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CONTENTS

	<i>Page</i>
Chong Fung Yun, Veronica Samion Guanih & Rimi Repin <i>Begonia kibanganensis</i> and <i>B. melanosticta</i> (Begoniaceae), Two New Species from Sabah, Borneo	1
Joffre Ali Ahmad, Ruth Kiew, Julia Sang & Rimi Repin The Begoniaceae of Brunei Darussalam, Borneo, including Two New Species	7
Chong Fung Yun, Veronica S. Guanih, Julia Sang & Ruth Kiew <i>Begonia</i> (Begoniaceae) in the Danum Valley Conservation Area, Sabah, Borneo, including Eleven New Species	51
Julia Sang, Ruth Kiew, Ling Chea Yiing & Connie Geri <i>Begonia</i> (Begoniaceae) from Kubah National Park and Environs, Sarawak, Borneo, including a New Species	87
Julia Sang & Ling Chea Yiing Eight New species of <i>Begonia</i> (Begoniaceae) from Murum Dam, Sarawak, Borneo	107
Julia Sang, Ruth Kiew & Ling Chea Yiing A Decade of <i>Begonia</i> (Begoniaceae) from Sarawak, Borneo	129
Rimi Repin, Rossiti M. Karim & Handry Mujih Three New <i>Begonia</i> (Begoniaceae) Species from Ultramafic Outcrops in Kinabalu Park, Sabah, Malaysia	155
Rimi Repin, Kinahim Sampang & Simun Limbawang <i>Begonia</i> (Begoniaceae) from Tawau Hills Park, Sabah, Malaysia, including Ten New Species	165

***Begonia kibambanganensis* and *B. melanosticta* (Begoniaceae),
Two New Species from Sabah, Borneo**

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Summary. Two new species of *Begonia* (Begoniaceae), *Begonia kibambanganensis* V.S. Guanih & F.Y. Chong and *B. melanosticta* F.Y. Chong & V.S. Guanih are described from the Malaysian state of Sabah in northern Borneo. Both belong to section *Petermannia*. *Begonia kibambanganensis* is currently known only from lowland dipterocarp forest in the Crocker Range Park, Penampang district, but *B. melanosticta* is found within two localities in Tongod district.

Borneo is rich in *Begonia* species, the majority of which have local distributions and are narrowly endemic. Begonias are a common component of the forest understorey and are often conspicuous for their leaves that have attractive shapes, colour, patterns and textures. Several native Bornean species have potential value as ornamental plants. However, the majority of *Begonia* species are still un-named and undescribed. For instance, 19 species have been recorded from the well botanised Kinabalu massive (Sands, 2001) but many more recently found species are new and await description (Rimi, *pers. obs*). The aim of this study is to describe two new attractive *Begonia* species that have potential as ornamental plants.

Methodology

The *Begonia* species were collected during the scientific expeditions to the Crocker Range Park, Inobong, Penampang, Sabah, and to Sungai Imbak Forest Reserve, Tongod, Sabah. Field work was carried out to collect and record (a) fertile species of *Begonia* for which the first set of herbarium specimens is deposited at the SAN Herbarium, Sandakan with duplicates distributed according to the SAN guidelines for plant deposition. All the herbarium specimens were processed using standard herbarium methods, and identified to species level. (b) for begonias encountered without flowers but with mature fruits, seeds were collected to germinate and cultivate by standard seed culture methods in the Forest Research Centre Nursery, Sandakan. Once they flower, herbarium specimens are made.

The New Species Described

1. *Begonia kibambanganensis* V.S. Guanih & F.Y. Chong sp. nov. (Section *Petermannia*)

It is most similar to *Begonia malachosticta* Sands (1990: 61) in which the leaves are spotted persistently on the upper surface of the mature foliage. However, *B. kibambanganensis* is different in having a variegated lamina with white spots that are distributed closely between the veins and sometimes coalescing (vs. mauve-pink to olive-green spots in *B. malachosticta*). The two tepals of the male flowers in *B. kibambanganensis* are pinkish white (vs. four tepals, greenish cream or white, flushed with pink to pale salmon-pink in *B. malachosticta*) while the female flowers have dark red tepals (vs. greenish cream to pale salmon-pink tepals) and the three wings in the ovary are unequal, two are 4–6.3 mm wide and one narrow wing is ca. 1.2 mm wide (vs. wings subequal, (9–)10–15mm wide at the distal end). Type: V.S. Guanih & F.Y. Chong SAN 157265, Borneo, Sabah, originally from Penampang District, Inobong, Kibambangan Waterfall area, cultivated in Forest Research Centre, Sepilok, 24 September 2012 (holotype SAN!). (**Fig. 1**)

Cane-like begonia to 21.5 cm tall, whole plant glabrous. Stem erect, red, succulent, ca. 4.8 mm diameter; internodes 3–4 cm long, thicker at nodes. Stipules lanceolate, pale green, 14–20 × 0.06–11 mm, margin entire, apex acute, caducous. Leaves alternate, distant and hanging downwards; petioles 27–57 mm, red and grooved above; lamina variegated with green and white spots between veins, each big spot with one or two hairs in centre, 7.9–8.1 × 6–7 cm, fleshy in life, oblique, asymmetrical, broad side 4.4–5.1 cm, base broadly ovate, basal lobe 12–16 mm, margin doubly toothed, apex acuminate, acumen 0.9–1.5 cm; main veins palmate-pinnate, red towards the petiole and with 3 veins on each side of the midrib and with 3 veins in basal lobe, impressed above near the junction between the lamina and petioles. Inflorescences terminal, pinkish white and shorter than petioles, protogynous, 1.6–1.8 cm long, male inflorescence with dense clusters of 16 male flowers per single cymose cluster. Female inflorescence branches to ca. 4.2 cm long. Bracts caducous and not found in female flowers. Bracts of male flowers broadly oval, ca. 11 × 9 mm, pale green, margin entire.

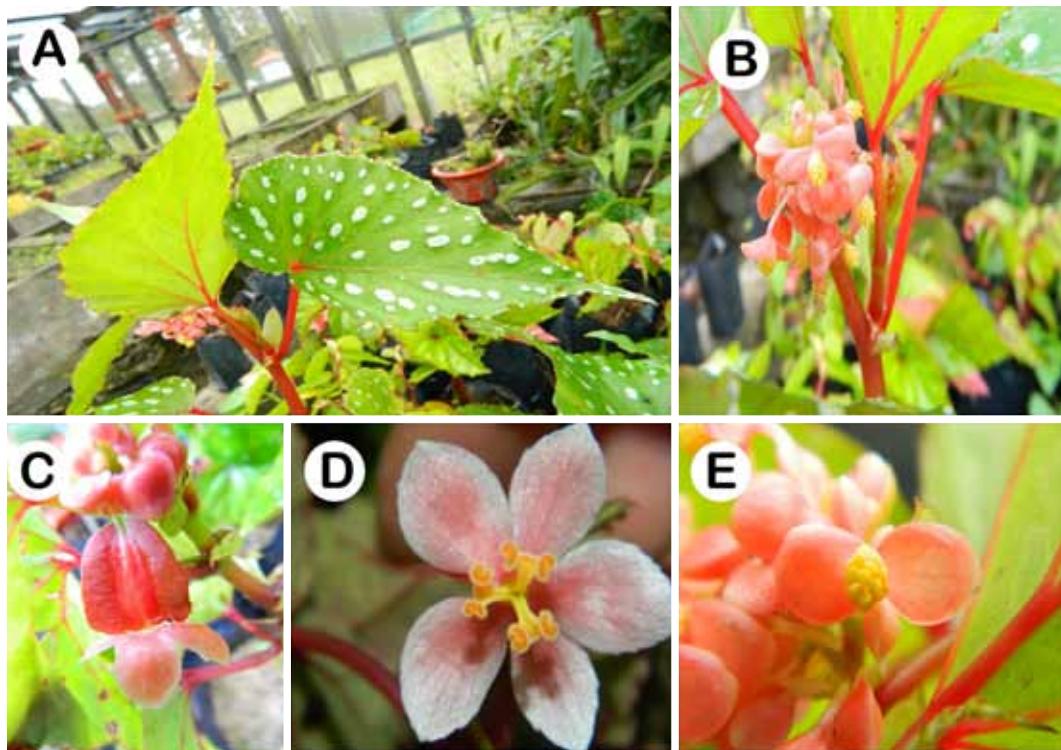


Fig. 1. *Begonia kibanganensis*. **A.** Shoot showing the upper and lower leaf surface; **B.** Male inflorescence; **C.** Female flower, side view; **D.** Female flower, top view; **E.** Male Flower. All photos from SAN 157265 by V.S. Guanih.

Bracteoles of male flowers broadly oval, ca. 9–11 mm long. Male flowers: pedicels pinkish white, ca. 13 mm long; tepals 2, pinkish white, oval, ca. 6 × 5 mm long, margin entire, apex rounded; stamens ca. 27, cluster narrowly ovate, stalk ca. 0.2 mm long; filaments ca. 0.1 mm long, dirty yellow; anthers yellow, apex rounded, 0.88 × 0.69 mm long. Female flowers: pedicels light green, ca. 8.5 mm long; ovary dark red, ca. 37 × 21 mm long, wings 3 to 5, unequal, parallel and rounded distally, broader wing, 4–6.3 mm wide, narrower wing, ca. 1.2 mm wide, locules 3, placentas bilamellate; tepals 5, pinkish white, ovate, margin minutely toothed, apex rounded, outer tepals 3, 11–12 × 10–11 mm, inner tepals 2, 9–10 × 7–8 mm; styles 3, bright yellow, ca. 2.7 mm long and divided to base, stigma yellow, in a spiral papillose band. Capsules (immature) broadly oblong, dark red, 2.2 × 1.5–1.6 cm; locules 3, wings equal, ca. 5 mm wide, fleshy, dehiscing between the wings and locules.

ETYMOLOGY. Named after the Kibangan Waterfall at Inobong, Crocker Range Park from where it was first collected.

ECOLOGY. Lowland dipterocarp forest at 447 m elevation adjacent to waterfall, on damp, shady, mossy substrates.

DISTRIBUTION. Borneo, Sabah. Penampang District: Inobong, Crocker Range Park, Kibambangan Waterfall area.

SPECIMENS EXAMINED—BORNEO. SABAH: Penampang District: Inobong, Crocker Range Park, Kibambangan Waterfall area. 21 January 2015, *Rossiti Karim, Handry Mujih and Wilson Salikun*, SNP 32964 (SNP); Originally from Penampang District, Inobong, Kibambangan Waterfall area, cultivated in Forest Research Centre, Sepilok, 24 September 2012, *V.S. Guanih & F.Y. Chong* SAN 157265 (holotype SAN!).

NOTES. This species is currently cultivated in the Forest Research Centre Nursery, Sandakan, from seed collected by Martin Tuyuk during the National Park Expedition on 24 September 2012. At present, only the holotype (SAN 157265) is available but as the plant continues to grow and flower, isotypes will be prepared for distribution.

2. ***Begonia melanosticta* F.Y. Chong & V.S. Guanih sp. nov.** (Section *Petermannia*)

It is similar to *B. fuscisetosa* (Sands, 1997: 433) in its short petiole, and the presence of a row of stiff bristles on the upper lamina surface but it is different in its thick hirsute stems (vs. slender and pilose as in *B. fuscisetosa*), the presence of a row of raised black spots between the veins and the many tiny scattered black spots in the lamina (vs. not present in *B. fuscisetosa*) and the male flowers that have 4 tepals, inner 2 tepals white, rosy red at the base (vs. 2 white tepals). Type: *Dayang Fazrinah Awg. Damit* SAN 156103, Borneo, Sabah, Tongod District, Gunung Rara Forest Reserve, 26 April 2014 (holotype SAN!; isotype KEP!). (**Fig. 2**)

Erect begonia to 1 m tall. Stems reddish brown, *ca.* 6 mm thick, fleshy, internodes 1.5–4.5 cm, brown thick hirsute, becoming woody. Stipules green, keeled, lanceolate, apex setose, seta 2–3 mm long, glabrous, 12–15 × 5–7 mm, margin entire, persistent. Leaves alternate, not oblique, distant, held horizontally; petioles pale brownish with reddish brown hairs, 9–15 mm long, flat above; lamina green above with a row of raised black spots between the veins each with a magenta–black hair in the centre and with many more small black spots scattered over the surface, glossy, fleshy when fresh, ovate to obovate, slightly asymmetrical, 12–15 × 5–7 cm, broad side 3–4.5 cm wide, base unequal, basal lobes rounded, 4–6 mm, margin minutely toothed, apex acuminate, acumen 1–1.2 cm long; main veins pinnate, impressed above, beneath prominent and with sparse red hairs, 4 veins on each side of the midrib, with a fine pair of veins in the basal lobe. Inflorescences axillary, pubescence with white hairs, erect, branched cyme, protogynous, 2.7–4.5 cm in the female phase, *ca.* 7 cm long in the male phase, peduncle *ca.* 5 mm long. Bracts similar to stipules but slightly smaller, 10–12 × 5 mm, margin entire, persistent. Bracteoles pale green sometimes tinged magenta, in a distinct

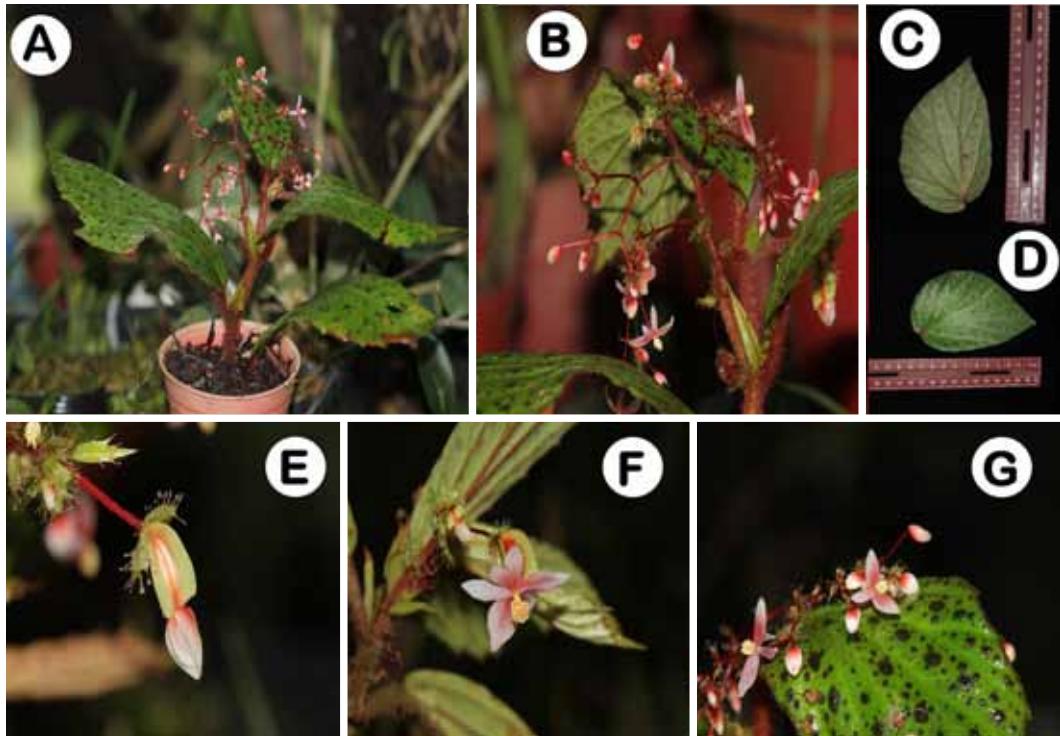


Fig. 2. *Begonia melanosticta*. **A.** Shoot showing the upper and lower leaf surface; **B.** Male inflorescence; **C.** Lower surface of lamina; **D.** Upper surface of lamina; **E.** Female flower, side view; **F.** Female flower, top view; **G.** Male Flower. All photos from KNP 36815. Photos A–B, E–G by Yabainus Johalin; Photos C & D by D.F. Awg. Damit.

pair, perpendicular to the rachis, triangular, $5–8 \times 6–7$ mm, margin with long glandular hairs, slightly scalloped, persistent. Male flowers: pedicels magenta, 8–16 mm long; tepals 4, outer 2 tepals broadly oval, glabrous, $5–9 \times 4–5$ mm, apex blunt to acute; inner 2 tepals white and rosy red at the base, glabrous, narrowly oval, $4–6 \times 2$ mm, margin entire, apex slightly acute; stamens ca. 18, cluster narrowly conical, subsessile; filaments lemon yellow, ca. 0.2 mm long; anthers lemon yellow, oblong, ca. 1.2×0.3 mm, apex emarginate. Female flowers: pedicels 13–23 mm long, red, glabrous; ovary red, wings green, oblong, $13–14 \times 10–12$ mm, wings 3, equal, locules 3, placenta bilamellate with many ovules on both surfaces; tepals 5, white, rosy red towards the base on the outside, ovate, outer tepals $8–9 \times 5–7$ mm and inner tepals ca. $9 \times 4–5$ mm, margin entire, apex acute; styles 3, pale yellow, ca. 4 mm long, divided near base, Y-shaped; stigma pale yellow, large papillose and forming a continuous twisted band. Capsules: pedicels thin but stiff, ca. 2 cm long; fruit ca. 15×12 mm, glabrous, locules 3, wing subequal, narrowed to the base, rounded distally, ca. 4 mm wide, thinly fibrous, dehiscing between the locules and the wings.

ETYMOLOGY. Named for the conspicuous and attractive black spots on the upper leaf surface (Greek: *melano* = black + *sticta* = spotted).

ECOLOGY. In disturbed heath forest at 205 m elevation.

DISTRIBUTION. Borneo, Sabah. Tongod District: Gunung Rara Forest Reserve.

SPECIMENS EXAMINED—BORNEO. SABAH: Tongod District: Kuamut, cultivated at Kipandi Butterfly Farm, 26 August 2014, *Julia & Kiew KNP 36815* (KEP, SAN, SAR, SNP); Tongod District, Gunung Rara Forest Reserve, 26 April 2014, *Dayang Fazrinah Awg. Damit SAN 156103* (holotype SAN!; isotype KEP!).

ACKNOWLEDGEMENTS

The two new species of *Begonia* were collected during scientific expeditions: Heart of Borneo programme to G. Rara, managed under the Deputy Director (Forest Sector Planning), Frederick Kugan (funded by 10th Malaysia Plan); and the Crocker Range National Park Expedition organised by Sabah Parks. We thank the fieldtrip coordinators, Dr Reuben Nilus, Dr Joan Pereira and Suzana Sabran for logistic support and information pertaining to the surveyed sites; research officer, Richard J. Majapun and research assistants from Sabah Forestry Department, Mr Martin Tuyok and Dayang Fazrinah Awg. Damit who encountered the new species during the survey; the Deputy Director (R&D) of Forest Research Centre, Dr Lee Ying Fah for the support of this study and to Dr Ruth Kiew and Julia Sang for advice on preparing the manuscript. Dr Steven Bosuang (S. Chew) of Kipandi Butterfly Park kindly providing the *Begonia melanosticta* plants for additional herbarium specimen.

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The Begoniaceae of Brunei Darussalam, Borneo, including Two New Species

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Summary. A key is provided to identify the 21 *Begonia* species presently known from Brunei Darussalam. Two new species, *B. joffrei* S. Julia and *B. nothobaramensis* Joffre, are described and illustrated. Based on field work, a further nine species are described and provided with diagnostic photographic plates. For the remaining 10 species, an English translation for the original diagnosis is provided. The three subspecies of *B. bruneiana* Sands are raised to specific level as *B. labiensis* (Sands) S. Julia, *B. retakensis* (Sands) Joffre and *B. rambaiensis* Kiew, the last requiring a new name because ‘*angustifolia*’ is not available. Specimen identification lists are provided for all species.

Prior to the Checklist of Flowering Plants and Gymnosperms of Brunei project (Coode *et al.*, 1997), only one begonia in Brunei, *Begonia baramensis* Merrill (1928: 529) had a name.

The checklist recognised and named 15 new species and three subspecies (Sands, 1997). However, to date these species have not been described nor illustrated and the brief diagnoses in some cases are confusing because the characters of the new taxon are not compared with an already described species. In addition, many specimens, including type specimens, do not have flowers and in some cases fruits and detailed field notes are also often lacking. This makes recognition of species difficult (Henrot *et al.*, 2012). With the aim of providing a means to identify species, this paper provides a key to all named species and complete descriptions illustrated by photographs of those species for which we have collected material, including of flowers and fruits, in the field. This is particularly important because of all the flowering plant families in Brunei, Begoniaceae is the family with the highest level of endemism (75% of species) by far (Henrot *et al.*, 2012). In addition, two new species have come to light and these are described here. No doubt there are other novelties awaiting discovery.

Methodology

This study was prompted by the need for accurately named photographs of Brunei begonias for the forthcoming Guide to Begonias of Borneo. Five days were spent in the field and with the expert knowledge of the staff of the Brunei National Herbarium (BRUN) we were able to locate, collect and photograph 14 taxa that are described here. Herbarium specimens and flowers and fruits in spirit were collected. The herbarium collections in BRUN and K were also included in the study.

We have not attempted to provide descriptions of species for which we lack complete material, namely *B. bruneiana* ssp. *angustifolia* Sands (1997: 433) here renamed *B. rambaiensis* Kiew, *B. bahakensis* Sands (1997: 432), *B. chlorandra* Sands (1997: 432), *B. laccophora* Sands (1997: 434), *B. leucochlora* Sands (1997: 432), *B. leucotricha* Sands (1997: 434), *B. retakensis* (Sands) Joffre and *B. temburongensis* Sands (1997: 432). However, a translation of the original Latin diagnosis (Sands, 1997) is provided in italics, together with a brief description for those characters that can be examined from sterile specimens and that are used in the key.

Results

Twenty one species were recognised from Brunei including two species newly described in this paper and four species raised from subspecies to species level.

KEY TO BRUNEI BEGONIA

1. Low creeping plant with small round leaves, 2.5–4.5 × 3.5–5 cm *B. laccophora*
Erect begonia or if creeping apex is erect and leaves larger 2

2. Leaf peltate 3
Leaf not peltate 4
3. Cane-like begonia to 50 cm tall; stamens *ca.* 36; fruit to 15 mm long, wings more or less equal in size with rounded tip *B. nothobaramensis*
Cane-like begonia to 250 cm tall; stamens 49–85; fruit 12–23 mm long, wings downward pointing with an acute tip, one wing much larger and up to twice the width of the other two *B. baramensis*
4. Leaves sub-opposite *B. joffrei*
All leaves alternate 5
5. Petiole 5–17 cm, leaf oblique 6
Petiole to 1.5(–3.5) cm, leaves not oblique (midrib in line with the petiole) 10
6. Petiole densely hairy, hairs erect, at least 1.5 mm long 7
Petiole glabrous or minute pubescent with appressed hairs 8
7. Leaf margin glabrous, base scarcely cordate; capsule 10–11 × 11–12 mm; leaf lamina 7.5–8 × 5.5–7.7 cm, petiole slender to 12 cm long, minutely hispid, hairs *ca.* 1.5 mm
..... *B. bahakensis*
Leaf margin ciliate, base deeply cordate; capsule 7–12 × 16–18 mm mm; leaf lamina to 11.5–15 × 7–15 cm, petiole 5.5–14.5 cm, densely hispid, hairs to 4 mm long
..... *B. awongii*
8. Petiole 5–12 cm long; inflorescences short, with 2 female flowers at base and a compact head of male flowers above; capsules large, longer than wide, 25–36 × 15–21 mm
..... *B. papyraptera*
Petiole 3–10 cm, inflorescences much branched, longer than 6 cm, with many flowers; capsules small, broader than long, 8–13 × 11–19 mm 9
9. Leaf margin minutely toothed, lamina to 7.5–11.5 cm long, petiole 3.5–10 cm; inflorescences from upper leaf axils, longer than leaves, 11–24 cm long; capsules 10–12 × 11–14 mm *B. temburongensis*
Leaf margin distinctly toothed, lamina 10–15 cm long, petiole to 6.5 cm; inflorescences to 10 cm long; capsules 6 or more per inflorescence, 12–13 × 17 mm *B. chlorandra*
10. Stem stout to 1.5 m tall, capsules 25–45 mm long 11
Low plant to 20–75 cm tall, rooting at nodes, capsules smaller, 7–15 mm long 12
11. Petiole 0.5–1.5(–3.5) cm, basal lobe scarcely developed, 0.5–1.5 cm long; capsules longer than wide, 30–43(–50) × 18–35 mm *B. stenogyna*

- Petiole 3–3.5 cm, basal lobe well developed, 2–3.5 cm long; capsules wider than long, ca. 25 × 35 mm *B. leucochlora*
12. Stem much branched; lamina margin deeply toothed to base, hairs in rows between veins *B. fuscisetosa*
 Stem stout or wiry, unbranched or sparsely branched; lamina margin entire or toothed in upper third, glabrous or with scattered hairs 13
13. Small plant, flowering at less than 10 cm tall; leaves closely arranged; pedicel of male flower long, 22–24 mm long, male flowers sessile on the adaxial of the leaf surface
 *B. eutricha*
 Robust plant, flowering at more than 10 cm tall; leaves distantly arranged; pedicel of male flowers short, less than 15 mm long, male flowers sessile on the abaxial of the leaf surface or stalked 14
14. Stem slender, sparsely branched; lamina base cuneate to rounded, margin ± entire or with small teeth in the upper half; inflorescences with distinct peduncle 15
 Stem stout, unbranched; lamina base auriculate, margin toothed at least in upper part; inflorescences sessile 16
15. Lamina 7–12.5 × 2–4.2 cm, petiole 3–7 mm; inflorescences one- or two-flowered in lower leaf axils or below leaves; male flowers with 4 tepals, female flowers with 5 tepals; capsules 9–15 × 14–30 mm with downward pointing wings *B. cynanescens*
 Lamina 8–13.5 × 3.5–5 cm, petiole 5–8 mm; inflorescences from upper leaf axils, several flowered; male flowers with 2 tepals, female flowers with 4 tepals; capsules 10–12 × 12–15 mm with wings truncate distally *B. sibutensis*
16. Leaf 7–9 times longer than broad, slightly falcate *B. leucotricha*
 Leaf 2.5–4 times longer than broad, straight 17
17. Densely hispid especially on the young stem and petioles *B. hexaptera*
 Not densely hispid 19
19. Leaf narrowly obovate, to 2.7 cm wide *B. rambaiensis*
 Leaf obovate, 3.5–7 cm wide 20
20. Leaf broadly obovate, (4–)5.5–7 cm wide; stipules long, 15–16 mm; in life veins distinctly brown on lower leaf surface *B. labiensis*
 Leaf obovate, 3.5–5.7 cm wide; stipules shorter 8–15 mm, in life veins concolorous ... 21
21. Plant ca. 25 cm tall; lamina longer 11.5–17 × 3.5–5.7 cm, if toothed in the upper half, teeth minute; stipules 8–15 *B. bruneiana*

Plant 45–50 cm tall; lamina short, 10–11.5 × 3.7–5.7 cm, conspicuously toothed in the upper half; stipules 10–13 mm *B. retakensis*

1. *Begonia awongii* Sands (1997: 432). Type: *Sands & Awong Kaya, MS 5568*, Brunei, Temburong District, Amo, upper Sungai Belalong west of Bukit Belalong, 24 March 1991 (holotype K!). (**Fig. 1**)

Cane-like begonia to 1 m tall. Stems pale green, 5–9 mm thick, succulent, densely hispid, hairs white to 5 mm long, internodes 2.5–9 cm, little- to much-branched, slightly swollen at the node, rooting at the lower nodes. Stipules green, ovate, 11.5–15 × 7–8 mm, keeled, glabrous above, densely hairy underneath, margin entire, apex acuminate, acumen to 4–8 mm, persistent. Leaves alternate, oblique, distant, held more or less vertically; petiole pale green to yellowish, 5.5–14.5 cm long, densely hairy, hairs to 4 mm long, terete; lamina plain pale green, covered with white hairs on both surfaces, hairs erect 2–3 mm long, papery in life, matt, asymmetric, broadly ovate, 12–16(–24) × 9–21 cm, broad side 7–9.5 cm wide, base deeply cordate, basal lobes 5.5–8.5 cm wide, margin ciliate, slightly dentate, apex acuminate; venation palmate-pinnate, veins pale green, slightly hairy, 6–7 pairs on either side of the midrib, 2 veins in basal lobe, impressed above, prominent beneath. Inflorescences protogynous, axillary, racemose, covered with short white hairs, rachis 14–17 cm long. Bracts pale green, covered with white hairs underneath, glabrous above, keeled, 6–8 × 4–5 mm, margin entire, persistent. Bracteoles green, covered with white erect hairs, oval, ca. 3 × 2 mm, margin slightly hairy, persistent. Male flowers: pedicel white, ca. 5 mm long, glabrous; tepals 4, outer 2 tepals white tinged green, with erect white hairy beneath, oval, ca. 5 × 4 mm, margin entire, apex rounded; inner 2 tepals, white, glabrous, oblanceolate, ca. 3 × 1.5 mm, margin entire, apex rounded; stamens ca. 46, cluster globose, filaments yellow, ca. 0.5 mm long; anthers yellow, oblong, ca. 0.25 × 0.2 mm, apex emarginate. Female flowers: pedicel pale green, 8–25 mm long, covered erect white hairs, hairs 2–4 mm long; ovary pale green with erect white hairs, 15–17 × 8–12 mm, wings 3, unequal, locules 3, placentas 2 per locule; tepals 5, isomorphic, white tinged green, lanceolate, 12–14 × 7–9 mm, margin slightly dentate, apex slightly acuminate; styles 3, pale yellow, wide Y-shaped, ca. 4 mm long, divided to base; stigma pale yellow, papillose forming a continuous twisted band. Capsule single on lower part of the rachis, 7–12 × 16–18 mm, pale green with erect hairs, locules 3, wings 3, unequal, covered with erect white hairs, thinly fibrous, dehiscing between the locule and wing; pedicel pendent, pale green, ca. 1.2 cm long, covered with erect white hairs.

ETYMOLOGY. It is named after Ibrahim Abdullah @ Awong Kaya, former staff of Brunei National Herbarium, Forestry Department.

ECOLOGY. On steep earth slopes above river banks above the flood zone, in semi-shaded areas in lowland diterocarp forest at 77 m elevation.

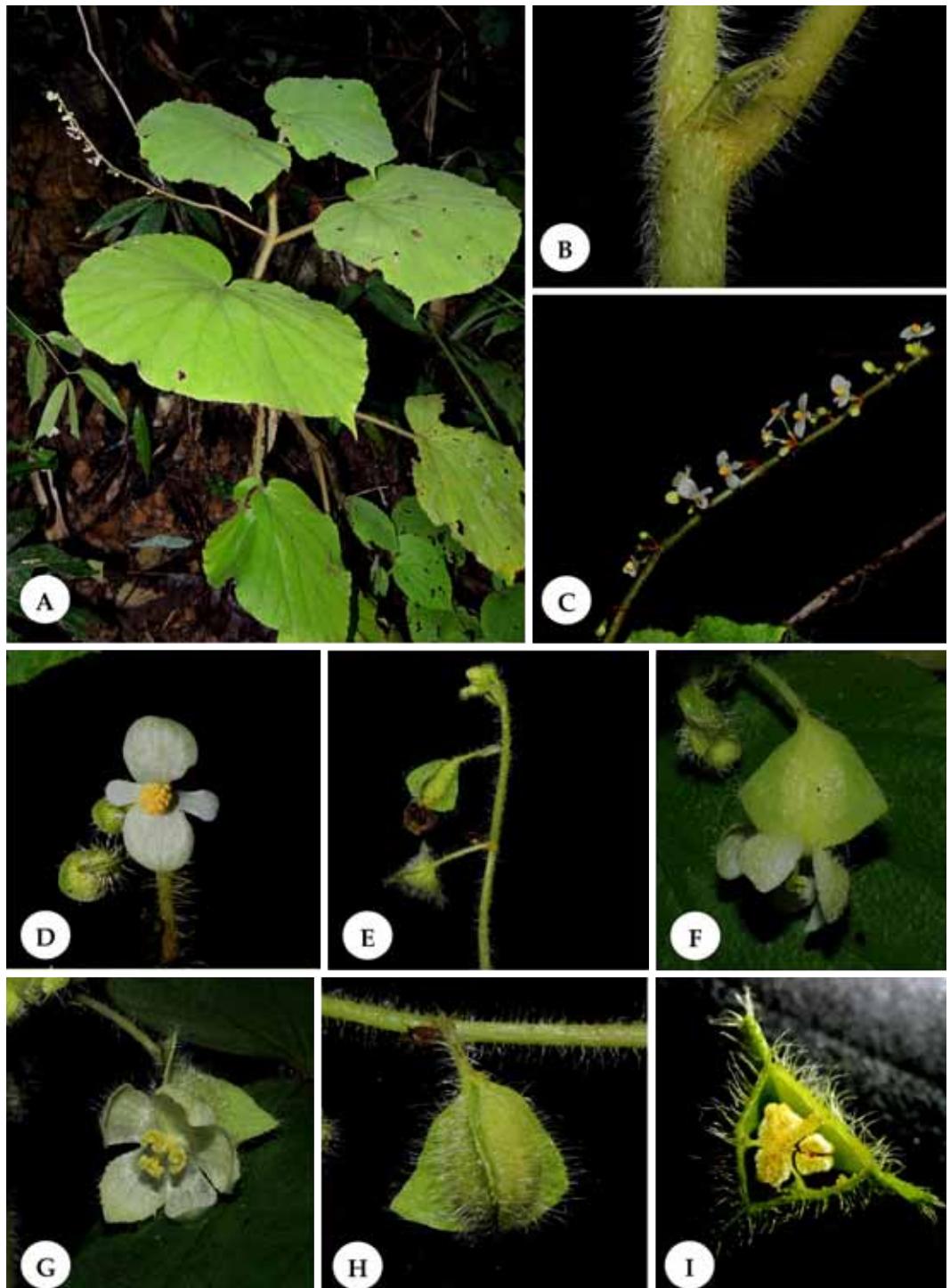


Fig. 1. *Begonia awongii*. A. Habit; B. Hairy stipule; C & D. Male inflorescences; E. Female inflorescence; F & G. Female flower; H. Fruit; I. Cross-section of fruit. Photos A, B, D–H from BRUN 24012 by Julia Sang; Photos C & I from BRUN 24012 by Yabainus Juhalin.

DISTRIBUTION. Endemic to Borneo, and so far known only from Temburong District in Brunei.

SPECIMENS EXAMINED—BORNEO. BRUNEI: Temburong District: Amo — Batu Apoi FR, Sungai Belalong, near Kuala Belalong Field Study Centre, 30 September 2012, *Watu et al. BRUN 23626* (BRUN!), 17 November 2014, *Joffre et al. BRUN 24012* (BRUN!); Sungai Belalong, 13 February 1992, *Dransfield JD 7046* (BRUN!, K!); Upper Sungai Belalong west of Bukit Belalong, 24 March 1991, *Sands & Awong Kaya, MS 5568* (holotype K!).

NOTES. It is common where it occurs but appears to be restricted in its distribution to Sungai Belalong and Sungai Temburong.

2. *Begonia bahakensis* Sands (1997: 432). Type: *Kirkup et al. DK 503*, Brunei, Tutong District, Rambai, Ulu Tutong, Bukit Bahak, 13 December 1991 (holotype K n.v.; isotype BRUN!).

Sands (1997): it differs from all other species of Begonia in Brunei by the glandulose-denticulate bracts. Habit ‘reclining’; flowers small, delicate; fruit small.

Shrubby erect begonia, rooting at nodes, red-stemmed; leaves alternate, oblique; petioles to 12 cm long, densely hairy, hairs erect to 1.5 mm long; lamina mid-green with paler green patches, pale green below, glabrous, asymmetric, broadly ovate, 7.5–8 × 5.5–7.7 cm, base scarcely cordate, margin glabrous, minutely toothed, apex acuminate, acumen to 1 cm long; inflorescences 1–3 cm from the upper leaf axils; tepals pale pink with red centre; capsules 10–11 × 11–12 mm.

ETYMOLOGY. Named after the type locality.

ECOLOGY. In a steep, small river valley in mixed dipterocarp forest at 220 m elevation.

DISTRIBUTION. Endemic to Borneo, and so far known only from Tutong District in Brunei.

SPECIMEN EXAMINED—BORNEO. BRUNEI: Tutong District: Rambai — Ulu Tutong, Bukit Bahak, 13 December 1991, *Kirkup et al. DK 503* (holotype K n.v., isotype BRUN!).

NOTES. This species is poorly known from just two specimens from the type locality. It is distinct in its petioles being longer than the laminas. In its relatively small, oblique leaves, it is most similar to *B. temburongensis*, but can be told apart by its longer, hairy petioles and shorter inflorescences. *Begonia temburongensis* in contrast has shorter, glabrous petioles and very long inflorescences.

3. *Begonia baramensis* Merrill (1928: 529). Type: *J.C. Moulton s.n.*, Borneo, Sarawak, Upper Baram River, 1920 (syntypes BM, K!). (Fig. 2)

Erect cane-like begonia usually, 0.5–1(–3) mm tall. Stems to 3 cm thick. Lamina peltate, oblong, 16–17 × 7–11 cm, often deep purple underneath, juvenile lamina green or with paler green blotches. Inflorescences axillary on the upper leaf axils, protogynous, paniculate, rachis 6.5–10.5 cm long. Male flowers: pedicel 3–7 mm long, tepals 2, oval or semi-orbicular, 8–10 × 7–8 mm, margin entire, apex acute; stamens 49–84, cluster globose, sessile. Female flowers one or 2 pairs, pedicel 18–25 mm long, glabrous, ovary 15–20 × 15–22 mm, wings 3, unequal, tip pointed, longer than tepals; tepals 5, more or less isomorphic, brownish or reddish, 10–11 × 4–6; styles 3, green, deep Y-shaped, ca. 5 mm long; stigma yellowish green papillose forming a continuous twisted band. Capsules in 1–2 pairs, 21–22 × 27–45 mm, wings 3, unequal, distinctively pointing downward, the broadest wing 12–25 mm wide and the two narrower ones 9–14 mm wide, green or pale red; pedicel pendent, 3.5–4 cm long.

ETYMOLOGY. Named after the type locality.

ECOLOGY. Lowland to hill mixed dipterocarp forest, frequently on river banks, on setap shale formation, at 55–850 m elevation.

DISTRIBUTION. Endemic to Borneo. In Brunei recorded from Temburong, Tutong and Brunei-Muara Districts. Also in Kalimantan, Sabah and Sarawak (Hughes, 2008).

SPECIMENS EXAMINED—BORNEO. BRUNEI: Temburong District: Amo — Batu Apoi FR, Sungai Temburong, 17 Nov 2014, Joffre *et al.* BRUN 24013 (BRUN!), 23 March 1991, Sands *et al.* MS 5565 (BRUN!), 28 September 2012, Watu *et al.* BRUN 23607 (BRUN!); Batu Apoi FR, Sungai Temburong, Wong Nguan rapids, 6 April 1990, Coode *et al.* MC 6577 (BRUN!), 9 April 1990, Coode *et al.* MC 6684 (BRUN!), 9 April 1990, Coode *et al.* MC 6692 (BRUN!); Batu Apoi FR, Sungai Engkiang, 20 November 1991, Hansen CH 1589 (BRUN!), 23 November 1991, Hansen CH 1609 (BRUN!); Batu Apoi FR, Sungai Apan, 13 July 1993, Sands *et al.* MS 5785 (BRUN!); Batu Apoi FR, Sungai Tulan, 15 July 1993, Sands *et al.* MS 5808 (BRUN!); Batu Apoi FR, Sungai Belalong, 3 August 2014, Challen *et al.* GC 11 (BRUN!), 30 September 1994, Duling DWD 25 (BRUN!); Batu Apoi FR, upper Sungai Belalong, west of Bukit Belalong, 24 March 1991, Sands *et al.* 5579 (BRUN!); Batu Apoi FR, Bukit Belalong, 20 July 1989, Wong WKM 1381 (BRUN!), 22 March 1992, Poulsen ADP 316 (BRUN!); Batu Apoi FR, Sungai Temburong valley, near LP 286, 25 April 1992, Johns *et al.* RJ 7301 (BRUN!), 28 April 1992, Johns *et al.* RJ 7406 (BRUN!), 28 April 1992, Johns RJ 7415 (BRUN!); Batu Apoi FR, Ulu Belalong valley, near LP 382, 18 January 1994, Idris *et al.* BRUN 16658 (BRUN!); Batu Apoi, Kuala Sekurop, 8 November 1957, Ashton BRUN 387 (BRUN!); Bangar — Kampong Biang, Sungai Biang, 24 May 2012, Azlan *et al.* BRUN 23839 (BRUN!). Tutong District: Rambai — Ladan Hills FR, Nyamokning West, north of LP 230, 4 June 1996, Ariffin *et al.* BRUN 17555 (BRUN!); Tasek Merimbun, 26

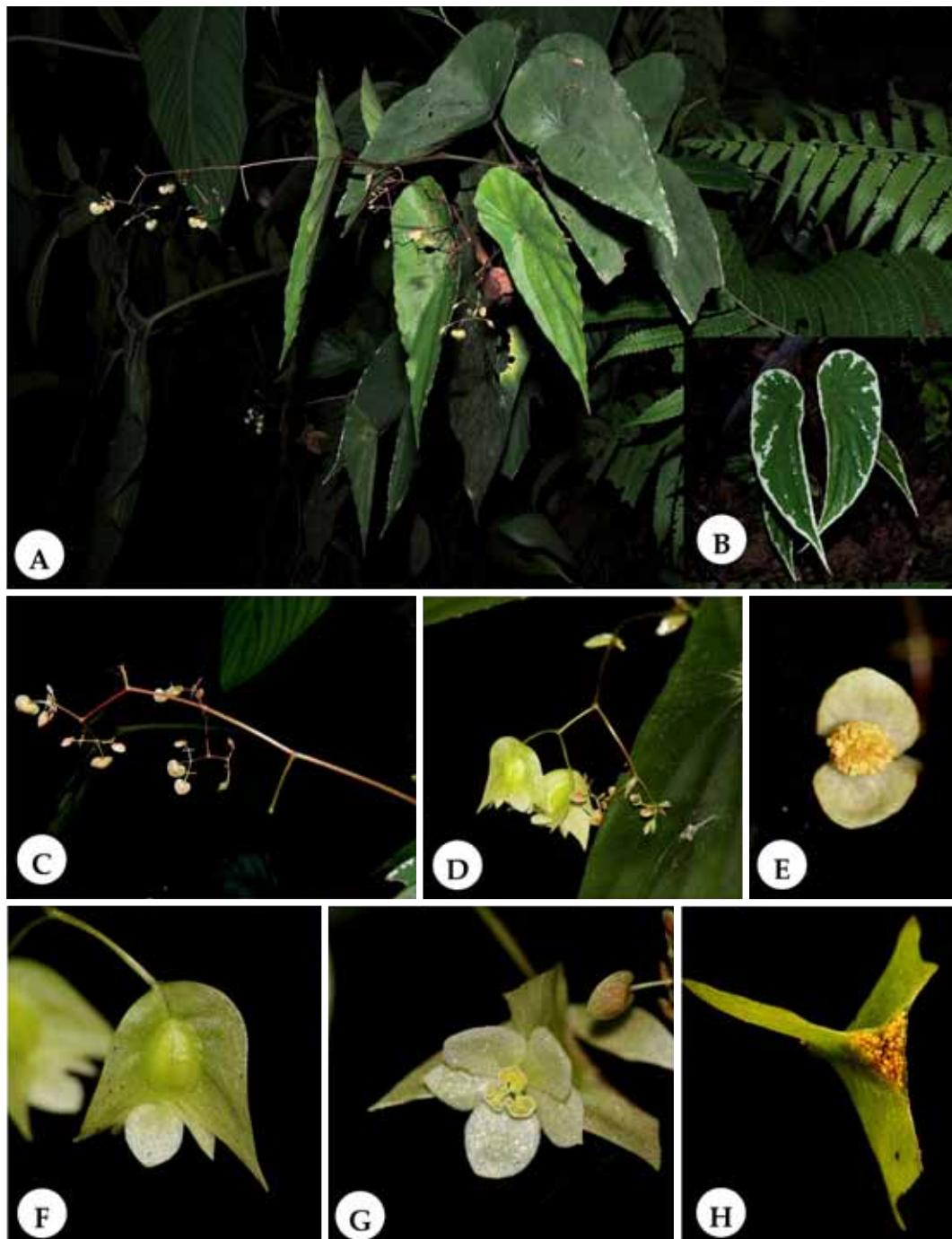


Fig. 2. *Begonia baramensis*. **A.** Habit; **B.** Juvenile plant; **C & D.** Inflorescences; **E.** Male flower; **F & G.** Female flower; **H.** Cross-section of ovary. Photos A–G from BRUN 24013 by Julia Sang; Photo H from BRUN 24013 by Yabainus Juhalin.

August 1992, Bernstein, JHB 55 (BRUN!). Brunei-Muara District: Lumapas — Kampong Lumasa, Bukit Sa'eh, 12 January 2011, Azlan et al. BRUN 23377 (BRUN!). **SARAWAK:** Upper Baram River, 1920, J.C. Moulton s.n. (syntypes BM, K!).

NOTES. It is one of the only two species recorded from all four regions of Borneo, Sabah, Sarawak, Brunei and Kalimantan, the other being *B. fuscisetosa* Sands (1997: 433) (Hughes, 2008). It is common where it occurs. It often grows on steep river banks, where it withstands periodic flood water as is witnessed by flood debris caught by its leaves. It is also found inland in lowland forest.

It is one of the tallest Bornean species growing to 2.5 m tall but can flower at *ca.* 50 cm tall. It is very variable in laminas, flowers and fruits coloration. The most handsome plants have leaves that are deep magenta-purple on the lower surface and are dark green above. Other forms lack the purple coloration completely. Yet other juvenile plants have green leaves with a silver-grey margin and silver-grey splashes towards the centre of the leaf. However, these are lost in adult leaves. In some plants, the capsule wings are pinkish and contrast with the green locules but in most they are green.

It is one of the few species in section *Petermannia* with peltate leaves. Another striking character is the fruit where the wings extend downwards and one wing is larger than the other two, at the extreme being twice the width of the two smaller ones, for example in a capsule 21 mm long and 45 mm from wing tip to wing tip, the longer wing can be 25 mm wide compared with the two smaller ones 11–12 mm wide.

Its young leaves have been reported to be eaten by the Dusun people as a vegetable (*JHB* 55) where it is called *pringas ragan*. Ashton (*BRUN* 387) noted that according to the Iban ‘tortoises like to eat it’.

4. *Begonia bruneiana* Sands (1997: 433). Type: *Sands et al. MS 5735*, Brunei, Tutong District, Lamunin, Ladan Hills, 30 March 1991 (holotype K!; isotype BRUN!). Synonym: *B. bruneiana* subsp. *bruneiana* Sands (1997: 433). (**Fig. 3**)

Reclinate begonia, erect stem to 24 cm tall. Stems reddish brown, 5–6 mm thick, stout, matted with brown pubescent hairs, internodes 6–9 mm long, unbranched, swollen at nodes. Stipules reddish brown, narrowly lanceolate, 8–15 × 2.5–3 mm, keeled, glabrous, margin entire, apex setose, seta 3–4 mm long, caducous. Leaves alternate, not oblique, arranged in a flat spray, distant; petiole reddish brown, 7–11 mm, matted with brown pubescent hairs, grooved above; lamina plain dark green and slightly bullate above, deep magenta purple beneath, sprinkled with hairs to 1 mm long, succulent in life, glossy, asymmetric but slightly falcate, slightly obovate, 11.5–17 × 3.5–5(–5.7) cm, broad side 2–3(–3.5) cm wide, base unequally auriculate, basal lobes 4–5 mm wide, margin minutely toothed particularly on

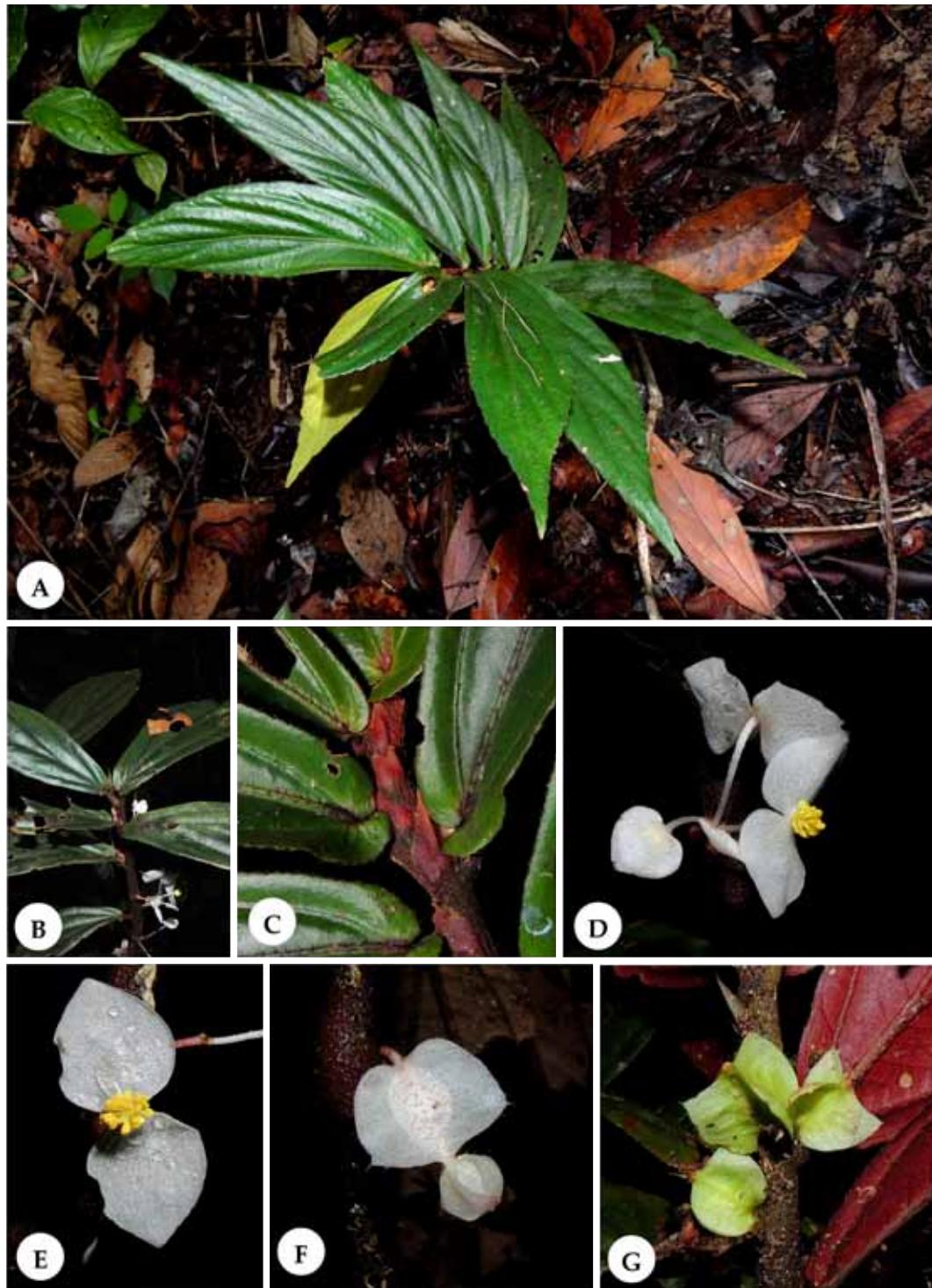


Fig. 3. *Begonia bruneiana*. **A.** Habit; **B.** Inflorescences; **C.** Stipule; **D & E.** Male flowers; **F.** Female flower; **G.** Fruits. Photos A, C & G from BRUN 24022; Photos B, D-F from BRUN 24026 by Julia Sang.

the upper half, ciliate, apex attenuate; venation pinnate, concolorous, sparsely hairy, hairs reddish brown, 3–4 veins on each side of the midrib, ascending steeply towards the margin, scarcely arched, 1 pair at the base, impressed above, prominent beneath. Inflorescences protogynous, axillary, single (male flower) or 1–2 (female flowers) along the main stem. Bracts of male flowers pale fawn, lanceolate, ca. 3 × 1.5 mm, margin entire, caducous. Bracteoles similar to bracts but slightly smaller. Male flowers (un-opened): pedicel white, ca. 1 mm long, densely pubescent; tepals 2, white, isomorphic, ovoid, ca. 20 × 10 mm, glabrous, margin entire, apex acute; stamens ca. 12, cluster loose, sessile; filaments yellowish, ca. 0.2 mm long; anthers yellowish, oblong, ca. 0.8 × 0.6 mm, apex emarginate. Female flowers: pedicel whitish, ca. 3 mm long, glabrous or sparsely hairy; ovary greenish white, ca. 10 × 14 mm, glabrous, wings 3, equal, ca. 4 mm wide, ciliate, locules 3, placenta 1 per locule; tepals 5, isomorphic, greenish white, oval, ca. 7 × 6 mm, glabrous, margin entire, apex broadly acute; styles 3, pale yellow, shallow Y-shaped, ca. 2 mm long, divided to base; stigma pale yellow, papillose forming a continuous twisted band. Capsule single or a pair, axillary, 7–9 × 9–13 mm, green, glabrous, beak persistent, ca. 1.5 mm long, locules 3, wings 3, equal, finely ciliate, truncate proximally and distally, 3–6 mm wide, beak ca. 2.5 mm long, thinly fibrous, dehiscing between the locule and wing; pedicel erect, pale green, ca. 2 mm long, glabrous.

ETYMOLOGY. Named after Brunei Darussalam.

ECOLOGY. In lowland dipterocarp forest at 25–150 m elevation, in deeply shaded, narrow stream valley on steep clay slope of stream bank.

DISTRIBUTION. Endemic to Borneo and known from Tutong and Belait Districts in Brunei.

SPECIMENS EXAMINED—BORNEO. BRUNEI: Belait District, Labi — Bukit Teraja, 28 March 1991, *Sands et al. MS 5699* (BRUN!); Tutong District, Lamunin, Ladan Hills, 20 November 2014, *Joffre et al. BRUN 24026* (BRUN!), 30 March 1991, *Sands et al. MS 5735* (holotype K!, isotype BRUN!). Tutong District, Lamunin — Ladan Hills FR, compt. 37, Benutan Forestry Nursery, 20 November 2014, *Joffre et al. BRUN 24022* (BRUN!); Ladan Hills FR, 9 July 1993, *Sands et al. MS 5762* (BRUN!), 9 July 1993, *Sands et al. MS 5769* (BRUN!).

NOTES. This species was originally described with four subspecies: subsp. *bruneiana*, subsp. *angustifolia*, subsp. *labiensis* and subsp. *retakensis* (Sands, 1997). These four taxa are similar in habit (reclinate, stems short, stout, unbranched with a flat spray of non-oblique, slightly asymmetric obovate leaves, slightly auriculate at the base) but can be distinguished by stipule, leaf and, where known, flower and fruit characters. *Begonia eutricha*, *B. leucotricha* and *B. hexaptera* also belong to this ‘bruneiana group’ of begonias. *Begonia bruneiana* is most similar to *B. labiensis* but can be distinguished by a combination of characters given in Table 1.

Table 1. Comparison between *Begonia bruneiana* and *B. labiensis*.

Character	<i>B. bruneiana</i>	<i>B. labiensis</i>
Stipule length (mm)	8–15	15–16
Petiole length (mm)	7–11	10–12
Lamina length (cm)	11.5–17	18–18.5
Lamina width (cm)	3.5–5.5	6.5–7
Lamina broad side (cm)	2–3.5	4–4.5
Veins (lower surface)	concolorous with lamina	rusty brown
Female peduncle + pedicel length (mm)	3	8
Male peduncle + pedicel length (mm)	1	15–16
Stamens no.	12	27
Fruit stalk (mm)	2	7–8

It comes in two colour forms: the striking one is maroon or deep crimson-purple on the lower leaf surface and dark green above or in a pale green form that is without any red-purple pigmentation. Plants with deep purple undersides to the leaf also have rosy pink tepals in the female flowers, while those of the green form are white.

5. *Begonia chlorandra* Sands (1997: 432). Type: *Sands et al. MS 5700*, Brunei, Tutong District, Lamunin, Ladan Hills FR, 30 March 1991 (holotype K!; isotype BRUN!).

Sands (1997): it is similar to Begonia temburongensis but differs in its larger more fragile leaves (18–22 cm, not ca. 15 cm long) dentate and denticulate (sometimes remotely and indistinctly), stipules caducous, male flowers pale greenish.

Cane-like, suffruticose begonia 60(–75) cm tall; petioles ca. 6.5 cm long, lamina very oblique, mid-green above, pale beneath, 10–12 × 10 cm, margin conspicuously toothed; tepals of male flowers greenish cream to green, stamens cream.

ETYMOLOGY. With green flowers.

ECOLOGY. On steep banks a little way above a water-course, in partial shade in lowland mixed dipterocarp forest at 125 m elevation, on sandstone derived soils or clay.

DISTRIBUTION. Endemic to Borneo, and so far known only from Tutong District in Brunei.

SPECIMEN EXAMINED—BORNEO. BRUNEI: Tutong District — Lamunin, Ladan Hills FR, 30 March 1991, *Sands et al. MS 5700* (holotype K!, isotype BRUN!).

NOTES. It is known only from the type specimen.

6. *Begonia cyanescens* Sands (1997: 433). Type: *Sands et al. MS 5577*, Brunei, Temburong District, Amo, upper Sungai Belalong west of Bukit Belalong, 24 March 1991 (holotype K!; isotype BRUN!). (Fig. 4)

Erect begonia to 20 cm tall, apex arching with the leaves pointing downward. Stems red brown, ca. 3 mm thick, wiry, appressed hairy, internodes 2–3.5 cm long, un-branched, swollen at nodes. Stipules reddish brown, narrowly lanceolate, ca. 6 × 1 mm, glabrous, margin entire, apex setose, seta ca. 1.5 mm long, caducous. Leaves alternate, not oblique distant, held horizontally except terminal leaves; petiole reddish brown, 3–7 mm long, covered by appressed hairs, terete; lamina plain bronzy in juvenile plant, pale green in adult plant above, whitish green beneath, sometimes bright iridescent blue above and purplish beneath, glabrous, succulent in life, matt, asymmetric, narrowly oval, 7–12 × 2–4.2 cm, broad side 1.5–2 cm wide, base cuneate, basal lobes scarcely developed, margin shallowly crenate, apex acuminate, acumen to 3 cm long, slightly bullate between the veins; venation pinnate, concolorous, glabrous, 5–7 veins on either side of the midrib, slightly prominent on both surfaces. Inflorescences protogynous; male inflorescences 1- or 2-flowered, in upper leaf axils, cymose, peduncle 3–7 mm long; female flower single from the lower leaf axil. Bracts brown, lanceolate, ca. 3 × 1 mm long, margin entire, apex acuminate. Bracteoles pinkish, lanceolate, ca. 1 mm long, margin entire, apex acuminate. Male flowers: pedicel whitish, 11–14 mm long, glabrous; tepals 4, dimorphic, rosy pink, glabrous, outer 2 tepals rotund, 4–9 × 7–11 mm, margin entire, apex rounded; inner 2 tepals narrowly lanceolate, 6–7 × 2 mm, margin entire, apex broadly acute; stamens ca. 34, cluster loose; filaments pale yellow, ca. 1.3 mm long; anthers pale yellow, broadly oval, ca. 1 × 0.5 mm, apex emarginate. Bracts and bracteoles similar to bracts and bracteoles of male flower. Female flowers: pedicel pale red, ca. 11 mm long, glabrous; ovary pale pink, ca. 12 × 20 mm, glabrous, wings 3, equal, tip extended and pointed, locules 3, placenta 1 per locule; tepals 5, isomorphic, pale pink, sometimes white, rhomboid, 11–13 × 6–7 mm, margin entire, apex narrowed; styles 3, pale yellow, shallow Y-shaped, ca. 3 mm long, divided to base; stigma pale yellow, papillose forming a continuous twisted band. Capsule single or in pair from leaf axils, up to 5 fruits along the stem, 9–15 × 14–30 cm, pale green, glabrous, beak persistent, ca. 2 mm long, locules 3, wings 3, equal, extended downward, attenuate to a point, thinly fibrous, dehiscing between the locule and wing; pedicel pale red, erect, 8–12 mm long, glabrous.

ETYMOLOGY. Becoming blue, referring to the leaves.

ECOLOGY. On rocky banks or gullies or steep earth slopes above streams, in shaded areas at 40–250 m elevation; on the Setap shales, sandstone or clay at 30 m elevation.



Fig. 4. *Begonia cyanescens*. **A.** Habit; **B.** Inflorescences; **C & D.** Male flowers; **E & F.** Female flower; **G.** Fruits. All photos from BRUN 24017 by Julia Sang.

DISTRIBUTION. Brunei, Temburong District. Also in Kalimantan, Sabah and Sarawak (Hughes, 2008).

SPECIMENS EXAMINED—BORNEO. BRUNEI: Temburong District: Amo — Batu Apoi FR, Sungai Temburong, 25 March 1991, *Sands et al. MS 5619* (BRUN!); Sungai Belalong, along Sungai Esu, 18 November 2014, Joffre et al. BRUN 24017 (BRUN!), upper Sungai Belalong west of Bukit Belalong, 24 March 1991, *Sands et al. MS 5577* (holotype K!, isotype BRUN!); Batu Apoi FR, Sungai Temburong, at Kuala Belalong, 25 June 1989, Boyce & Dransfield JD 441 (BRUN!), 21 June 1989, *Dransfield S. et al. SD 983* (BRUN!); Batu Apoi FR, ridge-slope west of Kuala Belalong, 22 March 1991, *Sands et al. MS 5519* (BRUN!); Batu Apoi FR, Kuala Belalong, near Kuala Belalong FSC, 15 November 1991, Hansen CH 1570 (BRUN!), 20 November 1991, Hansen CH 1588 (BRUN!); Batu Apoi FR, Kuala Belalong, at Kuala Belalong FSC, 7 November 1991, Hansen CH 1514 (BRUN!); Batu Apoi FR, Kuala Belalong FSC, along Ashton trail, 29 September 2012, Watu et al. BRUN 23623 (BRUN!), 29 September 2012, Watu et al. BRUN 23624 (BRUN!); Batu Apoi FR, ridge west of Kuala Belalong FSC, 23 March 1991, Poulsen ADP 30 (BRUN!); Batu Apoi FR, Sungai Temburong, Wong Nguan rapids, 8 April 1990, Coode et al. MC 6662 (BRUN!); Batu Apoi FR, Sungai Apan, ridges west of Sungai Tulan, 14 July 1993, *Sands et al. MS 5790* (BRUN!), 14 July 1993, *Sands et al. MS 5805* (BRUN!); Batu Apoi FR, Sungai Apan, Sungai Tulan, 28 September 2012, Watu et al. BRUN 23614 (BRUN!); Batu Apoi FR, Sungai Sibut headwaters, west of Bukit Belalong, 22 March 1991, *Sands et al. MS 5517* (BRUN!); Batu Apoi FR, Sungai Temburong, east flank of Bukit Belalong, 23 March 1991, *Sands et al. MS 5567* (BRUN!); Batu Apoi FR, upper Sungai Belalong, west of Bukit Belalong, 24 March 1991, *Sands et al. MS 5576* (BRUN!), 24 March 1991, *Sands et al. MS 5591* (BRUN!); Batu Apoi FR, Sungai Engkiang, 20 November 1991, Hansen CH 1588 (BRUN!); Batu Apoi, Selapon, Bukit Beliton, 19 November 1990, Kirkup et al. DK 324 (BRUN!); Labu — Peradayan Forest Reserve, 26 March 1991, *Sands et al. MS 5649* (BRUN!).

NOTES. It is one of the commonest collected species. The single (or paired) capsules with the downwardly extended wings are characteristic of this species. Plants with bright iridescent blue leaves are striking but unlike Sands' (1997) observation that the leaves were always iridescent-bluish, we found only about half the individuals encountered had blue leaves and even within a clump there is variation depending on the amount of light, the blue apparently being accentuated by deeply shaded conditions. This is one of the Brunei species with a single placenta per locule.

7. *Begonia eutricha* Sands (1997: 434). Type: *Dransfield et al. JD 6708*, Brunei, Temburong District, Amo, Sungai Temburong at Kuala Belalong, banks of Sungai Belalong, 24 June 1989 (holotype K!; isotype BRUN!). (Fig. 5)

Wiry, erect begonia to 3–7.5 cm tall. Stems green, 3–4 mm thick, succulent, densely hispid, hairs reddish brown, internodes 4–9 mm long, unbranched, swollen at nodes. Stipules pale green to pale bronze, narrowly lanceolate, 7–13 × 2 mm, keeled, sparsely hispid, margin entire but ciliate, apex setose, seta to 2–3 mm long, persistent at the upper leaf axil. Leaves alternate, not oblique, closely arranged, held horizontally; petiole pale green, 2–4 mm long, brown hispid hairs, terete; lamina plain green above, pale green or reddish below, slightly bullate between the secondary and tertiary veins, in life giving the leaf surface a blistered

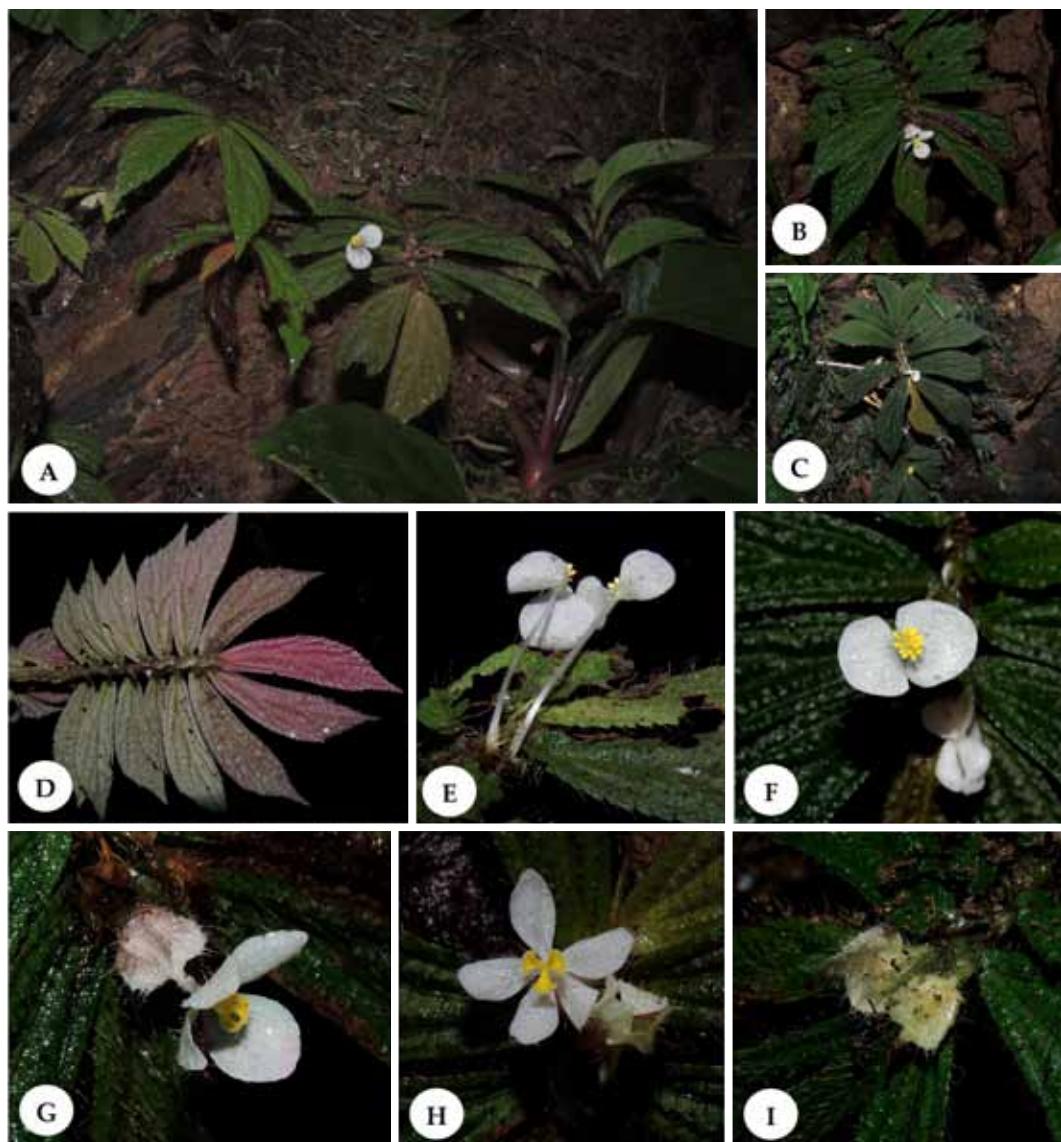


Fig. 5. *Begonia eutricha*. **A–C.** Habit; **D.** Undersurface of the leaf; **E & F.** Male flowers; **G & H.** Female flowers; **I.** Fruits. All photos from BRUN 24019 by Julia Sang.

appearance, densely hispid, hairs brown, matt, sometimes slightly falcate, narrowly obovate, 4–6.5(–10) × 1–1.8 cm, broad side 0.7–1.2 cm wide, base rounded, slightly unequal, basal lobes scarcely developed, margin scarcely toothed on lower third, ciliate, upper third minutely serrate, apex acuminate, acumen to 0.8–3 mm long; venation pinnate, concolorous, densely hairy, 4 veins on either side of the midrib, impressed above, prominent beneath. Inflorescences protogynous, single flowered, sessile, on the leaf axils above the leaf. Bracts narrowly pale green, covered with erect hairs, lanceolate, ca. 2 × 1–1.5 mm, margin entire, caducous. Bracteoles similar to bracts but minute, caducous. Male flowers: pedicel white, 22–24 mm long, covered with fine white hairs; tepals 2, isomorphic, white, 7–8 × 6–8 mm, glabrous, margin entire, apex broadly rounded on apex; stamens ca. 14, cluster loose; filaments pale yellow, ca. 1 mm long; anthers pale yellow, obovate, ca. 1 × 0.5 mm, apex emarginate. Female flowers: pedicel white, ca. 2.5 mm long, scattered long hair; ovary white tinged pink, 5–6 × 6–7 mm, covered with erect soft white hairs, beak on top of the ovary ca. 1 mm long, wings 3, equal, edge of wing ciliate, locules 3, placenta 1 per locule; tepals 5, more or less isomorphic, white, broadly oval, ca. 6 × 5 mm, hairy outside, glabrous inside, margin entire, apex rounded; styles 3, lemon yellow, spatulate, ca. 2.5 mm long, divided to base; stigma lemon yellow, papillose at the end. Capsule single on leaf axil, produce above the leaf surface, 7–11 × 8 mm, greenish yellow, hairy, beak persistent, ca. 2 mm long, locules 3, wing 3, equal, hairy, corner slightly rounded or truncate, ca. 4 mm wide, thinly fibrous, dehiscing between the locule and wing; pedicel erect, greenish yellow, ca. 2 mm long, hairy.

ETYMOLOGY. Completely hairy.

ECOLOGY. On steep stream banks in lowland or hill dipterocarp forests at 75–500 m altitude, on Setap shales or on yellow podzoic soil.

DISTRIBUTION. Endemic to Borneo, and so far known only from Temburong District in Brunei.

