

Novitates Gabonenses 86. The *Begonia clypeifolia* complex (Begoniaceae) unravelled

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Background – The acquisition of more data on the highly variable species *Begonia clypeifolia* Hook.f., necessitated a review of the taxonomic situation.

Methods – A detailed morphological study was performed on herbarium material. Standard practices of herbarium taxonomy have been applied. Preliminary assessments of the IUCN Red List categories of threat were performed using the IUCN criteria and guidelines.

Key results – The material revealed the existence of two new species and two new subspecies. All are endemic to the notoriously species-rich region between southern Cameroon and southwestern Republic of the Congo. The new taxa are: *B. monte-alenensis* Sosef (IUCN status Vulnerable under criterion D2), *B. puberula* Sosef (IUCN status Critically Endangered under criterion B2), *B. clypeifolia* subsp. *mayombensis* Sosef (IUCN status Endangered under criterion B1 and B2) and *B. clypeifolia* subsp. *celer* Sosef (IUCN status Vulnerable under criterion B1 and B2). The morphological distinctions between these taxa and *B. clypeifolia* subsp. *clypeifolia* (IUCN status Least Concern) are discussed, their distribution and habitat types are provided as well as a citation of all specimens studied.

Conclusions – The five new hypotheses about taxonomic distinctions within the *B. clypeifolia* complex, now based upon a thorough morphological study, should preferably be tested using molecular methods.

Key words – Africa, *Begonia*, Begoniaceae, Equatorial Guinea, Gabon, IUCN Red List, Republic of the Congo, *Scutobegonia*, taxonomy.

INTRODUCTION

Begonia clypeifolia Hook.f. is a member of *Begonia* section *Scutobegonia* Warb., characterized by plants being rhizomatous, flowers in a strongly contracted cincinnal monochasium, both male and female flowers with two, often yellow, perianth segments, a zygomorphic androecium, indehiscent fruits curving down towards the substrate and tertiary veins with a sclerenchymatous sheath (adding a protruding reticulate pattern to the leaves in dry condition) (Doorenbos et al. 1998, Sosef 1994). After the taxonomic revision of the section *Scutobegonia* (Sosef 1994), a single new species was discovered (Sosef & Leal 2002) bringing the total number of species in this section to 22. *B. clypeifolia* has its distribution centred in the Central African country of Gabon, which is not only notoriously rich in *Begonia* species (Sosef 1996), but is also believed to harbour the most species-rich lowland rain forest in the whole of tropical Africa (Sosef et al. 2006, Estrella et al. 2012, Küper et al. 2004, Ntore et al. 2009). Outlier populations of *B. clypeifolia* are found to the North in southern Cameroon and Equatorial Guinea and to the South

in the Republic of Congo (Sosef 1994, de Wilde & Sosef 2009).

B. clypeifolia is fairly easy to recognize based on its more or less shallowly obtriangular ovary and fruit, smooth leaves with an entire to shallowly sinuate-dentate margin, and the lack of long hairs on the ovary and fruit as well as on the petiole and veins. The remarkably high morphological variation within *B. clypeifolia* was already noted in the extensive treatment by Sosef (1994) and later in the Flore du Gabon (de Wilde & Sosef 2009). This variation concerns notably the colour of the flowers (yellow or white) and ovaries (white to pale green to brown, dark red or pink), plants that produce flowers at the end of a long runner before the leaves appear, plants with velvety 2-winged fruits, plants with peltate and others with non-peltate leaves, and a few collections comprising large plants with extremely large bracts. This seems sufficient to suspect that this ‘species’, in its present concept, in fact comprises a ‘complex’ of taxonomic elements. In 1994, I decided not to grant any of these elements a distinct taxonomic status, mainly because of the few collections

available, and given that it could not be excluded that these variations were the result of an occasional hybridization event (Sosef 1994). At present, more material has become available, making it possible to sufficiently back-up several new taxonomic decisions.

Best would be of course to perform an additional detailed molecular study, using the organelle and nuclear genomes to discover the phylogenetic relationships present within and among the various populations. However, lack of sufficient samples as well as time and funding constraints forced me to limit this study to a thorough morphological examination. I do express the hope, however, that in the future my conclusions, actually taxonomical hypotheses (Wheeler & Valdecasas 2007), will be tested using molecular data.

The various morphological entities recognized within the *Begonia clypeifolia* complex are discussed one by one in the Results section below, along with the taxonomic consequences, if any. In all, two new species and two new subspecies are described, thus raising the number of species within the section *Scutobegonia* to 24.

MATERIAL AND METHODS

To analyse patterns of morphological variation, standard herbarium techniques were used. Material from the following herbaria was studied: BR, BRLU, LBV, MO, P, WAG. All acronyms of herbarium collections follow Index Herbariorum (Thiers 2013). Apart from the total of 104 dried herbarium specimens, additional observations took place during field work in Gabon in 2005, 2007 and 2009, and in 2011 in the glasshouse of Mr. Jacky Duruisseau, Bois, Charente Maritime, France.

All herbarium specimens were databased using BRAHMS (Botanical Research And Herbarium Management System) version 7.2, available from <http://herbaria.plants.ox.ac.uk/bol>. The BRAHMS mapping facility was used to export files to ArcView GIS (©) version 3.3 from which the dot maps were created.

The assignments of the IUCN Red List categories of threat (IUCN Species Survival Commission 2012) follow the IUCN guidelines (IUCN Standards and Petitions Subcommittee 2013) and were performed using the add-in script developed by Moat (2007). Grid cell size to calculate the AOO was chosen according to the specific situation of each taxon, but always between 1×1 and 3.3×3.3 km, so the AOO of a species known only from a single subpopulation does not exceed 10 km², which would otherwise render it impossible to assess any species as being critically endangered under criterion B2.

RESULTS

As stated above, the most striking variation within the *B. clypeifolia* complex can be found in the flower colour, the indumentum, the size of leaves and bracts, the inflorescence being borne at the apex of runners, the leaves being peltate or basifixed, and the colour of the fruit. These characters are all subsequently discussed below.

Flower colour

During the years 1999–2002, staff of the BRLU herbarium at Brussels collected several specimens in the Monte Alén region in Equatorial Guinea which showed characteristics of *B. clypeifolia*, but were unusual in having white flowers, a feature not yet recorded for this species. The phenomenon of having either yellow or white perianth segments within the same species is not uncommon in *Begonia* section *Scutobegonia* or its related section *Loasibegonia* A.DC. (*B. hirsutula* Hook.f. and *B. lacunosa* Warb. in the first and *B. heterochroma* Sosef and *B. atroglandulosa* Sosef in the last). However, at first glance the specimens also appeared to have strikingly large flowers and leaves with a more elongated shape than ‘regular’ *B. clypeifolia*. A closer look at this material led to several other differences with true *B. clypeifolia*, summarized in table 1. Although the specimens show some overlap in the leaf blade ratio and size of the male perianth segments, the white colour of the perianth segments, the pale green bracts and the geographical restriction of the material to the Monte Alén region, are convincing enough to treat this material as a distinct species: *Begonia monte-alenensis* Sosef. There are, however, three specimens from the same region that challenge this conclusion. The first two, *Leal* 847 and *Stévert* 1408, from the same locality, have slightly broader leaves, but pale bracts and very large flowers (perianth segments of male flowers up to 33×31 mm) of which the label indicates that they are respectively “yellow” and “yellowish” (probably indicating a pale yellow colour). The third, *Senterre & Obiang* 3761, has the characteristic narrow leaves of our new species, but otherwise shows the dark bracts and smaller, yellow perianth segments characteristic for *B. clypeifolia*. Because the latter species also occurs within the Monte Alén region (see figs 1 & 5), I expect that some hybridization has taken place causing the occurrence of such ‘intermediate’ specimens and I feel comfortable in treating the white-flowered specimens as a distinct new species.

Begonia monte-alenensis Sosef, sp. nov.

Similar to *Begonia clypeifolia* but flowers with white and usually larger perianth segments, on usually longer pedicels, leaves usually narrower and bracts pale green. – Type: Equatorial Guinea, Rio Muni, Engong (Parc Nat. de Monte Alén), à 5 km au NO du village d’Engong, $1^{\circ}37'29''$ N $10^{\circ}18'05''$ E, 20 Jul. 2001, alt. 1110 m, *Stévert* 1055 (holo-: WAG; iso-: BRLU).

