

A REVISION OF *BEGONIA* SECT. *SYMBEGONIA* ON NEW GUINEA

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A revision of *Begonia* sect. *Symbegonia*, endemic to New Guinea, is presented, with descriptions of five new species (*B. arauensis* M.Hughes, *B. asaroensis* J.Gagul, *B. erodifolia* Sands, *B. mimikaensis* Sands and *B. vinkii* Sands). There are 18 species now recognised, and a key is provided for their identification. Ten of the species are assessed to belong to the IUCN category Data Deficient, and eight to Least Concern.

Keywords. Biodiversity, conservation, taxonomy, typification.

INTRODUCTION

New Guinea is one of the main centres of diversity for *Begonia*, and the genus is represented there by *Begonia* sects *Baryandra*, *Diploclinium*, *Oligandrae*, *Petermannia* and *Symbegonia*, covering a total of 84 species (Hughes, 2008; Rubite *et al.*, 2013; Hughes & Takeuchi, 2015; Hughes *et al.*, 2015–). The species within each section are generally poorly known, and the sections themselves have never been revised. *Symbegonia* was initially described as a genus by Warburg (1894), but molecular data indicate that it is deeply nested within *Begonia* sect. *Petermannia* (Thomas *et al.*, 2012), and it is currently recognised at the sectional level (Forrest & Hollingsworth, 2003).

Begonia sect. *Symbegonia* is characterised by having the female tepals fused into a distinctive tubular corolla, the male tepals sometimes also partially fused and the stamens on an often elongated column (Sands, 2009). In addition, species of the section have unique anther endothelial cells (Tebbutt & MacIver, 1999). However, many of the species within the section are difficult to delimit. It is tempting to speculate that the large amount of highly dissected yet fairly continuous montane habitat on New Guinea has promoted rapid yet incomplete diversification in this group, leading to difficult species complexes. The tubular flowers are very different from those in other sections of the genus, and hence the pollination syndrome is likely to differ also. Increased population connectivity may also contribute to the persistence of

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widespread species complexes, which would otherwise fragment into different taxa in the absence of gene flow (Hughes & Hollingsworth, 2008). In addition to this biological complexity, *Begonia* sect. *Symbegonia* is difficult to interpret because the species have been described separately over the decades, many without reference to existing taxa and hence without comparative diagnoses. Consequently, this revision has proved to be difficult, with the difficulty further compounded by the fact that *Begonia* species tend to make poor herbarium specimens, and male and female flowers as well as fruits rarely occur all on the same specimen.

This paper presents a revision of the currently known species in *Begonia* sect. *Symbegonia*, and in addition we have described five new taxa that were possible to delimit with reasonable confidence. However, there remains a considerable residue of unidentified material, and much work remains to be done.

Prior to the current revision, a total of 13 species of sect. *Symbegonia* were recorded for New Guinea (Tebbutt, 2005; Hughes, 2008; Sands, 2009; Hughes *et al.*, 2015, 2015–); here we describe 5 new species, bringing the total to 18. Images of most of the cited specimens are available online (Hughes *et al.*, 2015–).

For species descriptions, observations were made using the naked eye and light microscopy on dried material held at B, BM, BO, BRI, E, K, L, LAE, MAN, NY, P, SING and UPNG, and on living material in the field and in cultivation at the Royal Botanic Garden Edinburgh. Dried material was rehydrated by boiling with a small amount of detergent. Measurements were made with a ruler or microscope eyepiece graticule, using herbarium specimens or living material (*Begonia arfakensis* and *B. yapenensis* only). Information on plant growth habit and size, colour of fresh floral parts and fruit, habitat and locality were taken from the collector's notes recorded on the herbarium label and from field observations by the authors. All specimens cited, including the types, have been seen by the authors.

TAXONOMIC TREATMENT

Begonia* sect. *Symbegonia (Warb.) L.L.Forrest & Hollingsw., Pl. Syst. Evol. 241: 208 (2003). – *Symbegonia* Warb., Nat. Pflanzenfam. 3(6a): 149, pl. 52 (1894), emend. Irmsch., Bot. Jahrb. Syst. 50: 381 (1913). – Type: *Begonia fulvo-villosa* Warb., Bot. Jahrb. Syst. 13: 386 (1891).

Habit: erect or sprawling often sympodially branching herbs. **Stem:** internodes up to 5 cm, usually villose. **Stipules** persistent, cuspidate, usually glabrous, sometimes with hairs on the keel. **Leaves:** petiole sessile to 1(–3.5) cm long; lamina symmetric, subsymmetric or asymmetric, lanceolate, oblanceolate, obovate, ovate or rhomboid, colour uniform or variegated, glabrous to densely hairy above, with hairs on the veins below; base cuneate to oblique or cordate, basal lobe sometimes overlapping the petiole; margins subentire, sinuate, denticulate, dentate to bidentate, biserrate, sometimes lacinate to deeply dissected; venation pinnate to palmate; tip shortly acute to acuminate. **Inflorescence:** unisexual or bisexual, usually terminal, sometimes confined to the uppermost axils; bracts persistent, sometimes markedly conspicuous,

oblong to ovate-lanceolate. *Male flower*: tepals 2, free or fused at the base, orbicular to ovate-lanceolate; androecium: stamens few to many, arranged on a thin or thick column, or sometimes on a short torus; anthers globose to ellipsoid, dehiscing through lateral slits. *Female flower*: corolla cupuliform, with 5 lobes; ovary with 3 equal to subequal wings, styles 3, elongate, bifid, stigmatic surface twice spirally twisted. *Fruit* on a short, stiff pedicel, glabrous to hairy, wings slightly extending along the pedicel in most species, capsule ellipsoid or globose, wings arcuate, extending apically above the ovary, or subtruncate.

Distribution. Endemic to New Guinea and widely distributed throughout the island.

Ecology. Occurs from 50 to 3000 m altitude, near streams, along riverbanks and in wet shaded places in primary and secondary mid- to upper-montane forests.

Key to species of Begonia sect. Symbegonia

- 1a. Leaves deeply dissected to near the midrib _____ 2
- 1b. Leaves not deeply dissected _____ 5
- 2a. Leaves small, < 2.5 cm long _____ **5. B. erodiifolia**
- 2b. Leaves large, > 2.5 cm long _____ 3
- 3a. Leaves with a distinct amplexicaul basal lobe _____ **7. B. mimikaensis**
- 3b. Leaves without a distinct amplexicaul basal lobe _____ 4
- 4a. Leaf lobes usually > 6 pairs, stamens on a torus _____ **12. B. symgeraniifolia**
- 4b. Leaf lobes usually < 6 pairs, stamens on a thin column _____ **4. B. asaroensis**
- 5a. Leaves small, < 1 cm wide _____ **15. B. symparvifolia**
- 5b. Leaves large, > 1.5 cm wide _____ 6
- 6a. Leaves subentire or denticulate _____ 7
- 6b. Leaves dentate or dentate-denticulate _____ 9
- 7a. Leaf lamina rhomboid _____ **10. B. strigosa**
- 7b. Leaf lamina broadly ovate _____ 8
- 8a. Leaf tip not attenuate, stamens on a torus, flowers white _____ **13. B. symhirta**
- 8b. Leaf tip attenuate, stamens on a thin column, flowers deep pink-red (rarely white) _____ **16. B. symsanguinea**
- 9a. Inflorescence with showy persistent white bracts similar in size to the tepals _____ **11. B. symbracteosa**
- 9b. Inflorescence with bracts smaller than the tepals, persistent or deciduous, white or pale green _____ 10
- 10a. Leaf lamina conspicuously hairy on the upper surface _____ 11
- 10b. Leaf lamina glabrous above or with sparse evenly spaced bristles _____ 14
- 11a. Leaf lamina with a silver margin _____ **3. B. argenteomarginata**
- 11b. Leaf lamina without a silver margin _____ 12

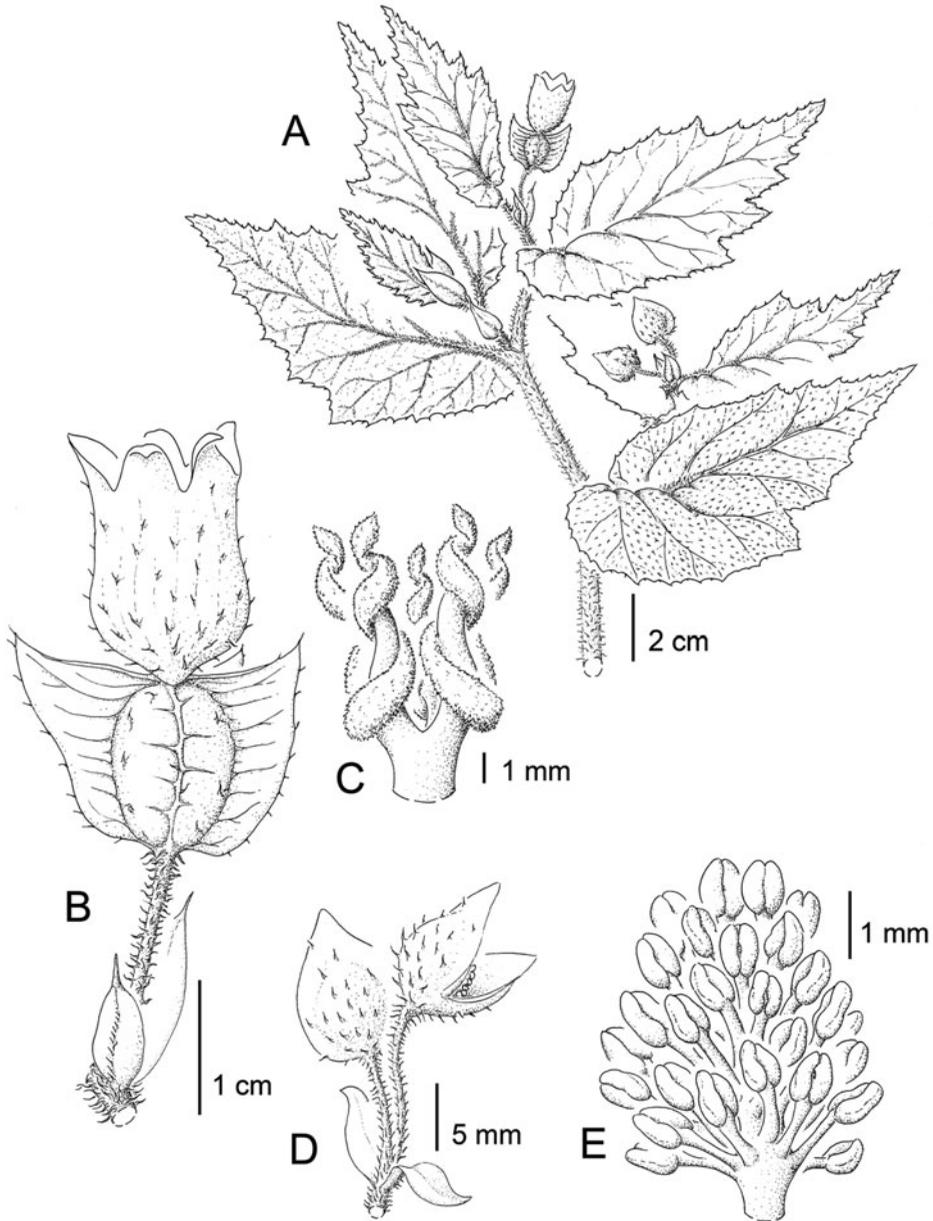


FIG. 1. *Begonia arauensis* M. Hughes. A, Habit; B, female flower; C, style and stigmas; D, male flowers and bracts; E, androecium. Drawn from Brass 32000.