SPECIMENS EXAMINED—BORNEO. BRUNEI: Temburong District: Amo — Batu Apoi FR, Sungai Temburong, at Kuala Belalong, 24 June 1989, *Dransfield J. et al. JD* 6699 (BRUN!); Sungai Temburong at Kuala Belalong, banks of Sungai Belalong, 24 June 1989, *Dransfield et al. JD* 6708 (holotype K!, isotype BRUN!); Batu Apoi FR, Kuala Belalong FSC, 6 November 1991, *Hansen CH* 1504 (BRUN!); Batu Apoi FR, Sungai Belalong, 21 June 1989, *Wong WKM* 1184 (BRUN!); Batu Apoi FR, Sungai Belalong, Sungai Esu, 18 November 2014, *Joffre et al. BRUN* 24019 (BRUN!); Batu Apoi FR, Ulu Belalong, near LP 382, 18 January 1994, *Idris et al. BRUN* 16657 (BRUN!), 21 January 1994, *Kirkup et al. DK* 883 (BRUN!); Batu Apoi FR, Sungai Belalong, 21 June 1989, *Wong WKM* 1183 (BRUN!).

NOTES. Although common where it occurs it is apparently very locally distributed. The species is here interpreted narrowly to include only those small plants with short trapezoid leaves from the Temburong area. Characteristic is the upper leaf surface that in the field

appears blistered because it is bullate not only between the secondary veins but also between each of the tertiary veins. This is lost on drying. A remarkable feature of this species is the extremely long pedicels of the male flowers (to 24 mm long), by far the longest of any species we have examined either in Brunei or elsewhere in Borneo. The male flowers also have a very low number of stamens, (*ca.* 14), which among the Brunei species is matched only by *B. bruneiana* with *ca.* 12 stamens.

Excluded are larger, more robust plants (*BRUN 18130, BRUN 21590, Atkins 500; Coode 6641*) with stout stems to 25 cm tall with internodes 1–2.5 cm and spaced leaves. The leaves are obovate (not trapezoid), 13.5–15.5 × 3–5.5 cm, dark green above, maroon beneath with hispid ferruginous hairs on the petiole and lower surface of the midrib. These represent a distinct taxon, the most conspicuous characteristic of which is the very hispid petioles with the ferruginous hairs that extend up the midrib on the lower surface (see lower photograph in Henrot *et al.* (2012) p. 66). Lack of flowers and fruits precludes description of this taxon.

8. *Begonia fuscisetosa* Sands (1997: 433). Type: *Sands et al. MS 5606*, Brunei, Temburong District, Amo, Sungai Temburong *ca.* 0.5 km upstream from Kuala Belalong, 25 March 1991 (holotype K!; isotype BRUN!).

*Sands (1997): it differs from *Begonia sibutensis* Sands (1997: 433) in the stems being pilose above and the leaves more distinctly serrate. Habit reclinate up to 60 cm tall, leaves short-petioled, pilose above with solitary erect more or less rigid dark (often red) hairs between the veins; fruit axillary, solitary or in pairs, wings rounded.*

Suffruticose, clump-forming begonia to 60(–75) cm tall; stems slender, branching; leaves 6–13.5 × 2–6.5 cm, with a row of red hairs between secondary veins, margin serrate; female flowers with 5 white tepals, ovary with 2 placentas per locule; male flowers with 2 white tepals; fruits 10–12 × 9–10 mm.

ETYMOLOGY. With dark brown bristles, presumably referring to those on the upper leaf surface.

ECOLOGY. Common locally, in river valleys, often on river banks or near streams in lowland mixed dipterocarp forest to lower montane at 40–1025 m elevation, on sandstone derived soils, shale or clay.

DISTRIBUTION. In Brunei only recorded from Temburong District. Also in Kalimantan, Sabah and Sarawak (Hughes, 2008).

SPECIMENS EXAMINED—BORNEO. BRUNEI: Temburong District: Amo — Batu Apoi FR, Sungai Temburong, 28 September 2012, *Watu et al. BRUN 23604* (BRUN!); Sungai Temburong *ca.* 0.5 km upstream from Kuala Belalong, 25 March 1991, *Sands et al. MS 5606*

(holotype K!, isotype BRUN!); Batu Apoi FR, Kuala Belalong, 13 July 1993, *Sands et al.* MS 5781 (BRUN!); Batu Apoi FR, Sungai Temburong, at Kuala Belalong, 23 June 1989, *Dransfield S. et al. JD* 994 (BRUN!); Batu Apoi FR, Ulu Belalong, LP 382, 21 January 1994, *Kirkup et al. DK* 884 (BRUN!); Batu Apoi FR, Sungai Temburong catchment, Sungai Tulan, 15 July 1993, *Sands et al. MS* 5810 (BRUN!), 16 July 1993, *Sands et al. MS* 5843 (BRUN!); Batu Apoi FR, Sungai Temburong, Kuala Temburong-Machang, 20 August 1990, *Wong WKM* 1968 (BRUN!); Batu Apoi FR, Sungai Temburong, Wong Nguan rapids, 4 April 1990, *Coode et al. MC* 6550 (BRUN!), 9 April 1990, *Coode et al. MC* 6670 (BRUN!); Batu Apoi FR, Bukit Belalong, 22 July 1989, *Wong WKM* 1513 (BRUN!); Batu Apoi FR, Sungai Temburong headwaters, NE of Gunong Retak, 10 March 1991, *Sands MS* 5317 (BRUN!), 12 March 1991, *Sands MS* 5353 (BRUN!), 12 March 1991, *Sands MS* 5393 (BRUN!), 12 March 1991, *Sands MS* 5394 (BRUN!), 12 March 1991, *Sands MS* 5395 (BRUN!).

9. *Begonia hexaptera* Sands (1997: 434). Type: *Sands 5940*, Brunei, Belait District, Melilas, between Batu Melintang and Hot Springs, 25 July 1993 (holotype K!; isotype BRUN!). (Fig. 6)

Erect, robust begonia to 34 cm tall, flowering at 7 cm tall. Stems green, *ca.* 9 mm thick, stout and woody, softly hispid, hairs on the stems, petioles and leaves to 2 mm long, white (in the green form) or magenta hairs (in the magenta form), denser and to 4 mm long on the stem apex and petiole, internodes 5–13 mm long, unbranched, not swollen at nodes. Stipules pale magenta (in magenta form) or pale green (in green form), narrowly lanceolate, 6–10 × 2–6 mm, keeled, keel and margin hispid, margin entire, apex acute with a tuff of hairs, caducous. Leaves alternate, not oblique, distant, slightly spirally arranged, sometimes forming a distinct spray of leaves; petioles pale green, 2.5–7 mm long, softly hispid, slightly grooved above; lamina plain, green above, paler beneath (in green form) or green above, magenta beneath (in magenta form), softly hispid, slightly succulent in life, matt, asymmetric, broadly lanceolate, 10–16 × 3.5–5.5 cm, broad side 2–3.5 mm wide, base unequal, slightly auriculate in the broader side, basal lobes 3–7 mm wide, margin shallowly serrate with larger teeth towards the apex, apex acuminate, acumen *ca.* 1.5 cm long; venation pinnate, veins green above, whitish green below (in green form) or dark green above, deep magenta below (in magenta form), 3 veins on either side of the midrib, 1 pair at the base, none in basal lobe, impressed above, prominent beneath. Inflorescences protogynous, axillary. Male inflorescences cymose with one, sometimes two flowers, peduncle *ca.* 2 mm long, hispid or peduncle lacking. Bracts similar to the stipule, narrowly lanceolate, *ca.* 4 × 1.5 mm, persistent. Male flowers similar in colour in both the green and magenta forms, pedicel white, *ca.* 16 mm long, sparsely hairy; tepals 2, completely white, broadly ovate, 6–7 × 9 mm, covered with scattered short white hairs on the outside, margin entire, apex acute; stamens *ca.* 21, cluster loose, sessile; filaments pale yellow, *ca.* 1.2 mm long; anthers pale yellow, obovate, *ca.* 1 × 0.5 mm, apex emarginate. Female flowers completely white (in the green form) or pinkish (in the magenta form), sessile, single in the lower leaf axils, ovary *ca.* 8 × 10 mm, densely hispid, beak



Fig. 6. *Begonia hexaptera*. **A.** Habit (magenta form); **B.** Habit (green form); **C.** Male inflorescences; **D.** Male flowers; **E.** White female flower (magenta form); **F.** Pinkish female flower (green form); **G.** Fruit; **H.** Cross-section of fruit. Photos A, C, D, F–H from BRUN 24030 by Julia Sang; Photos B & E from BRUN 24030 by Yabainus Juhalin.

persistent, *ca.* 1 mm long, wings 3 with a longitudinal ridge along the locule, equal, *ca.* 2.5 mm wide, densely hispid, locules 3, placenta 1 per locule; tepals 4–5, dimorphic, white (in green form) or rosy pink (in magenta form), outer tepal broadly elliptic, 6–7 × 6–7 mm, inner 3 tepals smaller, elliptic, *ca.* 5 × 4.5 mm, densely hispid outside, glabrous inside, margin entire and ciliate, apex acute; styles 3, pale yellow, distally bifurcating and Y-shaped, *ca.* 2 mm long, divided to base; stigma pale yellow, papillose forming a continuous twisted band. Capsule single per leaf axil with several along the stem, sessile, *ca.* 12 × 12 mm, yellowish (in green form), hispid particularly on the longitudinal ridge and wing margin, locules 3, wings 3, equal, hispid, square in the outline, wing tip rounded, *ca.* 4 mm wide, thinly fibrous, ridges 3, *ca.* 1 mm high, dehiscing between the locule and wing.

ETYMOLOGY. With six wings, referring to the additional three longitudinal ridges on the capsule.

ECOLOGY. In swampy areas, near stream banks in disturbed lowland mixed dipterocarp forest at 60–80 m elevation, on yellow and sandy clay soil or on setap shale.

DISTRIBUTION. Endemic to Borneo, and so far known only from Belait District in Brunei.

SPECIMENS EXAMINED—BORNEO. BRUNEI: Belait District: Labi — Labi Hills FR, compt. 13, Ulu Sungai Tibadak, 21 November 2014, *Joffre et al.* BRUN 24030 (BRUN!); Melilas, between Batu Melintang and Hot Springs, 25 July 1993, *Sands* 5940 (holotype K!, isotype BRUN!); Melilas, Batu Melintang, 4 January 1989, *Wong WKM* 697 (BRUN!); Sungai Melayan, 19 April 2014, *Azlan et al.* BRUN 22297 (BRUN!).

NOTES. Among the ‘bruneiana group’, this is the only species with soft hispid hairs. Like other species in this group it also has ovaries with a single placenta per locule. It is remarkable for its female flowers with extremely long white hairs covering the ovary and outside of the tepals and for its four tepals (most begonias have female flowers with five tepals). As Sands (1997) noted it is different from all the other species in Brunei in the three longitudinally ridges that Sands called ‘crests’ raised about 1.5 mm high along each of the three locule faces and that alternate with the three true wings.

It was described originally from a single specimen but we located a second population in the Labi Hills FR. It is variable for colour with green- and purple-leaved forms. The former has white tepals and the latter with rosy-pink tepals in the female flower. In Sands (1997: 40) *Dransfield* 7046 was listed under this species when in fact it belongs to *B. awongii*.

10. *Begonia joffrei* S. Julia sp. nov. (Section *Petermannia*)

Similar to *Begonia sympodialis* Irmscher (1953: 495) in habit and its apparently opposite, obovate, slightly asymmetric leaves, but it is distinct in its larger stipules 14–17 mm long (not 5.5–9 mm as in *B. sympodialis*), its longer petioles 8–10 mm long and laminas 11.5–16.5 ×

4–4.5 cm (not 3–5 mm and 7–8 × 1.7–2 cm) and larger, *ca.* 20 mm long capsules with a stalk *ca.* 19 mm long (not 8.5–9 mm long with a stalk *ca.* 2 mm long as in *B. sympodialis*). Type: Joffre et al. BRUN 24016, Brunei, Temburong District, Amo, Batu Apoi Forest Reserve, Kuala Belalong, Sungai Esu, 18 November 2014 (holotype BRUN!; isotypes K!, SING!). (**Fig. 7**)

Bushy begonia to 1 m tall, flowering at 15 cm tall. Stems green, *ca.* 6 mm thick, slightly woody, hispid appressed hairs light brown, long internodes 1.7–4.5 cm long, short internodes 3–5 mm long, much branched, thicker at nodes. Stipules pale green, lanceolate, 14–17 × 4–6 mm, glabrous, margin entire, apex setose, seta *ca.* 2 mm long, dry and papery and persistent. At first stems erect with alternate leaves, then on branched, more or less horizontal branches leaves appearing opposite. Leaves slightly oblique, held more or less horizontally; petioles pale green, 8–10 mm long, densely hairy, hairs appressed on petiole, midrib and veins, terete; lamina plain green above, paler beneath, sparsely hairy, denser on the sunken veins, slightly succulent in life, glossy above, slightly asymmetric, obovate, 11.5–16.5 × 4–4.5 cm, broad side *ca.* 2.5 cm wide, base very unequal, narrow side rounded, broader side auriculate, basal lobes 7–10 mm wide, margin more or less entire on lower half, regularly toothed on upper half, apex acuminate, acumen to 1.2–2 mm long; venation pinnate, concolorous, densely hairy, 6 veins on either side of the midrib, 1 vein in basal lobe, impressed above, prominent beneath. Inflorescences axillary on a short branch opposite the leaf from the adjacent leaf, branch *ca.* 1.8 cm long bearing the male inflorescences and a leaf that appears opposite the adjacent leaf, female inflorescence single flowered from the upper leaf axils. Male inflorescences compact, producing 2 male flowers. Bracts of the male flower similar to the stipule, 8–15 × 5–8 mm, keeled, pale green. Male flowers: pedicel white, 6–11 mm long; tepals 2, isomorphic, completely white, broadly oval, *ca.* 7 × 5–6 mm, glabrous, margin entire, apex rounded; stamens *ca.* 11, pale yellow, cluster oval, sessile; filaments pale yellow, 0.2–0.3 mm long; anthers pale yellow, obovate, *ca.* 1.2 × 0.5 mm, apex emarginate. Female flower: pedicel white, *ca.* 15 mm long, softly hispid; ovary whitish green, *ca.* 22 × 9 mm, densely hispid, wings 3, equal, *ca.* 5 mm wide, wing margin with white hairs, locules 3, placentas 2 per locule; tepals 4, dimorphic, pale green, outer 3 tepals ovate, *ca.* 11 × 9 mm, margin entire, apex acute or rounded, innermost one narrower, *ca.* 9 × 7 mm, margin entire, ciliate with white hairs, sparsely hairy on outer side; styles 3, anchor-shaped, 3–4 mm long, divided to base; stigma papillose forming a continuous twisted band. Capsule single, axillary on upper leaf axils, on top of the leaf, *ca.* 20 × 15 mm, green, sparsely hairy, locules 3, wings 3, equal, ciliate, narrowed proximally, rounded distally, *ca.* 5 mm wide, thinly fibrous, dehiscing between the locule and wing; pedicel erect, *ca.* 19 mm long, green, sparsely hairy.

ETYMOLOGY. Named after Joffre Ali Ahmad, Forestry Officer, Brunei Forestry Department/Brunei National Herbarium, who collected the type specimen.

ECOLOGY. Above the banks of a seasonal stream in semi-shade or on steep earthy slope in lowland mixed dipterocarp forest, on setap shales.

DISTRIBUTION. Endemic to Borneo, and so far known only from Temburong District in Brunei.

SPECIMENS EXAMINED—BORNEO. BRUNEI: Temburong District — Amo, Batu Apoi FR, Sungai Temburong valley, along stream to east of helicopter pad LP 286, 27 April 1992, Johns *et al.* RJ 7396 (BRUN!); Batu Apoi Forest Reserve, Kuala Belalong, Sungai Esu, 18 November 2014, Joffre *et al.* BRUN 24016 (holotype BRUN!; isotypes K!, SING!).

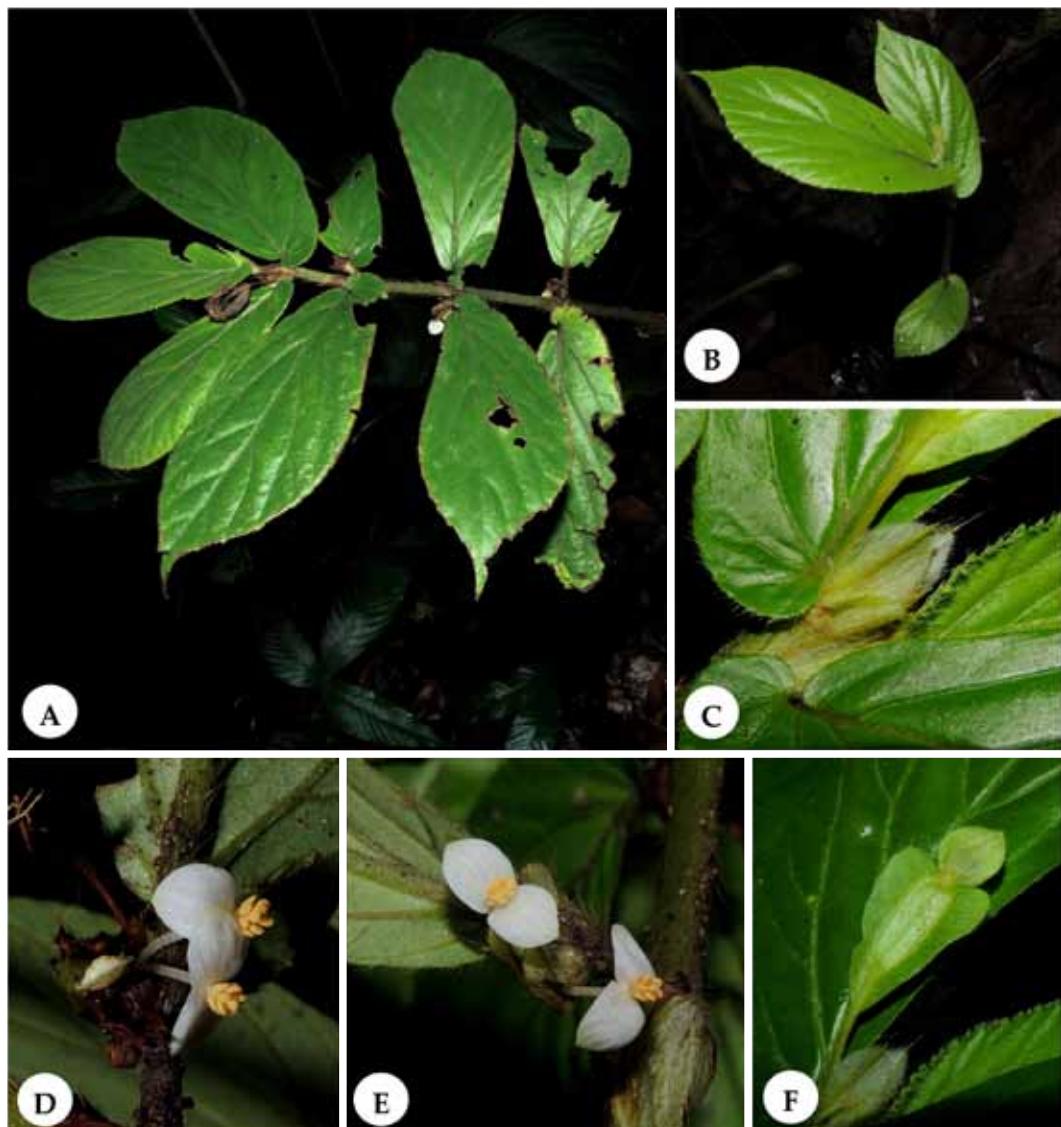


Fig. 7. *Begonia joffrei*. **A.** Horizontal branches with leaves appearing opposite; **B.** Erect stem with alternate leaves; **C.** Stipule; **D & E.** Male flowers; **F.** Fruit. All photos from BRUN 24016 by Julia Sang.

NOTES. This species is strikingly different from other Brunei begonias in its apparently opposite leaves, which are the result of an internode hardly extending so that two alternate leaves are brought almost next to and opposite each other. When fertile, one node produces a leaf (petiole and lamina) and the other node produces a short branch with an inflorescence and leaf, which gives the appearance of the inflorescence being produced from the petiole. Irmscher (1954) was the first to draw attention to this leaf arrangement which he described in several Sarawak begonias, namely *B. articulata* Irmscher (1953: 497), *B. longiseta* Irmscher (1953: 499) and *B. sympodialis* Irmscher (1953: 495).

11. *Begonia labiensis* (Sands) S. Julia stat. nov. Type: Coode 7293 et al., Brunei, Belait District, Labi, Sungai Rampayoh, 20 March 1993 (holotype K!; isotype BRUN!). Basionym: *B. bruneiana* subsp. *labiensis* Sands (1997: 433). (**Fig. 8**)

Erect begonia to 30 cm tall. Stems dark brown, 5–6 mm thick, stout, appressed dark brown pubescent, internodes 1.5–2.5 cm long, unbranched, swollen at nodes. Stipules pale brown green, narrowly lanceolate, 15–16 × 3–3.5 mm, minutely pubescent, keeled, margin entire, apex acute or setose, seta to 1.5 mm long, caducous. Leaves alternate, not oblique, distant, arranged in a flat spray; petiole dark brown, 10–12 mm long, appressed dark brown pubescent, terete; lamina plain green to pale green above, whitish green or slightly reddish brown beneath, glabrous, thinly leathery in life, glossy, slightly bullate above, slightly asymmetric, broadly obovate, 18–18.5 × (4–)5.5–7 cm, broad side 4–4.5 cm wide, base slightly auriculate, basal lobes 0.2–0.3 cm wide, margin distantly serrate, with pronounced teeth on the upper third to 3–5 mm long on the broad side, apex acute or acuminate, acumen to 2.5 cm long; venation pinnate, veins green above, rusty brown pubescent beneath, 2–3 veins on either side of the midrib, deeply ascending to the margin, 1 pair at the base, 1 vein in basal lobe, sunken above, prominent beneath. Inflorescences protogynous, axillary. Bracts pale green brown, sparsely pubescent, narrowly lanceolate, ca. 2 × 1 mm, caducous. Bracteoles similar to bracts but minute, caducous. Male inflorescences in the axil of upper leaves, cymose, peduncle deep red with hairs, 2–3 mm long. Male flowers: pedicel white, ca. 13 mm long; tepals 2, white or pale pink, broadly ovate, 7–8 × 10–11 mm, few scattered red hairs at the base on the outside, margin entire, apex rounded to slightly acute; stamens ca. 27, cluster globose, sessile; filaments pale yellow, ca. 1 mm long; anthers pale yellow, obovate, ca. 1.2 × 0.8 mm, apex emarginate. Bracts pale brown, lanceolate, to 1.5 mm long, caducous. Bracteoles similar to bracts but minute, caducous. Female flowers single from the lower leaf axils below the leaf, peduncle to 6.5 mm long; pedicel pink, ca. 1.5 mm long; ovary white tinged pink, ca. 10 × 14 mm, scattered red hairs on the capsule, denser at the base, beak of the ovary to 1.5 mm long, wings 3, equal, ca. 4 mm wide, sparsely ciliate, locules 3, placenta 1 per locule; tepals 5, isomorphic, white, ovate, ca. 9 × 5 mm, scattered red hairs on outer surfaces of tepals, margin entire, apex narrowed to acute; styles 3, pale yellow, spatula-shaped, ca. 3 mm long, divided to base; stigma pale yellow, papillose with twisted band at the tip. Capsule single on leaf axils, 9–12 × 15 mm, greenish yellow, covered with sparsely

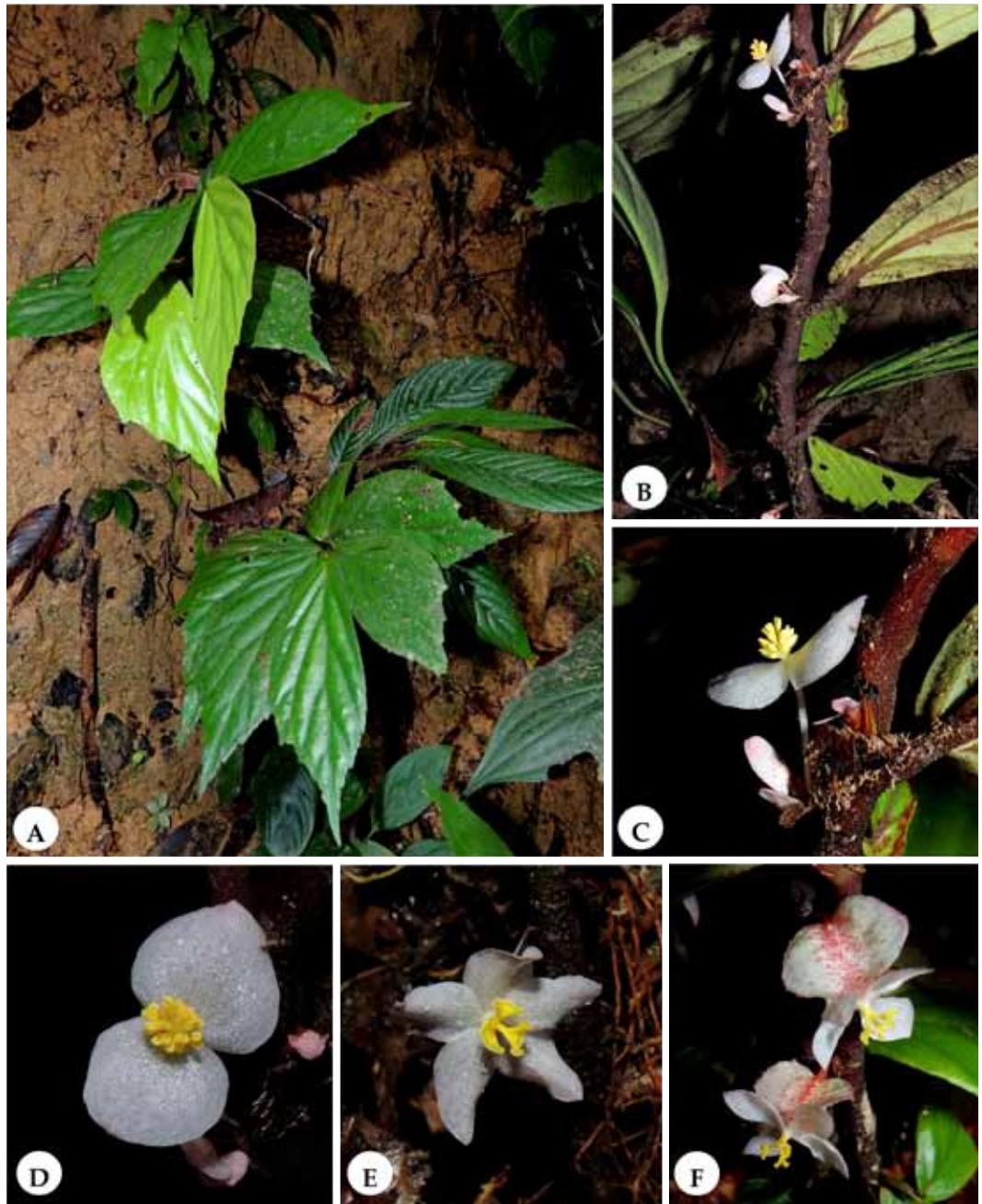


Fig. 8. *Begonia labiensis*. **A.** Habit; **B.** Male inflorescence; **C & D.** Male flowers; **E & F.** Female flowers.
All photos from BRUN 24024 by Julia Sang.

red hairs, beak 1.5–2 mm long, locules 3, wings 3, equal, 4–7 mm wide, margin entire, thinly fibrous, dehiscing between the locule and wing; pedicel pendent, greenish yellow with sparse red hairs, 7–8 mm long.

ETYMOLOGY. Named after the type locality.

ECOLOGY. By rivers, on earth banks in shaded stream-valley in lowland, sometimes disturbed, dipterocarp forest, on sandstone derived soil or clay, at 60–80 m elevation.

DISTRIBUTION. Endemic to Borneo and known from Belait, Temburong and Tutong Districts in Brunei.

SPECIMENS EXAMINED—BORNEO. BRUNEI: Belait District: Labi — Rampayoh waterfall, 2 May 1992, *Johns et al. RJ 7454* (BRUN!); Sungai Rampayoh, 20 March 1993, *Coode 7293 et al.* (holotype K!, isotype BRUN!), 9 January 1994, *Coode et al. MC 7769* (BRUN!), 8 July 1993, *Sands et al. MS 5756* (BRUN!), 30 July 1993, *Sands et al. MS 5990* (BRUN!), 30 July 1993, *Sands et al. MS 5991* (BRUN!); Bukit Teraja, 25 June 1991, *Wong WKM 2100* (BRUN!), 28 March 1991, *Sands et al. MS 5698* (BRUN!); Sungai Mendaram, 20 March 1991, *Sands & Shanang MS 5505* (BRUN!). Temburong District: Batu Apoi — Kampong Selapon, 18 November 1990, *Dransfield et al. SD 1167* (BRUN!). Tutong District: Lamunin — Ladan Hills FR, 20 November 2014, *Joffre et al. BRUN 24024* (BRUN!), 30 March 1991, *Sands et al. MS 5733* (BRUN!), 30 March 1991, *Sands et al. MS 5734* (BRUN!), 9 March 2006, *Muhd Ariffin et al. BRUN 21591* (BRUN!); Ladan Hills FR, Sungai Tutong, upstream from Belabau, 28 March 1990, *Coode et al. MC 6327* (BRUN!), 29 March 1990, *Coode et al. MC 6373* (BRUN!), 30 March 1990, *Coode et al. MC 6404* (BRUN!); Lamunin, Layong-Gadong pipeline track, 14 November 1990, *Dransfield J. et al. JD 6890* (BRUN!).

NOTES. Originally described as a subspecies of *B. bruneiana* it is distinguished from that species by the characters listed in Table 1. It is a common species and in the field is readily recognised by its veins that are covered in appressed reddish brown pubescent making the veins conspicuous against the pale green undersurface of the leaf. The green form is more common but plants with a purple lower leaf surface are also encountered. As in *B. bruneiana* and *B. hexaptera*, flower colour also depends on the colour form, those with green leaves have white flowers and those with purple-maroon leaves have rosy pink flowers. Sands (1997) diagnosis characterises this species by its stipules 5–8(–10) cm long, wing margins dentate or remotely setose.

12. *Begonia laccophora* Sands (1997: 434). Type: *Johns et al. RJ 7303*, Brunei, Temburong District: Amo, Batu Apor FR, near helipad LP 286, 25 April 1992 (holotype K!).

*Sands (1997): it differs from *B. pyrrha* Ridley (1906: 260) in the leaves having distinct pits beneath, the pits under the broad bases of the scattered hairs of the upper surface; bracts*

broad, entire (not denticulate), the inflorescences shorter up to 4 cm long (not up to 7.5 cm); stamens >20 (not 13–15). Prostrate herb with rounded leaves, sharp-rugose above in life, the margins with irregular teeth intermixed with setae.

ETYMOLOGY. From ‘lacunose’ indicating the deep pits on the lower leaf surface.

ECOLOGY. In river valleys or steep-sided ridges in hill dipterocarp forest at 30–480 m elevation, on clay loam soil or setap shale.

DISTRIBUTION. Endemic to Borneo, and so far known only from Temburong District in Brunei.

SPECIMENS EXAMINED—BORNEO. BRUNEI: Temburong District: Amo — Batu Apoi FR, Sungai Temburong valley, near LP 286, 23 April 1992, *Johns et al. RJ 7180* (BRUN!), 23 April 1992, *Johns et al. RJ 7181* (BRUN!), 25 April 1992, *Johns et al. RJ 7304* (BRUN!); Batu Apor FR, near helipad LP 286, 25 April 1992, *Johns et al. RJ 7303* (holotype K!); Batu Apoi FR, Ulu Belalong, LP 382, 20 January 1994, *Coode MC 7866* (BRUN!); Batu Apoi FR, Bukit Belalong, 23 March 1992, *Poulsen ADP 317* (BRUN!).

NOTES. This is a pretty species with its small round leaves and low creeping habit. It is the only species in Brunei with this habit. It appears to be a local species, because it has only been collected from Bukit Belalong and Sungai Temburong.

13. *Begonia leucochlora* Sands (1997: 432). Type: *Sands et al. MS 5566*, Brunei, Temburong District, Amo, by Sungai Temburong ca. 0.5 km downstream from Kuala Belalong, 23 March 1991 (holotype K!; isotype BRUN!).

*Sands (1997): it differs from *B. baramensis* in the leaves never entire, more or less remotely serrulate and with the ovary elliptic in fruit (not broadly elliptic or globose).*

ETYMOLOGY. White-green, presumably referring to the flowers.

ECOLOGY. Lowland mixed dipterocarp forest on setap shale formation at elevation 100 m.

DISTRIBUTION. Endemic to Borneo and so far known only from Temburong District in Brunei.

SPECIMENS EXAMINED—BORNEO. BRUNEI: Temburong District: Amo — Batu Apoi FR., Kuala Belalong, 22 June 1989, *Wong WKM 1207B* (BRUN!); Sungai Temburong ca. 0.5 km downstream from Kuala Belalong, 23 March 1991, *Sands et al. MS 5566* (holotype K!, isotype BRUN!).

NOTES. This species is still poorly known, being represented only by the type and one other specimen. In its cane-like habit and leaf shape, it resembles the common *B. stenogyna* but is distinguished by the larger basal lobe of the leaf and shorter inflorescences.

14. *Begonia leucotricha* Sands (1997: 434). Type: *Sands et al. MS 5452*, Brunei, Belait District, Labi, Mendaram valley near waterfall, 18 March 1991 (holotype K!).

*Sands (1997): it is like *B. bruneiana* ssp. *angustifolia* (here treated as *B. rambaiensis*) in having narrow leaves, narrow and persistent stipules and small axillary flowers, but differs in the long-attenuate leaf apex, conspicuously white-hairy above (not glabrous) with silvery hairs and the margin thinly ciliate-serrulate (in *B. bruneiana* ssp. *angustifolia* the leaves are acute at apex not attenuate and in the distal half irregularly and distantly acutely dentate-serrate, with the setae fewer and more distant).*

ETYMOLOGY. With white hairs.

ECOLOGY. On a sandstone cliff near a waterfall in mixed dipterocarp forest at 70 m elevation.

DISTRIBUTION. Endemic to Borneo, and so far known only from Belait District in Brunei.

SPECIMEN EXAMINED—BORNEO. BRUNEI: Belait District: Labi — Mendaram valley near waterfall, 18 March 1991, *Sands et al. MS 5452* (holotype K!).

NOTES. Apparently known from a single plant specimen. It belongs to the ‘bruneiana group’ of species and is distinct from the others in its much longer, narrow falcate leaves. The type specimen lacks flowers and fruits, which preclude it from being described.

15. *Begonia nothobaramensis* Joffre sp. nov. (Section *Petermannia*)

Similar to *Begonia baramensis* Merrill in its habit and peltate leave but it is different in its smaller stature, ca. 1 m tall (vs. to 2.5 m tall), margin entire on narrow side, or minutely and shallowly toothed at the vein endings on the broader side (vs. conspicuously toothed at veins ending), the tip of the wings of female flower rounded, longer or as long as tepals (vs. tip of the wings of female flower sharply pointed, longer than the tepals), stamens ca. 36 (vs. 49–85 in *B. baramensis*), the capsule is smaller, 12–14 × 12–16 mm (vs. 14–20 × 25–47 mm), the wings are only slightly unequal and are rounded or truncate distally, narrower 2 wings 2.5–4 mm wide, widest wing ca. 5 mm wide (vs. wings tip pointed, and one wing much larger than the other 2 wings, narrower wings 9–14 mm, widest wing 13–30 mm). Type: *Azlan et al. BRUN 24035*, Brunei, Belait District, Bukit Sawat, Jalan Meranking, Long Mayan, 22 November 2014 (holotype BRUN!; isotypes K!, SAR!, SING!). (**Fig. 9**)

Cane-like begonia to 1 m tall, flowering at 18 cm tall. Stems reddish or brown, (3–)5–6 cm thick, slightly woody, glabrous, internodes (3–)7.5–14 cm long, much-branched, conspicuously swollen at the nodes. Stipules brownish green, narrowly lanceolate, 4–6 × 1–3 mm, glabrous, keeled, margin entire, apex setose, seta to 1.5 mm long, caducous. Leaves alternate, oblique, distant, held more or less vertically; petioles red-brown, (2.2–)5–11 cm long, glabrous, slightly grooved above; lamina plain green above with a red patch at



Fig. 9. *Begonia nothobaramensis*. **A.** Leaves of flowering plant; **B.** Leaves of juvenile plant; **C.** Stipule; **D.** Male inflorescences and old fruit; **E.** Male flower; **F & G.** Female flowers; **H.** Old fruit. All photos from BRUN 24035 by Julia Sang.

junction with petiole, paler beneath, young leaves light bronzy-green, sometime red beneath, sometimes with silvery grey margin or a few scattered spots, glabrous, thinly leathery in life, glossy, asymmetric, peltate, broadly lanceolate, $9.5\text{--}18 \times 5\text{--}9$ cm, broad side $3.7\text{--}5.5$ cm wide, base rounded, basal lobe $3\text{--}6.5$ cm wide, margin entire on narrow side, or minutely and shallowly toothed at the vein endings on the broader side, apex acuminate, acumen $1.5\text{--}2.5$ cm long; venation palmate, concolorous, glabrous, 8 veins radiating from the petiole, branching once or twice, visible above, prominent beneath. Inflorescences protogynous, axillary from the upper leaf axils, peduncle $(1\text{--})2.2\text{--}4.5$ cm long, 1–2 pairs of female flowers and many male flowers; male rachis $4.5\text{--}14$ cm, very fine and much branched. Bracts similar to the stipules, reddish, keeled, narrowly lanceolate, $ca.$ 3×1.5 mm, margin entire, caducous. Bracteoles similar to bracts but smaller, $ca.$ 1×0.4 mm, caducous. Male flowers: pedicel pinkish, $3\text{--}7$ mm long, glabrous; tepals 2, rosy pink, broadly ovate, $3\text{--}5 \times 3\text{--}7$ mm, glabrous, margin entire, apex rounded; stamens $ca.$ 36, cluster globose, sessile, filaments pale yellow, 1 mm long; anthers pale yellow, obovate, $ca.$ 1×0.5 mm, apex emarginate. Female flowers: pedicel pale pink, $1.7\text{--}2$ cm long, glabrous; ovary pale green, ovoid, $1.5 \times 1.5\text{--}1.8$ cm, glabrous, wings 3, slightly unequal, widest wing $5\text{--}6$ mm wide, narrower 2 wings $ca.$ 3 mm wide, locules 3, placentas 2 per locule; tepals 5, whitish pink, outer 3 tepals elliptic, $8\text{--}9 \times 6$ mm, inner 2 tepals narrowly lanceolate, $6\text{--}7 \times 3\text{--}4$ mm, margin entire, apex acute; styles 3, brownish orange, wide Y-shaped, $2\text{--}3$ mm long, divided to base; stigma golden yellow, papillose forming a short twisted band. Capsule solitary or in pair, $12\text{--}14 \times 12\text{--}16$ mm, pale green, glabrous, locules 3, wings 3, unequal, narrow 2 wings $2.5\text{--}4$ mm wide, broadest one $ca.$ 5 mm wide, rounded proximally and distally, thinly fibrous, dehiscing between the locules and wings; pedicel brownish green, $14\text{--}23$ mm long, glabrous.

ETYMOLOGY. False *Begonia baramensis*, because having a peltate leaf it was not recognised as different from *B. baramensis*.

ECOLOGY. In valley bottoms and on steep clay slopes above seasonal stream in lowland mixed dipterocarp forest or disturbed lowland forest, to 90 m elevation.

DISTRIBUTION. Endemic to Borneo and known from Belait, Temburong and Tutong Districts in Brunei.

SPECIMENS EXAMINED—BORNEO. BRUNEI: Belait District — Bukit Sawat, Jalan Meranking, Long Mayan, Azlan *et al.* BRUN 24035 (holotype BRUN!; isotypes K!, SAR!, SING!), 12 September 2013, Mediana *et al.* BRUN 23996 (BRUN!); Tasek Merimbun, Pok Pasal, 3 August 1993, Bernstein JHB 509 (BRUN!). Temburong District — Selapon, bank of Sungai Selapon east of village, 20 November 1990, Dransfield *et al.* JD 6963 (BRUN!). Tutong District — Lamunin, Ladan Hills, 23 March 1993, Coode *et al.* MC 7338 (BRUN!).

NOTES. It is sometimes the case with a common easily recognised species that a similar species may be lumped together and so be overlooked. In this case, *B. baramensis* was

immediately recognised by its peltate leaves, a very uncommon character in section *Petermannia*. However, this new taxon, *B. nothobaramensis* while also having peltate leaves is distinct from it in size and shape of the capsule without there being intermediate forms and in the suite of characters listed above. It is therefore described here as a new species.

16. *Begonia papyraptera* Sands (1997: 432). Type: *Johns et al. RJ 7422*, Brunei, Temburong District, Amo, Sungai Temburong valley, downstream from helipad LP 286, 28 April 1992 (holotype K!; isotype BRUN!). (Fig. 10)

Cane-like begonia, 21–40 cm tall, whole parts of the plant glabrous. Stems light green, 1–1.5 cm thick, very succulent, angular, internodes 3–4.5 cm long, little branched, nodes red,



Fig. 10. *Begonia papyraptera*. **A.** Habit; **B.** Inflorescences with male and female flowers; **C.** Inflorescences and fruit; **D.** Female flower; **E.** Male flowers; **F.** Fruit. All photos from BRUN 24014 by Julia Sang.

swollen. Stipules pale green, narrowly lanceolate, *ca.* 3.5 × 2.2 cm, keeled, margin entire, apex acute, caducous. Leaves alternate, oblique, distant, held horizontally; petioles light green, 5–12 cm long, angular, grooved above; lamina dark green above, maroon beneath, young leaves with white spots above, the spots appeared pale green below, older leaves plain, slightly fleshy in life, glossy, asymmetric, lanceolate, 10–14 × 9–11.5 cm, broad side 7–9 cm wide, base cordate, basal lobes 4–5.5 cm, margin dentate, apex acuminate, acumen 2–3 cm long; venation palmate-pinnate, veins red near junction of petiole, pale green towards the margin, 3 veins on either side of the midrib, 3–5 pairs at the base, 2 veins in basal lobe, impressed above, prominent beneath. Inflorescences protogynous, axillary on the upper leaf axils, peduncle 3–3.5 cm long with one or two pairs of female flowers below and a compact cluster of male flowers above. Bracts light green or reddish, oval, keeled, *ca.* 1.8 × 1.5 cm, margin entire, persistent. Male flowers: pedicel rosy pink, 3–12 mm long; tepals 2, rosy pink, oval, 5–7 × 4–5 mm, margin entire, apex rounded; stamens *ca.* 31, cluster conical, sessile; filaments *ca.* 0.5 mm long; anthers pale yellow, oblong, *ca.* 1.4 mm long, apex emarginate. Female flowers: pedicel light green, 3.5–4 mm long; ovary light green, 3–4 × 2–3 cm, wings 3, equal, locules 3, placentas 2 per locule; tepals 5, pink, greenish along the margin, outer 4 tepals oval, 10–12 × 8–9 mm, innermost ones *ca.* 10 × 5 mm, margin entire, apex rounded; styles 3, deeply Y-shaped, *ca.* 6 mm long, divided to base; stigma yellow, papillose forming a continuous twisted band. Capsule in 1–2 pairs, 2.5–3.6 × 1.5–2.1 cm, pale green, locules 3, wings 3, equal, thinly fibrous, slightly expanded, tip rounded, dehiscing between locule and wing; pedicel pendent, *ca.* 5 mm long.

ETYMOLOGY. With papery wings, referring to the fruit.

ECOLOGY. Very local on riverbanks or river valleys in lowland mixed dipterocarp forest at 25–100 m altitude, on setap shale or soil derived from sandstone formation.

DISTRIBUTION. Endemic to Borneo, and so far known only from Temburong District in Brunei.

SPECIMENS EXAMINED—BORNEO. BRUNEI: Temburong District: Amo — Batu Apoi FR, Kuala Belalong FSC, 18 November 2014, *Joffre et al. BRUN 24014* (BRUN!); Sungai Temburong valley, downstream from helipad LP 286, 28 April 1992, *Johns et al. RJ 7422* (holotype K!, isotype BRUN!); Batu Apoi FR, Sungai Temburong at Kuala Belalong, 22 June 1989, *Dransfield S. et al. SD 995* (BRUN!); Batu Apoi FR, Sungai Temburong, 29 May 1991, *Poulsen ADP 105* (BRUN!), 30 Sepetember 1994, *Duling DW 26* (BRUN!).

NOTES. A most beautiful species in its large glossy, dark green leaves with pale grey-green spots and flowers with rosy red tepals. The male flowers in addition having red anthers, a most unusual feature in Bornean begonias. The spots are unusual too because they penetrate to the lower leaf surface, like windows. It is readily distinguished from other species by its robust, pale green, succulent, angled, almost winged stems, spotted young leaves and

inflorescences with a stout rachis and a pair or two of female flowers below and a compact cluster of male flowers above, the cymules of which are enclosed in broadly ovate foliose green or reddish bracteoles.

17. *Begonia rambaiensis* Kiew nom. nov. et stat. nov. Type: *Johns et al. RJ 7510*, Brunei, Tutong District, Rambai, E of helipad 239, 7 May 1992 (holotype K!; isotype BRUN!). Homotypic synonym: *B. bruneiana* subsp. *angustifolia* Sands (1997: 38, 433).

Sands (1997): the leaves 3–4 times longer than broad, narrowed towards the base or sometimes slightly constricted, serrate and setose-ciliate in distal half; stipules ovate-lanceolate, 8–12 mm long, with some appressed hairs on the midrib beneath; stem hairs long, more or less appressed; fruit wings with margins distantly setose, sometimes with minute glands.

Stems to 20 cm tall. Lamina narrowly obovate, ca. 10.5 × 2.7 cm, margin shallowly dentate, apex attenuate, acuminate. Male flowers small, pedicels hair-like 3–4 mm long, pure white, tepals ca. 3 mm long, stamens lemon yellow. Female flower and wings of fruit white.

ETYMOLOGY. From the locality where it was first collected.

ECOLOGY. Lowland dipterocarp forest at 200 m elevation.

DISTRIBUTION. Endemic to Borneo, and so far known only from Tutong District in Brunei.

SPECIMEN EXAMINED—BORNEO. BRUNEI: Tutong District: Rambai — E of helipad 239, 7 May 1992, *Johns et al. RJ 7510* (holotype K!, isotype BRUN!).

NOTES. Originally described as a subspecies of *B. bruneiana*, it was distinguished from the other subspecies by its narrower leaves. At present it is known only from the type specimen and one other specimen so whether leaf width is a consistent character needs to be assessed by population studies in the field. Because ‘*augustifolia*’ has already been used to describe a begonia from Java (Blume, 1827), it requires a new name. In the Checklist (Sands, 1997), a specimen of *Begonia papyraptera*, Poulsen 105, is in error listed under this species.

18. *Begonia retakensis* (Sands) Joffre stat. nov. Type: *Sands et al. MS 5316*, Brunei, Temburong District, Amo, headwaters of Sungai Temburong, NE of Bukit Retak, 10 March 1991 (holotype K!; isotype BRUN!). Basionym: *Begonia bruneiana* subsp. *retakensis* Sands (1997: 433).

Sands (1997): the leaves up to 3 times longer than broad, distinctly serrate in the distal half; stipules broadly ovate, acuminate, 5–8(–10) mm long, glabrous; stem hairs short, mostly appressed; fruit wings glabrous, sometimes with minute scattered glands, entire.

ETYMOLOGY. From the type locality.

ECOLOGY. Lower montane forest at 1150 m elevation.

DISTRIBUTION. Endemic to Borneo, and so far known only from Temburong District (Bukit Retak) in Brunei.

SPECIMENS EXAMINED—BORNEO. BRUNEI: Temburong District: Amo — Batu Apoi FR, Sungai Temburong, 24 April 1992, *John et al. RJ* 7297 (BRUN!); Headwaters of Sungai Temburong, NE of Bukit Retak, 10 March 1991, *Sands et al. MS* 5316 (holotype K!, isotype BRUN!); Batu Apoi FR, Bukit Retak, 12 March 1991, *Sands et al. MS* 5396 (BRUN!), 12 March 1991, *Sands et al. MS* 5397 (BRUN!).

NOTES. Originally described as a subspecies of *B. bruneiana* it was distinguished from the typical subspecies by its more deeply incised dentation of the upper third of the leaf margin. Whether dentation is a consistent diagnostic character needs to be assessed by population studies in the field. It is the only species in the ‘bruneiana group’ that is described from lower montane forest.

19. *Begonia sibutensis* Sands (1997: 433). Type: *Poulsen ADP 31*, Brunei, Temburong District, Amo, Batu Apoi FR, West of Kuala Belalong, 23 March 1991 (holotype K!; isotype BRUN!). (**Fig. 11**)

Erect, shrubby begonia to 40 cm tall, all parts of the plant glabrous. Stems reddish-brown, ca. 4 mm thick, robust and woody, internodes 3–5 cm long, little-branched, thicker at node. Stipules pale green, lanceolate, ca. 9 × 2 mm, keeled, margin entire, apex acuminate, caducous. Leaves alternate, not oblique, distant, held more or less horizontally; petiole reddish brown, 5–8 × 1.5–2 mm, grooved above; lamina plain green above, pale green beneath, slightly succulent in life, glossy, scarcely asymmetric, lanceolate, 8–13.5 × 3.5–5 cm, broad side 2–3.5 cm wide, base attenuate, basal lobe scarcely developed, margin slightly crenate, apex acuminate, acumen to 1.5–2 cm long; venation pinnate, main veins red on petiole junction, 3 pairs on either side of the midrib, prominent near the petiole, more or less plane towards the margin, prominent beneath. Inflorescences protogynous, axillary in the upper leaf axils, with ca. 2 female flowers below and above rachis 1–1.2 cm long with two branches, 5–8 mm long, with male flowers in simple cymules. Bracts pale green, lanceolate, keeled, 10–15 × 3–4 mm, margin entire, apex acuminate, caducous. Bracteoles similar to bracts but minute, caducous. Male flowers: pedicel greenish white, ca. 3 mm long; tepals 2, greenish white, ovate, ca. 5 × 6 mm, margin entire, apex slightly acute; stamens ca. 63, cluster sessile; filaments pale yellow, ca. 1 mm long; anthers pale yellow, obovate, 0.8–1 × 0.4 mm, apex emarginate. Female flowers: pedicel pale green, ca. 1.2 cm long; ovary light green, shortly oblong, ca. 8 × 5 mm, wings 3, unequal, locules 3, placentas 2 per locule; tepals 4, greenish



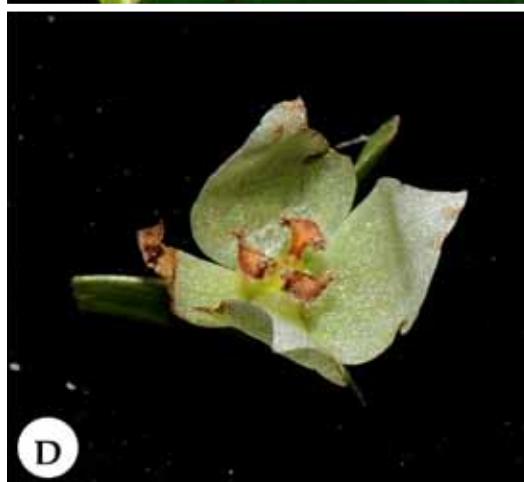
A



B



C



D



E

Fig. 11. *Begonia sibutensis*. **A.** Habit; **B.** Old fruit and male flower; **C.** Male inflorescence; **D.** Old female flower; **E.** Old fruit. Photos A & B from BRUN 24015 by Yabainus Juhalin; Photos C–E from BRUN 2015 by Julia Sang.

white, ovate, *ca.* 8 × 5–6 mm, margin entire, apex acute; styles 3, light green-whitish, distally anchor-shaped, *ca.* 2 mm long, divided to base; stigma pale yellow, forming a continuous twisted papillose band. Capsule in pair, 10–12 × 12–15 mm, pale green, locules 3, wings 3, more or less equal, rounded distally, truncate distally, 4–6 mm wide, thinly fibrous, dehiscing between the locule and wing; pedicel pale green, dangling, fine thread-like, (5–)8–13 mm long.

ETYMOLOGY. Named for the type locality.

ECOLOGY. In valley bottoms and on slopes in mixed dipterocarp forest at 20–250 m elevation on setap shales.

DISTRIBUTION. Endemic to Borneo, and so far known only from Temburong District in Brunei.

SPECIMENS EXAMINED—BORNEO. BRUNEI: Temburong District: Amo — Batu Apoi FR, Kuala Belalong FSC, Ashton trail, 18 November 2014, *Rimi et al. BRUN 24015* (BRUN!); Batu Apoi FR, West of Kuala Belalong, 23 March 1991, *Poulsen ADP 31* (holotype K!, isotype BRUN!); Batu Apoi FR, catchment of the Sungai Sibut, 22 March 1991, *Sands et al. MS 5515* (BRUN!); Batu Apoi, Selapon, Sungai Selapon, 20 November 1990, *Dransfield J. et al. JD 6982* (BRUN!).

NOTES. In habit and leaf shape and texture, it superficially resembles *B. cyanescens* but is immediately distinguished by its many-flowered inflorescences produced from the upper leaf axils (not 1–2 fruits produced from the lower axils), its female flowers with 5 tepals (not 4) and a single placenta per locule (not with 2 placentas) and male flowers with 2 tepals and 34 stamens (not 4 tepals and 63 stamens) and truncate tip of the capsule wings (vs. wings not extended downwards to a point).

The checklist (Sands, 1997) lists this species as an epiphyte, which is misleading because the field notes (*JD 6982*) record it as ‘epiphyte at base of large riverside tree’. Many begonia species are encountered growing on mossy substrates whether on rocks, fallen trees or the base of forest trees but none is truly epiphytic, i.e., growing on branches in tree canopies.

20. *Begonia stenogyna* Sands (1997: 432). Type: *Sands et al. MS 5782*, Brunei, Temburong District, Amo, Batu Apoi FR, Kuala Belalong, 13 July 1993 (holotype K!; isotypes BRUN!). (**Fig. 12**)

Shrubby, erect begonia to 2.5 m tall, flowering at 30 cm tall, forming clumps. Stems brownish green, 5–12 mm thick, becoming woody, brown pubescent becoming glabrescent, internodes 2–9 cm long, much-branched, thicker at nodes. Stipules pale green, narrowly lanceolate,

$18\text{--}25 \times 6\text{--}9$ mm, glabrous, strongly keeled, margin entire, apex setose, seta 2–4 mm long, caducous. Leaves alternate, usually not oblique, distant, held more or less horizontally; petiole brownish green, 0.5–1.5(–3.5) cm long, sparsely hairy on lower side, above densely ferrugineous, especially at the base of the veins, grooved above; lamina plain dark green above, paler beneath, glabrous above, sparsely hairy on the veins beneath, succulent in life, glossy, asymmetric, broadly lanceolate, $15.5\text{--}22.5 \times 6.2\text{--}12.5$ cm, broad side 4–6.5 cm wide, base slightly cordate, basal lobes 0.5–1.5 cm wide, margin minutely dentate with large teeth to 2 mm long at the vein ending, apex acuminate, acumen 1.5–2 cm long; venation

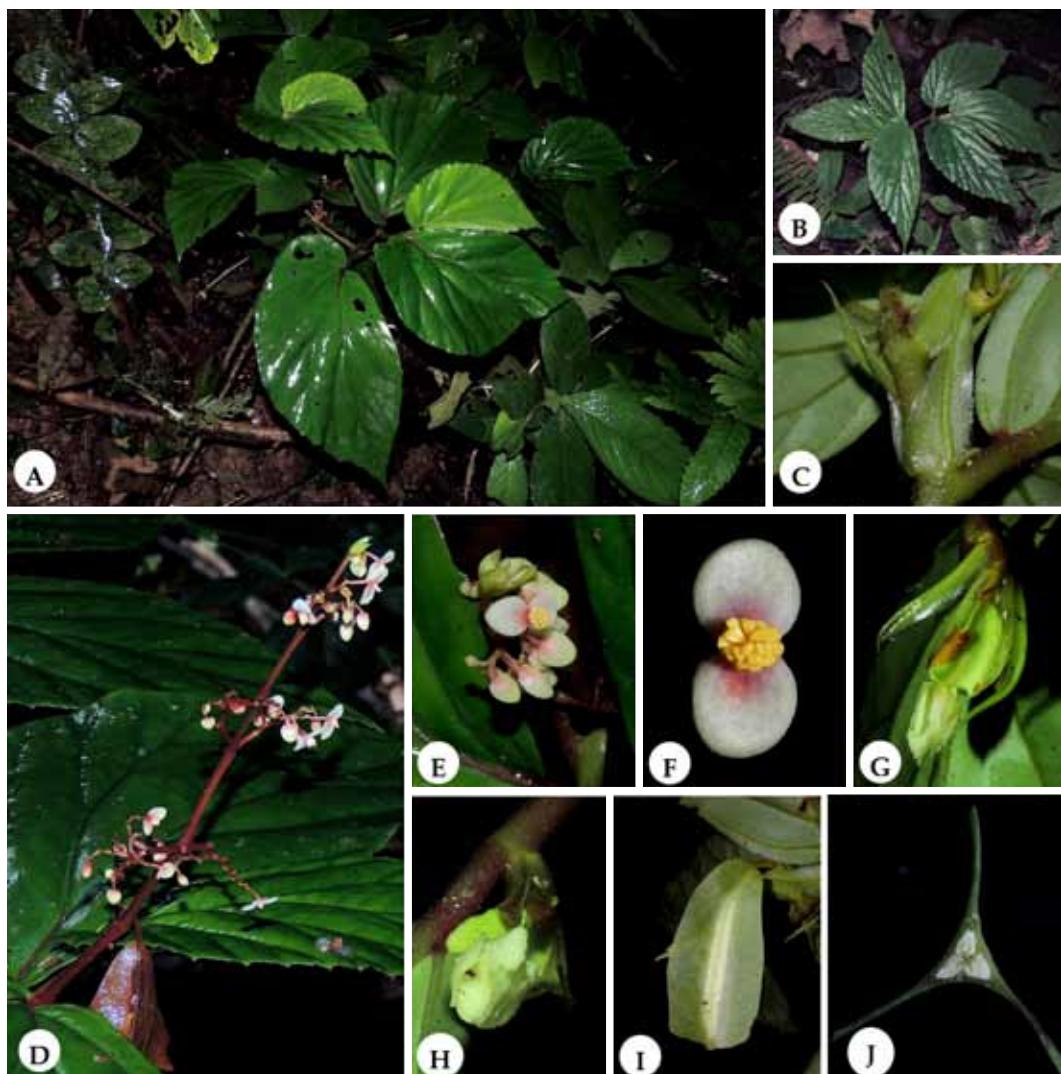


Fig. 12. *Begonia stenogyna*. **A.** Habit of mature plant; **B.** Leaves of juvenile plant; **C.** Stipule; **D.** Male inflorescences; **E & F.** Male flowers; **G & H.** Young female flower; **I.** Fruit; **J.** Cross-section of fruit. All photos from BRUN 24021. Photos **A** & **I** by Julia Sang; Photo **J** by Yabainus Johailin.

pinnate, concolorous, 3–4 veins on either side of the midrib, 1 pair at the base, deeply sunken above, slightly prominent beneath. Inflorescences protogynous, axillary on upper leaf axils, peduncle 3.5–11 mm long, single female flower basal, male rachis 12.5–24 mm long with short branches with clusters of flowers, branches *ca.* 6 mm long. Bracts similar to the stipule, *ca.* 7 × 2 cm, caducous. Bracteoles similar to bracts but smaller, *ca.* 5 × 2 caducous. Male flowers: pedicel pale red, 6–6 mm long, pubescent; tepals 2, whitish green, pale red towards the base, narrowly ovate, *ca.* 7 × 6 mm, glabrous, margin entire, apex acute; stamens *ca.* 29, cluster obovate, sessile; filaments pale yellow, *ca.* 0.6 mm long; anthers golden yellow, *ca.* 1.4 × 0.5 mm, apex emarginate. Female flowers (un-opened): pedicel light brown, *ca.* 9 mm long, glabrous; ovary pale green, *ca.* 12 × 7 mm, glabrous, wings 3, equal, *ca.* 2 mm wide, locules 3, placentas 2 per locule; tepals 5, greenish white, inner 3 tepals elliptic, *ca.* 11 × 5–6 mm long, glabrous, outer 2 tepals elliptic, *ca.* 8 × 6 mm, margin toothed on upper half, apex slightly acute; styles 3, pale yellow, distally Y-shaped, 3–4 mm long, divided to base; stigma pale yellow, forming a spiral papillose band at the apex. Capsule single on the basal part of infructescence, 3.5–4.3 × 2–3.5 cm, glabrous, locules 3, wings 3, equal, thinly fibrous, rounded proximally, trunciate distally, 7–9 mm wide, dehiscing between the locule and wing; pedicel pale green, pendent, 7–12 mm long, glabrous.

ETYMOLOGY. With narrow fruits.

ECOLOGY. Riversides or on the margins of mixed dipterocarp forest at 20–110 m altitude, on setap shale, also in secondary forest or in disturbed montane forest on steep slopes to 1480 m altitude.

DISTRIBUTION. Borneo, Brunei: Temburong and Tutong Districts. Also in Sarawak (Hughes, 2008).

SPECIMENS EXAMINED—BORNEO. BRUNEI: Temburong District: Amo — Batu Apoi FR, Kuala Belalong, Ulu Temburong NP, 23 February 1994, *Niga et al. BRUN* 15048 (BRUN!); Batu Apoi FR, Kuala Belalong, 13 July 1993, *Sands et al. MS* 5782 (holotype K!, isotypes BRUN!); Batu Apoi FR, Kuala Belalong, 22 June 1989, *Wong WKM* 1207A (BRUN!); Batu Apoi FR, Sungai Apan, 19 November 2014, *Joffre et al. BRUN* 24021 (BRUN!); Batu Apoi FR, Sungai Tulan, 17 July 1993, *Sands et al. MS* 5846 (BRUN!); Batu Apoi FR, Sungai Belalong, 30 September 1994, *Duling DWD* 24 (BRUN!); Batu Apoi FR, Sungai Belalong, along Sungai Sitam, 11 November 1991, *Hansen CH* 1546 (BRUN!); Batu Apoi FR, upper Sungai Belalong, 24 March 1991, *Sands et al. MS* 5582 (BRUN!); Batu Apoi FR, Ulu Belalong, LP382, 21 January 1994, *Kirkup DK* 889 (BRUN!); Batu Apoi FR, Sungai Temburong Machang, 17 August 1990, *Wong WKM* 1926 (BRUN!); Batu Apoi FR, Temburong river valley, near LP 286, 22 April 1992, *Johns et al. RJ* 7148 (BRUN!), 27 April 1992, *Johns et al. RJ* 7393 (BRUN!), 27 April 1992, *Johns et al. RJ* 7395 (BRUN!); Batu Apoi FR, Gunong Pagon, 1 April 1993, *Coode et al.* 7595 (BRUN!); Batu Apoi, Bukit Gelagas, 23 October 1991, *Simpson & Marsh DS* 2205 (BRUN!). Tutong District: Kiudang

— Kampong Kiudang-Mungkom, Wasai Bedanu, 17 April 2012, *Muhd. Ariffin et al.* BRUN 23197 (BRUN!); Lamunin, Layong-Gadong Pipeline track, 14 November 1990, *Kirkup et al.* DK 292 (BRUN!).

NOTES. It is a commonly collected species called *riang kura-kura* in Iban (*Kirkup* 292, *WKM* 1926). As one of the larger cane-like begonias, it is a striking bushy begonia with long inflorescences with many reddish flowers held above the leaves. It has the largest oblong fruits of any species in Brunei. The short petiole and scarcely developed basal lobe are characteristic of this species and immediately distinguish it from *B. leucochlora*. It is reported as being cooked with fish for its sourish flavour (*Kirkup* 292).

21. *Begonia temburongensis* Sands (1997: 432). Type: *Sands et al. MS 5399*, Brunei, Temburong District, Amo, Headwater of Sungai Temburong to the NE of Gunung Retak, 12 March 1991 (holotype K!; isotype BRUN!).

Sands (1997): *it differs from B. baramensis in being glabrous and with a caducous style. Stipules marcescent. Male flowers small, white, generally spreading from the rachis, when young clearly almost hidden by the bracts.*

Cane-like begonia to 1 m tall, rather woody at base, stem 9–10 mm thick; petioles 3.5–5(–10) cm, glabrous; lamina 7.5–11 × 5.5–9 cm, margin toothed; inflorescences from the upper leaf axils, much branched, many flowered, 11–24 cm, longer than leaves; male flowers with 4 white tepals, stamens 10–15 (*Sands* 5318); female flowers with 5 pale green tepals; capsule 10–12 × 11–14 mm.

ETYMOLOGY. Named for the type locality.

ECOLOGY. On steep slopes, in gullies, on earth banks above rivers in lowland mixed dipterocarp forest or lower montane forest from 30–800 m elevation on sandstone derived soil or on shale.

DISTRIBUTION. Endemic to Borneo, and so far known only from Temburong District in Brunei.

SPECIMENS EXAMINED—BORNEO. BRUNEI: Temburong District: Amo — Batu Apoi FR, headwater of Temburong River to the NE of Gunung Retak, 10 March 1991, *Sands et al. MS 5318* (BRUN!), 12 March 1991, *Sands et al. MS 5398* (BRUN!); Headwater of Sungai Temburong to the NE of Gunung Retak, 12 March 1991, *Sands et al. MS 5399* (holotype K!, isotype BRUN!); Batu Apoi FR, Temburong River valley, near LP 286, 23 April 1992, *Johns et al. RJ 7179* (BRUN!), 25 April 1992, *Johns et al. RJ 7305* (BRUN!), 27 April 1992, *Johns et al. RJ 7395* (BRUN!), 2 August 1992, *Johns et al. RJ 7424* (BRUN!);

Batu Apoi FR, Ulu Belalong, LP 382, 18 January 1994, Idris *et al.* BRUN 16659 (BRUN!), 23 January 1994, Dransfield J. *et al.* JD 7430 (BRUN!).

DISCUSSION

Twenty one species are currently known from Brunei of which only four have been reported from elsewhere: *B. baramensis* and *B. fuscisetosa* from Sabah, Sarawak and Kalimantan, and *B. cyanescens* and *B. stenogyna* from Sarawak (Hughes, 2008).

Compared with Sabah and Sarawak, Brunei is rather poor in begonia diversity, particularly of the cane-like begonias. In Brunei, the largest species are *B. baramensis* and *B. stenogyna* that reach 2 m or more in height and produce woody almost bamboo-like stems (they become hollow when dry). On the other hand, Brunei has a preponderance of small begonias with non-oblique leaves with short petioles, obovate laminas with an auriculate base and that are only slightly asymmetric. Some, such as *B. cyanescens* and *B. sibutensis*, have slender branched stems, while a larger group (the ‘*bruneiana* group’) has reclinate, short, unbranched, stout stems that arch and produce a flat spray of leaves. Because they are similar in habit, species in this latter group are difficult to distinguish unless flowers and fruits are available. It was perhaps for this reason that Sands (1997) chose to recognise four subspecies of *B. bruneiana*. In the field we paid particular attention to individuals of the subspecies of *B. bruneiana* in order to understand variation of pertinent characters. We conclude that there is no evidence to support their belonging to the same species and that it is better to have narrow well-defined species rather than one large variable species that obviously includes more than one taxon. Therefore the subspecies are here recognised at specific level. Molecular analysis of these erstwhile subspecies and allied species such as *B. eutricha*, *B. leucotricha* and *B. hexaptera* would be useful to settle their status but that is beyond the scope of this study.

Another reason for lower begonia diversity in Brunei is habitat. Limestone that is home to a rich begonia flora is not present in Brunei and begonias are also poor in *kerangas* and swamp forest (Julia & Kiew, 2014). It is also noticeable that begonias are not common on shale substrates. This is particularly striking on waterfalls, where for granite or sandstone waterfalls a begonia species or two are be expected, while those on shale are completely devoid of begonias. However, in suitable habitats, such as at the Kuala Belalong Field Studies Centre that is one of the best collected areas in Brunei, a rich diversity of 12 species has been recorded. One habitat that is likely to yield new begonia species is lower montane forest, which at present appears to be relatively undercollected.

From their habit, all species described here belong to section *Petermannia*, the predominant section in Borneo. However, it is notable that three species, *B. awongii*, *B. cyanescens* and *B. eutricha*, have male flowers with four tepals, while two is the typical number for section *Petermannia* (Doorenbos *et al.*, 1998). However, in Sabah the majority of the cane-like

begonias that grow on limestone also have four tepals (Kiew, 2001) indicating that for Bornean begonias this is not a diagnostic character for section *Petermannia*. The number of placentas per locule has been considered a fundamental distinction between, for example, section *Diploclinium/Baryandra* and section *Reichenheimia* both defined by having a single placenta compared with section *Petermannia* that has two placentas per locule (Doorenbos *et al.*, 1998; Rubitie *et al.*, 2013). In this study *B. cyanescens* and species in the ‘*bruneiana* group’ namely *B. bruneiana*, *B. eutricha*, *B. hexaptera* and *B. labiensis* all have a single placenta per locule although based on a combination of other characters they belong to section *Petermannia*. The taxonomic value of stamen number has not been investigated, and it is also not known whether it has any significance in pollination. However, the range is great from a low number in *B. bruneiana* (12) and *B. eutricha* (14) to 75 in *B. baramensis* (Merrill, 1928), 63 in *B. sibutensis* and 46 in *B. awongii*, whereas in the majority of species the ranges is from 20 to 30 stamens.

It is always a problem to know whether local distribution is real or is an artefact of lack of collecting in other areas. From the maps provided by Henrot *et al.* (2012), many begonia species have disjunct distributions so unless they are restricted to a specific habitat, this suggests that more intensive collecting will reveal that they are more widespread. For example, we found *B. hexaptera* distant from its previous only known locality. Others do seem more local, such as *B. awongii*, its large pale green leaves that grows along river banks are readily visible from a boat and would be likely to be collected where seen. At the moment it is only known from the Sungai Temburong and Sungai Belalong. On the other hand, as Henrot *et al.* (2012) pointed out, it is likely that some of the species currently endemic in Brunei will prove to be more widespread particularly in neighbouring Sarawak, which the area contiguous with Brunei is almost completely unknown begonia-wise.

Several native Brunei begonias deserve to be brought into cultivation. It is surprising that the purple-leaved form of *B. baramensis* is not grown for it is a tall handsome begonia with peltate leaves and in the purple form with many red male flowers and pink wings of the ovary contrasting with green locules. *Begonia papyraptera* is also an outstanding species with glossy, dark green leaves with large grey-green spots and deep red-purple undersides to the leaves and large rosy-pink flowers. At the other extreme is the sweet little *B. laccophora* with its small, rotund leaves, low creeping habit and relatively large pale pink or white flowers.

CONCLUSION

Without being able to identify and accurately name begonias species, it is not possible to have a foundation for further study using molecular techniques, or for the study of their phytogeography, ecology or conservation status. Without doubt there are new species to be discovered, which is another reason why those presently named need to be precisely described to make comparison with existing species possible.

