–18-flowered terminal or axillary raceme, sometimes branching once near base or two inflorescence axes arising at the same point, axis 7.5–15 cm long, including peduncle 1.5–5 cm long, moderately golden brown puberulous, hairs hooked (only visible at $\times 100$ or greater magnification), bracts caducous, not seen in herbarium, pale green when young (*Wieringa 2413*); pedicel 15–27 mm long (at anthesis), moderately puberulous, hairs hooked (only visible at $\times 100$ or

greater magnification); bracteoles opposite, persistent, borne at the apex of the pedicel, directly below the hypanthium, petaloid, broadly ovate, $8\text{--}20 \times 7\text{--}13$ mm, when mature white or pinkish, deep red or purple spot at base, sometimes red-veined and with red or pale purplish margins, puberulous on both surfaces, more densely in the central area of the abaxial surface, margins ciliate; hypanthium 6–9 mm long, inside glabrous, outside glabrous or with some sparse hairs. Sepals pink, reddish brown, greenish purple outside, brownish green or purple brown inside, reflexed after anthesis, slightly longer than the hypanthium, puberulous towards the base on the inside, otherwise glabrous. Petals 5, glabrous, adaxial and lateral ones similar in size, $10\text{--}13 \times 5\text{--}6$ mm, yellow with white lower margins, a small purple basal-central spot and a pale claw when first in flower, turning red with age, claw of lateral petals very narrow, abaxial petals smaller, c. 4×1 mm, white. Stamens 10, filaments white or pink, free, anthers deep cream, pale pinkish or purplish brown, connective purple-grey (*Wieringa 4493*). Ovary 2–3 ovulate, stipitate, the stipe fused along most of its length to the adaxial sidewall of the hypanthium, green, orange-red or brownish with dark red sutures, hairs c. 0.75 mm long, white, sparse on the faces but dense along the margins, the marginal hairs persisting into young fruit and extending along the lower half of the style, stigma peltate, pistil white or greenish-white. Pod compressed, glabrous, dull greyish green or greenish blue outside, light brown to medium brown inside, $23\text{--}28 \times 6.5\text{--}8.8$ cm, trapeziform, broadest (“height”) about one-third distance from the apex, lower margin rounded, upper suture not broadened into wings, beak c. 5 mm long on immature pods, remnant of base only seen on mature pods, valves revolute after dehiscence. Seeds 1–2, discoid, c. 3 cm diameter (*Wieringa 4493*). Seedlings: (based on *J.J.F.E. de Wilde 9329*), first leaf pair opposite, possibly reduced (see notes), subsequent leaves are alternate, leaflets sessile, glabrous, in 2–4 pairs, largest leaflets at apex of the leaf $60\text{--}72 \times 18\text{--}25$ mm, very similar in appearance to adult foliage.

Habitat and Ecology:—Primary and secondary evergreen forest: elevation sea level–510 m. Populations seem to flower synchronously (*van der Burgt 1*), flowering recorded from November to July but most commonly in April.

Distribution:—Endemic to Gabon, occurring in the western part of the country from the border with Equatorial Guinea in the north to that with Congo (Brazzaville) in the south (fig. 2).