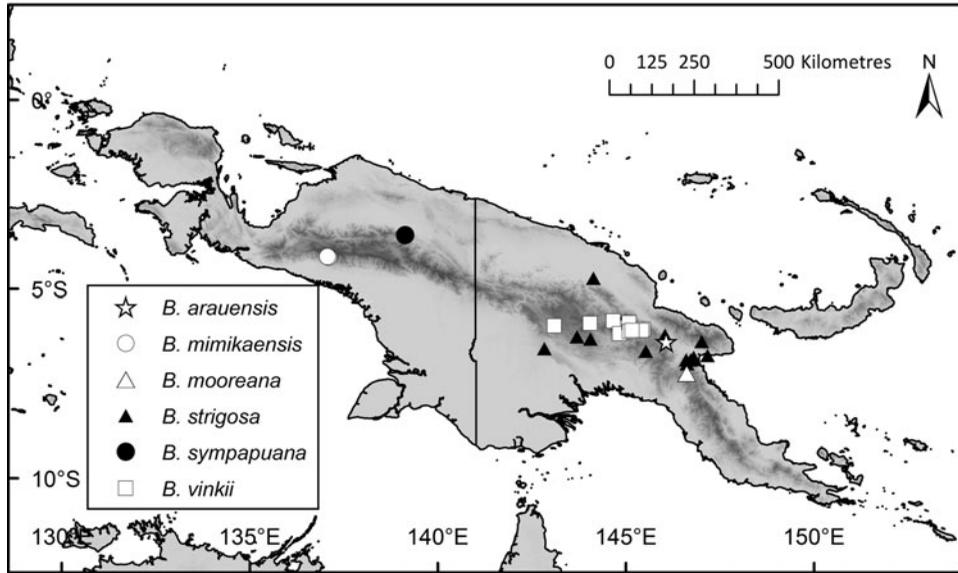


FIG. 2. Map of New Guinea and surrounding islands, showing species distributions based on georeferenced herbarium records.

ovary 17×22 mm including wings, capsule subglobose, 12×10 mm, wings 3, subequal, 17 mm wide, extending apically slightly; corolla 2.5 cm long, sparsely villose, lobes 5, 5 mm long; styles 3, elongate, 12 mm long, bifid, stigmatic surface twice spirally twisted. *Fruit* not seen.

Additional specimen examined. PAPUA NEW GUINEA. Eastern Highlands District, Arau, 6 x 1959, Brass 31904 (K, L).

Distribution and ecology. Papua New Guinea, endemic to the type locality of Arau. Described by Brass as “gregarious in ravines in *Castanopsis*-oak forest”; the leaves are “flat, shining above, nerves deeply impressed”. The two collections are both from c.1400 m altitude.

IUCN category. Data Deficient. The type locality could not be accurately georeferenced.

One of the larger species, in stature and also leaf and flower size. The epithet is derived from the type locality of Arau.

2. *Begonia arfakensis* (Gibbs) L.L.Forrest & Hollingsw., *Plant Syst. Evol.* 241: 208 (2003). – *Symbegonia arfakensis* Gibbs, *Fl. Arfak. Mts* 149 (1917). – Type: Indonesia, West Papua, Vogelkop, Arfak Mts, Anggi Lakes, xii 1913, *Gibbs* 5953 (lecto BM [BM000901364] here designated). **Figs 3, 4.**



FIG. 3. *Begonia arfakensis* (Gibbs) L.L.Forrest & Hollingsw. A, Habit; B, female flower; C, male flower. Photographed from a living plant in cultivation at the Royal Botanic Garden Edinburgh (accession no. 20090808), collected from near Minyambou in the Arfak Mountains.

Begonia beccarii Irmsch. *Webbia* 9: 507 (1953); *Begonia symbeccarii* (Irmsch.) L.L.Forrest & Hollingsw., *Plant Syst. Evol.* 241: 208 (2003). – Type: Indonesia, West Papua, Vogelkop, Arfak Mts, 1875, *Beccari* HB 4504 (lecto B [B100471344] here designated, isolecto FI [FI008017]) **syn. nov.**

Erect herb 30–40 cm high. *Stem* slender, wiry, with a few long suberect hairs, internodes to c.5 cm long. *Stipules* persistent, lanceolate, 10×4 mm, glabrous, shortly cuspidate, reddish brown. *Leaves*: petiole less than 3 mm; lamina green, subsymmetric, ovate-lanceolate, up to 6.5×3 cm, uniformly green, glabrous or with scattered minute bristles between the veins above, with reddish hairs on the veins below; basal lobe slightly oblique, sometimes slightly crossing the petiole; margin biserrate; venation pinnate; tip acute. *Inflorescence* 5 cm long, unisexual, male flowers 10–15, terminal, female flowers usually solitary, axillary or terminal; bracts 7×6 mm, broadly elliptic, margin minutely fimbriate, apex obtuse, shortly caudate, white, glabrous. *Male flower*: pedicel up to 12 mm, sparsely puberulous, tepals 2, partly fused at the base, ovate, $c.8 \times 8$ mm, tip acute, sparsely puberulous; androecium arranged on a thin white column, stamens 11–17; filaments 1 mm, anthers 0.75 mm, ellipsoid, white. *Female flower*: pedicel c.5 mm, sparsely puberulous, ovary pale green with pale pink wings, 11×18 mm including

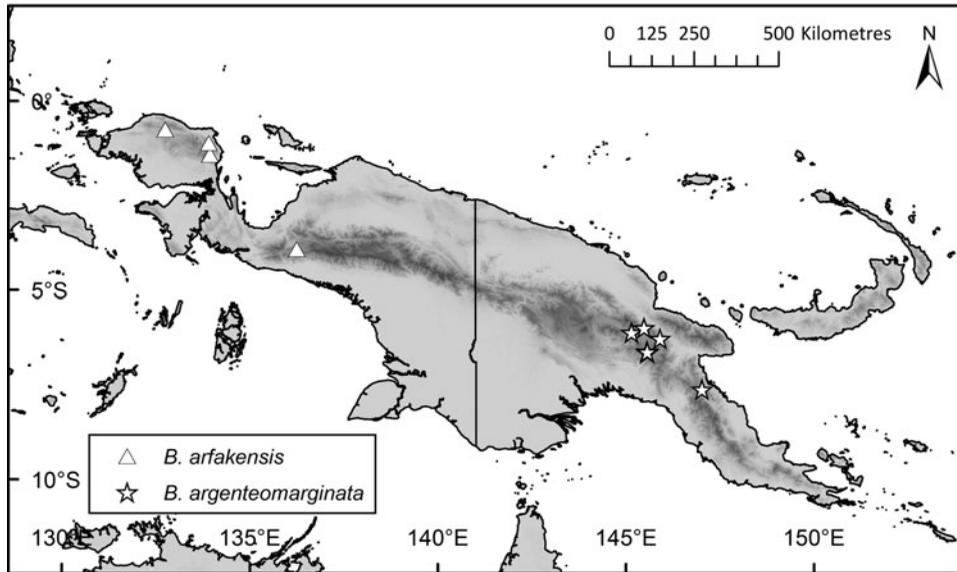


FIG. 4. Map of New Guinea and surrounding islands, showing species distributions based on georeferenced herbarium records.

wings, capsule suborbicular to ellipsoid, 8×5 mm, wings 9 mm wide at apex, sparsely puberulous, apex truncate to deeply arcuate; corolla 15 mm long, with 5 lobes each 4 mm long, styles 3, elongate, c.6 mm long, bifid with stigmatic surface twice spirally twisted. *Fruit*: pedicel c.1 cm long; shape as for the ovary, enlarging to c. 15×20 mm, apex variable but usually markedly arcuate.

Additional specimens examined. INDONESIA. **West Papua Province**: Vogelkop, Arfak Mts, Anggi Lakes, 9 x 1948 – 22 x 1948, *Kostermans* 2061 (BO, L); *ibid.*, 9 x 1948 – 22 x 1948, *Kostermans* 2273 (BO); Vogelkop, Arfak Mts, Minjambau, 19 v 1962, *Koster BW* 13859 (L [2 sheets]); Vogelkop, Ije River Valley, 8 xi 1961, *van Royen & Sleumer* 7789 (BO, K, L); Wissel Lakes, 11 iv 1939, *Eyma* 4848 (BO).

Distribution and ecology. Indonesia, West Papua Province, in the Arfak Mountains and near Wissel (Enarotali) Lakes. Terrestrial herb of the forest floor occurring from 900 to 1750 m altitude.

IUCN category. Least Concern. Quite widespread in montane forests in West Papua.

Begonia symbeccarii (Irmsch.) L.L.Forrest & Hollingsw. is reduced here, because there are no characters to distinguish it from Gibbs's earlier name and the type is from the same locality; Irmscher made no mention of *Begonia arfakensis* in his publication, and it would appear that he overlooked Gibbs's earlier work. The collection number of Gibbs's type was misprinted as '6953' in the protologue; the number on the sheet is '5953'. Gibbs (1917) mentioned that the fruit wings may be unequally developed, and this is reflected in the fruit apex shape variation seen on the type collection,



FIG. 5. *Begonia argenteomarginata* Tebbitt. A, Habit; B, female flowers. Photographed in Gahavisuka Provincial Park, Eastern Highlands Province, Papua New Guinea, at 2070 m altitude. Voucher: Gagul 609 (UPNG).

which ranges from concave to arcuate; further variation is represented by *van Royen & Sleumer 7789*, which has fruit with very concave apices. Gibbs also observed a 4-winged fruit, but this is likely to be the result of a developmental aberration. In cultivation, the male flowers are produced prolifically, but female flowers appear very sporadically. The measurements in the above description were taken from living material.

3. *Begonia argenteomarginata* Tebbitt, *Edinburgh J. Bot.* 61: 98 (2005). – Type: Papua New Guinea, Simbu Province, Chuave District, Mt Elimbari, 2000 m, xii 1981, *Reeve 595* (holo E; iso K, L, UPNG). **Figs 4, 5.**

Sympodially branching herb to 30 cm high. *Stem* c.5 mm wide, with long reddish pink glandular hairs, internodes c.5 cm long. *Stipules* persistent, lanceolate, 0.7–1 × 0.4–0.5 mm, green becoming brown when dry, cuspidate, generally glabrous, sometimes with hairs on main vein. *Leaves*: petiole up to 2 cm long, villose; lamina green with a silver margin, asymmetric, ovate, 5–11 × 2.2–4.5 cm, bullate above with evenly spaced short stiff hairs, green to bronze-green with silvery white or pink spots near the leaf margin of young leaves, which usually are merged to form a single band, dense villose indumentum on the veins below; basal lobe slightly oblique; margin serrate-ciliate

to biserrate; venation palmate-pinnate; tip acute. *Inflorescence* c.3 cm long, terminal, sometimes in uppermost axils, male flowers 2–10, female 1 or 2; bracts 4–7 × 2–3 mm, ovate, pale green, villose on the keel and tip, apex shortly caudate. *Male flower*: pedicel 3–11 mm long, with short reddish pink hairs; tepals 2, fused for 1–2 mm at the base, ovate, c.1 × 1 cm, white, with short white hairs at the base, apex obtuse; androecium on a thick column; stamens 15–18, filament 0.5 mm long, anther 0.75 mm long, ellipsoid, reddish brown. *Female flower*: pedicel c.5 mm long, villose; ovary 11 × 16 mm including wings, capsule ellipsoid, c.9 × 6 mm, wings c.5 mm wide at apex, sparsely villose, apex truncate; corolla c.15 mm long, sparsely villose, with 5 lobes each 4 mm long; styles 3, elongate, bifid, white, stigmatic surface twice spirally twisted. *Fruit*: shape as for the ovary, enlarging to c.15 × 20 mm.

Additional specimens examined. PAPUA NEW GUINEA. **Eastern Highlands Province**: Mt Gahavisuka Provincial Park, 30 vi 2011, *Gagul* 609 (UPNG); Sosointenu, between Yonki and Kainantu, 1800 m, xii 1981, *Reeve* 594 (K).

Distribution and ecology. Papua New Guinea, in the Eastern Highlands Province. In secondary wet montane forests at 1800–2000 m altitude.

IUCN category. Data Deficient. Only a small population of the species exists within the Gahavisuka Provincial Park, but there are scattered populations elsewhere. The delimitation of the species and its distribution needs further work.