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***Begonia* (Begoniaceae) in the Danum Valley Conservation Area,
Sabah, Borneo, including Eleven New Species**

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Summary. The Danum Valley Conservation Area (DVCA) lies in a tropical rainforest and harbours a diverse begonia flora. Based on a field survey, 15 species of *Begonia* are described and illustrated and a key for their identification is provided. Twelve are new species, *B. bernadusii* V.S. Guanih, *B. danumensis* F.Y. Chong, *B. dimorpha* S. Julia, *B. incompta* Kiew, *B. inopinata* V.S. Guanih, *B. inostegioides* F.Y. Chong, *B. prasinimarginata* S. Julia, *B. rotundibracteata* Kiew, *B. ruthiae* S. Julia, *B. taniana* V.S. Guanih, and *B. vespipropinqua* F.Y. Chong and one remains un-named due to lack of mature flowers and fruit. Two species, *B. bernadusii* and *B. vespipropinqua* belong to section *Baryandra*, the remainder to section *Petermannia*. All are endemic to Sabah and 12 are endemic to DVCA with only *B. gomantongensis* Kiew, *B. gueritziana* Gibbs and *B. postarii* Kiew recorded outside DVCA. The DVCA is a totally protected area having been gazetted as Class I Protection Forest. Therefore, the conservation status of 14 species is assessed as Least Concern and the one that is still incompletely known is assessed as Data Deficient.

The Danum Valley Conservation Area (DVCA) in SE Sabah, Malaysian Borneo, lies 65 km from Lahad Datu, the nearest town (Fig. 1). Under the jurisdiction of the Sabah Foundation, it covers 438 sq km of rainforest. It was first recommended as a permanent conservation area following the 1976 WWF-Malaysia Survey. It was gazetted in 1981 and in 1986 the Danum Valley Field Centre (DVFC) opened, subsequently in 1995, the area was declared as Class I Protection Forest (Hazebroek *et al.*, 2012).

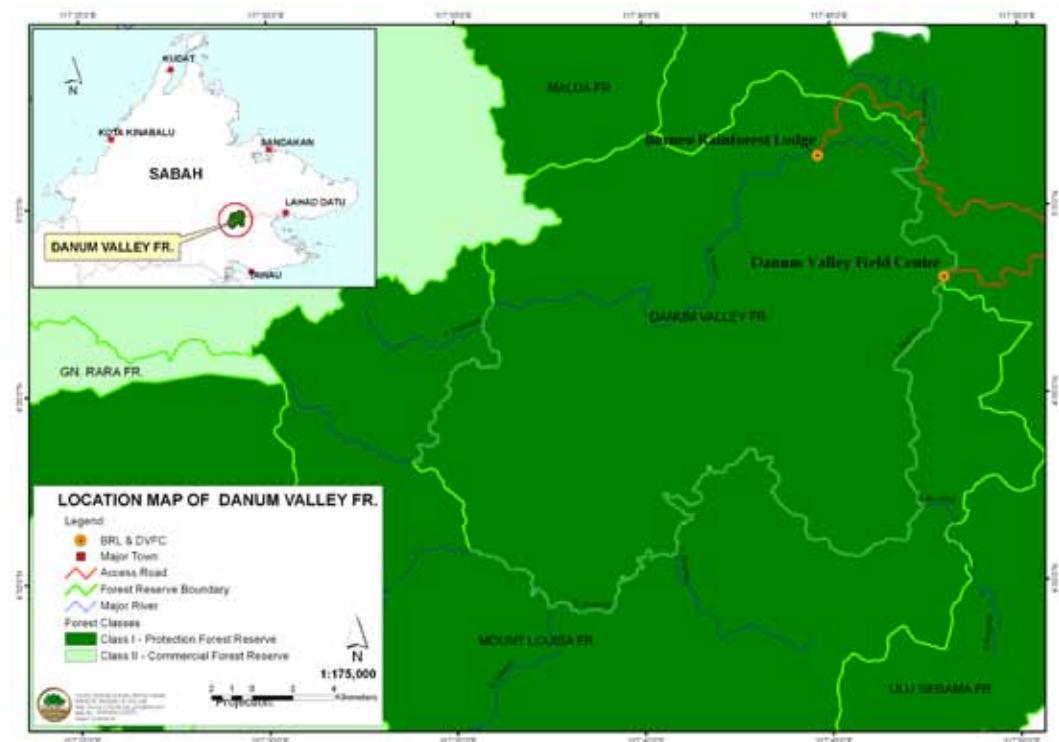


Fig. 1. Location map of Danum Valley Conservation Area.

The area has been well collected from the first 1976 survey, where the unpublished botanical report by Stone and Cockburn (Hazebroek *et al.*, 2012) reported the presence of at least three un-named species of begonia. Since then botanists from the Sandakan Herbarium (L. Madani, A. Berhaman, S. Diwol, J. Sugau, M. Postar, S. Suzana), the Royal Society (G. Argent, E. Campbell-Gasis, C.A. Ridsdale), the Royal Botanic Gardens, Kew (S. Andrews, R. de Kok) among others have all collected herbarium specimens.

The impetus to investigate the Danum begonias in detail came from the ‘Guide to Begonias of Borneo Project’ that showed that in Sabah, the number of begonias described from lowland

mixed dipterocarp forest was grossly under represented. At present, of the 43 species listed for Sabah in the Southeast Asian Begonia Database (Hughes & Pullan, 2007), 17 species have been described from limestone, 15 from the Kinabalu National Park and only 11 species for all other areas in Sabah. To fill this gap, DVCA was chosen because an initial herbarium search in the *Begonia* collection in the herbarium of the Sabah Forest Department (SAN) revealed it was biodiverse for *Begonia* compared with other areas. However, many of the specimens are incomplete (without male and female flowers and fruits) and field notes for the colour of leaves and flowers and details of habitat were often lacking.

Materials and Methods

Based on herbarium specimens, the trails where begonias had previously been collected were mapped and the itinerary planned to re-collect as many species as possible to make complete herbarium specimens (with spirit specimens for flowers) and a photographic record. The survey was carried out on 26–28 July 2014 and covered the following trails: Danum Valley Field Centre (DVFC) — East Trail, Nature Trail, Riverine Trail and West Trail; Borneo Rainforest Lodge (BRL) — Belian Trail, Coffin Trail, East Trail, Jacuzzi Trail, Serpent Trail, Sapa Bebandil Trail, Segama Trail and East Trail. This enabled us to assess the commonness or rarity of the species and details of their habitat. Conservation assessments follow standard IUCN procedures (IUCN, 2001).

Results

Fifteen species were collected of which three species belong to known species, *Begonia gomantongensis* Kiew (2001: 259), *B. gueritziana* Gibbs (1914: 82), and *B. postarii* Kiew (1998: 164). Of the remaining 12 species, 11 are new species described below with the remaining one incompletely known because plants with flowers and fruits could not be found.

KEY TO SPECIES IN THE DANUM VALLEY CONSERVATION AREA (DVCA)

1. Rhizomatous begonia 2
Erect or cane begonia 4
2. Rhizome less than 1 cm thick *B. gueritziana*
Rhizome at least 1 cm thick 3
3. Lamina glabrous, margin crenate *B. bernardusii*
Undersurface of lamina and petiole hairy, margin scalloped between veins and minutely dentate *B. vespipropinqua*
4. Leaves not oblique (petiole in line with the midrib) 5
Leaves oblique (midrib at an angle to the petiole) 8

5. Upper leaf surface with hairs 6
 Upper leaf surface glabrous 7
6. Lamina with a row of bristly hairs between the veins on the upper surface
 *B. danumensis*
 Lamina hairy on both surfaces *Begonia* sp. 1 (incompletely known)
7. Internodes to 4 cm long. Bracteoles rotund, foliose, $6\text{--}9 \times 4\text{--}9$ mm *B. rotundibracteata*
 Internodes 4–8 cm long. Bracteoles lanceolate, c. 6×2 mm *B. incompta*
8. Lamina hairy above 9
 Lamina glabrous above 10
9. Low begonia, less than 10 cm tall. Leaves strongly bullate, hairs on upper surface raised
 on a conical base *B. ruthiae*
 Stem at least 20 cm tall at flowering. Leaves not bullate, hairs without a conical base
 *B. postarii*
10. Low begonia, erect apex to 8 cm tall. Petiole 0.8–1.4 cm, lamina with a silvery pale green
 border 6–9 mm wide (visible on dried specimens as a paler border)
 10. *B. prasinimarginata*
 Erect begonias, stem 20 cm or taller. Petiole more than 2 cm long, lamina plain green
 11
11. Petioles 6.5–18 cm long. Surface of the ovary and fruit locules distinctly verruculose
 (pimply) 4. *B. gomantongensis*
 Petioles 1.7–8.5 cm long. Surface of the ovary and fruit locule surface smooth 12
12. Petiole densely hispid. Inflorescences 10–16 cm long. Male flowers with 4 elliptic tepals
 $4\text{--}5 \times 2\text{--}3$ mm 7. *B. inopinata*
 Petiole glabrous. Inflorescences to 4 cm long. Male flowers with 2 rotund tepals $3.5\text{--}5 \times$
 3–5 mm 13
13. Stem to 21 cm tall. Inflorescences c. 0.7 cm long 13. *B. taniana*
 Stem 25–117 cm tall. Inflorescences 3.8–2.5 cm long 14
14. Stipules c. 7×1 mm. Fruit oblong, 2×0.9 cm, pedicel stiff, c. 5 mm long
 8. *B. inostegioides*
 Stipules $16\text{--}21 \times 5\text{--}10$ mm. Fruit broadly triangular in outline, $1.7\text{--}1.9 \times 2.9\text{--}3$ cm,
 dangling on a thread-like pedicel, 20–33 mm long 3. *B. dimorpha*

1. *Begonia bernadusii* V.S. Guanh sp. nov. (Section *Baryandra*)

Among the rhizomatous begonia species in Borneo, *Begonia bernadusii* most resembles *B. gueritziana* in size and habit, but it is different in its larger leaves with petioles 14.5–24.5 cm long and lamina 8.5–12 × 12.7–15.5 cm (vs. with petioles 6–13 cm long and lamina 5–8 × 5.5–7 cm as in *B. gueritziana*), basal lobe 2–3 cm long (vs. 0.3–1.8 cm long) and wider outer tepals in the male flowers 12–14 mm (vs. 5–8 mm). Type: Chong et al. SAN 156808, Borneo, Sabah, Lahad Datu, Danum Valley Conservation Area, Garden next to the canteen of the Field Station, 26 July 2014 (holotype SAN!; isotype KEP!). (**Fig. 2**)

Rosette, rhizomatous begonia. Rhizome 12–15 mm diameter, succulent, pale greenish brown, glabrous, unbranched, internodes c. 1.8 cm long. Stipules light green, glabrous, lanceolate, c. 15 × 3–8 mm, margin entire, apex acute, persistent. Leaves alternate, oblique, distant; petiole pinkish green, glabrous, 14.5–24.5 cm long, terete, succulent; lamina pale plain yellowish green, glabrous, fleshy in life, matt, broadly ovate, asymmetric, 8.5–12 × 12.7–15.5 cm, broad side 7–10.2 cm wide, basal lobe rounded, 2–3 cm long, margin crenate, apex acute; venation palmate with 3 pairs at base branched three times and with 5 veins in the basal lobe, veins concolourous, impressed above, slightly prominent beneath. Inflorescences protandrous, axillary, cymose, greenish red, glabrous, erect, longer than petioles, 15–26 cm long, peduncle 13.5–23 cm long, branches 2, c. 3 cm long with 3 male flowers and 1 female flower. Bracts caducous; bracteoles pale green, boat-shaped, 4–7 mm long, glabrous, margin entire, persistent. Male flowers: pedicel c. 5 mm long; tepals 4, outer 2 tepals pale pink, glabrous, rounded, 10–12 × 12–14 mm, margin entire; inner 2 tepals white, narrowly obovate, glabrous, c. 8 × 3.5–4 mm, margin entire, apex rounded; stamens c. 30, cluster globose, shortly stalked; filaments yellow, 1–1.2 mm long; anthers golden yellow, obovate, 1–1.2 × 0.8 mm, apex rotund. Female flower (immature): pedicel c. 6 mm long, pale green, glabrous; ovary pale green, wings 4, 3 wings equal and 1 wing larger, locules (not seen); tepals (not seen); styles 3, pale yellow, c. 2 mm long, divided to base; stigma pale yellow, papillose forming a continuous twisted band. Fruits not seen.

ETYMOLOGY. Named after Bernadus Bala Ola, principal botanist and naturalist, SEA Rainforest Research Programme, DVFC, in recognition of his keen interest in begonias and his knowledge of DVCA having worked at DVFC for almost 30 years.

ECOLOGY. Planted in soil sheltered under an overhanging rock.

DISTRIBUTION. Borneo. Endemic to Sabah (Danum Valley Conservation Area, Lahad Datu). From a plant originally collected by Bernadus Bala Ola from DVCA and presently cultivated in the small garden at the Field Centre.

SPECIMEN EXAMINED—BORNEO. SABAH: Lahad Datu District: Danum Valley Conservation Area, Garden next to the canteen of the Field Station, Chong et al. SAN 156808 (holotype SAN!; isotype KEP!).

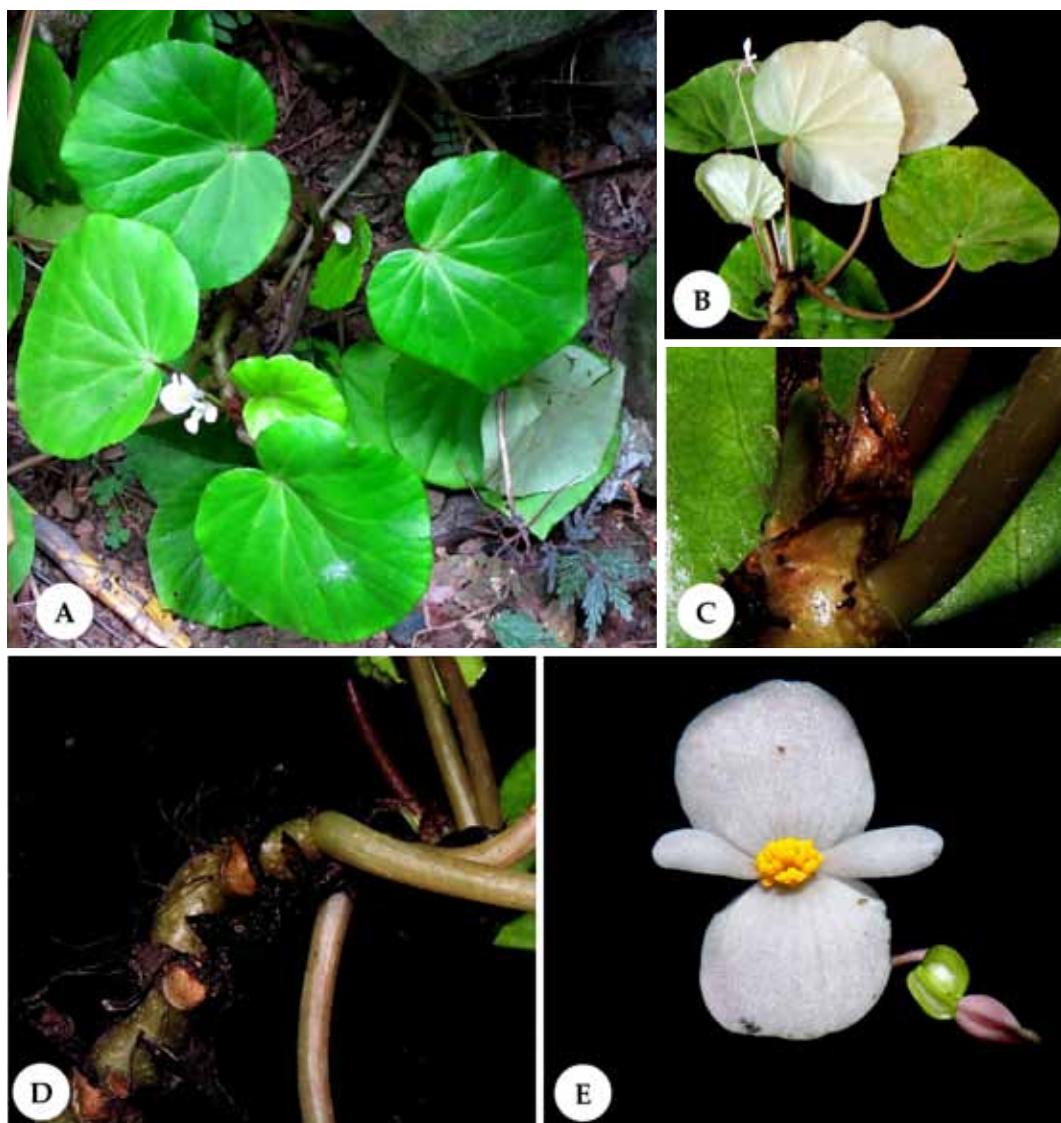


Fig. 2. *Begonia bernardusii*. A & B. Habit; C. Stipule; D. Rhizomatous stem; E. Opened male flower and unopened female flower. All photos from SAN 156808 by Julia Sang.

NOTES. The original locality and habitat are not recorded, nor are there specimens in SAN. Only one plant was in flower. This showed that the inflorescence is protandrous and has boat-shaped bracts that place it in section *Baryandra*. However, the female flower was immature, so characters of the tepals and interior of the ovary could not be seen. The fourth ‘wing’ on the ovary is a thick rib rather than a thin fibrous wing. It remains to be seen whether this is an abnormality when the plant next flowers.

2. *Begonia danumensis* F.Y. Chong sp. nov. (Section *Petermannia*)

In its habit, non-oblique leaves and hairs on the upper leaf surface, it is most similar to *Begonia fuscisetosa* Sands (1997: 433), but it is different from this species in its obovate leaves, less than three times longer than wide (vs. elliptic leaves, more than three times longer than wide as in *B. fuscisetosa*), many flowered inflorescences (vs. few flowered ones) and fruit stalks shorter than the capsule (vs. longer than the capsule). Type: *Chong et al.* SAN 156802, Borneo, Sabah, Lahad Datu, Danum Valley Conservation Area, Nature Trail, 26 July 2014 (holotype SAN!; isotypes KEP!, K!, SAR!, SING!, SNP!). (**Fig. 3**)

Robust begonia to 1 m tall, becoming bushy with a few erect branches from the base, individual stems unbranched or sometimes two-branched with short lateral branches. Stems greenish brown, woody, c. 7 mm diameter, pubescent, hairs white, internodes 3.5–5.5 cm long, swollen at the nodes. Stipules dark red, pubescent, lanceolate, 12–14 × 4–6 mm, margin entire, apex setose, seta c. 1 mm long, caducous. Leaves alternate and distant or with an extremely short internode and appearing opposite, not oblique, held more or less horizontally; petiole green, pubescent, 1–1.7 cm long, flat above; lamina plain rice green, with a row of short dark red bristles with a white tip between the veins, thin in life, matt, obovate, slightly asymmetric, 13–17.5 × 5–7 cm, broad side 2.7–4 cm wide, basal lobe rounded, 0.4–1.2 cm long, margin minutely toothed, apex attenuate to acuminate, acumen to 1.5 cm long; venation pinnate with 7 veins on either side of the midrib, twice branched, 2 veins in the basal lobe, concolorous, strongly impressed above and prominent beneath, midrib pubescent above. Inflorescences protogynous, axillary, racemose, reddish green, pubescent, erect, longer than petioles, 4.5–5.5 cm long with peduncle c. 3.5 cm long, with 2 female flowers at the base and many male flowers above. Bracts maroon, lanceolate, 4.5–9 × ca. 4 mm, pubescent, margin entire, caducous. Bracteoles light brown, triangular, 1–4 × 1–3 mm, margin entire, caducous. Male flower: pedicel pale red, c. 4 mm long; tepals 2, outside deep pink with dark red hairs, inside white pink towards the base, broadly oval, c. 5 × 4 mm, margin entire, apex rounded; stamens 25–28, cluster conical, shortly stalked; filament pale yellow; anthers pale yellow, obovate, c. 1 × 0.5 mm, apex emarginate. Female flower: pedicel c. 6 mm long, pale green, white or red, hairy; ovary pale green, narrowly triangle, c. 1.5 × 1.2 cm, wings 3, more or less equal, locules 3, placentas bilamellate with many ovules on both surfaces; tepals 5, pale green, equal, c. 7 × 5 mm, margin denticulate, with a single pair of teeth in the upper half of the apex; styles 3, pale yellowish green, c. 2.5 mm long, divided to base; stigma pale yellow, papillose forming a continuous twisted band. Capsules (1.6–)1.8(–2.3) × 1.4–1.7(–1.9) cm, locules 3, wings 3, equal, rounded proximally, distally truncate with a pointed tip, c. 6 mm wide, thinly fibrous, dehiscing between the locule and the wing, pendent, pedicel stiff, 4–8 mm long. Seeds ellipsoid, c. 0.4 × 0.2 mm, columnar cells more than half of seed length.

ETYMOLOGY. It is named for the locality because it is one of the most common species in DVCA.



Fig. 3. *Begonia danumensis*. **A.** Habit; **B.** Male inflorescence; **C.** Female flower; **D.** Fruits and unopened male flowers. All photos from SAN 156802 by Julia Sang.

ECOLOGY. This is the most common begonia species in DVCA and was found along all trails visited in lowland mixed dipterocarp forest on slight slopes in deep shade or on the side of gullies to 150 m elevation. From the few herbarium collections, it appears to have been overlooked by collectors. It often grows together with *B. rotundibracteata* Kiew that is similar in habit.

DISTRIBUTION. Borneo. Endemic to Sabah (Danum Valley Conservation Area, Lahad Datu).

SPECIMENS EXAMINED—BORNEO. SABAH: Lahad Datu District: Danum Valley Field Centre Nature — South Side, *Argent et al.* 141987 (SAN), Nature Trail, *Chong, F.Y. et al.* SAN 156802 (holotype SAN!; isotypes KEP!, K!, SAR!, SING!, SNP!); Main Trail East, *Gregson & Bala Ola* 85 (SAN); Ulu Segama, *Diwol* SAN 109680 (SAN), Ulu Sg. Segama, *Argent et al.* 107700 (SAN).

3. *Begonia dimorpha* S. Julia sp. nov. (Section *Petermannia*)

It is similar to *Begonia malachosticta* Sands (1990: 64) in being a cane-like begonia with large, pendent, spotted leaves and female flowers located in the lower leaf axils with the male inflorescences terminal. However, *B. dimorpha* is different in having white or pink spots in the young leaves, disappearing in the adult leaves that are plain green and the flowers are not produced on the main stem but on horizontal lateral branches. Type: *Chong et al.* SAN 157257, Borneo, Sabah, Lahad Datu, Danum Valley, Borneo Rainforest Lodge, Coffin Trail, 27 July 2014 (holotype SAN!; isotypes KEP!, SAR!, SING!, SNP!). (**Fig. 4**)

Cane-like glabrous begonia, erect, to 117 cm tall, main stem unbranched with lateral horizontal branches towards the apex. Stems reddish, becoming brown and woody, c. 5 mm diameter, internodes 5.1–9.2 cm long, thicker at the nodes. Stipules pale green, lanceolate, 16–21 × 5–10 mm, midrib keeled outside, margin entire, apex setose, seta to 8 mm long, caducous. Leaves alternate, distant, oblique, hanging downwards; petiole reddish, terete, on main stem 4.4–6.1 cm long, on lateral branches 0.9–1.9 cm long; lamina of young plants with rows of white or pink spots between the veins and with a white or pink line around the margin; leaves of mature plants plain dark green with a red blotch at the junction of the lamina and petiole, in juvenile and mature leaves completely deep magenta or tinged magenta beneath, matt, slightly fleshy in life, ovate, asymmetric; lamina on the main stem 10.3–16.3 × 6.2–8 cm, broad side 4.1–5.1 cm wide, basal lobe rounded, 3.7–5.6 cm long, margin remotely and minutely toothed, apex attenuate, lamina of lateral branches smaller, c. 8.7 × 4.4 cm, broad side c. 2.6 cm wide, basal lobe c. 2.3 cm long; venation palmate-pinnate, with a pair of veins at the base of the midrib, 2–3 veins on either side of the midrib, branched once or twice, 4 veins in the basal lobe, slightly impressed above, beneath paler and slightly prominent. Inflorescences protogynous; female flowers axillary, 1–3, each single from lower leaf axils; male inflorescences terminal, cymose, few-flowered, c. 3.8 cm long, peduncle thin, c. 3.4 cm long, pale green or magenta. Bracts pale green, narrowly lanceolate, c. 11 × 4 mm, margin entire, apex setose, seta c. 0.3 cm long, persistent. Bracteoles minute. Male flower (bud) cherry red or white outside, pedicel cherry red or white, c. 4 mm long; tepals 2, oval, c. 4 × 4 mm, margin entire, apex broadly acute; stamens 56–60, cluster subglobose, sessile; filaments pale yellow, 0.7–1 mm long; anthers pale yellow, obovate or oblong, 0.5–0.6 × c. 0.3 mm, apex emarginate. Female flower: pedicel c. 4 mm long, pale green; ovary

green tinged pink, c. 3×2.5 cm, wings 3, subequal, locules 3, placentas bilamellate with many ovules on both surfaces; tepals 5, all white, elliptic, 4 larger c. 11×7 mm, the fifth narrower c. 11×5 mm, margin entire, apex broadly acute; styles 3, brownish yellow, c. 3.5 mm long, divided to base; stigma white, papillose forming a continuous twisted band. Capsules broadly triangular in outline, $1.7\text{--}3.0 \times 1.9\text{--}2.9$ cm, wings subequal, narrowed proximally, truncate distally, tip acute, 0.8–1.0 cm wide, thinly fibrous, dehiscing between locules and wings, dangling on fine thread-like pedicel, 2.1–3.3 cm long.

ETYMOLOGY. *Dimorpha* (two forms), so named because of the great difference in appearance between the juvenile plants with an erect, unbranched stem with large, spotted leaves and fertile plants with horizontal lateral branches with smaller, plain green leaves.

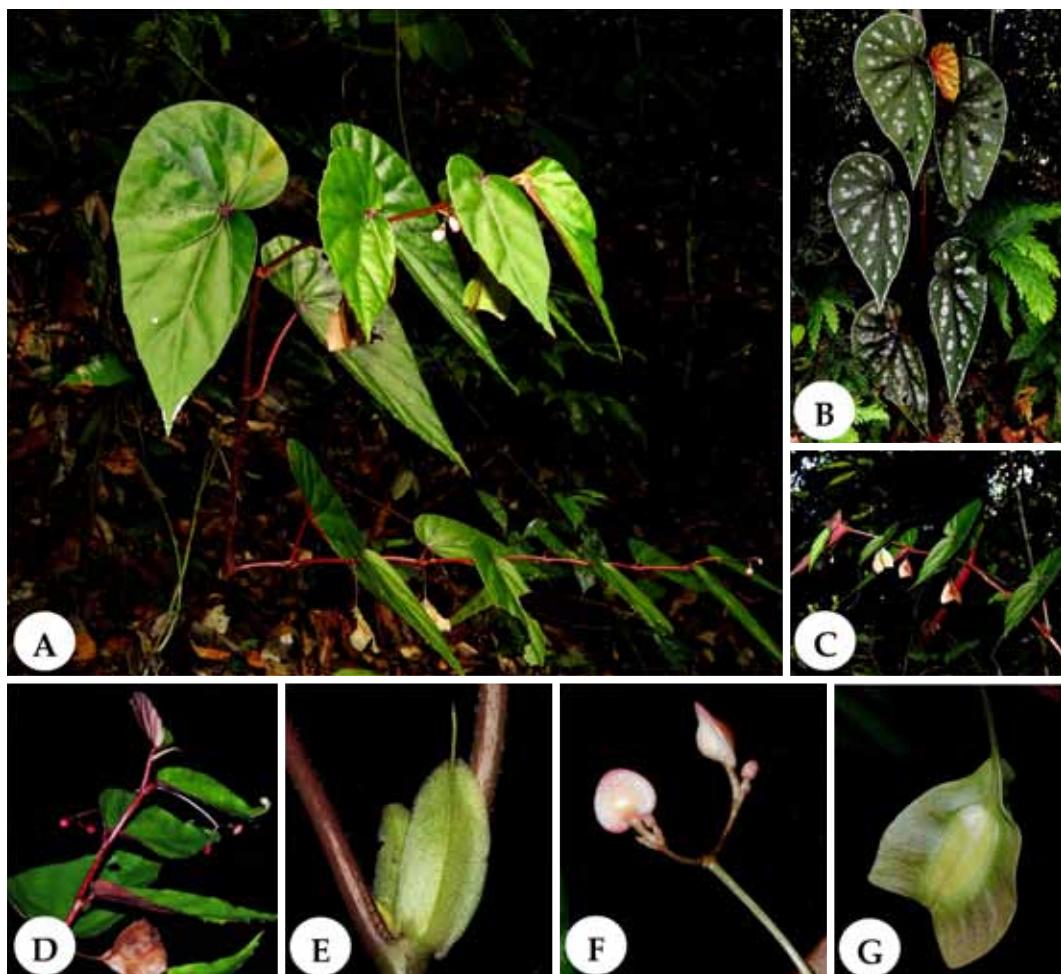


Fig. 4. *Begonia dimorpha*. **A.** Habit of flowering plant; **B.** Juvenile plant with white spotted leaves; **C.** Fruiting lateral twig; **D.** Flowering lateral twig; **E.** Stipule; **F.** Unopened male flowers; **G.** Fruit. All photos from SAN 157257 by Julia Sang.

ECOLOGY. Occasional in alluvial forest, but only found fertile on very steep, lightly shaded slopes at 310 m elevation.

DISTRIBUTION. Borneo. Endemic to Sabah (Danum Valley Conservation Area, Lahad Datu).

SPECIMEN EXAMINED—BORNEO. SABAH: Lahad Datu District: Danum Valley, Borneo Rainforest Lodge, Coffin Trail, *Chong et al. SAN 157257* (holotype SAN!; isotypes KEP!, SAR!, SING!, SNP!).

NOTES. A striking species when young because of its bright white or pink spotted leaves. Unfortunately, this variegation is lost in mature plants, or it would be an attractive ornamental plant.

4. *Begonia gomantongensis* Kiew (1998: 164) (Section *Petermannia*). Type: *James Awing SAN 47257*, Borneo, Sabah, Kinabatangan, Gomantong, Bukit Dulong Lambu, 11 October 1964 (holotype SAN!).

Cane-like begonia, erect, to 60 cm tall. Stems sparsely branched, young stem minutely bristly, becoming brown and woody, c. 4–5 mm diameter. Stipules green, narrowly lanceolate, c. 20 × 5 mm, apex acute, caducous. Leaves alternate, distant, oblique, held horizontally; petiole deep purplish, minutely bristly, (6.5–)11(–18) cm long; lamina glossy, plain mid-green to dark green above, pale green beneath, glabrous, obliquely subrotund, asymmetric, 10–16(–30) × (10–)13.5(–23) cm, base cordate, basal lobe rounded, 3.5–8 cm long, margin minutely serrulate, apex shortly acuminate, acumen to 0.5 cm long; venation palmate-pinnate, with a pair of veins at the base of the midrib, 3 veins on either side of the midrib, branching three times before reaching the margin, 2–4 veins in the basal lobe, slightly impressed above, conspicuously prominent beneath. Inflorescences protogynous with 1–2 female flowers from the leaf axil and many male flowers on an erect rachis 2.5–6.5 cm long with short cymose branches c. 0.5 cm long. Bracts foliaceous, broadly ovate to semi-circular, c. 25 × 17 mm. Bracteoles similar but diminishing in size towards the apex, margin undulate, upper bracteoles enveloping clusters of male flowers and overlapping with the bracteole above. Male flower: pedicel slender, 3–3.5 mm long; tepals 2, white, rotund, 3.5–4 × 3–3.5 mm; stamens (45–)51(–53), cluster obovoid, stalk c. 0.75 mm long; filaments c. 0.5 mm long; anthers yellow, ovoid, c. 1 × 0.5 mm, apex emarginate. Female flower: pedicel pale yellow-green, 10–12 mm long; ovary oblong tapered into pedicel, green tinged pink, c. 16 × 11 mm, surface of the locules conspicuously verruculose, wings 3, pale yellowish green, subequal, c. 4 mm wide, locules 3, placentas bilamellate with many ovules on both surfaces; tepals 5, white, elliptic, four outer ones larger c. 11 × 7 mm, the innermost narrower c. 7 × 4 mm, margin entire, apex acute; styles 3, c. 3–4 mm long, divided to base, bifurcating; stigma papillose forming a continuous twisted band. Capsules oblong, 1.7–2(–2.7) × 1.3–1.8 cm, wings 3, equal, broadly rounded proximally, truncate or rounded distally, 4–5 mm wide, stiffly papery, outer surface of locule completely verruculose, dehiscing between the locules

and wings, dangling on fine thread-like pedicel, 2.1–3.3 cm long. Seeds broadly ovoid, c. 0.3 × 0.2 mm, columnar cell more than half the seed length.

ETYMOLOGY. Named for the locality from where it was originally collected, Bukit Gomantong being the more familiar name for Bukit Dulong Lambu.

ECOLOGY. In DVCA, it is a relatively common species growing on clay soil in lowland mixed dipterocarp forest between 200–500 m elevation. At the type site, it grows at the foot of limestone cliff faces or on limestone boulders in deep shade.

DISTRIBUTION. Borneo. Endemic to Sabah.

SPECIMENS EXAMINED—BORNEO. SABAH: Lahad Datu District: Borneo Rainforest Lodge, Coffin Cliff Trail, *Gregson et al.* 122 (SAN), *Gregson et al.* 123 (SAN); Gusher Waterfall, *Campbell EG* 241 (SAN), trail to Fairy Waterfall, *Chong et al.* SAN 157258 (E, K, KEP, KNP, SAN, SAR, SING); Segama River, *Andrews* 751 (SAN), Sg. Danum Segama, *Cockburn SAN* 85047 (KEP, SAN); Danum Valley Field Station Centre — South side, *Argent et al.* 211987 (SAN), Nature Trail, *Chong et al.* SAN 156803 (KEP, SAN, SAR, SING); Sandakan District: Gomantong FR, *Lim SP* 785 (SAN); Bukit Dulong Lambu, *James Awing SAN* 47257 (holotype SAN!).

NOTES. This species is distinct in its oblong capsules and the distinctly pimply surface of the locules.

5. *Begonia gueritziana* Gibbs (1914: 82). Section *Baryandra*. Type: *Gibbs* 2892, Borneo, Sabah, Tenom District, Kayoh Hills, January 1910 (holotype BM).

Rhizomatous begonia. Rhizomes brownish red, densely pubescent, 4–5 mm diameter, internodes 2–4 mm long. Stipules pubescent, narrowly lanceolate, 6–8 × 2–4 mm, margin entire, apex setose, seta 1–1.5 mm, persistent. Leaves alternate, crowded, oblique; petiole erect, densely pubescent to hispid, (3.5–)10(–14) cm long, terete; lamina plain dark green above, often reddish purple beneath, glossy and slightly fleshy in life, broadly ovate, asymmetric, (3.5–)7(–9.5) × (4–)6(–7.5) cm, broad side 2–5 cm wide, base cordate, basal lobes rounded, 0.3–1.8 cm long, margin entire, slightly undulate, ciliate, apex acute to acuminate; venation palmate, veins 5–6(–7), concolorous, pubescent beneath, plane above and prominent beneath. Inflorescences protandrous, axillary, erect and longer than petioles, cymose, (9–)20(–38) cm long, peduncle slender (8–)16(–30.5) cm with few branches 3(–8) cm long at the apex. Bracts pink, lanceolate, c. 7 × 2 mm, margin entire, caducous. Bracteoles lanceolate, c. 3 × 1.5 mm, caducous. Male flowers: pedicel 4(–11) mm long; tepals 4, pink, sometimes white, margin entire, apex rounded, outer two broadly elliptic, 9–12 × 5–8 mm, inner two narrowly elliptic to narrowly obovate, c. 11 × 3 mm; stamens c. 25, cluster shortly stalked, c. 1 mm long; anthers pale yellow. Female flower: pedicel red, 6–9 mm long; ovary pale green, glabrous, 5–9 × 4–11 mm, locules 2, placentas bilamellate, wings 3, unequal,

larger wing c. 4–7 mm wide, narrower two c. 2 mm wide; tepals 4, rosy pink, sometimes white, outer two almost rotund, 5–9 × 5–8 mm, inner two elliptic, 4–8 × 4–5 mm; styles and stigma yellow, styles 2.5–3 mm long, bifurcating, stigma a twisted continuous papillose band. Capsules (7–)11(–15) × (9–)14(–17) mm, glabrous, wings 3, very unequal, one wing greatly enlarged, slightly concave, c. (5–)10(–14) mm wide, broadly rounded, smaller two wings (2–)3(–7) mm wide, thinly fibrous, dehiscing between locule and wing, pendent, pedicel stiff, 10–17 mm long.

ETYMOLOGY. Named in honour of Edward Peregrine Gueritz, Governor of British North Borneo (1904–1911), who facilitated L.S. Gibb's expeditions.

ECOLOGY. It grows in soil-filled crevices and ledges in rock. In DVCA it has only been collected from Coffin Cliff that is composed of East Sabah Mélange rock type (Hazebroek *et al.*, 2012). Elsewhere it grows on limestone, basalt, gabbro or sandstone (Kiew, 2001). It most commonly grows in the lowlands but on Gunung Kinabalu it has been collected at 750 m elevation.

DISTRIBUTION. Borneo. Endemic but widespread in Sabah. In DVCA, it was only collected from rocks at the Coffin Cave.

CONSERVATION STATUS. Least Concern.

SPECIMENS EXAMINED—BORNEO. SABAH: Beluran District: Labuk Sugut, *Meijer SAN 51623* (SAN), Labuk Sugut, Kiabau, *Meijer SAN 43816* (SAN), Labuk Sugut, Lubok Buaya, *Meijer SAN 23103* (SAN); Keningau District — Ulu Sungai Punteh, *Fidilis SAN 125408* (SAN), Ulu Sungai Mentuluk, *Fidilis SAN 113288* (SAN); Kinabatangan District: Lamag, *Diwol Harun SAN 89912* (SAN), *Majawat et al. SAN 88005* (SAN), *Sing & Eging SAN 51826* (SAN), Sukau, *Lim et al. LSP 1151* (SAN), Batu Puteh, *Lim et al. LSP 625* (SAN), Dermakot FR, *Aban & Suin SAN 66302* (SAN), Keruak, *Gambating & Martin, SAN 108092* (SAN), Batu Puteh, *Sands & Wong Sands 6022* (SAN), *Lim et al. LSP 771* (SAN), Sukau, *Reza et al. RA 313* (SAN), *Kiew & Lim RK 4183* (SAN), *Kiew & Lim RK 4192* (SAN), *Kiew & Lim RK 4291* (SAN); Kota Marudu District: Marak Parak, *Mansus & Pius SAN 118933* (SAN); Lahad Datu District: Ulu Segama, *Talip SAN 70979* (SAN), Borneo Rainforest Lodge, Coffin Cliff Trail, *Gregson et al. 117* (SAN), *Chong et al. SAN 157256* (E, KEP, KNP, SAN, SAR, SING); Ranau District: Unspecified locality, *Gambating SAN 118248* (SAN), *Sadau SAN 53857* (SAN), Kampung Miruru, *Aban SAN 90246* (SAN), Kampung Paus, *Gambating SAN 94680* (SAN), Sungai Naputan, *Aban SAN 94570* (SAN), Poring, *Sinit SAN 2551* (SAN), Mt. Kinabalu, *Chew et al. CWL 1187* (SAN), Tenompok, *Sario SAN 27660* (SAN); Sandakan District: Gomantong FR, *Lim et al. LSP 616* (SAN); Tambunan District: Kampung Mansurolong, *Nordin SAN 85913* (SAN); Tawau District: Ulu Balong, *Meijer SAN 28678* (SAN); Tenom District: Unspecified locality, *Maikin SAN 113655* (SAN), Ulu Sungai Kalang, *Berhaman SAN 133057* (SAN), Ulu Kalang, *Kiew & Lim RK 4280* (SAN), Kayoh Hills, *Gibbs 2892* (holotype BM).

NOTES. Very characteristic of this species is the capsule with the larger wing expanded into a concave sail-like structure.

6. *Begonia incompta* Kiew sp. nov. (Section *Petermannia*)

In habit and leaf size and shape, *Begonia incompta* is similar to *B. rotundibracteata*, but it is different in its longer internodes 4–8 cm long (vs. 2.5–4 cm as in *B. rotundibracteata*), its small lanceolate bracteoles c. 6 × 2 mm (vs. 6–9 × 4–9 mm), its male flowers with shorter pedicels 1–6 mm long (vs. 12 mm) and smaller tepals 4–5 × 4 mm (vs. c. 8 × 8 mm). Type: *Chong et al. SAN 157261*, Borneo, Sabah, Lahad Datu, Danum Valley, Borneo Rainforest Lodge, Fairy Waterfall Trail, 27 July 2014 (holotype SAN!; isotypes KEP!, SAR!, SING!). (Fig. 5)

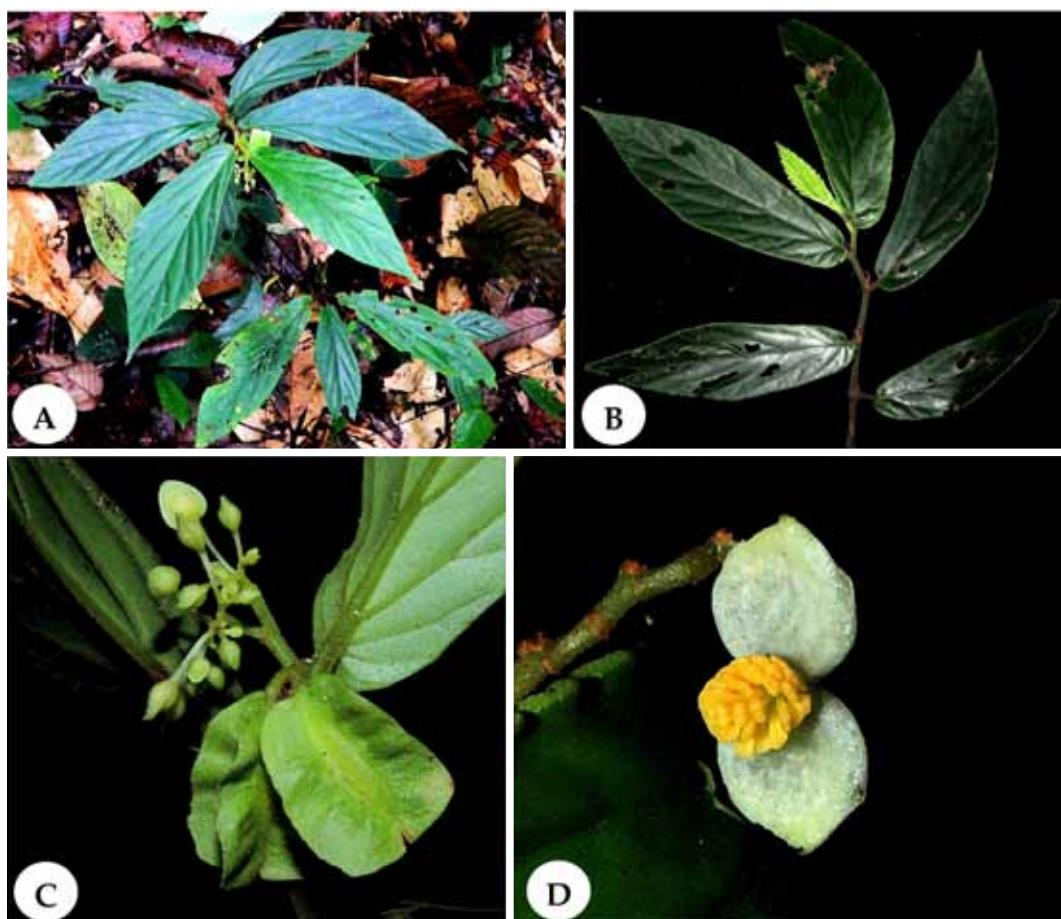


Fig. 5. *Begonia incompta*. **A.** Habit; **B.** Leafy twig; **C.** Male inflorescence and fruits; **D.** Opened male flower. Photo A from SAN 157261 by Martin Tuyok; Photos B–D from SAN 157261 by Julia Sang.

Erect begonia to 87 cm tall. Stems dull green, brownish pubescent, c. 6 mm diameter, internodes 4–8 cm long, nodes strongly swollen. Stipules pale green, pubescent, lanceolate, 8–16 × 2.5–4 mm, margin entire, apex sharply acute, caducous. Leaves alternate and distant or sometimes appearing opposite, not oblique, held horizontally; petiole dull green, pubescent, (0.8–)2(–3) cm long, terete; lamina plain dark green above, paler beneath, slightly fleshy in life, matt, glabrous on both sides, elliptic, asymmetric, (12.5–)17(–22) × (5–)6(–7.5) cm, broad side 3.2–4.2 cm wide, base unequal, lobes sometimes overlapping, basal lobe (0.5–)0.8(–1.2) cm long, margin minutely toothed, apex acute to acuminate, acumen to 1.5 cm long; venation pinnate, 5–7 veins on each side of midrib, once or twice branched, 1–2 veins in basal lobe, midrib and veins concolorous, veins impressed above, prominent and pubescent beneath. Inflorescences protogynous, axillary, sessile, racemose with cymose branches, rachis dull green, pubescent, erect, (1.2–)3(–5.5) cm long, with one or two female flowers and many male flowers. Bracts lanceolate, c. 7 × 2 mm, margin entire, caducous. Bracteoles lanceolate, c. 6 × 2 mm, margin entire, caducous. Male flowers (young): pedicel greenish white, 1–3(–6) mm long; tepals 2, greenish white, minutely pubescent outside, oval, 4–5 × c. 4 mm, margin entire, apex rounded; stamens c. 33, cluster conical, shortly stalked; filaments pale green, c. 1 mm long; anthers pale green, oblanceolate, 1–1.3 × c. 0.5 mm, apex bluntly acute. Female flower not available. Capsules single or in pairs, (1.6–)1.9(–2.4) × (1.4–)1.7(–1.8) cm, glabrous, wings 3, equal, wing rounded proximately, pointed distally, 6–7 mm wide, thinly fibrous, dehiscing between locules and wing, pendent, pedicel stiff, (4–)6–9 mm long.

ETYMOLOGY. *Incomptus* (unadorned), referring to the very plain appearance of this species.

ECOLOGY. In lowland mixed dipterocarp forest on steep slopes above streams or by paths in light shade at c. 180 m elevation.

DISTRIBUTION. Borneo. Endemic to Sabah (Danum Valley Conservation Area, Lahad Datu).

SPECIMENS EXAMINED—BORNEO. SABAH: Lahad Datu District: Danum Valley, Borneo Rainforest Lodge, Fairy Waterfall trail, *Chong et al.* SAN 157261 (holotype SAN!; isotypes KEP!, SAR!, SING!); Danum Valley Field Centre, East trail, *Madani* SAN 112914 (SAN), Trail to Water Pool, *de Kok* 1038 (KEP, SAN), Main trail East, *Gregson* 46 (KEP, SAN).

7. *Begonia inopinata* V.S. Guanh sp. nov. (Section *Petermannia*)

Similar to *Begonia postarii* in inflorescence structure, its conspicuous bracteoles and many small male flowers, but *B. inopinata* is different in its smaller stipules 17–18 × 6–6.5 mm (vs. to 25 × 15 mm as in *B. postarii*), its glabrous lamina 12.5–14.5 × 7–8 cm that is longer

than wide (vs. conspicuously hairy on both surfaces and (8–)11(–17) × 7–9(–12.5) cm that is almost as wide as long), its smaller male outer tepals 4–5 × 2–3 mm (vs. 7–8 × 4.5–5 mm long) and larger, glabrous fruit 15–17 × 17–19 mm (vs. hispid and (8–)12 × (–9)13(–17) mm long). Type: *George et al.* SAN 123711, Borneo, Sabah, Lahad Datu District, KM 46, Jalan Danum, 12 March 1988 (holotype SAN!).

Cane-like begonia to 60 cm tall. Stems erect, c. 3 mm diameter, hispid towards the apex, hairs rusty brown when dry, internodes 5.5–7 cm long. Stipules oblong, 17–18 × 6–6.5 mm, midrib keeled, margin dentate, densely hispid, apex setose, seta c. 3 mm long, persistent. Leaves alternate, distant, oblique; petiole hispid, 2.5–8.5 cm long, slightly grooved above; lamina plain dark green in life, thinly leathery and khaki on both surfaces when dry, glabrous on both surfaces, ovate, asymmetric, 12.5–14.5 × 7–8 cm, broad side 5–6.2 cm wide, basal lobe broadly rounded, 4.2–4.5 cm long, margin shortly toothed, apex acuminate, acumen to 1.5–2.5 cm long; venation palmate-pinnate, 2–3 veins on either side of midrib, branching 2–3 times, 3–4 veins in basal lobe, midrib and lateral veins brown beneath, impressed above, slightly prominent beneath. Inflorescences protogynous, in the uppermost leaf axils, 10–16 cm long, peduncle 4–4.5 cm long, rachis sparsely hispid, a pair of female flowers at the base, above with cymose branches with many male flowers, branches 2.5–3 cm long. Bracts caducous. Bracteoles oval to reniform, margin toothed and studded with stalked glands, 3.5–6 × c. 3 mm, persistent. Male flowers: pedicel 2.5–6 mm long; tepals 4, reddish purple, glabrous, margin entire, outer 2 tepals elliptic, 4–5 × 2–3 mm, apex acute; inner 2 tepals narrowly elliptic, 3 × 1–1.5 mm; stamens c. 22, cluster conical, sessile; filaments 0.2–0.4 mm long; anthers obovate, 1–1.2 × 0.5 mm, apex emarginate. Female flower not available. Capsules bell-shaped in outline, 1.5–1.7 × 1.7–1.9 cm, glabrous, locules 3, wings equal, rounded proximally, distally tip pointed, 7–10 mm wide, thinly fibrous, dehiscing between the locules and wings, pedicel c. 15 mm long.

ETYMOLOGY. *Inopinata* (unexpected), so-called because it was discovered mixed with herbarium specimens of *B. postarii*.

ECOLOGY. On the side of a valley in submontane forest at 800 m or by rivers.

DISTRIBUTION. Borneo. Endemic to Sabah (Danum Valley Conservation Area, Lahad Datu).

SPECIMENS EXAMINED—BORNEO. SABAH: Lahad Datu District: Danum Valley, Gunung Danum, East Ridge, *Argent et al.* 1987156 (KEP, SAN); Danum Valey Road, Mile 46, *Majawat* SAN 123711 (holotype SAN).

NOTES. This species was not encountered during the present field survey, probably because it grows at higher elevations, being reported from submontane forest.

8. *Begonia inostegioides* F.Y. Chong sp. nov. (Section *Petermannia*)

It belongs to the *B. inostegia* group of species that has corrugate leaves and within this group it is similar to *Begonia gomantongensis* in habit and leaf venation, but *B. inostegioides* is different in its smaller stipules $c. 7 \times 1$ mm (vs. $c. 20 \times 5$ mm as in *B. gomantongensis*), its longer petioles 1.7–7.5 cm long (vs. (6.5–)11(–18) cm long), its narrower, ovate lamina 6.7–9.5 cm wide (vs. sub-rotund and (10–)13.5(–23) cm wide), its male flowers with long pedicels 6–8 mm long and oval tepals $c. 5 \times 5$ mm (vs. with pedicels 3–3.5 mm long and rotund tepals, $3.5\text{--}4 \times 3\text{--}3.5$ mm) and its narrower capsule that has locules with a smooth surface and a short stalk $c. 5$ mm long (vs. with locules having a conspicuously pimply surface and a stalk 15–25 mm long). Type: Chong et al. SAN 157804, Borneo, Sabah, Lahad Datu District, Danum Valley Field Centre, Riverine Trail, 26 July 2014 (holotype SAN!; isotype KEP!). (Fig. 6)



Fig. 6. *Begonia inostegioides*. **A.** Habit; **B.** Leafy twig showing undersurface of leaf; **C.** Male inflorescence with opened flowers; **D.** Fruit. All photos from SAN 156804 by Julia Sang.

Cane-like begonia, 25–30 cm tall. Stems erect, dark green or reddish, glabrous, woody, c. 5 mm diameter, branching with lateral side shoots, internodes 3.5–7 cm long, thicker at nodes. Stipules red, glabrous, narrowly lanceolate, c. 7 × 1 mm, margin entire, apex acute, caducous. Leaves alternate, distant, oblique, held more or less horizontally; petiole greenish brown or red, glabrous, 1.7–7.5 cm long, grooved above; lamina plain dark green, thin in life, matt, ovate, asymmetric, 10–15.7 × 6.7–9.5 cm, broad side c. 4 cm wide, basal lobe rounded, c. 1.1 cm long, margin shallowly toothed, apex acuminate, acumen to 1.5 cm long; venation pinnate, 4 veins on each side of the midrib, branching once, 2 veins in basal lobe, on upper surface reddish toward the base with a line of raised red short hairs and veins impressed above, beneath greenish brown and prominent. Inflorescences protogynous, racemose, erect, greenish or red, glabrous, c. 2.5 cm long, peduncle c. 0.9 cm long, branches 3, each branch 2–3 mm long with many male flowers. Bracts caducous. Bracteoles minute, less than 1 mm long. Male flowers white, pedicel 6–8 mm long; tepals 2, completely white, glabrous, oval, c. 5 × 5 mm, entire, apex slightly acute; stamens 35–38, cluster globose, stalked, c. 0.5 mm long; filaments pale yellow, c. 1.5 mm long; anthers pale yellow, oblong, c. 0.5 × 0.3 mm, apex emarginate. Female flower not available. Capsules positioned under the leaves, oblong, c. 2 × 0.9 cm, glabrous, wings 3, equal, narrow proximally, rounded distally, 3 mm wide, thinly fibrous, dehiscing between the locules and wings, pedicel stiff, c. 5 mm long.

ETYMOLOGY. Named for its resemblance to *Begonia inostegia* Stapf (1894: 166) from Gunung Kinabalu in habit and the lamina with narrowly parallel, impressed veins.

ECOLOGY. Slope above a small stream.

DISTRIBUTION. Borneo. Endemic to Sabah (Danum Valley Conservation Area, Lahad Datu).

SPECIMEN EXAMINED—BORNEO. SABAH: Lahad Datu District: Danum Valley Field Centre, Riverine Trail, Chong *et al.* SAN 157804 (holotype SAN!; isotype KEP!).

NOTES. There are no specimens in SAN of this species apart from the type, probably because it has been overlooked due to its similarity to the more common *B. gomantongensis*.

9. *Begonia postarii* Kiew (1998: 165). Type: *Kiew & Lim RK 4221*, Borneo, Sabah, Kinabatangan District, Bukit Panggi, 19 September 1996 (holotype SAN!; isotype SING).

Cane-like begonia, 40–60 cm tall, beginning to flower at 20 cm tall, hispid with white (sometimes red) hairs 1–3 mm long on the stem, stipules, petioles, lamina (both upper and lower surfaces), bracts, inflorescence, and ovary. Stems erect, reddish, c. 8 mm diameter. Stipules foliaceous, broadly elliptic, c. 25 × 15 mm, keeled, margin entire with a dense fringe of hairs, apex rounded or slightly acute, persistent. Leaves alternate, distant, oblique; petiole reddish, (4–)6–8 cm long; lamina plain pale green above and beneath, soft and thin in life, thinly papery when dry, ovate, asymmetric, (8–)11(–17) × 7–9(–12.5) cm, broad side 4–9 cm wide, base cordate, basal lobe rounded, (2.7–)6–8 cm long, margin minutely dentate,

apex cuspidate, acumen 1.25–1.5 cm long; venation pinnate, 4–5 veins on each side of the midrib, branching twice, 2 pairs veins at base, 1 vein in basal lobe, veins slightly impressed above, prominent beneath. Inflorescences protogynous, racemose, erect and reaching above the leaves, 9.5–26.5 cm long, peduncle 5.5–7 cm long, lowest 1–2 branches, 1.5–3.5 cm long with 2–3 female flowers, upper branches reddish, 1.5–3 cm long with many male flowers. Bracts pale green, broadly oval, c. 15 × 10 mm, margin minutely toothed. Bracteoles pale green tipped red, broadly ovate, c. 3 × 4 mm with dentate margin each tooth tipped by a long glandular hair. Male flowers: pedicel to 8 mm long; tepals 4, outer two white tinged pink merging to cherry red towards centre or deep pink or red with a white margin, elliptic, 7–8 × 4.5–5 mm, entire, apex rounded, conspicuously hirsute outside, inner pair glabrous, narrowly lanceolate, 7 × 1.3–2 mm; stamens 23–35, cluster conical, stalk c. 2 mm long, filaments c. 0.5 mm long, anthers yellow, c. 1 × 0.5 mm, apex emarginate. Female flower: pedicels reddish, 7–10 mm long; ovary broadly ovate, c. 3 × 4 mm, wings crimson, c. 2 mm wide, locules 3, placentas bilamellate with many ovules on both surfaces; tepals 5, pink, margin entire, apex rounded, outer broadly ovate, c. 8 × 4 mm, inner narrower, c. 4.5 × 2.5 mm; styles c. 3 mm long, divided to base, bifurcating, stigma papillose forming a continuous twisted band. Capsules broadly ovate, (0.8–)1.2 × (0.9–)1.3(–1.7) cm, wings 3, equal, rounded proximally, 3 mm wide, thinly papery, dehiscing between the locule and wing, pendent, pedicel thin, thread-like, 1–2 cm long. Seeds ovoid, c. 0.4–0.3 mm.

ETYMOLOGY. Named in honour of Postar Jaiwit, research assistant in the Herbarium, Forest Research Centre, and diligent plant collector, who discovered this species.

ECOLOGY. Lowland mixed dipterocarp forest, particularly common on banks above rivers at low elevations but also widespread and collected from rocky areas, ultramafic soils (Gunung Nicola) and lower montane forest to 800 m elevation; elsewhere in deep shade at the base of limestone hills at about 100 m elevation.

DISTRIBUTION. Borneo. Endemic to Sabah.

SPECIMENS EXAMINED—BORNEO. SABAH: Beluran District: Bidu-Bidu FR, *Suzana et al. SAN 150044* (SAN); Lahad Datu District: DVCA, Gunung Nicola, *Campbell EG 265* (SAN); Danum Valley, *Ridsdale & Postar SAN 148789* (SAN, KEP); Km 46, Jalan Danum, *Majawat et al. SAN 123711* (SAN); Gunung Danum, East Ridge, *Argent et al. 1987156* (SAN), *Argent et al. SAN 1987153* (SAN); path from field centre to water pool, *de kok 1043* (SAN), Ulu Sg. Segama; Coffin Trail, *Gregson & Bala Ola 92* (SAN), Segama East Trail, *Madani SAN 112901* (SAN), Next to Rhino trail, *Clark 28* (SAN), Ulu Segama, Malua FR, *Suzana et al. SAN 154625* (SAN), BRL, Coffin Trail, *Campbell EG 225* (SAN), BRL, Jacuzzi trail, *Chong et al. SAN 157255* (KEP, SAN, SING); Sandakan District: Gomantong, *Bousi et al. SAN 122763* (SAN), Gomantong FR, *Lim & Ubaldus LSP 802* (SAN), Kinabatangan District: Lower Kinabatangan, Subak Estate, *Dransfield et al. JD 5770* (SAN); Sapulut District: Sg. Sansiang, *Jamirus et al. SAN 154782* (SAN), Bukit Panggi, *Kiew & Lim RK 4221* (holotype SAN!; isotype SING).

NOTES. It is a striking species in its broad softly hairy leaves with long inflorescences held above the leaves with many tiny deep red male flowers. It is the most commonly collected species from DVCA. Previously it was known only from limestone hills along the Kinabatangan River. Compared with the Kinabatangan population that has fruits $1 \times (0.9\text{--}1.3)$ cm, the DVCA population has broader fruits $1\text{--}1.2 \times 1.4\text{--}1.7$ cm but otherwise there are no significant differences between the two populations.

10. *Begonia prasinimarginata* S. Julia sp. nov. (Section *Petermannia*)

Similar to *Begonia heliotrophe* Kiew (2001: 262) in its leaf shape and inflorescence type, *B. prasinimarginata* differs in its smaller stature, it grows to c. 8 cm tall (vs. to 125 cm tall as in *B. heliotrophe*), its leaves have very short petioles, 0.8–1.4 cm long with a lamina twice as long as wide, $9\text{--}14.5 \times 5.5\text{--}6.5$ cm and a broad silvery pale green border (vs. with a petiole 5–7 cm long and a plain green lamina, three times longer than wide, $10.5\text{--}19 \times 3.5\text{--}6.5$ cm), its male flowers have two tepals (vs. four tepals) and its fruit is smaller c. 1.2 \times 1.4 cm (vs. $1.7\text{--}2.3 \times 1.7\text{--}2.2$ cm). Type: *Diwol SAN 144346*, Borneo, Sabah, Lahad Datu District, Danum Valley Field Centre, Sungai Ril, Danum Segama, 22 March 2000 (holotype SAN!). (Fig. 7)

Low glabrous begonia. Stems decumbent and rooting at the nodes, erect apex to 8 cm tall, slightly woody, 2–3 mm diameter when dry, internodes 1.5–2.5 cm long. Stipules lanceolate, c. 5×2.5 mm, margin entire, apex acute, caducous. Leaves alternate, distant, oblique; petiole reddish brown, 0.8–1.4 cm long, grooved above; lamina dark green above with a broad silvery pale green border, 6–9 mm wide, thin in life, matt, ovate, asymmetric, $9\text{--}14.5 \times 5.5\text{--}6.5$ cm, broad side 4–4.5 cm wide, basal lobe rounded, 2.5–3.5 cm long, margin minutely toothed, apex attenuate; venation pinnate, veins 3 on the broad side, branching once or twice, 2 veins on the narrow side, unbranched, 3 veins in basal lobe, impressed above, prominent beneath. Inflorescences protogynous, in the uppermost leaf axils, racemose with cymose branches with male flowers, c. 10 cm long, peduncle c. 5.2 cm long. Bracts caducous. Male flowers: pedicel rosy pink, c. 3 mm long; tepals 4, oval, $2\text{--}2.5 \times c. 2$ mm, rosy pink, inner 2 tepals slightly smaller, margin entire, apex acute; stamens >30, cluster globose, sessile; filaments c. 0.5 mm long; anthers oblong, $0.8\text{--}1 \times c. 0.6$ mm, apex rotund. Female flower: pedicel c. 4.5 cm long, reddish pink, glabrous; ovary reddish pink or greenish red, pendent, c. 16 \times 13 mm; wings 3, equal, c. 3 mm wide; locules 3, placentas bilamellate with many ovules on both surfaces; tepals 5, reddish, outer tepals ovate, c. 10×9 mm, inner ones obovate, c. 11×5 mm, margin entire, apex rounded; styles 3, bright yellow, 1–1.5 mm long, divided to base, bifurcating, stigma widely Y-shaped, papillose forming a continuous twisted band. Capsules c. 1.2×1.4 cm, wings equal, triangular, widest midway, c. 5 mm wide, thinly fibrous, dehiscing between locules and wings, pedicel c. 22 mm long, fine and thread-like.

ETYMOLOGY. *Prasinus* (leek green), referring to the conspicuous pale green margin of the lamina.



Fig. 7. *Begonia prasinimarginata*. **A.** Habit of sterile plant; **B.** Habit of flowering plant; **C.** Male inflorescences; **D.** Open male flower; **E.** Female inflorescence; **F.** Open female flower. Photo A from SAN 156813 by Julia Sang; Photos B–F from SAN 156813 by Ubaldus Majawal.

ECOLOGY. Not common, on slopes or in flat alluvial forest, sometimes slightly raised above the leaf litter on banks or on tree roots at 300–660 m elevation.

DISTRIBUTION. Borneo. Endemic to Sabah (Danum Valley Conservation Area, Lahad Datu).

SPECIMENS EXAMINED—BORNEO. SABAH: Lahad Datu District: DVCA, Borneo Rainforest Lodge, Coffin trail, Chong *et al.* SAN 156813 (nursery grown plant originally collected from DVCA) (SAN), Sungai Ril, Danum Segama, Diwol SAN 144346 (holotype SAN!).

11. *Begonia rotundibracteata* Kiew sp. nov. (Section *Petermannia*)

Very similar to *Begonia danumensis* in habit, leaf size and shape, but *B. rotundibracteata* is different in its leaf arrangement that is always alternate (vs. alternate and sometimes appearing opposite as in *B. danumensis*), the upper leaf surface is glabrous (vs. with a row of bristles between the veins), the bracteoles are conspicuous, foliose, $6-9 \times 4-9$ mm and persistent (vs. inconspicuous, triangular, $1-4 \times 1-3$ mm) and caducous, male flowers have 2 or 3 or 4 tepals, the outer pair $c. 8 \times 8$ mm, and 50–52 stamens (vs. 2 tepals, $c. 5 \times 4$ mm and with 25–30 stamens), and the female flowers have deep pink entire tepals (vs. pale green denticulate tepals). Type: Chong et al. SAN 157801, Borneo, Sabah, Lahad Datu District, Danum Valley Field Centre, Nature Trail, 26 July 2014 (holotype SAN!; isotypes E!, K!, KEP!, SAR!, SING!, SNP!). (Fig. 8)

Erect begonia branching from the base, individual erect stems unbranched. Stems 20–66 cm tall, reddish brown, becoming woody, $c.$ 10 mm thick, pubescent, internodes 2.5–4 cm long, much thicker at the nodes. Stipules pale green, shortly pubescent, lanceolate, $7-17 \times 2-4$ mm, margin entire, apex acute, caducous. Leaves alternate, distant, not oblique, slightly pendent,



Fig. 8. *Begonia rotundibracteata*. A. Habit; B. Female flowers and fruits; C. Male flowers and fruit; D. Female flower with conspicuous bracts; E. Female flower; F. Male flowers with conspicuous bracts; G. Male flower. All photos SAN 157801 by Julia Sang.

leaves of young plants iridescent blue; petiole greenish brown, pubescent, uppermost reddish brown, (0.5–)1.2(–1.7) cm long, flat above; lamina plain dark green, paler beneath, glabrous on upper surfaces, slightly leathery in life, matt, lanceolate, widest in the middle or sometimes slightly obovate, asymmetric, (13.5–)15(–18) × (4.2–)7(–9.2) cm, broad side (2.5–)4(–5.5) cm wide, base auriculate, basal lobes 0.3–0.6 cm long, margin minutely toothed, apex narrowly acuminate, acumen 1.1–1.5 cm long; venation pinnate, 8 veins on each side of midrib, branched once or twice, veins concolorous with red or brown pubescence, impressed above, prominent beneath. Inflorescences protogynous, in the lowermost leaf axils or below the leaves with 2 female flowers at the base and a few male flowers above; inflorescences in the upper leaf axils with male flowers only, racemose, erect, longer than petioles, (1–)4(–9) cm long, peduncle c. 2.9 cm long, reddish, hairy. Bracts broadly ovate, persistent, reddish in female flowers, greenish in most male flowers. Bracteoles whitish green, foliose, ovate, 6–9 × 4–9 mm (female flowers) or c. 10 × 6 mm (male flowers), margin studded with red glands, persistent. Male flower: pedicel pale pink and white towards the apex, c. 12 mm long; tepals 2 or 3 or 4, white or pink, outer 2 tepals glabrous, broadly oval, c. 8 × 8 mm, margin entire, apex slightly acute; inner tepals 2, 1 or 0, glabrous, narrowly oblong, c. 4 × 1 mm, margin entire, apex acute; stamens 50–52, yellow, cluster globose, sessile; filaments pale yellow, 1.5–2 mm long; anthers pale yellow, oblong, c. 1 × 0.6 mm, apex emarginate. Female flower: pedicel 5 mm long, rosy red, pubescent with red hairs; ovary pinkish, wings pinkish, triangular in outline, c. 1.5 × 1.6 cm, wings 3, equal, locules 3, placentas bilamellate with many ovules on both surfaces; tepals 5, deep pink, margin entire, apex rounded, covered with red hairs outside, 4 broadly oval, c. 9 × 7 mm, the innermost tepal narrower, c. 9 × 4 mm; styles 3, lemon yellow, c. 4.5 mm long, divided to base; stigma lemon yellow, papillose forming a continuous twisted band. Capsules c. 1.3 × 1.5 cm, pubescence hairs red, locules 3, wings equal, narrow proximally, distally tip acute, dehiscing between the locules and wings, pendent, pedicel stiff, 5–12 mm long. Seeds oblong, c. 0.3 × 0.2 mm, columnar cells more than half of the seed length.

ETYMOLOGY. *Rotundibracteata* refers to the conspicuous rotund foliose bracteoles that persist on the infructescence.

ECOLOGY. Quite common in DVCA, in lowland mixed dipterocarp forest in deep shade at 150–350 m elevation, on moist banks, sometimes close to streams.

DISTRIBUTION. Borneo. Endemic to Sabah (Danum Valley Conservation Area, Lahad Datu).

SPECIMENS EXAMINED—BORNEO. SABAH: Lahad Datu District: Danum Valley Field Centre, East trail, *Lee & Pius SAN 119794* (SAN); South side, *Argent et al. 161987* (SAN); Main trail East, *Gregson 47* (KEP, SAN); Nature Trail, *Chong et al. SAN 157801* (holotype SAN!; isotypes E!, K!, KEP!, SAR!, SING!, SNP!); Trail to Air Terjun Tembalung, *Magintan et al. 527* (SAN), *Poulsen & Albaek 527* (SAN); unspecified locality, *Newman SAN 112165* (SAN), *Campbell SAN 109072* (SAN).

NOTES. *Begonia rotundibracteata* grows together, often side-by-side, with *B. danumensis* (Fig. 9) though it appears to be less common. It is easy to distinguish between these two species because *B. rotundibracteata* has glabrous leaves while *B. danumensis* has a row of bristly hairs between the veins. Since they occupy the same habitat, it raises the question as to why the two species have not hybridised. One possibility is that they are reproductively isolated because they do not share the same pollinator. Their flowers differ in colour, size and the number of stamens. Very little is known about pollination in begonia, and as far as we know there are no records of flower visitors to Bornean species. In Peninsular Malaysia, *Trigona* bees are likely to be pollinators (Kiew, 2005). DVFC is the ideal site for such observations to be carried out. The leaves of young plants are a distinct iridescent blue, a feature not seen in *B. danumensis*.



Fig. 9. Comparison between *Begonia danumensis* and *B. rotundibracteata*. **A.** Habit of *B. danumensis* (above) and *B. rotundibracteata* (below) growing together; **B.** Leaf and male flowers of *B. danumensis* (right) and *B. rotundibracteata* (left); **C.** Male flowers of *B. danumensis* (right) and *B. rotundibracteata* (left). All photos by Julia Sang.