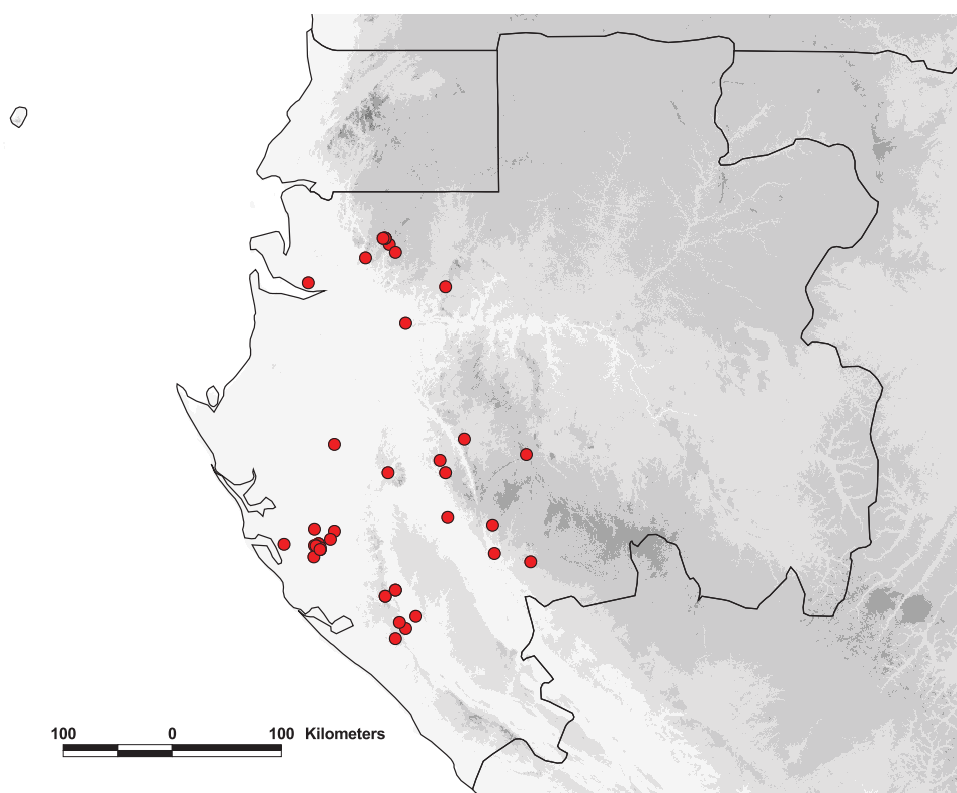


FIGURE 2. Distribution of *Gabonius ngouniensis*.

Since we have chosen to name this genus after Gabon, we decided to test the likelihood that the taxon distribution is indeed limited to Gabon. To assess this we generated a Species Distribution Model (SDM). For generating SDM's based on presence-only data as in this case, MaxEnt has been documented to outperform other methods (Elith *et al.* 2006). As the foreseen distribution is limited to Gabon and possibly to neighbouring countries, we used a 30 arc-sec resolution and applied the analysis to a study area ranging from 8° N to 8° S and from 6 to 24° E, thus roughly encompassing the countries of Gabon, Equatorial Guinea, Cameroon, Democratic Republic of Congo, and Sao Tomé & Príncipe. The collecting localities of all herbarium vouchers examined in this study were used as input species data. Environmental layers used for model building and projection include 19 BIOCLIM variables (Hijmans *et al.* 2005). In addition, the range as well as standard deviation of altitude based on SRTM DEM 90 × 90 m data, obtained through (<srtm.csi.cgiar.org>, accessed 07-10-2011) within each grid cell was calculated and added as variables to act as a proxy for ruggedness of the landscape. Finally, soil parameters of the dominant soil type within each grid cell were extracted from the Harmonised World Soil Database (<<http://webarchive.iiasa.ac.at/Research/LUC/External-World-soil-database/HTML/index.html?sb=1>> accessed 16-08-2012). Environmental parameters were checked for multi-collinearity separately for climatic and altitude data as well as for soil data. To avoid overfitting and errors due to multi-collinearity, only uncorrelated parameters were used for model building (Pearson $r < 0.65$ or Spearman Rho < 0.65). This resulted in the selection of the following parameters: temperature annual range (BIO7), mean temperature of coldest quarter (BIO11), annual precipitation (BIO12), precipitation seasonality (BIO15), precipitation of warmest quarter (BIO18), precipitation of coldest quarter (BIO19), altitude range (DEM-range), available water capacity range (AWC_CLASS, categorical variable), topsoil bulk density (T_BULK_DENSITY), topsoil calcium carbonate (T_CACO3), topsoil salinity (T_ECE), topsoil sodicity (T_ESP), topsoil gravel content (T_GRAVEL), topsoil organic carbon (T_OC), topsoil pH H2O (T_PH_H2O), topsoil sand fraction (T_SAND), topsoil base saturation (T_BS) and topsoil cation exchange capacity of the clay fraction (T_CEC_CLAY, categorical variable). Models were built using MaxEnt V.3.3.3.k (Phillips *et al.* 2004) applying the default features. In addition a presence / absence distribution map was generated applying a 10 percentile trainings threshold, meaning that 10% of the training locations are allowed to fall outside the predicted distribution, which is assumed to correct for errors in identification and estimation of locations.

The final model was generated using 41 presence records; the result is shown in fig. 3. The Area Under the Curve (AUC) of our model has a value of 0.990, which lies well above the critical threshold of 0.7. As the use of AUC has been highly criticised (Peterson *et al.* 2008), we also tested the model against a null model (Raes & Ter Steege 2007) resulting in a rank number of 100 (out of 100) clearly indicating that the model performs significantly better than random. Based on the predicted potential distribution, *Gabonius* is nearly endemic for the country of Gabon. The predicted presence on Sao Tomé, as displayed in fig. 3, is not realistic as Sao Tomé is a non-continental island located approx. 250 km off the coastline of Gabon which is impossible to reach for a species with explosive seed dispersal like *Gabonius ngouniensis*. Moreover, this island is of volcanic origin, with phosphorus-rich soils, which in general are not favourable for Detarieae as discussed above. The only place where *Gabonius* might occur outside of Gabon is just over the border in Equatorial Guinea; so far the species has not been found in that area.