There are further collections (Eastern Highlands Province: *Henty* NGF 49160 & 49260, *Brass* 31597, *Gagul* 610 [see Fig. 13D], *Womersley* 17644; Morobe Province: *Kairo* 414), which are potentially near to *Begonia argenteomarginata*, because they have leaves with a silver margin. However, the leaf shape differs slightly, being more lanceolate and sometimes with a less distinct basal lobe. The specimen *Reeve* 594 is intermediate between the type and these collections. More collections are required to understand the variation within *Begonia argenteomarginata* and whether these collections represent a new taxon. *Begonia symyanguinea* has variants (or possibly hybrids) with silver blotches on the margin, and appears to be closely related to *B. argenteomarginata*, which differs in having more dentate leaves and sparser bristles above with the glossy lamina visible between.

4. *Begonia asaroensis* J.Gagul sp. nov.

Similar to *Begonia symgeraniifolia*, but leaves are not dissected to the midrib in the lower third of the lamina; the sinuses between the lobes are narrower; and the stamens are on a thin column, not a short torus. – Type: Papua New Guinea, Mt Michael, Eastern Highland Province, c.2600 m, 27 x 1986, *Argent & Sandham* 86/82 (holo E [E00841603]). **Figs 6, 7.**

Erect branching herb c.40 cm high. *Stem*: slender, sometimes becoming woody, with short stiff hairs, glabrescent, internodes up to 7 cm long, becoming shorter (1–2 cm) distally. *Stipules* persistent, up to 5–7 × 3 mm, lanceolate, cuspidate, glabrous. *Leaves*: petiole 1–4(–6) mm long, with short stiff hairs; lamina green, subsymmetric, lanceolate,



FIG. 6. *Begonia asaroensis* J.Gagul, in Eastern Highland Province, Papua New Guinea. A, Habit, photographed in Gahavisuka Provincial Park (*Gagul* 611, UPNG); B, female flower and stigmas (inset), photographed in Namta, Asaro Subdistrict (*Gagul* 607, UPNG); C, male flowers, photographed in Ganaveroka, Daulo (*Gagul* 604, UPNG).

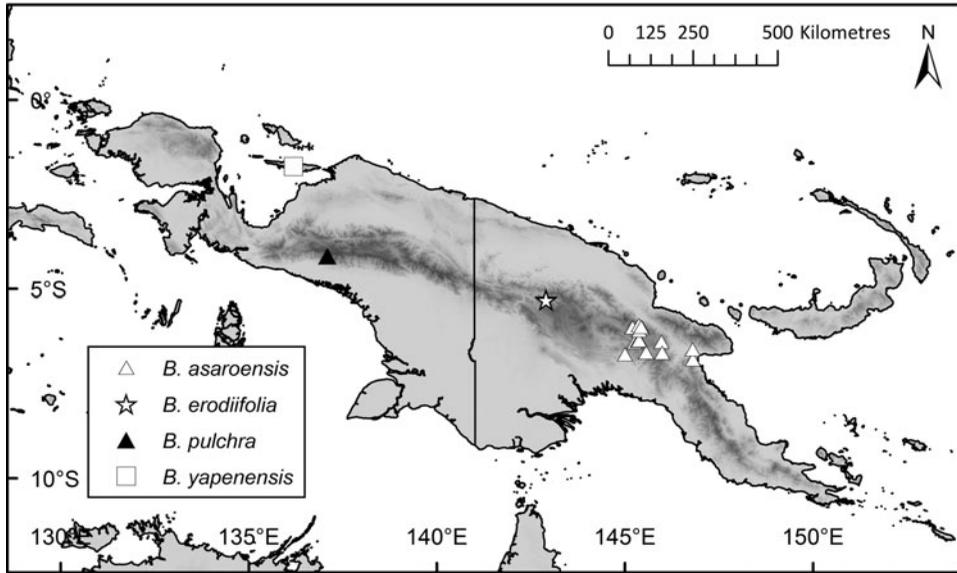


FIG. 7. Map of New Guinea and surrounding islands, showing species distributions based on georeferenced herbarium records.

(2.5)–3.5–5(–8) cm long, usually glabrous, sometimes with minute sparse bristles above, lower surface with appressed short hairs on the veins, basal lobe absent or up to 2 mm long; margin dissected into no more than 6 lobes, more so towards apex, to within 2 mm of the midrib, venation pinnate, tip acute. *Inflorescence* c.3 cm long, bi- or unisexual, terminal, male flowers 2–12, female flowers solitary; bracts c.4 mm long, lanceolate, glabrous, tip caudate. *Male flower*: pedicel up to 1 cm long, sparsely puberulous, tepals 2, slightly fused at the base, ovate, c.6 mm long, whitish pink, sometimes with a red patch at the base, glabrous, sparsely puberulous at the base, tip acuminate; androecium arranged on a thin column, with c.20 stamens, anthers usually extending beyond the tepals at anthesis, filaments c.0.5 mm long; anthers 0.5 mm long, suborbicular, apex slightly retuse. *Female flower*: pedicel 4–6 mm long, sparsely puberulous; ovary c.12 × 14 mm including wings, capsule ellipsoid, c.8 × 4 mm, wings 6 mm wide at apex, sparsely villose, apex arcuate; corolla 10 mm long, sparsely villose, with 5 lobes each 3 mm long, styles 3, elongate, c.6 mm long, bifid, white, stigmatic surface twice spirally twisted. *Fruit*: shape as for the ovary, enlarging to c.15 × 20 mm.

Additional specimens examined. PAPUA NEW GUINEA. **Eastern Highlands Province**: Above Goroka, 17 xi 1954, *Womersley & Floyd* NGF 6117 (LAE); Aiyura-Lae Road, 2 ix 1966, *Millar* 22722 (L, LAE); Ganaveroka, Daulo, 27 vi 2011, *Gagul* 604 (UPNG); Kainantu sub-dist., Mt Piora foothills, 12 vi 1972, *Coode* NGF 46286 (L, LAE); Kainantu to Okapa road, 25 v 1972, *Hartley* 13697 (L, LAE [2 sheets]); Kortumi, 22 xi 1954, *Floyd & Womersley* NGF 6714 (L, LAE); *ibid.*, 23 xi 1954, *Floyd & Womersley* NGF 6775 (L, LAE, SING); Lufa, 21 iv 1977, *Mege & Johns* 1857 (LAE); Mt Gahavisuka, iv 1983, *Cruttwell* 2313 (L, LAE); *ibid.*, 26 x 1987, *Cruttwell* 2180 (LAE); *ibid.*, 27 ix 1982, *Cruttwell* 2116 (LAE); *ibid.*, 30 vi 2011, *Gagul* 611 (UPNG); *ibid.*,



FIG. 8. *Begonia erodiifolia* Sands, photographed from a living plant in cultivation at the Royal Botanic Garden Edinburgh (Reeve 596, type collection).

12 xii 1983, *Kerenga & Cruttwell LAE 56669* (K, L, LAE); Mt Hozeke, 29 xi 1984, *Kerenga & Baker 56892* (L, LAE); Mt Michael, 25 viii 1959, *Brass 31152* (L, LAE); *ibid.*, 10 ix 1959, *Brass 31500* (K, L, LAE); *ibid.*, 13 ix 1959, *Brass 31582* (L, LAE); *ibid.*, xi 1977, *Hoover 58* (L, B, E, LAE); *ibid.*, 13 vi 1979, *Sohmer et al. LAE 75415* (LAE); *ibid.*, 2 ix 1959, *Womersley NGF 11367* (BM, L, SING, LAE); Mt Otto, 7 viii 1959, *Brass 30875* (L, LAE); *ibid.*, 5 viii 1959, *Brass 30834* (LAE); *ibid.*, 11 i 1958, *White NGF 9650* (L, LAE [2 sheets]); *ibid.*, 26 i 1970, *Johns & Noble NGF 47121* (LAE); Namta, Asaro Subdistrict, 29 vi 2011, *Gagul 607* (UPNG); Okapa, Purosa, 22 ix 1959, *Brass 31665* (L, LAE, NY); *ibid.*, xi 1977, *Hoover 62* (LAE); West of Omaura, 5 vii 1963, *Hartley 11979* (L, LAE); Wonatabe, iv 1963, *Womersley NGF 17670* (L, LAE). **Simbu Province:** Crater Mt Wildlife Management area, 21 vii 1998, *Takeuchi 12321* (L, LAE).

Distribution and ecology. Papua New Guinea, widespread throughout the Eastern Highlands Province, particularly around Mount Michael, Mount Otto and the Okapa area. It also occurs in Crater Mountain Wildlife Management Area in Simbu Province. It is common in montane forests along riverbanks and streams in wet, shaded places. The type was collected from a cliff in mossy submontane rain forest, with other collections found in *Castanopsis/Nothofagus* forest on shady banks, and in subalpine forests, at 1500–3400 m altitude.

IUCN category. Least Concern. Widespread across Eastern Highlands Province around Mount Michael, Mount Otto and Mount Gahavisuka; sometimes noted as common on specimens.

This species differs from *Begonia symgeraniifolia* in having leaves that are less divided, particularly in the lower third of the lamina. The distributions of the two species are exclusive, with *Begonia asaroensis* being restricted to the highlands of Papua New Guinea and *B. symgeraniifolia* being endemic to Papua Province in Indonesian New Guinea. See also notes under *Begonia mimikaensis*, which also has lobed leaves. The epithet is derived from the distribution of the species, centred around the Asaro River area.

5. *Begonia erodiifolia* Sands sp. nov.

Differs from all other species in *Begonia* sect. *Symbegonia* with incised leaves in having a smaller lamina (less than 2.6 cm long) and 3-lobed tepals in the male flowers.

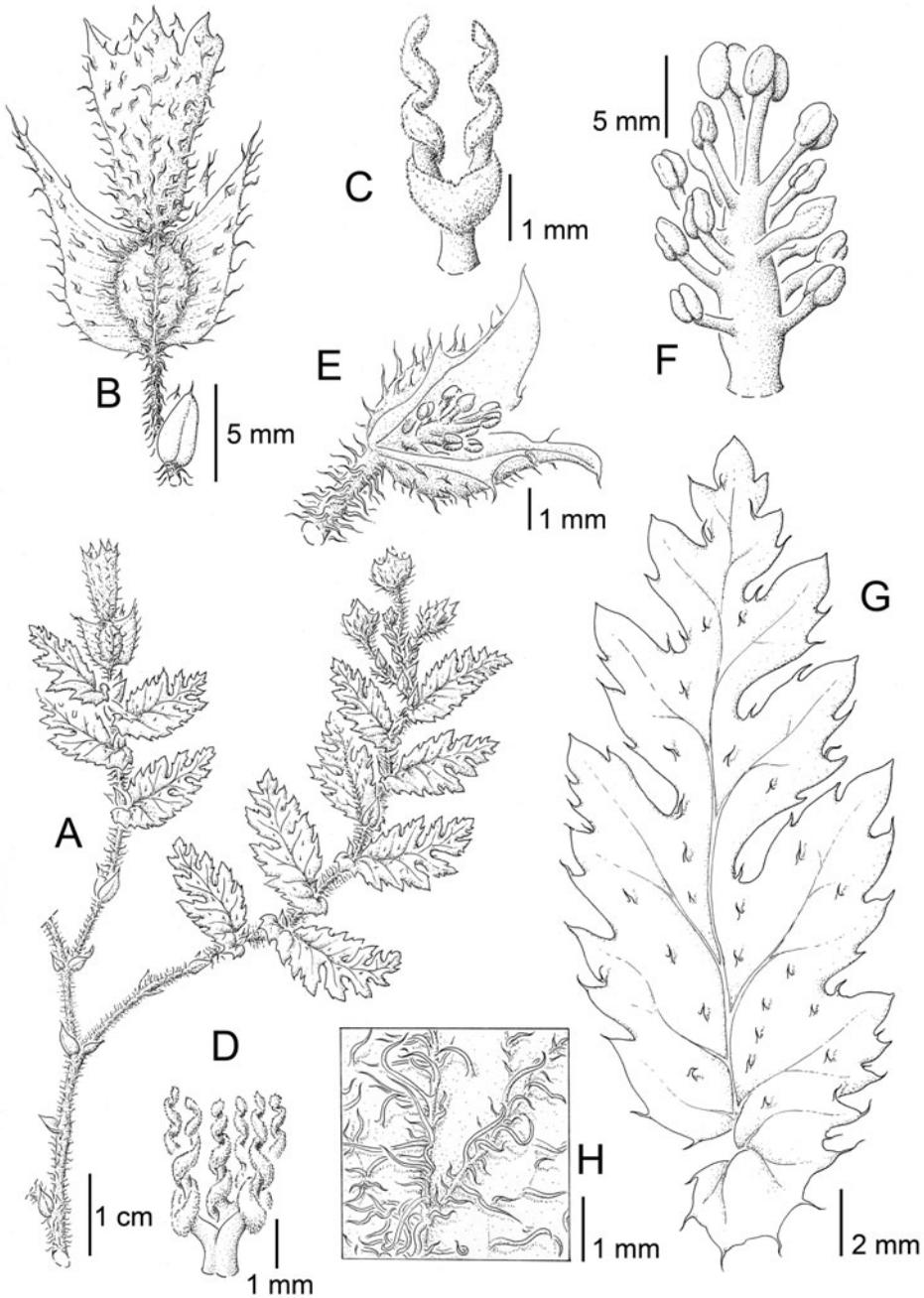
– Type: Papua New Guinea, Enga Province, Porgera District, Bealo, xii 1981, *Reeve* 596 (holo K; iso E [E00841604], L, LAE). **Figs 7–9.**

