

## **Baphia vili (Leguminosae: Papilionoideae), a new species from coastal thicket in the Republic of the Congo and Gabon**

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## *Baphia vili* (Leguminosae: Papilionoideae), a new species from coastal thicket in the Republic of the Congo and Gabon

### Abstract

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*Baphia vili* Cheek is described as a new species from coastal thicket on white sand in Gabon and the Republic of the Congo (Congo-Brazzaville). It is distinguished from other species of the genus by its small, glossy, shallowly cordate leaves and is unusual in its winged fruit. Its taxonomic placement near *B. letestui* Pellegr. is discussed. It is assessed as Vulnerable using the IUCN standard. Based on observations of the species near Pointe Noire in the months of October, December and July, an account of its phenology is presented.

Additional key words: conservation, IUCN, taxonomy, threatened, vegetation, vulnerable

### Introduction

Among the woody papilionoid legumes of tropical Africa, members of the genus *Baphia* G. Lodd. are easily recognized by their simple (unifoliolate) and not compound leaves and free (not united) stamens. They share these features with allied but less usually encountered genera of the *Sophoreae* (in the traditional sense), namely *Airy-antlia* Brummitt, *Baphiastrum* Harms, *Bowringia* Benth., *Dalhousiea* Benth. and *Leucomphalos* Planch., but can easily be distinguished by their flat, dark brown seeds. The other genera have subglobose, arillate, bicoloured or brightly coloured seeds and are retained as the Baphioid clade in Lewis & al. (2005).

There are about 45 species of *Baphia* in tropical Africa, with one extending to Madagascar (Soladoye 1985) and a second endemic there (Stirton & Du Puy 1992). The species are usually shrubs or small trees of evergreen forest, thicket or woodland. *Baphia nitida* G. Lodd., a forest species, is renowned for its hard, densely grained

wood, much used for pestles and mortars in Cameroon and neighbouring countries (Burkhill 1995).

*Baphia* was revised by Soladoye (1985). Since then, three species have been reduced to subspecies and four new species have been described: *B. madagascariensis* C. H. Stirt. & Du Puy (1992), of thicket on white sands in NW Madagascar (Cheek pers. obs.), *B. cymosa* Breteler (Breteler 1994) and *B. megaphylla* Breteler (Breteler 2008), both of forests in Gabon, and *B. rosa* Mackinder & R. Clark (2012), from NW Zambia. A new taxonomic account of *Baphia* has been published in Russian by Goncharov & al. (2011), in which changes to the taxonomy of Soladoye (1985) were made at the supraspecific level, leaving specific delimitations almost unchanged.

### Results and Discussion

Among the specimens resulting from a botanical reconnaissance survey of a potential port site in the Republic

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Table 1. The more significant morphological characters separating *Baphia vili* and *B. letestui*.

	<i>Baphia vili</i>	<i>Baphia letestui</i>
Petiole length [mm]	(3–)5–6(–7)	5.5–13
Leaf blade dimensions [mm]	21–34(–50) × 12–21(–26)	30–105 × 15–46
Leaf blade base shape	shallowly cordate (rarely rounded)	rounded or cuneate
Pedicele length [mm]	7.5–10.5(–14)	14–20
Bracteoles length [mm]	c. 3.5	5.5–7.5
Calyx length [mm]	c. 11	20–25
Calyx indumentum	sparsely hairy	glabrous
Fruit	winged	not winged

of the Congo (Congo-Brazzaville), conducted in October 2010, was a *Baphia* (*T. Kami 331*), which matched no other species from Tropical Africa in the Kew Herbarium. Subsequently, more specimens matching *T. Kami 331* were collected at different stages of growth from the same habitat at multiple locations along the coast in the Republic of the Congo and were also found unidentified or misidentified in other herbaria (see below). These are here described as *B. vili* Cheek. All specimens cited have been seen unless otherwise indicated.

*Baphia vili* is remarkable for its small, glossy, leathery leaf blades, usually ovate or elliptic, which are cordate at the base. It is also unusual in having winged fruit, otherwise known only in *B. cordifolia* Harms (see Taxonomic affinities, below). However, fruits are unknown in some taxa of *Baphia*. Setting aside the winged fruit, our species, with its bracteoles inserted at the tip of the pedicel, opposite, free at the base, and triangular-ovate, calyx spathaceous, keel petals villous at the line of fusion, and staminal filaments glabrous, keyed out in Soladoye (1985) to couplet 21, which terminates in *B. letestui* Pellegr. and *B. bequaertii* De Wild., but did not fit the key characters of either of these two species.