Rhizomatous plants up to 35 cm high; rhizome with the apical part curving upwards to form a more or less distinct stem of up to 15 cm long. *Stipules* triangular, 3–10 mm long. *Leaves* peltate; petiole 5–27 cm long, purplish red, set with a minute puberulence of glandular hairs but lacking any long hairs; blade in a more or less horizontal position, asymmetrical, narrowly elliptic-ovate, $10\text{--}21.5 \times 3\text{--}7.5$ cm, length/width ratio 2.6–3.5, apex long-acuminate, margin shallowly dentate, upper surface dark green to dark purplish green, shiny, lower surface paler; main veins below green, indumentum like the petiole, tertiary veins creating a protruding reticulate pattern in dry condition. *Inflorescence* a strongly contracted cincinnal monochasium with 2 male flowers and 1 female one; peduncle simple, 1–2 cm long; bracts ovate to

Table 1 – Characters distinguishing *B. clypeifolia* and *B. monte-alenensis*.
Based on 85 and 5 collections respectively.

character	taxon	
	<i>B. clypeifolia</i>	<i>B. monte-alenensis</i>
length/width ratio of leaf blade	(1.3–)1.5–2.3(–2.7)	2.6–3.5
bracts colour	brown-red to dark red	pale green
colour of perianth segments	yellow	white
female flower: pedicel length (mm)	1–11(–15)	11–16
male flower: pedicel length (mm)	6–18	12–26
male flower: size of perianth segments (mm)	6–15(–18) × 6–13(–16)	15–29 × 16–20
female flower: size of perianth segments (mm)	6–15(–18) × 6–15	15–22 × 12–20

triangular-ovate, 2–6 mm long, pale green. Male flower with its pedicel at anthesis 12–26 mm long; perianth segments 2, more or less circular, 15–29 × 16–20 mm, white; androecium zygomorphic, with 22–25 stamens, filaments fused at base, anthers opening by longitudinal slits. Female flower similar to the male, but pedicel 11–16 mm long; perianth segments 15–22 × 12–20 mm; styles 3, 3–6 mm long, the top V-shaped and with an only slightly curved slender stigmatic band; ovary green, set with a minute puberulence of glandular hairs but lacking any long hairs, the locular part globose, 3–5 mm in diameter, with a short beak and three patent elliptic wings with rounded tips. Infructescence with its peduncle recurved towards the substrate; fruit indehiscent, pendulous, the locular part c. 6 × 7 mm, wings up to 8 mm long. Electronic appendix 1.

Distribution – Endemic to the Monte Alén region in Equatorial Guinea (see fig. 1).

Habitat – Primary submontane rain forest, on slight slope, on deep, well-drained soil, also on rocks, at 730–1110 m altitude.

Etymology – The species seems to be endemic to the Monte Alén National Park and its direct surroundings, hence the name.

IUCN Conservation Status – VU D2. Because the populations are found at comparatively high elevation, sometimes on the very summit of hills or low mountains, the grid cell size was set to 1 × 1 km. The extent of occurrence (EOO) is estimated to be 333 km² (i.e. less than the 5,000 km² upper limit of the endangered category under criterion B1) and its area of occupancy (AOO) is about 5 km² (which falls within the limits of the critically endangered category under criterion B2). All five known collections are from within the boundaries of the Monte Alén National Park. This species is known from four subpopulations that represent four locations. Criterion B2 could not be applied (number of locations is 4, but no continuing decline nor extreme fluctuations). We could have opted for EN under criterion B1. However, regarding the fact that no immediate threat seems to be present, this was not deemed a suitable category. Then, because of the extremely restricted AOO (< 20 km²) and only 4 locations, stochastic events (storms, fire, landslides, etc.) could easily render the species critically endangered or even extinct, and

hence the Vulnerable category under criterion D2 should be applied.

Other collections examined – Equatorial Guinea: Région continentale, Parc Nat. de Monte Alén, 3 km NO de Engong, 1°37'N 10°19'E, 3 Jan. 1999, *Lejoly* 99/154 (BRLU); SO du Parc National de Monte Alén, 2 km au NE du site de traversée du rio Uolo pour aller aux cataractes, 1.61049°N 10.09207°E, 21 Jun. 2002, *Senterre & Nguema* 2942 (BRLU); SE du Parc National de Monte Alén, au S de rio Laña, près de la Cabaña Ecofac de Misergue, 1.43838°N 10.20629°E, 13 Jul. 2002, *Senterre & Obiang* 3314 (BRLU); SE du Parc National de Monte Alén, 2 km au NE du transect Ecofac de Nkumékié, vers 5 km de l'origine, 1.50348°N 10.31723°E, 8 Dec. 2002, *Senterre & Obiang* 3678 (BRLU).

Velvety indumentum

In my 1994 publication, I mentioned a specimen, *Hallé & Villiers* 5181, collected in 1968 in the Monts de Cristal in Gabon, that stood out from the rest of the *B. clypeifolia* material because of its large and almost circular leaf blades and a velvety/puberulous indumentum on the 2-winged fruits. I could not rule out that this was a strange mutation or hybrid. However, in 2001, Norberto Nguema Miyono collected two other specimens from another locality in the same region exactly matching the characters of the previous specimen, providing reason to regard this material as a distinct taxon. Closer examination of the material revealed that the leaf blades are almost symmetrical (asymmetrical or occasionally almost symmetrical in *B. clypeifolia*) while the inflorescences are borne on the apical part of a distinct leafless part of the rhizome (see also fig. 5). It shares the latter characteristic with the new *B. clypeifolia* subsp. *celer* described below. Because of the presence of at least four differentiating characters, viz. leaf shape (and symmetry), indumentum, position of the inflorescence and 2-winged instead of 3–4-winged fruit, it seems best to grant this taxon distinction at species level. Its formal description is provided here.

***Begonia puberula* Sosef, sp. nov.**

Similar to *Begonia clypeifolia* but with almost circular and only slightly asymmetrical leaf blades, a puberulous indumentum on rhizome, petiole, inflorescence and fruit, and a 2-winged ovary and fruit. – Type: Gabon, Monts de Cristal,

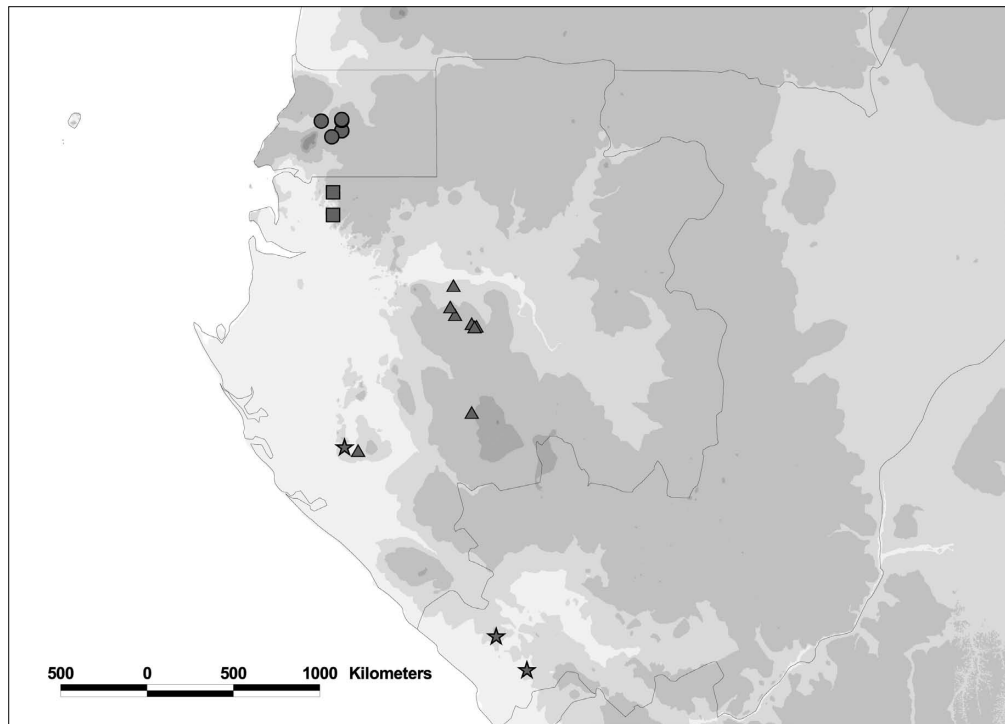


Figure 1— Distribution of *Begonia monte-alenensis* (circles), *B. puberula* (squares), *B. clypeifolia* subsp. *mayombensis* (asterisks) and *B. clypeifolia* subsp. *celer* (triangles).

Mont Mvélakéné, 0°35'N 10°13'E, 10 Feb. 1968, *Hallé & Villiers* 5181 (holo-: P, barcode P00692605; iso-: P, barcode P00692606).

Rhizomatous plants up to 50 cm high, with a puberulous indumentum on the rhizome, stipules, apical part of petioles, leaf blade main veins below, peduncle, bracts, pedicels, ovary, outer surface of perianth segments and fruit; rhizome horizontal, c. 9 mm in diameter (when fresh), the part forming an inflorescence ascending. *Stipules* triangular, 3–10 mm long. *Leaves* peltate; petiole (12–)20–50 cm long, reddish, set with a minute puberulence of glandular hairs; blade in a more or less horizontal position, almost symmetrical, broadly ovate to almost circular, (14–)17–25 × (9–)12–17 cm, length/width ratio 1.3–1.5, apex shortly acuminate, margin smooth to shallowly sinuate-dentate; main palmate veins 7–8, tertiary veins creating a protruding reticulate pattern in dry condition. *Inflorescence* borne on the apical part of a distinct leafless part of the rhizome, a strongly contracted cincinnal monochasium with 2–4 male flowers and 1 female one; peduncle simple, 2–6 cm long; bracts elliptic, 4–5 mm long, dark red. *Male flower* with its pedicel at anthesis 8–15 mm long; perianth segments 2, more or less circular, 7–8 × 6–7 mm, red outside, inside yellow to orange-yellow; androecium zygomorphic, with c. 22 stamens, filaments fused at base, anthers opening by longitudinal slits. *Female flower* similar to the male, but pedicel up to 6 mm long; perianth segments 8–11 × 7–9.5 mm; styles 2 or 3, 4–5.5 mm long, the top V-shaped and with an only slightly curved slender stigmatic band; ovary red: the locular part obovate, 4–5 × 2–3 mm, beak absent, two triangular wings attached to its apical half and perpendicular to the ovary or pointing upwards. *Infructescence* with its peduncle recurved towards the substrate; fruit inde-

hiscent, pendulous, more or less cupuliform in outline, dark red, the locular part 8–14 × 5–8 mm, wings up to 7 mm long. Electronic appendix 2.