Erect much-branched herb up to 30 cm high. *Stem:* slender, villose, hairs 1 mm long, internodes up to 5 cm long, becoming shorter at the apex. *Stipules* persistent, c.5 × 3 mm, ovate, sometimes with sparse hairs on the keel, cuspidate. *Leaves* subsessile; lamina green, subsymmetric, narrowly ovate, 1.5–2(–2.5) × 0.7–1.2 cm, upper surface with sparse bristles, green with pink-red veins and margins, lower surface villose; basal lobe 1–2 mm, oblique; margin dissected in the apical half to within 1 mm of the midrib, lobes serrulate-ciliate, venation pinnate; tip acute. *Inflorescence* c.2 cm long, often unisexual, sometimes bisexual, usually terminal, female flowers usually solitary, male flowers 3–5; bracts 3–4 × 1.5 mm, ovate-lanceolate, glabrous, shortly cuspidate. *Male flower:* pedicel 4–7 mm long, villose, tepals 2, fused two-thirds of the length, c.6 × 5 mm, villose, each with 3 acute lobes c.2 mm long, pink to white; androecium arranged on a thin column, with c.16 stamens, filaments c.0.5 mm long, anthers less than 0.5 mm, obovate, white. *Female flower:* pedicel c.3 mm long, villose; ovary c.10 × 10 mm including wings, capsule ellipsoid, c.7 × 3 mm, wings 5 mm wide at apex, sparsely villose, apex arcuate; corolla 10 mm long, sparsely villose, with 5 lobes each 2–3 mm long, styles 3, elongate, c.5 mm long, bifid, stigmatic surface twice spirally twisted. *Fruit:* shape as for the ovary, enlarging to c.15 × 15 mm.

Distribution and ecology. Papua New Guinea, Enga Province, Porgera District. In wet shaded places, 1800 m altitude. Known only from the type collection.

IUCN category. Data Deficient. Known only from the type, on which it is described as ‘uncommon’.

The small, divided leaves make this a very distinct species. The acute lobes in the tepals of the male flowers give the illusion of a 6-tepalled corolla. The epithet is derived from the similarity of the leaf outline to some species of *Erodium*.



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FIG. 9. *Begonia erodiifolia* Sands. A, Habit; B, female flower; C, stigma detail; D, style; E, male flower; F, androecium; G, leaf lamina; H, detail of leaf underside. Drawn from Reeve 596.

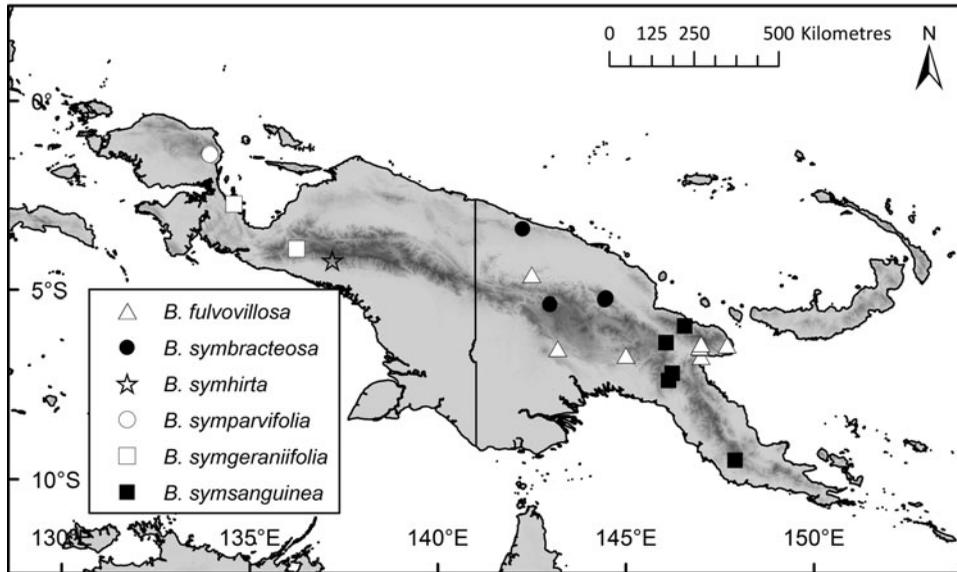


FIG. 10. Map of New Guinea and surrounding islands, showing species distributions based on georeferenced herbarium records.

6. *Begonia fulvovillosa* Warb., Bot. Jahrb. Syst. 13: 386 (1891); Irmischer, Bot. Jahrb. Syst. 50: 381 (1913); L.L Forrest & Hollingsw., Plant Syst. Evol. 241: 208 (2003). – *Symbegonia fulvo-villosa* (Warb.) Warb., Nat. Pflanzenfam. 3(6a): 149 (1894); Warburg, Fl. Deutsch. Schutzgeb. Südsee 459 (1901). – Type: Papua New Guinea, Morobe Province, Sattelberg, *Warburg* 20476 (lecto B [B100471346] here designated, isolecto A [A00068325]). **Fig. 10.**

Sympodially branching herb up to 1 m high. *Stem*: slender, becoming woody, villose with reddish brown, 2 mm long hairs, internodes c.5–7 cm long, becoming shorter nearer the apex. *Stipules* persistent, lanceolate, 0.5–1.2 cm long, keel and tip villose, cuspidate with tip extending 3–4 mm. *Leaves*: petiole 0.5–1 cm; lamina dark olive-green, asymmetric, lanceolate to nearly oblanceolate, c.6–9 × 2–3.5 cm, venation palmate pinnate, upper surface with appressed hairs, lower surface with red hairs on veins; base oblique, rounded; margin biserrate, becoming more prominently so towards the apex; venation pinnate-palmate, tip acute. *Inflorescence* c.3 cm long, uni- or bisexual, terminal, female flowers solitary male flowers 1–3; bracts c.8 × 3 mm, ovate, shortly caudate, apex slightly villose. *Male flower*: pedicel 5–15 mm long, villose, tepals 2, fused halfway, ovate-orbicular, c.10 × 7 mm, white, villose, tip rounded; androecium arranged on a stout column; stamens c.15, anthers subsessile, ellipsoid. *Female flower*: pedicel up to 3 mm long, villose; ovary 10 × 12 mm including wings, capsule broadly ellipsoid, c.8 × 3 mm, wings c.6 mm wide at apex, subtruncate to arcuate at the apex, sparsely villose; corolla c.11 mm long, white, sparsely villose, 5-lobed, each lobe 3 mm

long; styles 3, elongate, bifid, stigmatic surface twice spirally twisted. *Fruit*: shape as for the ovary, enlarging to c.14 × 18 mm.

Additional specimens examined. PAPUA NEW GUINEA. **Morobe Province**: Lae, Musom Village, 19 vi 1978, *Katik LAE 70830* (K, L, LAE); Mumeng, Wagau, 11 vi 1964, *Millar 23383* (L, LAE); Rawlinson Range, *Woods 2151* (K); Rawlinson Range, Kopsanik Village, 21 ii 1963, *van Royen NGF 16097* (BO, K, L); Sattelberg, 5 iii 1936, *Clemens, J & M.S. suppl.* (B); *ibid.*, 11 xii 1893, *Karnbach 70* (B); *ibid.*, 23 vi 1899, *Nyman 511* (B); *ibid.*, 1889–1891, *Weinland 327* (B); Yunzaing, 17 vii 1936, *Clemens, J & M.S. 4493* (B); Zatari, 23 ii 1963, *van Royen & Millar NGF 15661* (BO, K, L, LAE). **Simbu Province**: Crater Mt Wildlife Management area, 15 vii 1998, *Takeuchi 12029* (LAE); *ibid.*, 17 vii 1998, *Takeuchi 12154* (L, LAE); *ibid.*, 16 vii 1998, *Takeuchi 12086* (LAE); Kaiser-Wilhelmsland, 3 i 1889, *Hellwig 237* (B [2 sheets], BO, K); *ibid.*, 8 ix 1889, *Hellwig 517* (B). **Southern Highlands Province**: Ebenda, 21 vii 1961, *Schodde 1547* (L, LAE); Mendi Valley, above Kiburu, 1 vii 1961, *Schodde 1379* (K, L, LAE); Mt Bosavi, 27 x 1973, *Jacobs 8880* (L); Waro airstrip, 13 x 1973, *Jacobs 9196* (L, LAE).

Distribution and ecology. Papua New Guinea, common in Morobe, Simbu and Southern Highlands Provinces. In secondary forests, 500–2000 m altitude.

IUCN category. Least Concern. Reasonably widespread across the highlands of Papua New Guinea, especially in Simbu, Southern Highlands and Morobe Provinces.

Warburg's epithet *fulvo-villosa* (meaning with tawny or yellowish brown hairs) seems inappropriate when compared to the type and to his notes in the protologue: "The reddish brown, spreading, coarse hairs make the young twigs appear shaggy". *Begonia fulvovillosa* is very close to *B. mooreana*, but the leaves are hairier above. The specimens cited above include some smaller-leaved plants (*Takeuchi 12154*, *Schodde 1379 & 1547*), which we consider to be part of the variation within *Begonia fulvovillosa*, but further study, including molecular work, would be valuable.