*Baphia vili* differs greatly from *B. bequaertii*, having shorter petioles, (3–)5–6(–7) mm long (not 20–120 mm), smaller leaf blades, 21–34(–39) mm long (not 50–180 mm), glabrous (not densely tomentose) on the lower surface, and flowers solitary in axils (not in fascicles). In contrast, *B. vili* is closer in general morphology to *B. letestui*, overlapping in many characters, although not the main diagnostic characters, and also in geography. *Baphia vili* and *B. letestui* can be differentiated using the characters in Table 1.

Fifteen species of *Baphia* are listed by Sita & Moutambote (1988) for the Republic of the Congo, but only three species have been found in coastal thicket on white sand. These can be identified using the key below.

#### Key to the species of *Baphia* in coastal thicket on white sand in the Republic of the Congo:

1. Leaf blade cordate at base; ovary densely hairy; fruits winged ..... *B. vili*

- Leaf blade rounded or cuneate at base; ovary glabrous; fruits not winged ..... 2
- 2. Flowering axes usually non-leafy, densely brown pubescent; pedicels robust, 4–16 mm long ..... *B. brachybotrys*
- Flowering axes usually leafy, glabrous or very sparsely hairy; pedicels slender, (10–)25 mm long ..... *B. leptostemma*

*Baphia vili* Cheek, **sp. nov.** – Fig. 1.

Holotypus: Republic of the Congo (Congo-Brazzaville), Kouilou Department, Pointe Indienne-Loango, fl., 21 Oct 2010, *T. Kami 331* (IEC; isotypus: K).

*Diagnosis* — A ceteris speciebus *Baphiae* foliis parvis (21–34(–50) × 12–21(–26) mm) ovato-ellipticis cordatis nitentibus, et praesertim a *B. letestui* Pellegr. floribus circa dimidio minoribus, calyce indumentoso (non glabro) distincta.

*Description* — *Small tree or shrub* (0.8–)2–7 m tall, often branching from base, but older trees often with single trunks 4–15(–25) cm in diam. at 1.5 m above ground, grey, sinuous, smooth. *Stems* of leafy shoots grey-brown, longitudinally ridged, lacking lenticels; *new extension shoots* emerging from buds in Oct, each bearing 3–7(–9) leaves of differing shape, stem hairs densely subappressed to patent, red-brown, crinkled, c. 0.6 mm long, glabrescent; *dormant season buds* (Jun–Oct) produced at stem apex, glossy, narrowly ellipsoid, 5–6 × 2–3 mm, with 10–12 distichous bud-scales, apex acute; *basal bud-scales* c. 8, grey, rounded, 0.2–0.4 mm long, falling as bud opens; *apical bud-scales* c. 4, basal part (concealed when in bud) matt green, expanding as bud opens, exposed part glossy green with brown margin, persisting as bud opens, expanded bud-scales ligulate-oblong, 6–8 × c. 1 mm, striate, apex acute. *Stipules* caducous, resembling bud-scales, ligulate-triangular, 8.5–9.5 × c. 1 mm, with 4–7 longitudinal nerves, margin hairy (as on stems). *Petiole* terete, (3–)5–6(–7) × 0.6–0.7 mm, initially appearing even in diameter, with age clearly bipulvinate with interpulvinate area c. 2 mm long, indumentum as on stem, glabrescent. *Leaf blade* glossy, elliptic-oblong, ovate-