Conservation:—*Gabonius ngouniensis* is widespread in Gabon with an A00 of 38137 km² (cell size 46 km) and an E00 of 72300 km² and occurs within the borders of several National Parks. It is assessed here as Least Concern (LC) according to the criteria of IUCN (2001).

Notes:—Small scars observed on the seedling axis suggest the abscission of a reduced first pair of opposite leaves. At the point of abscission, the epicotyl continues without any signs of transformation into a first stem, suggesting growth is not paused when the reduced first pair of leaves appears. As such this represents a transition between two commonly observed seedling morphologies in Detarieae (Léonard 1957). They are (i) seedlings that possess a clear epicotyl and an opposite first leaf pair indicating a pause in growth while this first pair fully develops, for example *Talbotiella korupensis* Mackinder & Wieringa (Mackinder *et*

al. 2011: 411) and (ii) seedlings that immediately start producing a shoot with alternative leaves, for example *Annea afzelii*. This apparent presence of a reduced first leaf pair in *Gabonius* seedlings represents a (so far) unique morphology in Detarieae. Functionally we consider the seedlings to belong to type (ii) since growth continues beyond the first reduced leaves. We think it unlikely the reduced leaves are functional given they do not persist (see also Mackinder *et al.* 2013c).

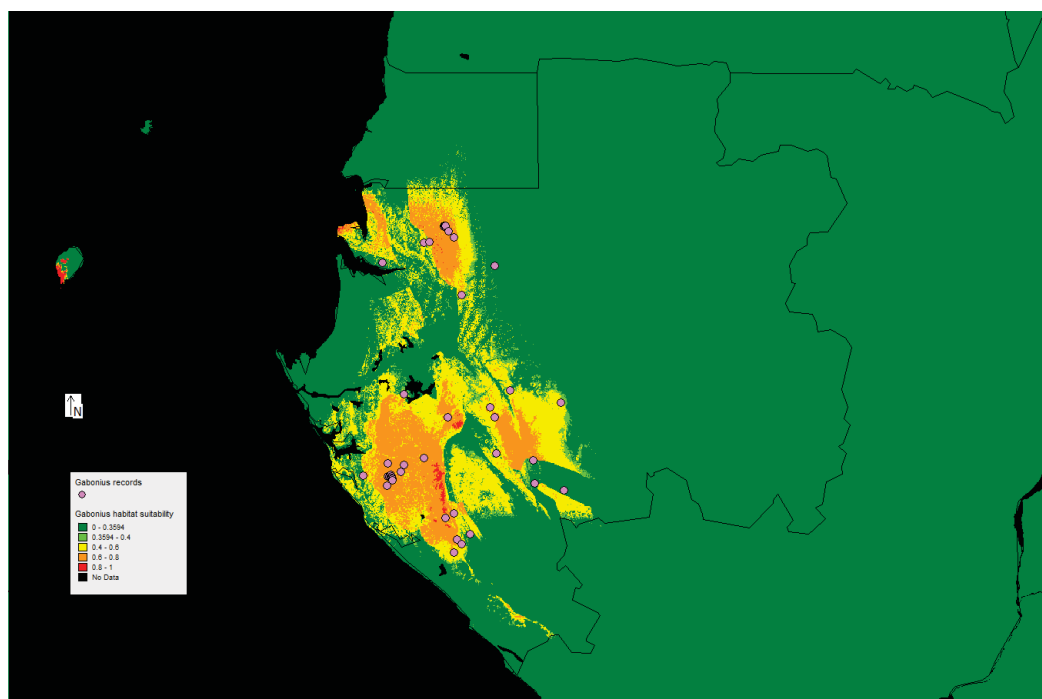


FIGURE 3. Potential distribution of *Gabonius ngouniensis* according to our species distribution model. The habitat suitability value 0.3594 corresponds to the 10th percentile training presence threshold as applied to generate a presence/absence distribution map.

Bark with Green bean-odour (*Dibata* 132). Freshly dried material has a “nut-like” smell (*van der Burgt* 1). Several collectors note the flowers are fragrant.

The epithet was written as “ngouniensis” by Pellegrin in 1942, but in a later publication that is much more widely available (Pellegrin 1949: 90) he spelled it as “ngounyensis”. Since Aubréville (1968a) in his flora treatment also used the later spelling, this spelling currently prevails in publications and databases. Since the epithet refers to a geographical name, its spelling should follow that of the original protologue and is not to be corrected.