7. *Begonia mimikaensis* Sands *sp. nov.*

Similar to *Begonia symgeraniifolia*, but differs in having leaves with a distinct amplexicaul basal lobe, rather than a cuneate base, and male flowers with free tepals (not fused halfway). – Type: Indonesia, Papua Province, Mimika Regency, Utekini Valley, 18 viii 1998, 4°10'S, 137°6'E, 18 viii 1998, *Beaman 12264* (holo K). **Figs 2, 11.**

Sympodially branching herb up to 70 cm high. *Stem*: slender, with hairs, more dense towards the apex, internodes 2–6 cm long, becoming shorter near the apex. *Stipules* persistent, lanceolate, cuspidate, glabrous, 8–12 × 5 mm. *Leaves*: petiole subsessile to 5 mm long, villose; lamina green, asymmetric, lanceolate, 5.5–7.8 cm × (1.5–)2.5–4 cm, glabrous above, hairy on main veins below; basal lobe 0.8–1.2 cm long, crossing the petiole; margin dissected to 2 mm or less from the midrib, lobes serrate; venation pinnate, tip acute. *Inflorescence* c.2.5 cm long, uni- or bisexual, terminal, female flowers solitary or subtending 3–7 male flowers; bracts conspicuous, 8–10 × 8 mm, broadly ovate, glabrous, apex acute. *Male flower*: pedicel c.5 mm long, sparsely puberulous, tepals 2, free, white, ovate-orbicular, 8 × 7 mm long, sparsely puberulous, tip obtuse; androecium on a short torus: stamens c.10, anthers subsessile to being borne on a 1-mm

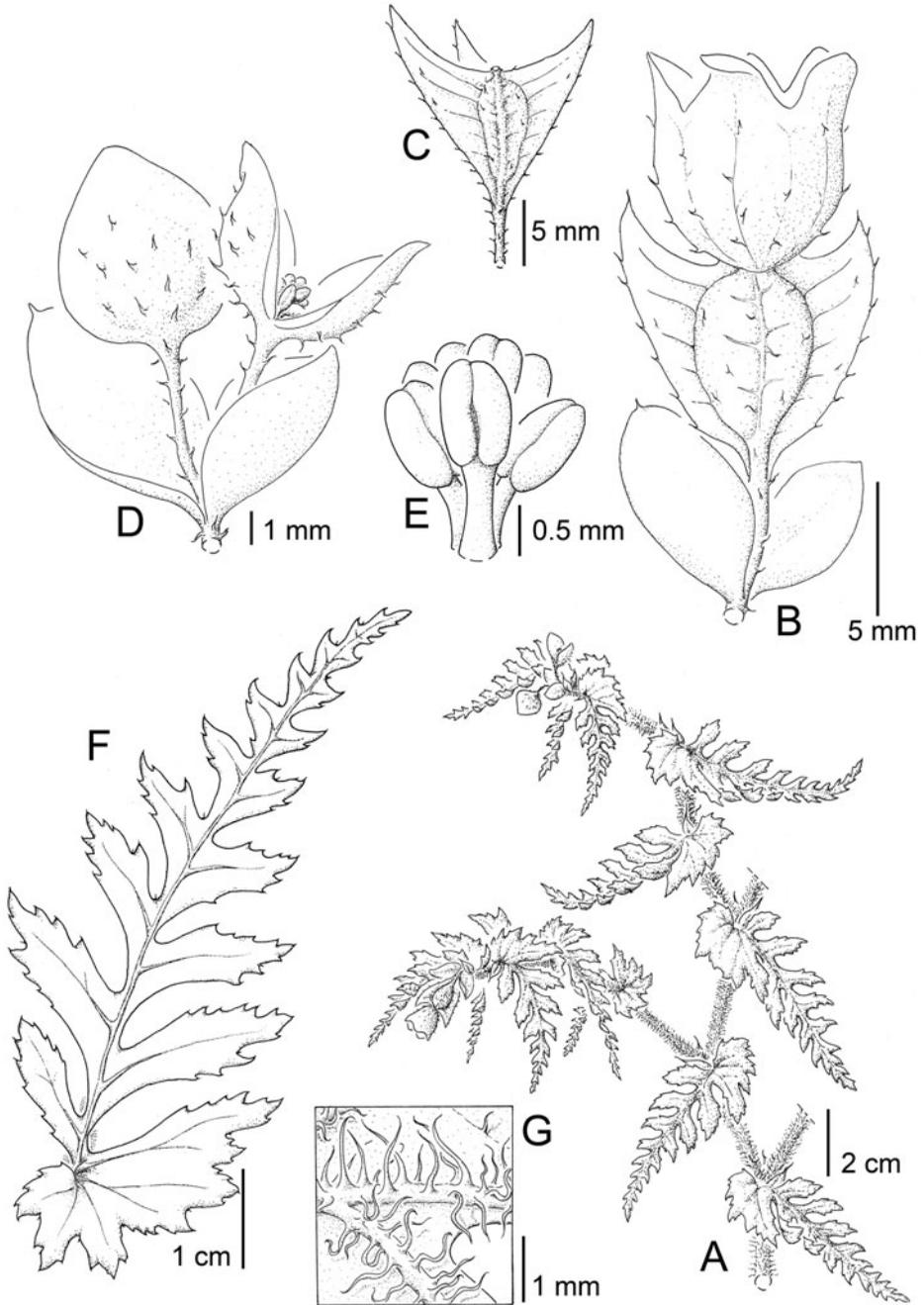


FIG. 11. *Begonia mimikaensis* Sands. A, Habit; B female flower subtended by bracts; C, fruit; D, male flowers subtended by bracts; E, androecium; F, leaf lamina; G, detail of leaf underside. Drawn from *Beaman* 12264 (A, B, D, F and G), *Cook* 199 (C) and *Utteridge* 235 (E).

filament in the centre of the androecium, anthers c.1 mm long, ellipsoid. *Female flower*: pedicel 4 mm long, sparsely villose; ovary 15 × 15 mm including wings, capsule ellipsoid, 10 × 4 mm, wings 7 mm wide at apex, sparsely villose, apex arcuate; corolla up to 10 mm long, sparsely villose, with 5 lobes each up to 4 mm long; styles 3, elongate, bifid, stigmatic surface twice spirally twisted. *Fruit*: shape as for the ovary, enlarging to c.15 × 18 mm.

Additional specimens examined. INDONESIA. **Papua Province**: Mimika Regency, Utekini Valley, 2005, Cook 199 (E); *ibid.*, 7 xii 1996, Sands 7300 (K, SING); *ibid.*, 3 iii 1999, Utteridge 235 (K, L).

Distribution and ecology. Indonesia, Papua Province, Utekini Valley, Mimika area. In disturbed lower montane and mid-montane forests, 1600–2750 m altitude.

IUCN category. Least Concern. One of the collections is from a heavily disturbed area (Utteridge 235), indicating the species has some tolerance of non-primary forests. However, it is known only from the Freeport Concession Area, and any large-scale forest clearance will probably result in *Begonia mimikaensis* becoming threatened.

This species differs from the two other species in sect. *Symbegonia* with divided leaves of a similar size (*Begonia asaroensis* and *B. symgeraniifolia*) in having a pronounced amplexicaul basal leaf lobe, rather than leaves that narrow towards the base, lacking a basal lobe. The epithet is derived from the type locality of the Mimika regency.

8. *Begonia mooreana* (Irmsch.) L.L.Forrest & Hollingsw., *Plant Syst. Evol.* 241: 208 (2003). – *Symbegonia mooreana* Irmsch., *Bot. Jahrb. Syst.* 50: 381 (1913). – Type: Papua New Guinea, Ibo Mts, 28 v 1908, *Schlechter* 17800 (lecto B [B100217772]). **Fig. 2.**

Symbegonia fulvo-villosa auct. non. Warb.: Sprague, *Bot. Mag.* (1911) t. 8409.

Sympodially branching herb. *Stem*: slender, internodes c.5 cm long becoming shorter towards the apex, appressed-villose. *Stipules* persistent, ovate lanceolate, c.10–15 × 3–4 mm, glabrous, cuspidate. *Leaves*: petiole subsessile to 5 mm long, villose; lamina green, asymmetric, lanceolate-acuminate, c.5.5–8.5 × 2–3.5 cm, upper surface sparsely puberulent, lower surface shortly villose on the veins; basal lobe slightly oblique, sometimes overlapping the petiole; margin biserrate to laciniate; venation palmate-pinnate; tip acuminate. *Inflorescence* c.2 cm long, uni- or bisexual, terminal, few-flowered, female flowers solitary or subtending 2 male flowers; bracts 15 × 4 mm, lanceolate, glabrous, cuspidate. *Male flower*: pedicel 10–15 mm, sparsely puberulous, tepals 2, fused for 2 mm at the base, ovate, 15 × 10 mm, white, sparsely puberulous at the base; androecium on a thick column, stamens c.13, subsessile, anthers ellipsoid. *Female flower*: pedicel c.5 mm long, sparsely puberulous; ovary 8 × 10 mm including wings, capsule globose-ellipsoid, c.7 × 5 mm, wings c.5 mm wide at apex, sparsely puberulous, apex arcuate; corolla 10 mm long, sparsely puberulous, with 5 lobes each c.3 mm long; styles 3, elongate, bifid, stigmatic surface twice spirally twisted. *Fruit*: shape as for the ovary, enlarging to c.14 × 18 mm.

Additional specimen examined. PAPUA NEW GUINEA. Bololo, 10 ix 1907, *Schlechter* 16541 (B, P).

Distribution and ecology. Papua New Guinea, Bololo, Ibo Mountains, c.1000 m altitude.

IUCN category. Data Deficient.

This species is most similar to *Begonia fulvovillosa*, and indeed has been confused with that species (Sprague, 1911). Imscher described it as distinct owing to its having leaf margins that are slightly lobed; also, comparison of the types of both species shows *Begonia mooreana* to have a slightly larger and more auriculate basal lobe, and it also has an almost glabrous upper leaf surface. However, florally the two species appear identical, and as they become better known it may be feasible to recognise them as one taxon if collections with intermediate leaf forms are found. The duplicate of *Schlechter* 17800 in P (P019007690) has leaves that are conspicuously shortly hairy above, and less lobed than the sheet in B; we consider this not to be a duplicate and probably referable to *Begonia fulvovillosa*.

9. *Begonia pulchra* (Ridl.) L.L.Forrest & Hollingsw., *Plant Syst. Evol.* 241: 208 (2003). – *Symbegonia pulchra* Ridl., *Trans. Linn. Soc. London, Bot.*, II 9: 62 (1916). – Type: Indonesia, Papua Province, Otakwa River, Camp IX–X, 26 i 1913, *Kloss s.n.* (lecto BM here designated; isolecto BM, K [K000739911]). **Fig. 7.**

Sympodially branching herb to 60 cm high. *Stem*: slender, villose, internodes c.5 cm long. *Stipules* persistent, ovate lanceolate, 14 × 7 mm, glabrous, shortly cuspidate. *Leaves*: petiole 2 mm long, with short hairs; lamina glossy green with scarlet venation, asymmetric, basal lobe extending down the petiole slightly, occasionally becoming auriculate, lanceolate, 6–12.5 × 2.5–5 cm, venation pinnate, upper surface glabrous, lower surface with hairs on veins, margin bidentate, major teeth larger, more angular and opposite in the apical half of the lamina. *Inflorescence* 3–7 cm long, terminal, uni- or bisexual, larger ones with a distinct central axis and appearing racemose, female flowers solitary or in pairs, male flowers c.10, occasionally more; bracts 7 × 4 mm at the base of the inflorescence, becoming smaller towards the apex, ovate, white, glabrous, apex acute. *Male flower*: pedicel 1 cm long, glabrous; tepals 2, fused at the base, ovate-orbicular, 6 × 7 mm, white, villose at the base, tip obtuse; androecium on a short torus, with 9–12 stamens, basal ones subsessile, central ones on a c.1-mm filament, anthers ellipsoid, apex slightly retuse. *Female flower*: pedicel c.1 cm long, subglabrous; ovary 12 × 20 mm including wings, capsule ellipsoid, c.10 × 5 mm, wings 9 mm wide at apex, sparsely puberulous, apex arcuate; corolla 12 mm long, sparsely puberulous, with 5 lobes each 4 mm long, styles 3, elongate, bifid, stigmatic surface twice spirally twisted. *Fruit*: shape as for the ovary, enlarging to c.15 × 20 mm.

Additional specimens examined. INDONESIA. **Papua Province**: Mt Jaya, 5 iv 1999, *Edwards et al.* 4394 (K [2 sheets], L); *ibid.*, 1 viii 1998, *Sands* 7033 (K, SING); *ibid.*, 25 iv 2000, *Triono et al.* 158 (K); *ibid.*, 26 iii 1999, *Utteridge et al.* 191 (K, SING); *ibid.*, 26 iii 1999, *Utteridge et al.* 194

(K); Otakwa River, Camp 6a, i 1913, 17 i 1913, *Kloss s.n.* (BM [BM000901260]); Otakwa River, Camp 7–8, i 1913 *Kloss s.n.* (BM, K [000739909]); Otakwa River, Camp XI–IX, ii 1913, *Kloss s.n.* (BM [000901261], K [K000739908]).

Distribution and ecology. Indonesia, Papua Province, Otakwa River and Mount Jaya. In humus-rich soils along stream edges, c.2000 m altitude. Described as common (*Edwards* 4394).

IUCN category. Least Concern. The forests in the region of the type locality are intact and inaccessible, and the species was collected from several localities during the Wollaston Expedition (Ridley, 1916) and so does not appear to be especially restricted in distribution or altitude.