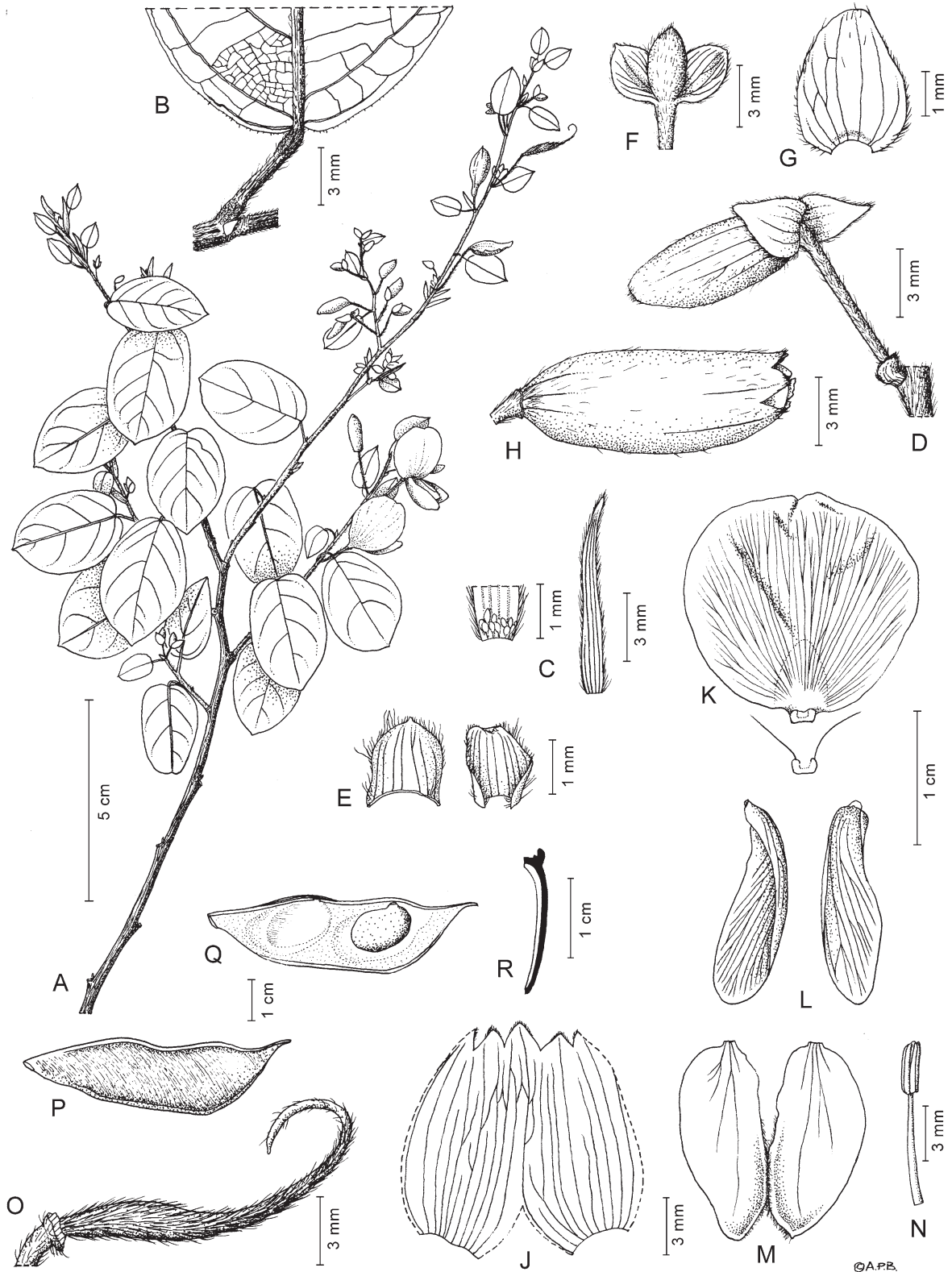


Fig. 1. *Baphia vili* – A: habit, flowering branch; B: leaf base, petiole and stem, from newly expanded shoot; C: stipule, base of adaxial surface, showing colleters (left); D: mature flower bud, pedicel and stem, shortly before abscission of bracteoles; E: bract, abaxial surface, flattened (left), adaxial surface, natural curvature (right); F: immature flower bud, showing bracteole pair subtending unexpanded calyx; G: bracteole, abaxial surface; H: flower bud, after abscission of bracteoles, before splitting of calyx; J: calyx, from bud, opened out flat, inner surface; K: standard petal, adaxial surface, with detail of claw; L: wing petal, inner surface (left), outer surface (right); M: keel petals, opened and flattened, inner surface, united by villous hairs at margin; N: longest stamen; O: pistil, post-anthesis; P: pod, side view; Q: pod valve, inner surface, with 1 seed in situ; R: pod valve, transverse section, showing short wing adjacent to dorsal suture. – A–P from *T. Kami 331*; Q–R from *Mpandzou 1316*. – Drawn by Andrew Brown.

Table 2. Significant morphological differences between plants of *Baphia vili* during two seasons.