Distribution – Endemic to the western part of the Crystal Mountains, northwestern Gabon (see fig. 1).

Habitat – Primary or secondary forest.

IUCN Conservation Status – CE B2ab(ii,iii,iv,v). The fact that the Crystal Mountains have been visited frequently by *Begonia* specialists, but still only three collections exist, clearly indicates the species is extremely rare and that occurrences are highly scattered. Knowing about the poor seed dispersal potentials (see Sosef 1994: 79–80), the subpopulations are severely fragmented (criterion B2a). Because of its restricted distribution, grid cell size was set to 1 km². The AOO = 2 km² (CE) and number of subpopulations is 2 (EN). EOO could not be calculated. The northern subpopulation lies within the boundaries of the Monts de Cristal National Park, but the southern one falls within a timber logging concession and is thus under risk of decline. The number of locations is 2 (criterion B2a), since both known subpopulations occur in the same ecologically distinct area (Crystal Mountains) but do not face the same threat. The projected ongoing loss of its habitat leads us to predict a continuous decline of number of subpopulations and mature individuals and thus also of its AOO. In conclusion, the combination of a very small AOO, a severely fragmented subpopulations and their continuous decline justify a risk of extinction assessment of critically endangered.

Other collections examined – **Gabon**: Estuaire Prov., Crystal Mountains, 23750 m on transect F, 0°50'N 10°13'E, 20 Jan. 2001, *Nguema Miyono* 1673 (LBV, WAG); Estuaire Prov., Crystal Moun-

tains, 100 m on transect F12, 0°50'N 10°13'E, 20 Jan. 2001, *Ngue-ma Miyono* 1676 (LBV, WAG).

Large leaves and bracts

Already in my 1994 revision (Sosef 1994), a peculiar specimen from the Mayombe hills in the South-West of the Republic of the Congo (*Barabé et al.* 85-1) was mentioned, which stood out because of its large leaves, stipules and bracts. Meanwhile, two additional specimens showing these peculiar character states were collected, one from the same region and one from the Doudou Mountains in southwestern Gabon which belong to the same geological formation (Thibault et al. 2004). This Mayombe chain is postulated to represent one of the Pleistocene rain forest refuge areas (Sosef et al. 1994, 2004) and hence the three specimens are geographically clustered rendering it more likely they represent a historical entity. As such, it deserves taxonomic recognition.

Table 2 shows the morphological differences between this taxon and typical *B. clypeifolia*. Apart from that, the size of the stipules, though large in the new taxon (12–17 × 9–12 mm), overlaps with those of typical *B. clypeifolia*. The material is also uniform in having a smooth leaf margin, but again this state can also be found in *B. clypeifolia* subsp. *clypeifolia*. Thus, the new segregated taxon exceeds *B. clypeifolia* especially in size of various organs, while only the size of the bract shows no overlap, and a distinction at a level below the species seems most appropriate. Because of the geographical separation, indicating a certain degree of

population integrity, the level of subspecies is deemed most appropriate here.

Begonia clypeifolia Hook.f. subsp. *mayombensis* Sosef, subsp. nov.

Similar to subsp. *clypeifolia*, but petioles 20–40 cm long; leaf blades 20–30 × 9–18 cm, with a blunt to shortly acuminate apex, shiny dark green above, margin smooth; bracts ovate, 11–28 mm long, dark red; fruit on a pedicel up to 15 mm long, dark red, the locular part 9–15 mm across, with wings up to 18 mm long. – Type: Gabon, Ogooué-Maritime Prov., plateau southern summit Mt. Igoumbi, 1°56.43'S 10°20.67'E, alt. 770 m, 19 Apr. 2005, *van Valkenburg et al.* 3122 (holo-: WAG; iso-: BR, LBV). Fig. 2.

Distribution – The Mayombe hills in southwestern Republic of the Congo and the Doudou Mountains (Mt. Igoumbi) in southwestern Gabon (see fig. 1).

Habitat – Primary rain forest, relatively open, submontane forest on summit (canopy at 15 m), near source of a small stream, at 770 m altitude.

IUCN Conservation Status – EN B1+B2ab(i,ii,iii,iv). Because of its restricted distribution and apparent rareness (only three known collections), the grid cell size was set to 1 km². The EOO = 490 km², AOO = 3 km² and number of subpopulations is 3. Because one of the three known collections (*R. Becker* 979) has no exact locality, the exact EOO is uncertain. Despite this, this subspecies is probably very rare, its EOO is well below 5000 km² (criterion B1) and the number of locations is 3 (criterion B2a). The only known



Figure 2 – *Begonia clypeifolia* Hook.f. subsp. *mayombensis* Sosef. Photograph showing fruits and large bracts of the type collection *van Valkenburg et al.* 3122 (photograph by J.L.C.H. van Valkenburg).

Gabon collection is from an isolated hill top within the Doudou Mountains National Park. The two collections from the Republic of the Congo are from the unprotected Mayombe forest, known to be subjected to a high rate of degradation mainly through heavy logging. Therefore, EOO, AOO, habitat quality and number of subpopulations are likely to decline (criterion B2bi,ii,iii,iv) and hence the Endangered category seems most appropriate.

Other collections examined – Republic of the Congo: Mayombe, M'Vouti, 4°15'S 12°29'E, 12 Oct. 1985, *Barabé et al.* 85-1 (WAG); Mayombe, sine loc., Mar. 2010, *R. Becker* 979 (WAG).

Note – I hesitate in adding a specimen brought into cultivation by the begonia amateur Mr. Jacky Duruisseau from Bois, southern France. This specimen, originating from the Méla – Asok road, Crystal Mountains in northwestern Gabon (and so from a different area than the others), and which I saw in his glasshouse in 2011, definitely has the large (c. 12 mm long) and dark red bracts characteristic for subsp. *mayombensis* and has leaf blades of c. 23 × 14 cm. However, the fruits are light green while the leaves are not peltate and have a dentate margin. Although I regards none of these features in itself as being sufficient for taxon distinction within this group (see also below), the fact that they are combined in one specimen as opposed to a small group of others, makes me decide, for the moment, not to regard it as belonging to this subspecies. It could also be that, since structures such as bracts tend to shrink when preserved as a herbarium collection, the bract size falls only just outside the normal range of subsp. *clypeifolia*. Material with similarly shaped leaves but smaller bracts and collected in the same region (Crystal Mountains) is available (for example *Leal* 270, *N.S. Nguema* 1944). The cultivated specimen illustrates well the complexity of the taxonomy of this species group, and the limitations of creating a sound taxonomic framework based on morphological observations alone.

Flowers at apex of runners

This concerns several herbarium specimens which show horizontal rhizomes ('runners') that produce a peduncled inflorescence at their apex before the leaves are formed. The normal situation within *Begonia* section *Scutobegonia* is that the rhizome produces leaves at regular intervals, and eventually one or a few inflorescences from the axils of those in the apical part, after which the rhizome continues to produce only leaves. The same phenomenon, flowers at the apex of 'naked' runners, was observed in the new species *B. puberula* described above. In total, eight collections were located that show this feature, six of which originate from the Lopé Reserve in central Gabon, the seventh is from the northern part of the Doudou Mountains in southwestern Gabon, and the eighth from the Chaillu Massif south of the Lopé Reserve. Four of the Lopé collections share the presence of fairly broad (length/width ratio 1.3–1.6) leaf blades with a rounded apical part and shortly acuminate apex (rather than the more common situation of a gradually tapering to slightly acuminate apical part), although in typical *B. clypeifolia* similar leaf shapes are occasionally present. In sterile samples the position of the inflorescence cannot be established and a few specimens might therefore not be recognized as belonging to

this taxon. After thorough investigation, no additional distinctive morphological features could be identified. Therefore, as only a single character is present to differentiate between typical *B. clypeifolia* and this deviating material, a taxonomic distinction at infraspecific level is most appropriate. Because the phenomenon does seem to be preserved in distinct geographical populations, it seems best to grant this taxon the status of subspecies.

Begonia clypeifolia Hook.f. subsp. *celer* Sosef, subsp. nov.