The leaves are glossy above with claret red veins (*Utteridge* 191), or green with reddish flushing around the margin (*Edwards* 4394).

10. *Begonia strigosa* (Warb.) L.L.Forrest & Hollingsw., Plant Syst. Evol. 241: 209 (2003). – *Symbegonia strigosa* Warb., Fl. Deutsch. Schutzgeb. Südsee 324 (1905). – Type: Papua New Guinea, Kaiser-Wilhelmsland, Bismark Mtns, i 1902, *Schlechter* 14019 (lecto B [B100365258] here designated; isolecto BO, K [K000739906]). **Figs 2, 12.**

Sympodially branching herb, to 30 cm high. *Stem* slender, becoming woody, with 3–5 mm long yellowish brown hairs, internodes c.5 cm long. *Stipules* persistent, c.12 × 4 mm, villose on the keel and tip, cuspidate. *Leaves*: petiole c.5 mm long, villose; lamina green, asymmetric, lanceolate-rhomboid; 7–11 × 3–4 cm, upper surface villose between the veins, lower surface villose on the veins; basal cuneate, oblique, overlapping the petiole slightly; margin subentire or denticulate; venation pinnate-palmate; tip acute. *Inflorescence* c.3 cm long, terminal, uni- or bisexual, female flowers solitary or subtending c.5 male flowers; bracts lanceolate, 10 × 4 mm, glabrous, tip acute. *Male flower*: pedicel 10–15 mm, villose; tepals 2, c.13 × 8 mm, fused for two-thirds of the length, white, villose and bulbiform at the base, lobe tips rounded; androecium on a stout column with c.10 stamens, anthers subsessile, ellipsoid. *Female flower*: pedicel c.2 mm long, villose; ovary c.13 × 12 mm including wings, capsule broadly ellipsoid, c.10 × 5 mm, wings c.6 mm wide at apex, sparsely villose, apex arcuate; corolla c.12 mm long, villose, with 5 lobes each 4 mm long, styles 3, elongate, bifid, stigmatic surface twice spirally twisted. *Fruit*: shape as for the ovary, enlarging to c.14 × 18 mm.

Additional specimens examined. PAPUA NEW GUINEA. **Eastern Highlands Province**: 4 miles N of Okapa, 28 ix 1959, *Brass* 31778 (K, L, LAE); Kassam, 11 i 1968, *Henty & Coode* NGF 29253 (L, LAE); Lehmfluss (Clay River), 25 v 1913, *Ledermann* 11573 (B [2 sheets]); Obura, Kainantu, 8 iv 1972, *Hays* 293 (LAE); Waisa, 25 ix 1964, *Hartley* TGH 13116 (L, LAE). **Morobe Province**: Aseki Valley, 25 iv 1966, *Schodde* 5041 (L, LAE); Bupu, 4 iii 1964, *Millar* NGF 23330 (L, LAE); Kasanombe, 27 viii 1973, *Katik & Taho* LAE 56394 (L, LAE); Menyamya, Oiwa–Benula Track, 24 xi 1970, *Streimann & Kairo* NGF 42487 (LAE [2 sheets]); Mt Shungol, 10 xii 1963, *Hartley* TGH 12467 (K, L, LAE); *ibid.*, 14 xi 1970, *Stevens* 50475 (BO, K, L, LAE); Mumeng, Wagau,

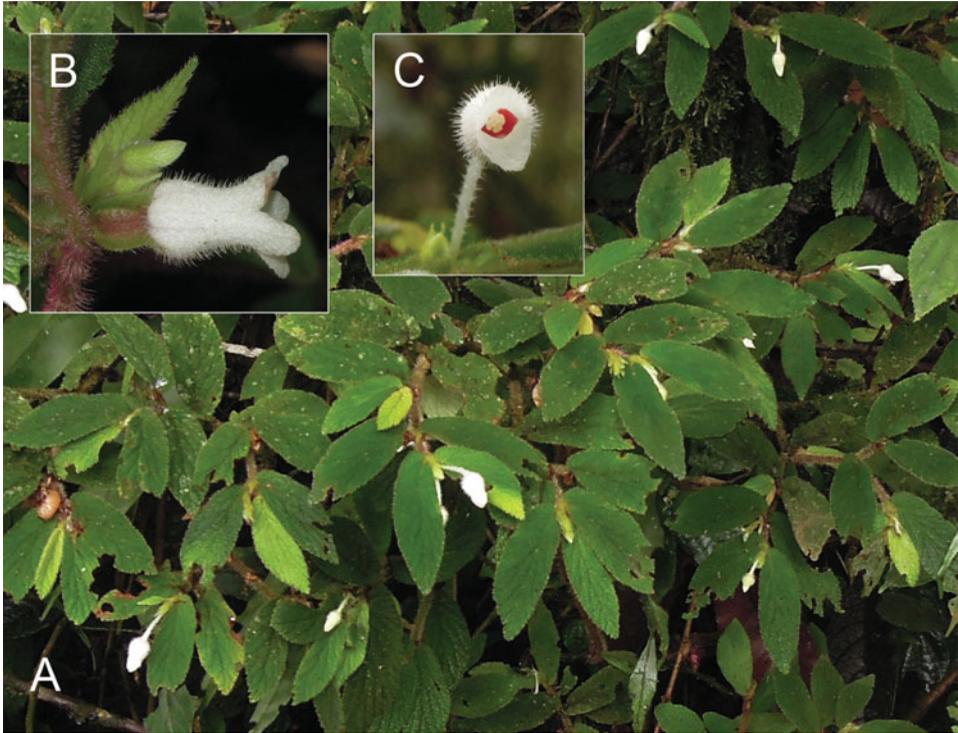


FIG. 12. *Begonia strigosa* (Warb.) L.L.Forrest & Hollingsw., photographed on Mount Hagen, Western Highlands Province, Papua New Guinea. A, Habit; B, female flower; C, male flower (not vouchered).

22 xi 1967, *Millar & Dockrill NGF 12081* (L, LAE); *ibid.*, 3 xi 1963, *Womersley NGF 17871* (K, L, LAE). **Simbu Province:** Kerowagi distr., Koronigi River, 27 viii 1968, *Millar 37798* (L, LAE).

Distribution and ecology. Papua New Guinea, common in Morobe, Eastern Highlands and Simbu Provinces, 760–2260 m altitude.

IUCN category. Least Concern. Widespread in the Central Range of Papua New Guinea.

The type material is rather poor; the subtire sinuate-ciliate margin seems to be distinctive. Although widespread, not a well-understood species, and it is not inconceivable that the specimens above relate to more than one taxon, once better observations based on living material are available.

11. *Begonia symbracteosa* (Warb.) L.L.Forrest & Hollingsw., *Plant Syst. Evol.* 241: 208 (2003). – *Symbegonia bracteosa* Warb., *Fl. Deutsch. Schutzgeb. Südsee* 323 (1905). – Type: Papua New Guinea, Kaiser Wilhelmsland, Torricelli Mtns, iv 1902, *Schlechter* 14369 (lecto B B100217775] here designated; isolecto B, BM [BM000901236], BO, G [G00237341, G00237342], K [K000739916], P [P01900774]). **Fig. 10.**

Erect branching herb. *Stem* slender, becoming woody, villose, with hairs c.4 mm long, internodes c.5 cm long. *Stipules* persistent, c.12 × 4 mm, glabrous, cuspidate. *Leaves*: petiole c.5 mm long, hairy; lamina green, slightly asymmetric, oblanceolate, widest in the apical half, 5–8 × 2–3 cm, glabrous above, paler green below often with red veins, reddish pubescent on the veins; base oblique, basal lobe overlapping the petiole; margin biserrate, with long sparse hairs between the teeth and at the tips of lobes; venation pinnate-palmate; tip acuminate. *Inflorescence* c.5 cm long, usually bisexual, terminal, single female flower subtending 20–30 male flowers; bracts conspicuous, broadly ovate, 12 × 8 mm, white, glabrous, tip acute. *Male flower*: pedicel up to 1 cm long, sparsely villose; tepals 2, fused at the base, sparsely villose at the base, broadly ovate, c.8 × 8 mm, white, tip acuminate; androecium with c.10 stamens, arranged on a thin column, filaments 0.5 mm long, anther ellipsoid, 0.5 mm. *Female flower*: pedicel c.5 mm long, glabrous; ovary c.15 × 15 mm including wings, capsule ellipsoid, c.8 × 4 mm, wings 7 mm wide at apex, apex deeply arcuate; corolla 12 mm long, sparsely puberulous, with 5 lobes each 5 mm long, styles 3, elongate, bifid, stigmatic surface twice spirally twisted. *Fruit*: shape as for the ovary, enlarging to c.20 × 20 mm.

Additional specimens examined. PAPUA NEW GUINEA. **Enga Province**: Paiela, 6 xi 1981, *Rees & Reeve* 345 (K). **West Sepik Province**: Kaiser-Wilhelmsland, Torricelli Mtns, Mt Somoro, 31 viii 1961, *Darbyshire* 310 (K, L, LAE); *ibid.*, 17 ix 1961, *Darbyshire* 462 (LAE); Mt Amdutakin, 17 ix 1966, *Kalkman* 5307 (K, L, LAE).

Distribution and ecology. Papua New Guinea, in Enga Province and West Sepik Province, Torricelli Mountains. In primary dense to secondary forests, 2000–2350 m altitude.

IUCN category. Data Deficient. Further information is needed on the three rather isolated locations.

Begonia symbracteosa is distinguished by its showy, white glabrous bracts.

12. *Begonia symgeraniifolia* (Ridl.) L.L.Forrest & Hollingsw., *Plant Syst. Evol.* 241: 208 (2003). – *Symbegonia geraniifolia* Ridl., *Trans. Linn. Soc. London, Bot.* II 9: 61 (1916). – Type: Papua, Otakwa River, Camp 7–8, i 1913, *Kloss s.n.* (lecto BM [BM000944676] here designated, isolecto K [K000739915]). **Fig. 10.**

Erect branching herb. *Stem*: slender, villose, internodes up to 5 cm long. *Stipules* persistent, lanceolate, 8 × 3 mm, glabrous, tip acute. *Leaves*: petiole less than 2 mm long, villose; lamina green, subsymmetric, lanceolate, 4–7 × 1.5–2.5 cm, glabrous above, with short dense hairs on the veins below; margin pinnately dissected almost to the midrib, into 6 or more lobes, the pinnae in the lower two-thirds of the lamina being further dissected; base rounded to cuneate, slightly oblique; venation pinnate; tip acuminate. *Inflorescence* c.2 cm long, unisexual, terminal, female flowers solitary, male flowers 1–5; bracts ovate, 7 × 4 mm, white, glabrous, tip acute. *Male flower*: pedicel 5–10 mm long, sparsely villose, tepals 2, ovate, 10 × 7 mm, fused halfway, sparsely villose at the base; androecium on a torus with c.6 stamens, filaments free, anthers ellipsoid.

Female flower: pedicel 5 mm long, villose; ovary 10 × 12 mm including wings, capsule ellipsoid, 7 × 5 mm, wings 6 mm wide at apex, apex truncate to arcuate; corolla 10 mm long, sparsely villose, with 5 lobes each 3 mm long; styles 3, elongate, bifid, stigmatic surface twice spirally twisted. *Fruit*: shape as for the ovary, enlarging to c.12 × 15 mm.

Additional specimen examined: INDONESIA. **Papua Province**: Wandammen Peninsula, 8 vii 1928, Mayr 292 (B, BO).

Distribution and ecology. Indonesia, Papua Province, Wandammen Peninsula and the foothills of Mount Jaya.

IUCN category. Data Deficient. Further distribution information is needed.

See notes under *Begonia mimikaensis* for similar species.