12. *Begonia ruthiae* S. Julia sp. nov. (Section *Petermannia*)

In its conspicuous hairs on the basal lobes, each hair is raised on a conical base, *Begonia ruthiae* resembles *B. conipila* Irmsch. ex Kiew (2001: 287), but *B. ruthiae* is different from *B. conipila* in having a narrow bright silvery lamina margin and a contrasting deep green lamina (vs. veins that are lighter yellowish green compared with a dark background lamina as in *B. conipila*). *B. ruthiae* is an erect plant (vs. creeping as in *B. conipila*), the lamina is longer 7–8(–10.3) × 4.7–6(–8.5) cm (vs. 4–7.5 × 3.5–8.5 cm), the male flowers have longer tepals 9–12 mm long and c. 30 stamens (vs. 3.5–5 mm long tepals and 10–11 stamens) and the capsule is almost as wide as long (1.2–)1.4(–1.7) × 1.3–1.4 cm (vs. longer than wide (1.1–8 × 1–1.5 cm). Type: *Chong et al.* SAN 157254, Borneo, Sabah, Lahad Datu District, Danum Valley Conservation Area, Borneo Rainforest lodge, Coffin Trail, 27 July 2014 (holotype SAN!; isotypes KEP!, SING!). (**Fig. 10**)

Beautiful small begonia with up to 5 leaves on the soil surface. Stems decumbent to 17 cm long, erect apex 2–6 cm long, reddish brown, 4–5 mm diameter, glabrous, wiry, internodes 0.8–1.5 cm long. Stipules deep pink, glabrous, lanceolate or broadly oval, 6–11 × 7–9 mm, margin entire, apex setose, seta c. 1 mm, persistent. Leaves alternate, crowded, oblique; petiole light red, 1.7–4(–6.5) cm long, glabrous, grooved above; lamina velvety, deep green with a silvery margin (some populations without the silvery margin), deep magenta beneath, strongly bullate, thin in life, ovate, asymmetric, 7–8(–10.3) × 4.7–6(–8.5) cm, broad side 3–5.5 cm, base deeply cordate, basal lobe 1.7–2.4(–3.5) cm, with a row of hairs between the veins, hairs red, 1–2 mm long, each hair raised on a conical base, margin minutely toothed, apex acuminate, acumen c. 0.8 cm long; venation palmate-pinnate, 3–4 on either side of the midrib, branching twice, 3–4 veins in the basal lobe, veins deeply impressed above, major and minor veins prominent beneath, glabrous. Inflorescences protogynous, axillary in the upper leaf axils, racemose, 3.5–8.5(–15.5) cm long, held above the leaves, peduncle 3.5–4 cm, red, glabrous, erect, 1–2 female flowers at the base, male flowers in sessile cymules of 3–5 flowers. Bracts pale green, broadly lanceolate, (8–)10(–13) × 4–5 mm, margin entire, persistent. Bracteoles pale green, pinkish towards the apex, broadly ovate, 4–9 × c. 5 mm, margin entire, persistent. Male flowers: pedicel white, 10–12 mm long; tepals 2, white tinged pink towards the margin, glabrous, broadly oval, 9–12 × 9–10 mm, margin entire, apex acute; stamens c. 30, pale yellow, cluster globose, sessile; filaments yellow, 1.5–2 mm long; anthers yellow, oblong, 0.8–1 × 0.6 mm, apex rotund. Female flowers: pedicel 12–15 mm long, rosy red, glabrous; ovary deep magenta, ovate, 7–10 × 7–13 mm, wings 3, unequal, locules 3, placentas bilamellate with many ovules on both surfaces; tepals 5, rosy pink, oval, apex acute, margin entire, subequal, larger tepals 12–13 × 8 mm, smallest tepal 10–13 × 6–7 mm; styles 3, lemon yellow, c. 5.5 mm long, divided to base; stigma lemon yellow, papillose forming a continuous twisted band. Capsules broadly oblong, (1.2–)1.4(–1.7) × 1.3–1.4 cm, glabrous, wings 3, one wing slightly larger, 4–6(–7) mm wide, smaller wings 4–5 mm wide, thinly fibrous, dehiscing between the locule and wing, pendent on a fine hair-like pedicel, 1.4–2.2 cm long. Seeds oblong, c. 0.3 × 0.2 mm, columnar cells more than half of the seed length.

ETYMOLOGY. Named in honour of Ruth Kiew, the author of *Begonias of Peninsular Malaysia*, who has discovered and described many species of *Begonia* in Borneo, particularly from limestone hills.

ECOLOGY. Locally common, in deep shade on banks in lowland dipterocarp forest with hardly any leaf litter, often on raised roots, on wet rocks along the river at 200–500 m elevation.

DISTRIBUTION. Borneo. Endemic to Sabah (Danum Valley Conservation Area, Lahad Datu).



Fig. 10. *Begonia ruthiae*. **A.** Habit; **B.** Male inflorescence and fruits; **C & D.** Male flowers; **E & F.** Female flower; **G.** Fruit. All photos SAN 156809 by Julia Sang.

SPECIMENS EXAMINED—BORNEO. SABAH: Lahad Datu District: Danum Valley Conservation Area, Borneo Rainforest Lodge, Segama Trail, Chong *et al.* SAN 156809 (SAN), Sg. RIL, Collector SAN 144328 (SAN); Coffin Trail, Chong *et al.* SAN 157254 (holotype SAN!; isotypes KEP!, SING!), Gregson *et al.* 125 (SAN); Gunung Danum East ridge, Argent *et al.* 1987154 (SAN); over south bridge, Andrews 740 (SAN).

NOTES. This is a most decorative species worthy of cultivation for its attractive velvety, crinkled, dark green foliage with a bright silvery margin (though this is lacking in some individuals), and its relatively large pink flowers. There is one report (SAN 84957) of its leaves being found in the gut of a tortoise.

13. *Begonia taniana* V.S. Guanh sp. nov. (Section *Petermannia*)

Similar to *Begonia imbricata* Sands (1990: 64) in its glossy, wedge-shaped leaves with an undulating margin, but *B. taniana* is different in its caducous stipules (vs. large, 19–30 mm long, and persistent as in *B. imbricata*), glabrous, longer petioles 4–7.5 cm long (vs. hirsute and 1–3.5 cm long), extremely short inflorescences 7 mm long (vs. 70 mm long), narrower bracteoles 8–10 × 5–6 mm that do not overlap (vs. overlapping bracteoles 12–18 × 14–21 mm) and male flowers with two tepals (vs. four tepals). Type: Chong *et al.* SAN 156811, Borneo, Sabah, Lahad Datu District, Danum Valley Conservation Area, Borneo Rainforest lodge, Sapa Bebandil Trail, 28 July 2014 (holotype SAN!). (Fig. 11)

Cane-like begonia. Stems erect to 21 cm tall, unbranched, glossy reddish brown, c. 6 mm diameter, glabrous. Stipules caducous. Leaves alternate, distant, oblique, slightly pointing upward; petiole rosy red, glabrous, 4–7.5 cm long, grooved above; lamina plain deep green above, dark magenta below, slightly succulent in life, glossy, broadly ovate, asymmetric, c. 15.5 × 9.6 cm, broad side c. 7.5 cm wide, basal lobe rounded, c. 2.5 cm long, margin remotely toothed, slightly scalloped, apex acuminate, acumen to 2.5 cm long; venation palmate-pinnate, 1 pair at the base and 3 on each side of the midrib, 3 veins in basal lobe, glabrous, slightly impressed above, slightly prominent beneath. Inflorescences protogynous, cymose in the uppermost leaf axils, glabrous, c. 7 mm long; peduncle c. 4 mm long, 1 female flower at base and 3 male flowers above. Bracts pale green, broadly lanceolate, c. 12 × 8 mm, margin entire, midrib keeled, persistent. Bracteoles similar to the bracts but smaller, 8–10 × 5–6 mm, caducous. Male flowers: pedicel pink, c. 5 mm long; tepals 2, glabrous, oval, c. 3.5 × 3 mm, margin entire, apex slightly acute; stamens 15–17, cluster globose, c. 2.2 mm long, sessile; filaments pale yellow, c. 0.6 mm long; anthers pale yellow, obovate, c. 0.6 × 0.4 mm, apex rotund. Female flower: pedicel c. 8 mm long, green, glabrous; ovary yellowish, slightly obovate, c. 14 × 14 mm, wings 3, equal, green tinged red, locules 3, placentas bilamellate with many ovules on both surfaces; tepals 5, pink and deeper rosy red towards the centre, slightly obovate, margin slightly toothed towards apex, apex acute, outermost tepal widest, c. 16 × 13 mm, inner four tepals isomorphic, c. 14 × 10 mm; styles 3, yellow, c. 6 mm long, divided to base; stigma yellow, papillose forming a continuous twisted band. Fruits not seen.

ETYMOLOGY. Named in recognition of Tan Jiew Hoe's interest in initiating the Guide to the Begonias of Borneo project and for providing financial support for this and many other field trips.

ECOLOGY. Base of the tree in alluvial forest at 166 m elevation.

DISTRIBUTION. Borneo. Endemic to Sabah (Danum Valley Conservation Area, Lahad Datu).

SPECIMENS EXAMINED—BORNEO. SABAH: Lahad Datu District: DVCA, Borneo Rainforest lodge, Sapa Bebandil Trail, *Chong et al. SAN 156811* (holotype SAN!).



Fig. 11. *Begonia taniana*. A. Habit; B. Leafy twig with male inflorescence; C. Male inflorescence; D. Unopened male flower; E & F. Female flower. Photos A, D–F from SAN 156811 by Julia Sang; Photos B & C from SAN 156811 by Ubaldus Majawal.

NOTES. It is a handsome species that has glossy dark green leaves that are deep magenta underneath and has large, rosy pink female flowers. Although at present it is known from one specimen that lacks the fruit, the species is sufficiently distinct to describe as a new species.

14. **Begonia vespipropinqua** F.Y. Chong sp. nov. (Section *Baryandra*)

In the enlarged concave wing of the fruit, it resembles *Begonia gueritziana* but *B. vespipropinqua* is different in its hairy lamina, with scattered hairs above and densely hairy beneath (vs. glabrous as in *B. gueritziana*), the leaf margin is conspicuously scalloped and minutely dentate (vs. entire) and the basal lobe is well developed, 2.7–5 cm long and often overlapping (vs. small 0.3–1.8 cm and not overlapping) and the capsule is larger, with the largest wing 12–15 mm wide (vs. (5–)10(–14) mm wide). Type: Chong et al. SAN 156812, Borneo, Sabah, Lahad Datu District, Danum Valley Conservation Area, Field Centre, Forest behind Education Centre, 28 July 2014 (holotype SAN!). (**Fig. 12**)

Rosette rhizomatous begonia. Rhizome to 33 cm long, c. 12 mm diameter, ruby red, glabrous, succulent. Stipules magenta, glabrous, broadly lanceolate, 10–15 × 3–8 mm, or sometimes narrowly lanceolate, c. 6 × 2 mm, margin entire, apex acute, caducous. Leaves alternate and crowded, oblique, held horizontally; petiole ruby red, densely short hispid, 7.5–14(–18.5) cm long, c. 3 mm thick, terete; lamina plain pale green on both surfaces, fleshy in life, matt, with scattered hairs above, densely hairy beneath, broadly ovate, asymmetric, 6–9(–13) × 7–10(–17) cm, broad side 4–6(–9) cm long, basal lobes often overlapping, 2.7–5 cm long, margin scalloped between the veins, minutely dentate, fringed by hairs (ciliate), apex acuminate, acumen 1–2.5 cm long; venation palmate with 8 veins, concolorous, impressed with scattered hairs above, prominent and densely hairy beneath, hairs white. Inflorescences protandrous, erect, held above the leaves, 17–27.5 cm long, peduncle 15.5–24 cm; pale magenta, glabrous, with a few cymose branches at the top with a few male flowers and one female flower. Bracts caducous. Bracteoles lanceolate, 4–6 × 1.5–2 mm, margin entire, caducous. Male flower: pedicel reddish green, 4–6 mm long; tepals 4, pinkish, margin entire; outer 2 tepals broadly ovate, c. 6 × 6.5 mm, apex acute, inner 2 tepals oblanceolate, c. 5 × 2 mm; stamens 30–38, cluster globose, sessile, filaments yellow, c. 1.6 mm long, anthers yellow, obovate, c. 2 × 1.5 mm. Female flower: pedicel greenish red, 5–6 mm long, glabrous; ovary ovate, c. 6 × 4 mm, tepals 6, pinkish, margin entire, outer 5 tepals oval, 5–6 × 3 mm, apex acute or rounded, innermost tepals oblanceolate, c. 4 × 1.5 mm, apex rounded. Capsules 13–16 × c. 14 mm, glabrous, wings unequal, 2 wings shorter, c. 5 mm wide, 1 wing enlarged, concave, 12–15 mm wide, thinly fibrous, dehiscing between the locules and wings, pendent, pedicel stiff, 14–16 mm long.

ETYMOLOGY. *Vespi-* (wasp) + *propinqua* (neighbour), so-called because a large ground nest of aggressive 4 cm-long wasps was close to the rock face where the begonia grew and prevented us from collecting good flowering material of this species.

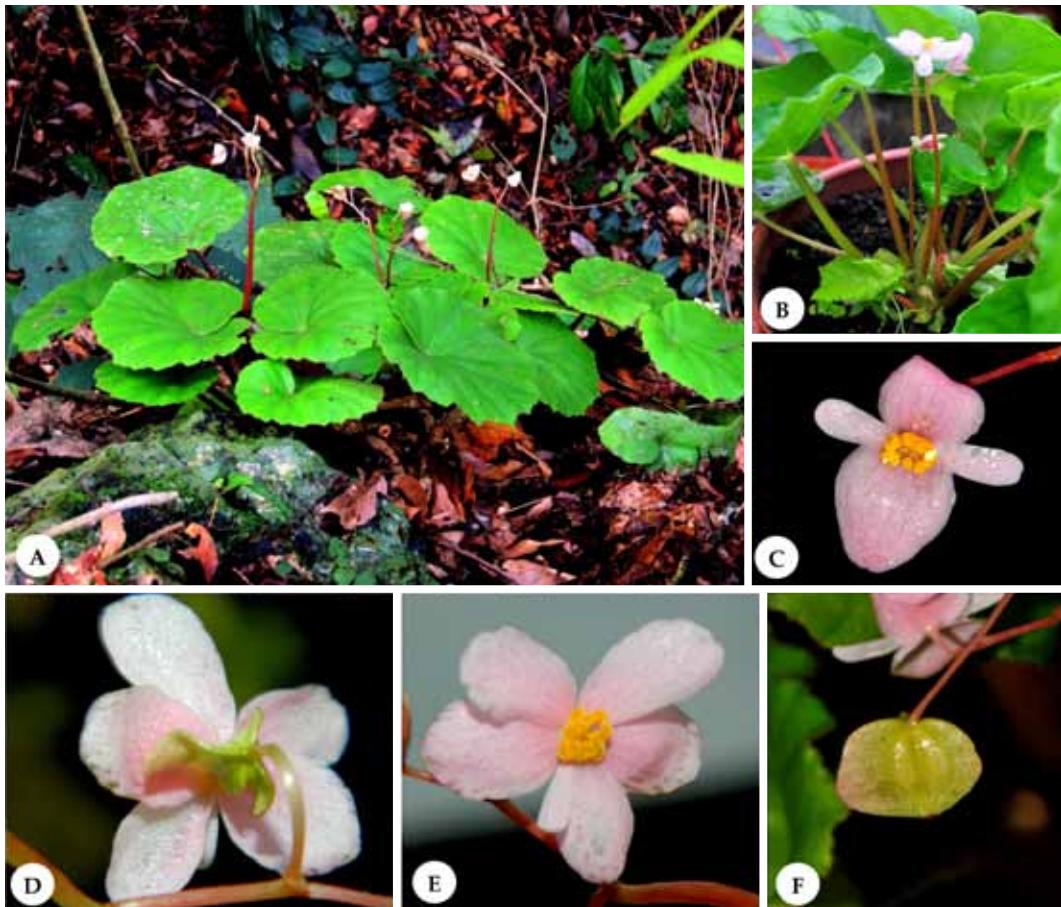


Fig. 12. *Begonia vespipropinqua*. **A.** Habit; **B.** Flowering plant; **C.** Male flower; **D & E.** Female flower; **F.** Fruit. Photo **A** from SAN 156812 by Julia Sang; Photos **B–F** from SAN 156812 (plant grown in the nursery) by Ubaldus Majawal.

ECOLOGY. Lowland mixed dipterocarp forest or submontane forest to 500–900 m elevation, on sandstone rocks in forest. Only one population was seen, where it was abundant and covered the vertical rock face 3–4 m high.

DISTRIBUTION. Borneo. Endemic to Sabah (Danum Valley Conservation Area, Lahad Datu).

SPECIMENS EXAMINED—BORNEO. SABAH: Lahad Datu District: Danum Valley, East trail, *Campbell SAN 112139* (SAN); Gunung Danum, east ridge, *Argent et al. 1987158* (SAN); Field Centre, Forest behind Education Centre, *Chong et al. SAN 156812* (holotype SAN!).

INCOMPLETELY KNOWN

Begonia sp. 1 (Section *Petermannia*)

Erect begonia. Stems brown, wiry to 40 cm long, 4–6 mm thick, hispid with red brown hairs; internodes 1–1.5 cm long, thicker at nodes. Stipules pale green, lanceolate, c. 10 × 3 mm (when dry), margin toothed and hispid, apex attenuate into a tuft of hairs c. 5 mm long, persistent. Leaves alternate, close, not oblique, held horizontally; petiole densely hispid, thickened, 3–10 mm long; lamina red beneath when young, when mature only the veins are red, upper surface plain pale greyish green, thin (in life), matt, obovate, almost symmetric, 11.5–15.5 × 2.5–4.5 cm, broad side 2–2.5 cm wide, base unequal, basal lobes

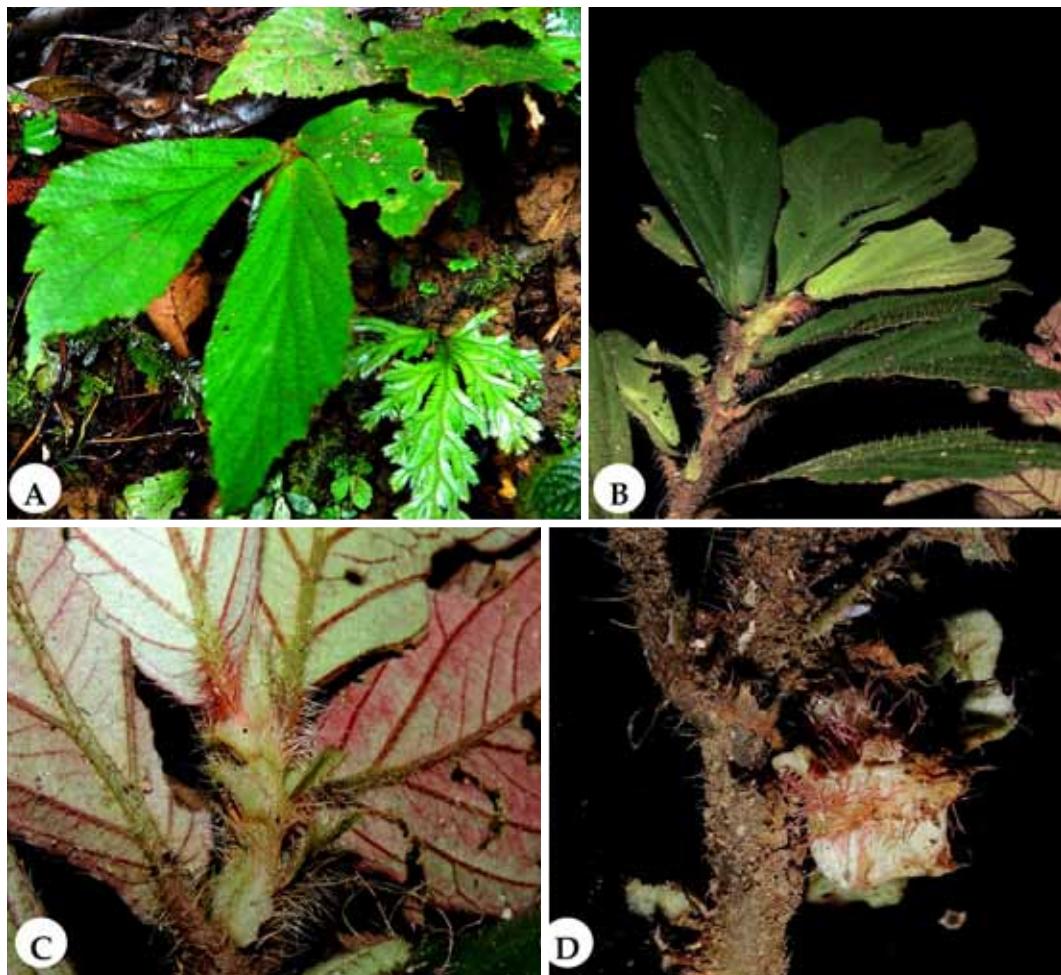


Fig. 13. *Begonia* sp. 1. **A.** Habit; **B.** Leafy twig; **C.** Leaf undersurface showing stipule; **D.** fruits. All photos from SAN 156807 by Julia Sang.

scarcely developed, c. 0.2–0.3 cm long, bristly above, bristles white, beneath hairy only on the veins, hairs black, margin shallowly serrate, apex acuminate, acumen to 0.5–1 cm long; venation pinnate with c. 5 veins on each side of the midrib, branched once, impressed above, prominent beneath. Male flowers (buds) white with a touch of pink. Female flowers unknown. Fruits (immature) sessile, hirsute with red hairs, wings 3, pale green. (**Fig. 13**)

ECOLOGY. In mixed dipterocarp forest on steep banks above the small streams or on sandstone rocks on steep slopes at 313–350 m elevation.

DISTRIBUTION. Borneo. Endemic to Sabah (Danum Valley Conservation Area, Lahad Datu).

CONSERVATION STATUS. Data Deficient because the taxonomic status of this species is not resolved.

SPECIMENS EXAMINED—BORNEO. SABAH: Lahad Datu District: Danum Valley Conservation Area, Borneo Rainforest Lodge, Serpent trail, *Chong et al.* SAN 157262 (SAN); Danum Valley Field Centre, West Trail, *Chong et al.* SAN 156807 (SAN), Madani SAN 113641 (SAN).

NOTES. Without flowers and a mature fruit, the specimens are insufficient to describe as a novel taxon. It belongs to the *Begonia pubescens* Ridley (1906: 254) group of begonias that are small wiry herbs with short petioles and non-oblique, almost symmetric laminas with pinnate venation, and short, few-flowered inflorescences.

DISCUSSION

All 15 species included in this account are endemic to Sabah and 12 are at present known only from the DVCA. Of the three recorded outside the DVCA, *Begonia gueritziana* is known to be widespread (Kiew, 2001), but for *B. gomantongensis* and *B. postarii*, both previously known from the Kinabatangan District, Danum is a new locality record. This illustrates how poorly collected Sabah is for begonias and that we can expect species to have wider geographic ranges than are presently known. Even so, the general situation for begonias in Borneo is that very few are widespread, the great majority are narrowly endemic (Kiew, 2001; Julia & Kiew, 2014).

To encounter 15 begonia species within three days indicates an extremely high level of biodiversity. One reason for this may be that the DVCA does not experience dry periods — annual rainfall averages about 1850 mm and no month has less than 100 mm (except occasionally in El Niño years). In addition, Hazebroek *et al.* (2012) reported that the soil in the DVCA has higher nutrient status and high water retaining capacity than elsewhere in

Sabah and this might be favourable for the growth of these understorey begonias. Another reason for high diversity is species pairs are closely similar in habit and occupy the same physical habitat, such as *B. danumensis*-*B. rotundibracteata* and *B. gomantongensis*-*B. inostegioides*. That they can co-exist without hybridising is likely due to their significantly different flowers that may result in reproductive isolation because they attract different pollinators (see *B. rotundibracteata* above).

The large proportion of new species is an indication of how little is known about the lowland *Begonia* flora in Sabah. Our three-day survey did not cover either the forests on ultramafic soils nor at the higher elevations where there is submontane forest. Indeed, in the SAN herbarium there are at least another 13 begonia taxa that we did not encounter and which, when complete material is available for them, can be described as new species.

In Borneo, about 85% of begonia species belong to section *Petermannia* (Klotzsch 1854: 124) A. de Candolle (1859: 128) (Julia & Kiew, 2014) and the proportion is even higher for Sabah (about 92%) where section *Reichenheimia* (Klotzsch 1855: 174) A. de Candolle (1864: 385) is hardly represented. While the majority of Danum species belong to section *Petermannia*, it was a surprise to discover that two of the new species belong to section *Baryandra* A. de Candolle (1859: 122). Previous to this study, only three Sabah species, *B. diwolii* Kiew (2001: 254), *B. gueritziana* and *B. subnummularifolia* Merr. (1926: 403) were recorded for this section (Rubite *et al.*, 2013) so the discovery of *B. bernadusii* and *B. vespipropinqua* significantly increases our knowledge of this section in Borneo. Like *B. gueritziana*, the new species are rhizomatous rosette plants. *Begonia diwolii* and *B. subnummularifolia* are creeping plants.

Apart from the species that is still incompletely known and so has been assessed as Data Deficient category, the remaining 14 species fall within the Least Concern category because the DVCA is a totally protected area being Class I Protection Forest.

Several of these species have potential as ornamental plants, most notably *B. ruthiae* and *B. prasinimarginata* for their variegated foliage. *Begonia taniana* with glossy deep green leaves and large pink flowers is another decorative species, while *B. postarii* produces attractive sprays of many small, deep red flowers.

CONCLUSION

The *Begonia* flora of Sabah is still largely unknown and because of relatively high biodiversity and narrow endemism, exploration of pristine rainforest on non-ultramafic soils is likely to result in the discovery of many new species. Indeed, Julia and Kiew (2014) estimate that Borneo, for which at present 126 species have been described, is likely to have a *Begonia* flora in excess of 600 species.

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***Begonia* (Begoniaceae) from Kubah National Park and Environs, Sarawak, Borneo, including a New Species**

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Summary. Seven *Begonia* species were recorded from Kubah National Park and its environs, including a new species (*Begonia matangensis* S. Julia & Kiew). Three species (*B. hullettii* Ridley, *B. propinqua* Ridley and *B. xiphophylla* Ridley) previously recorded by Ridley (1906) were re-collected and two species (*B. lailana* Kiew & Geri and *B. paoana* Kiew & S. Julia) are the new records for Kubah National Park. One species, *B. pubescens* Ridley, previously recorded by Ridley (1906), was not re-collected during the recent survey. Detailed descriptions of the species described by Ridley (1906) and the new species are provided, as well as a key for their identification. All species belong to section *Petermannia*. Following the guidelines for the IUCN categories and criteria, the conservation status of six species is assessed as ‘Least Concern’ and one species as ‘Data Deficient’.

The Kubah National Park (NP) is located about 22 km northwest of Kuching, Sarawak, Borneo, and covers an area of 2230 hectares (Hazebroek & Abang Kassim, 2000). Kubah NP and its surrounding area are better known to botanists as Matang or Gunung (Mount) Matang. It was made famous by the Italian biologist, Odoardo Beccari, who stayed on the mountain for several months in 1866 and made extensive collections, a great many of which were new to science (Beccari, 1904). Part of this area was gazetted as a national park in 1989

and the name changed to Kubah NP (Fig. 1). The Kubah NP and environs are protected for various reasons, for example as totally protected area, water catchment, recreational areas and religious sites (Boyce & Wong, 2007).

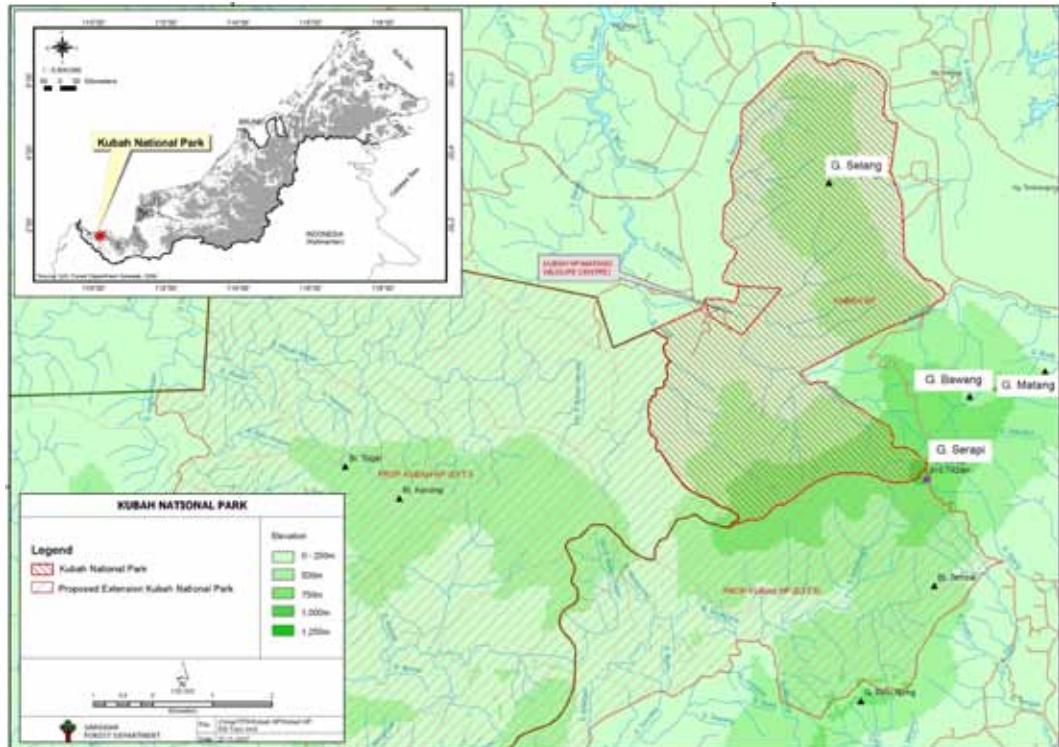


Fig. 1. Map showing Kubah National Park, Sarawak.

Since Beccari's time, most botanists have collected there, which have confirmed Beccari's observation of the 'immense variety and richness of its flora' (Beccari, 1904). For example, palms have proved particularly diverse with 100 species recorded of which 16 are endemic to the mountain, more than anywhere else of comparable size (Pearce, 1994; Pearce & Geri, 2007). Kubah NP is also rich in gingers (Poulsen, 2006) and aroids (Boyce & Wong, 2007 & 2008). Many new species have been discovered from here including several species endemic to the Kubah NP. Since the National Park is totally protected and adjacent forest is water catchment area, its flora is well protected, so endemic species found there fall within the IUCN (2001) Least Concern category.

The species richness of Kubah NP and its surrounding areas can be attributed to its very diverse topography and soil types. From about 33 m elevation it rises to mountain peaks:

Gunung Serapi, the highest at 911 m, Gunung Bawang at 500 m, Gunung Selang (396 m) and Gunung Matang. The hilly terrain is dissected by streams that cut through the sandstone punctuated by bands of hardened shale that creates picturesque waterfalls. The heavily forested slopes and ridges support lowland mixed dipterocarp forest and riverine forest near the base that are replaced higher up by hill dipterocarp forest and then ridge and summit forest. In places isolated patches of *kerangas* (tropical heath forest) occur.

The first account of begonias from the Kubah NP and its environs is that of Ridley (1906) who visited Matang in August 1905. He based his species on the specimens he collected together with those collected by G.D. Haviland, Curator of the Government Museum in Kuching 1893–1895 and R.W. Hullett, Headmaster of the Raffles School, Singapore, who collected plants in Sarawak in 1885 and 1890. Ridley described five species from Matang, four of which, *B. hullettii* Ridley (1906: 255), *B. polygonoides* Ridley (1906: 254) (later renamed *B. xiphophylla* Irmsch. (1953: 100), *B. propinqua* Ridley (1906: 249) and *B. pubescens* Ridley (1906: 254) were new to science. He also reported that *B. oblongifolia* Stapf (1894: 165), previously described from Gunung Kinabalu, Sabah, also occurred in Matang.

Since 1906, there have been no further publications on the begonias of Matang and its environs. The aim of our survey of the Kubah National Park was therefore to re-find the begonias described by Ridley (1906) which were based on very few specimens, many of which have not been re-located in herbaria. Also, to visit begonia habitats to see whether any species have been overlooked, to produce detailed species descriptions backed by a photographic record, a key to species, and more information on their habitat and abundance.

Materials and Methods

The species descriptions are based on specimens collected during various field work to Kubah National Park and the adjacent areas between 2012 and 2014 as well as the existing specimens collected over the years and deposited at Sarawak Herbarium (SAR). *Begonia pubescens* was not recollected in spite of several searches, so its description is based on the description by Ridley (1906) and examination of herbarium specimens at SAR. The measurements of other species are based on fresh specimens unless otherwise stated. The species distribution in other areas in Kuching Division is also included. Conservation assessments follow standard IUCN procedures (IUCN, 2001).

Taxonomy Treatment

Seven begonia species were recorded from Kubah National Park and adjacent areas, including one new species described below. All species belong to section *Petermannia*.

KEY TO BEGONIA SPECIES IN KUBAH NATIONAL PARK AND ITS ENVIRONS

1. Erect or cane-begonia 2
Low herb 6
2. Leaves extremely narrow and long; with length: width ratio of 6:1 *B. xiphophylla*
Leaves broader than long or longer than broad with length: width ratio of 2–3:1 3
3. Leaves asymmetric and oblique *B. propinqua*
Leaves asymmetric but not oblique 4
4. All parts of the plant densely hairy *B. matangensis*
Leaves and stem sparingly pubescent 5
5. Lamina with 4–6 veins on either side of the midrib; narrow side of the lamina broader, 4–8 mm wide, more rounded; ovary broader, 12–14 mm wide; capsules with wings broadly acute proximally, truncate distally *B. paoana*
Lamina with 3 veins on either side of the midrib; narrow side of the lamina narrower, 3–3.5 mm wide, narrow side slightly falcate or straight; ovary narrower, 6–8 mm wide; capsules with wings tip distally rounded *B. lailana*
6. Leaves densely hairy, almost sessile, 2–5 mm long; capsule 9–12 × 11–15 mm *B. pubescens*
Leaves covered with sparse adpressed hairs, petiole 5–8 mm long; capsule 5–7 × 15–20 mm *B. hullettii*

Species Descriptions

1. ***Begonia hullettii*** Ridley (1906: 255). Type: *Ridley 11776*, Borneo, Sarawak, Kuching District, Matang, August 1905 (lectotype K, here chosen). (**Fig. 2**)

Erect begonia, to 25 cm tall. Stem dull green, covered with adpressed hairs, *ca.* 5 mm thick, internodes 1.5–2 cm long, not branched, rooting at nodes on the leafless stem, succulent, slightly thicker at nodes. Stipules pale green, densely pilose, triangular, *ca.* 7 × 2 mm, margin entire, apex setose, seta to 3 mm long, caducous. Leaves alternate, slightly close, held horizontally, not oblique; petiole dull green, covered with adpressed hairs, 5–8 mm long, slightly grooved above; lamina plain, green above, paler beneath, covered with sparse adpressed hairs, plain, papery (not fleshy) in life, matt, asymmetric, slightly falcate, slightly obovate, 8–14 × 2.5–4.3 cm, narrow side 1.2–2.5 cm wide, base slightly cordate, basal lobes *ca.* 0.4 cm wide, margin finely serrate, apex acuminate, acumen 1–1.5 cm long; venation pinnate, concolorous, sparsely pilose, 3–4 veins on either side of the midrib, one vein in basal lobe, prominent both sides, stronger beneath. Plant protogynous. Inflorescences

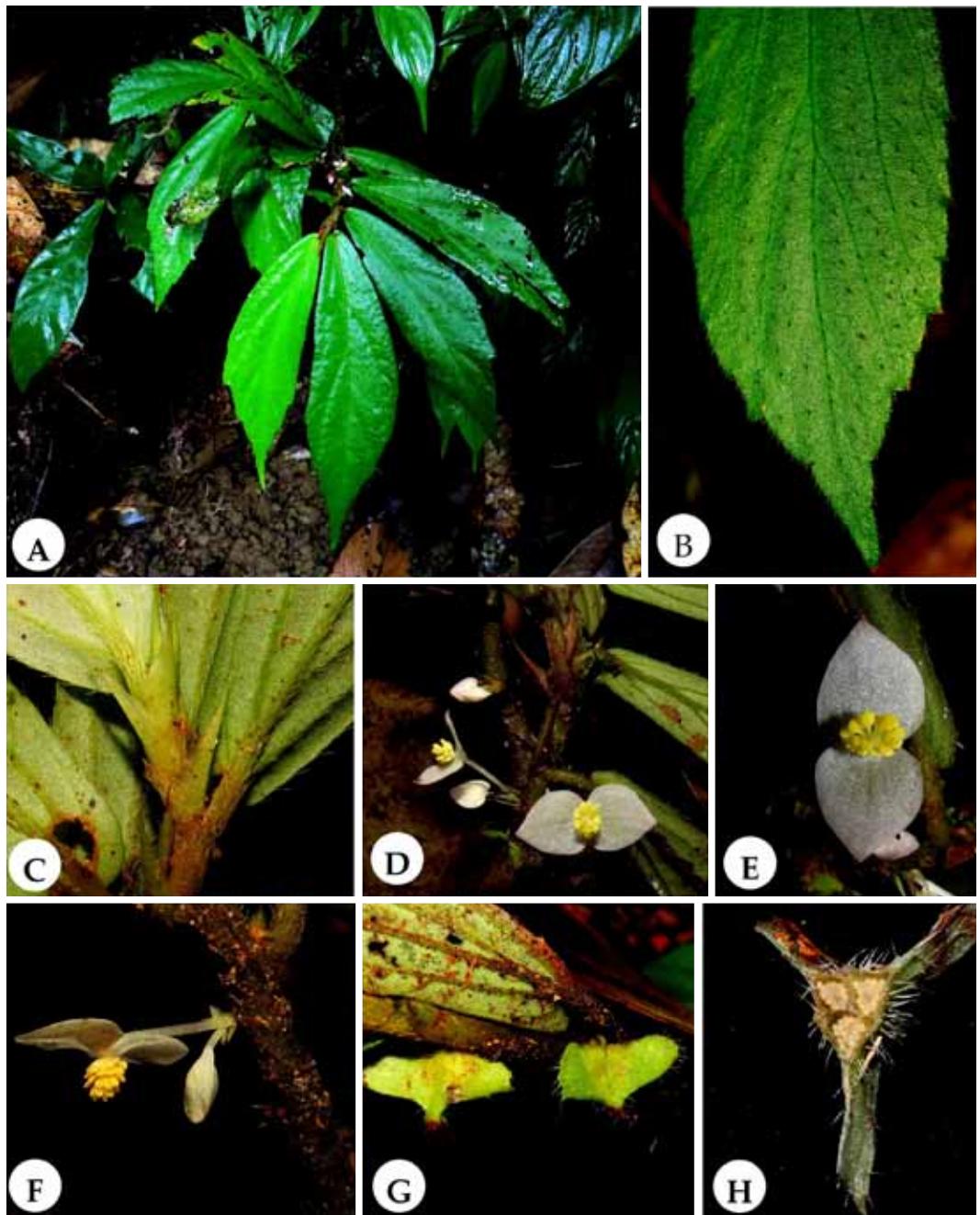


Fig. 2. *Begonia hullettii*. **A.** Habit; **B.** Close-up of leaf; **C.** Stipule; **D–F.** Male flowers; **G.** Fruits; **H.** Cross-section of fruit. All photos from SFC 3990 by Ling Chea Yiing.

axillary along the stem, 1–4 male flowers, subsessile, glabrous, white. Bracts pale green, lanceolate, *ca.* 5 × 2 mm, margin entire, caducous. Bracteoles similar to bracts but smaller, caducous. Male flowers: pedicel white, 6–10 mm long; tepals 2, white, curved backward when fully opened, glabrous, elliptic, 6–8 × 4–5 mm, margin entire, apex acute; stamens 13–15, cluster subglobose, stalked to 0.1 mm; filaments pale yellow, *ca.* 2 mm long; anthers pale yellow, oblong, *ca.* 1 × 0.4 mm, apex emarginate. Female flower not seen. Capsules axillary along the main stem, pale green, 5–7 × 15–20 mm, sparsely pilose, locules 3, wings 3, equal, broadly acute proximally, pointed distally, 8–10 mm wide, papery, sessile. Seeds barrel-shaped, 0.2–0.3 × 0.2 mm, collar cells more than half the seed length.

ETYMOLOGY. It is named after R.W. Hullett, Headmaster of the Raffles School, Singapore, who collected plants, including this species in Sarawak in 1885 and 1890.

ECOLOGY. Grows at 240–300 m elevation according to Ridley (1906), which separates it from *B. pubescens* that is recorded from higher altitudes above 500 m elevation. It grows on mossy sandstone rocks by waterfall, in seasonal streams and about 10 m from stream bank at 58–428 m elevation.

DISTRIBUTION. Borneo. Endemic to Sarawak (Kubah National Park).

CONSERVATION STATUS. Least Concern as the species occurs in the totally protected area.

SPECIMENS EXAMINED—BORNEO. SARAWAK: Kuching District: Kubah NP — Sg. Buloh, Matang Wildlife Centre, *Yahud et al.* S 99928 (SAR); Matang Wildlife Centre, along the way to Rayu Waterfall, *Ling et al.* SFC 3990 (SAR); along the trail to Mt. Serapi, *Ling et al.* SFC 3995 (SAR); trail from Matang Wildlife Centre to Sg. Rayu, *Julia et al.* SFC 4206 (SAR); Matang—Sungai China, Gunung Matang, *Burtt & Wood* B2500 (SAR); Matang, *Ridley* 11776 (lectotype K).

NOTES. Ridley's specimen is chosen as the lectotype because the other syntype, *Hullett s.n.*, has not been located (Hughes, 2008).

2. *Begonia lailana* Kiew & Geri (2003: 117). Type: *Geri et al.* SBC 3753, Sarawak, Bau, Gunung Kawa, 12 November 2002 (holotype SAR!; isotypes K!, L!, SAN!, SBC!, SING!). Synonym: *Begonia oblongifolia* Stapf *auct. non* Ridley (1906: 251). (**Fig. 3**)

Cane-like begonia up to 2 m tall. Stem reddish or greenish brown, glabrous or hispid, *ca.* 7 mm thick, internodes 3–7.5 cm long, branching near the base to form a bushy crown, succulent, slightly thicker at nodes. Stipules pale green, pubescent, lanceolate, 15–27 × 6–10 mm, margin entire, apex narrowly pointed, caducous. Leaves alternate, distant, held more or

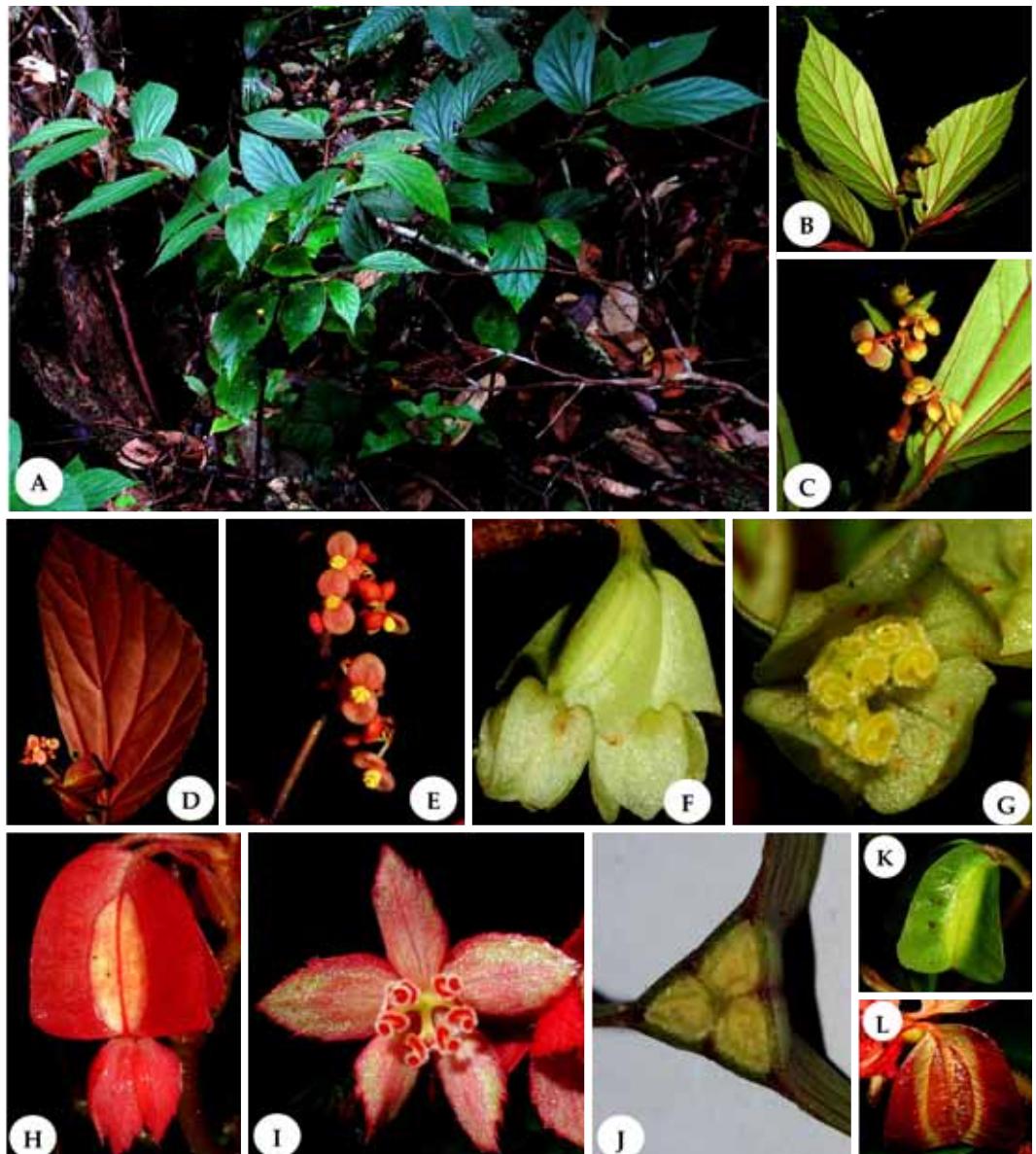


Fig. 3. *Begonia lailana*. **A.** Habit; **B.** Fruiting twig; **C.** Flowering twig; **D.** Infructescence; **E.** Male inflorescence; **F.** Female flowers (green form); **G.** Close-up of pistil; **H.** Female flower (red form); **I.** Close-up of female flower; **J.** Cross-section of ovary; **K & L.** Fruits (green and red forms). Photos A–C & J from SFC 5508; Photos D & E from SFC 5507; Photos F–G & K from SFC 5501; Photos H–I & L from SFC 3985. All photos by Ling Chea Yiing.

less horizontally, not oblique; petiole reddish, densely hirsute, 3–5 mm long in upper leaves, 8–10 mm in lower leaves, slightly grooved above; lamina silver-spotted between the veins (in juvenile), green above, pale green or reddish beneath, glabrous or with scattered red bristles on the veins and midrib, succulent in life, matt, asymmetric, broadly oblanceolate, 12.5–25 × 8–11.5 cm, narrow side 3–3.5 cm wide, slightly falcate or straight, base cuneate and subequal, basal lobes ca. 0.5–1 cm wide, margin minutely toothed, apex acuminate, acumen 1–1.5 cm long; venation palmate-pinnate, concolorous or sometime red beneath, bristles, 3 veins on either side of the midrib, 2 pairs in basal lobe, prominent impressed above, prominent beneath. Plant protogynous. Inflorescences axillary, erect, cymose panicle, 10–16 cm long, 1–2 female flowers on lowest node, many male flowers on upper node, peduncle to 3.5 cm long. Bracts green, lanceolate, 6–8 × 2 mm, margin entire, caducous. Bracteoles similar to bracts but smaller, caducous. Male flowers: pedicel red to pale red, 4–9 mm long; tepals 2, deep pink to pale cream and deeper pink towards the base or sometimes red, glabrous, rotund or oval, 5–8 × 7–7 mm, margin entire, apex rounded; stamens 35–38, cluster globose, stalked to 1 mm; filaments pale yellow, ca. 0.5 mm long; anthers pale yellow, ovoid, ca. 1–1.5 × 0.4 mm, apex emarginate. Female flowers: pedicel greenish or reddish, 7–9 mm long, sparsely bristles; ovary pale green with red veins on the wings or dark red, ovate, 13–18 × 6–8 mm, wings 3, equal, locules 3, placentas 2 per locule; tepals 5, pale pink to pale green or dark red outside, yellowish green inside, sparsely bristles outside, glabrous inside, obovate, 6–12 × 3–8 mm, margin minutely toothed towards the apex, apex acute; styles 3, pale yellow or pinkish, deeply Y-shaped, 2–6 mm long, divided to base; stigma yellowish or reddish, papillose forming a continuous twisted band. Capsules single or in pair on lower peduncle, green or red, 2–2.7 × 1.8–2.8 cm, glabrous, locules 3, wings 3, slightly unequal, broadly acute proximally, rounded distally, 6–11 mm wide, fibrous. Seeds barrel-shaped, ca. 0.4 × 0.3 mm, collar cells more than half the seed length.

ETYMOLOGY. Named in honour of the late Datuk Amar Puan Sri Dr Hajjah Laila Taib, wife of the 4th Chief Minister of Sarawak.

ECOLOGY. Lowland mixed dipterocarp forest, riverbank and at base of limestone hills in light shade.

DISTRIBUTION. Borneo. Endemic to Sarawak (Kuching Division).

CONSERVATION STATUS. Least Concern as the species is widespread in Kuching, including in the totally protected area such as Kubah National Park.

SPECIMENS EXAMINED—BORNEO. SARAWAK: Kuching District: Gunung Gading NP — waterfall trail, *Julia & Kiew SFC 3416* (SAR); Kubah NP — trail to waterfall, *Jossy et al. SFC 3218* (SAR); *Ling et al. SFC 5501* (SAR); Sg. Sendok, Matang, *Bernard S 53366* (SAR); Ulu Sg. Rayu, *Bernard S 54092* (SAR); Belian trail, *Ling et al. SFC 5508* (SAR); *Ling et al. SFC 5507* (SAR); Matang Wildlife Centre, *Ling et al. SFC 3985* (SAR); *Ling et al. SFC 3989* (SAR); Bau limestone hills — Gunung Kawa, *Geri et al. SBC 3753* (holotype)

SAR!; isotypes K!, L!, SAN!, SBC!, SING!); Gunung Aup, *Malcom et al.* SBC 3303 (SAR); Gunung Doya, *Raymond & Stephen* SBC 3451 (SAR); SBC 3473 (SAR); Gunung Jambusan, *Yi S* 50314 (SAR); Gunung Kawa, *Meekiong* SBC 3114 (SAR); Gunung Lanyang, *Julia et al.* SBC 2901 (SAR); Gunung Poing, *Julia et al.* SBC 353 (SAR); Serian limestone hills — Gunung Seburan, *Anderson* S 25143 (SAR).

NOTES. Ridley (1906) included this species in *B. oblongifolia* originally described from Gunung Kinabalu, Sabah and he noted that it was the ‘commonest species in Sarawak’ and ‘is somewhat variable in the form of the foliage’. Although *B. lailana* shares with *B. oblongifolia* the cane-like habit, leaves with short petioles that are not oblique, and the racemose inflorescence with a pair of fruits at the base and above, several branches above with many male flowers, it is very different from *B. oblongifolia* which has oblong leaves that are more than twice as long as wide, 10–16 × 4.5–5 cm compared with *B. lailana* that has much broader, obovate leaves, 12.5–25 × 8–11.5 cm. In addition, the stipules, lower surface of the veins and inflorescences are minutely pubescent in *B. oblongifolia*, while *B. lailana* is glabrescent.

3. *Begonia matangensis* S. Julia & Kiew sp. nov.

It most resembles *Begonia sympodialis* Irmsch. (1953: 495) in its erect, slightly woody, thin (*ca.* 2 mm wide) and hispid stems with small, narrowly lanceolate leaves that are not oblique and are slightly asymmetric with pinnate venation, a short petiole and in the sessile few-flowered inflorescences surrounded by the stipule and bracts. It is different from *B. sympodialis* in its taller branched stem to 40 cm tall (vs. to 30 cm tall and unbranched as in *B. sympodialis*), its larger leaves 8.5–15 × 2.5–3.5 cm (vs. 7–8 × 1.7–2.1 cm) with fewer veins, 4–5 veins (vs. 6–7 veins) on either side of the midrib. Type: *Julia & Geri* SFC 4211, Borneo, Sarawak, Kuching District, Kubah NP, Matang Wildlife Centre, 18 August 2013 (holotype SAR!). (Fig. 4)

Erect begonia to 40 cm tall. Stem brown, covered with dense white long hairs, 4–5 mm thick, internodes (0.5–)2.5–6 cm long, branched, slightly woody, thicker at nodes. Stipules greenish yellow, covered with dense long hairs, ovate, 10–17 × 5–6 mm, margin entire, apex acuminate, acumen to 0.5 mm long, persistent. Leaves alternate below, upper leaves opposite, distant, held horizontally, not oblique; petiole reddish, covered with dense long hairs, 8–12 mm long, terete; lamina plain, green above, paler beneath, densely pilose or velvety, plain, papery and soft (not fleshy) in life, matt, slightly falcate, slightly asymmetric, elliptic, 8.5–15 × 2.5–3.5 cm, narrow side 1.5–2 cm wide, base attenuate on narrow side, rounded on broad side, basal lobes rounded, 0.5–1 cm wide, margin toothed, apex acuminate, acumen 2–2.5 cm long; venation pinnate, concolorous, densely pilose, 4–5 veins on either side of the midrib, 1–2 veins in basal lobe, slightly impressed above, prominent beneath. Inflorescences protogynous, axillary, a simple cyme reduced to a single male flower on upper axil and female flower on lower axil, densely pilose. Bracts and bracteoles similar to stipules, persistent.

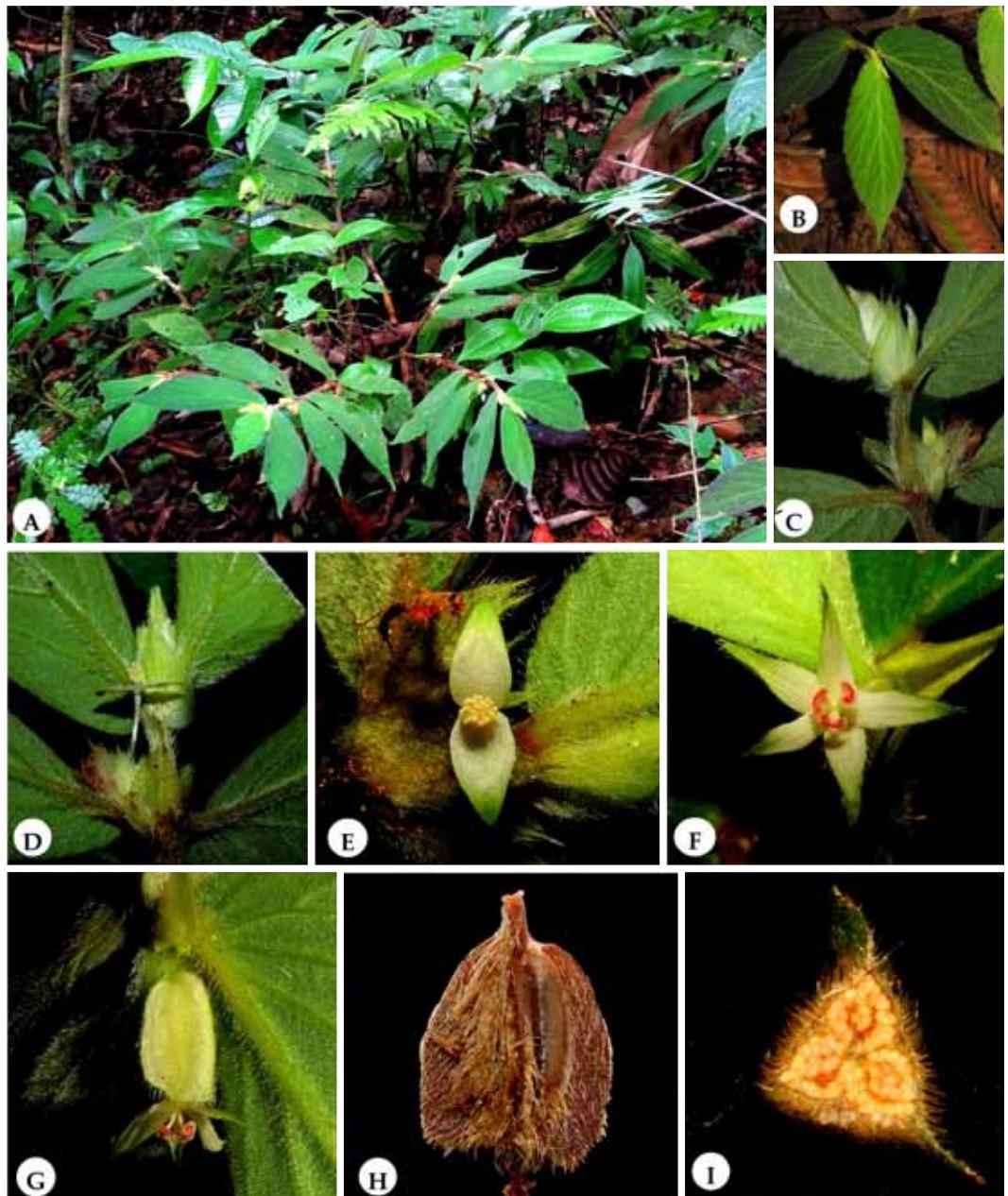


Fig. 4. *Begonia matangensis*. **A & B.** Habit; **C.** Stipule; **D & E.** Male flowers; **F & G.** Female flower. **H.** Old fruit; **I.** Cross-section of ovary. Photos A–G & I from SFC 3992 by Ling Chea Yiing; Photo H from SFC 4211 by Julia Sang.

Male flowers: pedicel white, 1–1.4 cm long; tepals 2, greenish towards the apex, otherwise greenish yellow, densely pilose outside, glabrous inside, ovoid, *ca.* 5 × 4 mm, margin entire, apex acute; stamens 12–15, cluster conical, stalked to 1 mm long; filaments pale yellow, *ca.* 1 mm long; anthers pale yellow, obovate, *ca.* 3 × 2 mm, apex emarginate. Female flowers: pedicel 2–3 mm long, greenish white, densely pilose; ovary greenish, oblong, 8–13 × 6–8 mm, wings 3, equal, locules 3, placentas 2 per locule; tepals 5, pale green, densely pilose outside, glabrous inside, lanceolate, 6–8 × 2–3 mm, margin entire, apex sharply acute; styles 3, pale green, widely Y-shaped, *ca.* 2 mm long, divided to base; stigma yellowish or reddish, papillose forming a continuous twisted band. Capsule single, axillary, pale green, *ca.* 10 × 8 mm, densely hairy, locules 3, wings 3, equal, acute proximally, rounded distally, 2–3 mm wide, papery; pedicel straight, very thin, 2–3 mm long, *ca.* 1 mm wide. Seeds barrel-shaped, *ca.* 0.4 × 0.1 mm, columnar cells more than half the seed length.

ETYMOLOGY. Denoting the locality where it grows.

ECOLOGY. Lowland mixed dipterocarp forest growing by seasonal streams or on the edge of forest on semi-exposed gentle slopes at 36 m elevation.

DISTRIBUTION. Borneo. Endemic to Sarawak (Matang Wildlife Centre).

CONSERVATION STATUS. Least Concern. Although it is known from one locality, it falls within the Least Concern category because it grows within a totally protected area.

SPECIMENS EXAMINED—BORNEO. SARAWAK: Kuching District: Kubah NP — Matang Wildlife Centre, *Ling et al. SFC 3992* (SAR); Kubah NP, Matang Wildlife Centre, *Julia & Geri SFC 4211* (holotype SAR!).

NOTES. This species is very localised and was found only in one location in the Matang Wildlife Centre. In its hairiness, it resembles *B. pubescens* but it can be distinguished from *B. pubescens* by its tall, erect stem, conspicuous internodes and narrower leaves.

4. *Begonia paoana* Kiew & S. Julia (2007: 217). Type: *Julia, Kiew & Geri S 91390*, Borneo, Sarawak, Kuching Division, Gunung Rimo, 29 April 2006 (holotype SAR!). (Fig. 5)

Cane-like begonia up to 1.2 m tall. Stem reddish brown, minutely pubescent, 3–4 mm thick, internodes 3–13.5 cm long, branching, woody, slightly thicker at nodes. Stipules pale green, glabrescent, lanceolate, 16–35 × 6–10 mm, margin entire, apex attenuate, caducous. Leaves alternate, distant, held more or less horizontally, not oblique; petiole brownish red, minutely pubescent, 6–10(–20) mm long in upper leaves, 5–10(–18) mm in lower leaves, terete; lamina plain, mid-green above, paler beneath, glabrous or with sparse minute red hairs, succulent in life, glossy, asymmetric, broadly ovate, 15–24 × 4.5–11 cm, narrow side 4–8

cm wide, base rounded on the broad side, cuneate or rounded on the narrow side, basal lobes 0.5–1 cm wide, margin minutely dentate, apex acuminate, acumen *ca.* 1 cm long; venation palmate-pinnate, concolorous, glabrous or minutely pubescent, 4–6 veins on either side of the midrib, 2–3 veins in basal lobe, prominent impressed above, slightly prominent beneath. Plant protogynous. Inflorescences axillary, erect, racemose with cymose branches of male

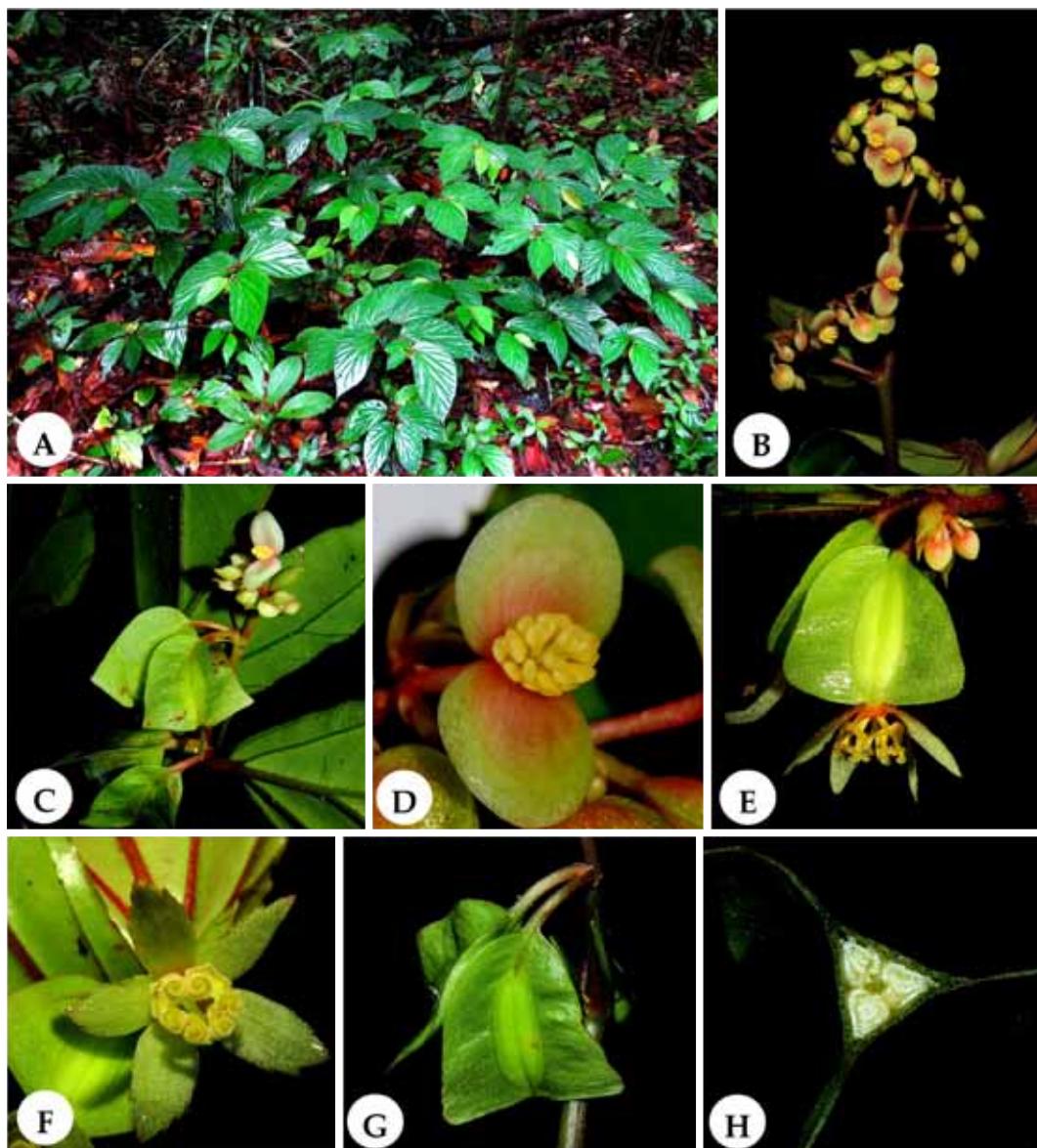


Fig. 5. *Begonia paoana*. **A.** Habit; **B.** Male inflorescence; **C.** Fruits and male inflorescence; **D.** Male flower; **E & F.** Female flower; **G.** Fruit; **H.** Cross-section of fruit. All photos from SFC 5510 by Ling Chea Ying.

flowers, (3–)11–25 cm long, 1–2 pairs of female flowers on lowest node, many male flowers on upper node, peduncle to 3.5 cm long. Bracts pale green, lanceolate, *ca.* 7 × 3 mm, margin entire, caducous. Bracteoles similar to bracts but smaller, caducous. Male flowers: pedicel red, 6–7 mm long; tepals 2, pale green flush crimson, glabrous, round with recurved margin, 5–7 × 5–7 mm, margin entire, apex rounded; stamens *ca.* 40, cluster conical, subsessile; filaments pale yellow, *ca.* 0.75 mm long; anthers pale yellow, oblanceolate, *ca.* 1 × 0.3 mm, apex rounded. Female flowers: pedicel pale red, 7–8 mm long, sparsely pubescent; ovary pale red or green, ovate, *ca.* 15 × 12–14 mm, wings 3, equal, locules 3, placentas 2 per locule; tepals 5, greenish yellow, glabrous, oval or ellipsoid, 10–11 × 4–6 mm, margin distantly toothed towards the apex, apex acute; styles 3, pale yellow, widely Y-shaped, 3–4 mm long, divided to base; stigma yellowish, papillose forming a continuous twisted band. Capsules 1–2 pairs on lower peduncle, green, 2–2.8 × 2.1–2.5 cm, glabrous, locules 3, wings 3, subequal, broadly acute proximally, truncate distally, 6–8 mm wide, fibrous; pedicel pendent, 10–22 mm long. Seeds barrel-shaped, *ca.* 0.25 mm across, collar cells more than half the seed length.

ETYMOLOGY. Named in honour of Joseph Pao Chiong Chai, botanical artist in the SAR Herbarium and Sarawak Forestry Corporation (1983–present).

ECOLOGY. Lowland mixed dipterocarp forest, on riverbanks and on the slopes up to limestone hills, also on limestone screes, rubble or rocks at 65–280 m altitude.

DISTRIBUTION. Borneo. Endemic to Sarawak (Kuching Division).

CONSERVATION STATUS. Least Concern. Widespread, including within a totally protected area (Kubah NP).

SPECIMENS EXAMINED—BORNEO. SARAWAK: Kuching District: Kubah NP — Waterfall Trail, *Ling et al. SFC 5502* (SAR); *SFC 5510* (SAR), along Kubah NP boundary, near Gunung Selang, *Ling SFC 4212* (SAR); Matang — Gunung Matang, *Julia S 99386* (SAR); Gunung Serapi, *Yahud et al. S 103419* (SAR); Sungai Cina Recreational area, *Julia et al. SFC 4208* (SAR); *SFC 4209* (SAR); Bau — Siniawan, Gunung Peninjau, *Julia et al. SFC 3421* (SAR); Seburan, *Anderson S 12921* (SAR); Padawan — Gunung Rimo, *Julia, Kiew & Geri S 91390* (holotype SAR!); Sungai Bengoh, *Ling et al. SFC 1811* (SAR); Bukit Manok, *Mamit S 33476* (SAR); Temurang, *Julia et al. S 105586* (SAR); *S 105091* (SAR); Tiang Bekap, *Mamit S 32641* (SAR); Gunung Rimo, *Julia et al. S 91390* (SAR); Serian — Gunung Selebor, *Anderson S 20827* (SAR); *Ilias S 28053* (SAR); *Julia & Kiew S 95676* (SAR); Bukit Peyang, *Yii & Othman S 46218* (SAR); Tebakang, Bukit Alak, *Dayang Awa & Ilias S 45200* (SAR); Gunung Bakat, *Dayang Awa & Ilias S 45848* (SAR); *S 45815* (SAR); Tebedu, *Ling et al. SFC 639* (SAR).