Similar to subsp. *clypeifolia*, but with the inflorescence borne on the apical part of horizontal rhizomes before the appearance of the leaves; leaf blade usually broadly elliptic to broadly elliptic-ovate, 12–20 × 6.5–14 cm, with a rounded occasionally slightly acuminate apical part, apex generally shortly acuminate. – Type: Gabon, Réserve de la Lopé, chantier SOFORGA, 0°30'S 11°33'E, 19 Jun. 1986, *J.M. Reitsma & B. Reitsma* 2319 (holo-: WAG; iso-: LBV, NY, WAG). Electronic appendix 3.

Distribution – Endemic to Gabon, most collections are from the Lopé National Park (Ogooué-Ivindo Province) with one from the Chaillu Massif and one from the northern part of the Doudou Mountains (both Ngounié Province) (see fig. 1).

Habitat – Primary rain forest, on level soil to steep bank of dry creek, at 210–550 m altitude.

IUCN Conservation Status – VU B1+B2ab(i,ii,iii). Because the taxon seems fairly widespread within Gabon, grid cell size was set to 3.3 × 3.3 km. Number of subpopulations is 7, EOO = 12,733 km², AOO = 70 km². The number of locations (geographically or ecologically distinct area where a single threatening event can rapidly affect all individuals) is estimated to be 6, based on personal field knowledge, which matches the VU category under criterion B2a. Although most of the localities lie within the boundaries of the Lopé National Park and the Doudou Mountains National Park, logging for timber does take place within the first. Thus a decline in EOO, AOO and general habitat quality is likely (criterion B2bi,ii,iii) which, in combination with the relatively small EOO (criterion B1) and AOO (criterion B2), then validates the assignment of the Vulnerable category.

Etymology – The Latin subspecies name meaning 'swift', refers to both the rapidly growing runners and to the fact that they swiftly produce an inflorescence even before the appearance of the leaves.

Other collections examined – Gabon: Ogooué-Ivindo Prov., Lopé Forest Reserve, 0°11'S 11°32'E, 20 Jul. 1998, *Leal* 68 (WAG); Massif du Chaillu, along road Mimongo – Koulamoutou, between Dibandi and Diyanga, 20–30 km NE of Mimongo, 1°34'S 11°44'E, 27 Nov. 1983, *A.M. Louis et al.* 945 (WAG); Lopé Reserve, chantier Leledi (SOFORGA), 0°25'S 11°30'E, 27 May 1987, *J.M. Reitsma et al.* 3549 (LBV, WAG); Ogooué-Ivindo Prov., Réserve de la Lopé, Chantier Mitendi, 0°36'S 11°44'E, 20 Oct. 1999, *Sosef et al.* 524 (LBV, WAG); Ogooué-Ivindo Prov., Réserve de la Lopé, Chantier Mitendi, ca 13 km Sud du campement, 0°38'S 11°46'E, 22 Oct. 1999, *Sosef et al.* 631 (LBV, WAG); Ngounié Prov., logging road CBG concession eastward of Peni, 1°58.90'S 10°29.50'E, 20 Apr. 2005, *van Valkenburg et al.* 3139 (BR, E, K, LBV, MO, WAG); Ogooué-Ivindo Prov., SE part of Lopé Reserve, 0°37.6'S 11°47.1'E, 27 Dec. 1996, *J.J. de Wilde* 11834 (WAG).

Leaves peltate or basifixed

Within the genus *Begonia*, the fact of whether a leaf is peltate or has the petiole attached to the margin of the blade is often seen as an important character distinguishing species or even groups of species (for example Doorenbos et al. 1998, Golding & Wasshausen 2002). It also, for example, figures as the first question in my key to the species of *Begonia* sections *Loasibegonia* and *Scutobegonia* (Sosef 1994). As such, it is rare to see both states within a single species, even within the section *Scutobegonia*. In 1994, I have accepted the presence of both states within *B. clypeifolia*, but in the context of this new study it seems appropriate to re-evaluate this decision.

Out of a total of 81 available collections of *B. clypeifolia* subsp. *clypeifolia*, thirteen collections represent the form with basifixed leaves. Thus, the state is uncommon, but not rare. Already at a first glance, the variation amongst this material is striking. Leaf size for example ranges from 8×3.5 cm to 26×8.5 cm with a length/width ratio of 1.5–3.2, and flowering plants range from small (7 cm tall) to very large (some 30 cm tall). Many other characters of leaves, flowers and fruits were examined, but no patterns could be observed and no distinction with the remainder of the *B. clypeifolia* subsp. *clypeifolia* material could be found. Finally, the collecting localities of the material with basifixed leaf blades were found to be scattered throughout the distribution range of *B. clypeifolia* subsp. *clypeifolia* and no geographical pattern could be distinguished. For an additional remark on a peculiar plant with large and basifixed leaf blades in cultivation, see *B. clypeifolia* subsp. *mayombensis* treated above.

From the above, we can only conclude that the occurrence of plants with basifixed leaves within this predominantly peltate-leaved species appears to arise from occasional mutations and does not deserve a taxonomic status. The same was concluded for several other species within *Begonia*

section *Scutobegonia* (*B. hirsutula* Hook.f., *B. mildbraedii* Warb. and *B. ciliobracteata* Warb.; Sosef 1994) where both peltate and basifixed forms can be found, further supporting this decision.

Fruit colour

From personal observations in the field and in the glasshouse at Wageningen, as well as from annotations on herbarium sheet labels, it is clear that the colour of the mature fruit of *B. clypeifolia* subsp. *clypeifolia* shows a striking variation. It can be white (Sosef 2567), pale green (Breteler & J.J. de Wilde 126, Hallé & Villiers 5330, A.M. Louis et al. 891, see fig. 3), green (A.M. Louis 3034), green with reddish wings (Breteler & J.J. de Wilde 45), brown (Breteler & J.J. de Wilde 263, Nzabi et al. 80), brown-red (Arends et al. 369, Arends et al. 688, Breteler 7687), dark (purplish) red (Breteler et al. 12982, Sosef et al. 524, Wieringa 935) or pink (Tchouto et al. 2622). Especially since the fruit colour seems uniform within at least the newly described *B. puberula* and *B. clypeifolia* subsp. *mayombensis*, such variation seems aberrant and may point to yet another hidden taxon. On the other hand, the labels accompanying specimens Wieringa 914 and 4550 specifically mention fruit colour to vary from pale green to medium green or pink-green and from pale green to greenish red, respectively. Again, after a thorough search for any other correlating morphological patterns, such could not be found. Furthermore, no correlation between fruit colour and geographic location could be identified. Finally, variation in fruit colour, though not as extreme as in our situation, does occur in even the majority of species belonging to *Begonia* section *Scutobegonia* (Sosef 1992, 1994). Therefore, we conclude that this taxon shows a remarkable variation in fruit colour. As to what may cause this, or whether certain colours occur under specific environmental conditions for example, we can at the moment only guess.



Figure 3 – *Begonia clypeifolia* Hook.f. subsp. *clypeifolia*, form with pale green ovary. Living plant at WAG, from collection Breteler 7687.

Description of *B. clypeifolia* subsp. *clypeifolia*

Because of the above taxonomic changes within what was formally recognized as a single taxon, it is appropriate to also provide a new and full description of the typical taxon.

Begonia clypeifolia Hook.f. subsp. *clypeifolia* (Hooker 1871: 576). – Type: Sierra del Cristal, W. Trop. Africa, Lat. 1°N, Jul. 1862, Mann 1648 (holo-: K).

Rhizomatous plants up to 25(–35) cm high, with scattered minute glandular hairs, often densely so on the petioles; rhizome with the apical part curving upwards to form a more or less distinct stem of up to 10(–20) cm. Stipules more or less triangular, 2–15(–17) mm long, generally dark red. Leaves peltate or occasionally basifixed; petiole 5–35 cm long, purplish red to brownish green, without or with very few long hairs; blade in a more or less horizontal position, distinctly to slightly asymmetrical, usually elliptic-ovate or broadly so, (6–)7–20(–25) × (3–)4–10(–13) cm, length/width ratio (1.3–)1.5–2.3(–2.7), apex gradually tapering to distinctly acuminate, base in basifixed leaves with one side rounded to cuneate and the other cordate to auriculate, margin entire to shallowly sinuate-dentate or less often coarsely dentate, upper surface medium to dark green, sometimes with a dark red to purplish margin, lower surface pale green, sometimes with a purplish tinge; main veins below dark red to brown-red or sometimes green, indumentum like the petiole, tertiary veins creating a protruding reticulate pattern in dry condition. Inflorescence positioned in between the petioles on the rhizome, a strongly contracted cincinnal monochasium with 2–4(–7) male flowers and 1(–2) female ones; peduncle simple, 0.5–5(–7.5) cm long; bracts ovate or triangular-ovate to elliptic, 2–8(–11) mm long, brown-red to dark red. Male flower: pedicel at anthesis 6–18 mm long; perianth segments 2, more or less circular, 6–15(–18) × 6–13(–16) mm, red to orange outside, yellow inside, the upper often with a red patch at its base; androecium zygomorphic, with (22–)30–48 stamens, filaments fused at base, anthers opening by longitudinal slits. Female flower: similar to the male but pedicel 1–11(–15) mm long; perianth segments 6–15(–18) × 6–15 mm; styles 3 or 4, 3–8 mm long, the top V-shaped and with an only slightly curved slender stigmatic band; ovary pale green to dark red or rarely whitish, lacking any long hairs, the locular part broadly obovoid to globose, 3–8 mm wide, without or with a short beak and 3 or 4 patent to erecto-patent elliptic to triangular or narrowly triangular wings. Infructescence: peduncle recurved towards the substrate; fruit indehiscent, pendulous, the locular part 6–13 mm wide, wings up to 8 mm long. Fig. 4.