13. *Begonia symhirta* (Ridl.) L.L.Forrest & Hollingsw. *Plant Syst. Evol.* 241: 208 (2003). – *Symbegonia hirta* Ridl., *Trans. Linn. Soc. London, Bot.* II 9: 61 (1916). – Type: Papua, Camp 8–9, i 1913, *Kloss s.n.* (lecto BM [BM000901263] here designated). **Fig. 10.**

Sympodially branching herb. *Stem*: c.4 mm wide, villose, internodes c.5 cm long. *Stipules* persistent, ovate, 10 × 8 mm, keel villose, shortly cuspidate. *Leaves*: petiole up to 1 cm long, villose; lamina green, asymmetric, broadly ovate, c.4–6 × 5 cm, sparsely villose between the veins above, villose on veins below with scattered hairs between; base cordate, basal lobe markedly overlapping the petiole; margin subentire-denticulate; venation palmate-pinnate; tip shortly acute. *Inflorescence*: c.5 cm long with a distinct axis, unisexual, terminal, 10–15 male flowers, white; bracts 4 × 3 mm, oblong, glabrous, tip obtuse. *Male flower*: pedicel c.7 mm long, sparsely villose, tepals 2, fused at the base, ovate, c.8 × 6 mm, sparsely villose at the base, tip obtuse; androecium on a short torus, stamens c.20, filaments up to c.1 mm long, anther ellipsoid. *Female flower* not seen. *Fruit* not seen.

Distribution and ecology. Indonesia, Papua Province, Otakwa River, from 1480 to 1670 m altitude.

IUCN category. Data Deficient.

A poorly understood species. Ridley (1916) noted “There are two forms of the plant, both gathered in the same district; in one the leaves are obliquely ovate with short petioles, in the other they are almost reniform and symmetrical with longer petioles.” Here we have typified using the short-petioled form, and consider the material with long petioles in K [K000739914] to be very likely to represent a different taxon, although the material is not sufficient to furnish a description.

14. *Begonia sympapuana* (Merr. & Perry) L.L.Forrest & Hollingsw., *Plant Syst. Evol.* 241: 208 (2003). – *Symbegonia papuana* Merr. & L.M. Perry, *J. Arnold Arbor.* 24: 59 (1943). – Type: Indonesia, Papua Province, Idenburg River, i 1939, *Brass* 12161

(lecto A [A00068355] here designated; iso BM [BM000901262], BO, BRI [BRI-AQ0333170], L [L0530904, L0530905]). **Fig. 2.**

Sympodially branching herb up to 50 cm high. *Stem* c.5 mm wide, villose; internodes c.5 cm long. *Stipules* persistent, lanceolate, 10 × 6 mm, shortly villose on the keel, shortly cuspidate. *Leaves*: petiole 0.5–2 cm long, villose; lamina green, asymmetric, ovate-lanceolate, c.9–12 × 3.5–5 cm, upper surface sparsely villose between the veins, lower surface with short hairs on the veins; base oblique, overlapping the petiole slightly; margin dentate-denticulate; venation palmate-pinnate; tip shortly acuminate. *Inflorescence* c.7 cm long, bisexual, terminal, with (1 or) 2 female flowers subtending c.10–15 male flowers; bracts broadly ovate, 6 × 4 mm, glabrous, tip acute. *Male flower*: pedicel c.4 mm long, villose, tepals 2, fused at base, ovate-elliptic, c.10 × 8 mm, villose at the base, tip rounded; androecium on a short torus, stamens c.15, subsessile, anthers ellipsoid. *Female flower*: pedicel 5 mm long, puberulous; ovary c.15 × 18 mm including wings, capsule ellipsoid, c.12 × 5 mm, wings 9 mm wide at apex, sparsely puberulous, apex subtruncate; corolla 15 mm long, sparsely puberulous, with 5 lobes each 5 mm long, styles 3, elongate, bifid, stigmatic surface twice spirally twisted. *Fruit*: shape as for the ovary, enlarging to c.15 × 18 mm.

Distribution and ecology. Indonesia, Papua Province, Idenburg River. In rain forest gullies, 550–1750 m altitude.

IUCN category. Data Deficient. Known only from the type.

The truncate apex to the fruits is distinctive, differing from the all the other species, which are arcuate at the apex to some extent.

15. *Begonia symparvifolia* (Gibbs) L.L.Forrest & Hollingsw., *Plant Syst. Evol.* 241: 208 (2003). – *Symbegonia parvifolia* Gibbs, *Fl. Arfak. Mts* 150 (1917). – Type: Indonesia, West Papua, Vogelkop, Arfak Mts, Koebre Mt, xii 1913, *Gibbs* 5644 (lecto BM [BM000901271] here designated). **Fig. 10.**

Erect much-branched herb. *Stem*: slender, shortly villose, glabrescent, internodes c.5 cm long at the base, becoming shorter toward the apex. *Stipules* persistent, 5 × 2 mm, glabrous, shortly cuspidate. *Leaves*: petiole nearly absent; lamina green, subsymmetric, lanceolate, up to 3 × 0.9 cm, upper surface with sparse glandular hairs, lower surface with reddish short hairs on the veins and scattered between; base rounded to cuneate, slightly oblique; margin dentate; venation pinnate; tip acuminate. *Inflorescence* c.2 cm long, unisexual, terminal, male flowers c.5, female flowers solitary; bracts ovate-lanceolate, 4 × 3 mm, glabrous, tip acute to shortly caudate. *Male flower*: pedicel c.3 mm long, puberulous; tepals 2, fused at the base, orbicular-ovate, c.7 × 5 mm, glabrous, tip acute, stamens on a thin column, c.10, subsessile, anthers ellipsoid. *Female flower*: pedicel c.2 mm long, puberulous; ovary c.9 × 9 mm including wings, capsule broadly ellipsoid, c.8 × 3 mm, wings 5 mm wide at apex, sparsely puberulous, apex arcuate; corolla 9 mm long, sparsely puberulous, with 5 lobes each

3 mm long, styles 3, elongate, bifid, stigmatic surface twice spirally twisted. *Fruit*: shape as for the ovary, enlarging to c. 12×7 mm.

Additional specimens examined. INDONESIA. **West Papua Province**: Manokwari, Iraiweri, 8 vi 1991, *Widjaja EAW* 4271 (L); Vogelkop, Arfak Mts, Anggi Lakes, 11 i 1962, *Sleumer & Vink BW* 14089 (L, LAE); *ibid.*, 22 vi 1961, *Vink BW* 11478 (LAE).

Distribution and ecology. Indonesia, West Papua Province, in the Arfak Mountains at around 2000 m altitude, along stream-sides.

IUCN category. Data Deficient.

This species appears to be very close to *Begonia arfakensis*, differing mainly in its smaller leaves with a cuneate base and a more deeply dentate margin. The specimen from Mount Tidjei (*Sleumer & Vink BW* 14310) is somewhat intermediate between the two species.

16. *Begonia symsanguinea* (Warb.) L.L. Forrest & Hollingsw., *Plant Syst. Evol.* 241:208 (2003); Tebbitt, *Begonias* 220 (2005). – *Symbegonia sanguinea* Warb., *Fl. Deutsch. Schutzgeb. Südsee* 323 (1905). – Type: Papua New Guinea, Bismarck Mts, i 1902, *Schlechter* 13979 (lecto B [B100217769] here designated; isolecto B [B100217770], BO, K [K000739907]). **Figs 10, 13.**

Sympodially branching sprawling herb. *Stem*: fleshy when young, villose, glabrescent, internodes c. 5–7 cm long. *Stipules*: persistent, ovate, 10×5 mm, sparsely villose on the keel, shortly cuspidate. *Leaves*: petiole c. 5 mm long, villose; lamina deep reddish green, asymmetric, broadly ovate to ovate, $7\text{--}12 \times 3.5\text{--}6$ cm, rugose and villose above, villose on the veins below; base oblique, basal lobe markedly overlapping the petiole; margin irregularly denticulate-ciliate; venation palmate-pinnate; tip acute. *Inflorescence* c. 5 cm long, uni- or bisexual, terminal, 1 or 2 female flowers and 5–10 male flowers, deep pink-red (rarely white); bracts ovate, $c. 8 \times 5$ mm, glabrous, apex shortly caudate. *Male flower*: pedicel c. 1.5 cm long, puberulous; tepals 2, deep pink-red, fused halfway, ovate, $12\text{--}14 \times 8$ mm, puberulous, tip acute; androecium on a short column, anthers 10–15, filaments c. 0.25 mm, anthers ellipsoid. *Female flower*: pedicel 10 mm long, puberulous; ovary $c. 24 \times 20$ mm including wings, capsule ellipsoid, $c. 9 \times 4$ mm, wings c. 10 mm wide at apex, villose, apex arcuate; corolla c. 20 mm long, deep pink-red, sparsely puberulous, with 5 lobes each 3 mm long; styles 3, elongate, bifid, stigmatic surface twice spirally twisted. *Fruit* not seen.

Additional specimens examined. PAPUA NEW GUINEA. **Central Province**: 11 viii 1968, *Cruttwell* 1476 (L, LAE). **Eastern Highlands Province**: Arau, 7 x 1959, *Brass* 31911 (K, L, NY); Mt Gahavisuka Provincial Park, 30 vi 2011, *Gagul* 612 & 613 (UPNG). **Milne Bay Province**: Dumora, ix 1953, *Cruttwell* 1653 (K, LAE). **Morobe Province**: Menyama, Aiwa, 18 v 1968, *Streimann & Kairo* 39020 (K, L, LAE); *ibid.*, 24 xi 1970, *Streimann & Kairo NGF* 42477 (K, LAE); Skindewai, 9 i 1956, *Womersley & Millar NGF* 8474 (K, L, LAE). **Simbu Province**: Yumbenden (Yumenigle), Mingendi, 24 vi 2011, *Gagul* 601 & 603 (UPNG).

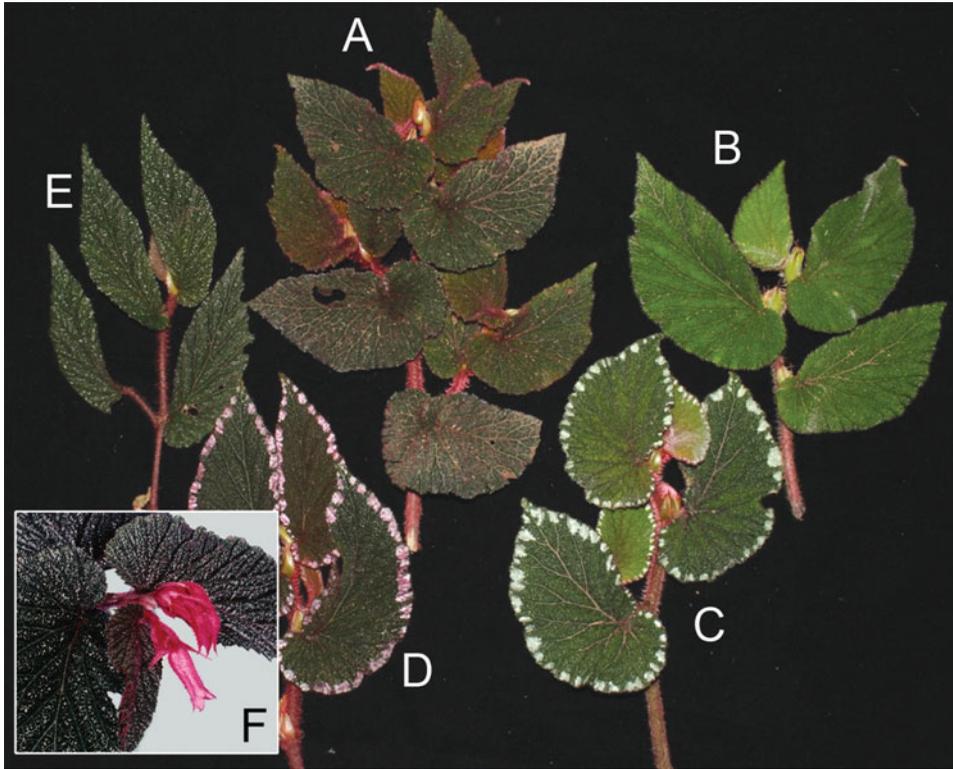


FIG. 13. *Begonia symsanguinea* (Warb.) L.L.Forrest & Hollingsw., photographed in Gahavisuka Provincial Park, Eastern Highlands Province, Papua New Guinea. A (*Gagul* 613, UPNG), a plant resembling the type form; B (*Gagul* 612, UPNG), a green form, and C (not vouchered), a variegated form, both morphologically similar to A; D (*Gagul* 610, UPNG) and E (not vouchered), forms with more lanceolate leaves than the type and possibly different taxa; F, a cultivated plant at the RBGE from Mount Dayman, Milne Bay Province, Papua New Guinea (accession no. 19682364).