5. *Begonia propinqua* Ridley (1906: 249). Type: *Ridley 11771*, Borneo, Sarawak, Matang, August 1905 (lectotype K, here chosen; isolectotype BM). (Fig. 6)

Cane-like begonia to 0.4–2 m tall. Stem reddish-brown, sometimes green, lenticellate, glabrous, ca. 6 mm thick, slightly ridged, much branched, succulent, internodes 6–8 cm long, slightly thicker at nodes. Stipules pale green, glabrous, broadly lanceolate, 1.8–3 × 0.6–0.8 cm, keeled, margin entire, apex setose, seta to 2–15 mm long, caducous. Leaves alternate, distant, held horizontally, oblique; petiole reddish-brown, glabrous, 7.5–16 cm long, terete; lamina plain, pale green, paler beneath, glabrous, fleshy and sticky in life, matt, asymmetric, ovate, 9–20 × 9–16.5 cm, narrow side 4.5–6.5 cm wide, base cordate, basal

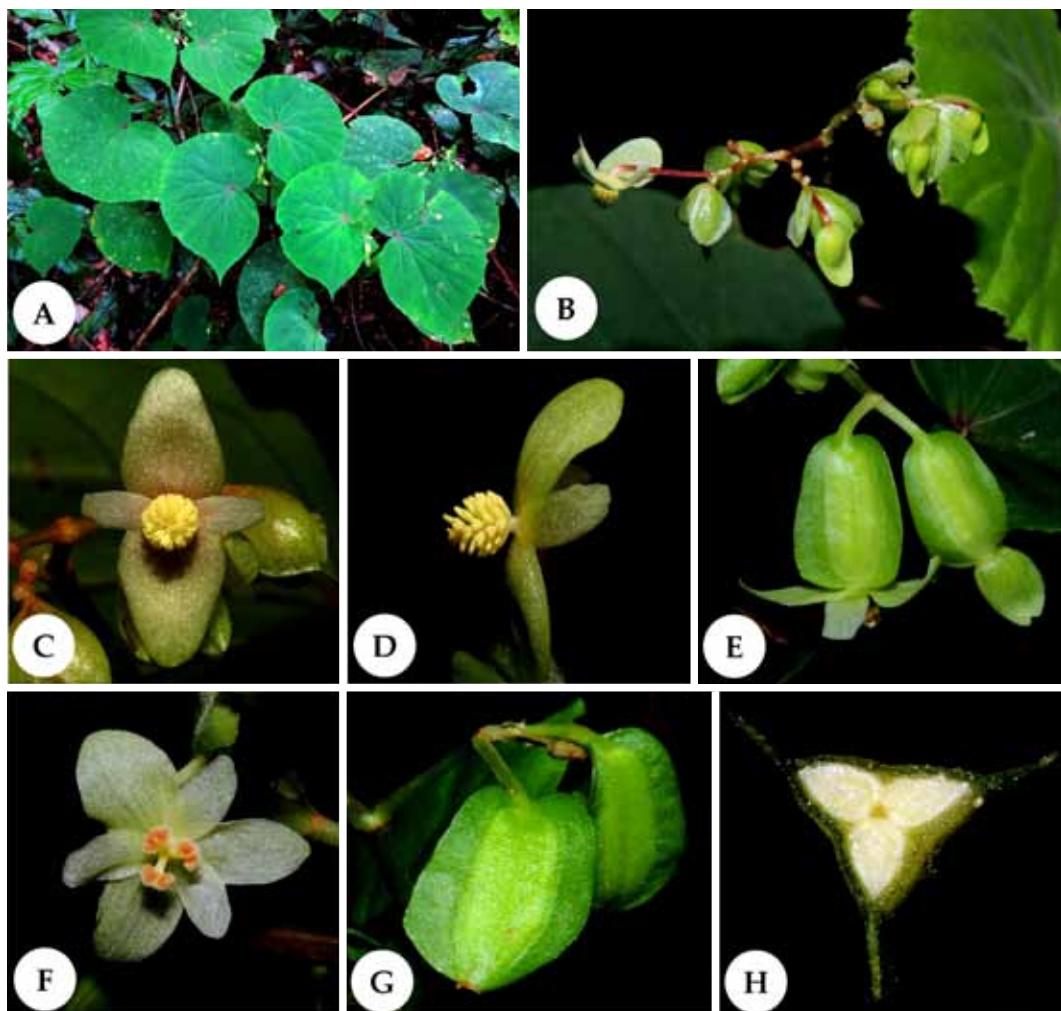


Fig. 6. *Begonia propinqua*. A. Habit; B. Male inflorescence; C & D. Male flowers; E & F. Female flowers; G. Fruits; H. Cross-section of fruit. Photo A from SFC 3987; Photos B & D–G from SFC 5516; Photo C from SFC 4207; Photo H from SFC 3986. All photos by Ling Chea Yiing.

lobes 3.5–8 cm wide, margin dentate at vein endings, finely toothed in between or rarely entire, apex acuminate, acumen 2–2.5 cm long; venation palmate-pinnate, veins concolorous or reddish-brown at base, glabrous, 3–5 veins on either side of the midrib, 4–5 veins in basal lobe, slightly sunken above, prominent beneath. Plant protogynous. Inflorescences axillary on upper leaf axils, erect, paniculate, 13–26 cm long with 1–3 pairs of female flowers at top of peduncle and above 2–3 branches with male flowers, peduncle glabrous, 4.5–7 cm long. Bracts pale green, ovate, 6–12 × 6 mm, margin entire, caducous. Bracteoles similar shape to bracts but smaller, caducous. Male flowers: pedicel greenish red or pinkish, 4–8 mm long; tepals 4, outer 2 tepals whitish, glabrous, ellipsoid, ca. 10 × 5 mm, margin entire, apex acute; inner 2 tepals white, glabrous, narrowly ellipsoid, ca. 5 × 2–3 mm, margin entire, apex acute; stamens 41–50, pale yellow, cluster globose, subsessile; filaments yellow, ca. 0.3 mm long; anthers yellow, oblanceolate, ca. 1 × 0.3–0.4 mm, apex emarginate. Female flowers: pedicel pinkish or green, 6–10 mm long, glabrous; ovary pale green, oblong, 1–1.2 × 1–1.4 cm, wings 3, equal, locules 3, placentas 2 per locule; tepals 5 or 6, whitish tinged greenish, glabrous, elliptic, 10–12 × 5 mm, margin entire, apex acute; styles 3, yellowish, shallow Y-shaped, ca. 2 mm long, divided to base; stigma orange-yellow or pinkish, papillose forming a continuous twisted band. Capsules 1–3 pairs on lower peduncle, green or green tinged red, 1–1.5 × 0.8–1.5 cm, glabrous, locules 3, wings 3, equal, rounded proximally and distally, 3–4 mm wide, thinly fibrous; pedicel pendent, 8–10 mm long. Seeds barrel-shaped, ca. 0.3 × 0.2 mm, collar half the seed length.

ETYMOLOGY. *propinquua* means ‘neighbour’, perhaps so-called because it grows in places where other begonias are found such as Kubah National Park.

ECOLOGY. Lowland to hill mixed dipterocarp forests on very steep slopes and above rocky stream bank at 35–497 m elevation. Ridley (1906) noted that this species was common in woods in Kuching.

DISTRIBUTION. Borneo. Endemic to Sarawak.

CONSERVATION STATUS. Least Concern. The species is widespread in the Kuching Division, including in totally protected area.

SPECIMENS EXAMINED—BORNEO. SARAWAK: Kuching District: Matang — Sungai Cina Recreational Park, *Julia et al. SFC 4207* (SAR); Gunung Matang, *Julia et al. SFC 4201* (SAR); Matang, *Ridley 11771* (lectotype K; isolectotype BM); Kubah NP — Matang Wildlife Centre, Senduk Waterfall, *Ling SFC 4214* (SAR); *SFC 3984* (SAR); *SFC 3986* (SAR); *SFC 3987* (SAR); *SFC 3988* (SAR); waterfall trail, *Ling et al. SFC 5501* (SAR); main trail to Gunung Serapi, *Yahud et al. S 103643* (SAR); *Ling et al. SFC 3997* (SAR); Rayu trail, *Jossy et al. SFC 3206* (SAR); Gunung Selang, *Bernard S 53817* (SAR); Sungai Rayu, *Yahud et al. S 100640* (SAR); Bau — Sungai Adis, *Ling et al. SFC 5516* (SAR).

NOTES. The lectotype is selected here because the other two syntypes collected by Hullett and Haviland have not been located. This begonia is unusual because its leaves and inflorescences are sometimes sticky to touch in life. The leaves of juvenile plants are bronzy.

6. *Begonia pubescens* Ridley (1906: 254). Type: *Haviland 76*, Borneo, Sarawak, Kuching District, Matang (lectotype K, here chosen).

Low erect herb, 5–10 cm tall or decumbent. Stem densely pubescent, *ca.* 4 mm thick, internodes 0.5–1 cm long. Stipules densely pubescent, lanceolate, 8–12 × 3–5 mm, keeled, margin entire, apex pointed, persistent. Leaves alternate, crowded, not oblique; petiole densely pubescent, 2–5 mm long, terete; lamina reddish beneath, densely pubescent on both surfaces and margin, thinly papery when dried, slightly falcate, asymmetric, obovate to oblanceolate, 5.5–10.5 × 2.5–4.5 cm, narrow side 0.8–1.7 cm wide, base slightly rounded or cuneate, basal lobes inconspicuously developed, margin irregularly minutely toothed on the upper half, apex acute to acuminate, acumen *ca.* 1 cm long; venation pinnate, 3–4 veins on each side of midrib, prominent on both surfaces. Plant protogynous. Bracts lanceolate, *ca.* 6 mm long. Male inflorescence racemose on upper leaf axil, *ca.* 3 cm long, peduncle *ca.* 0.7 cm long. Male flower on a slender pedicel, 5–14 mm long; tepals white, oval, 3–8 × 7–8 mm; stamens *ca.* 12, filaments white, free nearly to the base; anthers yellow, oblong oblanceolate, apex emarginate. Female flower not seen. Capsules axillary along the stem, single, 9–12 × 11–15 mm, beaked, hairy on the edge of wings; locules 3; wings 3, unequal, rounded proximally and distally, 3–7 mm wide, dehiscing between the locule and wing; pedicel erect, 3–4 mm long.

ETYMOLOGY. It is named for its very hairy nature.

ECOLOGY. On sandstone cliff faces at 540 m elevation. According to Ridley (1906), the species is abundant in Matang at 548 m elevation.

DISTRIBUTION. Borneo. Endemic to Sarawak (Kuching District).

CONSERVATION STATUS. Data Deficient. Because this species was not re-located, the exact site where it was collected is unknown, so it is not certain whether it falls within the national park boundary. In addition, the size of its population and the stability of its habitat are also unknown.

SPECIMENS EXAMINED—BORNEO. SARAWAK: Kuching District: Matang — Gunung (Mt.) Matang, Burtt & Woods B 1958 (SAR); Anderson S 25108 (SAR); Matang, *Haviland 76* (lectotype K); Gunung Serapi, Yahud *et al.* S 92634 (SAR).

NOTES. Among the three syntypes cited by Ridley (1906), *Hullet 346* was not located and between the Ridley and Haviland specimens, *Haviland 76* is more informative because it shows male flowers and fruits clearly.

Ridley (1906) noted that the species is ‘closely allied to *B. hullettii* but differs in its hairiness, shorter broader leaves and beaked hairy capsule’. On Gunung Serapi, the two species appear to be separated altitudinally with *B. pubescens* at 548 m and *B. hullettii* lower down below 300 m altitude.

It was the first species to be described from the group of short, usually unbranched begonias with short petioles, non-oblique rather small leaves that are only slightly asymmetric, and have few-flowered, almost sessile inflorescences or solitary flowers produced from the leaf axils, simultaneously from the bottom to the top of the stem. It is not surprising, therefore, that this name has been applied in herbaria for several similar, but as yet un-named species, e.g., for the specimens from Gunung Mulu cited by Hughes (2008). *Begonia pubescens* is characterised by its short stature with crowded, small leaves that are wedge-shaped on the broad side and closely dentate towards the apex. As its name suggests, it is densely hairy. The few other specimens that match this description are listed above.

7. ***Begonia xiphophylla*** Irmsch. (1953: 100). Type: *Ridley 11770*, Borneo, Sarawak, Matang, August 1905 (lectotype K). Synonym: *B. polygonoides* Hook.f. in Oliver, *auct. non* *B. polygonoides* Ridley (1906: 254). (**Fig. 7**)

Erect begonia 20–45 cm tall. Stem brownish red, glabrous, *ca.* 5 mm thick, internodes 1–2 cm long, little-branched, slightly woody, thicker at nodes. Stipules pale green, glabrous, triangular, 5–8 × 3 mm, margin entire, apex acute, caducous. Leaves alternate, distant, held horizontally, not oblique; petiole reddish-brown, glabrous, 0.6–1 cm long, slightly grooved above; lamina plain green above, paler beneath, glabrous, slightly succulent in life, glossy, symmetric, sometime slightly falcate, narrowly lanceolate, 11–23 × 1.8–2.6 cm, narrow side 0.8–1.2 cm wide, base broadly acute, basal lobe scarcely developed, margin toothed with slightly reddish margin, apex pointed; venation pinnate, concolorous, glabrous, 2–3 veins on either side of the midrib, ascending steeply to the margin, slightly prominent on both surfaces. Plant protogynous. Inflorescences axillary in upper leaf axils, cymes, the 1st branch with 2 female flowers on the lower part and a male flower terminal, *ca.* 4.5 cm long, 2 branches each 2–2.5 cm long. Bracts pale green, triangular, *ca.* 5 × 3 mm, margin entire, caducous. Bracteoles similar to bracts but smaller. Male flowers: pedicel pinkish, 4–6 mm long; tepals 4, outer 2 tepals pinkish, glabrous, almost rounded, *ca.* 5 × 4 mm, margin entire, apex rounded; inner 2 tepals pinkish, glabrous, linear, *ca.* 5 × 2 mm, margin entire, apex acute; stamens *ca.* 30, cluster subglobose, stalked to 1 mm long; filaments pale yellow, *ca.* 0.5 mm long; anthers pale yellow, oblanceolate, *ca.* 1 × 0.3 mm, apex emarginate. Female flowers: pedicel pinkish, 5–12 mm long, glabrous; ovary pale green sometime tinged red,

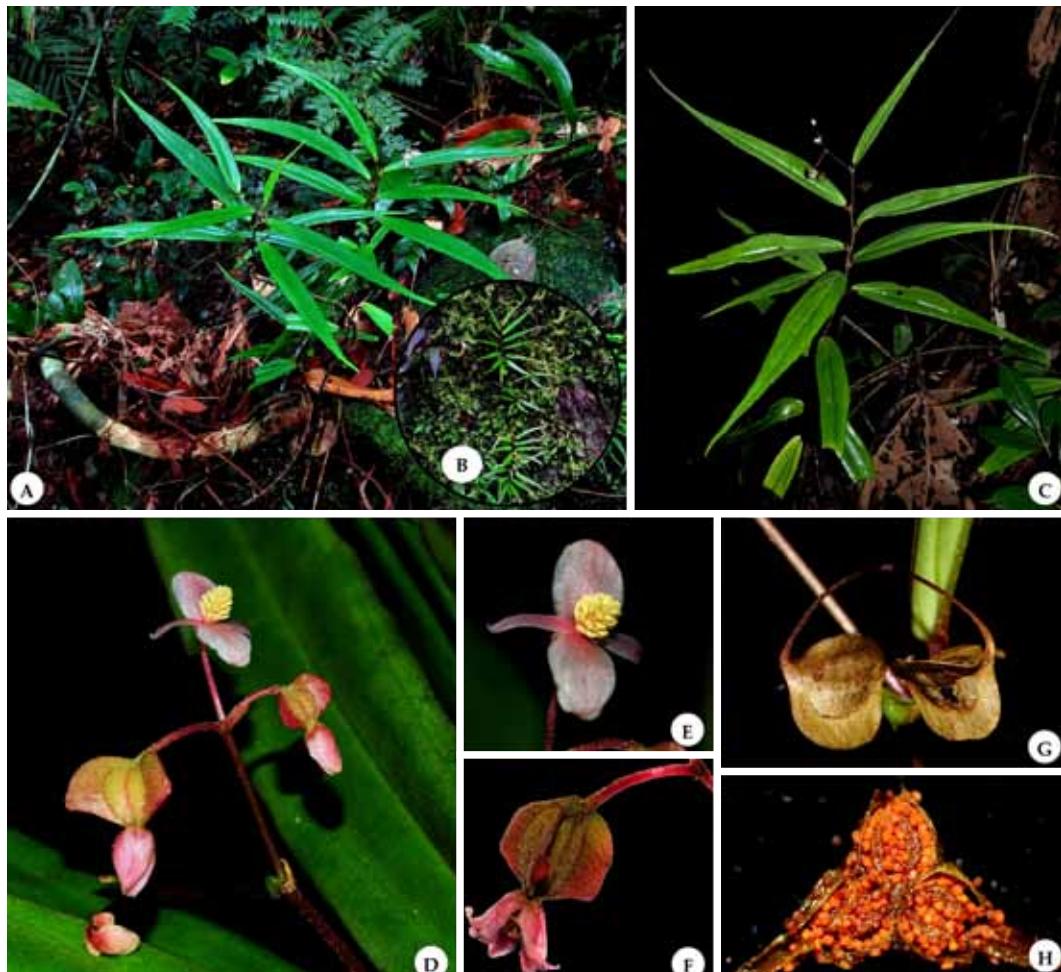


Fig. 7. *Begonia xiphophylla*. A–C. Habit; D. Inflorescence; E. Male flower; F. Female flower; G. Fruits; H. Cross-section of fruit. All photos from SFC 3998 by Ling Chea Yiing.

ovoid, 4–6 × 2–4 mm, wings 3, subequal, locules 3, placentas 2 per locule; tepals 5, pinkish, outer tepals elliptic, 5–6 × 4 mm, inner tepals narrowly elliptic, ca. 4 × 2 mm, margin entire, apex acute; styles 3, pale green, wide Y-shaped, ca. 2 mm, divided to base; stigma brownish, papillose forming a continuous twisted band. Capsules single or in pair, reddish green, ca. 8–10 × 10–14 mm, glabrous, locules 3, wings 3, subequal, acute proximally, rounded distally, 2–3 mm wide, papery; pedicel pendent, 1–1.5 cm long, thread-like. Seeds barrel-shaped, ca. 0.2 × 0.1 mm, collar cells more than half the seed length.

ETYMOLOGY. Its name commemorates its remarkably narrow leaves; Greek, *xipho* = narrow; *phyllus* = leaf.

ECOLOGY. Hill forest on large mossy sandstone boulders in deep shaded area above 650 m elevation. Very localised.

DISTRIBUTION. Borneo. Endemic to Sarawak (Kubah National Park).

CONSERVATION STATUS. Least Concern as the species is well protected within the Kubah National Park.

SPECIMENS EXAMINED—BORNEO. SARAWAK: Kuching District: Kubah NP — near main trail to Mt. Serapi, *Ling et al. SFC 3998* (SAR); Matang — Bukit Tanduk, *Bernard S 54032* (SAR); Gunung Serapi, *Yahud et al. S 92640* (SAR); Matang, *Ridley 11770* (lectotype K).

NOTES. It is a striking species characterised by its extremely narrow symmetric leaves with ascending veins that reach halfway or more up the lamina, the margin that has distant conspicuous teeth, and the fine panicle with very small male flowers and small fruits that are round in outline. In the Sarawak herbarium, a few specimens with similar narrow leaves collected from other localities outside Kuching District have been identified as *B. xiphophylla* but more complete material is needed to determine whether these specimens correctly belong to *B. xiphophylla*. Hughes (2008) stated that the syntype, *Haviland 1906* has not been located, so the other syntype, *Ridley 11770* is here designated as the lectotype.

ACKNOWLEDGEMENTS

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Eight New Species of *Begonia* (Begoniaceae) from Murum Dam, Sarawak, Borneo

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Summary. Eight new species of *Begonia*, *B. chakensis* S. Julia & C.Y. Ling, *B. johariana* S. Julia & C.Y. Ling, *B. julaihiana* S. Julia & C.Y. Ling, *B. murumensis* S. Julia & C.Y. Ling, *B. plieranensis* S. Julia & C.Y. Ling, *B. rhodotricha* S. Julia & C.Y. Ling, *B. rhombipetala* S. Julia & C.Y. Ling and *B. tenuissima* S. Julia & C.Y. Ling are described from Sarawak. Currently all species are known only from the Murum Dam area. All species belong to the section *Petermannia* except for one species (*B. chakensis*) that is not placed in any section as the female flower and fruit are incompletely known. Species descriptions and colour photographs are provided for all species.

Our knowledge and understanding of *Begonia* in Borneo is hindered by the fact that the majority of the species remain undescribed and unnamed. The slow rate of publication of new species is in part due to the lack of complete specimen materials in local herbaria. In Borneo, currently a total of 126 species are named and described, representing approximately 20% of the species estimated for Borneo (Julia & Kiew, 2014). Of the 72 species recorded from Sarawak, 38 species are endemic to limestone habitats. Although limestone habitats are well known for harbouring high *Begonia* species diversity, other habitats such as lowland or hill forests and habitats associated with rivers and streams are also particularly rich in begonias. The Murum Dam area is no exception. The study of *Begonia* in the Murum Dam area was part of the WiMOR (Wildlife Monitoring and Rescue Operation) Project, the collaboration between Sarawak Forestry Corporation (SFC) and Sarawak Energy Berhad (SEB), to document, collect and maintain the *ex-situ* collections of plants affected by the rising waters of the dam.

The Murum Dam is located on Sungai (Sg.) Murum ($114^{\circ} 21.4' E$ to $114^{\circ} 22.4' E$ and $2^{\circ} 38.5' N$ to $2^{\circ} 39.4' N$), a tributary of Batang Rajang in Belaga District. The three main rivers affected by the dam are Sg. Murum and its major tributaries (Sg. Plieran and Sg. Danum). The reservoir lies between the base elevation of 410 m at the dam site and the maximum operating level of elevation (540 m), giving a depth of 130 m and the reservoir extends over an area of 245 km² (EIA, 2008). The area is poorly known botanically as most of the rivers in this area are inaccessible due to their remoteness and to the river conditions with dangerous rapids that are not navigable.

During the WiMOR project at Murum Dam, collections of selected plants including *Begonia* species were carried out between 2013 and 2014. The collections were made along the main river systems of Sg. Murum, Sg. Danum, Sg. Plieran, Sg. Palutan and its many smaller tributaries. Live plants were established *ex-situ* in Murum and the duplicates are deposited in the SFC Nursery at Semengoh Nature Reserve. The species descriptions are based on specimens collected during various field surveys to Murum Dam areas between 2013 and 2014 as well as materials from the nurseries. The measurements are based on live specimens unless otherwise stated.

This account is just the beginning of a comprehensive study of the begonias of Murum Dam. More taxa await detailed descriptions when complete materials (specimens with flowers and fruits) become available.

Description of New Species

1. *Begonia chakensis* S. Julia & C.Y. Ling sp. nov. (Section: Uncertain)

Similar to *Begonia johariana* in its creeping habit and the shape of bracts and bracteoles but it is different in being sturdier and having unbranched stems (vs. thinner and branched stems), the stems densely pilose (vs. sparsely covered with fine short white hairs), the stipules are larger, *ca.* 13–15 × 5–12 mm (vs. *ca.* 5–8 × 2–4 mm), the petioles grooved above (vs. terete), the leaves are larger, 11–13.8 × 6.6–8.5 cm (vs. 5–9 × 3–5 cm), the basal lobes shorter, *ca.* 5 mm long (vs. 8–20 mm long), the inflorescences with a single female flower and male inflorescences in a simple cyme to *ca.* 4 cm long (vs. paniculate inflorescences to 5 cm long), the pedicel of male flower is longer, 4–9 mm long (vs. *ca.* 3 mm long). Type: Ling et al. BMHEP 3826, Borneo, Sarawak, Belaga District, Murum, Sg. Chak (tributary of Sg. Danum), 20 March 2014 (holotype SAR!). (Fig. 1)

Low herb, sometimes rooting at the nodes and creeping. Stems, petioles and veins beneath densely pilose, hairs white to pale green. Stems pale brown or green, 2–4 mm thick, internodes 3.5–6 cm long, unbranched, succulent, thicker at nodes. Stipules pale green or brownish green, broadly ovate, 13–15 × 5–12 mm, keeled, margin serrate, apex acute, persistent. Leaves alternate, distant, oblique, held horizontally; petioles red-brown, (1.8–)

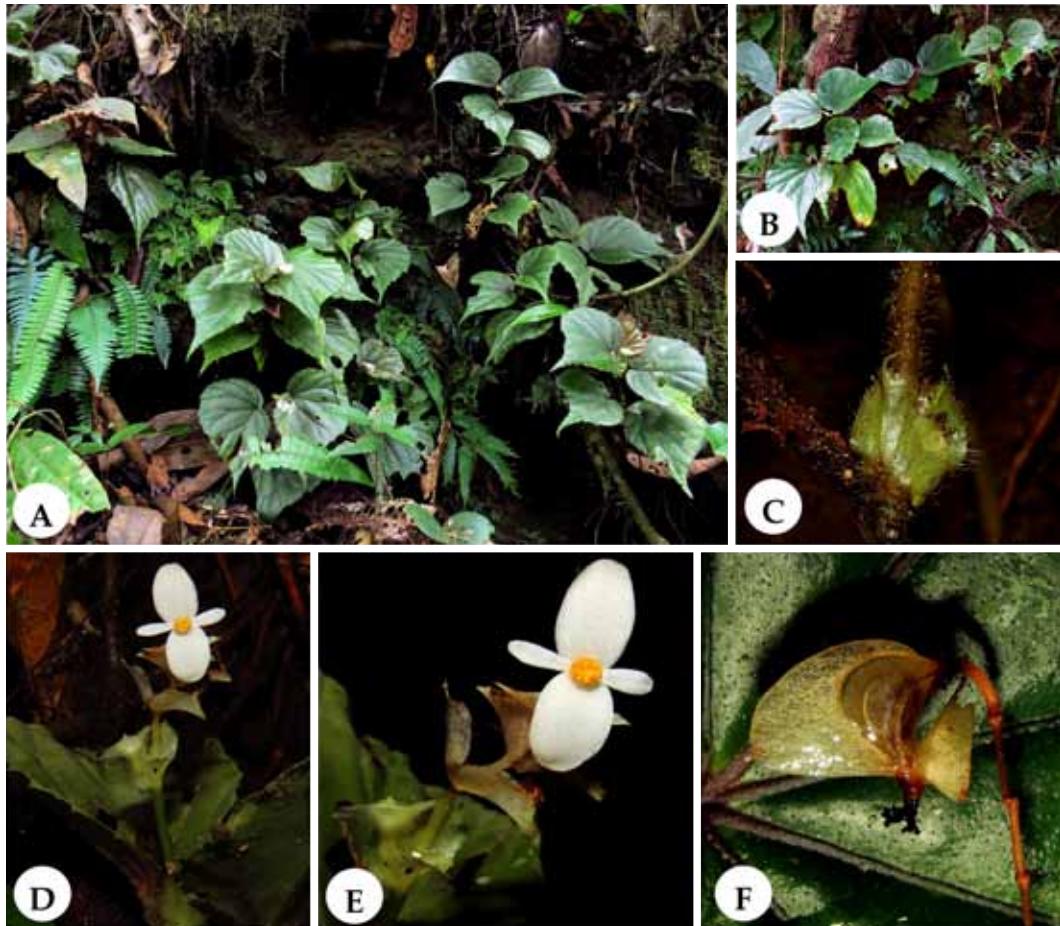


Fig. 1. *Begonia chakensis*. A & B. Habit; C. Stipule; D & E. Male flowers; F. Old fruit. All photos from BMHEP 3826 by Ling Chea Yiing.

3.5–5 cm long, slightly grooved above; lamina plain green to dark green above, dark red or sometimes pale green tinged red beneath, young leaves pale green tinged red, wavy, in life succulent, glabrous, glossy, asymmetric, ovate, $11\text{--}13.8 \times 6.6\text{--}8.5$ cm, broad side 4.5–6 cm wide, base acute or slightly cordate, basal lobes ca. 5 mm long, margin minutely serrate, apex acuminate, acumen to 1–2.5 cm long; venation pinnate-palmate, veins greenish above except near the leaf base, dark red beneath, 3–4 veins on either side of the midrib, 1–2 veins in basal lobe, prominent on both surfaces. Inflorescences protogynous, axillary on the uppermost part of the stem, with single female flower and male inflorescences in a simple cyme to ca. 4 cm long. Bracts pale green, sometimes tinged red, ovate, $12\text{--}15 \times 6\text{--}8$ mm, margin serrate and ciliate, persistent. Bracteoles (lower part) pale green, upper ones white, ovate, $4\text{--}12 \times 3\text{--}6$ mm, margin ciliate, persistent. Male flowers: pedicel white, 4–9 mm long, glabrous; tepals

4, white, glabrous, margin entire, apex rounded, outer 2 tepals oval, 8–10 × 5 mm, inner 2 tepals lanceolate, ca. 5 × 2 mm; stamens 39–40, cluster globose, sessile; filaments yellow, ca. 1 mm long; anthers yellow, obovate, ca. 1 × 0.5 mm, apex emarginate. Female flowers: not seen. Capsules single, brown, ca. 6 × 11 mm, glabrous, wings 3, unequal, larger wing ca. 6 mm wide, smaller two ca. 4 mm wide, wings acute proximally, rounded distally, thinly fibrous, dehiscing between locule and wing; pedicel pendent, ca. 5 mm long.

ETYMOLOGY. Named for the stream where the species was collected (Sg. Chak).

ECOLOGY. Riparian forest at 586 m elevation.

DISTRIBUTION. Borneo. Endemic to Sarawak (Sg. Chak in Murum, Belaga District).

SPECIMEN EXAMINED—BORNEO. SARAWAK: Belaga District, Murum, Sg. Chak (tributary of Sg. Danum), 20 March 2014, *Ling et al. BMHEP 3826* (holotype SAR!).

NOTES. Very rare and known only from the type locality above the inundated area. The species is not placed in any section as the number of locules and placentas is unknown as no female flowers were available and the only old fruit had already dehisced and its internal structures could not be seen. Live plants were established *ex-situ* in Murum and Semengoh NR.

2. *Begonia johariana* S. Julia & C.Y. Ling sp. nov. (Section *Petermannia*)

Similar to *Begonia pendula* Ridley (1906: 257) in its creeping and somewhat wiry stem but it is different in its ovate leaves with unequally cordate base, 5–9.2 × 3–5 cm (vs. lanceolate with rounded base, 5–6.3 × 2.5–3.8 cm), the acuminate leaf apex with acumen 1–2 cm long (vs. apex acute), the floral bract and bracteoles persistent (vs. caducous), the tepals of male flowers 4 (vs. tepals 2) and the fruits smaller, 5–7 × 10–12 mm (vs. ca. 9 × 12 mm). Type: *Ling et al. AMHEP 2444*, Borneo, Sarawak, Belaga District, Murum, Sg. Adam, 30 November 2013 (holotype SAR!). (Fig. 2)

Creeping wiry herb, sometimes hanging on rocky cliffs. Stems, stipules, petioles and leaves beneath sparsely covered with fine short white hairs, more noticeable on petioles. Stems red-brown, 1–3 mm thick, internodes (2.2–)4–8.5 cm long, branched, succulent, slightly thicker at nodes. Stipules pale green tinged pale red at midrib, ovate, 5–8 × 2–4 mm, margin dentate, apex acuminate, seta 1–2 mm long, persistent. Leaves alternate, distant, oblique, held horizontally; petioles red-brown, 2.5–6(–8) cm long, terete; lamina plain green to dark green above, pale red brown beneath, young leaves tinged peachy-orange, in life succulent, glossy, asymmetric, ovate, 5–9.2 × 3–5 cm, broad side 1.7–3.4 cm wide, base unequally

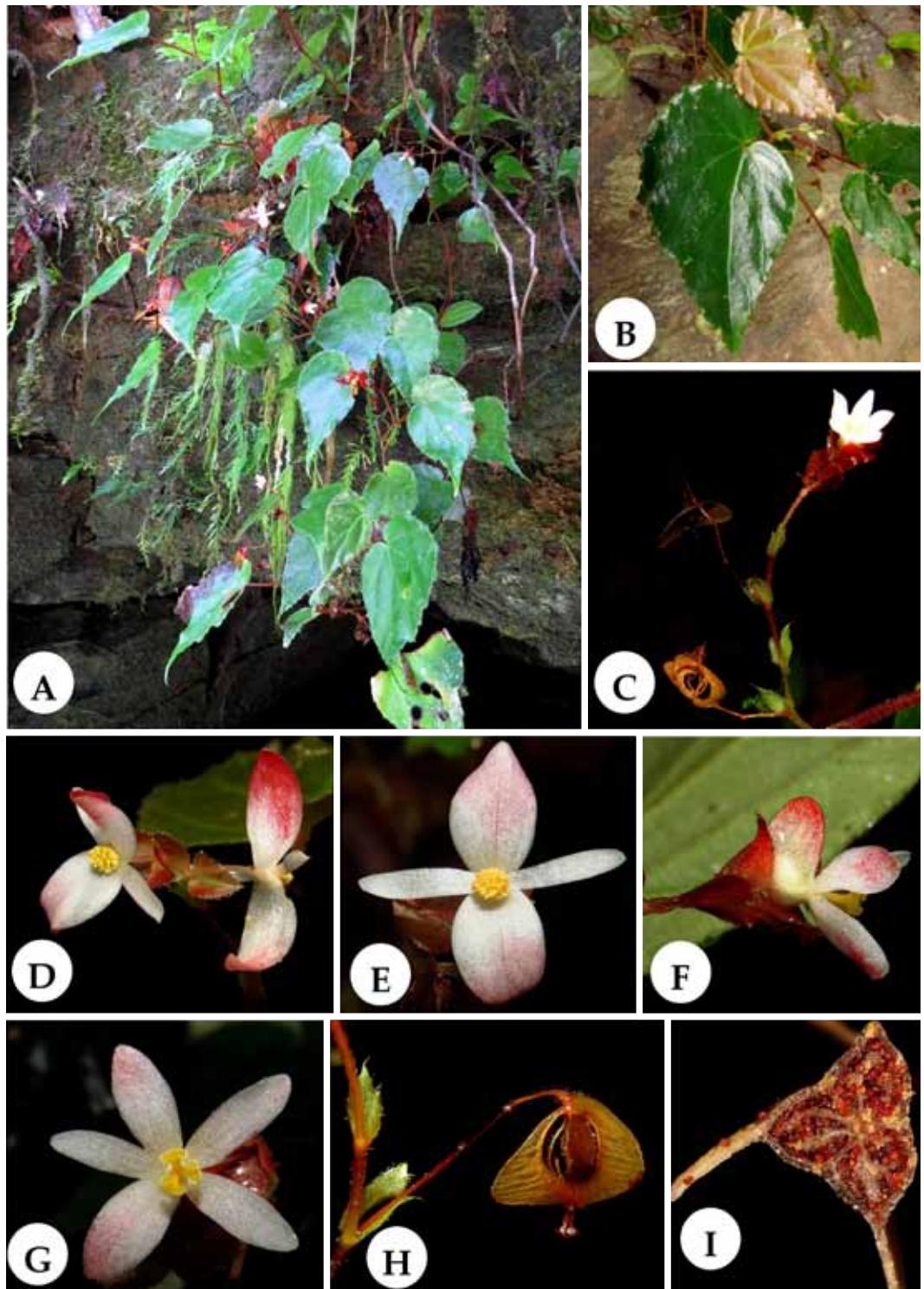


Fig. 2. *Begonia johariana*. **A & B.** Habit; **C.** Inflorescence; **D & E.** Male flowers; **F & G.** Female flower; **H.** Old fruit; **I.** Cross-section of fruit. All Photos from BMHEP 2444 by Ling Chea Yiing.

cordate, sometimes overlapping, basal lobes 8–20 mm long, margin minutely serrate and sparsely hairy, apex acuminate, acumen 1–2 cm long; venation pinnate-palmate, veins greenish above except near the leaf base, pale green beneath, 2–4 veins on either side of the midrib, 2–3 veins in basal lobe, slightly impressed above, prominent beneath. Inflorescences protogynous, axillary on upper parts of the stem, paniculate to 5 cm long. Bracts pale green, ovate, 5–7 × 2–4 mm, margin ciliate, persistent. Bracteoles 2–4 pairs, lower bracteoles similar to bracts, pale green tinged reddish, 4–6 × 2–5 mm, upper bracteoles reddish, oval, 5–6 × 4–5 mm, keeled, margin ciliate, persistent. Male flowers: pedicel white, ca. 3 mm long, glabrous; tepals 4, white inside, white or sometimes reddish towards the apex, glabrous, margin entire, apex broadly acute to rounded, outer 2 tepals broadly ovoid, 7–8 × 5 mm, inner 2 tepals lanceolate, 5–7 × 2–3 mm; stamens ca. 40, cluster conical, subsessile; filaments pale yellow, 0.8–1.1 mm long; anthers pale yellow, obovate, 0.8–1 × 0.4 mm, apex emarginate. Female flowers: pedicel reddish green to pale green, ca. 3 mm long, glabrous; ovary white or pale green with reddish wings or deep red, broadly elliptic, 5–6 × 8–9 mm, glabrous, wings 3, unequal, locules 3, placentas 2 per locule; tepals 5, white inside, white tinged reddish outside, glabrous, outer 4 tepals elliptic, 6–7 × 2–3 mm, margin entire, apex acute, innermost tepal slightly smaller, ca. 5 × 1.5–2 mm; styles 3 rarely 2, pale yellow, ca. 2 mm long, divided to base, widely Y-shaped; stigma pale yellow, papillose forming a continuous twisted band. Capsules single on the lower rachis, 5–7 × 10–12 mm, glabrous, locules 3, wings 3, unequal, broadly acute proximally, rounded distally, 2–3 mm wide, thinly fibrous, dehiscing between locule and wing; pedicel pendent, ca. 5 mm long.

ETYMOLOGY. Named after Haji Johari bin Atok, Senior Manager of Environmental Impact Assessment Division, SEB, for his strong support for WiMOR project.

ECOLOGY. Riparian forest on mossy sandstone boulders in shaded and consistently wet areas near waterfalls or near streams at 480–554 m elevation.

DISTRIBUTION. Borneo. Endemic to Sarawak (Sg. Danum).

SPECIMENS EXAMINED—BORNEO. SARAWAK: Belaga District, Murum Dam: Sg. Danum — Sg. Danum, Whillander *et al.* BMHEP 2554 (SAR); Sg. Adam, Vilma *et al.* BMHEP 2045 (SAR); Ling *et al.* AMHEP 2444 (holotype SAR); Sg. Po, Vilma *et al.* BMHEP 1916 (SAR). Live plants established in Murum and Semengoh NR under accession number Ling *et al.* AMHEP 1042 (collected from Sg. Danum), Andy *et al.* BMHEP 3661 (collected from Sg. Lemujan, a tributary of Sg. Danum) and Vilma *et al.* BMHEP 1951 (collected from Sg. Piling, a tributary of Sg. Danum).

3. *Begonia julaihiana* S. Julia & C.Y. Ling sp. nov. (Section *Petermannia*)

Similar to *Begonia subisensis* K.G. Pearce (2003: 85) in its habit, the woody stems, the lamina coloration and the number of stamens but it is different in its larger stipules, 21–24

\times 6–8 mm, that are conspicuously keeled (vs. stipules *ca.* 5.5 \times 1.5 mm and not keeled in *B. subisensis*), the petioles are shorter, 4–6 mm long (vs. 10–25 mm long), the basal lobe scarcely developed (vs. basal lobes to 1.3 cm long), the inflorescence longer, 7.5–14.5 cm long (vs. *ca.* 7.5 cm long), the bracts bigger, 10–14 \times 4–6 mm (vs. *ca.* 4 \times 2.5 mm), the ovary narrower, *ca.* 8 \times 11 mm (vs. *ca.* 16 \times 20 mm), the fruit pedicel shorter, 1.2–1.5 cm long (vs. *ca.* 3 cm long) and the fruits longer, 1.7–2.5 \times 2.5–2.8 cm (vs. 1.4 \times 2.3 cm). Type: *Ling et al. AMHEP 1181*, Borneo, Sarawak, Belaga District, Murum, Ulu Sg. Sauh, 18 October 2013 (holotype SAR!). (**Fig. 3**)

Cane begonia to 1 m tall, whole plant glabrous. Stems pale brown, red-brown towards the apex, 6–8 mm thick, internodes (1.3–)3.7–6 cm long, little-branched, woody, thicker at nodes. Stipules pale green or greenish pink, lanceolate, 21–24 \times 6–8 mm, margin entire, keeled, apex acuminate, acumen 1–2 mm long, caducous. Leaves alternate, distant, slightly falcate but not oblique, held more or less horizontally; petioles dark red, 4–6 mm long, slightly grooved above; lamina plain bronzy green above, dark red beneath, in life succulent, with reflective sheen above, matt beneath, slightly asymmetric, ovate to lanceolate, (8–)13–16 \times (2.8–)4–6 cm, broad side 2–3.7 cm wide, base acute, basal lobes scarcely developed, margin dentate and slightly wavy, apex acuminate, acumen 1–2.6 cm long; venation pinnate, veins greenish above, reddish near the leaf base, reddish beneath, 3–5 veins on either side of the midrib, prominent on both surfaces. Inflorescences protogynous, axillary in the upper leaf axils, rachis 7.5–14.5 cm long with 1–2 female flowers at the base and paniculate male inflorescences at the top of rachis. Bracts pale green, lanceolate, 10–14 \times 4–6 mm, margin entire, caducous; bracteoles similar to bracts but smaller, 5–10 \times 3 mm, caducous. Male flowers: pedicel reddish or greenish towards the tepals, 4–6 mm long; tepals 2, reddish, sometimes greenish and reddish at the base, oval or rounded, 4–5 \times 4 mm, margin entire, apex rounded; stamens *ca.* 26, cluster conical, subsessile; filaments pale yellow, 0.8–1 mm long; anthers pale yellow, obovate, 0.6–0.8 \times 0.4–0.6 mm, apex emarginate. Female flowers: pedicel pale green, *ca.* 1 mm long, sparsely pubescent; ovary pale green, wings tips reddish, ovoid, *ca.* 8 \times 11 mm, sparsely pubescent, wings 3, equal, locules 3, placentas 2 per locule; tepals 5, pale green tinged red, outer sparsely pubescent, inner glabrous, outer 3 tepals elliptic, 7–9 \times 3–4 mm, margin entire, apex acute, inner 2 tepals narrowly elliptic, *ca.* 6 \times 2 mm, margin entire, apex acute; styles 3, pale yellow, *ca.* 1 mm long, divided to base, shallowly Y-shaped; stigma pale yellow, papillose forming a continuous twisted band. Capsules in pairs, pale green, tinged reddish, triangular in outline, 1.7–2.5 \times 2.5–2.8 cm, glabrous, locules 3, wings 3, equal, acute and unequal proximally, truncate with rounded wings tips distally, 1–1.3 cm wide, thinly fibrous, dehiscing between locule and wing; pedicel pendent 1.2–1.5 cm long, reddish towards the base.

ETYMOLOGY. Named after Julaihi Lai Abdullah, forest botanist and Acting Deputy General Manager, Sarawak Forestry Corporation, who has strongly supported *Begonia* research in Sarawak.

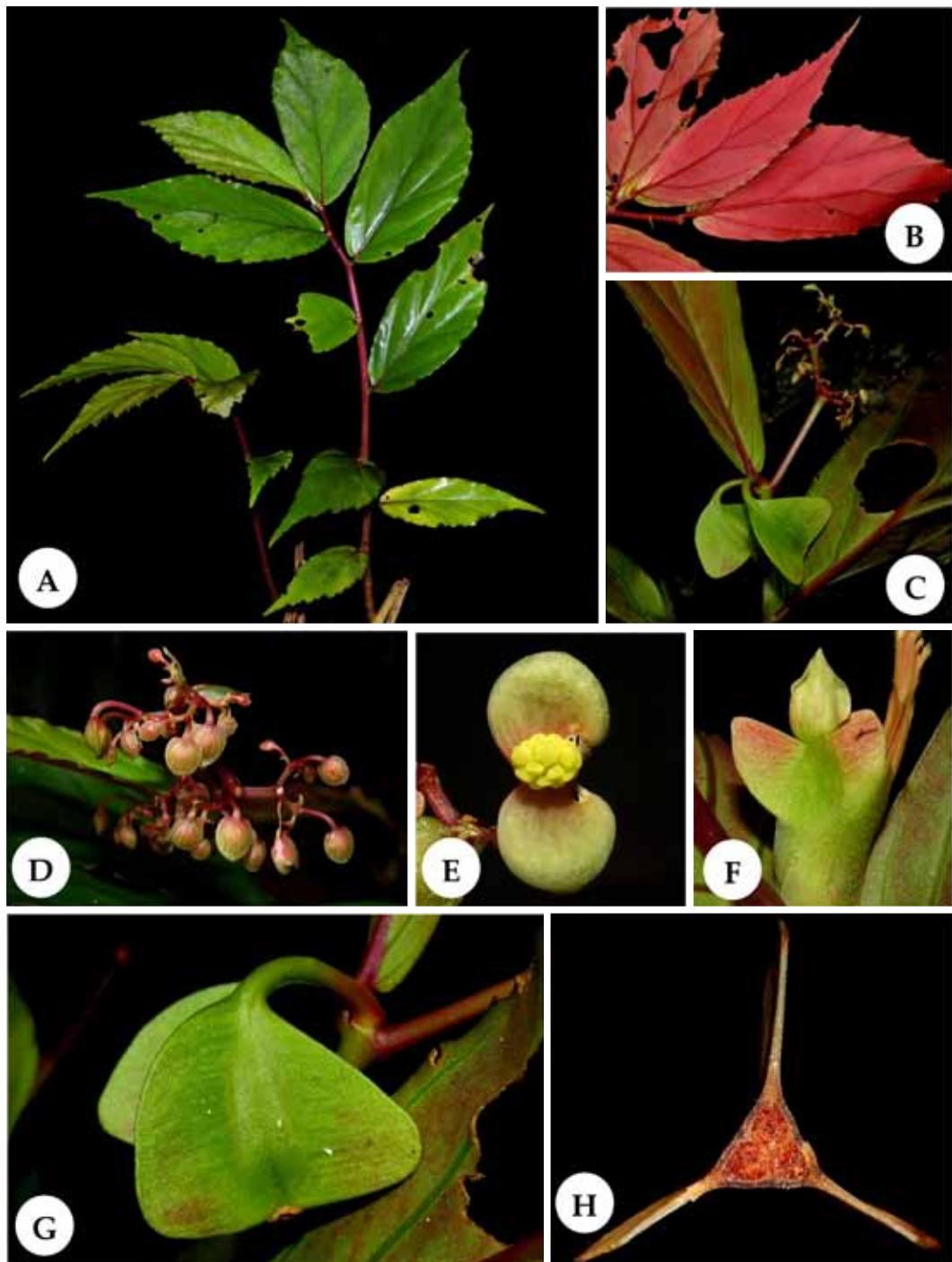


Fig. 3. *Begonia julaihiana*. **A.** Habit; **B.** Undersurface of lamina; **C.** Fruits and male inflorescence; **D.** Male inflorescence; **E.** Male flower; **F.** Female flower (immature); **G.** Fruit; **H.** Cross-section of fruit. Photo A from CMHEP 5099; Photo B from AMHEP 3687; Photos C–E & G–H from AMHEP 1181; Photo F from CMHEP 6058. Photos A & C–H by Ling Chea Yiing; Photo B by Andy Samuel.

ECOLOGY. Stream bank with mossy boulders at 479–590 m elevation.

DISTRIBUTION. Borneo. Endemic to Sarawak (Murum area).

SPECIMENS EXAMINED—BORNEO. SARAWAK: Belaga District, Murum Dam: Sg. Murum — Sg. Sailing, *Andy et al. AMHEP 3687* (SAR); Ulu Sg. Sauh, *Ling et al. AMHEP 1181* (SAR); Sg. Danum — Sg. Jelanok, *Peter et al. BMHEP 3940* (SAR); Sg. Plieran — Sg. Menapun, *Ling et al. CMHEP 6058* (SAR). Live plants established in Murum and Semengoh NR under accession number *Ling et al. AMHEP 2357* (collected from Ulu Sg. Sailing), *Whillander et al. CMHEP 5099* (collected from Sg. Singu, a tributary of Sg. Plieran) and *Ling et al. CMHEP 6019* (collected from Sg. Menaban, a tributary of Sg. Plieran).

NOTES. This species is rather common in the Murum area and also occurs in forest above the inundated areas.

4. *Begonia murumensis* S. Julia & C.Y. Ling sp. nov. (Section *Petermannia*)

Similar to *Begonia lailana* Kiew & C. Geri (2003: 117) in its cane-like habit, hairy stem, not oblique leaf and paniculate inflorescences but it is different in its little-branched and less robust stems, *ca.* 0.5 cm thick (vs. much-branched and robust stems, *ca.* 0.7 cm thick in *B. lailana*), the internodes are shorter, 1.8–5.5 cm long (vs. 7–11 cm long), the stipules smaller, *ca.* 7 × 2 mm (vs. 15–27 × 6–10 mm), the lamina lanceolate and narrower, 3–5 cm wide (vs. oblanceolate, 8–10 cm wide) with 4–5 veins on each side of the midrib (vs. 3 veins), the inflorescences are shorter, rachis 4.5–8.5 cm long (vs. rachis 10–16 cm long), the ovary shorter, 10–11 mm long (vs. 13–18 mm long) and the fruits smaller, 12–15 × 11–18 mm (vs. 22–27 × 18–28 mm). Type: *Jacqualine et al. BMHEP 5765*, Borneo, Sarawak, Belaga District, Murum, Sg. Siat (tributary of Sg. Danum), 14 June 2014 (holotype SAR!). (Fig. 4)

Cane-like begonia 30–50 cm tall. Stem, petioles, stipules and veins underneath sparsely hirsute, hairs white or brownish. Stems red-brown to dark brown, *ca.* 0.5 cm thick, internodes (1.8–)2–3.5(–5.5) cm long, little-branched, slightly succulent, slightly thicker at nodes. Stipules pale green, lanceolate, *ca.* 7 × 2 mm, keeled, margin entire, apex setose, seta *ca.* 2 mm long, caducous. Leaves alternate, distant, not oblique, held horizontally; petioles red-brown, 0.5–1 cm long, slightly grooved above; lamina dark green above, green sometimes tinged reddish beneath, young leaves bronzy-green or reddish, silvery spots of irregular sizes scattered on upper surface, usually the spots disappear in adult leaves, in life slightly succulent, glabrous, matt or slightly glossy, slightly asymmetric, lanceolate, 10–14(–17) × 3–4(–5) cm, broad side 2–2.5(–3) cm wide, base cuneate on narrow side, rounded on broad side, basal lobes scarcely developed, margin dentate, apex sharply acuminate, acumen to 2 cm long; venation pinnate, veins greenish on both surfaces except near the leaf base, 4–5 veins on either side of the midrib, slightly impressed above, prominent beneath. Inflorescences

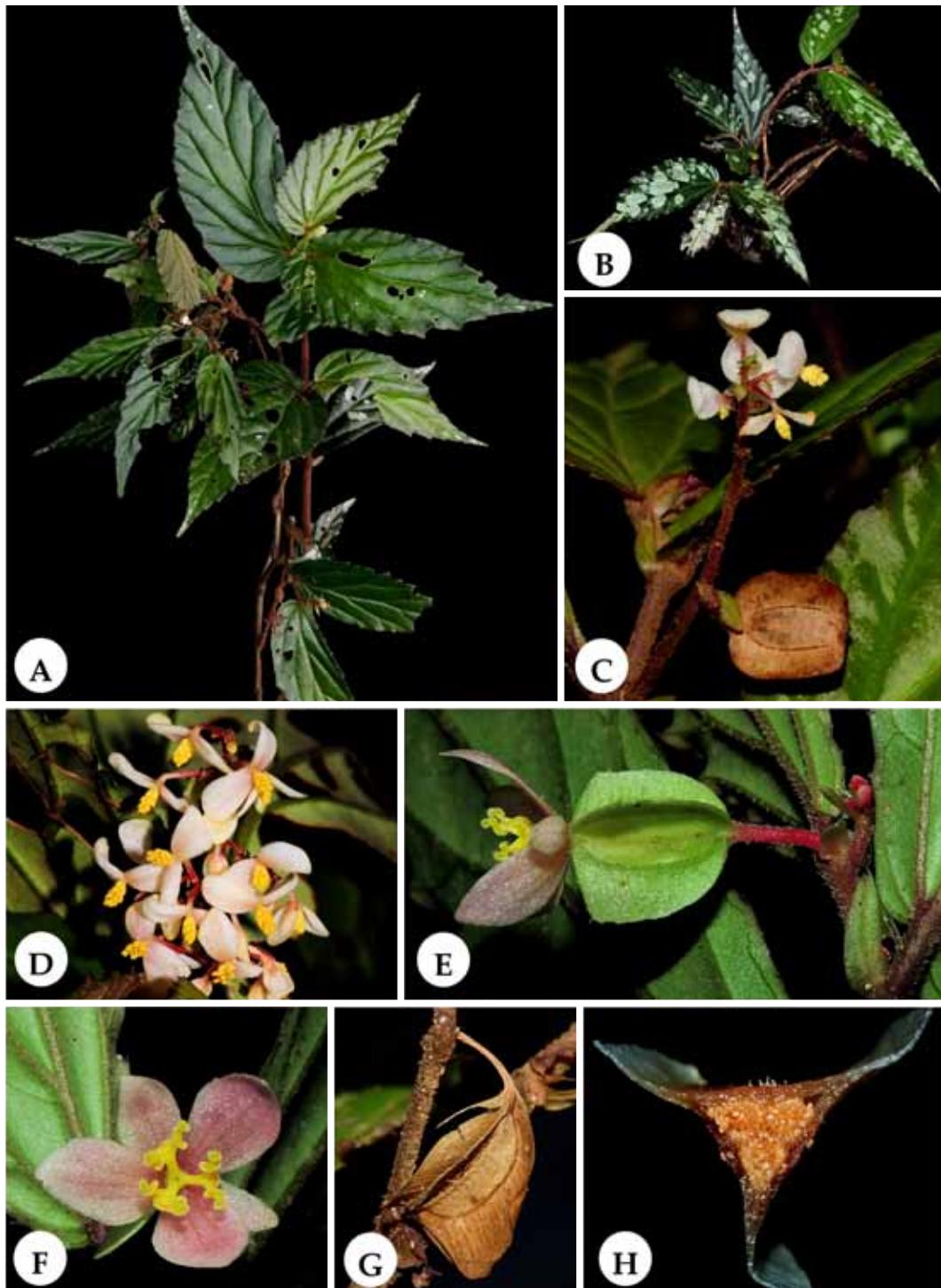


Fig. 4. *Begonia murumensis*. **A.** Habit; **B.** Young plant with spotted leaves; **C.** Male inflorescence and fruit; **D.** Male flowers; **E & F.** Female flower; **G.** Old fruit; **H.** Cross-section of fruit. Photos A & C–D from BMHEP 5765; Photo B from CMHEP 4672; Photos E–F & H from BMHEP 4922; G from AMHEP 1192. Photos A–D & G–H by Ling Chea Yiing; Photos E & F by Vilma Bodos.

protogynous, axillary on upper parts of the stem, with 1–2 female flowers at the base and male inflorescences a panicle, rachis 4.5–8.5 cm long. Bracts pale green or green tinged red, lanceolate, *ca.* 9 × 2 mm, keeled, margin entire, caducous. Bracteoles pale green, lanceolate, *ca.* 6 × 2 mm, margin entire, caducous. Male flowers: pedicel greenish white or pale pink, 2–4 mm long, glabrous; tepals 2, greenish white to completely white or pale pink, glabrous, oval, 4–5 × 3 mm, margin entire, apex rounded; stamens *ca.* 19, cluster conical, sessile; filaments yellow, 0.3–0.4 mm long; anthers yellow, obovate, *ca.* 1 × 0.5 mm, apex emarginate. Female flowers: pedicel pale green or reddish, 6–9 mm long, densely hirsute; ovary pale green, ovate, 10–11 × 7–9 mm, glabrescent, wings 3, equal, locules 3, placentas 2 per locule; tepals 5, pale green or pink, glabrous inside, sparsely hirsute outside, margin entire or sometimes slightly toothed on the upper half, apex acute, outer 2 tepals elliptic, 5–6 × 2–3 mm, inner 3 tepals broadly elliptic, 10–11 × 7–9 mm; styles 3, lemon yellow, *ca.* 3 mm long, divided to base, widely and deeply Y-shaped; stigma lemon yellow, papillose forming a continuous twisted band. Capsules single or in pairs, pale red, 12–15 × 11–18 mm, glabrous, locules 3, wings 3, slightly unequal, broadly acute proximally, rounded or truncate distally, 3–4 mm wide, thinly fibrous, dehiscing between locule and wing; pedicel pendent, *ca.* 8 mm long.

ETYMOLOGY. It takes its name from the Murum area where it is common.

ECOLOGY. On riverbanks with sandy clay soil at 480–561 m elevation.

DISTRIBUTION. Borneo. Endemic to Sarawak (Murum area).

SPECIMENS EXAMINED—BORNEO. SARAWAK: Belaga District, Murum Dam: Sg. Danum, *Vilma et al. BMHEP* 4922 (SAR); Sg. Payau, *Suzila et al. BMHEP* 2851 (SAR); Sg. Tilin, *Ling et al. BMHEP* 1192 (SAR); Sg. Jelanok, *Peter et al. BMHEP* 3949 (SAR); Sg. Siat, *Jacqualine et al. BMHEP* 5765 (holotype SAR!); Sg. Plieran — Sg. Menawan, *Vilma et al. CMHEP* 7 (SAR). Live plants established in Murum and Semengoh NR under accession number *Suzila et al. BMHEP* 4671 and *BMHEP* 4672 (both collected from Sg. Danum).

NOTES. One of the commonest species in the Murum Dam area. It also occurs in forest above the inundated areas.

5. *Begonia plieranensis* S. Julia & C.Y. Ling sp. nov. (Section *Petermannia*)

Similar to *Begonia fuscisetosa* Sands (1997: 433) in its habit, petiole and inflorescence lengths but it is different in being a shorter plant, *ca.* 40 cm (vs. 60–70 cm tall), its thicker stems 4–5 mm wide (vs. *ca.* 2 mm wide), the hairs on leaves are pale green or white on a green base (vs. red or dark hairs on a dark red base), are sparse and irregularly distributed (vs. dense and regularly distributed), the lamina is larger, 11.2–16 × 5–8 cm (vs. 6–9 ×

2.3–3.5 cm), with broad side 2.7–4.5 cm wide (vs. *ca.* 2 cm wide), the leaf margin is dentate to doubly dentate (vs. serrate with teeth to 1 mm long at the vein endings), the basal lobes are 5–7 mm long (vs. scarcely developed), the fruit pedicel is shorter, *ca.* 8 mm long (vs. 10–14 mm long) and the fruits are narrower, *ca.* 8 mm wide (vs. 10–11 mm wide). Type: Ling et al. CMHEP 5982, Borneo, Sarawak, Belaga District, Murum, Sg. Plieran, 26 June 2014 (holotype SAR!). (**Fig. 5**)

Erect begonia to 40 cm tall. Stems green to pale green, 4–5 mm thick, internodes 2–5.5(–7.5) cm long, little branched, succulent, slightly thicker at nodes. Stipules pale green, lanceolate, *ca.* 6–9 × 2–3 mm, margin entire, apex acute, caducous. Leaves alternate, distant, slightly falcate but not oblique, held horizontally; petioles pale green to yellow-green, 4–13 mm long, terete above; lamina plain green to pale green above, paler beneath, in life succulent, papery when dry, with sparse, stiff, erect pale greenish or whitish hairs in between of veins on upper surfaces, glossy, asymmetric, obovate to oblanceolate, 11.2–16 × 5–8 cm, broad side 2.7–4.5 cm wide, base asymmetric, basal lobes 5–7 mm long, margin dentate to doubly dentate, teeth to *ca.* 9 mm long, apex acute to acuminate, acumen 1–1.5 cm long; venation pinnate, veins pale yellow-green above, pale green beneath, 3–5 veins on either side of the midrib, 1–2 veins in basal lobe, prominent on both surfaces with sparse short stiff hairs beneath, hairs pale green or whitish. Inflorescences protogynous, axillary in upper leaf axils, with 1–2 female flowers at the base and male inflorescences racemose, 2–6 cm long. Bracts pale green or sometimes whitish, lanceolate, 7–12 × 5 mm, keeled, margin entire, caducous. Bracteoles white to pale green, broadly elliptic, 1–1.3 × 0.8–1 cm, margin entire, persistent. Male flowers: pedicel pale green or white, 4–9 mm long, glabrous; tepals 2, white, glabrous, oval or obovate, 5–8 × 4–5 mm, margin entire, apex rounded; stamens 19–20, cluster conical, torus *ca.* 0.2 mm long; filaments pale yellow, 0.6–1 mm long; anthers pale yellow, obovate, *ca.* 0.6 × 0.5 mm, apex emarginate. Female flowers: pedicel pale green, 4–5 mm long, pubescent; ovary pale green or creamy yellow, ellipsoid, *ca.* 9 × 5 mm, pubescent, wings 3, subequal, locules 3, placentas 2 per locule; tepals 5, white, outer pubescent, inner glabrous, outermost tepals slightly smaller, elliptic, 11–12 × 5 mm, margin entire or toothed in the upper half, apex acute, inner 4 tepals obovate, 12–13 × 5–6 mm, margin toothed on the upper half, apex acute; styles 3, pale yellow, *ca.* 3 mm long, divided to base, shallowly Y-shaped; stigma pale yellow, papillose forming a continuous twisted band. Capsules single or in pairs at the base of rachis, *ca.* 12 × 8 mm, pubescent, locules 3, wings 3, equal, broadly acute proximally, acute to rounded distally, *ca.* 2 mm wide, thinly fibrous, dehiscing between locule and wing; pedicel pendent, *ca.* 8 mm long, pale green.

ETYMOLOGY. The species is named for the locality in which the type specimen was collected (Sg. Plieran).

ECOLOGY. Riparian forest with mossy boulders and rocky banks at 522–567 m elevation.

DISTRIBUTION. Borneo. Endemic to Sarawak (Murum area).

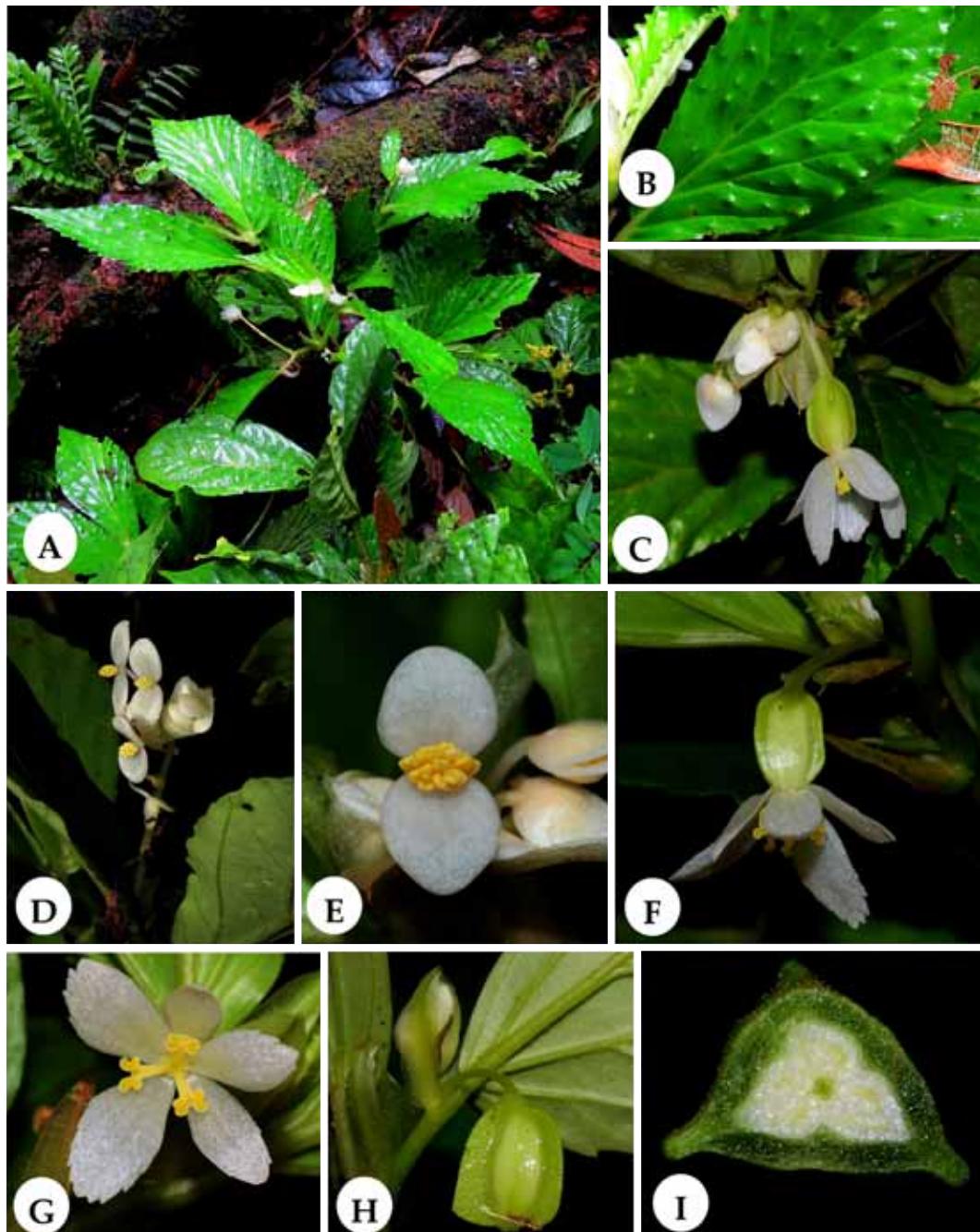


Fig. 5. *Begonia plieranensis*. **A.** Habit; **B.** Upper leaf surface with raised hair bases; **C.** Inflorescence; **D & E.** Male flowers; **F & G.** Female flowers; **H.** Fruit; **I.** Cross-section of fruits. Photos A & B from CMHEP 6602; Photos D & H from CMHEP 5982; Photos C, E–G & I from CMHEP 162. Photos A & B by Jacqualine Henry; Photos C–I by Ling Chea Yiing.

SPECIMENS EXAMINED—BORNEO. SARAWAK: Belaga District, Murum Dam: Sg. Plieran, *Jacqualine et al.* CMHEP 5900 (SAR); Vilma et al. CMHEP 162 (SAR); Ling et al. CMHEP 5982 (SAR); Sg. Menapun, *Jacqualine et al.* CMHEP 6602 (SAR). Live plants established in Murum and Semengoh NR under accession number Ling et al. CMHEP 5982 (collected a Sg. Plieran), Ling et al. BMHEP 3872 (collected from Sg. Danum) and Ling et al. BMHEP 3824 (collected from Sg. Chak, a tributary of Sg. Danum).

6. *Begonia rhodotricha* S. Julia & C.Y. Ling sp. nov. (Section *Petermannia*)

Similar to *Begonia longiseta* Irmscher (1953a: 499) in its densely hairy stems, petioles and veins but it is different in its alternate and distant leaves with internodes 3–3.5 cm long (vs. 2–4 cm long between the pairs of sub-opposite leaves associated with the inflorescence and 3–5 mm long between the internodes of the subopposite leaves), the stem is thicker, ca. 8 mm thick (vs. 2–3 mm thick), the petioles longer, 6–13 mm long (vs. 3–5 mm long), the female flowers solitary and the male flowers in simple cymes (vs. racemose inflorescence with lateral cymes), the male flowers have shorter pedicels, ca. 6 mm long (vs. ca. 12 mm long) and 4 tepals (vs. 2 tepals) and the female flowers have a larger ovary, 10–14 × 9 mm (vs. 6.5–8.5 × 4–5 mm). Type: Ling et al. AMHEP 3819, Borneo, Sarawak, Belaga District, Murum, Sg. Danum, 20 March 2013 (holotype SAR!). (**Fig. 6**)

Erect begonia to 45 cm tall. Stems brown, 3–8 mm thick, internodes 3–3.5 cm long, densely pilose, hairs white, little-branched, slightly succulent, slightly thicker at nodes. Stipules pale green, triangular, 8–12 × 2–3 mm, densely pilose, hairs white, margin entire, apex pointed, caducous. Leaves alternate, crowded, not oblique, held horizontally; petioles greenish brown, (0.2–)0.6–1.3 cm long, slightly grooved above; lamina plain green above, pale green beneath, in young leaves sometimes with silvery patches on the upper surface, in life slightly succulent, glabrous or sparsely bristly above, densely pubescent beneath, glossy, slightly asymmetric, broadly ovate, 9–14(–19) × 4–7(–7.5) cm, broad side 2.5–4.5 cm wide, base cordate, sometimes overlapping, basal lobes ca. 5 mm long, margin serrate, apex acuminate, acumen to 5–7 mm long; venation pinnate, veins greenish on both surfaces except near the leaf base, 3–5 veins on either side of the midrib, 1–2 veins in basal lobe, slightly impressed above, prominent beneath. Inflorescences protogynous, axillary with solitary female flowers and male flowers in simple cymes. Bracts of male flowers red, lanceolate, ca. 6 × 2 mm, densely pilose, hairs white, margin entire, persistent. Bracteoles of male flowers similar to bracts but smaller, ca. 4 × 2 mm, persistent. Male flowers: pedicel white, ca. 6 mm long, densely pilose, hairs white; tepals 4, white or white tinged pale pink and glabrous inside, outside reddish and densely pilose, hairs red, margin entire, outer 2 tepals oval, 6–7 × 5–6 mm, apex acute, inner 2 tepals narrowly oblanceolate, 6–7 × 2–3 mm, apex rounded; stamens ca. 27, sessile; filaments pale yellow, ca. 1 mm long; anthers pale yellow, obovate, ca. 0.5 × 0.2 mm, apex emarginate. Bracts of female flowers magenta or white, broadly ovate, ca. 5 × 4 mm, densely pilose, hairs reddish or pinkish, margin ciliate, persistent. Bracteoles

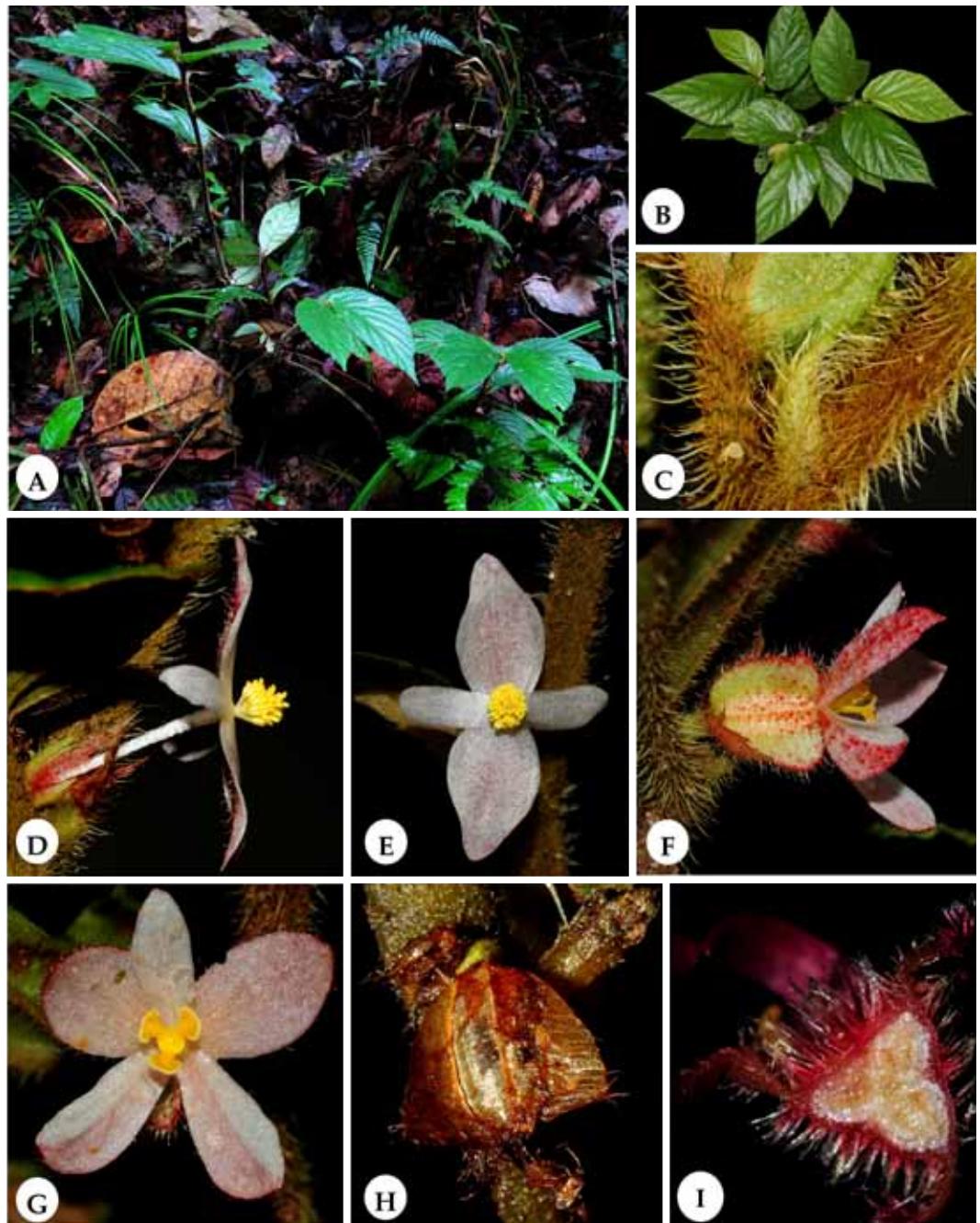


Fig. 6. *Begonia rhodotricha*. **A & B.** Habit; **C.** Stipule and petiole; **D & E.** Male flower; **F & G.** Female flower; **H.** Old fruit; **I.** Cross section of ovary. Photo A from CMHEP 6062; Photos B & C from BMHEP 3963; Photos D-E & H from BMHEP 3819; Photos F-G & I from BMHEP 5764. All photos by Ling Chea Yeing.

of female flowers similar to bracts but smaller, *ca.* 3 × 1 mm, persistent. Female flowers: pedicel pale green, 5–6 mm long, hairy; ovary green to greenish yellow or white, ovoid, 10–14 × 9 mm, sparsely pilose, hairs whitish or reddish with red or pink bases, wings 3, equal, locules 3, placentas 2 per locule; tepals 5, yellowish green to white or pale pink and glabrous inside, pink and densely pilose outside, hairs reddish or pinkish, margin entire, apex acute, outer 4 tepals elliptic, 8–9 × 5–6 mm, innermost one narrowly elliptic, *ca.* 8 × 4 mm; styles 3, yellow to orange-yellow, *ca.* 2 mm long, divided to base, shallowly Y-shaped; stigma yellow, papillose forming a continuous twisted band. Capsules single or in pairs, pale green, *ca.* 15 × 10 mm, hairy, locules 3, wings 3, equal, rounded proximally, rounded or truncate distally, *ca.* 3 mm wide, thinly fibrous, dehiscing between locule and wing; pedicel erect, 6–8 mm long.