	December (early wet season)	July (early dry season)
Leafy stems	red-brown patent hairy	glabrous, grey
Petiole	hairy, interpulvinar area inconspicuous	glabrous, interpulvinar area conspicuous
Leaf blade	matt, thinly leathery, midrib hairy on lower surface	glossy, thickly leathery, midrib glabrous on lower surface

elliptic, rarely obovate-elliptic, 21–34(–50) × 12–21 (–26) mm, leathery, sparsely hairy on midrib on lower surface and on margin, hairs as on stem, glabrescent, base cordate (sinus to 1.5 mm deep, 5–7 mm wide) or rounded (on distal-most leaf of stem), margin entire, apex obtuse to weakly acuminate, rarely emarginate; secondary nerves 3 or 4 (or 5) on each side of midrib; tertiary nerves conspicuous on lower surface, raised, finely reticulate. *Flowers* 1–4 per leafy stem, 1 (or 2) in axils of bud-scales and basal leaves. *Bract* subtending pedicel, basal, quadrangular-ovate, c. 1.7 × 1.4 mm, longitudinal nerves 7–9, base clasping, margin hairy, hairs patent, 0.1–0.6 mm long, apex obtuse-apiculate. *Pedicel* ascending, terete, 7.5–10.5(–14) mm long, indumentum as on petiole. *Bracteoles* caducous, falling before anthesis, at apex of pedicel immediately below calyx, opposite, free, not united, ovate, c. 3.5 × 2.7 mm, longitudinal nerves 7–9, surfaces very sparsely hairy or glabrous, base clasping pedicel, margin hairy, as on bract, apex rounded to obtuse. *Calyx* caducous, falling before anthesis but after bracteoles fall, spathaceous, cylindric-ellipsoid, c. 11 × 4.2 mm, splitting along 1 longitudinal fissure at anthesis, outer surface very sparsely hairy, hairs subappressed to 0.7 mm long, apex 4-toothed. *Petals* predominantly white; *standard* petal with a bright yellow elliptic patch in basal half, orbicular-obovate, 12–16(–26) × 12–15(–17) mm, basal claw c. 1 mm long, apex obtuse-rounded; *wing petals* white, arcuate, oblanceolate 11.6–17(–24) × 3–3.3(–4) mm, basal margin with a fold c. 1 mm deep along its length; *keel petals* white, flushed pink at free edges, lanceolate, slightly asymmetric, 10–19(–28) × 4–4.5(–6) mm, basal claw c. 0.5 mm long, apex subacuminate, both petals united along basal edge by a line of hairs c. 0.3 mm long. *Androecium* of 10 free stamens; *filaments* terete, c. 6 mm long, glabrous; *anthers* subcylindric, c. 3 × 1 mm. *Ovary* (post-anthesis) slender, sinuate; *style* recurved, overall c. 12 × 2.5 mm, with dense indumentum, hairs appressed, copper-coloured, straight, 1–1.5 mm long. *Pod* elastically dehiscent, propelling seeds for a distance of a metre or more, (1 or)2(or 3)-seeded, sub-oblong, laterally flattened, 5–8 × 18–22 × c. 6 mm, outer surface of flattened valves of developing pods with numerous narrow lines 0.5–1.5 mm long, arranged in parallel diagonal lines, raised in dried specimens, hairs becoming very sparse, persisting on nearly mature pod, base sub-stipitate, upper placental edge with 2 narrow wings each 1–3 mm wide, apex asymmetrically rostrate. *Seeds* dark brown-black, glossy, elliptic, laterally flattened, c. 16 × 10 mm.

*Phenology and seasonal variation* — The dormant buds of the dry season (June–October) burst at the end of October producing shoots 3–8 cm long., the flowers, solitary from 1 to several of the basal axils of the shoot, including the bud scales, begin to open before the leaves are fully expanded in late October, continue through November, with a few flowers surviving to early December. The leaves of each shoot are fully expanded by late November and follow a definite pattern. The first-formed leaf of the shoot is the most broadly ovate and deeply cordate; subsequent leaves are progressively longer than wide and less cordate. The last-formed leaf of the shoot is usually elliptic or elliptic-obovate, with a rounded (not cordate) base. The largest leaves are those formed not at the base or apex of the shoot, but in between. New shoots are only produced once per year. As the shoots and leaves age through the warm wet season (October–May) and cold dry season, (June–October), morphological changes occur to the extent that specimens collected in early December were thought at one point to be a different species from specimens collected in July (early dry season, when ripe fruits are borne) (see Table 2).

During the dry season many, but not all, of the leaves turn yellow and fall, rendering some of the stems produced in the previous wet season leafless, with but a terminal dormant bud. A count of 14 stems on a specimen collected in July showed that 6 were leafless, while the remainder each had only 1 or 2 (or 3) leaves as opposed to the 3–7 leaves produced per stem at the beginning of the wet season.