Distribution – Centred in Gabon, with outlier populations in southwestern Cameroon, Equatorial Guinea and southern Republic of the Congo (see fig. 5).

Habitat – Primary or secondary rain forest, on steep slopes or banks, often along small streams or rivers, on humid but not inundated, clayey soils; at up to 1000 m altitude.

IUCN Conservation Status – LC. Because of the taxon being comparatively widespread, grid cell size was set to 3.16 × 3.16 km. The number of subpopulations is 43, EOO = 492,145 km², AOO = 619 km². Although this subspecies has a distribution restricted to Central Africa, the comparatively

high number of collections show it is fairly common and is widespread within that region. Thus, the Least Concern category seems most appropriate.

Other collections examined – **Cameroon**: South Province: Campo-Ma'an area, Mvini, Forest around Chantier B., 2°14.4'N 10°10.7'E, 19 Feb. 2000, G.P. Tchouto Mbatchesou 2622 (KRIBI, WAG, YA); Mvila Dept., Bingalanda Mountains, Arrond. Ebolowa, village of Nyangong, c. 2°57'N 10°44'E, 5 Dec. 1998, J.J. de Wilde 12096 (KRIBI, MO, WAG, WAG).

Republic of the Congo: Niari: Kuyi, piste Moukoudi-Malinga, c. 2°29'S 12°25'E, 23 Apr. 1977, P. Sita 4128 (WAG).

Equatorial Guinea: Rio Muni, Litoral: Monte Alén National Park, Monte Mitra, 1°22.8'N 9°57.2'E, 6 Oct. 2005, M.E. Leal 847 (MO, WAG); Rio Muni, Centro Sur: Mount Alén, c. 1°40'N 10°20'E, 28 Feb. 1998, J.J. de Wilde 12035 (BATA, WAG).

Gabon: Ngounié: Waka forest exploitation road, 1°18'S 10°57'E, 21 Nov. 1984, J.C. Arends 369 (LBV, WAG); Waka forest exploitation road, 1°18'S 10°57'E, 22 Nov. 1984, J.C. Arends 387 (LBV, WAG); Eastern foothills of the Doudou Mountains, 2°15'S 10°20'E, 7 Dec. 1984, J.C. Arends 688 (LBV, WAG); Parc des Monts de Cristal, le long de la rivière Mbé, piste après la case picnic sur la droite, 0°37'N 10°24'E, 13 Feb. 2010, P. Bissengou 969 (LBV, WAG); *ibid.*, P. Bissengou 970 (LBV, WAG); Parc des Monts de Cristal, vers antenne Celtel, après le petit barrage d'eau hydrolique, 0°38'N 10°24'E, 15 Mar. 2010, P. Bissengou 979 (LBV, WAG); 30 km Fougamou – Lambarené, 1°00'S 10°30'E, 26 May 1981, F.J. Breteler 7687 (WAG); Mouyanama falls, c. 20 km before Mimongo coming from Mbigou, 1°39'S 11°42'E, 29 May 1981, F.J. Breteler 7712 (WAG); 60 km Mouila to Yeno, 1°44'S 11°24'E, 21 Sep. 1986, F.J. Breteler 8065 (LBV, WAG); 12 km N of road Libreville – Kango, ancien concession Sogacel, 0°17'N 10°05'E, 2 Oct. 1986, F.J. Breteler 8314 (LBV, WAG); Crystal Mountains, 9 km S of Kingué, 0°24'N 10°15'E, 21 Sep. 1994, F.J. Breteler 12982 (LBV, MO, WAG); Ogooué-Lolo: Makande surroundings, c. 65 km SSW of Booué, Makande, 0°41'S 11°55'E, 9 Feb. 1999, F.J. Breteler 14982 (BR, E, HUI, K, LBV, MO, WAG); Estuaire: 13 km along the road Asok – Tchimbélé dam, 0°39'N 10°23'E, 15 Aug. 1978, F.J. Breteler & J.J. de Wilde 45 (BR, MO, WAG); Monts de Cristal, 12–15 km N.E. of Asok, 0°49'N 10°26'E, 18 Aug. 1978, F.J. Breteler & J.J. de Wilde 126 (WAG); Monts de Cristal, c. 9 km W of Asok, along a confluent of the Soung River, 0°42'N 10°15'E, 19 Aug. 1978, F.J. Breteler & J.J. de Wilde 156 (WAG); Monts de Cristal, forest c. 15 km N.E. of Asok, 0°43'N 10°24'E, 21 Aug. 1978, F.J. Breteler & J.J. de Wilde 197 (WAG); Monts de Cristal, 7–8 km S.W. of Asok, hill W. of the village Nkan, 0°39'N 10°19'E, 24 Aug. 1978, F.J. Breteler & J.J. de Wilde 262 (WAG); *ibid.*, F.J. Breteler & J.J.F.E. de Wilde 263 (WAG); Monts de Cristal, Nkan village, c. 8 km along the road Assok – Mala, 1 km W. of the village, 0°40'N 10°19'E, 29 Aug. 1978, F.J. Breteler & J.J. de Wilde 360 (WAG); Ogooué-Ivindo: 92 km along the road Achouka – Lastoursville, counted from the forking at Achouka, 0°33'S 12°09'E, 22 Sep. 1978, F.J. Breteler & J.J. de Wilde 734 (WAG); Monts de Cristal, 6 km S of Assok, 0°40'N 10°22'E, 29 Jan. 1968, N. Hallé 4708 (P, WAG); *ibid.*, N. Hallé 4709 (P, WAG); Monts de Cristal, Nkan, 0°39'N 10°19'E, 31 Jan. 1968, N. Hallé 4786 (P); Monts de Cristal, 3 km S Nkan, 0°38'N 10°18'E, 1 Feb. 1968, N. Hallé 4834 (P); Mont Méla, 0°35'N 10°16'E, 9 Feb. 1968, N. Hallé 5127 (P, WAG); Est de Nkan, 0°39'N 10°20'E, 13 Feb. 1968, N. Hallé 5220 (P, WAG); *ibid.*, N. Hallé 5255 (P, WAG); Etéké, Ovala, carrière micaschiste des recherches filoniennes près d'Etéké, 1°26'S 11°24'E, 16 May 1963, N. Hallé 5931 (P); Bouvala hills, midslope, 1°37.4'S 11°46.2'E, 10 Oct. 2007, M.E. Leal 1983 (LBV, MO, WAG); Massif du Chaillu, near Mouyanama, ± 27 km E. of Mimongo, 1°39'S 11°46'E, 25 Nov. 1983, A.M. Louis 891 (WAG); along expl. rd 20 km NE of Forestry Camp Waka situated ± 32 km S.E. of Sindara, 1°14'S 10°53'E, 11 Dec. 1983, A.M. Louis 1290 (WAG); 2–3 km SE of Forestry Camp Waka situated ± 32 km S.E.