ETYMOLOGY. Greek, *rhodos* = reddish; *trichos* = hairs, referring to the reddish hairs on the flowers and fruits.

ECOLOGY. Riparian on shaded riverbanks, near waterfalls with large boulders or in hill forest near streams at 514–574 m elevation.

DISTRIBUTION. Borneo. Endemic to Sarawak (Murum area).

SPECIMENS EXAMINED—BORNEO. SARAWAK: Belaga District, Murum Dam: Sg. Danum, Ling *et al.* BMHEP 2426 (SAR); BMHEP 3870 (SAR); BMHEP 3868 (SAR); Sg. Lemunjan, Andy *et al.* BMHEP 3661 (SAR); Sg. Chak, Ling *et al.* BMHEP 3818 (SAR); BMHEP 3819 (holotype SAR); Long Malim, Rantai *et al.* BMHEP 3107 (SAR); Sg. Siat, Jacqualine *et al.* BMHEP 5770 (SAR); BMHEP 5771 (SAR); BMHEP 5764 (SAR); Sg. Pampong, Peter *et al.* BMHEP 3963 (SAR), Sg. Plieran — Sg. Menawan, Vilma *et al.* CMHEP 0062 (SAR); Sg. Penampang, Rantai *et al.* CMHEP 2754 (SAR), Sg. Menapun, Ling *et al.* CMHEP 6062 (SAR). Live plants established in Murum and Semengoh NR under accession number Ling *et al.* BMHEP 2426, BMHEP 3870, BMHEP 3868, Andy *et al.* BMHEP 3661, Ling *et al.* BMHEP 3818, BMHEP 3819, Rantai *et al.* BMHEP 3107 and Jacqualine *et al.* BMHEP 5764.

NOTES. It is a common species that also occurs in forest above inundated area.

7. *Begonia rhombipetala* S. Julia & C.Y. Ling sp. nov. (Section *Petermannia*)

Similar to *Begonia lunatistyla* Irmscher (1953a: 503) in its habit, slightly falcate leaves and the indumentum on the stems but it is different in its longer internodes 1.5–2 cm long (vs. 0.6–1.2 cm long in *B. lunatistyla*), the lamina sparsely hirsute above and beneath (vs. glabrous above), the veins 3–4 on each side of the midrib (vs. 1–2 veins on each side of the midrib), the tepals of male flower are isomorphic and larger, *ca.* 14 × 9 mm (vs. dimorphic

and smaller, outer ones $3\text{--}6.3 \times 3\text{--}6$ mm, inner ones $3\text{--}6 \times 2.3\text{--}4$ mm), the tepals of female flower are larger, *ca.* 10×7 mm (vs. $4.5\text{--}5 \times 2\text{--}2.5$ mm), the capsule is larger, *ca.* 12×12 mm with a longer pedicel, $12\text{--}14$ mm long (vs. capsule $7\text{--}11 \times 5\text{--}6$ mm and pedicel $2\text{--}3$ mm long). Type: *Ling et al. AMHEP 2368*, Borneo, Sarawak, Belaga District, Sg. Murum, 27 November 2013 (holotype SAR!). (**Fig. 7**)

Low herb, sometimes decumbent, erect stem to 30 cm tall. Stems, stipules, petioles and veins beneath densely hirsute, hairs magenta, 2–2.5 mm long. Stems red-brown, *ca.* 0.5 cm thick, internodes 1.5–2 cm long, unbranched, succulent, slightly thicker at nodes. Stipules red, lanceolate, $9\text{--}10 \times 4\text{--}5$ mm, margin entire, apex setose, seta *ca.* 3 mm long, persistent. Leaves alternate, crowded, falcate but not oblique, held horizontally; petioles red, (0.8–)1.2–2 cm long, slightly grooved or terete above; lamina plain metallic green to olive green above, dark red beneath, young leaves tinged peachy-orange, in life succulent, sparsely hirsute above and beneath, hairs magenta, glossy, slightly asymmetric, lanceolate to oblanceolate, $(8.5\text{--})10.5\text{--}14 \times (2.5\text{--})3.5\text{--}5$ cm, broad side 2–3.5 cm wide, base acute or slightly rounded, basal lobes *ca.* 5 mm long, margin minutely serrate, apex acute or shortly acuminate, acumen to 1 cm long; venation pinnate, veins greenish above except near the leaf base, magenta beneath, 3–4 veins on either side of the midrib, 1–2 veins in basal lobe, slightly impressed above, prominent beneath. Inflorescences protogynous, axillary usually on lower parts of the stem, sometimes towards the upper leaves, with single female flower or a pair of female flowers at the base, male inflorescences a simple cyme to 4–6 mm long. Bracts magenta, lanceolate, *ca.* 8×2 mm, margin entire, persistent. Bracteoles magenta, lanceolate, *ca.* 3×1 mm, margin entire, persistent. Male flowers: pedicel white, *ca.* 8 mm long, glabrous; tepals 4, isomorphic, pure white, crystalline, glabrous, ovoid, *ca.* 14×9 mm, margin slightly toothed towards the apex or entire, apex acute; stamens 10–18, torus *ca.* 0.5 mm long; filaments yellow, 2.5–3 mm long; anthers lemon yellow, obovate, $0.5\text{--}0.8 \times 0.4$ mm, apex emarginate. Female flowers: pedicel reddish near the base, otherwise white, *ca.* 9 mm long, glabrous; ovary completely white when young, later turning reddish, ovoid, *ca.* 10×10 mm, glabrous, wings 3, equal, locules 3, placentas 2 per locule; tepals 5, white, crystalline, glabrous, rhomboid, strongly and abruptly narrowed to the base, *ca.* 10×7 mm, margin entire, apex acute; styles 3, lemon yellow, *ca.* 3 mm long, divided to base, deeply Y-shaped; stigma lemon yellow, papillose forming a continuous twisted band. Capsules single or in pairs, white tinged red, *ca.* 12×12 mm, glabrous, locules 3, wings 3, equal, acute proximally, rounded distally, *ca.* 5 mm wide, thinly fibrous, dehiscing between locule and wing; pedicel pendent, 1.2–1.4 cm long.

ETYMOLOGY. Greek, *rhombos* = rhomboid; *petalon* = petal; referring to the shape of the tepals of female flower.

ECOLOGY. Riparian or mixed dipterocarp forests near small creeks at 490–820 m elevation.

DISTRIBUTION. Borneo. Endemic to Sarawak (Murum area).

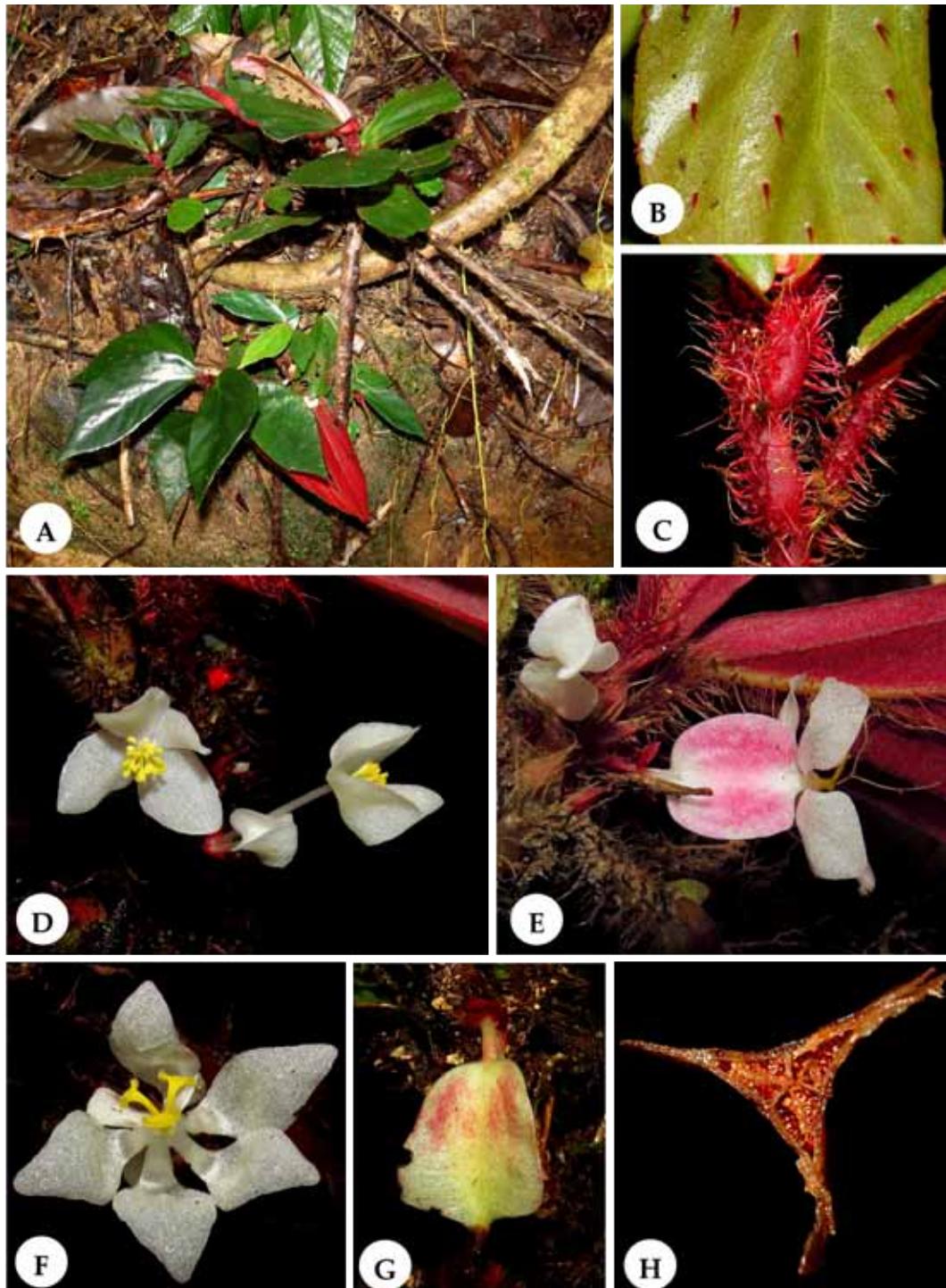


Fig. 7. *Begonia rhombipetala*. **A.** Habit; **B.** Upper leaf surface with red hairs; **C.** Stipule and petioles; **D.** Male flowers; **E & F.** Female flowers; **G.** Fruit; **H.** Cross-section of fruit. Photos A–C & F from AMHEP 2355; Photos D–E & G–H from AMHEP 1148. All photos by Ling Chea Yiing.

SPECIMENS EXAMINED—BORNEO. SARAWAK: Belaga District, Murum Dam: Sg. Murum — Sg. Sailing, *Ling et al. AMHEP 1148* (SAR); Ulu Sg. Sauh, *Ling et al. AMHEP 2355* (SAR); Sg. Sauh, *Vilma et al. AMHEP 1883* (SAR); Sg. Murum, 27 November 2013, *Ling et al. AMHEP 2368* (holotype SAR!); Sg. Plieran — Sg. Menapun, *Julia et al. CMHEP 4403* (SAR). Live plants established in Murum and Semengoh NR under accession number *Ling et al. CMHEP 1145* (collected from Sg. Sailing); *Andy et al. CMHEP 3637* (collected from Sg. Menapun).

NOTES. This species is quite common in the Murum area. It also occurs in forest above the inundated area.

8. *Begonia tenuissima* S. Julia & C.Y. Ling sp. nov. (Section *Petermannia*)

Like *Begonia xiphophylla* Irmscher (1953b: 100) in its narrow leaves but it is different in its even narrower leaves, 8–18 mm wide (vs. 18–26 mm wide in *B. xiphophylla*), smaller, 3–5 × 2 mm, and caducous stipules (vs. 5–8 × 3 mm and persistent), the internodes longer, 2–4 cm long (vs. 1–2 cm long), the capsules longer, ca. 14–20 × 8–10 mm (vs. ca. 10 × 12 mm), the pedicel longer, ca. 20 mm long (vs. 10–12 mm long), the female flowers with a larger ovary, ca. 12 × 7 mm (vs. 4–6 × 2–4 mm) and the male flowers with 2 tepals (vs. 4 tepals in *B. xiphophylla*). Type: *Jacqualine et al. CMHEP 6606*, Borneo, Sarawak, Belaga District, Murum Dam, Sg. Plieran, 15 September 2014 (holotype SAR!). (**Fig. 8**)

Erect begonia to 50 cm tall. Stems reddish brown, 3–4 mm thick, internodes 2–4 cm long, much-branched, slightly thicker at nodes, becoming woody in old plants. Stipules pale green, linear, 3–5 × 2 mm, margin entire, apex acute, caducous. Leaves alternate, distant, not oblique, held more or less horizontally; petiole reddish, 3–5 mm long, glabrous, grooved above; lamina plain green, paler beneath, in life slightly fleshy, matt, narrowly lanceolate, (8.5–)10–15 × (0.8–)1–1.8 cm, asymmetrical, broad side 0.5–0.8 cm wide, basal lobe inconspicuous, base unequal, acute, margin irregularly toothed at veins ending, teeth 3–5 mm long, apex sharply acuminate, acumen 1.5–2 cm long; venation pinnate, concolorous, 3–4 on each side of the midrib, sunken above, slightly prominent beneath. Inflorescence protogynous in the uppermost leaf axils, to 8 cm long, racemose, 1–2 female flowers and many male flowers, peduncle 3–5 cm long. Bracts pale green, linear, ca. 5 × 2 mm, apex acute, margin entire, caducous. Bracteoles pale green, linear, ca. 3 × 1 mm, margin entire, caducous. Male flowers: pedicel pinkish, 1.8–2 mm long; tepals 2, pale pink, oval, 2–4 × 1.2–2 mm, glabrous, margin entire, apex acute; stamens ca. 18, cluster conical, subsessile; filaments pale yellow, 0.2–0.3 mm long; anthers pale yellow, obovate, 0.8–1 × 0.5 mm, apex emarginate. Female flower: pedicel 6–9 mm long, reddish, glabrous; ovary pale green, glabrous, triangular in outline, 12–16 × 6–7 mm, wings 3, equal, locules 3, placentas 2 per locule; tepals 5, pinkish, lanceolate, more or less isomorphic, 7–10 × 3–5 mm, glabrous, margin entire, apex acute; styles 3, pale yellow, deeply Y-shaped, ca. 2 mm long, divided

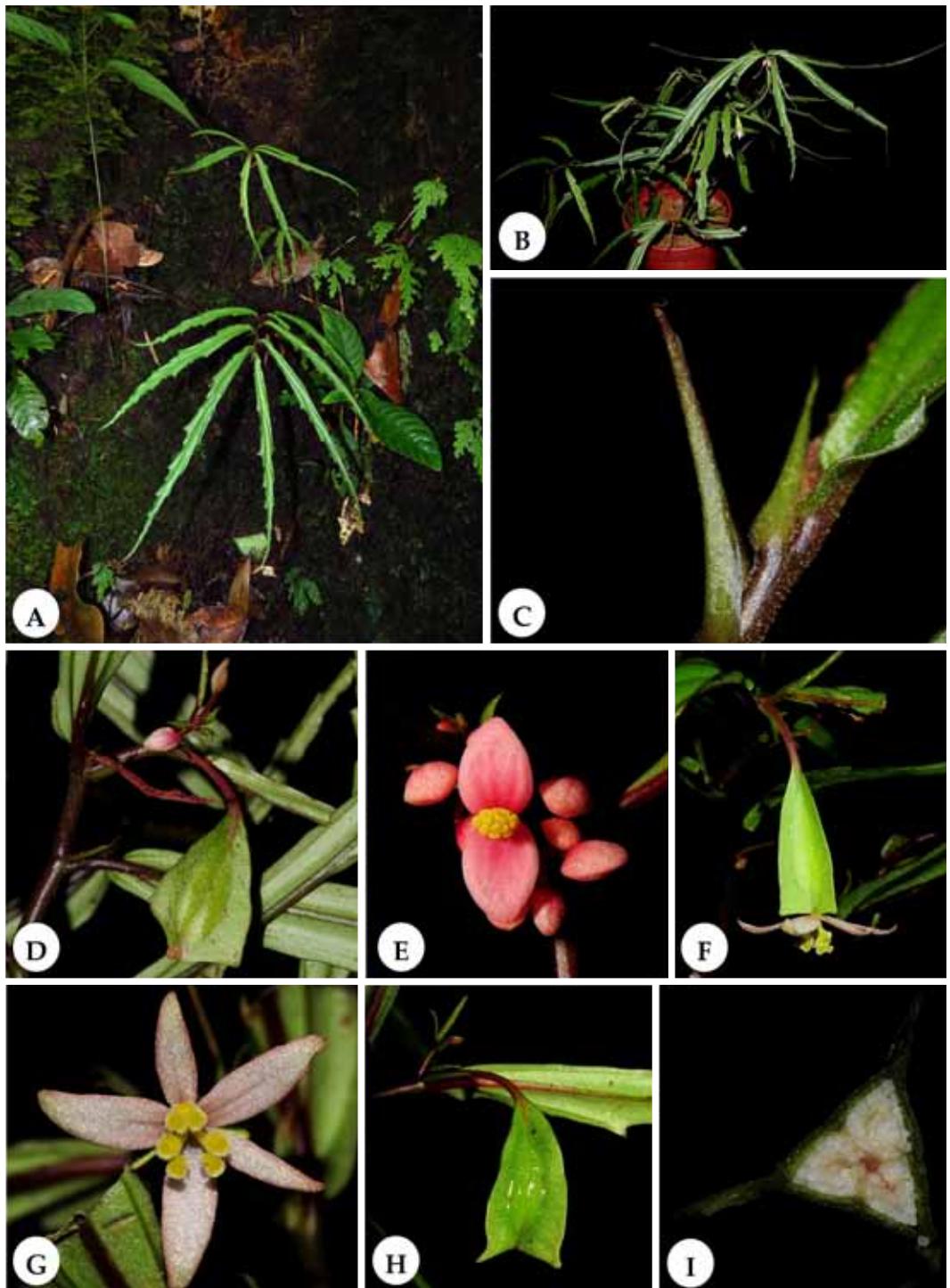


Fig. 8. *Begonia tenuissima*. A & B. Habit; C. Stipule; D. Male inflorescence and fruit; E. Male flowers; F & G. Female flowers; H. Fruit; I. Cross-section of fruit. Photos A–B & E–H from CMHEP 6913; Photo C from CMHEP 6606; Photos D & I from CMHEP 5897. All photos by Ling Chea Yiing.

to base; stigma yellow, papillose forming a continuous twisted band. Capsules at the base of rachis, 14–20 × 8–10 mm, glabrous, locules 3, wings 3, equal, broadly acute proximally, truncate distally, 2–5 mm wide, thinly papery, dehiscing between the locule and wing; pedicel pendent, 10–20 mm long, glabrous.

ETYMOLOGY. Latin, *tenuissima* = the narrowest; referring to the leaf shape that is the narrowest of any Bornean *Begonia* species.

ECOLOGY. Deeply shaded mossy rock surfaces or mossy steep slopes at 541–589 m elevation.

DISTRIBUTION. Borneo. Endemic to Sarawak (Sg. Plieran).

SPECIMENS EXAMINED—BORNEO. SARAWAK: Belaga District, Murum Dam: Sg. Plieran, *Jacqualine et al. CMHEP 5897* (SAR); Sg. Plieran, 15 September 2014, *Jacqualine et al. CMHEP 6606* (holotype SAR!); Ling *et al. CMHEP 6913* (SAR). Live plants established at Murum and Semengoh NR.

NOTES. The species also occurs above the inundated area but it has a very localised distribution and has only been recorded from Sg. Plirean.

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A Decade of *Begonia* (Begoniaceae) from Sarawak, Borneo

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Summary. Ten new species of *Begonia*, *B. bakunensis* S. Julia, *B. belagaensis* S. Julia, *B. bengohensis* S. Julia, *B. flavovirens* Kiew & S. Julia, *B. jugamensis* S. Julia & Kiew, *B. lambirensis* Kiew & S. Julia, *B. linauensis* S. Julia, *B. roseopunctata* Kiew, *B. setiamensis* S. Julia & Kiew and *B. sirukitii* S. Julia & C.Y. Ling, are described from Sarawak based on collections accumulated over a decade. All species have very narrow distributions with six known only from a single locality while others are known only from 2–5 localities. All species belong to the section *Petermannia*. Descriptions and colour photographs are provided for all species as well as a distribution map for all species.

Study of *Begonia* diversity in Borneo continues to reveal an astonishing number of new species as areas previously not explored botanically are visited. In Sarawak, only begonias associated with limestone hills have been the focus of study (Kiew, 2001; Pearce, 2003; Kiew & Geri, 2003; Kiew & Julia, 2007; Kiew & Julia, 2009; Julia *et al.*, 2013), resulting in the enumeration of 31 species, many confined to a single hill or group of hills. In general, this appears to be the pattern of distribution for Bornean begonias where very few species are widely distributed.

The impetus for this study comes from the preparation of the Guide to Begonias of Borneo, which drew attention to many attractive and interesting species that had not previously been

described and named. One focus of our study has been the documentation of *Begonia* in national parks. These begonias are among species that are most accessible to the general public but surprisingly many remain undescribed and without a name. Another focus has been the programmes by Sarawak Forestry to document plants from areas that will be flooded by hydroelectric dams, most recently at Bakun, Bengoh and Murum (Pascal *et al.*, 2014). In other areas, as a result of on-going landuse changes, begonias that are restricted to primary forest are vulnerable to disturbance, both from exposure following the opening of the canopy or from siltation and flooding of rocky streams, where they often grow. The forest of Bukit Setiam, Tatau District, is an extreme example of this. Part of the area has already been converted to oil palm plantations, the rest has been severely disturbed by logging where bulldozing the soft mudstone has obliterated smaller streams and caused massive siltation of the main river. Begonias now only survive on a few vertical rock faces. Wildlife corridors can be a refuge for *Begonia* species, as is seen in the Bukit Mina Wildlife Corridor area, Tatau District, where streams protected by a broad forest margin still harbour pristine vegetation and where begonias can survive. This latter illustrates the importance of planning wildlife corridors and implementing their integrity as areas are cleared for plantations.

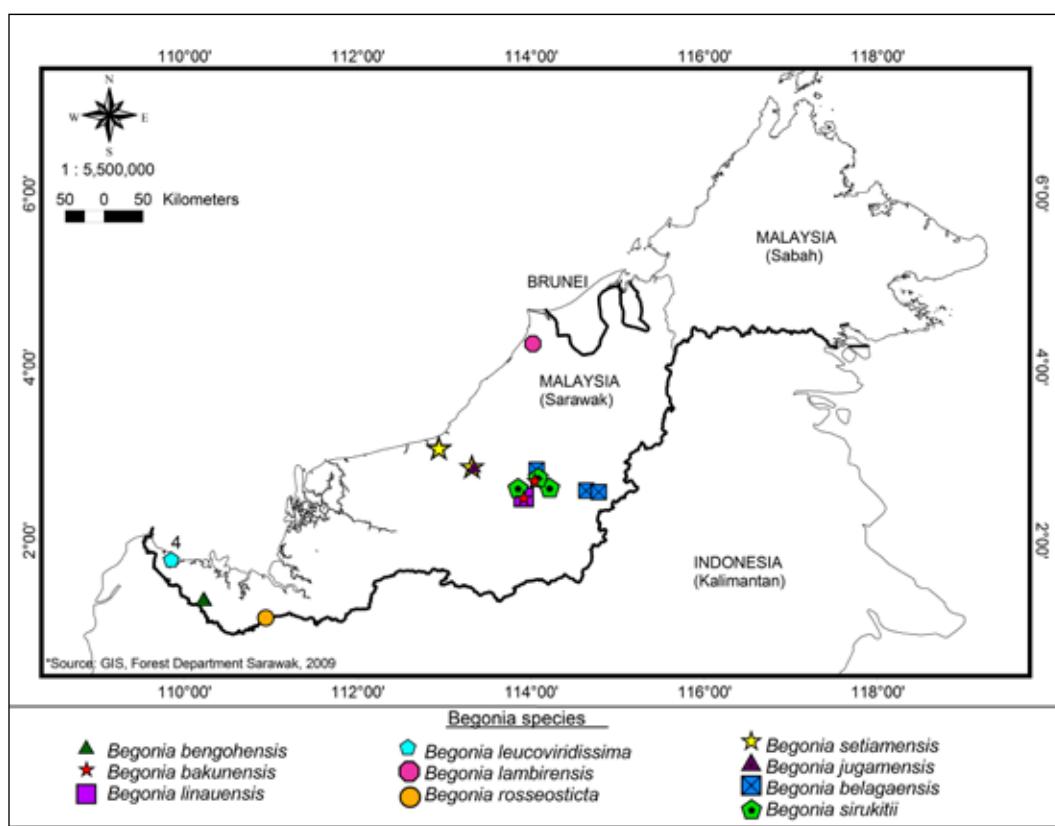


Fig. 1. Distribution of the ten species in Sarawak.

Materials and Methods

This study is based on herbarium collections made over a decade and deposited in the Sarawak Herbarium (SAR). All collections are from fieldwork by various staff of Sarawak Forestry and SAR, as well as the living collections in the nursery at the Semengoh Nature Reserve (NR), Kuching. All species descriptions are based on living material, unless otherwise specified.

Results

In this paper, ten new species are described and all are illustrated by colour photographs of living plants. All the species described here belong to section *Petermannia*. Based on current knowledge, most species have narrow distributions (Fig. 1).

Taxonomy Treatment

1. *Begonia bakunensis* S. Julia sp. nov.

This species is distinct in its semi-orbicular glandular bracts and bracteoles. Similar to *Begonia bahakensis* Sands (1997: 432) in its creeping or wiry habit, hispid petioles and broadly ovate lamina; it is different in having larger stipules, 7–12 × 6 mm, apex setose with seta to 5 mm long (vs. smaller stipules, ca. 5 × 3 mm, apex setose with seta to 2 mm long in *B. bahakensis*), longer lamina, 8–10 cm long (vs. 5.5–7.8 cm long), the narrow side 3.5–4.5 cm wide (vs. narrow side 1–2.5 cm wide), the basal lobes 1.5–2.5 cm long (vs. basal lobes 1 cm long, the base cordate and overlapping (vs. cordate but not overlapping), fruit pedicels shorter, 15–18 mm long (vs. 22–27 mm long) and the capsules wider, 1.5–1.7 cm (vs. narrower, 1.0–1.2 cm) with wings 4–5 mm wide, rounded distally and broadly acute proximally (vs. 3–5 mm wide, narrowed distally and proximally). Type: *Julia et al. SFC 575, Borneo, Sarawak, Belaga District, Bakun, Sungai Linau, 13 October 2009 (holotype SAR!). (Fig. 2)*

Creeping begonia, to 80 cm long. Stems 4–8 mm thick, red or reddish brown, densely covered with red hispid hairs, 3–4 mm long, much branched, slightly succulent, internodes 3.5–7.5 cm long, slightly thickened at nodes. Stipules brownish or greenish, densely hispid, ovate, 7–12 × 5–6 mm, keeled, margin entire, apex setose, seta to 5 mm long, persistent. Leaves alternate, distant, held horizontally, oblique; petioles red, densely covered with red hispid hairs, 5–10.5 cm long, terete; lamina plain pale green above, paler below, in life fleshy, glossy, broadly ovate, 8–10 × 6.5–8.5 cm, asymmetric, narrow side 3.5–4.5 cm wide, base cordate, overlapping, basal lobes 1.5–2.5 cm long, margin almost entire with minute teeth, apex acuminate, acumen to 1.5 cm long; venation palmate, veins red at the base, otherwise green, 2 veins on either side of the midrib, 3–4 veins in basal lobe, glabrous, impressed above, prominent beneath. Inflorescences protogynous, female flower single or



Fig. 2. *Begonia bakunensis*. **A.** Habit; **B.** Male inflorescence; **C.** Unopened male flowers and glandular bracts and bracteoles; **D.** Male flowers; **E & F.** Female flower; **G.** Cross-section of ovary. Photo A from SFC 719 by Ling Chea Yiing; Photos B–D from Linau 1-81 by Ong Poh Teck; Photos E & F from Linau 1-81 by Ling Chea Yiing; Photo G from Linau 1-81 by Julia Sang.

in pairs on the lower part of the stem; male inflorescences axillary, producing one to several cymes of male flowers, 2.5–4 cm long. Bracts pinkish red, reniform, 5–6 × 4–5 mm, margin entire with stalked glands, glabrous, persistent. Bracteoles similar shape but smaller. Male flowers: pedicel crimson, 4–6 mm long; tepals 4, glabrous, outer 2 tepals rotund, 4–6 × 5–6 mm, outside crimson, inside pale red, inner 2 tepals pinkish, narrowly elliptic, ca. 3 × 1 mm; stamens 28–30, yellow, cluster globose, torus short; filaments yellow, 1–2 mm long; anthers yellow, obovate, ca. 1 × 0.4 mm, apex emarginate. Female flowers: pedicel crimson, 1.3–1.8 cm long, glabrous; ovary crimson, ovoid, 0.8–1.4 × 1–1.5 cm, wings 3, more or less equal, locules 3, placentas bilamellate; tepals 5, crimson, glabrous, margin entire, outer 4 tepals more or less isomorphic, elliptic, ca. 10 × 4 mm, apex broadly acute or almost rounded, the innermost ones narrowly elliptic, ca. 9 × 4 mm, apex acute; styles 3, lemon yellow, ca. 2 mm long, divided to base, deeply Y-shaped; stigma lemon yellow, papillose forming a continuous twisted band. Capsules rotund, 1.2–1.5 × 1.5–1.7 cm, glabrous, locules 3, wings 3, sub-equal, rounded proximally, broadly acute distally, 4–5 mm wide, thinly fibrous, dehiscing between the locule and wing, pendent on pedicels 15–18 mm long. Seeds barrel-shaped, ca. 0.3 × 0.1 mm, columnar cells more than half the seed length.

ETYMOLOGY. Named for Bakun where the specimens were collected.

ECOLOGY. On very rocky steep slopes covered with thick leaf litter or in shaded areas on steep slopes in mixed dipterocarp forest at 168 m elevation.

DISTRIBUTION. Borneo. Endemic to Sarawak (Bakun area in Belaga District).

SPECIMENS EXAMINED—BORNEO. SARAWAK: Belaga District: Bakun Dam — Linau, Sungai Iban, *Lee*, BS 45550 (SAR); Sungai Linau, *Julia et al.* SFC 575 (holotype SAR!); Ulu Sungai Linau, Giam Talang, *Ling et al.* SFC 2273 (SAR); Sungai Linau, Bukit Anyob, *Julia et al.* Linau 1-81 (SAR); Ulu Sungai Linau, Wong Talang, *Rantai et al.* SFC 719 (SAR); Balupeh, *Julia* S 97238 (SAR).

2. *Begonia belagaensis* S. Julia sp. nov.

Similar to *Begonia propinqua* Ridley (1906: 249) in its bushy habit and very oblique and asymmetric leaves; however the species is different in having a succulent and thicker stem, 10–12 mm thick (vs. 6 mm thick in *B. propinqua*), wider stipules, 10–12 mm wide (vs. 6–8 mm wide), shorter petioles, 4–5 cm long (vs. 7.5–16 cm long), inflorescence bracts with glandular margins (vs. entire margin), longer female flower pedicel, ca. 2.5 cm long (vs. 0.6–1 cm long), longer fruit pedicel, 1–2.5 cm long (vs. 0.8–1 cm long), larger fruit, 1.5–1.8 × 1.4–1.5 cm (vs. 1–1.5 × 0.8–1.5 cm) and wider fruit wings, 5–6 mm wide (vs. 3–4 mm wide). Type: *Ling et al.*, BMHEP 3821, Borneo, Sarawak, Belaga District, Sungai Chak (tributary of Sungai Murum), 20 March 2014 (holotype SAR!). (**Fig. 3**)

Semi-erect begonia, to 30–50 cm tall, bushy and forming large clumps. Stems little-branched, pale green, 1–1.2 cm thick, glabrous, very succulent, internodes 3–6.5 cm long, slightly thicker at nodes. Stipules pale green glabrous, broadly ovate, 2.3–2.5 × 1–1.2 cm, keeled,



Fig. 3. *Begonia belagaensis*. A & B. Habit; C. Glandular bracts and bracteoles; D. Male flower; E. Male flowers; F & G. Female flower; H. Fruits on pendent pedicel. All photos from CMHEP 4785 by Ling Chea Ying.

margin entire, apex acute, persistent. Leaves alternate, distant, held horizontally, oblique, held vertically; petioles pale green, glabrous, 4–5 cm long, fleshy, *ca.* 6 mm thick, grooved above; lamina plain green, paler below, in life succulent and thick, glossy, asymmetric, broadly ovate, 12–12.5 × 11.5–12 cm, narrow side *ca.* 4 cm wide, base cordate, overlapping, basal lobes 1.5–2 cm long, margin minutely serrate, apex acuminate, acumen to 1 cm long; venation palmate-pinnate, 2–3 veins on either side of the midrib, twice branching, 3–4 veins in basal lobe, concolorous, glabrous, prominent on both surfaces, more so below. Inflorescences protogynous, axillary in upper leaf axils, glabrous, paniculate, peduncle *ca.* 4 cm long, rachis 14–30 cm long, 1–2 female flowers at the base, many male flowers on the upper rachis. Bracts pale green, broadly ovate, 18–22 × 7–10 mm, keeled, margin glandular, apex setose, seta *ca.* 2 mm long, caducous. Bracteoles pale green, orbicular, 6–7 × 5–6 cm, margin glandular. Male flowers: pedicel reddish, 5–12(–20)–13 mm long; tepals 4, pale green, reddish towards the base, glabrous, margin entire, apex acute, outer 2 tepals broadly oval, 4–6 × 5–6 mm; inner 2 tepals lanceolate, 2–5 × 1–2 mm; stamens 42–45, cluster conical, sessile; filaments lemon yellow, *ca.* 0.8 mm long; anthers lemon yellow, obovoid, 0.6–0.8 × 0.4 mm, apex emarginate. Female flowers: pedicel greenish or reddish, *ca.* 2.5 cm long, glabrous; ovary pale green or reddish tinged green, obovate, *ca.* 1.7 × 1.3–1.5 cm, wings 3, subequal, locules 3, placentas bilamellate; tepals 5, completely greenish or greenish at the apex, pinkish toward the base, outer 4 tepals elliptic, *ca.* 10–12 × 6–8 mm, margin entire, apex acute, innermost tepal linear or narrowly elliptic, *ca.* 8 × 2–5 mm; styles 3, lemon yellow, 2–3 mm long, divided to base, widely Y-shaped; stigma lemon yellow, papillose forming a continuous twisted band. Capsules single on the lower part of the rachis, completely green or reddish-green, 1.5–1.8 × 1.4–1.5, glabrous, locules 3, wing 3, subequal, rounded at both ends, 5–6 mm wide, thinly fibrous, dehiscing between the locule and wing, pendant on pedicels greenish or reddish, 1–2.5 cm long. Seeds barrel-shaped, *ca.* 0.3 × 0.2 mm, columnar cells more than half the seed length.

ETYMOLOGY. Named for the Belaga District where the species was collected.

ECOLOGY. Riparian forest in semi-shaded areas at 540–560 m elevation.

DISTRIBUTION. Borneo. Endemic to Sarawak (Bakun and Murum area in Belaga District).

SPECIMENS EXAMINED—BORNEO. SARAWAK: Belaga District: Murum Dam — Sungai Danum, Peter *et al.* BMHEP 4134 (SAR); Sungai Teba (tributary of Sg. Danum), Peter *et al.* BMHEP 4123 (SAR); Sungai Muat, Vilma *et al.* CMHEP 4785 (SAR); Sungai Nawang (tributary of Sungai Danum), Jacqualine *et al.* BMHEP 5843 (SAR); Bakun Dam — Sungai Balui, Ling *et al.* SFC 1301 (SAR), SFC 1302 (SAR); Sungai Chak (tributary of Sungai Murum), Ling *et al.* BMHEP 3821 (holotype SAR).

NOTES. Widespread in the Bakun Dam and Murum Dam area where the species still can be found above the inundated areas.

3. *Begonia bengohensis* S. Julia sp. nov.

Similar to *Begonia malachosticta* Sands (1990: 61) in its white spotted leaves but the species is different in its shorter stipules, ca. 13 mm long (vs. 17–22 mm long in *B. malachosticta*), length to width ratio of the lamina <3:1 (vs. 3–6:1), longer paniculate inflorescences, 9–20 cm long (vs. inflorescences cymose and not more than 4 cm long), larger bracts, 3–4 × 2 mm (vs. 0.75–1.5 × 0.5–0.75 mm), shorter pedicels of female flowers, ca. 8 mm long (vs. 13–25 mm long), fewer stamens, 30–40 (vs. 75–85) and broader outer tepals of female flowers, 9 × 5–6 mm (vs. 10–14 × 6–8 mm). Type: *Ling et al., SFC 1814, Borneo, Sarawak, Kuching District, Padawan, Sungai Bengoh, 24 June 2010 (holotype SAR!). (Fig. 4)*

Cane-like begonia, to 1.5 m tall. Stems erect and much-branched, reddish brown, slightly woody, 3–5 mm diameter, glabrescent, internodes 4–7 cm long, inconspicuously thicker at nodes. Stipules pale green, glabrous, lanceolate, ca. 13 × 4 mm, margin entire, apex setose, seta to 3 mm long, persistent. Leaves alternate, distant, held horizontally to slightly pointing downwards, oblique; petioles reddish brown, glabrescent, (2.8–)3–5 cm long, grooved above; lamina dark green above, paler below or purplish below on young leaves, plain or variegated above with irregular white patches between the veins on upper surface, in life bullate, coriaceous, glossy, ovate to triangular, asymmetric, 10–15.5 × 4–8 cm, the narrow side 1.8–2.5 cm wide, base cordate, basal lobes 0.8–1.2 cm long, margin minutely dentate, wavy, apex strongly acuminate, acumen to 3 cm long; venation palmate-pinnate, 2–3 veins on either side of the midrib, 3–4 veins in basal lobe, reddish brown, glabrous, strongly impressed above, prominent beneath. Inflorescences protogynous, axillary in upper leaf axils, paniculate, peduncle 4.5–6 cm long, rachis 9–20 cm long, with 1–2 female flowers and many male flowers. Bracts greenish, linear, 3–4 × 2 mm, entire, caducous. Bracteoles same shape as bracts but smaller. Male flowers: pedicel reddish or pinkish, 5–7 mm long; tepals 4, glabrous, margin entire, apex acute or rounded, outer 2 tepals pale green to yellowish green, oval, 3–5 × 4–5 mm; inner 2 tepals greenish or yellowish green, elliptic, 3–4 × 2 mm; stamens 30–40, cluster globose, sessile; filaments pale yellow, ca. 1 mm long; anthers pale yellow, obovoid, 1–1.6 × 1 mm, apex emarginate. Female flowers: pedicel pale pink or greenish, ca. 8 mm long, glabrescent; ovary greenish yellow, oblong or rotund, ca. 13 × 10 mm, wings 3, equal, locules 3, placentas bilamellate; tepals 5, yellowish green, margin entire, apex acute, 4 outer tepals ovate or elliptic, ca. 9 × 5–6 mm, the innermost ones smaller, lanceolate, ca. 8 × 2 mm; styles 3, pale yellow to pale brown, ca. 2 mm long, divided to base; stigma pale yellow or brownish, widely Y-shaped, papillose forming a continuous twisted band. Capsules ellipsoid or rotund, 1.7–2.2 × 1–1.5 cm, glabrous, locule 3, wings unequal, slightly rounded proximally, acute distally, 4–5 mm wide, thinly fibrous, dehiscing between the locules and wings, pendent on pedicels to 1.5–2 cm long, ca. 1 mm thick when dry. Seeds barrel-shaped, ca. 0.3 × 0.2 mm, columnar cells more than half the seed length.

ETYMOLOGY. Named for Sungai Bengoh where the type specimen was collected.

ECOLOGY. Shaded areas along rivers in lowland forest below 100 m elevation.

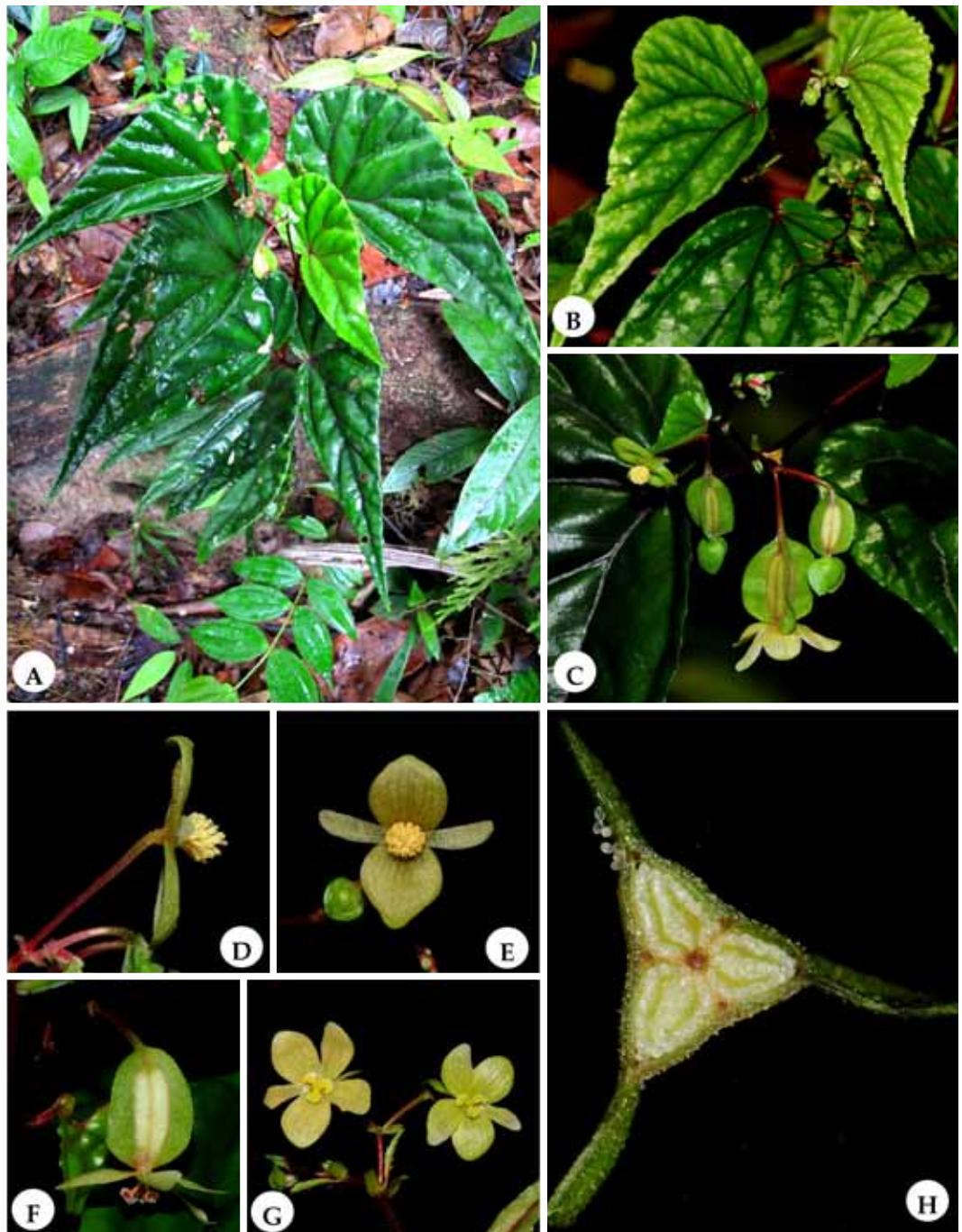


Fig. 4. *Begonia bengohensis*. **A.** Habit with plain leaves; **B.** Leaves with white spots; **C.** Inflorescence on upper leaf axil; **D & E.** Male flower; **F & G.** Female flowers; **H.** Cross-section of ovary showing 3 locules with 2 placentas each. All photos from SFC 1814 by Ling Chea Yiing.

DISTRIBUTION. Borneo. Endemic to Sarawak (Padawan).

SPECIMENS EXAMINED—BORNEO. SARAWAK: Kuching District: Padawan — Sungai Bengoh, Ling *et al.* SFC 1814 (holotype SAR!); Bengoh Dam site, along the trail to Kampung Sait, Ling *et al.* SFC 1613 (SAR).

NOTES. Living plants are currently grown in the *ex-situ* conservation collection in Semengoh NR.

4. *Begonia flavovirens* Kiew & S. Julia sp. nov.

Similar to *Begonia lailana* Kiew & Geri (2003: 117) in its habit and size of the stipule but it is different in its less robust stem and leaves, basal lobes 2.5–4 mm long (vs. 5–10 mm long in *B. lailana*), 5–6 veins on either side of the midrib (not 3), its inflorescences less branched with fewer male flowers and female tepals with entire margin (vs. toothed margin). Type: Julia & Kiew SFC 3415, Borneo, Sarawak, Lundu district, Gunung Gading National Park, main trail to Waterfall 2, 16 May 2014 (holotype SAR!). (**Fig. 5**)

Cane-like begonia, to 1.5 m tall. Stems 4–6 mm thick, reddish brown with adpressed pubescence; internodes 3–9.5 cm long, swollen at the nodes. Stipules pale green, lanceolate, ca. 2 × 0.7 cm, keeled outside, keel covered with long adpressed red hairs, apex setose, seta ca. 6 mm long, caducous. Leaves alternate, distant, tip pointing downward at an angle ca. 30°, not oblique; petioles reddish brown with adpressed pubescence, 8–13 mm long, slightly grooved above; lamina plain yellowish green above, pale green below, in life coriaceous, matt, asymmetric, slightly obovate, 11–18 × 5.5–9 cm, broad side 3.5–5.5 cm wide, base very unequal, slightly acute, basal lobes 2.5–4 mm long, margin finely serrate, apex acuminate, acumen 1–1.5 cm long; venation pinnate, 5–6 veins on either side of the midrib, a pair of vein in basal lobe, usually red below and at the base of the veins above, adpressed red hairs, midrib and base of the secondary veins slightly raised above (sometimes appearing slightly bullate), otherwise impressed, prominent beneath. Inflorescences protogynous, in the upper leaf axils, cymose, glabrous; peduncle 3.5–5.5 cm long, rachis to 5.5 cm long, very slender, ca. 1 mm thick, held horizontally, with a single female flower and 2–5 male flowers spaced 1–1.5 cm apart. Bracts and bracteoles similar to stipules but smaller in size, narrowly lanceolate, 4–8 mm long, margin entire, persistent. Male flowers: pedicel pale green, 3–5 mm long; tepals 2, very rarely 4, outside whitish green or white with long red hairs, inside greenish white, glabrous, broadly ovate, 5–7 × 6–7 mm, base slightly cordate, margin entire, apex rounded; stamens 20–35, pale yellow, cluster conical; filaments pale yellow, ca. 0.6 mm long; anthers pale yellow, obovoid, ca. 0.5 × 0.4 mm, apex emarginate. Female flowers: pedicel pale red, 3–7 mm, with sparse long hairs; ovary whitish green, ovoid, 1.2–1.5 × 1.2–1.5 mm, narrow to the base; tepals 5, outer 4 tepals completely isomorphic, broadly oval, ca. 7 × 4–5 mm, apex slightly acute; the fifth tepal narrower, ca. 7 × 4 mm; wings 3, equal, locules 3, placenta bilamellate; styles 3, pale yellow, ca. 3 mm long, divided to base;

stigma pale yellow, Y-shaped, papillose forming a continuous twisted band. Capsules on the lower part of the rachis, (1–)1.6–2.4 × (1–)1.3–1.9 cm, glabrous, locules 3, wings 3, equal, rounded proximally, expanding towards the apex, not projecting beyond the stigma, 3–7 mm wide, thin, dehiscing between the locules and wings, pedicel recurved and holding the capsules horizontally underneath the lamina, (5–)8–12 mm long, stiff. Seeds barrel-shaped, ca. 0.3 × 0.2 mm, collar cells half the seed length.

ETYMOLOGY. Latin, *flavovirens* = yellowish green, in reference to the colour of the foliage, its yellowish green foliage making it stand out against the duller green of the surrounding vegetation.

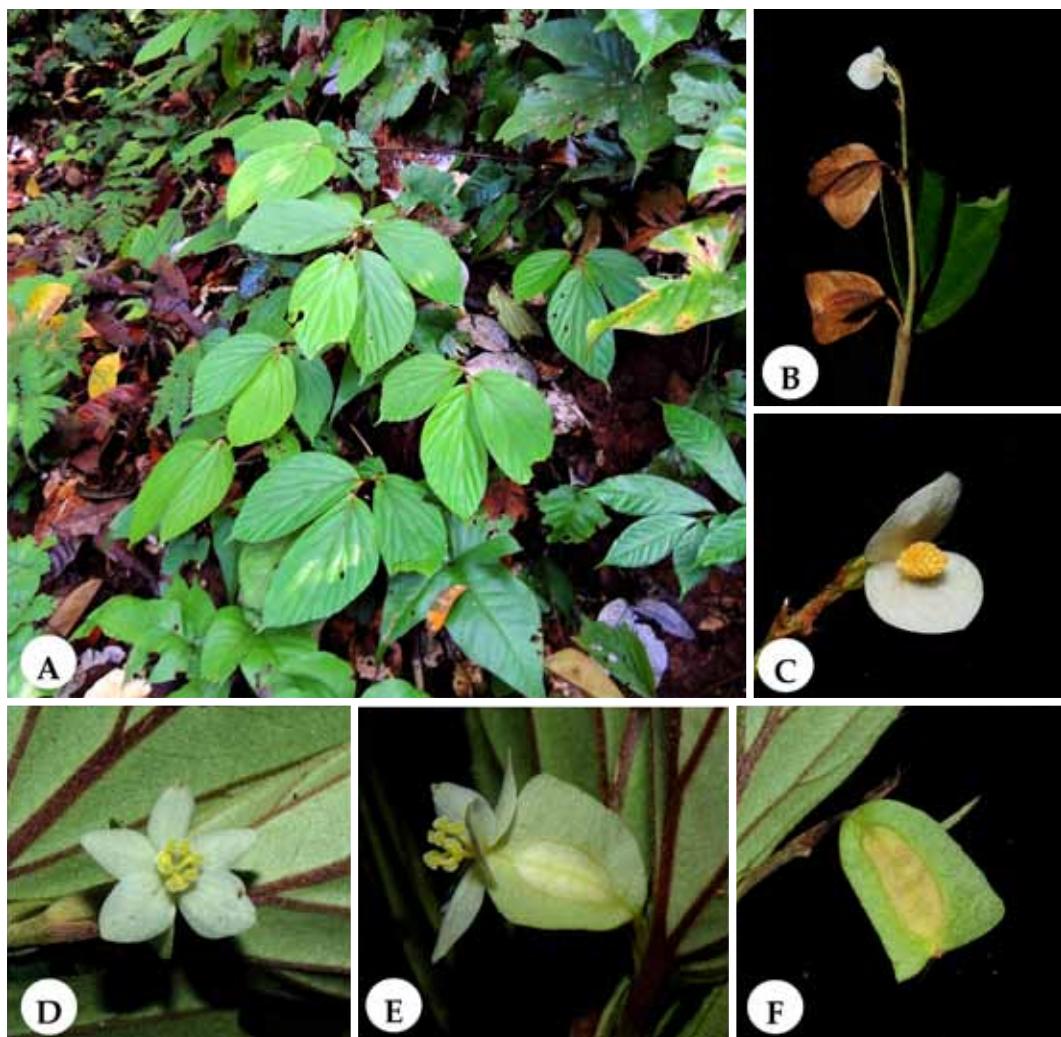


Fig. 5. *Begonia flavovirens*. A. Habit; B. Protogynous inflorescence showing old fruits and male flower; C. Opened male flower; D & E. Female flower; F. Fruit. All photos from SFC 3415 by Julia Sang.

ECOLOGY. On steep earth banks in lowland mixed dipterocarp forest with thin vegetation, at 200–350 m elevation.

DISTRIBUTION. Borneo. Endemic to Sarawak (Gunung Gading National Park, Lundu District).

SPECIMEN EXAMINED—BORNEO. SARAWAK: Lundu District: Gunung Gading National Park, main trail to Waterfall 2, *Julia & Kiew SFC 3415* (holotype SAR!).

NOTES. The species is so far known only from the type specimen. It occurs in a totally protected area.

5. *Begonia jugamensis* S. Julia & Kiew sp. nov.

Similar to *Begonia hullettii* Ridley (1906: 255) in its habit and narrowly lanceolate, non-oblique leaves with short petioles but it differs in its longer leaves, 16–25 cm (vs. 8–14 cm as in *B. hullettii*), longer petioles, 12–33 mm long (vs. 5–8 mm long), stalked male flowers with 4 tepals (vs. sessile with 2 tepals), capsule pedicel, 9–15 mm long (not sessile) and capsules as long as wide, 10–15 × 10–15 mm (vs. shorter but wider, 5–7 × 15–20 mm as in *B. hullettii*). Type: *Julia et al. SFC 4234*, Borneo, Sarawak, Tatau District, Bukit Mina Wildlife Corridor, Bukit Jugam, 15 July 2014 (holotype SAR!). (**Fig. 6**)

Erect begonia to 22 cm long, flowering at *ca.* 7 cm tall, becoming decumbent and rooting at nodes, prostrate stem 22–47 cm long, *ca.* 9 mm thick. Erect stems deep red at the apex, green towards the base, *ca.* 8 mm diameter, sparsely hispid at the apex, becoming glabrescent towards the base; internodes 0.7–5 cm long, succulent and slightly thicker at nodes. Stipules deep magenta, sparsely hispid, narrowly lanceolate, 13–15 × 3–4 mm, margin entire, apex setose, seta 1.5–2 mm long, persistent. Leaves alternate, slightly downward pointing, not oblique; petioles deep red, sparsely hispid, 1.2–3.3 × 0.2–0.4 cm, succulent, grooved above; lamina plain mid-green above, whitish green below, young leaves sometimes tinged reddish, usually with *ca.* 2 mm long red bristles on the upper surface, sometimes completely glabrous, in life thinly succulent, matt, slightly asymmetric, slightly falcate, 16–25 × 3.3–4 cm, broad side 2–2.5 cm wide, base rounded, almost equal, basal lobes 2–3 mm long, margin minutely dentate and deeply serrate at the veins ending, apex acuminate, acumen 1.5–2 cm long; venation pinnate, 4(–5) veins on either side of the midrib, none in the basal lobe, green on both surfaces, glabrous above, with red bristles on midrib and veins beneath, slightly impressed above, slightly prominent beneath. Inflorescences protogynous, female inflorescence single-flowered cyme, axillary in the lower leaves axils, peduncle 7–12 mm long. Bracts and bracteoles minute, less than 1 mm long; male inflorescence a simple cyme of 3–4 male flowers, glabrous, *ca.* 45° above the subtending leaves, peduncle deep red, 12–20 mm long. Bracts and bracteoles deep magenta, *ca.* 1 × 1 mm, caducous. Male flowers:



Fig. 6. *Begonia jugamensis*. **A & B.** Habit; **C.** Male inflorescence; **D.** Male flower; **E.** Female inflorescence; **F & G.** Female flowers; **H.** Cross-section of ovary. All photos from SFC 4234 by Ling Chea Yiing.

pedicel white tinged pink, 7–13 mm long; tepals 4, white with pale pink tip, outer 2 oval with narrowed apex, *ca.* 8 × 6 mm, glabrous, margin entire; inner 2 tepals similar but slightly smaller, broadly ovate, *ca.* 7 × 6 mm; stamens 22–24, cluster globose, stalked, stalk *ca.* 1 mm long; filaments pale lemon yellow, less than 2 mm long; anthers pale lemon yellow, obovate, *ca.* 1 × 0.8 mm, apex emarginate. Female flowers: pedicel magenta, 10–15 mm long, less than 1 mm thick, glabrous; ovary magenta, broadly oblong, 9–10 × 9–10 mm, wings 3, equal, 3–5 mm wide, locules 3, placenta bilamellate; tepals 5, deep magenta, broadly ovate, more or less isomorphic, 6–7 × 5–6 mm, margin entire, apex slightly acute; styles 3, yellowish, *ca.* 3 mm long, divided to base; stigma yellow, widely Y-shaped, papillose forming a continuous twisted band. Capsules 10–15 × 10–15 mm, glabrous, locules 3, wings equal, rounded proximally and slightly rounded or truncate distally, 4–5 mm wide, thinly fibrous, dehiscing between the locules and wings, pendent on pedicel 9–15 mm long. Seeds barrel-shaped, *ca.* 0.3 × 0.2 mm, collar cells more than half the seed length.

ETYMOLOGY. Named for its locality (Bukit Jugam).

ECOLOGY. Growing on low vertical mudstone cliff faces in a deeply shaded narrow gorge at the headwaters of a small stream at 100 m elevation. Locally common.

DISTRIBUTION. Borneo. Endemic to Sarawak (Bukit Mina Wildlife Corridor in Tatau District).

SPECIMENS EXAMINED—BORNEO. SARAWAK: Tatau District: Bukit Mina Wildlife Corridor — Bukit Jugam, *Julia et al. SFC 4234* (holotype SAR!), *Julia et al. SFC 4245* (SAR).

6. *Begonia lambirensis* Kiew & S. Julia sp. nov.

Close to *Begonia bruneiana* subsp. *bruneiana* Sand (1997: 433) in its habit and non-oblique and narrow leaves but it is different in having shorter internodes, 1–3 cm long (vs. 6–9 cm long in *B. bruneiana* subsp. *bruneiana*), smaller leaves, 7.5–9.5 × 1.5–2.25 cm (vs. 11.5–17 × 3.5–5.5), smaller stipules, *ca.* 5 × 2 mm (vs. 8–15 × 2.5–3 mm), 4 tepals in the female flowers (vs. 5 tepals) and the tepals of the male flowers are distantly toothed (vs. entire). Type: *Julia et al., SFC 3410*, Borneo, Sarawak, Miri District, Lambir Hills National Park, 12 May 2014 (holotype SAR!). (**Fig. 7**)

Erect begonia to 30 cm tall, branching at the base, rooting at nodes. Stems greenish brown, woody, 3–4 mm thick, shortly pubescent, succulent, internodes 1–3 cm long, slightly thicker at nodes. Stipules pale purple (in the purple form) or pale green (in the green form), narrowly lanceolate, *ca.* 5 × 2 mm, margin entire, apex acute, caducous. Leaves alternate, close, held slightly horizontal, not oblique; petioles greenish brown, shortly pubescent, 2–4 mm long,

terete; lamina plain blackish green above, and deep red purple beneath (purple form) or mid-green above and pale green beneath (green form), in life slightly fleshy, slightly glossy, unequally lanceolate, $7.5\text{--}9.5 \times 2.7\text{--}4$ cm, broad side 1.5–2.25 cm wide, rounded at base, margin entire at the lower half and finely serrate at upper half, apex acute. Venation pinnate, 4–5 veins on either side of the midrib, concolorous on both surfaces (green form) or reddish on lower surface of purple form, impressed above, prominent beneath. Bracts brownish,

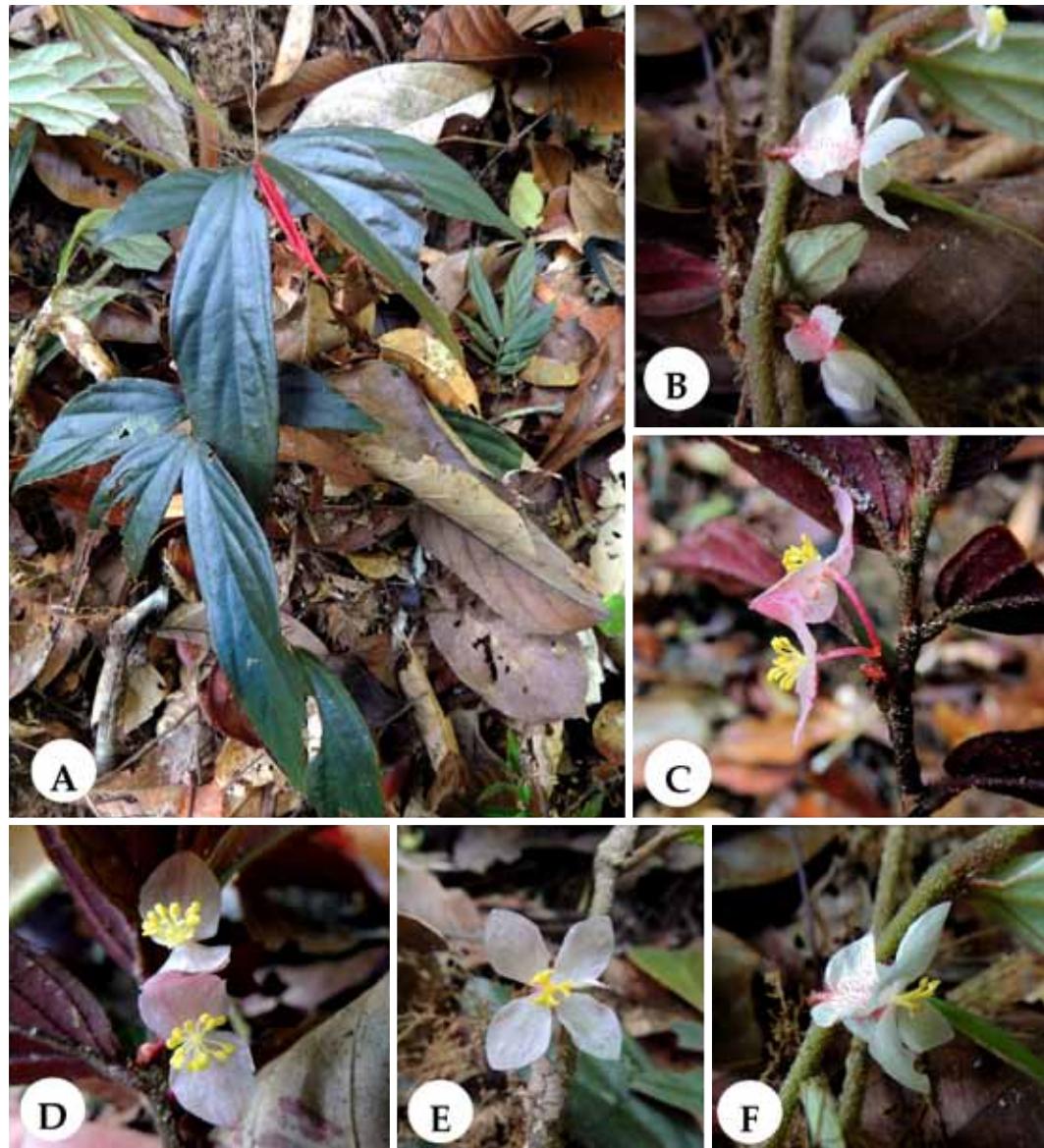


Fig. 7. *Begonia lambirensis*. **A.** Habit; **B.** Female and male inflorescence; **C & D.** Opened male flower; **E & F.** Opened female flowers. All photos from SFC 3410 by Julia Sang.

minute, linear, less than 1 mm long, margin entire, caducous. Bracteoles similar but smaller, caducous. Inflorescences protogynous, axillary in the lower leaf axils, female flowers solitary, male inflorescence with a pair of male flowers, peduncle pale pink, *ca.* 4 mm long, glabrous. Male flowers: pedicel pale pink, 3–9 mm long; tepals 2, rounded or ovate, 6–11 × 6–8 mm, pale pink or white, glabrous, margin toothed, ciliate, apex rounded or acute; stamens 12–14, spreading and very loose, subsessile; filaments pale yellow, 2–3 mm long; anthers pale yellow, obovate, *ca.* 1 × 0.8 mm, apex emarginate. Female flowers: pedicel pale red, 4–5 mm long; ovary very pale pink, broadly elliptic, 8–10 × 12 mm, wings 3, equal, white, locules 3, placenta 1 per locule; tepals 4, isomorphic, white to pale pinkish, elliptic, 9–10 × 6–7 mm, margin entire, apex slightly acute; styles 3, lemon yellow, *ca.* 4 mm long, divided to base; stigma lemon yellow, wide but shallowly Y-shaped, papillose forming a continuous twisted band. Capsules pinkish with red hairs, turbinate, *ca.* 9 × 12 mm, locules 3, wing equal, 3–4 mm wide, papery, dehiscing between the locules and wings, on erect pedicels 2–4 mm long. Seeds barrel-shaped, *ca.* 0.3 × 0.2 mm, columnar cells more than half the seed length.

ETYMOLOGY. Named for the locality where the species was found.

ECOLOGY. Growing on sandstone cliff faces in pockets of soil in lightly shaded areas.

DISTRIBUTION. Borneo. Endemic to Sarawak (Lambir Hills National Park, Miri District).

SPECIMENS EXAMINED—BORNEO. SARAWAK: Miri District: Lambir Hills National Park, *Julia et al. SFC 3410* (holotype SAR!).

NOTES. The species is so far only known from the type specimen. It occurs in the totally protected area.

7. *Begonia linauensis* S. Julia sp. nov.

Like *Begonia kasutensis* K.G. Pearce (2003: 82) in its low habit and small rounded or sub-orbicular leaves, but it is different in being a low erect begonia (vs. creeping as in *B. kasutensis*), the lamina is glabrous (vs. minutely papillose), shorter inflorescence with a rachis, 3.5–5 cm long (vs. *ca.* 11.5 cm long), larger floral bracts, *ca.* 6 × 6 mm (vs. 4 × 2.5 mm), male flower with 4 tepals (vs. 2 tepals), longer fruit pedicels, *ca.* 1.6 cm long (vs. *ca.* 0.7 cm long) and larger capsule, 1.6–2 × 2–2.5 cm (not *ca.* 1.6 × 1.2 cm). Type: *Julia et al. SFC 576*, Borneo, Sarawak, Belaga District, Bakun, Sungai Linau, Bukit Giham Separang, 13 October 2009 (holotype SAR!). (**Fig. 8**)

Low erect herb to 15 cm tall, branching near the base. Stem dark red, little to much branched, *ca.* 5 mm thick, pubescent, slightly succulent; internodes 2–3 cm long, slightly thicker at nodes. Stipules dark red, glabrous, ovate, *ca.* 10 × 3 mm, margin entire, apex acute, caducous.

Leaves alternate, close, held straight upwards, not oblique; petioles dark red, sparsely hairy, 1–4.5 cm long, slightly grooved above; lamina plain dark green to bronzy above, usually with a silvery or whitish stripe on the midrib, magenta below, in life slightly succulent, glossy, almost rounded or sub-orbicular, symmetrical to slightly asymmetric, 4.5–8.5 × 4.5–7 cm, narrow side 2–3.2 cm wide, base rounded, equal, basal lobe inconspicuously developed, margin shallowly dentate, apex acute or rounded; venation pinnate, 3–4 veins on either side of the midrib, veins glabrous, bronzy and impressed above, magenta and prominent below.



Fig. 8. *Begonia linauensis*. **A.** Habit showing bronzy leaves; **B.** Habit showing bronzy leaves with whitish green stripe on the midrib; **C & D.** Male inflorescence; **E.** Male flower; **F.** Female flower; **G.** Cross-section of ovary. Photos **A, B & G** from SFC 576 by Julia Sang; Photos **C–E** from *Linau 1-83* by Ong Poh Teck; Photo **F** from *Linau 1-83* by Ling Chea Yiing.

Inflorescences protogynous, axillary in the upper leaf axils, a pair of female flowers and many male flowers, male phase cymose, rachis 3.5–5 cm long, peduncle *ca.* 2 cm long. Bracts pale green or dark red, ovate or elliptic, *ca.* 6 × 6 mm, margin entire, apex acute, persistent. Bracteoles similar but smaller, 3–5 pairs arranged more or less in two rows. Male flowers: pedicels dark red, 12–14 mm long; tepals 4, glabrous, margin entire, outer 2 tepals dark red outside, pinkish inside, broadly oval or rounded, 7–8 × 8 mm, apex rounded; inner 2 tepals pinkish, narrowly elliptic, 6–7 × 4 mm, apex acute; stamens 28–35, cluster globose, sessile; filaments pale yellow, *ca.* 2 mm long; anthers pale yellow, ovoid, *ca.* 3 × 1.5 mm, apex emarginate. Female flowers: pedicel dark red, 0.4–1 cm long, glabrous; ovary dark red, broadly ovoid, 0.7–1.2 × 0.4–1 cm long, wings 3, subequal, locules 3, placenta bilamellate with many ovules on both surfaces; tepals 5 (rarely 6), glabrous, margin entire, outer 4 tepals elliptic, 10–12 × 8 mm, dark red outside, pinkish inside apex broadly acute or rounded, the innermost tepals lanceolate, 10–11 × 3–4 mm, pinkish inside and out, sometimes reddish at the centre outside, apex acute, styles 3, pale yellow, *ca.* 2 mm long, divided to base; stigma pale yellow, shallowly Y-shaped, papillose forming a continuous twisted band. Capsules in a pair on the lower rachis, 1.6–2 × 2–2.5 cm, glabrous, locules 3, wing subequal, wing broadly acute proximally and distally, 3–5 mm long, thinly fibrous, dehiscing between the locules and wings, pendent on pedicel *ca.* 1.6 cm long. Seeds barrel-shaped, *ca.* 0.3 × 0.2 mm, columnar cells more than half the seed length.

ETYMOLOGY. Named after Sungai Linau in Belaga District where the specimens were collected.

ECOLOGY. On very rocky steep slopes covered with thick leaf litter.

DISTRIBUTION. Borneo. Endemic to Sarawak (Sungai Linau, Belaga District).

SPECIMENS EXAMINED—BORNEO. SARAWAK: Belaga District: Bakun, Sungai Linau, Bukit Giham Separang, *Julia et al. SFC 576* (holotype SAR!), *Julia et al. Linau 1-83* (SAR).

NOTES. So far the species is only known from the type locality in the area that is affected by the dam. However, the occurrence of the species in similar habitats is not known as no detailed survey was carried out and the area is still not well explored.