In the Flore du Gabon treatment, Aubréville (1968a: 102) lists *Le Testu* 5890 (P) as the holotype. This is incorrect, since the protologue mentions two collections (*Le Testu* 5284 & *Le Testu* 5890) but does not indicate a holotype. Moreover, this cannot be seen as a lectotypification since a lectotype had already been selected by Léonard (1951: 441), who selected 5284.

Specimens examined

GABON, Estuaire: Crystal Mountains, Mbe National Park, S of Mont Mbilan, 400m, 0°27.3' N, 10°15.2' E, 10 February 2005 (fl), *Leal* 250 (MO, WAG); Crystal Mountains, 0°34' N, 10°27' E, 12 March 2001 (st), *Nguema Miyono* 1774 (LBV, WAG); between Ntoum and Donguila, 0°15' N, 9°47' E, 20 May 1986 (fl), *Reitsma* 2277 (LBV, WAG); Crystal Mountains, c. 0°30' N, 10°30' E, September 1959 (st), *de Saint Aubin* *SRFG* 2005 (LBV); **Moyen-Ogooué:** mission Otouma, 0°13' N, 10°55' E, 18 January 1992 (fl), *Dibata* 937 (K, MO, P, PRE, UPS, WAG); Crystal Mountains, Chantier CEFA (Compagnie Exploitation Forestière