Distribution and ecology. Papua New Guinea, Morobe, Eastern Highlands, Central, Simbu and Milne Bay Provinces. Montane forests on limestone ridges and also in *Castanopsis* forests, 300–2400 m altitude.

IUCN category. Least Concern. Widespread, and covers a considerable altitudinal range.

In the protologue, Warburg erroneously described this species as having leaves that are glabrous above. The name is derived from the deep-red colour of the young leaves and flowers, although pale variants of the species have recently come to light; it forms either a species complex or a hybrid swarm in the Mount Gahavisuka area with *Begonia argenteomarginata* and possibly other unnamed taxa (Fig. 5). It seems to be a rather fleshy, succulent species, because it makes terrible herbarium specimens. The collection



FIG. 14. *Begonia vinkii* Sands, photographed in Yumebenden, Mingendi, Simbu Province, Papua New Guinea, 2252 m altitude. Voucher: Gagul 600 (UPNG).

Reeve 592 from Enga Province is close to *Begonia symsanguinea* but is a very woody plant, considered here as aff. *B. symsanguinea*.

17. *Begonia vinkii* Sands sp. nov.

Allied to *Begonia symbracteosa*, but differs in having the androecium exceeding the corolla at anthesis, and brownish ovate-lanceolate bracts (not white broadly ovate).

– Type: Papua New Guinea, Western Highlands, Kubor Range, Uinba, Nona–Minj divide, 9 ix 1963, *Vink 16533* (holo K, iso LAE). **Figs 2, 14.**

Sympodially branching herb to 60 cm high. *Stem*: c.3 mm wide, villose, internodes 1.2–3(–7) cm long. *Stipules*: persistent, lanceolate, 8 × 4 mm, glabrous, cuspidate. *Leaves*: petiole c.1–2 mm long, villose; lamina green, slightly asymmetric, lanceolate, 3.5–7.5(–10) × 1–2.5(–4) cm, glabrous above, villose on the veins below; base slightly oblique, overlapping the petiole; margin dentate, more so towards the apex; venation pinnate; tip acute. *Inflorescence* c.3 cm long, uni- or bisexual, female flowers solitary, subtending 10–15 male flowers; bracts brownish ovate-lanceolate 5 × 2 mm, becoming

smaller towards the terminal flowers, glabrous, tip shortly cuspidate. *Male flower*: pedicel 0.3–1.4 cm long, puberulous; tepals 2, fused one-third of the length, ovate, 5–7 × 5 mm, puberulous, tip acute; androecium on an elongate thin column, exceeding the corolla at anthesis, stamens 15–20, filaments c.1 mm, anthers ellipsoid. *Female flower*: pedicel 4–8 mm long, sparsely puberulous; ovary c.13 × 13 mm including wings, capsule ellipsoid, 9 × 4 mm, wings c.6 mm wide at apex, sparsely puberulous, apex arcuate; corolla c.10 mm long, sparsely villose, with 5 lobes each 3 mm long; styles 3, elongate, bifid, stigmatic surface twice spirally twisted. *Fruit*: shape as for the ovary, enlarging to c.15 × 18 mm.

Additional specimens examined. PAPUA NEW GUINEA. **Eastern Highlands Province**: Asaro–Mairifutica divide, 30 viii 1957, *Pullen* 399 (L, LAE); Daulo Chuave Road, 21 xi 1954, *McKee* 1307 (L); Daulo Pass, 7 xi 1968, *Millar NGF* 40630 (L, LAE); *ibid.*, 26 viii 1970, *Millar NGF* 48629 (LAE [2 sheets]); *ibid.*, 20 v 1966, *Womersley NGF* 24722 (K, L, LAE); *ibid.*, 20 v 1956, *Womersley NGF* 24732 (BO); Engwegl, 22 xi 1960, *E. Borgmann* 385 (B, LAE); Ganaveroka, Daulo, 27 vi 2011, *Gagul* 605 (UPNG); Kanawyroka Creek, 30 viii 1963, *Millar & van Royen* 15978 (BO, K, L, LAE); Malu, 21 xii 1912, *Ledermann* 10381 & 10382 (B); Marafunga Sawmill, 17 v 1971, *Grubb & Edwards* 218 (LAE); Obura, Kainantu, 27 viii 1971, *Hays* 004 (LAE); Warrapuri River, 2 ix 1963, *van Royen* 18117 (BO, K, L, LAE). **Madang Province**: Simbai, *Cruttwell* 1533 (K, LAE). **Simbu Province**: Bomkane Village, xi 1977, *Hoover* 72 (L, LAE); Chimbu (Simbu) Divide, 22 xi 1954, *McKee & Floyd* 6377 (LAE); Gembogl, 10 x 1980, *Sterly* 80–319 (L); *ibid.*, 10 x 1980, *Sterly* 80–320 (E, L); Keglsugl, 20 iv 1967, *Wade ANU* 7641 (BO, K, L, LAE); Koge Mission, Sinasina, 7 x 1972, *Hide* 224 (LAE); Kumul Mission, 12 i 1962, *Womersley NGF* 14134 (E, K, L, LAE); *ibid.*, 12 i 1962, *Womersley NGF* 14141 (LAE); Mingendi, Yumebenden (Yumenigle), 24 vi 2011, *Gagul* 600 (UPNG); Road to Nilguma, 19 x 1969, *Millar NGF* 38376 (L, LAE). **Southern Highlands Province**: West of Mt Ne, 20 viii 1966, *Frodin NGF* 28408 (BO, K, L). **Western Highlands Province**: Al River, 3 iv 1953, *Womersley NGF* 4834 (BM, BO, K, L); *ibid.*, 7 ix 1953, *Womersley NGF* 5334 (K, L, LAE); Kubor Range, Minj Nona Divide, 26 viii 1963, *Pullen* 5261 (BO, K, L, LAE); Mazmal, 1 ix 1963, *Millar & van Royen NGF* 18573 (BO, K, L, LAE); Nondugl, 20 iv – 15 v 1950, *Gilliard s.n.* (LAE [sheet 223456]); *ibid.*, 20 iv – 15 v 1950, *Gilliard s.n.* (LAE [sheet 223476]); *ibid.*, 20 iv – 15 v 1950, *Gilliard s.n.* (LAE [sheet 223481]); *ibid.*, 20 iv – 15 v 1950, *Gilliard s.n.* (LAE [sheet 223482]); *ibid.*, iv 1951, *Womersley* 4374 (BO); *ibid.*, 5 vii 1956, *Womersley & Jones NGF* 8796 (LAE); Mt Hagen vicinity, xii 1977, *Hoover* 75 (B, L, E, LAE); *ibid.*, 4 vii 1957, *Robbins* 190 (LAE); Mur Mur Pass, 17 vi 1984, *Kerenga & Symon LAE* 56818 (L, LAE); Mur Mur Pass along road from Mt Hagen City to Tambul Village, 22 viii 1994, *Regalado & Katik* 1229 (B, NY); Mur Mur Pass – Mt Hagen, 1 x 1963, *Vandenberg et al. NGF* 39909 (BO, K, L, LAE); *ibid.*, 19 vi 1979, *Sohmer et al. LAE* 75525 (LAE); Upper Kaugel, Kurupili, Kepaka, 5 ii 1969, *Bowers* 633 & 634 (LAE).

Distribution and ecology. Widespread in the highlands of Papua New Guinea, in montane forests, as a terrestrial or stream-side herb, 1700–2790 m altitude.

IUCN category. Least Concern. Widespread in the highlands of Papua New Guinea, covering a considerable altitudinal range.

The flowers are white with a red spot near the style base (*Frodin NGF* 28408) or the base of the androecium (*Millar & van Royen NGF* 15978). The epithet honours the collector of the type, Dutch botanist Willem Vink, whose collections have enabled much insight into the flora of New Guinea.



FIG. 15. *Begonia yapenensis* M.Hughes, photographed from a living plant in cultivation at the Royal Botanic Garden Edinburgh (accession no. 20090830), collected from Yapen Island. A, Habit; B, male flower; C, female flower. The type specimens were derived from this accession.

18. *Begonia yapenensis* M.Hughes, *Eur. J. Taxon* 119: 1–6 (2015). Cultivated collection 20 viii 2014, *Barber SBAR* 86 (holo BO; iso E, MAN). Cultivated in the Royal Botanic Garden Edinburgh from vegetative material collected in the wild (accession no. 20090830: Indonesia, Papua Province, Yapen Island, Ambaidiru, 1000 m, 18 ii 2009, *Argent, Barber, Ensoll & Galloway ABEG* 211). **Figs 7, 15.**

Sprawling much-branched herb to 30 cm high. *Stem* becoming woody at the base, pilose with 3 mm long white hairs, internodes 3–5 cm long. *Stipules* persistent, lanceolate, c.15 × 4 mm, glabrous, shortly cuspidate. *Leaves*: petiole c.5 mm long, pilose; lamina green with purple venation, asymmetric, lanceolate, 8–10 × 2.5–4 cm, upper surface rugose, shortly hispid between veins, underside paler than upper surface, shortly hispid on veins only; base cordate, lobes not overlapping; margin biserrate; venation pinnate palmate, tip acute. *Inflorescence* terminal, total length 3–5 cm, cymose, compressed at first and becoming more elongate at maturity, unisexual or bisexual, protogynous, female flowers solitary or in pairs, basal, male flowers c.10–15; primary peduncle 3–13 mm long, shortly hispid; secondary peduncles shorter and glabrous; bracts 7–11 × 2–4 mm, linear-lanceolate, apex acute, white, glabrous. *Male flower*: pedicel 4–12 mm long, white, shortly hispid; tepals 2, fused just under halfway, rhombic-ovate, 10–13 × 8–10 mm, white, shortly hispid at base, base bulbiform, apex

acute; androecium with 6–9 stamens, basal 5 subsessile, remainder on a thick 1 mm long column; filaments 0.5 mm long, white; anthers 1 mm long, burgundy, ellipsoid, pollen white. *Female flower*: pedicel 4–7 mm long, pale green, shortly hispid, ovary whitish green, total size 10 × 19 mm including wings, capsule ellipsoid, 8 × 5 mm, wings c.10 mm wide at apex, sparsely hispid, apex arcuate; corolla c.18 mm long, with 5 lobes each 4 mm long, shortly hispid, hairs denser near the base; stigmas 3, on a 1-mm style, length 7 mm, forked for two-thirds of the length, spirally twisted twice, pale yellow. *Fruit*: shape as for the ovary, enlarging to c.11 × 21 mm.

Distribution and ecology. Indonesia, known only from the type locality in central Yapen Island. Collected in the forest around Ambaidiru village, away from disturbed areas on relatively unspoilt steep mountain sides with orange clay soil and large limestone boulders, near the top of the mountain at c.1000 m altitude, in an *Agathis* grove showing signs of tapping for resin on the trunks. Understorey vegetation in the area consists of *Marattia*, *Angiopteris*, *Laportea*, *Zingiberaceae*, *Aeschynanthus*, *Begonia*, *Cyrtandra*, *Pandanus*, *Davallia* and *Selaginella*.

IUCN category. Data Deficient (Hughes *et al.*, 2015).

Begonia yapenensis appears to be closest to *B. sympapuana*, which shares the rugose leaves with reddish veins and broadly similar inflorescences and flowers. *Begonia yapenensis* differs in being a smaller, lower-growing plant with shorter internodes and a white indumentum (not reddish); the leaves having shorter petioles (c.5 mm, not 1–1.5 cm); male flowers with tepals fused halfway (not shortly fused at the base) and fewer stamens (6–9, not c.15), which are arranged along a short column (not arising from a low torus); and fruits that have more attenuate wings. Plants of *Begonia yapenensis* in cultivation in deep shade show a blue iridescence of the upper leaf surface.

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