8. *Begonia roseopunctata* Kiew sp. nov.

This species most resembles *Begonia murudensis* Merrill (1928: 530) in its habit, leaf size and shape particularly in the narrowly attenuate apex and sub-orbicular capsule but it differs in its small stipules *ca.* 2 mm long (vs. *ca.* 20 mm long as in *B. murudensis*), *ca.* 5

veins radiating from the base of the petioles (vs. 7–9 veins), the longer inflorescence with a peduncle, 3.5–5 cm long (vs. *ca.* 2.5 cm long), smaller male flowers with 4 tepals, 5–6 mm long (vs. male flowers with 2 tepals, *ca.* 20 mm long) and smaller capsules, (8–)10–12 × (4–)12–15 mm (vs. *ca.* 30 × 40 mm). Type: *Kiew et al. S 93271*, Borneo, Sarawak, Simunjan District, Gunung Gaharu, 8 August 2004 (holotype SAR!). (**Fig. 9**)

Erect or low climbing begonia, whole plant glabrous. Stems 15–30 cm long, branching, rooting at nodes and climbing vertically up rock faces, young stems deep red, becoming brown and woody at the base, slender, 4–6 mm thick; internodes 5–7.5 cm long. Stipules deep red, narrowly lanceolate, *ca.* 6 × 2 mm, margin entire, persistent. Leaves distant, held more-or-less horizontally, oblique; petioles deep red, 1.5–2.2 cm long, succulent; lamina of young plants pale green with candy pink spots between veins, leaves of older plants have white spots that coalesce, and leaves of mature flowering plants are plain mid-green, pale green beneath, thinly succulent, drying papery, asymmetric, broadly lanceolate, 10.5–13.5 × 9–9.5 cm, broad side 6.5–7 cm long, base unequal, basal lobe *ca.* 10 mm long, margin dentate, apex acuminate; venation palmate-pinnate with 2 pairs at the base and 1 veins on either side of the midrib, branching towards the margin, concolorous, slightly impressed above, prominent beneath. Inflorescences protogynous, axillary, cymose, (5–)7–13 cm long, peduncle 3.5–5 cm long, female flowers 1–2 on a short branch at the base, 7–9 cm long, upper branches 7–9 cm long with many clustered male flowers. Bracts pale reddish green, lanceolate, *ca.* 4 × 2 mm, margin entire, apex acuminate, acumen to 1 mm long; bracteoles similar but smaller. Male flowers: buds green, pedicels pale red or greenish, 3–7 mm long; tepals 4, pale yellowish green, margin entire, apex rounded, outer 2 tepals oval, 4–6 × 4–5 mm, inner 2 tepals narrowly oval or elliptic, 4–5 × 2 mm, stamens *ca.* 26, cluster globose, sessile, filaments 0.5–1 mm long, anthers pale yellow, narrowly obovate, *ca.* 1 mm long, apex emarginated. Female flowers: pedicels 8–15 mm long, ovary reddish green or pale green, 6–8 × 5–10 mm, wings 3, more or less equal, 5–6 mm wide, locules 3, placenta bilamellate, tepals 5, pale green or yellowish green, outer 4 tepals isomorphic, elliptic or oblong, 6–10 × 3–6 mm, margin entire, apex acute, inner tepal smaller, narrowly elliptic, 4–8 × 3–4 mm, styles 3, red or yellow, 2–3 mm long; stigma brownish, shallowly Y-shaped, papillose forming a continuous twisted band. Capsules pale green, (8–)10–12 × (4–)12–15 mm, locules 3, wings 3, equal, rounded proximally, slightly extended distally, 3.5–4.5 mm wide, dehiscing between the locules and wings, pendent on a stiff pedicel, *ca.* 12–15 mm long. Seeds barrel-shaped, *ca.* 0.4 × 0.2 mm, collar cells more than half the seed length.

ETYMOLOGY. Latin, *roseo* = rosy + *punctata* = spots, referring to the conspicuous variegation of the leaves of young plants.

ECOLOGY. Lowland mixed dipterocarp forest below 500 m elevation, on rocky sandstone slopes in deeply shaded areas.

DISTRIBUTION. Borneo. Endemic to Sarawak (Gunung Gaharu).

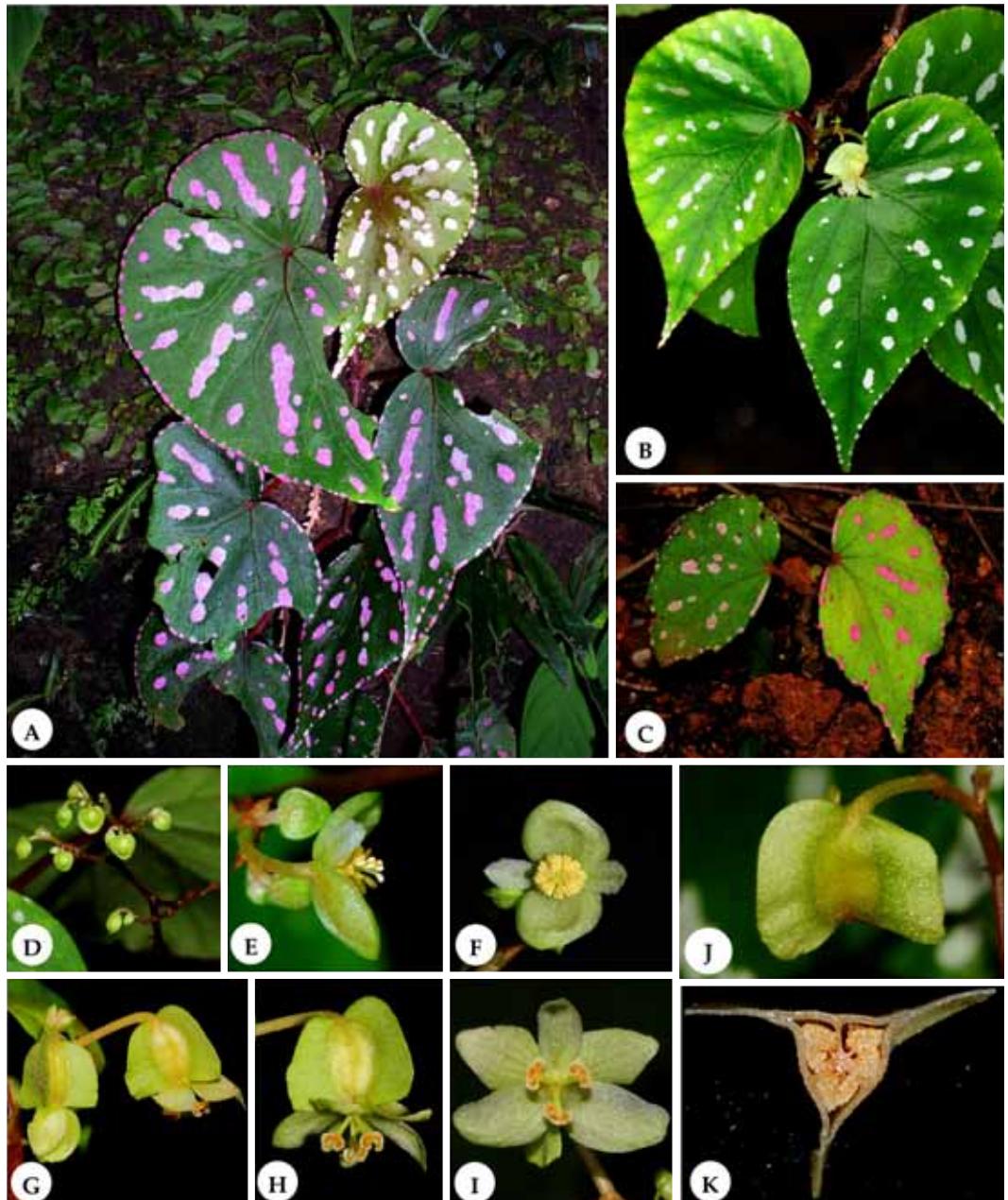


Fig. 9. *Begonia roseopunctata*. **A.** Habit; **B.** Leaves of adult plant with white spots; **C.** Leaves of juvenile plant with pink spots; **D.** Male inflorescence; **E & F.** Male flowers; **G.** Female inflorescence; **H & I.** Female flower; **J.** Fruit; **K.** Cross section of fruit. Photo A from S 93271 by Julia Sang; Photos B–K from JS 5184 by Julia Sang.

SPECIMENS EXAMINED—BORNEO. SARAWAK: Simunjan District: specimen from live plant grown in Nursery at Semengoh NR originally collected from Gunung Gaharu, *Julia JS 5184* (SAR); Gunung Gaharu, *Kiew et al. S 93271* (holotype SAR!).

NOTES. The species was discovered by Peter C. Boyce from Gunung Gaharu, Sarawak. The striking character is the bright pink spots on juvenile plants that unfortunately, turn white and eventually disappear completely in mature plants. This is a common phenomenon in other plants with spotted leaves. The only known locality is located outside the totally protected area on Gunung Gaharu and is subject to forest exploitation. The plant is currently grown in the nursery at Semengoh NR.

9. *Begonia setiamensis* S. Julia & Kiew sp. nov.

Like *Begonia sarangica* Kiew & S. Julia (2009: 369) in its habit and parallel veins but it differs in having longer stipules, 20–25 cm long (vs. ca. 17 cm long as in *B. sarangica*), longer pedicels on the female flower, ca. 6 mm (vs. 2–4 mm), larger ovary, ca. 26 × 14 mm (vs. 13–17 × 9–11 mm) and longer fruit, 2.8–3.2 cm long (vs. 1.7–2.3 cm long). Type: *Julia et al. SFC 4217*, Borneo, Sarawak, Tatau District, Bukit Setiam, 11 July 2014 (holotype SAR!). (**Fig. 10**)

Erect begonia to 60 cm tall, flowering at 22 cm tall. Stem little-branched, reddish brown, 6–8 mm diameter, covered with soft white hairs, internodes 2.5–7.5 cm long, slightly swollen at the nodes. Stipules pale green, covered with soft white hairs, narrowly lanceolate, 20–25 × 6–10 mm wide, margin entire, apex acute, caducous. Leaves alternate, slightly close, held horizontally, slightly oblique; petioles reddish brown, covered with dense soft white hairs, 17–25 cm long, 3.5–4.5 mm thick, terete; lamina plain dark green above, slightly paler below, asymmetric, stiff or in life appearing fleshy, glossy, broadly ovate, 17–17.5 × 10–12.5 cm, broad side 7–8 cm wide, base rounded, basal lobes 2.5–2.8 cm long, margin uniformly crenate or shallowly dentate, apex acuminate, acumen to 2 cm long; venation palmate-pinnate, 4–5 pairs on either side of the midrib, 3–4 veins in basal lobe, branching twice, veins red brown at the base on upper surface, otherwise green, impressed above, prominent beneath. Inflorescences protogynous, axillary in upper leaf axils, compact, pale green, racemose, rachis ca. 2.5 cm long, peduncle 0.7–1.2 cm long. Bracts pale green, in pairs, lanceolate, margin entire, caducous, 15–16 × 7–11 mm, sheathing the male flowers, diminishing size towards apex, margin entire, caducous. Bracteoles similar to bracts but slightly smaller, 9–10 × 6 mm. Male flowers (unopened): pedicels pale green, 2–4 mm long; tepals 2, greenish white, reddish towards the pedicel, hairy outside, elliptic, ca. 5 × 2, margin entire, apex broadly acute; stamens ca. 23, cluster globose, sessile; filaments pale yellow, ca. 0.5 mm; anthers pale yellow, oblong, ca. 1 × 0.6 mm, apex emarginate. Female flowers: pedicels pale green, ca. 6 mm long, pubescent; ovary pale green, oblong, ca. 26 × 14 mm, wings ca. 4.5 mm wide, equal, locules 3, bilamellate; tepals 5, pale yellowish green,

elliptic, outer tepals $10\text{--}13 \times 6\text{--}7$ mm, margin toothed towards apex, apex acute; inner tepals broadly elliptic, ca. 7×5 mm, margin toothed towards apex, apex broadly acute; styles pale yellow, ca. 5 mm long, divided to base; stigma pale yellow, with wide base, papillose forming a continuous twisted band. Capsules 1–2 per infructescence, oblong, $28\text{--}32 \times 17$ mm, pubescent, locules 3, wing equal, ca. 5 mm wide, rounded proximally, truncate distally, dehiscing between the locules and wings, ripening under the leaf on a stiff pedicel, ca. 7 mm long. Seeds barrel-shaped, ca. 0.3×0.2 mm, collar cells more than half the seed length.

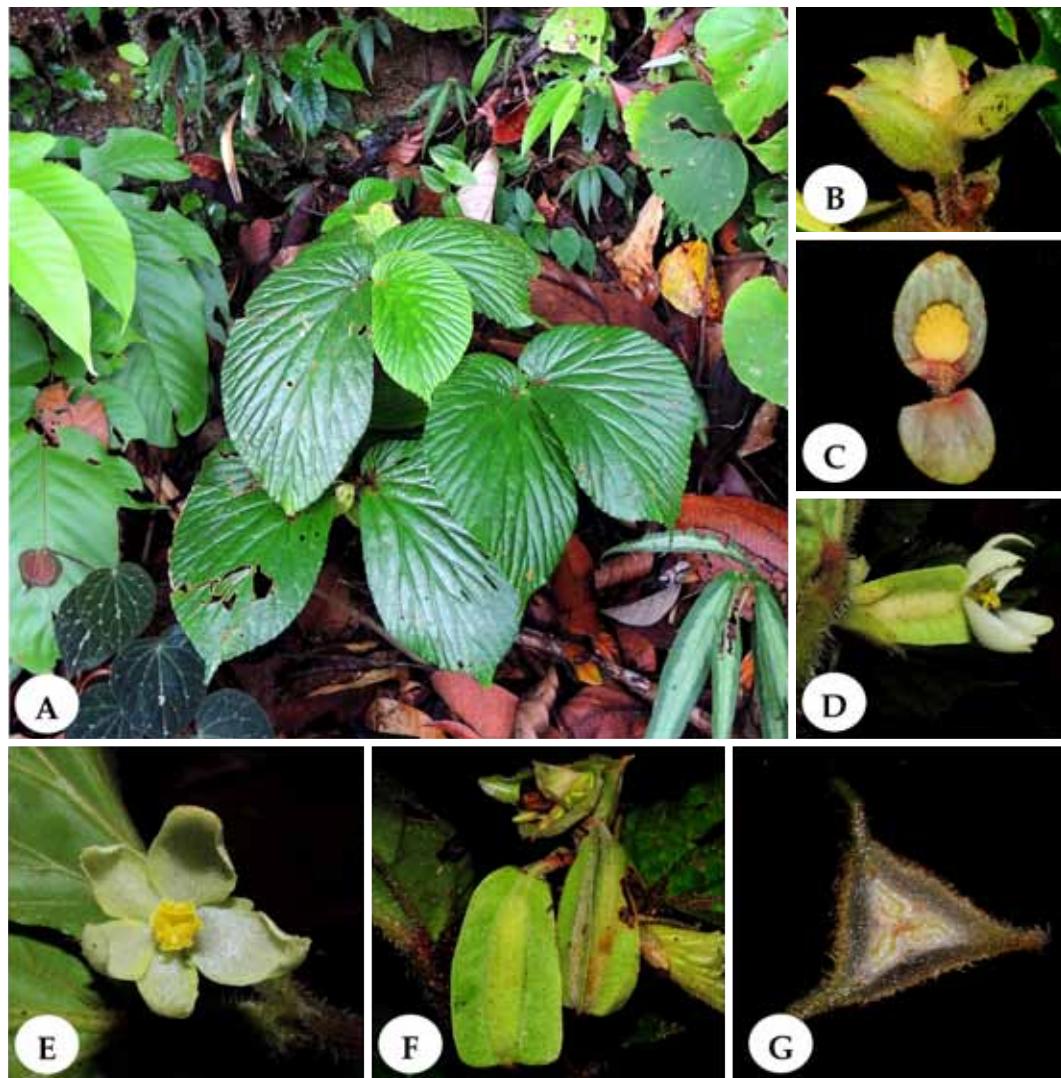


Fig. 10. *Begonia setiamensis*. **A.** Habit; **B.** Floral bracts and bracteoles; **C.** Male flower; **D & E.** Female flower; **F.** Fruit; **G.** Cross-section of capsule. All photos from SFC 4217 by Ling Chea Yiing.

ETYMOLOGY. Named for its locality, Bukit Setiam, where the species was first collected.

ECOLOGY. In lowland mixed dipterocarp forest at elevations below 100 m. Growing near a waterfall in a consistently humid and wet area, on a thin layer of moss on wet rock surface and also on thick layers of leaf litter.

DISTRIBUTION. Borneo. Endemic to Sarawak (Bintulu District).

SPECIMENS EXAMINED—BORNEO. SARAWAK: Bintulu District: Bukit Setiam, *Julia et al. SFC 4217* (holotype SAR!), *Julia et al. SFC 4225* (SAR); Bukit Mina Wildlife Corridor, Bukit Mina, *Julia et al. SFC 4243* (SAR).

NOTES. Two colour forms were observed in the field: (i) population at Bukit Setiam that had white pubescence on the fruit, pedicel, bracts etc.; (ii) the population at Bukit Mina where plants had red pubescence on fruit, pedicel, bracts etc.

10. *Begonia sirukitii* S. Julia & C.Y. Ling sp. nov.

Similar to *Begonia roseopunctata* in its spotted and oblique leaves but it is different in its longer stipules, ca. 12 × 3 mm (vs. ca. 6 × 2 mm as in *B. roseopunctata*), longer petioles, 5.5–9 cm long (vs. 1.5–2.2 cm long), larger leaves, 17–30(–60) × 12–16(–30) cm (vs. 10.5–13.5 × 9–9.5 cm), longer inflorescences, 19–24 cm long (vs. 5–13 cm long), female flowers with shorter pedicel, ca. 6 mm long (vs. 8–15 mm long), larger ovary, ca. 16 × 10 mm (vs. ca. 6–8 × 5–10 mm), tepals of female flowers 4 (vs. tepals 5), tepals of male flowers 2 (vs. tepals 4) and larger fruit, ca. 20 × 16 mm (vs. ca. 8–12 × 4–15 mm). Type: *Ling et al., SFC 2245*, Borneo, Sarawak, Belaga district, Bakun Dam, Ulu Sungai Linau, Sungai Anyah, 16 May 2011 (holotype SAR!). (**Fig. 11**)

Erect cane-like begonia, 11–75 cm tall. Stems, little-branched, reddish brown or dark green, becoming woody on old plants, 4–6 mm thick, internodes 3–8 cm long, thicker at nodes. Stipules greenish yellow, lanceolate, ca. 12 × 3 mm, margin entire, apex acute, caducous. Leaves alternate, distant, held vertically, oblique; petioles reddish or dark green, reddish brown near the base, 5.5–9 cm long, glabrous, grooved above; lamina green with scattered and irregular sized white spots between the veins on upper leaf surface, the spots sometimes pinkish on juvenile plants, paler below, in life fleshy, glossy above, asymmetric, broadly ovate, 17–30(–60) × 12–16(–30) cm, narrow side 5–6 cm wide, base cordate, sometimes slightly overlapping, basal lobe 3–4 cm long, margin whitish, entire or shallowly toothed, apex acuminate, acumen 1–2 cm long; venation pinnate 3–4 veins on either side of the midrib, 4–5 in basal lobe, concolorous, sunken above, prominent beneath. Inflorescences protogynous, axillary in the uppermost leaf axils, 19–24 cm long, paniculate, producing 1–2 pairs of female flowers at the base and many male flowers above. Bracts pale green,

lanceolate, 15–18 × 4 mm, strongly keeled, margin entire, apex setose, seta to 2 mm long, caducous. Bracteoles pale green, lanceolate, ca. 10 × 3 mm, margin entire, caducous. Male flowers: pedicel red brown or reddish, 2–3 mm long; tepals 2, oval, ca. 5 × 3 mm, reddish to pinkish or reddish with greenish margin, glabrous, margin entire, apex acute; stamens 19–23, cluster conical, subsessile; filaments pale yellow, ca. 1 mm long; anthers pale yellow, obovoid, 1–1.5 × 0.5–1 mm, apex emarginate. Female flowers: pedicel red to pale red, ca. 6 mm long; ovary greenish, glabrous, oblong, ca. 16 × 10 mm, wings 3 with ridge between two of the wings, equal, locules 3, placenta bilamellate with many ovules on both surfaces; tepals 4, pinkish, narrowly ovate, more or less isomorphic, ca. 8 × 5 mm, margin toothed on the upper half, apex acute; styles 4, pale yellow, ca. 3 mm long, divided to base; stigma yellowish, widely Y-shaped, papillose forming a continuous twisted band. Capsules in pairs,



Fig. 11. *Begonia sirukitii*. A. Habit; B. Juvenile plant; C. Floral bracts and bracteoles; D. Male flower; E. Male flower; F. Fruit. All photos from SFC 2245 by Ling Chea Yiing.

oblong, ca. 2×1.6 cm, glabrous, locules 3, wings equal, acute proximally, acute or truncate distally, 4–6 mm wide, thinly fibrous, dehiscing between the locules and wings, pendent on pedicels 1–2.5 cm long. Seeds barrel-shaped, ca. 0.3×0.1 mm, columnar cells more than half the seed length.

ETYMOLOGY. Named after Sirukit anak Dubod, field assistant at Sarawak Forestry Corporation (2005–present) who has a very good eye for begonias in the field.

ECOLOGY. Growing on rocky cliffs, near riverbanks or waterfalls and on steep to gentle earth slopes in semi-shaded area at 120 m elevation.

DISTRIBUTION. Borneo. Endemic to Sarawak (Belaga area).

SPECIMENS EXAMINED—BORNEO. SARAWAK: Belaga District: Bakun Dam — Ulu Sungai Linau, Sg. Jakah, *Ling et al. SFC 2231* (SAR), Sungai Anyah, *Ling et al. SFC 2245* (holotype SAR!); Ulu Sungai Balui, Sungai Pahak, *Ling et al. Balui 2-154* (SAR).

NOTES. The largest leaf observed in the field can reach ca. 60×30 cm.

DISCUSSION

All the begonias species described in this paper have narrow distributions. Six out of ten species are currently known only from a single locality while the other four species were collected from two or three localities in Sarawak. The ten species described here are just the tip of the iceberg because Julia and Kiew (2014) have estimated that there are at least 600 species in Borneo of which at the present time only about 190 are named. From our survey of specimens in the SAR herbarium, there are at least another 110 unnamed species, not to mention the many more awaiting discovery in Sarawak forest (Julia & Kiew, 2014).

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Three New *Begonia* (Begoniaceae) Species from Ultramafic Outcrops in Kinabalu Park, Sabah, Malaysia

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Summary. Three new species, *Begonia adliniana* Rimi, *B. ramlanii* Rimi & Handry and *B. vanderentii* Rossiti, from ultramafic outcrops are described and illustrated. *B. ramlanii* is an ultramafic facultative, *B. adliniana* is an ultramafic preferential, and *B. vanderentii* is an ultramafic obligate. All three species belong to section *Petermannia*.

Ultramafic outcrops are widespread and extensive in Sabah, Malaysia, covering an area of approximately 3500 km² (Ent *et al.*, 2014). Ultramafic outcrops, also referred to in the early literature as ultrabasic or serpentine rocks and derived soils, are chiefly igneous rocks composed of mafic minerals and are high in magnesium, iron, nickel, chromium and cobalt, that are toxic for most plants. The high content of these mafic minerals makes it so different from other soil substrates and it harbours a characteristic flora that includes many endemic species that are able to tolerate to this unique substrate. Some 142 km² of ultramafic formations are found around Mount Kinabalu, which is the most prominent site regionally in terms of biodiversity for ultramafic substrates (Collenette, 1964; Beaman, 2005). Mount Kinabalu is well known for both its species richness as well as the exceptionally high level of endemism, with many species restricted to a single locality (Ent *et al.*, 2014).

Materials and Methods

Materials for this study were collected during routine or scheduled fieldwork by Sabah Park (SNP herbarium) staff from a series of expeditions held in 2010–2013 as part of the “Plant diversity, soil chemistry and geospatial analysis of ultramafic outcrops on Mount Kinabalu and Mount Tambuyukon, Sabah, Malaysia”, a research collaboration between Sabah Parks and the University of Queensland, Australia (Fig. 1). Some species were collected and grown in the nursery until they flowered and herbarium specimens were prepared. Conservation assessments follow standard IUCN procedures (IUCN, 2001).

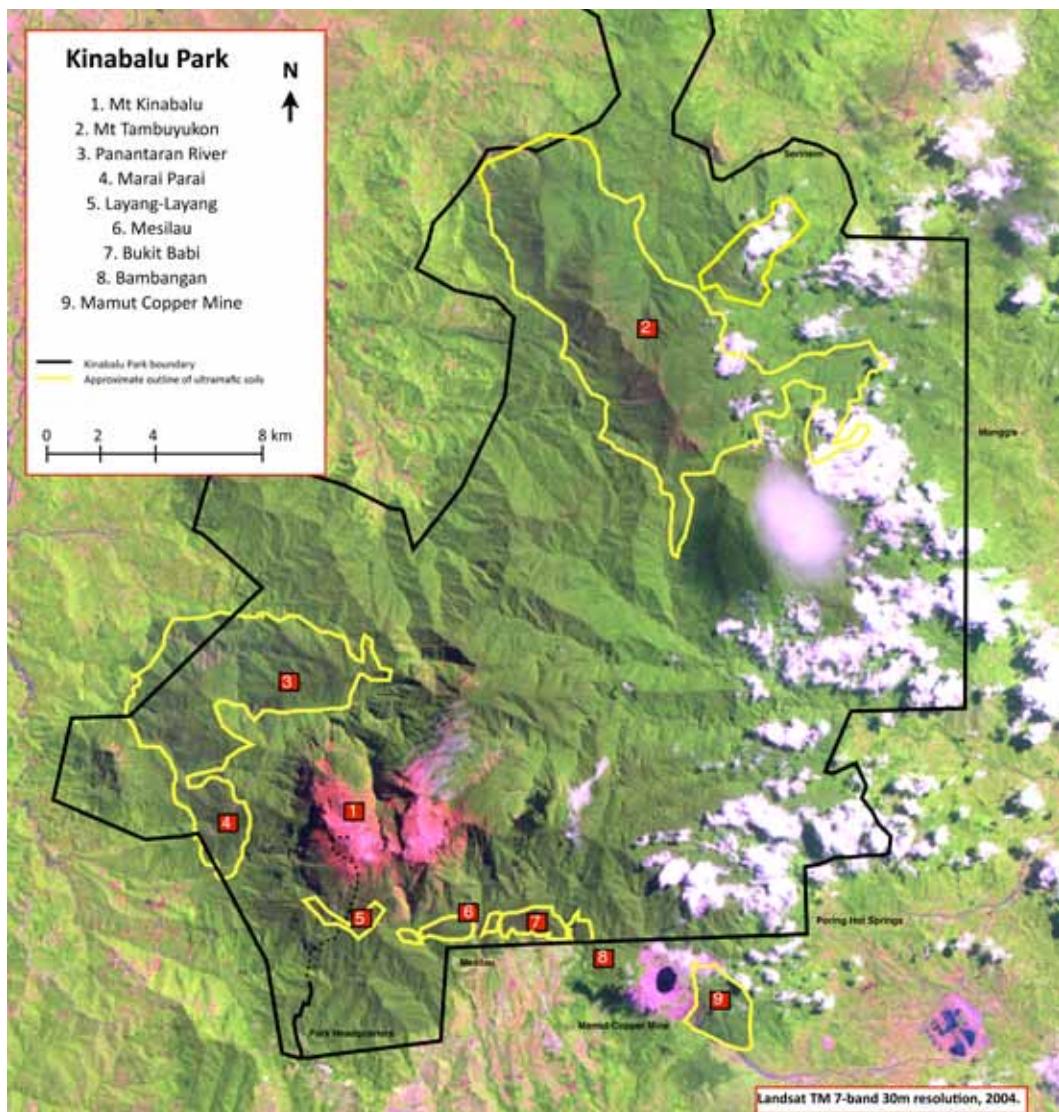


Fig. 1. Study sites on ultramafic outcrops within Kinabalu Park.

Taxonomy Treatment

All of the three new species belong to section *Petermannia*. Following Ent *et al.* (2014), these three species are designated as ultramafic facultatives, if they are sometimes found in ultramafic areas but are more usually found on other substrate types; ultramafic preferentials if they are usually found in ultramafic areas; and ultramafic obligates if they only occur on ultramafic substrates.

Species Descriptions

1. *Begonia adliniana* Rimi sp. nov.

Begonia adliniana is similar to *B. kipandiensis* S. Julia (2015) in its cane-like habit and inflorescences with pale green, dense fringe of long glandular hairs and overlapping bracteoles on the male branches but it differs in its leaf lamina that is only minutely toothed (vs. with prominent teeth 2–5 mm long as in *B. kipandiensis*), its smaller bracteoles *ca.* 4 × 4 mm (vs. 7–8 × 5–8 mm) and its male flowers with 4 tepals (vs. 2 tepals). Type: *Tisun G., Duni M., Benedict G. & Rossiti K. KNP A 15598* Borneo, Sabah, Kota Belud District, Lawag-Kinotoki River, 23 March 2008 (holotype SNP!). (Fig. 2)

Cane-like begonia, 40 cm tall. Stems erect, brownish, *ca.* 5 mm diameter, internodes 4.3–5.5 cm long, hairs brownish, succulent, thicker at nodes. Stipules light green, pubescent, elliptic, 6–16 × 5–10 mm, margin toothed, apex bluntly acute, persistent. Leaves alternate, oblique, distant, held horizontally; petiole 2–3.5 cm greenish red, hairs white, 3–4 mm thick, grooved above; lamina plain dark green, in life fleshy, matt, asymmetrical, *ca.* 12–14.5 × 6.5–8.5 cm, broad side 4.8–5.2 cm, broadly ovate, basal lobes 0.6–0.7 cm, margin minutely toothed, apex acute; venation palmate-pinnate, dark green, glabrous, 3 veins on each side of the midrib, unequal, 3 in basal lobe, impressed above and beneath, branching halfway towards margin. Inflorescences protogynous, axillary, white, glabrous, pendent, longer than petioles, 1 female flower on lowest branch, 18 male flowers above in a many-flowered raceme, 6 cm long with 5 branches arranged along the rachis, 3.2 cm long, branches almost equal-sized, 1.8 cm long. Bracts of male and female flowers light green, lanceolate, *ca.* 10 × 5 mm, margin entire with a dense fringe of long glandular hairs, persistent. Bracteoles many, on male branches, overlapping, light green, ovate, *ca.* 4 × 4 mm, margin toothed, persistent. Male flower: pedicel greenish, *ca.* 2 cm long; tepals 4, white, margin entire, outer 2 oval, *ca.* 6–7 × 4–5 mm, apex bluntly acute, inner 2 tepals lanceolate, *ca.* 4–5 × 1 mm, apex acute; stamens 14, cluster rounded, stalk *ca.* 0.5 mm long, light brown; filaments *ca.* 1 mm, white; anthers bright yellow, oval, *ca.* 1 × 0.5 mm, apex rounded. Female flower: pedicel 0.5 mm, light brown, glabrous; ovary white, oblong, *ca.* 6 × 5 mm, locules 3, placentas 2 per locule, ovules many on both surfaces; tepals 4, white, equal-sized, oval, *ca.* 6 × 8 mm, margin entire, apex bluntly acute; styles 3, light yellow, 2 mm long, stigma green, papillose forming a continuous twisted band. Capsule pointing upwards, 1–1.5 × 0.8–1 cm, wings 3, unequal, longer wing 3

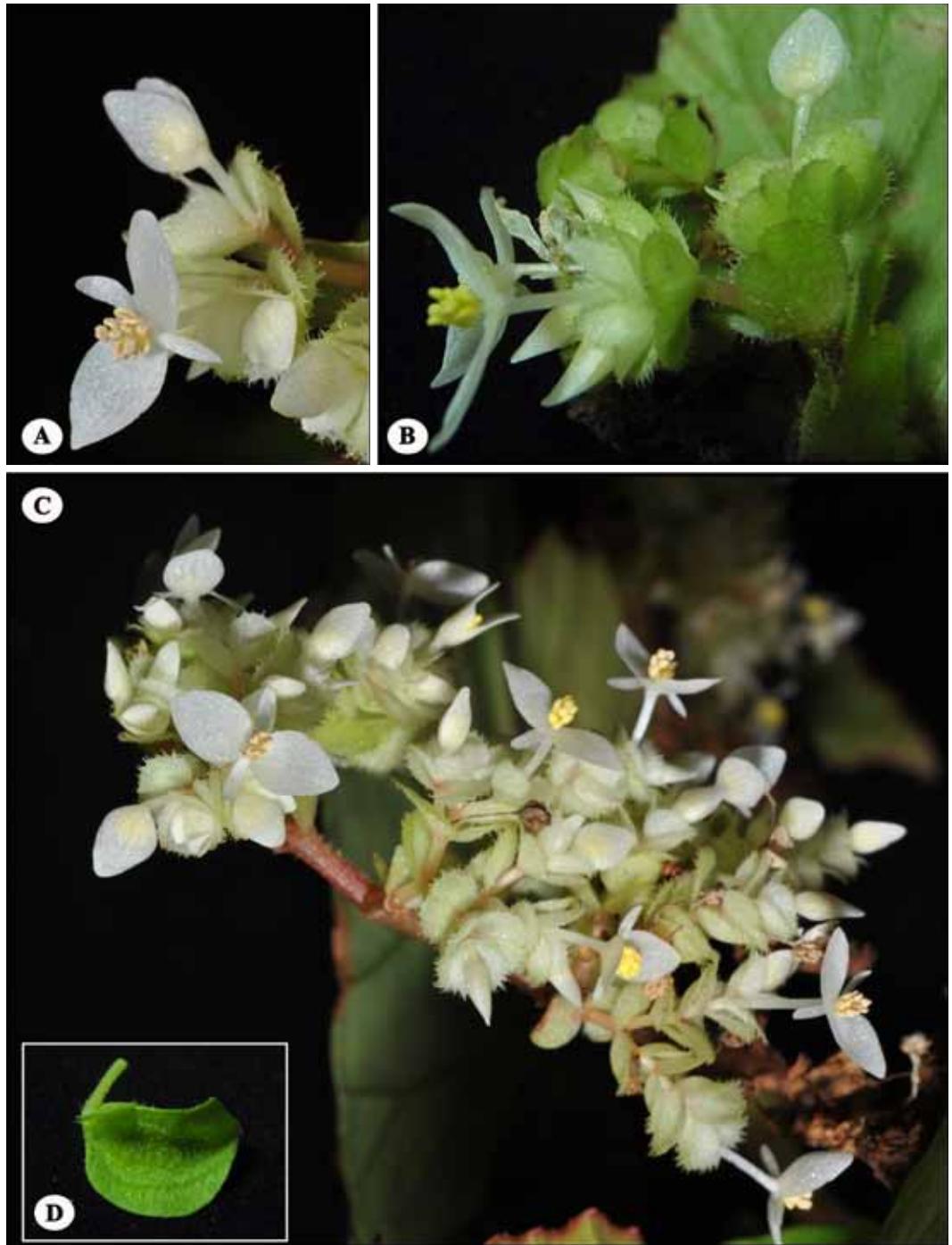


Fig. 2. *Begonia adliniana*. **A.** Male flower; **B.** Bracts on male flower; **C.** Male inflorescence; **D.** Fruit. Photos A & C by Rimi Repin; Photos B & D by Rossiti M. Karim.

mm wide, shorter two wings 1.5 mm, wings thinly fibrous, light green, locules 3, placentas 2 per locules, dehiscing between the locule and wing; pedicel reflexed, 5–7 mm long. Seeds barrel-shaped, 0.25 × 0.34 mm, collar cells slightly more than half the seed length.

ETYMOLOGY. Named in honour of YM Dato' Seri Tengku Dr Zainal Adlin bin Tengku Mahmood, the Chairman of The Board of Trustees of Sabah Parks, who has been actively involved in promoting the conservation of flora and fauna in Sabah.

ECOLOGY. Primary forest at 1500 m elevation on ultramafic substrates in shade on slopes. Ultramafic preferential.

DISTRIBUTION. Borneo. Endemic to Sabah (Mt. Kinabalu, near the Kineteki River).

CONSERVATION STATUS. Least Concern. It grows in the Kinabalu Park area, a totally protected area.

SPECIMENS EXAMINED—BORNEO. SABAH: Ranau District: Kinabalu Park — Poring Orchid Centre Nursery, *Rossiti et al. SNP 36818* (SNP!). Cultivated specimen from Poring Orchid Centre Nursery, originally collected from Kineteki, Mt. Kinabalu, Kota Belud District: Lawag-Kinotoki River, *Tisun G., Duni M., Benedict G. & Rossiti K. KNP A 15598* (holotype SNP!).

NOTES. This species is at present growing in the Poring Orchid Centre Nursery from where the type specimen was made. Further specimens for distribution need to be collected as the plants flower and fruit.

2. *Begonia ramlanii* Rimi & Handry sp. nov.

Similar to *Begonia beryllae* Ridl. (1915) in its cane-like habit, ovate leaves with a well-developed basal lobe, undulate margin and red veins, and its male flower with 4 tepals. The differences lie in the fruit of *B. ramlanii*, the width is more than twice the length (1.5 × 3.2 cm) and the wing shape is sharply triangular with a very sharp tip towards the top. The fruit of *B. beryllae* has a width of less than twice the length (1.5–2 × 2–2.5 cm) and the wings are broader with a rounded tip. *Begonia beryllae* has never been recorded as growing on ultramafic substrates. Type: *Handry et al. SNP 36809*, Borneo, Sabah, Ranau, Kinabalu Park, Poring Orchid Centre Nursery, 29 August 2014 (holotype SNP!; isotype SAN!). Cultivated specimen from Poring Orchid Centre Nursery. Originally collected from Nalumad — Sayap Trail, 2011. (**Fig. 3**)

Cane-like begonia, to 40 cm tall. Stems branching, erect, red, to 6 mm diameter, internodes 7.5–10 cm long, with soft red hairs, succulent, thicker at nodes. Stipules reddish green,

lanceolate, ca. 10–20 × 2–5 mm, margin entire, apex acute, caducous. Leaves alternate, distant, pendant, pointing downward; petiole red, hairy, 2.3–4.5 cm long, grooved above; lamina plain green, in life fleshy, matt, oblique, asymmetrical, ca. 3.5–18 cm × 8.4–13.4 cm, broad side 5.6–10 cm, base broadly ovate, basal lobes 1.2–1.3 cm, margin doubly toothed, apex acuminate ca. 1.3 cm; venation palmate-pinnate, veins red on both surfaces, glabrous, 3 on each side of midrib, 1 in basal lobe, impressed above near the junction between the lamina and petiole but impressed beneath. Inflorescences terminal, white, pendent, longer than petioles, cymose, protogynous; male inflorescence ca. 3.5 cm long with 2 branches each 1 cm long, 2 male flowers above; female inflorescence 5.6 cm long, with 2 branches 5.6 cm long and 2 female flowers. Bracts of male and female flowers lacking. Bracteoles of male flowers broadly oval, ca. 10 × 10 mm, pale green and margin entire. Bracteoles of female flower ca. 3 × 0.5 mm, pale green, needle-shaped, margin entire. Male flower: pedicel pinkish white, 5 mm long; tepals 4, white, glabrous, margin entire, apex rounded, outer 2 tepals oval, ca. 10 × 6 mm, inner 2 tepals narrowly lanceolate, 6 × 3 mm; stamens 16, stalk 0.6 mm long, cluster oval; filaments dirty yellow, 0.8 mm long; anthers dirty yellow, oblong, ca. 1.5 × 1 mm, apex emarginate. Female flower: pedicel 2 cm long, pinkish green, glabrous; ovary light green, deltoid, ca. 1 × 2.5 cm, wings 3, 1 cm wide, unequal, 3 locules, 2 placentas per locule; tepals 5, white, lanceolate, outer three ca. 13–14 × 6–7 mm, inner two ca. 10 × 3 mm, margin entire, apex rounded; styles 3, bright yellow, 2 mm long, divided to base, stigma yellow, papillose. Capsule dangling, ca. 1.5 × 3.2 cm, glabrous, locules 3, wings unequal, deltoid, 1.2 cm wide, fleshy, dehiscing between locule and wing. Seeds barrel-shaped, ca. 0.5 × 0.2 mm, columnar cells more than half the seed length.

ETYMOLOGY. Named after Ramlan Miadin, research assistant in Sabah Parks, who collected plant material during exploration of the Nalumad-Sayap ultramafic flora in 2011.

ECOLOGY. Lower montane forest, 1500–2000 m elevation. Ultramafic facultative.

DISTRIBUTION. Borneo. Endemic to Sabah (Kinabalu Park, Nalumad trail from Ranau to Sayap village).

CONSERVATION STATUS. Least Concern. It grows in the Kinabalu Park, a totally protected area.

SPECIMENS EXAMINED—BORNEO. SABAH: Ranau District: Kinabalu Park — *Handry M., Rossiti K. & Kinahim S. SNP 32960* (SNP, SAN), Poring Orchid Centre Nursery, *Handry et al. SNP 36809* (holotype SNP!; isotype SAN!). Cultivated specimen from Poring Orchid Centre Nursery. Originally collected from Nalumad — Sayap (Trail, 2011).

NOTES. This species is striking for having bracteoles that are needle-shaped in female flowers and broadly oval in the male flowers. This species is so far known only from the type collection.

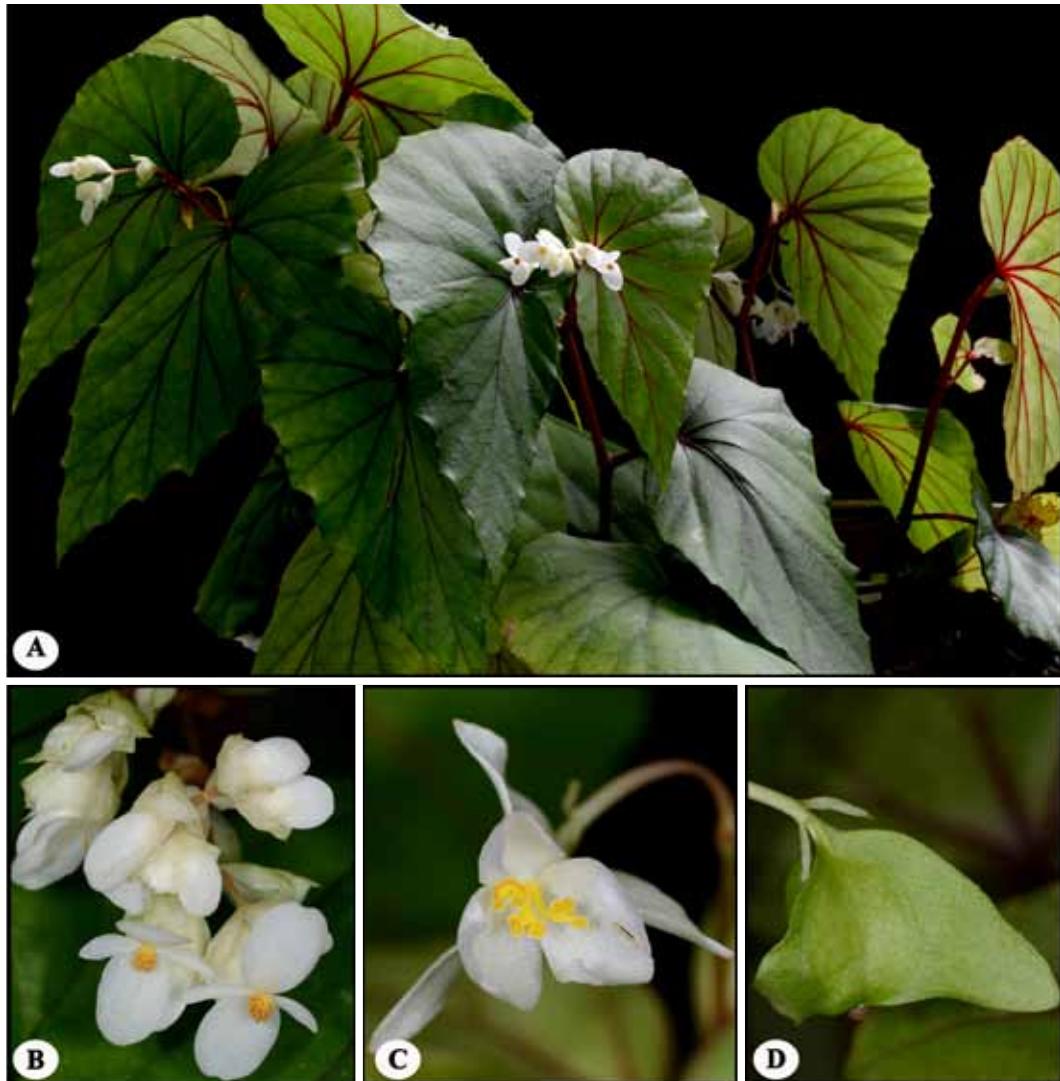


Fig. 3. *Begonia ramlanii*. **A.** Habit; **B.** Inflorescence and male flower; **C.** Female flower; **D.** Fruit. All photos by Ramlan Miadin.

3. *Begonia vanderentii* Rossiti sp. nov.

It resembles *Begonia taniana* V.S. Guanih (2015) in its cane-like habit, glabrous, glossy, dark green leaves with an entire margin and in its pink flowers, but it is different in its extremely attenuated ovate-lanceolate leaves with an acumen to 15 cm long (not 2.5 cm as in *B. taniana*), male flowers with 4 tepals (not 2 tepals), and female tepals with an entire margin (not toothed female tepals). Type: *Antony van der Ent et al. SNP 20947*, Borneo, Sabah,

Ranau District, Kinabalu Park, Monggis sub-station, Mt. Tambuyukon trail, Wuluh Camp to Musang Camp, Plot 1, 13 March 2011 (holotype SNP!). (**Fig. 4**)

Cane-like begonia to 40 cm tall. Stems erect, brown, 5–7 mm thick, becoming woody, internodes 3.5–7.5 cm long, glabrous, branched, swollen at nodes. Stipules pale green, glabrous, slightly triangular, ca. 10 × 16 mm, margin entire, apex acute, persistent. Leaves alternate, oblique, distant, ca. 7–10 cm apart, pointing downwards; petiole brown, sparsely hairy on the upper part, 3.5–4.5 cm, terete; lamina plain light green on both surfaces, in life fleshy, papery when dry, glossy, oblique, asymmetric, ca. 20–22 × 6.5–8.5 cm, broad side 4.5–5.5 cm wide, ovate-lanceolate, basal lobes 3–5.5 cm, margin entire, apex acuminate, acumen to 1–1.5 cm; venation palmate-pinnate, veins light green, 5–6 pairs vein, obscure above, prominent beneath. Inflorescences protogynous, pink, many-flowered raceme, terminal and axillary, glabrous, erect, shorter than petioles, peduncle 2 cm. Bracts on male and female flowers light green, oval, ca. 8 × 10 mm, margin entire, persistent. Bracteoles absent. Male flower: pedicel maroon, 5–10 mm long, tepals 4, oval, pinkish, glabrous, margin entire, outer 2, ca. 15 × 13 mm, apex rounded; inner 2 tepals oval, ca. 9 × 4 mm, apex lanceolate; stamens 20, cluster globose, sessile; filaments yellow, ca. 2.5 mm long; anthers yellow, narrowly obovate, ca. 1 × 0.2 mm, apex emarginate. Female flower: pedicel 1–1.5 cm, maroon, glabrous; ovary, pinkish-green, ca. 9 × 6 mm, locules 3, placentas 2 per locule, tepals 5, broadly oval, pink, outermost 4, equal, ca. 14 × 8 mm, innermost tepal smaller ca. 10 × 4 mm, margin entire, apex rounded; styles 3, yellow, 3 mm long, Y-shaped, divided to base; stigma yellow, papillose forming a continuous twisted band. Capsule 1.5 × 2.4 cm, glabrous, wings 3, equal, 18 × 10 mm, thinly fibrous, dehiscing between locule and wing; pedicel stiff, 2–3 cm long, maroon. Seeds barrel-shaped, ca. 0.5 × 0.2 mm, collar cells slightly more than half the seed length.

ETYMOLOGY. Named in honour of Dr Antony van der Ent, University of Queensland, Australia, research collaborator of Sabah Parks in the *Plant diversity, soil chemistry and geospatial analysis of ultramafic outcrops on Mount Kinabalu and Mount Tambuyukon Sabah, Malaysia 2009–2013* project. This project was led to the discovery of many new plant species including this begonia as well as the production of the landmark book on *The Ultramafic Flora of Sabah* (Ent *et al.*, 2014).

ECOLOGY. Growing in ultramafic areas at 300–1200 m elevation. Ultramafic obligate.

DISTRIBUTION. Borneo. Endemic to Sabah (Kinabalu Park, Mt. Tambuyukon, Serinsim substation and Monggis substation (Musang Camp, Wuluh Camp)).

CONSERVATION STATUS. Least Concern. It grows in the Kinabalu Park area, a totally protected area.

SPECIMENS EXAMINED—BORNEO. SABAH: Ranau and Kota Marudu District: Kinabalu Park — Serinsim substation, *Masrina et al. SP 10534* (SNP); Mt. Tambuyukon—Musang Camp Plot 2, *Antony van der Ent et al. SNP 21258* (SNP), Mt. Tambuyukon-



A



B



C



D

Fig. 4. *Begonia vanderentii*. A. Habit; B. Female flower; C. Male flower; D. Fruit. All photos by Rossiti M. Karim.

Wuluh Monggis Plot 5, *Antony van der Ent et al.* SNP 31770 (SNP), SNP 31953 (SNP), Mt. Tambuyukon-Wuluh Camp Plot 7, *Antony van der Ent et al.* SNP 31857 (SNP), SNP 37299 (SNP), Mt. Tambuyukon-Musang Camp (Tambuyukon Expedition 2007), *Yabainus et al.* SP 12012 (SNP); Monggis sub-station, Mt. Tambuyukon trail, Wuluh Camp to Musang Camp, Plot 1, *Antony van der Ent et al.* SNP 20947 (holotype SNP!).

NOTES. This species was illustrated by Ent *et al.* (2014) as *Begonia* sp. nov. 2 on page 91. It is restricted to ultramafic soil. The leaves of the juvenile plants are wavy.

ACKNOWLEDGEMENTS

We gratefully acknowledge the management of Sabah Parks particularly the Director of Sabah Parks for his support of biodiversity research work on *Begonia* in the Sabah Parks area. We are sincerely grateful to Dr Ruth Kiew (FRIM) and Julia Sang (Sarawak Forestry) who shared their detailed knowledge on begonias, and for their suggestions and comments in improving this paper. We would also like to thank all our fellow colleagues, Matsain M. Buang, Justinus G., Geofarry G., Dolois S., Kinahim S. and Yabainus J., for their assistance during the field work and in the herbarium. We also want to thank the management of Sabah Forestry Department and the Curator of SAN Herbarium for their support in facilitating our research by permitting us to access the herbarium specimens in their care.

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***Begonia* (Begoniaceae) from Tawau Hills Park, Sabah, Malaysia,
including Ten New Species**

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Summary. There are 13 *Begonia* species found in Tawau Hills Park, Sabah, Malaysia, of which ten species are new: *B. basintaliana* Rimi, *B. gelasensis* Rimi & Kinahim, *B. gusili* Rimi, *B. lamriana* Rimi, *B. mariaensis* Rimi & Simun, *B. jamiliana* Rimi, *B. paracaulliflora* Rimi, C.-I. Peng & S.M. Ku, *B. renek* Rimi, *B. simunii* Rimi and *B. tindan* Rimi & Kinahim. All ten species are endemic to Tawau Hills Park. Three widespread species, namely *B. fuscisetosa* Sands, *B. gomantongensis* Kiew and *B. postarii* Kiew, were also recorded. Twelve species belong to section *Petermannia* and only one, *B. simunii*, belongs to section *Baryandra*. A key to species and descriptions of new species are provided.

The Tawau Hills Park (THP), covering an area of 27,984 ha, is located in the east coast of Sabah (*ca.* 4° 27' N, 117° 57' E) (Fig. 1). The Park was gazetted in 1979 under the Sabah Parks Enactment, mainly to protect water catchment and to preserve the flora and fauna. The Park covers hilly terrain from 30 m to 1310 m elevation with three peaks, namely Mt. Magdalena (1310 m), Mt. Lucia (1189 m) and Mt. Maria (1067 m). Geologically, the area is comprised of alluvial volcanic soil with some patches of *kerangas*.

Most areas in Tawau Hills Park with pristine vegetation have not been fully explored. Historically, about 40% of the area had been logged long before it was gazetted as a State Park in 1979. Based on reports from a series of studies, the remaining forests represent an invaluable natural resource of flora and fauna. The predominant vegetation type consists

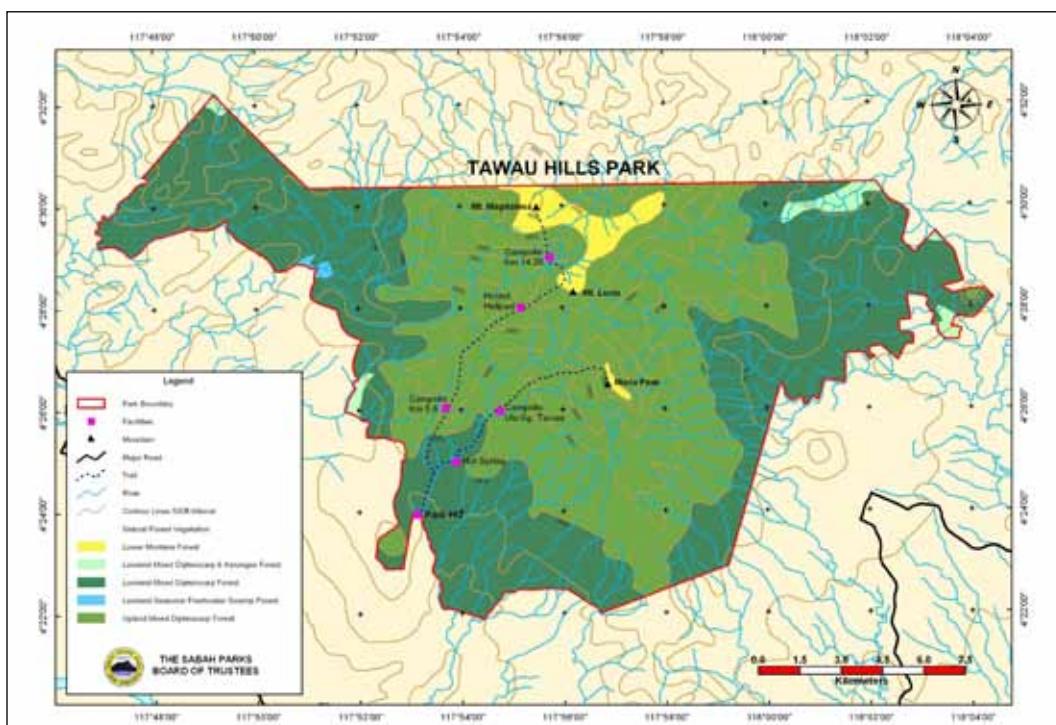


Fig. 1 (above). Locality of Tawau Hills Park within Sabah. **Fig. 2** (below). Study area. The main trails to Mt. Lucia, Mt. Magdalena and Mt. Maria.

of mixed dipterocarp forest luxuriant in many commercial timber species, including 62 species of Dipterocarpaceae (Rimi *et al.*, 2008) as well as a high diversity of non-woody plants such as 64 species of Zingiberaceae (Gobilik & Limbawang, 2010), 150 species of Orchidaceae (Lim, 1995) and 27 species of Araceae (Rimi & Yabainus, 2008). Seino *et al.* (2007) demonstrated the significant difference in floristic composition and stand structure in the Tawau Hills Park due to soil nutrient richness from accumulation of volcanic ash.

Materials and Methods

The *Begonia* study was started in 2005 under the ‘Plants of Forest Floor Documentation Project’. This project aims to document plants of ornamental interest to be planted at an *ex-situ* garden in Tawau Hills Park. The study area covered only a small patch of Tawau Hills Park mainly around the Headquarters and along the trails to the summits of Mt. Magdalena, Mt. Lucia and Mt. Maria (Fig. 2). Most collections were made during a series of fieldwork since 2005 and also included collections made in 2013 during the Balung sub-station flora and fauna exploration program. Conservation assessments follow standard IUCN procedures (IUCN, 2001).

Taxonomy Treatment

Thirteen begonia species were recorded from Tawau Hills Park, including ten new species described below. Twelve species belong to section *Petermannia* and one belongs to section *Baryandra*.

KEY TO SPECIES OF *BEGONIA* IN TAWAU HILLS PARK

1. Rhizomatous begonia. Stems *c.* 6.5–9 cm long, *c.* 1.8 cm thick, succulent, internodes short 12. *B. simunii*
Erect or cane-like begonia 2
2. Stems branched with 2 or more branches 3
Stems rarely branched 9
3. Leaves oblique (midrib at an angle to the petiole) 4
Leaves not oblique (petiole in line with the midrib) 12
4. Low herbs, less than 40 cm tall. Leaves brownish or blackish-green 7. *B. lamriana*
Herbs, more than 40 cm tall. Leaves green 5
5. Stems, lamina, inflorescence densely pubescence 10. *B. postarii*
Stems, lamina, inflorescence glabrous to partly hairy 6

- 6. Inflorescence peduncle hanging down, more or less horizontal 7
Inflorescence peduncle erect 8
- 7. Inflorescence up to 30 cm long; male and female flower on the same inflorescence
..... 8. *B. mariaeensis*
Inflorescence up to 7 cm long; male and female from different leaf axils 11. *B. renek*
- 8. Bract persistent, enveloping clusters of male flower. Capsules hairy
..... 4. *B. gomantongensis*
Bract caducous. Capsules with scattered fine hairs 3. *B. gelasensis*
- 9. Stems pubescent to hispid. Upper lamina surface with a row of bristly hairs between the veins 10
Stems with appressed hairs. Lamina glabrous 11
- 10. Fruits with 6 wings, 3 fully developed, 3 smaller and protruding from junctions of carpels 9. *B. paracauliflora*
Fruits with 3 short or more or less undeveloped wings 5. *B. gusilii*
- 11. Male flowers with 4 tepals, in a simple cyme of 1 to 2 flowers 6. *B. jamiliana*
Male flowers with 2 tepals, in a row of overlapping bracts 13. *B. tindan*
- 12. Leaves lanceolate, 4–8 cm wide and 11.5–22 cm long, apex acuminate
..... 1. *B. basintaliana*
Leaves oblanceolate, 1.5 cm wide and 4.5–10 cm long, apex sharply acute
..... 2. *B. fuscisetosa*

Species Descriptions

1. *Begonia basintaliana* Rimi sp. nov. (Section *Petermannia*)

It is similar to *Begonia danumensis* F.Y. Chong (2015) in its subopposite leaves and lamina shape, size and venation, but it is different in having glabrous lamina in *B. basintaliana* (vs. hairy as in *B. danumensis*), the lamina has fewer veins, 2–4 on each side of the midrib (vs. c. 7), a longer inflorescence 7 cm long (vs. 4.5–5.5 cm long and much longer fruit stalks 12–15 mm long (vs. 4–8 mm long). Type: *Masrina et al.* SP 10518, Borneo, Sabah, Tawau District, Tawau Hills Park, Trail to Bukit Bombalai, 2 March 2005 (holotype SNP!; isotype SAN!). (**Fig. 3**)

Cane-like begonia, 30–60 cm tall, glabrous. Stems red, c. 4–6 mm thick, internodes c. 4–7 cm long, glabrous, branches, slightly swollen at nodes. Stipules pale green, glabrous,

broadly lanceolate, c. $15–244 \times 5–10$ mm long, keeled, margin entire, apex acuminate, acumen c. 2 mm long, persistent. Leaves more or less opposite, not oblique, distant, held horizontally; petiole red, glabrous, c. $0.5–1.5$ cm long, grooved above; lamina plain green above, light green beneath, glabrous, fleshy in life and papery when dried, glossy, lanceolate, asymmetric, $11.5–22 \times 4–8$ cm long, broad side $2–4.5$ cm, base acuminate, basal lobes $0.5–0.8$ cm wide, broadly rounded, margin slightly serrate, apex acuminate, acumen 1.5 cm long; main veins green and red near the base, glabrous, venation palmate-pinnate, 2–4 veins on either side of the midrib, 2 veins in basal lobe, impressed above, prominent beneath. Inflorescences protogynous, terminal on lateral branches, glabrous; female inflorescences



Fig. 3. *Begonia basintaliana*. **A.** Habit with woody stem and flower; **B.** Close-up of male flower; **C.** Side view of female flower; **D.** Fruit. All photos by Ramlan Miadin.

with one or rarely two flowers at the base; male inflorescences 7 cm long with a few short cymose branches, peduncle 0.4 cm long, reddish. Bracts pale green, lanceolate, 12 × 4 mm, keeled, margin entire, persistent. Bracteoles pale greenish, lanceolate to broadly ovate, c. 6–8 × 4 mm, glabrous, persistent. Male flower: pedicel reddish, 4 mm long; tepals 2, white tinged greenish, sometimes reddish in the middle, glabrous, ovoid, c. 5–8 × 3–5 mm, margin entire, apex rounded; stamens c. 22, cluster conical, subsessile; filaments pale yellow, c. 1.5–2.2 mm long; anthers yellow, obovate, c. 0.7 × 0.2 mm, apex with short peak in the middle. Female flower: pedicel 12–15 mm long, greenish; ovary green or red, finely hairy, spindle-shaped, c. 15 × 5 mm, wings 3, equal, locules 3, placentas 2 per locule with many ovules on both surfaces; tepals 5, isomorphic, 6–8 × 4–7 mm broadly lanceolate to ovate, white-greenish sometimes reddish in the middle, margin serrate, apex slightly acuminate; styles 3, deep yellow, c. 3 mm long, divided to base, deeply Y-shaped with twisted tips; stigma yellow, papillose forming a continuous twisted band. Capsule pendent, c. 1.5–2.2 × 0.8–1.5 cm, short hairy in life, glabrous when dry, locules broadly spindle-shaped, wings 3, equal, narrowed proximally, c. 2 × 2–4 mm, fibrous, dehiscing between the locule and wing; pedicel c. 1.2–1.5 cm long. Seeds: barrel-shaped, c. 0.7–0.8 mm × 0.3 mm, columnar cells less than half the length of seed.

ETYMOLOGY. Named in honour of Paul Basintal, the former Director of Sabah Parks, who retired in 2014.

ECOLOGY. Primary forest, under forest canopy, 100–800 m elevation.

DISTRIBUTION. Borneo. Endemic to Sabah (Tawau Hills Park).

CONSERVATION STATUS. Least Concern. It is found in Tawau Hills Park, which is a totally protected area.

SPECIMENS EXAMINED—BORNEO. SABAH: Tawau District: Tawau Hills Park Lowland Garden, *Simun et al. KNP A 14706* (SNP, SAN); *Shahida et al. BORH 0624* (BORH, SNP); Trail to Bukit Bombalai, *Masrina et al. SP 10518* (holotype SNP!; isotype SAN!).

NOTES. The fruits vary in colour from reddish pink to greenish.

2. *Begonia fuscisetosa* Sands (1997: 433). (Section *Petermannia*). Type: *M.J.S. Sands 5606 et al.*, Brunei Darussalam, Temburung District, Subd. Amo, by the Temburung River c. 0.5 km upstream from Kuala Belalong, 25 March 1991 (holotype K, isotype BRUN!).

Erect begonia, shrubby, 50 cm tall. Stems reddish green, branched, slightly thicker at nodes on the lower stem, succulent, grooved when dried, internodes 1.5–4 cm long, 2–4 cm thick, becoming woody at base, sparsely hairy, hairs translucent, 1–1.5 mm long. Stipules keeled,

pale green, persistent above, margin entire, glabrous, lanceolate, c. 1.2–2 cm long, apex setose, seta 1 mm long. Leaves alternate, distant, held horizontally; petiole reddish-green, terete, 0.3–0.7 cm long, with sparsely translucent hairs; lamina oblanceolate, green, matt, slightly fleshy in life, becoming papery when dry, spotted red-brown with a bristle in between main veins, slightly asymmetric, 4.5–10.5 × 1.5–3.5 cm, broad side 1–2 cm, base acute, basal lobe 0.5–1 cm, margin doubly serrate, tip sharply acute; venation palmate-pinnate, 3–5 pairs of veins, 1 pair in basal lobe, branching halfway to margin, impressed above, concolorous, beneath impressed, green. Inflorescences protogynous, terminal on lateral branches, glabrous, 2–7.5 cm long, cymose branches short, peduncle pale green, 1.5–4 cm long; female inflorescence: a reduced cyme with one flower; male inflorescence: peduncle 1.5–4 cm with a few cymose branches. Bracts on male flower, narrowly triangular, pale green, c. 0.5 × 0.3 mm, margin entire, persistent. Male flowers many, pedicel light green, c. 0.2–0.5 cm long; tepals 2, white, margin entire, oval to rounded, tip rounded, glabrous; stamens 12, in a loose cluster, globose, 2 × 1.8 cm across, stalked c. 0.5 mm; filaments c. 0.5 mm long, anthers yellow, narrowly obovate, 0.8 × 0.6 mm, apex emarginate. Female flowers: ovary, 1–1.5 × 0.8 cm, pale green, locules 3, placentas 2 per locule, wings 3; tepals 5, white, lanceolate, apex rounded; styles 3, yellow, 3 mm, divided to base, yellow; stigma papillose forming a continuous twisted band. Capsule 8–9 × 5–6.5 cm, wings equal, 1–1.5 × 2–3 cm, dehiscing between locule and wing; pedicel 1–13 cm long. Seeds barrel-shaped, c. 0.5 mm long, collar cells slightly more than half the seeds length.

ETYMOLOGY. Latin, *fusci*- dark brown; *setosus* = bristly, referring to the characteristic row of bristles between the veins on the upper leaf surface.

ECOLOGY. It grows on the forest floor, under the shade of canopy trees.

DISTRIBUTION. Endemic to Borneo. Widespread throughout Sabah, Brunei Darussalam and Sarawak. In Tawau Hills, it was collected on the trail (800 m) to Mt. Magdalena. It was also found at the Sayap sub-station (950 m) and on the Liwagu trails (1500 m) in the Kinabalu Park.

CONSERVATION STATUS. Least Concern. Widespread and it is also found in Tawau Hills Park, which is a totally protected area.

SPECIMENS EXAMINED—BORNEO. SABAH: Tawau District: Tawau Hills Park — Trail to Mt. Magdalena, *Duni et al. KNP 14104* (SNP), Lowland Garden, *Rimi, SNP A 16606* (SNP, SAN). **BRUNEI DARUSSALAM:** Temburung District, Subd. Amo, by the Temburung River c. 0.5 km upstream from Kuala Belalong, *M.J.S. Sands 5606 et al.* (holotype K, isotype BRUN!).

NOTES. It is a shrubby small herb characterized by stiff red bristles with small red bases in between the veins on the upper leaf surface.

3. *Begonia gelasensis* Rimi & Kinahim sp. nov. (Section *Petermannia*)

It is similar to *Begonia inostegia* Stapf (1894: 166) in its habit and broad leaves with radiating parallel venation, but it is different in having fewer veins that are more distantly spaced (vs. many, close or compact veins as *B. inostegia*), larger male flowers with tepals c. 10×6 mm (vs. $4-6 \times 3-4$ mm), and sparsely branched inflorescences (vs. with tiers of much-branched side branches, and many male flowers as in the case of *B. inostegia*). Type: *Rimi R. SNP A16601*, Borneo, Sabah, Tawau District, Tawau Hills Park, Gelas Waterfall area, 18 December 2009 (holotype SNP!; isotype SAN!). (**Figs. 4 & 5**)

Erect, bushy herb to c. 40–60 cm tall. Stems glabrous, much branched, rooting at nodes, internodes 5–10 cm long, slightly swollen, 6–8 mm diameter, hollow and grooved when dry. Stipules pale green, narrowly lanceolate to triangular, c. 6×5 mm, margin entire, apex acuminate, acumen c. 0.5 mm, caducous. Leaves alternate, distant, slightly horizontal; petiole red brown or purple, c. 3–6.5 cm long; lamina plain green above, paler beneath, slightly fleshy in life and papery when dry, glossy, ovate, asymmetric, c. $10-18 \times 6.5-9$ cm, broad side 3.5–5.5 cm, base cordate, basal lobes 3 cm, rounded, margin entire to finely serrate, acute; venation dark red, palmate-pinnate, 3–4 pairs on both sides, basal lobes 2 pairs, branching halfway towards the margin, impressed half way towards the margin of upper surface, prominent beneath. Inflorescences protogynous, terminal on lateral branches, glabrous, c. 4–6 cm, racemose; male inflorescences, erect, c. 4–8 cm long with 3–5 cymose branches, rachis 4–6 mm long; peduncle c. 1–1.5 cm long, brownish red. Bracts not seen. Male flower: pedicel pale yellow, 1–3 mm long; tepals 2, white, glabrous, oval, c. 10×6 mm, margin entire, apex acute; stamens c. 39, cluster conical, c. $5 \text{ mm} \times 3 \text{ mm}$, subsessile; filaments yellow, c. 0.2 mm long; anthers deep yellow, oblong, c. 2×1 mm, apex emarginate. Female flower: pedicel 8 mm long, brownish red; ovary white tinged greenish, finely hairy, oblong, c. 1.5×0.4 cm, wings 3, equal, locules 3, placentas 2 per locule with many ovules on both surfaces; tepals 5, isomorphic, c. 10×5 mm, broadly lanceolate, white, margin entire, apex acute to obtuse; styles 3, deep yellow, c. 4 mm long, divided to base, Y-shaped; stigma yellow, papillose forming a twisted band. Capsule reflexed, c. $1.4-2 \times 1-1.8$ cm, glabrous, locules 3, wings 3, equal, narrowed proximally, c. 6 mm wide, thinly fibrous, dehiscing between the locule and wing; pedicel c. 8 mm long. Seeds barrel-shaped, c. 0.5×0.2 mm, columnar cells more than half the length of seed; pedicel c. 8 mm long.

ETYMOLOGY. The species named for the Gelas Waterfall, from where the first collection was made.

ECOLOGY. Lowland to lower montane forest at 200–830 m elevation in shady areas.

DISTRIBUTION. Borneo. Endemic to Sabah (Tawau Hills Park).

CONSERVATION STATUS. Least Concern. It is found in Tawau Hills Park, which is a totally protected area.