Africaine), Abanga, c. 0°05' S, 10°35' E, 5 June 1963 (fl), *N. Hallé 2243* (P, WAG); Lac Oguémoué, c. 1°05' S, 10°00' E, 10 December 1953 (st), *Nze SRFG 1236* (LBV, P); **Ngounié**: between Rabi-Kounga and Yeno, c. 1°48' S, 10°00' E, 15 May 1992 (fr), *Breteler 11469* (LBV, MO, WAG); entre Dibwangui & Issala, c. 2°03' S, 11°37' E, 25 April 1925 (fl), *Le Testu 5284* (B, IFAN, K, P); Mimongo, c. 1°10' S, 11°35' E, 5 April 1926 (fl), *Le Testu 5890* (BR, P, WAG); Chantier Leroy, route Mouila-Yeno, c. 1°59' S, 11°19' E, 11 February 1988 (fl), *A.M. Louis 2721* (LBV, MO, PRE, WAG); St. Martin, c. 1°41' S, 10°56' E, 13 June 1939 (fl), *Walker s.n.* (P, WAG); 15 km on road Ikobey to Bakongue, 400m, 1°02.41' S, 11°04.24' E, 29 November 2001 (fl, fr), *Wieringa 4493* (BR, E, K, LBV, MA, MO, WAG); upper Waka valley, IFL forestry camp, 200m, 1°12.92' S, 10°52.24' E, 27 March 2004 (fl), *Wieringa 5094* (BP, BR, E, G, K, LBV, LISC, MA, MO, P, WAG, YA); 39 km on the road Mouila - Yéno, 250m, 1°45' S, 11°18' E, 6 February 1991 (fl), *J.J.F.E. de Wilde 10378* (G, IEC, LBV, MPU, WAG); Massif de Koumounabwali, 260m, 1°18.9' S, 10°26.3' E, 12 December 1996 (fl), *J.J.F.E. de Wilde 11756* (LBV, WAG); vallée de la Waka, 20km ENE du confluent Ngounié-Waka, 1°19' S, 10°55' E, 23 February 1986 (fl), *Wilks 1216* (E, LBV, MO, WAG); **Nyanga**: route d'exploitation CEB, Monts Doudou ± 50 km W de Doussala, 2°20' S, 10°25' E, 16 April 1987 (fl), *Dibata 132* (LBV, MO, PRE, WAG); 32 road-km N of Igotchi-Mouenda, Bakker timber concession, 250m, 2°41' S, 10°30' E, 12 May 1997 (fl), *McPherson 16959* (LBV, MO, WAG); chantier CEB, Doussala, c. 25 km SSW of Doussala, c. 2°30' S, 10°40' E, 16 May 1985 (fl), *Reitsma 972* (WAG); chantier CEB, ca 50 km SW of Doussala, 480m, c. 2°36' S, 10°35' E, 12 June 1985 (fl), *Reitsma 1137* (LBV, WAG); c. 50 km SW of Doussala, 2°33' S, 10°32' E, 16 April 1987 (fl), *Reitsma 3272* (LBV, WAG); exploitation CEB ± 50 km W de Doussala, 2°20' S, 10°25' E, 18 April 1987 (fl), *Wilks 1516* (MO); **Ogooué-Maritime**: Rabi, c. 1°55' S, 9°52' E, 13 October 2002 (fr), *Bourobou 1021* (LBV, LBV, MO, P, WAG); Rabi, near Shell camp, c. 1°57' S, 9°53' E, 24 March 1990 (fl), *Breteler 9452* (BM, BR, C, G, K, LBV, MO, P, PRE, WAG); Rabi, c. 1°55' S, 9°50' E, 5 April 1990 (fl), *Breteler 9809* (BR, G, LBV, MO, WAG); Rabi-area, c. 1°55' S, 9°52' E, 19 May 1992 (fl, fr), *Breteler 11534* (BR, E, HUI, K, LBV, MO, PE, WAG); Rabi-Kounga, c. 1°54' S, 9°52' E, 8 July 1998 (fl), *Breteler 14351* (BR, E, K, LBV, MO, WAG); Rabi-Kounga, near Rabi 22, 40m, 1°54' S, 9°52' E, 21 January 1994 (fl), *Burgt 1* (BR, IAGB, LBV, MO, WAG); Rabi-Kounga, near Shell camp, 50m, 1°57' S, 9°53' E, 22 January 1994 (fl), *Burgt 2* (LBV, WAG); Rabi-Kounga, near Rabi 53, 30m, 1°55' S, 9°51' E, 6 January 1994 (fl), *Haegens 247* (E, LBV, MO, WAG); Loango National Park, c. 2 km south of Rabi village, 15m, 1°54.4' S, 9°35.1' E, 9 May 2005 (st), *D.J. Harris 8501* (E, LBV, WAG); Rabi-NE, near checkpoint Est, 1°52' S, 9°58' E, 17 November 1990 (fl), *van Nek 369* (WAG); Rabi-Kounga, between runway and Chamod camp, c. 1°56' S, 9°53' E, 14 January 1992 (fl), *Schoenmaker 338* (BR, E, HUI, K, LBV, MO, PE, PH, WAG, YA); Rabi-Kounga, 12 km on road 'Checkpoint Charlie' to Dianongo, 30m, 1°47' S, 9°50' E, 25 May 1992 (fl), *Wieringa 1045* (C, FHO, LBV, MO, WAG); road between Shell oil-exploitations Rabi and Echira, 50m, 2°00.6' S, 9°49.7' E, 7 March 1994 (fl, fr), *Wieringa 2413* (BR, C, E, FHO, G, IAGB, IEC, K, LBV, MA, MO, MPU, P, PRE, WAG, YA, Z); Rabi, 0.6 km on the road to Rabi 78, 50m, 1°55.1' S, 9°50.8' E, 25 March 1994 (fl, fr), *Wieringa 2579* (BR, C, E, FHO, G, IAGB, IEC, K, LBV, MA, MO, MPU, P, PRE, WAG, Z); foothills of Doudou Mts, 300m, c. 2°17' S, 10°30' E, 13 March 1988 (fl), *J.J.F.E. de Wilde 9328* (BR, C, K, LBV, MA, MO, P, PRE, WAG); foothills of Doudou Mts, 300m, c. 2°17' S, 10°30' E, 13 March 1988 (st), *J.J.F.E. de Wilde 9329* (WAG); Rabi, Shell/Gabon basecamp, 50m, 1°56.9' S, 9°52.8' E, 23 January 1993 (fl), *J.J.F.E. de Wilde 10926* (WAG); **Woleu-Ntem**: Crystal Mountains, 25m on transect D, 0°37' N, 10°25' E, 20 November 2000 (st), *Nguema Miyono 1382* (LBV, WAG); Crystal Mountains, 275m on transect D, 0°37' N, 10°25' E, 20 November 2000 (st), *Nguema Miyono 1387* (LBV); Tchimbélé, 0°36.8' N, 10°24.2' E, 8 April 2004 (fl), *Nzabi 62* (BR, K, LBV, MO, P, SCA, WAG, YA); Crystal Mountains, 250m on transect D, 0°37' N, 10°25' E, 20 November 2000 (st), *Obiang Mbomio 15* (LBV); Mbe National Park, Monts de Cristal, Tchimbele Dam area. Plot 2, 300m, 0°37.1' N, 10°24.6' E, 1 April 2004 (st), *SIMAB series 20905* (MO); Tchimbélé, c. 500 m of hydro-electric power plant, 510m, 0°37' N, 10°25' E, 9 February 2001 (st), *Tabak 16* (LBV, MO, WAG); just S of Tchimbélé dam, 500m, 0°37' N, 10°24' E, 24 April 1990 (fl), *Wieringa 753* (BR, C, E, G, IEC, K, LBV, MO, MPU, PRE, WAG).

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