*Distribution* — Republic of the Congo and Gabon. It is also to be expected in adjoining Cabinda province of Angola since its habitat (see Ecology, below) may occur there.

*Ecology* — *Baphia vili* appears restricted to evergreen coastal thicket on well-drained white sand at altitudes of 5–50 m. Associated species in the Republic of the Congo are: *Baphia leptostemma* Baill. subsp. *leptostemma* (*Leguminosae*), *Dalbergia grandibracteata* De Wild. (*Leguminosae*), *Fegimanra africana* Pierre (*Anacardiaceae*), *Maytenus undata* (Thunb.) Blakelock (*Celastraceae*), *Ochna multiflora* DC. (*Ochnaceae*), *Premna serratifolia* L. (*Labiatae*), *Psydrax moandensis* Bridson (*Rubiaceae*) and *Rytigynia* sp. nov. (*Rubiaceae*).

*Baphia vili* appears to be absent from coastal thicket where the water table is close to the surface in the wet season, as at Bas Kouilou near Madingo Kayes in the Re-

public of the Congo, where we searched for a day and a half in December 2012 without finding a single plant of the species. Where coastal thicket on well-drained white sand is intact, *B. vili* is often one of the most frequent canopy species and sometimes dominant. At Djeno in the Republic of the Congo in December 2012 we placed a 25 × 25 m plot in an area where the thicket understorey shrubs and lianas had been removed, leaving the trees intact, allowing easy access. Here all the 25 trees in the plot were *B. vili*, each with 1–8 stems from the base, the stems (4–)8–10(–25) cm in diam. at 1.5 m above the ground, and the canopy 6–7 m high.

*Conservation status* — *Baphia vili* is currently known from only seven location-management units: Nyanga, Vandji, Longoboundi, Tchimpounga, Point-Indienne-Loango, Pointe Noire and Djeno (see Additional specimens examined). At three of these, Djeno, Pointe Noire and Pointe Indienne-Loango it is known to be under severe threat from habitat destruction (Cheek pers. obs. 2011, 2012).

The area of *Baphia vili* habitat at the Djeno location was clearly once much larger and possibly continuous, but it has been mostly cleared, probably in connection with the Total petroleum oil installation immediately adjacent. This clearance is rapidly ongoing. Five fragments were found in 2012, totalling c. 10 ha in area. In IUCN (2012) terms, these may count as two or more, rather than a single, management unit. The two largest surviving thicket area fragments at Djeno, c. 1 km from the refinery, are c. 3 ha and 5 ha in area and have both been delimited with cut lines for sale as housing plots (Cheek pers. obs. Dec 2012). At Pointe Noire, the last remnant of the vegetation in which this species was seen in 1986 (de Foresta 1035), near the CORAF refinery, may already have been lost. At Point Indienne-Loango, perhaps 586 ha of the *B. vili* habitat have been mapped using imagery from 2009, but by February 2012, three years later, about 20% of this had been converted to secondary grassland, or burnt, or converted to residential accommodation or roads, e.g. by Maisons sans Frontieres (van der Burgt pers. comm.). The area is now scheduled as an expansion area for the Pointe Noire Port Authority and further loss of habitat for the species seems inevitable. However, MPD Congo S.A., which is considering developing a port within this area, has plans to protect parcels of *B. vili* habitat within its perimeter.

At Longoboundi, although not formally protected, the species seems secure for the present, apart from slight degradation in habitat quality due to tourism.

At Tchimpounga, Conkouati and Moukalaba Doudou locations, protected areas are in place. It is to be hoped that here *Baphia vili* might be protected from habitat destruction. Tchimpounga contains the largest documented protected area of habitat for the species, approximately 3000–4000 ha (T. Kami pers. obs. Nov 2012), and Tchimpounga is currently the most important single lo-

cation and best hope for the long-term survival of the species. At the other two protected locations, areas of only 1 ha at most have been documented so far.

It is to be hoped that further locations for the species will be found. To date (Dec 2012), searches in adjoining Cabinda province of Angola (Feb 2012) and along the coast of the Republic of the Congo (Nov–Dec 2011 and Dec 2012) have yielded no additional sites for the species other than those already cited, but searches have not been exhaustive.

Using the 4 km<sup>2</sup> grid cell size per location-management unit currently advocated by IUCN (2012) allows us to calculate an area of occupancy of 28 km<sup>2</sup> resulting in an assessment of Vulnerable: VU B2ab(iii) using IUCN (2012) criteria. However, if the highly threatened Djeno fragments, Pointe Noire and Point Indienne-Loango locations are lost, as is possible in the next three years or sooner if current conditions persist, it is likely that *Baphia vili* will be re-assessed as Endangered.