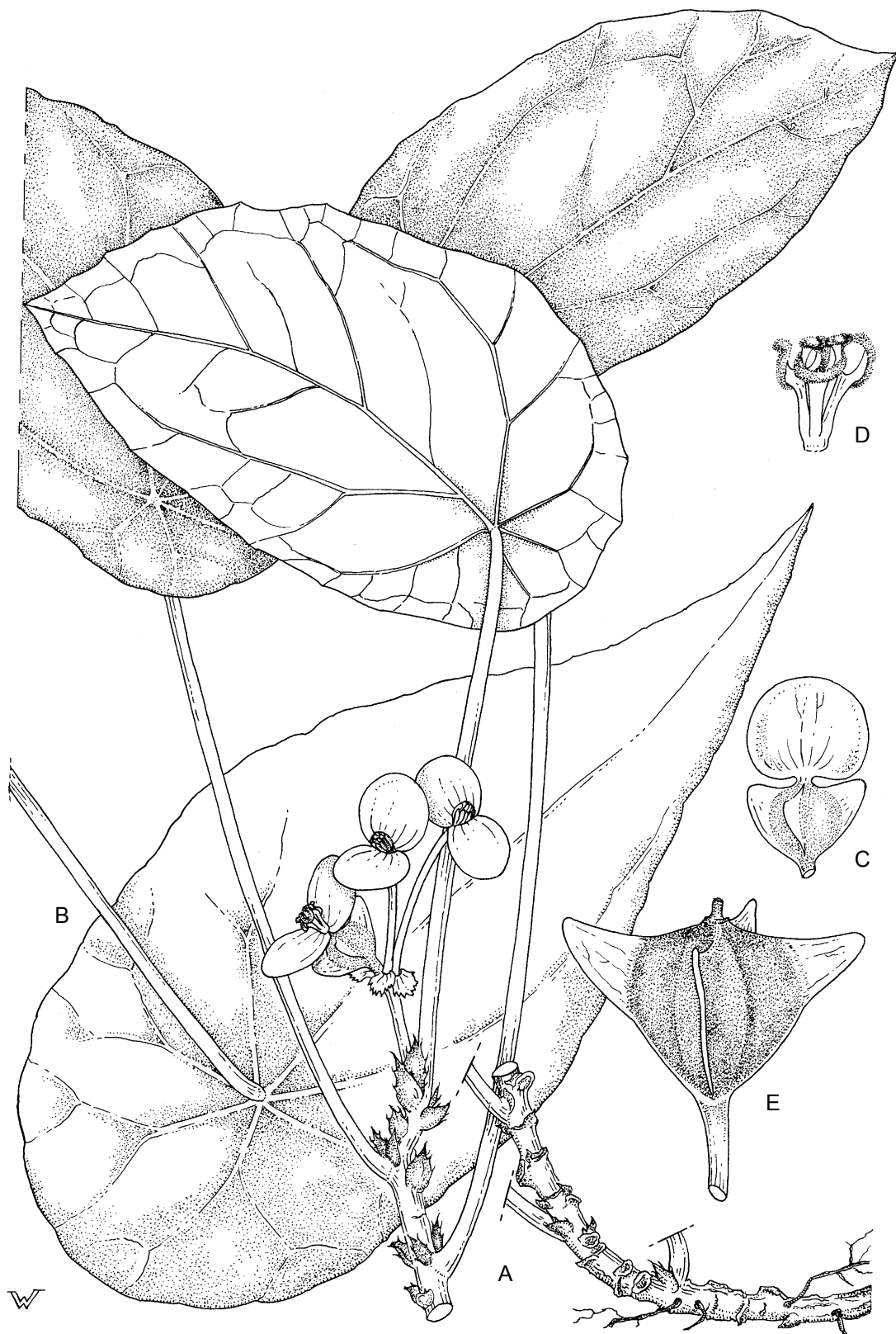


Figure 4 – *Begonia clypeifolia* Hook.f. subsp. *clypeifolia*. A, habitus (×2/3); B, leaf (×2/3); C, female flower (×1); D, styles (×2); E, fruit (×2). A from *A.M. Louis* 2841; B from *Arends et al.* 688; C & D from living plant at WAG, voucher *van Veldhuizen* 1050; E from *Arends et al.* 369. Drawing by Wil Wessel.

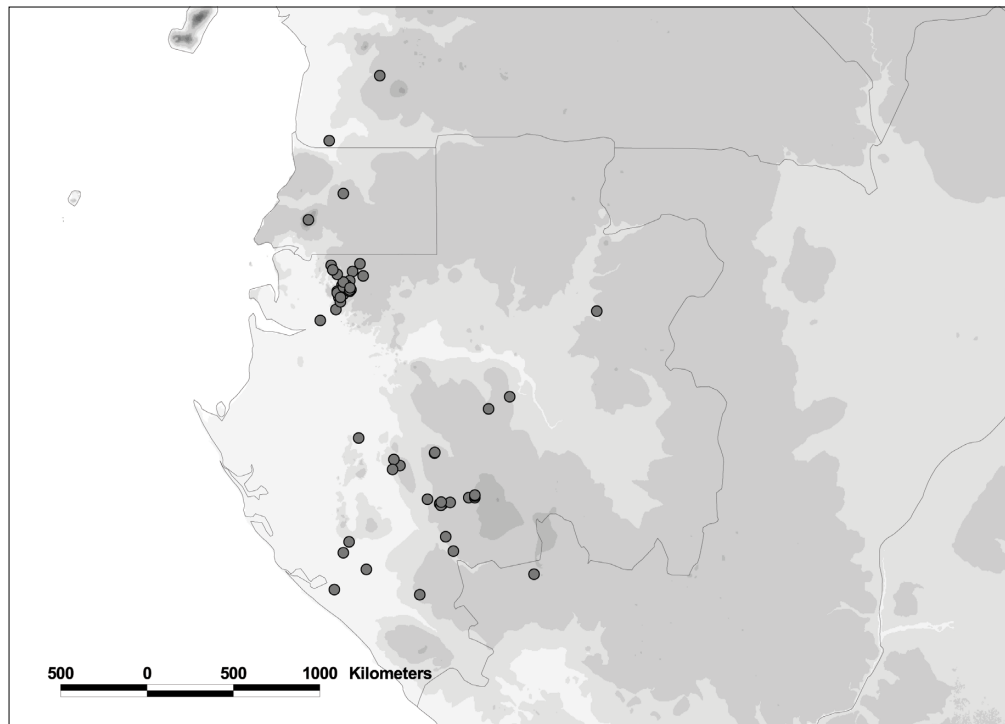


Figure 5 – Distribution of *Begonia clypeifolia* subsp. *clypeifolia*.

of Sindara, Waka R. Basin, 1°14'S 10°53'E, 12 Dec. 1983, *A.M. Louis* 1310 (WAG); Mouyanama, au delà de la rivière Mouetse, à l'est derrière la montagne Ngondo, 1°38'S 11°46'E, 8 Mar. 1984, *A.M. Louis* 1456 (LBV, WAG); route Kingélé vers Tchimbélé à 10 km, au pont numéro 10, ancienne carrière gravier route, 0°29'N 10°18'E, 23 Feb. 1988, *A.M. Louis* 2841 (LBV, WAG); route chantier Leroy Massika entre Mouila et Yeno, 1°40'S 11°15'E, 27 Apr. 1989, *A.M. Louis* 3034 (LBV, WAG); Crystal Mountains, on transect C, 0°36'N 10°24'E, 17 Nov. 2000, *N.S. Nguema Miyono* 1350 (LBV, WAG); Crystal Mountains, 375 m on transect F, 0°42'N 10°20'E, 17 Jan. 2001, *N.S. Nguema Miyono* 1594 (LBV, WAG); Crystal Mountains, 3125 m on transect F, 0°42'N 10°20'E, 19 Jan. 2001, *N.S. Nguema Miyono* 1608 (LBV, WAG); Crystal Mountains, 16000 m on transect F, 0°47'N 10°16'E, 26 Jan. 2001, *N.S. Nguema Miyono* 1661 (LBV, WAG); Crystal Mountains, 175 m on transect F12, 0°50'N 10°13'E, 20 Feb. 2001, *N.S. Nguema Miyono* 1679 (LBV, WAG); Crystal Mountains, 13450 m on transect G, 0°46'N 10°33'E, 11 Jul. 2001, *N.S. Nguema Miyono* 1944 (LBV, WAG); Ogooué-Maritime: c. 25 km E Gamba, à 80 m du camp de base, 2°39.2'S 10°14.1'E, 30 Mar. 2003, *R. Niangadouma* 231 (BR, LBV, MO, WAG); Tchimbélé, 0°36.8'N 10°24.2'E, 10 Apr. 2004, *T. Nzabi* 80 (BR, LBV, MO, P, SCA, WAG); sine loc., 1913, *C.H.O. Pobéguin* (*central Africa series*) s.n. (P, WAG); Dépt. de Tsamba-Magotsi, District d'Ikobe, Tranquille, 1°03.28'S 11°05.08'E, 11 Oct. 2012, *D.K. Quiroz-Villarreal* 1781 (WAG); Doudou Mountains, ca 50 km SW of Doussala, inventory, 2°26'S 10°35'E, 7 Jan. 1987, *J.M. Reitsma* 2788 (LBV, WAG); near village Ekobakoba, inventory, 0°23'N 13°06'E, 17 Feb. 1987, *J.M. Reitsma* 3065 (LBV, WAG); Crystal Mountains, road Kinguéle to Tchimbélé, 0°32'N 10°18'E, 26 Sep. 2002, *M.S.M. Sosef* 1779 (LBV, WAG); Crystal Mountains, Tchimbélé, a few km east of the dam, 0°37'N 10°25'E, 27 Sep. 2002, *M.S.M. Sosef* 1789 (LBV, WAG); Nyanga: along the road Tchibanga – Ndendé, 2°42.4'S 11°10.1'E, 2 Feb. 2003, *M.S.M. Sosef* 1847 (BR, E, LBV, MO, WAG); c. 15 km on the road Lebamba – Bilengui (to the North of Lebamba), 2°04.6'S 11°27.0'E, 2 Feb. 2003, *M.S.M. Sosef* 1848 (E, LBV, MO, WAG); Doudou Mountains National Parc, c. 50 km S of Mandji, 2°07.8'S

10°23.7'E, 17 Nov. 2005, *M.S.M. Sosef* 2351 (E, LBV, WAG); E of Waka National Park, along the road from Mimongo village heading in SE direction, 1°09.83'S 11°19.67'E, 25 Mar. 2007, *M.S.M. Sosef* 2554 (LBV, WAG); *ibid.*, 1°09.5'S 11°19.9'E, 26 Mar. 2007, *M.S.M. Sosef* 2567 (LBV, WAG); Woleu-Ntem: Tchimbélé, c. 1 km from the hydro-electric power station, along small track in riverbank, 0°36'N 10°24'E, 14 Feb. 2001, *A. Tabak* 69 (WAG); Tchimbélé, c. 1 km from hydro-electric power station, along small track, 0°36'N 10°24'E, 14 Feb. 2001, *A. Tabak* 70 (WAG); *ibid.*, 0°36'N 10°24'E, 14 Feb. 2001, *A. Tabak* 72 (WAG); Crystal mountains, 1 km WNW of Tchimbélé, riverbank of the Bingiligwen river, 0°37'N 10°23'E, 18 Jan. 1990, *J.J. Wieringa* 411 (BR, C, LBV, MO, WAG); Crystal Mountains, 1 km SE of Tchimbélé, 0°37'N 10°24'E, 17 Mar. 1990, *J.J. Wieringa* 703 (BR, C, E, IEC, K, LBV, MO, MPU, PRE, WAG); c. 1 km WNW of Tchimbélé, 0°37'N 10°23'E, 13 May 1990, *J.J. Wieringa* 914 (C, LBV, MO, WAG); 0.5 km SE of Tchimbélé, 0°37'N 10°24'E, 15 May 1990, *J.J. Wieringa* 935 (C, LBV, MO, WAG); 60 km on the road Mouila to Yeno, 1°41.91'S 11°24.09'E, 3 Dec. 2001, *J.J. Wieringa* 4550 (BR, LBV, MO, WAG); upper Waka area, 13 km on IFL forestry road B2, 1°20.5'S 10°52.2'E, 31 Mar. 2004, *J.J. Wieringa* 5185 (WAG); 50 km along the quite recently constructed road Mouila – Yeno, 1°42'S 11°30'E, 31 Mar. 1988, *J.J. de Wilde* 9641 (MO, WAG); Crystal Mountains, Tchimbélé, trail east of the dam, 0°37'N 10°24'E, 13 Dec. 1989, *J.J. de Wilde* 10042 (E, LBV, WAG); Crystal Mountains, 25 km on the road Kinguéle – Tchimbélé, 0°32'N, 10°17'E, 20 Jan. 1991, *J.J. de Wilde* 10084 (WAG); Crystal Mountains, 25 km on the road from Kinguéle to Tchimbélé, 0°32'N 10°17'E, 20 Jan. 1991, *J.J. de Wilde* 10089 (LBV, WAG); Crystal Mountains, on bank of the Mbé river, c. 10 km on road from Tchimbélé to Kinguéle, 0°37'N 10°24'E, 21 Jan. 1991, *J.J. de Wilde* 10106 (LBV, MO, P, WAG); Crystal Mountains, 13 km on the road from Tchimbélé to Kinguéle, 0°34'N 10°20'E, 21 Jan. 1991, *J.J. de Wilde* 10123 (BR, LBV, MO, P, WAG); Crystal Mountains, NNW of Nkan, along the road from Assok to Méla, 0°40'N 10°19'E, 23 Jan. 1991, *J.J. de Wilde* 10149 (K, LBV, MO, WAG); Ngounié Prov., 7 km on the road from Lebamba to Mbigou, and 4 km along trail to the South, 2°14'S

11°32'E, 8 Feb. 1991, *J.J. de Wilde* 10419 (LBV, WAG); 59 km on the road Mouila – Yéno, 1°43'S 11°25'E, 5 Feb. 1991, *J.J. de Wilde* 10348 (WAG); 50 km on the road from Mouila to Yéno, 1°43'S 11°23'E, 6 Feb. 1991, *J.J. de Wilde* 10381 (LBV, MO, WAG); Forest exploitation Leroy, 20 km N.W. of Asok, 0°53'N 10°12'E, 20 Jan. 1983, *J.J. de Wilde (WALKB-series)* 107 (WAG); Mytsibé river, an affluent of the Zang River, just east of Méla, 0°36'N 10°16'E, 22 Jan. 1983, *J.J. de Wilde (WALKB-series)* 153 (WAG); ca 10 km along the road Tchimbélé – Kingué, 0°37'N 10°21'E, 24 Jan. 1983, *J.J. de Wilde (WALKB-series)* 196 (WAG); Forest exploitation Leroy, 20 km N.W. of Asok, 0°53'N 10°12'E, 26 Jan. 1983, *J.J. de Wilde (WALKB-series)* 251 (WAG); NW de Mbe Akelayong, 2140 m on transect Y, 0°54'N 10°31'E, 29 Jan. 2001, *C.M. Wilks*

AP3236 (LBV, MO, WAG); NW de Mbe Akelayong, 3910 m on transect Y, 0°54'N 10°31'E, 30 Jan. 2001, *C.M. Wilks* AP3243 (LBV, WAG).

Key to the taxa belonging to the *B. clypeifolia* complex

Below, a key to the newly recognized taxa is presented below. It was decided not to provide a new identification key to all species/taxa within *Begonia* section *Scutobegonia*, because material of yet another one or even two new species await their formal description. Such an updated key will then be published along with those.

Key to the taxa belonging to the *B. clypeifolia* complex

1. Perianth segments white; length/width ratio leaf blade 2.6–3.5; bracts pale green (Equatorial Guinea) *B. monte-alenensis* Sosef
- Perianth segments yellow; length/width ratio leaf blade (1.3–)1.5–2.3(–2.7); bracts brown-red to dark red 2
2. Leaf blade almost circular, length/width ratio 1.3–1.5, only slightly asymmetrical; puberulous indumentum present on rhizome, petiole, inflorescence and fruit; ovary and fruit 2-winged (Gabon, Crystal Mountains) *B. puberula* Sosef
- Leaf blade usually elliptic-ovate or broadly so, length/width ratio (1.3–)1.5–2.3(–2.7), distinctly to slightly asymmetrical, plants without a puberulous indumentum; ovary and fruit 3–4-winged 3
3. Leaf blade 20–30 × 9–18 cm; bracts 11–28 mm long, dark red; fruit on a pedicel of up to 15 mm long, the locular part 9–15 mm across, with wings up to 18 mm long (southern Rep. of the Congo and southwestern Gabon) *B. clypeifolia* subsp. *mayombensis* Sosef
- Leaf blade (6–)7–20(–25) × (3–)4–10(–13) cm; bracts 2–8(–11) mm long, brown-red to dark red; fruit on a pedicel of 1–11(–15) mm long, the locular part 6–13 mm wide, wings up to 8 mm long (southern Cameroon to southern Rep. of the Congo) 4
4. Inflorescence borne on the apical part of horizontal rhizomes before the appearance of the leaves *B. clypeifolia* subsp. *celer* Sosef
- Inflorescence borne in the axils of young leaves *B. clypeifolia* subsp. *clypeifolia*

CONCLUSIONS

A detailed morphological study of the material formerly grouped in one highly variable species, *Begonia clypeifolia* Hook.f., revealed the existence of two new species and two new subspecies, leading to a total of five distinct taxa. A molecular study at population level is desirable to test these taxonomic hypotheses. However, due to the fact that DNA is generally difficult to extract from dried *Begonia* material (Kopperud & Einset 1995, Särkinen et al. 2012) in combination with the often difficult access to the areas where the various taxa grow in the wild, it is unlikely that such a study will be performed soon. In similar situations, a thorough study of the available herbarium material is still the most cost-effective solution, though maybe not the most satisfying one in complex situations like here.

The two newly recognized species are endemic to the Crystal Mountains, a massif of hills and low mountains up to 1250 m altitude running from southern Equatorial Guinea to north-western Gabon. This area is known for its exceptionally high species richness and endemism (de Wilde 1994, Sosef et al. 2006, Bissiengou et al. 2013) most likely related to the former presence of a rain forest refugium during the

last glacial period (Maley 1996, Sosef 1996). Recently, molecular studies have corroborated (Daïnou et al. 2010, Budde et al. 2013) as well as questioned (Dauby et al. 2010) the existence of such a causal factor.

The present adding of new plant taxa occurring in Gabon is one in a long series of publications, many of which have appeared in the now 86 articles of the series *Novitates Gabonenses* (f.e. Bissiengou & Sosef 2008, Walters et al. 2011, Sosef et al. 2007), proof of the extreme plant species richness of the Gabonese forests (Bissiengou et al. 2013, Sosef et al. 2006, Ley & Classen-Bockhoff 2012).

SUPPLEMENTARY DATA

Supplementary data are available in pdf at *Plant Ecology and Evolution*, Supplementary Data Site (<http://www.ingentaconnect.com/content/botbel/plecevo.supp-data>), and consists of the following: (1) scanned herbarium material of *B. monte-alenensis* Sosef; (2) scanned holotype herbarium material of *B. puberula* Sosef; (3) scanned holotype herbarium material of *B. clypeifolia* Hook.f. subsp. *celer* Sosef.