*Etymology* — The specific epithet derives, as a noun in apposition, from the Vili language area in coastal Republic of Congo, where most of the known individuals of the species are found.

*Taxonomic affinities* — It is remarkable that, owing to its winged fruit and its large, dry-season axillary buds, *Baphia vili* keys out as the East African *B. cordifolia* in Soladoye (1985) and on morphological data merits placement as the second species in *B. sect. Alatae* Soladoye. The two species also share cordate leaves. However, *B. vili* and *B. cordifolia* are unlikely to be confused since the second is much larger in the proportion of its leaves, and has multi-flowered pseudo-racemes rather than bearing 1(or 2) flowers in leaf axils. While it can be postulated that the two species share a common ancestor, this will be difficult to test without a molecular phylogenetic study of the genus involving a high level of species-sampling.

In addition to morphological characters, Soladoye (1985) characterized his *Baphia* sect. *Alatae* on anatomical and palynological characters. It would be useful in future to evaluate these characters in *B. vili* and determine if they correlate with the morphological characters and confirm its placement in *B. sect. Alatae*.

It is possible that the winged fruits of these two species have evolved independently of each other, in two different lineages. If so, the affinities of *Baphia vili* may well be with *B. letestui* and related species, with which it shares so many floral characteristics (see Introduction, above).

*Additional specimens examined (paratypes)* — GABON: NYANGA: Moukalaba Doudou National Park, S of Nyanga River, fr., 18 Feb 2004, van Valkenburg 2819 (K, LBV n.v., WAG n.v.).

REPUBLIC OF THE CONGO (CONGO-BRAZZAVILLE): KOUILOU DEPARTMENT: Conkouati-Douli National

Park, near Vandji, sterile, 11 Dec 2012, *Mpandzou 1847* (IEC, K); Longoboundi, fr., 12 Dec 2012, *Mpandzou 1889* (IEC, K); Tchimpounga Reserve Naturelle, immature fr., 3 Dec 2011, *T. Kami 1359* (IEC, K); *ibid.*, immature fr., 2 Nov 2012, *T. Kami 1420* (IEC, K); *ibid.*, *T. Kami 1436* (IEC, K); *ibid.*, *T. Kami 1457* (IEC, K); *ibid.*, *T. Kami 1463* (IEC, K); *ibid.*, Bois des Singes, fr., 6 Nov 2012, *Mpandzou 1652* (IEC, K); Pointe Indienne-Loango, fr., 11 Jul 2011, *Mpandzou 1316* (IEC, K, MO, P); *ibid.*, immature fr., 24 Nov 2011, *T. Kami 1233* (BR, IEC, K, WAG); *ibid.*, sterile, 25 Nov 2011, *Mpandzou 1356* (IEC, K); *ibid.*, fl., 26 Nov 2011, *Mpandzou 1365* (IEC, K); Pointe Noire, Plage de "CORAF", fl., 14 Jul 1986, *de Foresta 1035* (Herbier du Centre ORSTOM de Pointe Noire [2 sheets]), Djeno, fr., 21 Mar 1986, *de Foresta 862* (Herbier du Centre ORSTOM de Pointe Noire [3 sheets]); Djeno at Total Oil Refinery perimeter, 04°55'17"S, 11°56'01"E, fr., 6 Dec 2012, *Mpandzou 1756* (IEC, K); *ibid.*, *Mpandzou 1738* (IEC, K); Djeno, 04°55'27"S, 11°56'07"E, fr., Jul 2011, *Cheek photograph records* (IEC, K); Djeno 5 ha thicket, 04°55'48"S, 11°56'35"E, fr., 6 Dec 2012, *Cheek sight record*; Djeno 3 ha thicket, 04°55'59"S, 11°56'33"E, fr., 7 Dec 2012, *Cheek sight record*.

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where Jean-Claude Batchi was exceptionally helpful in the field. Mark Coode translated the diagnosis into Latin. Janis Shillito converted the manuscript into an electronic file. Aydrif Laurel Mpandzou first noted the field-diagnostic value of the winged fruit of this species. Raustand Mboundou of the MPD Environment team led the field team in December 2012 that provided much of the data for this paper, and Fabrice Jules Nkondi processed most of the specimens. Brian Schrire, Gwilym Lewis, Toby Pennington and especially Xander van der Burgt made valuable comments on earlier drafts of this manuscript.

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