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REFERENCES

- Bissiegou P., Chatrou L.W., Wieringa J.J., Sosef M.S.M. (2013) Taxonomic novelties in the genus *Campylospermum* (Ochnaceae). *Blumea* 58: 1–7. <http://dx.doi.org/10.3767/000651913X667817>
- Bissiegou P., Sosef M.S.M. (2008) Novitates Gabonenses 69. A new endemic species of and a new combination in *Campylospermum* (Ochnaceae). *Blumea* 53: 627–631. <http://dx.doi.org/10.3767/000651908X607576>
- Budde K.K., González-Martínez S.C., Hardy O.J., Heuertz M. (2013) The ancient tropical rainforest tree *Symphonia globulifera* L.f. (Clusiaceae) was not restricted to postulated Pleistocene refugia in Atlantic Equatorial Africa. *Heredity* 111: 66–76. <http://dx.doi.org/10.1038/hdy.2013.21>
- Dainou K., Bizoux J.-P., Doucet J.-L., Mahy G., Hardy O.J., Heuertz M. (2010) Forest refugia revisited: nSSRs and cp-DNA sequences support historical isolation in a wide-spread African tree with high colonization capacity, *Milicia excelsa* (Moraceae). *Molecular Ecology* 19: 4462–4477. <http://dx.doi.org/10.1111/j.1365-294X.2010.04831.x>
- Dauby G., Duminil J., Heuertz M., Hardy O.J. (2010) Chloroplast DNA polymorphism and phylogeography of a Central African tree species widespread in mature rainforests: *Greenwayodendron suaveolens* (Annonaceae). *Tropical Plant Biology* 3: 4–13. <http://dx.doi.org/10.1007/s12042-010-9041-6>
- Doorenbos J., Sosef M.S.M., Wilde J.J.F.E de (1998) The sections of *Begonia*, including descriptions, keys and species lists. (Studies in Begoniaceae VI). Wageningen Agricultural University Papers 98-2: 1–266.
- Estrella M. de la, Mateo R.G., Wieringa J.J., Mackinder B., Muñoz J. (2012) Legume diversity patterns in West Central Africa: Influence of species biology on distribution models. *PloS ONE* 7(7): e41526. <http://dx.doi.org/10.1371/journal.pone.0041526>
- Golding J., Wasshausen D.C. (2002) Begoniaceae, Edition 2. Part I: Annotated Species List. Part II: Illustrated Key, Abridgement and Supplement. Contributions from the United States National Herbarium 43: 1–289.
- Hooker J.D. (1871) LXV Begoniaceae. In: Oliver D. (ed.) *Flora of tropical Africa* 2: 569–580. Ashford, L. Reeve & Co.
- IUCN Species Survival Commission (2012) IUCN Red List Categories and Criteria. Version 3.1, 2nd Ed. Gland, IUCN. Available from http://jr.iucnredlist.org/documents/redlist_cats_crit_en.pdf [accessed 5 Feb. 2014].
- IUCN Standards and Petitions Subcommittee (2013) Guidelines for using the IUCN Red List Categories and Criteria. Version 10.1. The Standards and Petitions Subcommittee. Available from <http://www.iucnredlist.org/documents/RedListGuidelines.pdf> [accessed 5 Feb. 2014].
- Kopperud C., Einset J.W. (1995) DNA isolation from *Begonia* leaves. *Plant Molecular Biology Reporter* 13: 129–130. <http://dx.doi.org/10.1007/BF02668783>
- Küper W., Sommer H., Lovett J.C., Mutke J., Linder H.P., Beentje H.J., Van Rompaey R.S.A.R., Chatelain C., Sosef M., Barthlott W. (2004) Africa's hotspots of biodiversity redefined. *Annals of the Missouri Botanical Garden* 91: 525–535.
- Ley A.C., Classen-Bockhoff R. (2012) Five new species of Marantaceae endemic to Gabon. *Adansonia* 34: 37–52. <http://dx.doi.org/10.5252/a2012n1a4>
- Maley J. (1996) Le cadre paléoenvironnemental des refuges forestiers africains: quelques données et hypothèses. In: Maesen L.J.G. van der, Burgt X.M. van der, Medenbach de Rooy J.M. van (eds) *The biodiversity of African plants. Proceedings XIVth AETFAT Congress, 22–27 August 1994, Wageningen, The Netherlands*: 519–535. Dordrecht, Kluwer Academic Publishers.
- Moat J. (2007) Conservation assessment tools extension for ArcView 3.x, version 1.2. GIS Unit, Royal Botanic Gardens, Kew. Available from <http://www.kew.org/science-research-data/kew-in-depth/gis/resources-and-publications/tools/cat> [accessed 1 Jan. 2013].
- Ntore S., Lachenaud O., Janssens S., Dessein S. (2009) Four new Pauridiantha species (Rubiaceae) reflect the richness of Gabon's rainforests. *Belgian Journal of Botany* 142: 177–193.
- Särkinen T., Staats M., Richardson J.E., Cowan R.S., Bakker F.T. (2012) How to Open the Treasure Chest? Optimising DNA Extraction from Herbarium Specimens. *PLoS ONE* 7(8): e43808. <http://dx.doi.org/10.1371/journal.pone.0043808>
- Sosef M.S.M. (1992) Novitates Gabonenses 8: Seven new *Begonia* species from Gabon. In: Wilde J.J.F.E. de (ed.) *Studies in Begoniaceae III*. Wageningen Agricultural University Papers 91-4: 83–116.
- Sosef M.S.M. (1994) Refuge begonias. Taxonomy, phylogeny and historical biogeography of *Begonia* sect. *Loasibegonia* and sect. *Scutobegonia* in relation to glacial rain forest refuges in Africa. *Studies in Begoniaceae V*. Wageningen Agricultural University Papers 94-1: 1–306.
- Sosef M.S.M. (1996) Begonias and African rain forest refuges: general aspects and recent progress. In: Maesen L.J.G. van der, Burgt X.M. van der, Medenbach de Rooy J.M. van (eds) *The biodiversity of African plants. Proceedings XIVth AETFAT Congress, 22–27 August 1994, Wageningen, The Netherlands*: 602–611. Dordrecht, Kluwer Academic Publishers.
- Sosef M.S.M., Leal M.E. (2002) Novitates Gabonenses 41. A new *Begonia* species from the Lopé Reserve (Gabon). In: Wilde J.J.F.E. de (ed.) *Studies in Begoniaceae VII*. Wageningen University Papers 2001.2: 267–271.
- Sosef M.S.M., Issembé Y., Bourobou H.P., Koopman W.J.M. (2004) Botanical biodiversity of the Pleistocene forest refuge Monts Doudou (Gabon). In: Fisher B.L. (ed.) *Monts Doudou, Gabon: A floral and faunal inventory with references to elevational variation. Memoirs of the California Academy of Sciences* 28: 17–91.
- Sosef M.S.M., Wieringa J.J., Jongkind C.C.H., Achoundong G., Azizet Issembé Y., Bedigian D., Berg R.G. van den, Breteler F.J., Cheek M., Degreef J., Faden R.B., Goldblatt P., Maesen L.J.G. van der, Ngok Banak L., Niangadouma R., Nzabi T.,

- Nziengui B., Rogers Z.S., Stévant T., Valkenburg J.L.C.H. van, Walters G., Wilde J.J.F.E. de (2006) Check-list des plantes vasculaires du Gabon / Checklist of Gabonese vascular plants. *Scripta Botanica Belgica* 35.
- Sosef M.S.M., Harris D.J., Armstrong K.E. (2007) Novitates Gabonenses 64. A new species of *Campylospermum* (Ochnaceae) from coastal Gabon. *Blumea* 52: 15–19. <http://dx.doi.org/10.3767/000651907X612346>
- Thibault M., Fisher B.L., Goodman S.M. (2004) Description of Monts Doudou, Gabon, and the 2000 Biological Inventory of the Reserve. In: Fisher B.L. (ed.) Monts Doudou, Gabon. A floral and faunal inventory with reference to elevational distribution. *Memoirs of the California Academy of Sciences* 28: 3–15.
- Thiers B. (2013) [continuously updated]. Index Herbariorum: A global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. Available from <http://sweetgum.nybg.org/ih> [accessed 1 Mar. 2013].
- Walters G., Dauby G., Stévant T., Dessein S., Niangadouma R., Lachenaud O. (2011) Novitates Gabonenses 80. Additions and corrections to the flora of Gabon. *Edinburgh Journal of Botany* 68: 423–442. <http://dx.doi.org/10.1017/S0960428611000266>
- Wheeler Q., Valdecasas A.G. (2007) Taxonomy: Myths and Misconceptions. *Anales del Jardín Botánico de Madrid* 64: 237–241.
- Wilde J.J.F.E. de (1994) Cristal Mountains, Gabon. In: Davis S.D., Heywood V.H., Hamilton A.C. (eds) *Centres of plant diversity. Vol. 1: Europe, Africa, South West Asia and the Middle East*: 169–170. Cambridge, IUCN Publications Unit.
- Wilde J.J.F.E. de, Sosef M.S.M. (2009) Begoniaceae. In: Sosef M.S.M., Florence J., Bourobou H., Ngok Banak L. (eds) *Flore du Gabon* 39: 1–110. Weikersheim, Margraf Publishers.

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