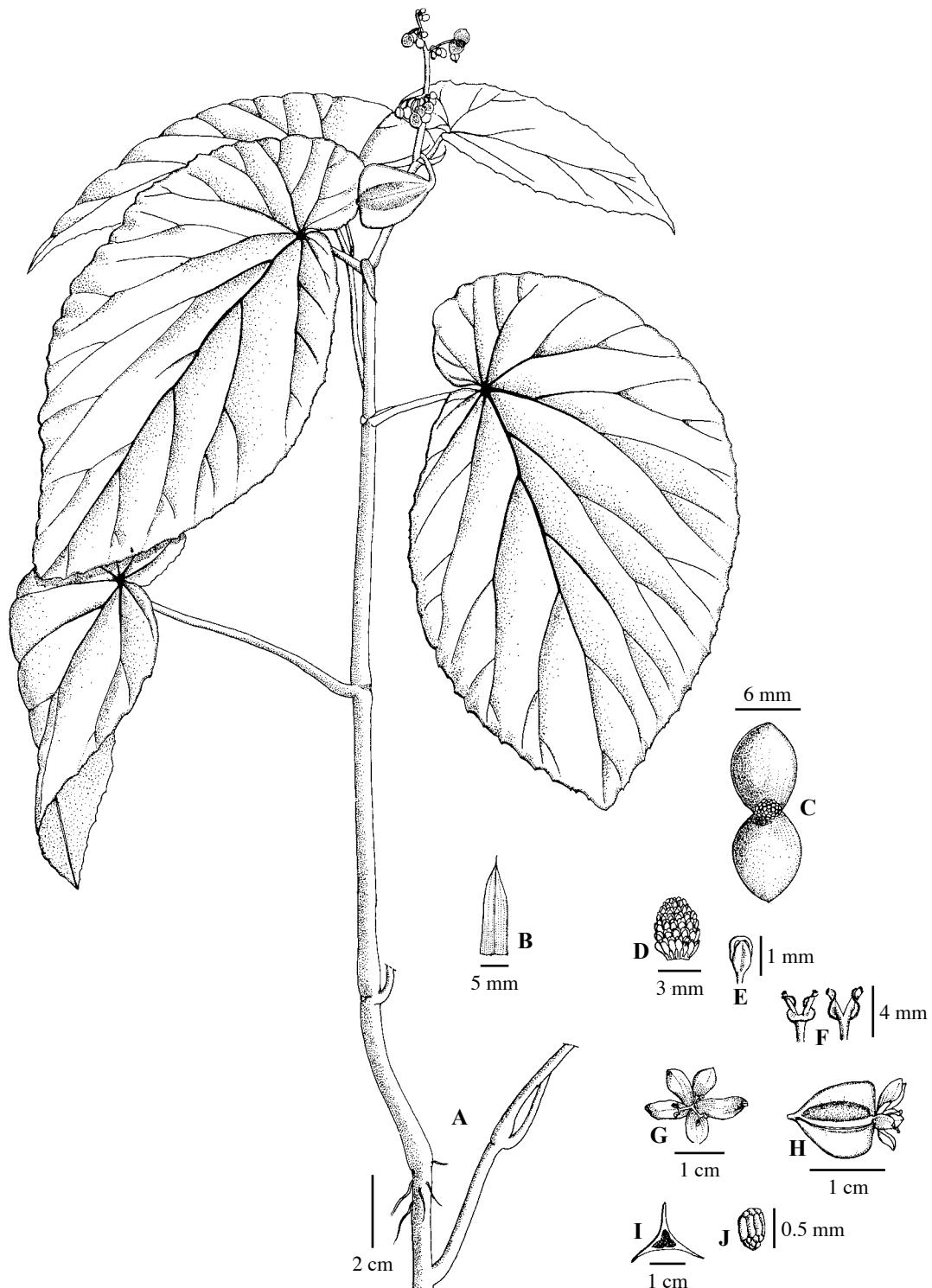


Fig. 4. *Begonia gelasensis*. **A.** The plant; **B.** Stipule; **C.** Male flower; **D.** Stamen cluster; **E.** Stamen; **F.** Styles and stigmas; **G.** Female flower; **H.** Fruit; **I.** Cross-section of ovary; **J.** Seed.

SPECIMENS EXAMINED—BORNEO. SABAH: Tawau District: Tawau Hills Park — Waterfall Bukit Gelas, *Rahimah et al. SP 18057* (SNP), *Rimi R. SNP A16601* (holotype SNP!; isotype SAN!); Bukit Gelas Waterfall area, *Masrina et al. SP 10514* (SNP), *Shahida & Siti Farhana No. 0628* (SNP); Balung Hot Spring area, *Dolois et al. SP 17421* (SNP); Lowland Garden, *Simun & Evertius, KNP A 14708* (SNP).

NOTES. This begonia is beautiful and has potential as an ornamental plant.

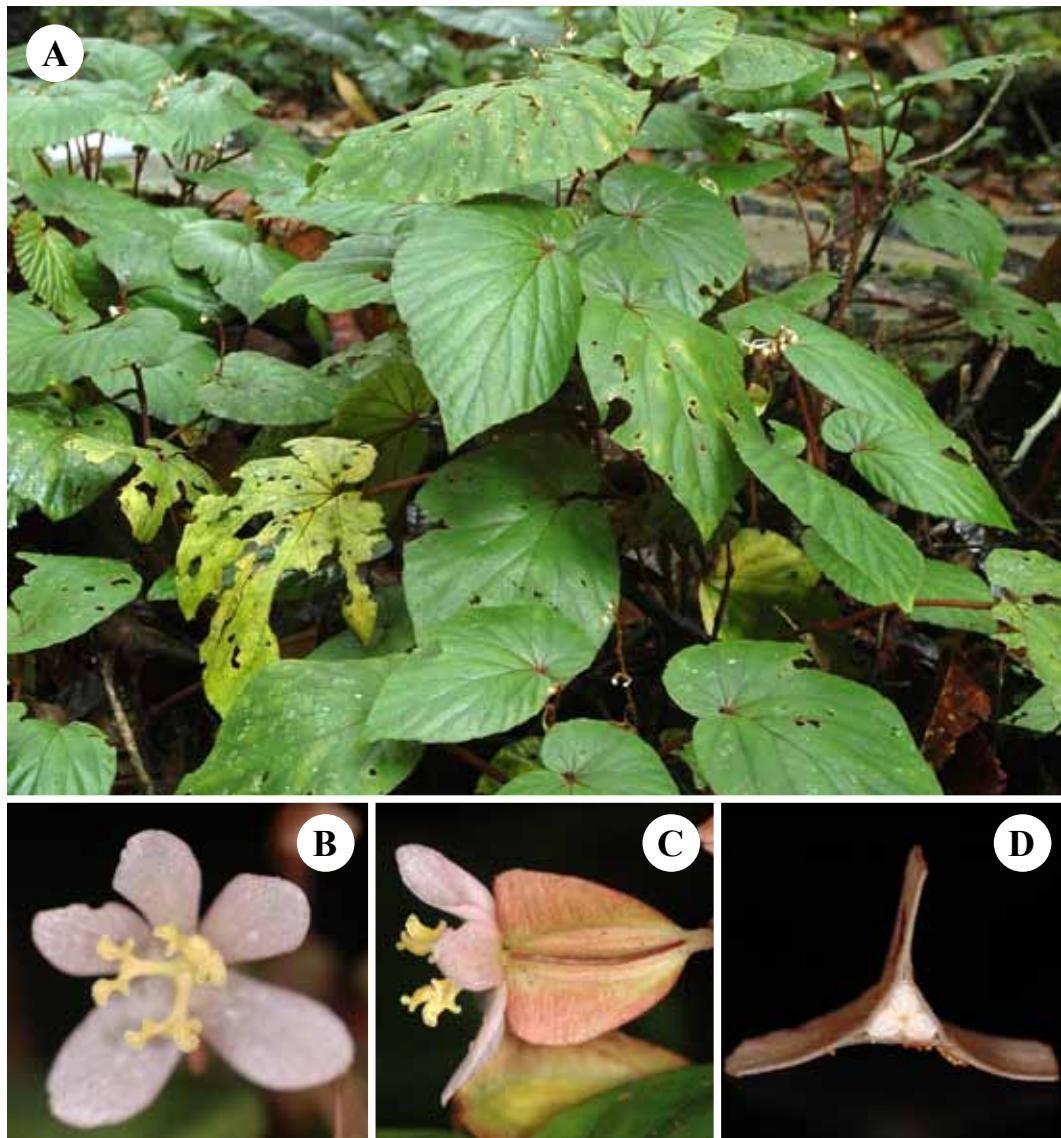


Fig. 5. *Begonia gelasensis*. **A.** Habit; **B.** Close-up of female flower; **C.** Female flower (side view); **D.** Cross-section of fruit (ovary). All photos by Ramlan Miadin.

4. *Begonia gomantongensis* Kiew (1998: 164). (Section *Petermannia*). Type: *James Awing SAN 47257*, Borneo, Sabah, Kinabatangan District, Gomantong, Bukit Dulong Lambu, 11 October 1964 (holotype SAN!).

Cane-like begonia, erect, to 60 cm tall. Stem sparsely branched, minutely bristly, woody, c. 4–5 mm diameter. Lamina oblique, large, 30 × 25 cm, glossy, dark green above, pale green beneath, glabrous, asymmetric, margin minutely serrulate, apex shortly acuminate. Inflorescences protogynous with 1–2 female flowers from the leaf axil and many male flowers on an erect rachis, 2.5–6.5 cm long with short cymose branches c. 0.5 cm long. Female flower: tepals 5, white; ovary oblong tapered into pedicel, green tinged pink, c. 16 × 11 mm, surface of the locules conspicuously verruculose, wings 3. Male flower: tepals 2, white, rotund, 3.5–4 × 3–3.5 mm; stamens 45, cluster obovoid. Fruits pendent, capsule oblong, 1.7–2.5 × 1.3–1.8 cm, wings 3, equal, broadly rounded proximally, truncate or rounded distally, 4–5 mm wide, stiffly papery, outer surface of locule completely verruculose, dehiscing between the locules and wings.

ETYMOLOGY. Named for the locality from where it was originally collected, Bukit Gomantong being the more familiar name for Bukit Dulong Lambu.

ECOLOGY. In Tawau Hills Park, it grows in deep shade, on wet, volcanic rock boulders on Mt. Maria (over 800 m) and also on trails to Hot Spring (400 m), Balung Sub-Station.

DISTRIBUTION. Borneo. Endemic to Sabah (Lahad Datu, Sandakan and Tawau Districts).

CONSERVATION STATUS. Least Concern. It is found in Tawau Hills Park, which is a totally protected area.

SPECIMENS EXAMINED—BORNEO. SABAH: Tawau District: Tawau Hills Park — *Sukaibin et al. SNP 32904* (SNP); Mt. Maria, Kawah river, *Dolois et al. SNP 36018* (SNP); Balung, route to Hot Spring, *Kinahim & Handry, SNP 25240* (SNP); Kinabatangan, Gua Gomantong, *Rimi et al. KNP 10650* (SNP).

NOTES. This species is distinct in having oblong capsules and distinct pimply surface of the locules.

5. *Begonia gusilii* Rimi sp. nov. (Section *Petermannia*)

It is similar to *B. bruneiana* Sands (1997: 433) in its hispid stems, its more or less symmetric, non-oblique, and narrow slightly obovate leaves, but it is different in its male flowers with 4 large tepals, the outer pair c. 14 × 13 mm (vs. with 2 tepals c. 7 × 6 mm as in *B. bruneiana*), and its small, almost wingless fruits, c. 3.5 × 7 mm (vs. 7–9 × 9–13 mm with 3 wings 3–6

mm wide). Type: *Rimi et al. KNP 12490*, Borneo, Sabah, Tawau District, Tawau Hills Park, Mt. Lucia, waterfall slope near km 10.5, 23 April 2007 (holotype SNP!; isotype SAN!). (**Fig. 6**)

Short herbs, decumbent at the base, rooting at the lower nodes, then erect, 30–40 cm tall. Stems green-reddish, dark brown, 3–4 mm thick, pubescent, hairs red at the base and whitish towards the apex, c. 1.5–2 mm long, with one short branched at the base, internodes c. 0.5–2 cm long. Stipules pale green to reddish, pubescent, hairs whitish, c. 1.5 mm, lanceolate, 11

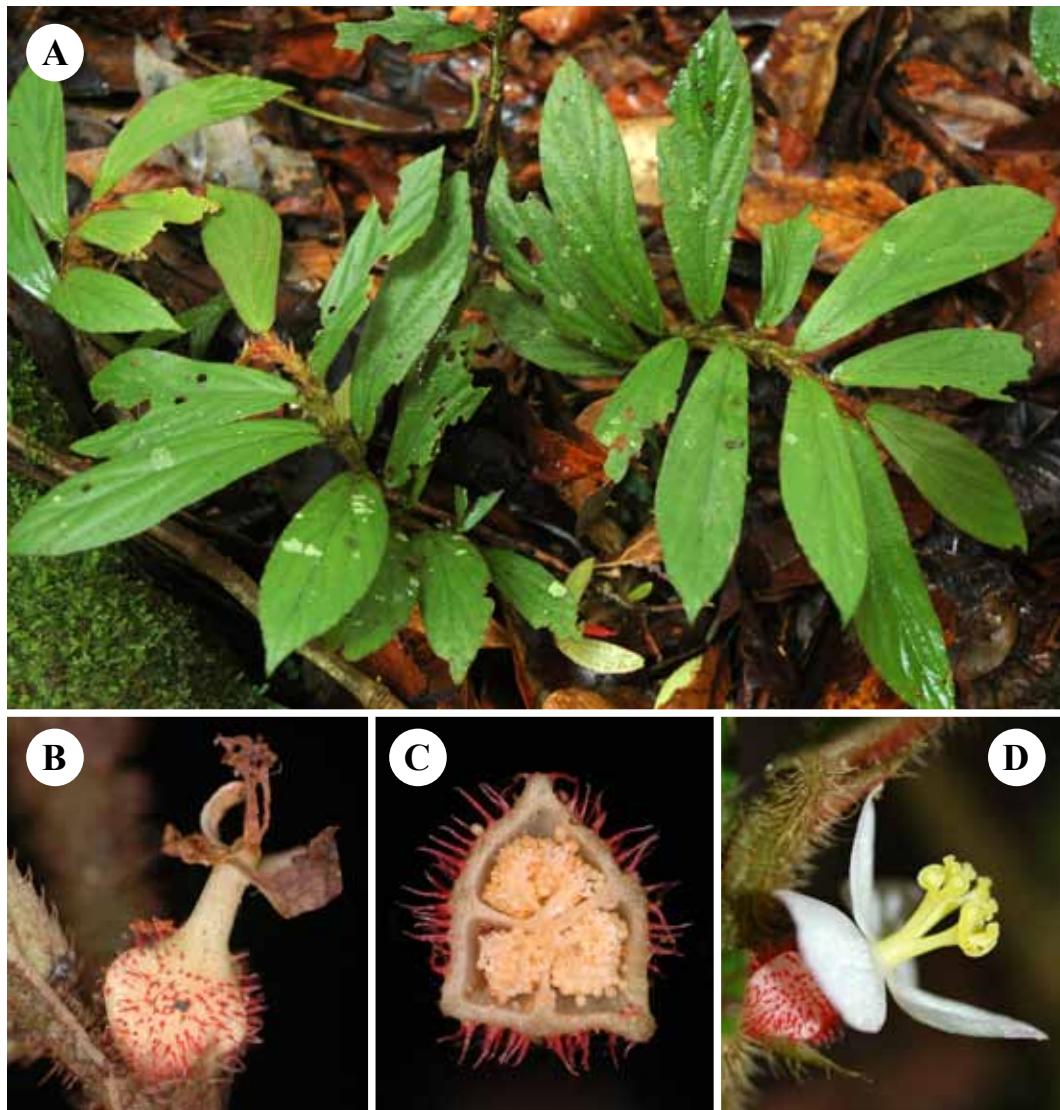


Fig. 6. *Begonia gusilii*. **A.** Habit; **B.** Fruit; **C.** Cross-section of ovary; **D.** Female flower (side view). All photos by Enroe Saudi.

\times 6 mm, margin entire with rows of pale brownish hairs below, apex setose, seta c. 2 mm long, persistent. Leaves alternate, slightly oblique, distant, held semi-erect to horizontally; petiole green or reddish, pubescent, hairs whitish, 6–8 mm long; lamina plain green, paler below, slightly fleshy in life, matt, with reddish bristles between the veins on upper surface, lanceolate, slightly asymmetric, c. 12 \times 3.5 cm, broad side 1.3 cm wide, base oblique acute, slightly overlapping, basal lobes 1.5–2 mm, margin entire with fine hairs, apex mucronate; main veins concolorous, bristly on the midrib and veins below, venation pinnate with 3–4 veins on each side of the midrib, 1–2 veins in basal lobe, impressed above, prominent beneath. Inflorescences protogynous, with a single female flower axillary on the lower stem, male inflorescence a simple cyme. Bracts green to reddish, lanceolate, c. 2 \times 1 mm, margin entire, persistent. Male flower: pedicel white, c. 4–5 cm long; tepals 4, glabrous, pure white, outer 2 tepals, broadly ovate or rounded, c. 14 \times 13 mm, margin entire, apex rounded, inner 2 tepals, narrowly lanceolate, c. 13 \times 5 mm; stamens yellow, in a loose conical cluster, stalk c. 0.5 mm long; filaments yellow, 1–1.2 mm long; anthers yellow, obovate, apex emarginate. Female flower: pedicel c. 3 mm long, white, sparsely red hairy; ovary white, with scattered red hairs, broadly ovate, c. 7 cm \times 3.5 cm, wings not fully developed, locules 3, placentas 2 per locule with many ovules on both surfaces; tepals 5, glabrous, outermost 3 tepals white, slightly rhomboid, c. 14 \times 10 mm, innermost 2 tepals, white, c. 14 \times 4 mm, margin entire, apex attenuate to a long point, glabrous; styles 3, persistent, pale yellow, c. 5 mm long, divided near the base, Y-shaped with twisted tips; stigma pale yellow, papillose forming a continuous twisted band. Capsule 3.5 \times 7 mm, covered with red hair, wings 3, short and not fully developed; pedicel short, 5 mm long. Seeds oblong, c. 0.3 \times 0.15 mm, columnar cells less than half the length of seed.

ETYMOLOGY. Named after Gusili Johalin, former staff of the Sabah Parks, who managed to climb the precipitous slope of the waterfall, from where it was first collected.

ECOLOGY. Primary forest, lower slope of waterfall, 741 m elevation.

DISTRIBUTION. Borneo. Endemic to Sabah (Tawau Hills Park).

CONSERVATION STATUS. Least Concern. It is found in Tawau Hills Park, which is a totally protected area.

SPECIMENS EXAMINED—BORNEO. SABAH: Tawau District: Tawau Hills Park — Lowland Garden, *Rimi R.* SNP A 16603 (SNP); Mt. Lucia, waterfall slope near km 10.5, *Rimi et al.* KNP 12490 (holotype SNP!; isotype SAN!).

NOTES. This is a remarkable species with fruits that are covered with red hairs and wings that are hardly developed. Unlike *B. paracauliflora* that has two colour forms (reddish or green beneath), leaves of *B. gusillii* are always plain green. Its stems are usually creeping then erect, which is an adaptation to its habitat. It grows on the slope of a waterfall boulder.

6. *Begonia jamiliana* Rimi sp. nov. (Section *Petermannia*)

In its rarely branched low stems, narrowly obovate and non-oblique leaves with short petioles, laminas that are usually reddish brown beneath, its male flowers in few-flowered simple cymes and solitary female flowers, it is similar to *B. bruneiana* Sands (1997: 433) but it differs from this species in its long internodes, 4.5–10 cm (vs. 0.6–0.9 cm as in *B. bruneiana*), 5–6 veins on either side of the midrib (vs. 3–4 veins), the male flowers are larger and have 4 tepals, the outer pair c. 10 × 5 mm (vs. with 2 tepals, c. 7 × 6 mm) and fruits that are longer than broad, c. 15 × 10 mm (vs. broader than long, 7–9 × 9–13 mm, as in *B. bruneiana*). Type: *Rimi R. SNP A 16607*, Borneo. Sabah, Tawau District, Tawau Hills Park, near by the Head Office and along the trail to the Mt. Lucia, 4 March 2004 (holotype SNP!; isotype SAN!). (**Figs. 7 & 8**)

Erect herb, rarely branched. Stem reddish brown, 30–60 cm tall, 6–8 mm thick, slightly swollen at nodes, woody, appressed hairs, yellowish green, internodes 4.5–10 cm. Stipules pale green with red, dense hairs, narrowly triangular, c. 10 × 5 mm, margin entire, apex acuminate, acumen c. 0.2 mm. Leaves alternate, distant, 4.5–10 cm apart; petiole dull red becoming brown, short c. 0.5–1 cm long; lamina plain dull or dark green above and dark red or maroon beneath, oblong-lanceolate, 10–12.5 × 3–5 cm, broad side c. 1.5–3 cm, apex acuminate, acumen c. 0.5–1 cm, base acute, margin dentate; venation pinnate, 5–6 pairs, branching more than halfway to margin, beneath slightly prominent, impressed above, prominent below, reddish, hairy. Inflorescences axillary, 1 female flower stalk arising from the lower to the middle axils, male flower a simple cyme, 1–2 flowers from the middle to the upper axils. Bract pair red, c. 5 × 3 mm, lanceolate, margin hairy, apex acuminate, persistent. Male flowers: pedicels c. 0.5 cm long, reddish-green; 4 tepals, outer 2 tepals c. 10 × 5 mm, inner 2 tepals c. 2.5 × 4–5 mm, pinkish-red, with short hairs outside, cluster shorter than the leaves. Female flowers (rarely fully open) red, sometimes pinkish white: pedicels 7–12 mm; hairy ovary crimson, c. 11–15 × 12–18 mm, hairy; tepals 5, c. 8–10 × 3–5 mm, red hairy outside. Capsules pendent, broadly oblong, c. 1.5 × 1 cm, 3 wings, equal, 3–5 mm wide; pedicels c. 1–1.2 cm, bent horizontally to downwards with the fruit held below the leaves. Seeds barrel-shaped c. 0.5 × 0.3 mm, columnar cells more than half of the seed length.

ETYMOLOGY. Named in honour of Dr Jamili Nais, ecologist and currently the Director of Sabah Parks.

ECOLOGY. Lowland to lower montane forest at 200–830 m elevation in shady areas.

DISTRIBUTION. Borneo. Endemic to Sabah (Tawau Hills Park).

CONSERVATION STATUS. Least Concern. It is found in Tawau Hills Park, which is a totally protected area.

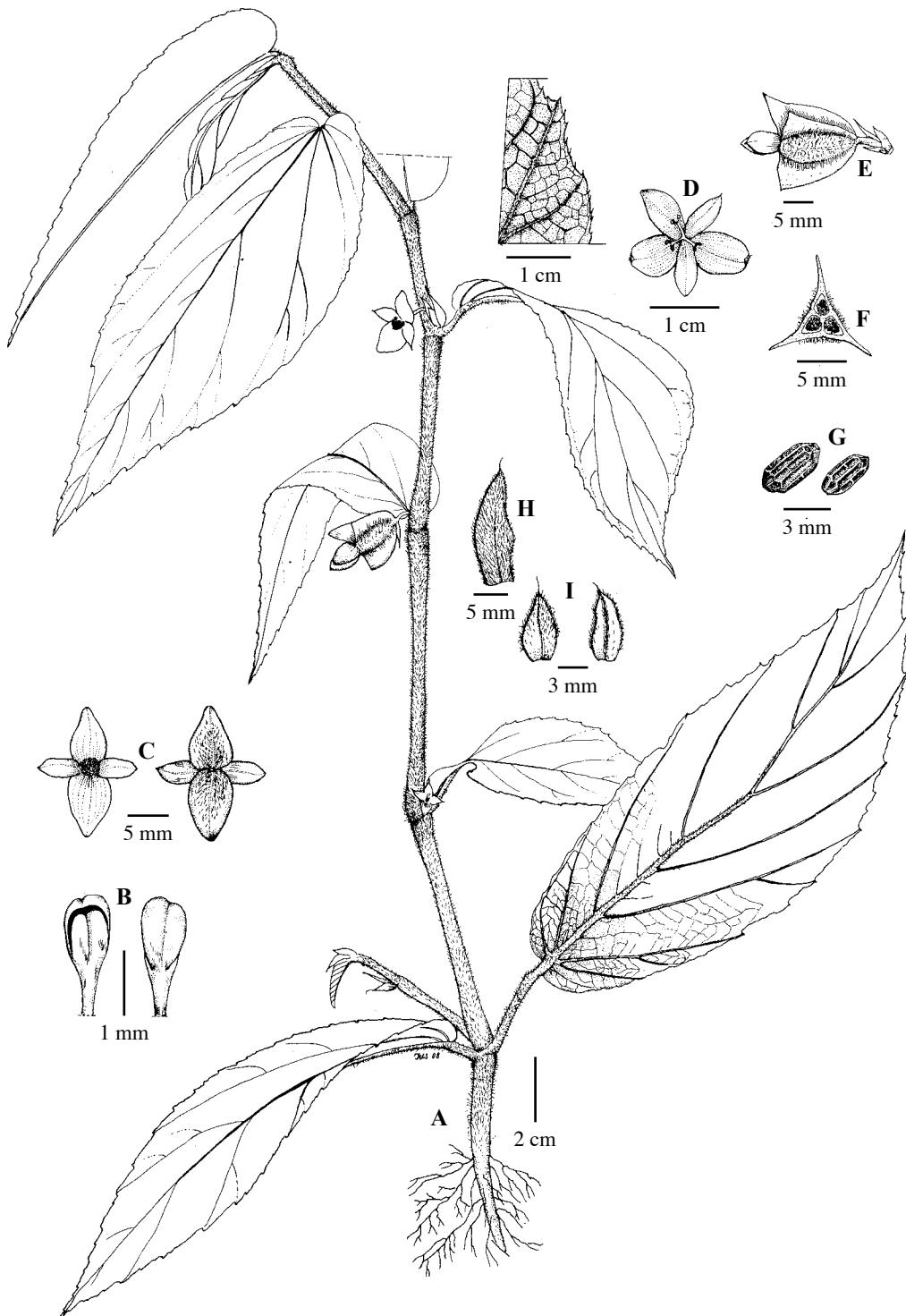


Fig. 7. *Begonia jamiliana*. **A.** The plant; **B.** Stamens; **C.** Male flower; **D.** Male flower; **E.** Fruit; **F.** Cross-section of ovary; **G.** Seeds; **H.** Stipule; **I.** Bract.

SPECIMENS EXAMINED—BORNEO. SABAH: Tawau District: Tawau Hills Park — Mt. Maria Valley, *Rimi et al.* KNP 14214 (SNP); near by the Head Office and along the trail to the Mt. Lucia, *Rimi R.* SNP A 16607 (holotype SNP!; isotype SAN!); Trail to Mt. Lucia, *Masrina Adin*, KNP 10544 (SNP, SAN); Lowland Garden, *Rimi et al.* SP 09761 (SNP), *Simun L & Evertius E*, KNP A 14703 (SNP), *V. Jamnicky et al.* VLJ 8 (SNP), *Rimi & Kinahim*, SP 18628 (SNP); Trail to Hot springs, *Dolois Sumbin*, KP 09373 (SNP); Waterfall Bukit Gelas, *Rahimah et al.* SP 18048 (SNP); Trail to HQ, *Shahida & Siti Farhana*, BORH 0623, (SNP, SAN, BORH); Trail to Gelas Waterfall, *Masrina et al.* SP 10517 (SNP), *Masrina*, SP 10515 (SNP).

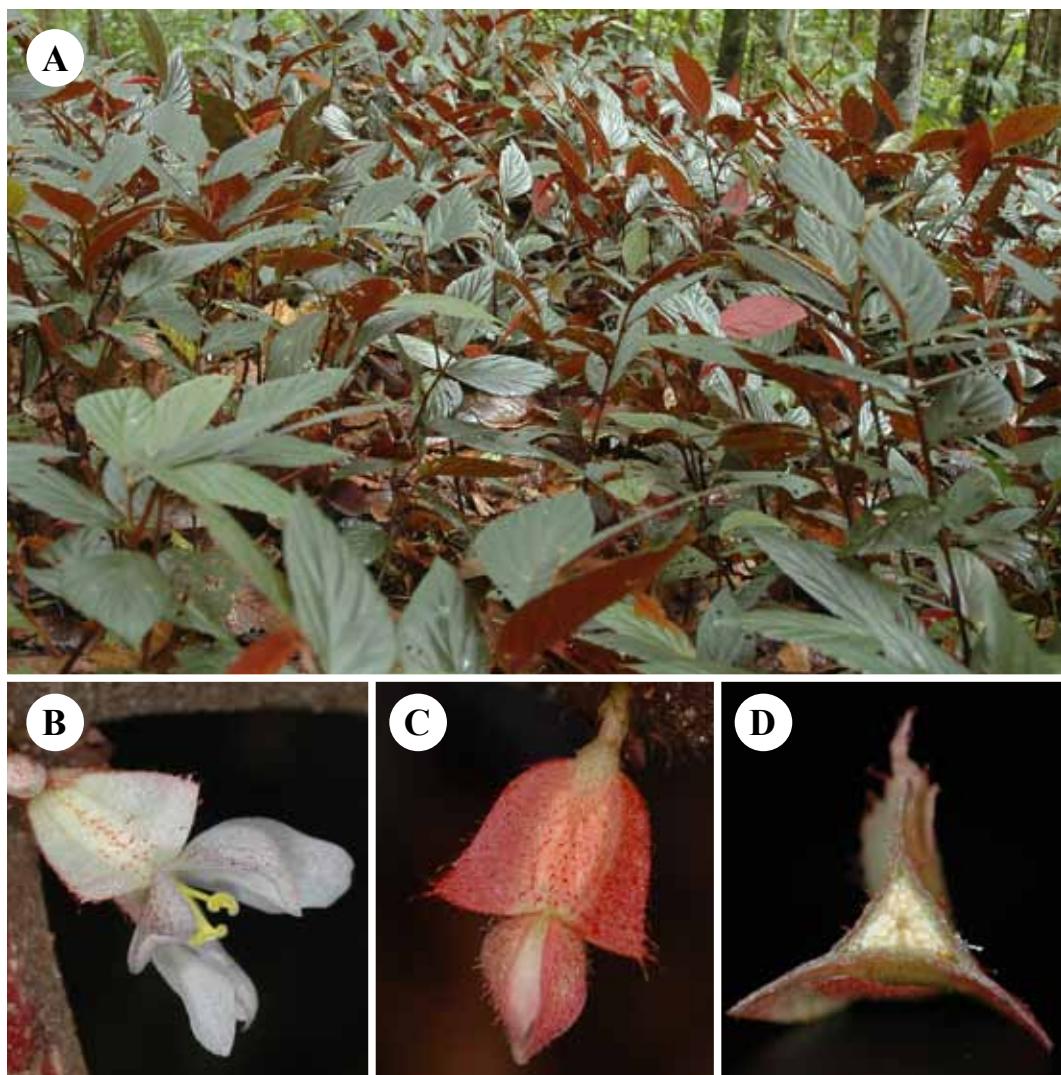


Fig. 8. *Begonia jamiliana*. **A.** Habit; **B.** Close-up of female flower (side view); **C.** Fruit; **D.** Cross-section of fruit (ovary). All photos by Ramlan Miadin.

NOTES. It has two colour forms. The green form, commonly grows at 600 m and above. Its lamina is green beneath and the male and female flowers have white to pinkish tepals. The magenta-red form grows at the lower elevations (200–700 m) and its lamina is maroon-red beneath and the flowers are more pinkish to reddish.

7. *Begonia lamriana* Rimi sp. nov. (Section *Petermannia*)

Like *B. ruthiae* S. Julia, *B. lamriana* is also a short herb less than 40 m tall. Both are similar in having dark or deep green leaves and deep magenta on the lower leaf surface. However, the silvery margin does not occur on *B. lamriana*. Both have inflorescences held above the leaves. In addition, *B. lamriana* branches from the lower half of the stems (*B. ruthiae* is rarely branched), its leaves are larger, 10–14 × 9.5–11 cm (vs. 7–10.5 × 4.7–8.5 cm in *B. ruthiae*), the tepals are smaller, 5–6 mm long in male flowers and 7–10 mm long in female flowers (vs. 9–12 mm in male flowers and 12–13 mm in female flowers) and the capsules have a short stiff stalk 4–9 mm (vs. a long thread-like stalk, 14–22 mm as in *B. ruthiae*). Type: Dolois S et al. SP18653, Borneo, Sabah, Tawau District, Tawau Hills Park, within the Dipterocarp Plot, 04 March 2004 (holotype SNP!; isotypes SAN!; KEP!). (Figs. 9 & 10)

Erect, short herbs, 20–30 cm tall, rooting at the lower nodes. Stems reddish, glabrous, 1–2 branched at the lower stems. Stipules pale red, narrowly triangular c. 4–5 × 5–10 mm, margin entire, apex acuminate. Leaves alternate, distant, 4–6 cm apart, 3–4 leaves on every branch, held horizontally; petiole pale red, glabrous, 3.5–5.5 cm, succulent; lamina blackish tinged deep green above with white or red bristles between the veins, magenta beneath, rugose, glossy metallic in life, thinly papery when dry, oblique, broadly oval to orbicular, 10–14 × 9.5–11 cm wide, strongly asymmetric, broad side 5–8 cm wide, basal lobes 25–40 cm, base broadly rounded, apex rounded and sometimes slightly mucronulate, margin finely double-serrate; venation palmate-pinnate, main veins paler, 4–5 veins in basal lobe, 1–2 veins on each side of midrib, branching twice before reaching the margin, impressed above, prominent beneath. Inflorescences protogynous with a single female flower at the base of male inflorescence, axillary, flowers clustered with 2 female flowers on stalk 5–8 cm long and 2–3 clusters of male flowers on stalks 10–15 cm long, clusters shorter than the leaves, glabrous. Bract pair reddish, broadly ovate, c. 4 × 5 mm, apex slightly acuminate. Male flowers: tepals 2, pure white or tinged pink, margin entire, broadly ovate, apex rounded, 5–6 mm long, filaments 0.5–1 mm; anthers yellow. Female flowers with reddish stalk 5–8 cm long; ovary rosy pink to reddish, glabrous, oblong, c. 10 mm, wing 3, rounded, locules 3, tepals 5, white tinged pink towards the margin, broadly ovate, margin entire, tip rounded, c. 7–10 × 6–10 mm, inner similar but almost without hairs and much smaller, 3.5–6 mm; styles 2, styles and stigmas yellow, 2–3 mm long, stigmas U-shaped. Capsules: locules 3, wings 3 equal, thinly fibrous, 2–4 mm wide; pedicel stiff, thin, 4–9 mm long. Seeds barrel-shaped, c. 0.1–0.2 mm long, columnar cells more than half the length of seed.

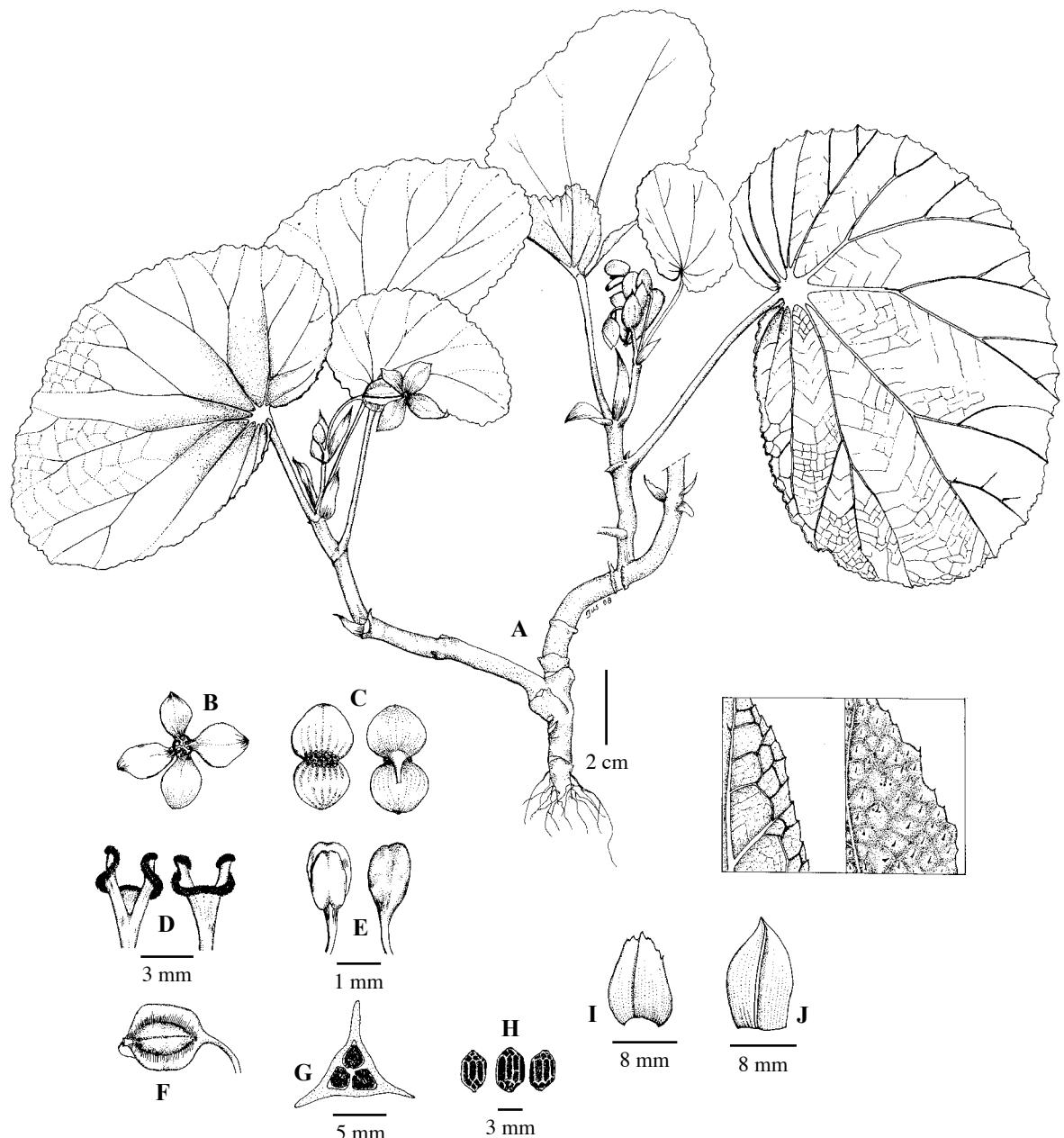


Fig. 9. *Begonia lamriana*. **A.** The plant; **B.** Female flower; **C.** Male flower; **D.** Styles and stigmas; **E.** Stamens; **F.** Fruit; **G.** Cross-section of ovary; **H.** Seeds; **I.** Bract; **J.** Stipule.

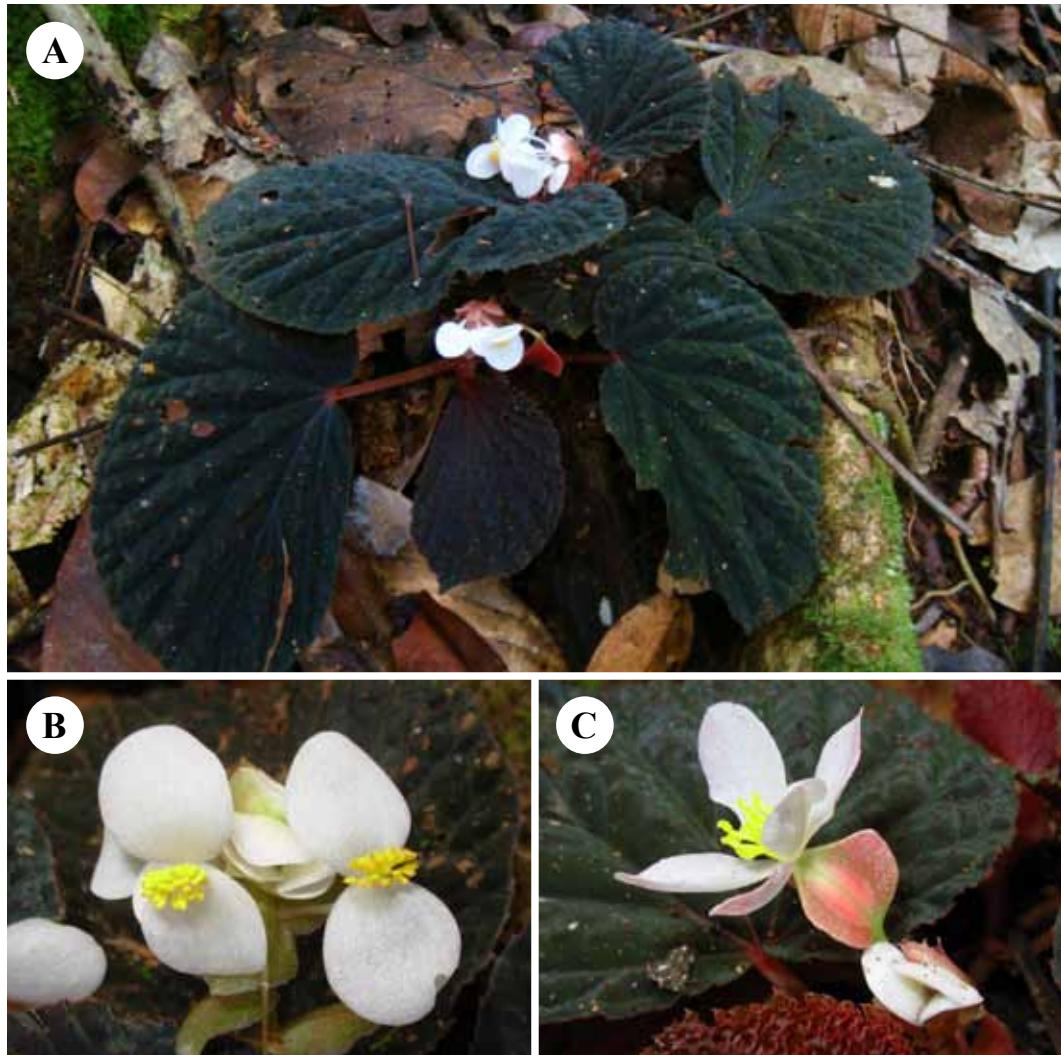


Fig. 10. *Begonia lamriana*. **A.** Habit; **B.** Close-up of male flower; **C.** Close-up of female flower (side view). All photos by Rimi Repin.

ETYMOLOGY. Named in honour of Datuk Lamri Ali, former Director of Sabah Parks, who was very supportive towards the establishment of the Lowland Garden and the collection of potential ornamental native plants from Tawau Hills Park.

ECOLOGY. Lowland to lower montane forest at 200–830 m elevation in shady areas.

DISTRIBUTION. Borneo. Endemic to Sabah (Tawau Hills Park).

CONSERVATION STATUS. Least Concern. It is found in Tawau Hills Park, which is a totally protected area.

SPECIMENS EXAMINED—BORNEO. SABAH: Tawau District: Tawau Hills Park — Mt. Lucia, km 10.5, *Kinahim & Frederick*, KNP 14116 (SNP, SAN, KEP); Trail to Mt. Lucia, *Duni & Yabainus*, SP 11542 (SNP); Near water Fall, Mt. Lucia, *Handry et al.* KNP 13843 (SNP); Trail to Hot Spring, *Dolois et al.* KNP 13090 (SNP); Plot Dipterocarpaceae, *Dolois et al.* SP 18653 (holotype SNP!; isotypes SAN!; KEP!); Trail 750 m from Tawau Hills HQ, *Noramly et al.* BORH 0655 (SNP, BORH); Tawau hills botanical garden, *Simun & Evertius*, KNP A 14714 (SNP), *Simun & Evertius*, KNP A 14715 (SNP, SAN).

NOTES. This species is striking in its leaf colour, which is always deep green to brown reddish. It has great potential as an ornamental plant.

8. *Begonia mariaensis* Rimi & Simun sp. nov. (Section *Petermannia*)

In its cane-like habit and leaves with narrowly parallel veins, it resembles *B. gomantongensis* Kiew (164: 1998) but it is different in its shorter petioles, 4–9 cm long (vs. 10–16 cm long as in *B. gomantongensis*), its long inflorescences, 24–27 cm long (vs. to 5 cm long), its larger male flowers with 4 tepals, the outer pair c. 5 × 3 mm (vs. with 2 tepals, 3.5–4 × 3–3.5 mm), and smaller fruits, c. 8 × 7 mm with narrow wings, c. 2 mm wide and smooth locules (vs. 17–20 × 13–15 mm with wings 4–5 mm wide and a distinctly verruculose surface). Type: *Rimi R. SNP A 16602*, Borneo, Sabah, Tawau District, Tawau Hills Park, planted at Tawau Hills Lowland Botanical Garden (originally collected from Mt. Maria), 18 December 2009 (holotype SNP!; isotype SAN!). (**Figs. 11 & 12**)

Cane-like begonia, 60–100 cm tall, woody at the base. Stems reddish, 3–6 mm thick, hollow when dry, internodes c. 5–7 cm long, shortly hairy, much branched, nodes swollen. Stipules light green, glabrous, triangular, c. 7–10 × 3–4 mm, margin entire, apex acuminate, acumen c. 1 mm long, persistent. Leaves alternate, oblique, distant, held horizontally; petiole reddish, glabrous, 4–9 cm long, grooved above; lamina light green above, plain pale green, slightly fleshy in life and papery when dry, glossy, asymmetric, c. 17–24 cm × 9–13 cm wide, broad side c. 7.5–11.5 cm wide, base cordate, basal lobes 5–7.5 cm wide, broadly rounded, margin distantly dentate, apex acuminate, acumen c. 1–1.5 cm long; venation palmate-pinnate, veins green, 3 veins on either side of the midrib, 1 pair at the base, 3 veins in basal lobe, impressed above, prominent beneath. Inflorescences protogynous, terminal on lateral branches, glabrous, 24–27 cm long, many flowered raceme; male inflorescences 5 cm long with a few cymose branches, peduncle c. 4 cm long, white, male rachis c. 1.5–2 cm. Bracteoles on female flower white translucent to greenish, bowl-shaped, concave, c. 5 × 4 mm, margin entire, persistent. Bracteoles on male flowers overlapping, white translucent to greenish, caducous, hemispherical, c. 3 × 2.5 mm. Male flower: pedicel pale yellow, c.

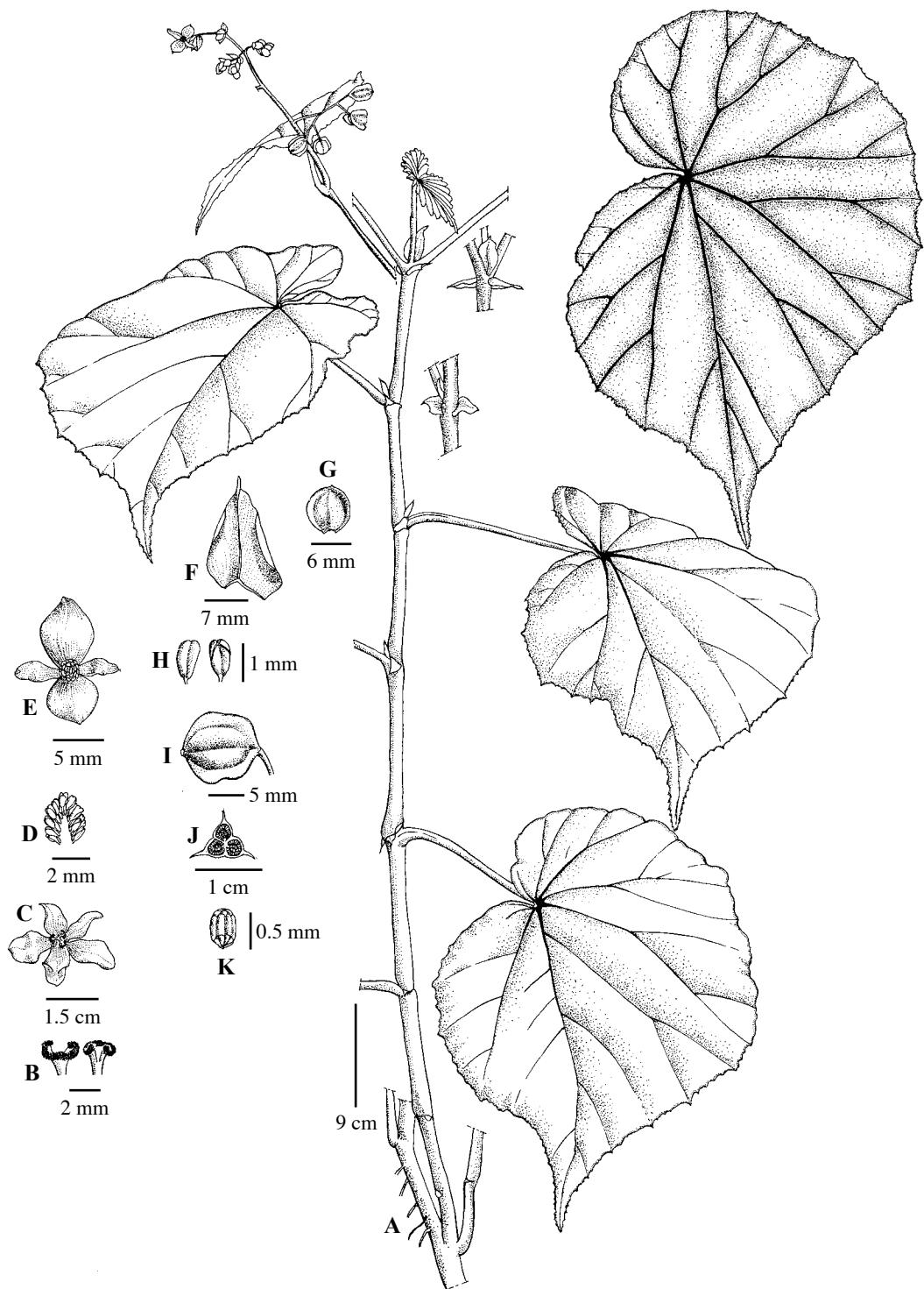


Fig. 11. *Begonia mariaensis*. A. The plant; B. Styles and stigmas; C. Female flower; D. Stamens cluster; E. Male flower; F. Stipule; G. Bract; H. Stamens; I. Fruit; J. Cross-section of ovary; K. Seed.

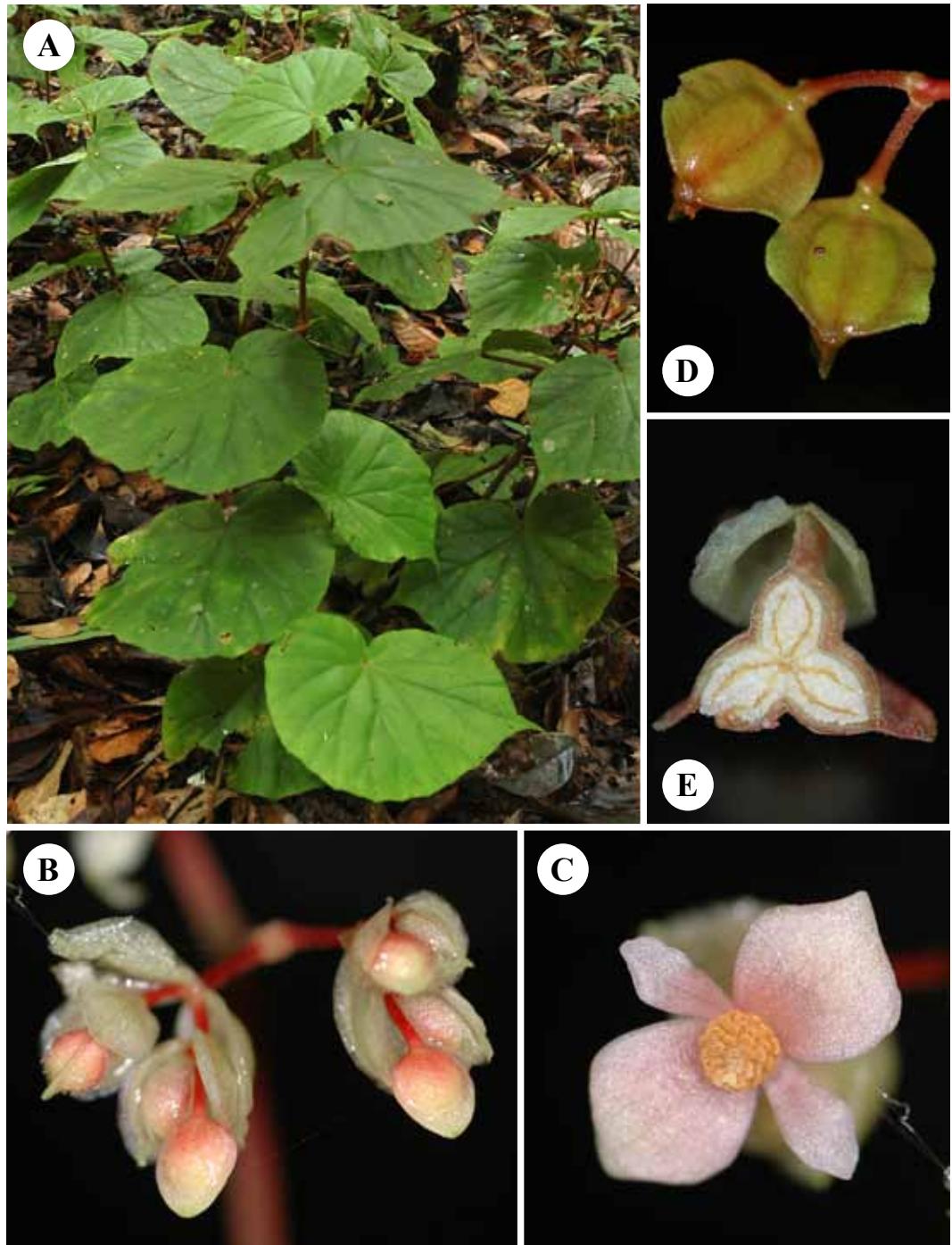


Fig. 12. *Begonia mariaensis*. **A.** Habit; **B.** Male flower; **C.** Close-up of male flower; **D.** Close-up of fruits; **E.** Cross-section of fruit (ovary). All photos by Ramlan Miadin.

1–1.5 cm long; tepals 4, pink, glabrous, margin entire, apex rounded, outer 2 tepals, c. 5 × 3 mm; inner 2 tepals, narrowly lanceolate, c. 3 × 1.3 mm; stamens c. 26, cluster conical, c. 3.5 × 2 mm, sessile; filaments pale yellow, c. 2 mm long; anthers pale yellow, oblong, c. 1 × 0.2 mm, apex emarginate. Female flower: pedicel 1 cm long, reddish; ovary rosy pink to reddish-green, glabrous, oblong, c. 8 × 3 cm, wings 3, equal, locules 3, placentas 2 per locule with many ovules on both surfaces; tepals 5, isomorphic, 12–14 × 5–7 mm, oval to narrowly obovate, rosy pink tinged white toward the margin, margin entire, apex rounded acute to obtuse; styles 3, pale green, c. 0.5 mm long, divided to base, Y-shaped with twisted tips; stigma pale green to white, papillose forming a twisted band. Capsule dangling, c. 8 × 7 mm, glabrous, locules 3, oblong, wings 3, equal, c. 2 mm wide, thinly fibrous, dehiscing between the locule and wing; pedicel stiff, c. 6–10 mm long. Seeds barrel-shaped, c. 0.5 × 0.2 mm, columnar cells more than half the length of seed.

ETYMOLOGY. Named for the locality, Mt. Maria, from where it was first collected.

ECOLOGY. Primary forest, on steep slopes along river, 1020 m elevation.

DISTRIBUTION. Borneo. Endemic to Sabah (Tawau Hills Park).

CONSERVATION STATUS. Least Concern. It is found in Tawau Hills Park, which is a totally protected area.

SPECIMEN EXAMINED—BORNEO. SABAH: Tawau District, Tawau Hills Park, Originally collected from Mt. Maria and planted at Tawau Hills Lowland Botanical Garden, December 2009, *Rimi R. SNP A 16602* (holotype SNP!; isotype SAN!).

NOTES. It is only known from the type specimen. It has a particularly long inflorescence.

9. *Begonia paracauliflora* Rimi, C.-I. Peng & S.M. Ku sp. nov. (Section *Petermannia*)

Fruits with 6 wings are very unusual in *Begonia*. Usually there are 3 wings (or in some cases 1 or 2 do not develop) but fruits with 3 fully developed wings and 3 smaller wings protruding from junctions of carpels in Borneo, is known only in *B. hexaptera* Sands (1997). *Begonia paracauliflora* is also similar to *B. hexaptera* in its low habit, size and shape of the leaves that are either green or reddish brown beneath, subsessile female flowers, male flowers in few-flowered cymes, and small fruits with 6 wings, but it is different in its longer petioles, 8–13 mm long (vs. 2.5–7 mm in *B. hexaptera*), and its male flowers with 4 larger tepals, the outer pair 11–12 × 8.5–12 mm (vs. with 2 tepals, 6–7 × 9 mm). Type: Ching-I. Peng, Shin-Ming Ku & Rimi Repin 21989, Borneo, Sabah, Tawau District, Tawau Hill Park Headquarters to Waterfall Trail, 04° 23' 52.5" N, 117° 53' 16.4" E, 17 December 2008 (holotype SNP!; isotype HAST!). (**Figs. 13 & 14**)

Erect herb. Stems 20–30 cm tall, usually unbranched or rarely branched near the ground, 7–9 mm thick, hispid or hirsute, hairs 2–5 mm long, more or less reddish, internodes 1–2 cm long. Stipules obliquely ovate, 13–17 × 6–9 mm wide, margin serrulate-ciliate, apex acute, sparingly long-pilose along midrib, persistent and often marcescent. Leaves alternate; petiole short, 0.8–1.3 cm long, hispid; lamina oblique, oblong-obovate or widely so, (5–)11–15 × (2.3–)4–5.5 cm, base rounded or slightly cordate on the broader side, cuneate or obtuse

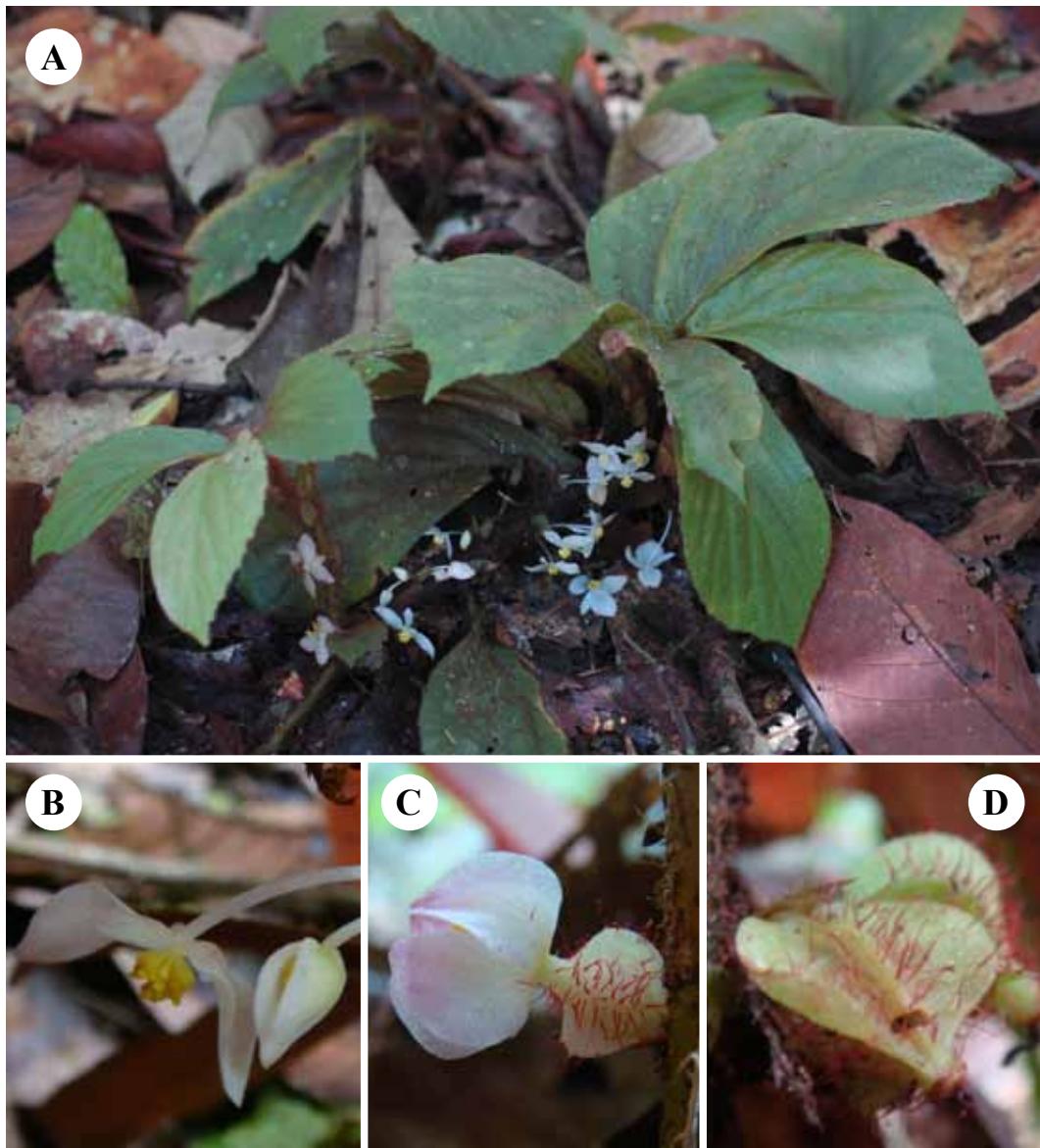


Fig. 13. *Begonia paracauliflora*. **A.** Habit; **B.** Male flower (side view); **C.** Female flower with ovary; **D.** Fruit. All photos by Rimi Repin.

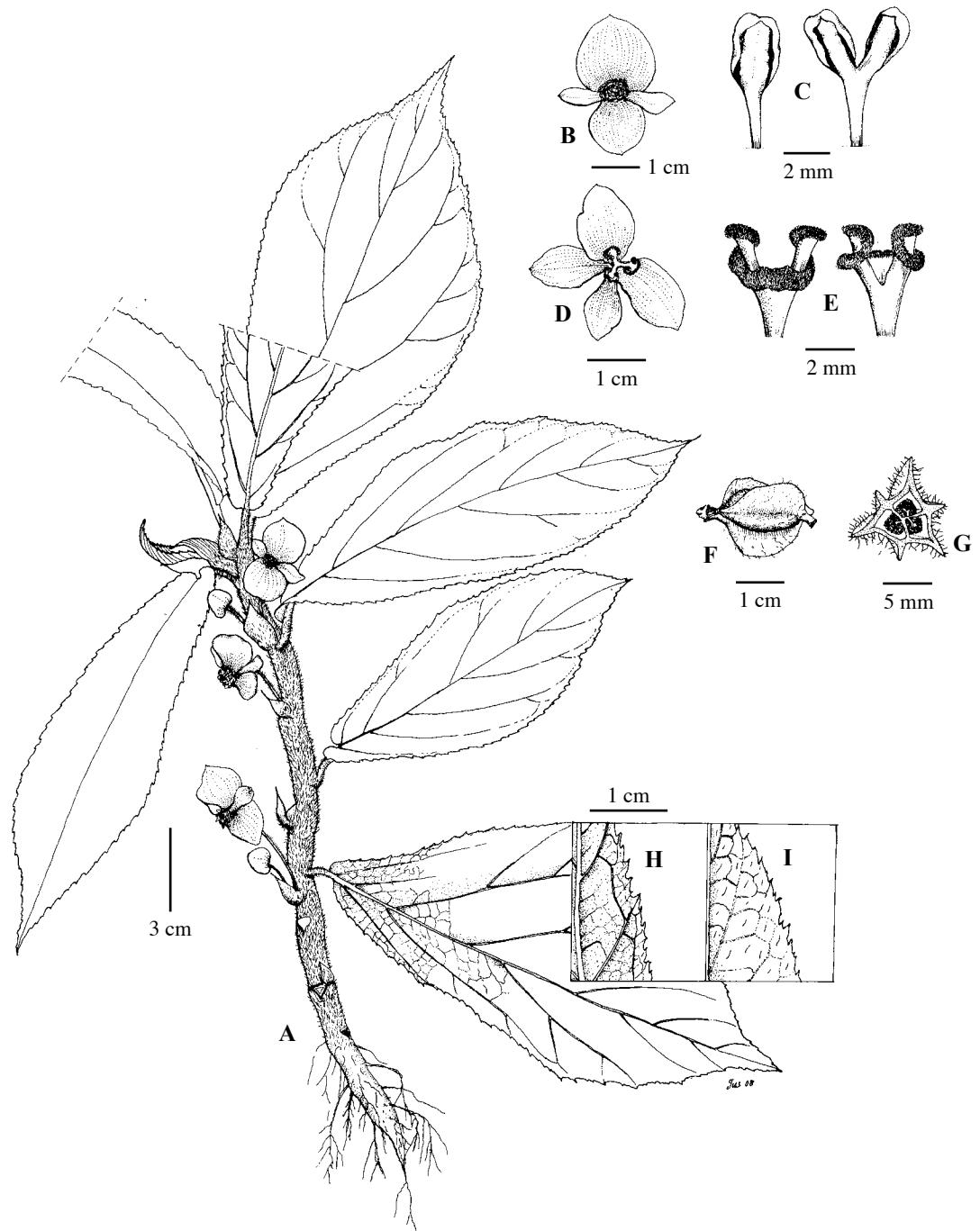


Fig. 14. *Begonia paracauliflora*. A. The plant; B. Male flower; C. Stamens; D. Female flower; E. Styles and stigmas; F. Fruit; G. Cross-section of ovary; H. Lower leaf surface; I. Upper leaf surface.

on the narrower side, margin irregularly serrate or double-serrate, each tooth bristle-tipped, apex acute to acuminate, dark green above and red beneath (in some plants, leaves green above and greenish beneath), adaxially sparsely to moderately setose, hairs 0.5–1.8 mm long, reddish, abaxially hispid or setose on major veins, longer and more frequent towards the petiole; venation pinnate, lateral veins 3–5 on each side of the midrib. Inflorescences very short, axillary, usually unisexual, male flowers in dense cymose clusters. Bracts 3–5 pairs, ovate, c. 5–8 × 3–5 mm, margin serrulate-ciliate, apex aristate. Female flowers occurring singly or sometimes in pairs, usually arising at the lower nodes. Male flowers: pedicel c. 15–20 mm long, tepals 4, white or slightly pinkish, decussate, outer two broadly ovate to orbicular, 11–12 × 8.5–12 mm, abaxially reddish pilose, inner two oblanceolate to narrowly obovate, 7–11 × 4–5 mm; stamens c. 20–35, nearly golf-club shaped, cluster sessile, filaments 1–2 mm long (central stamens longer), anthers ovoid to oblong, yellow, c. 1–1.3 × 0.6–0.8 mm, apex subemarginate. Female flowers subsessile, pedicel c. 1 mm long; ovary trigonous-ellipsoid, reddish hirsute, 6-winged, 3 larger wings protrude from midrib of carpels, the other 3 smaller wings protrude from junctions of carpels, with a short terminal beak; tepals 5 or 6, white or slightly pinkish, caducous, unequal or subequal, obovate, oblong, or oblanceolate, the largest 7–10 × 4.5–5 mm, the smallest 6–8 × 2.5–3 mm; styles 3, yellow, 4.5–7 mm long, at their base fused, c. 0.5–1 mm long, each bifid or fan-shaped; styles persistent, 3-locular, placentas 2 per locule. Capsules ellipsoid, 10–14 × 3–5 mm (excluding wings), dehiscing along the junction with the wings, wings 6, larger wings 4–5 mm long, smaller wings 1–1.5 mm long. Seeds numerous, brown, mostly ovoid and ellipsoid, minute.

ETYMOLOGY. Greek, *para-* similar to; indicating its superficial resemblance to the habit of *Begonia caulinflora* Sands.

ECOLOGY. Primary forest, under forest canopy, 100–800 m elevation.

DISTRIBUTION. Borneo. Endemic to Sabah (Tawau Hills Park).

CONSERVATION STATUS. Least Concern. It is found in Tawau Hills Park, which is a totally protected area.

SPECIMENS EXAMINED—BORNEO. SABAH: Tawau District: Tawau Hills Park — Along trail from Tawau Hill Park Headquarter to Waterfall, *Ching-I. Peng, Shin-Ming Ku & Rimi Repin* 21989 (holotype SNP!; isotype HAST!), *Ching-I. Peng, Shin-Ming Ku & Rimi Repin* 21990 (HAST); Lowland Garden, *Rimi & Kinahim*, SP 19169 (SNP, SAN), *Simun & Evertius*, KNP A 14707 (SNP, SAN), *Simun & Evertius*, KNP A 14701 (SNP), *Rimi Repin*, KNP 13879 (SNP), *Rimi Repin*, KNP 13878 (SNP); Balung, route to Hot Springs, *Kinahim & Handry*, SNP 25243 (SNP, SAN).

NOTES. The 6-winged fruit is the startling character of this species.

10. *Begonia postarii* Kiew (1998: 165). Type: *Kiew & Lim RK 4221*, Borneo, Sabah, Kinabatangan District, Bukit Panggi, 19 September 1996 (holotype SAN!; isotype SING).

ETYMOLOGY. Named in honour of Postar Jaiwit, research assistant in the Herbarium, Forest Research Centre, a diligent plant collector, who discovered this species.

ECOLOGY. Lowland mixed dipterocarp forest. Previously, it was known only from limestone hills along the Kinabatangan River (Kiew, 1998).

DISTRIBUTION. Borneo. Endemic to Sabah. Found in the Kinabatangan District (Bukit Panggi); Lahad Datu District (Danum Valley Conservation Area); and Tawau District.

CONSERVATION STATUS. Least Concern. Widespread and it is also found in Tawau Hills Park, which is a totally protected area.

SPECIMENS EXAMINED—BORNEO. SABAH: Tawau District: Tawau Hills Park — HQ area, *Dolois et al. KNP 13497* (SNP), *Simun & Evertius, KNP A 14712* (SNP); Lowland Garden, *Simun & Evertius, KNP A 14709* (SNP), *Rimi & Rahimah, SP 09753* (SNP); Sungai Apas, *Simun et al. KNP A 14719* (SNP), *Simun et al. KNP A 14718* (SNP); Balung, Dipterocarp Plot, *Dolois et al. KNP A 14729* (SNP, SAN); Balung, Sungai Papaya/Sungai Vanila, *Simun et al. KNP A 14723* (SNP). Kinabatangan District: Bukit Panggi, *Kiew & Lim RK 4221* (holotype SAN!; isotype SING).

NOTES. It is a striking species in its broad and softly hairy leaves with long inflorescences, held above the leaves with many tiny deep red male flowers.

11. *Begonia renek* Rimi sp. nov. (Section *Petermannia*)

Similar to *B. dimorpha* S. Julia (2015) in its large cane-like habit, young spotted leaves, fruit shape, and fruits that have long thread-like stalks, but *B. renek* differs in its larger leaves, 17–24 × 9–13 cm (vs. 10.3–16.3 × 6.2–8 cm as in *B. dimorpha*), and male flowers with 4 tepals and c. 26 stamens (vs. 2 tepals and 56–60 stamens as in *B. dimorpha*). Type: *Kinahim & Handry, SNP 25242*, Borneo, Sabah, Tawau District, Tawau Hills Park, Balung station, route to Hot Springs, 27 April 2012 (holotype SNP!). (**Figs. 15 & 16**)

Cane-like begonia, 60–150 cm tall, woody at the base. Stems reddish, 3–6 mm thick, hollow when dry, internodes 5–7 cm long, shortly hairy, much branched, nodes swollen. Stipules light green, glabrous, triangular, 7–10 × 3–4 mm, margin entire, apex acuminate, acumen c. 1 mm long, persistent. Leaves alternate, oblique, distant, held horizontally; petiole reddish, glabrous, 4–9 cm long, grooved above; lamina of juvenile leaves with rows of white or pink

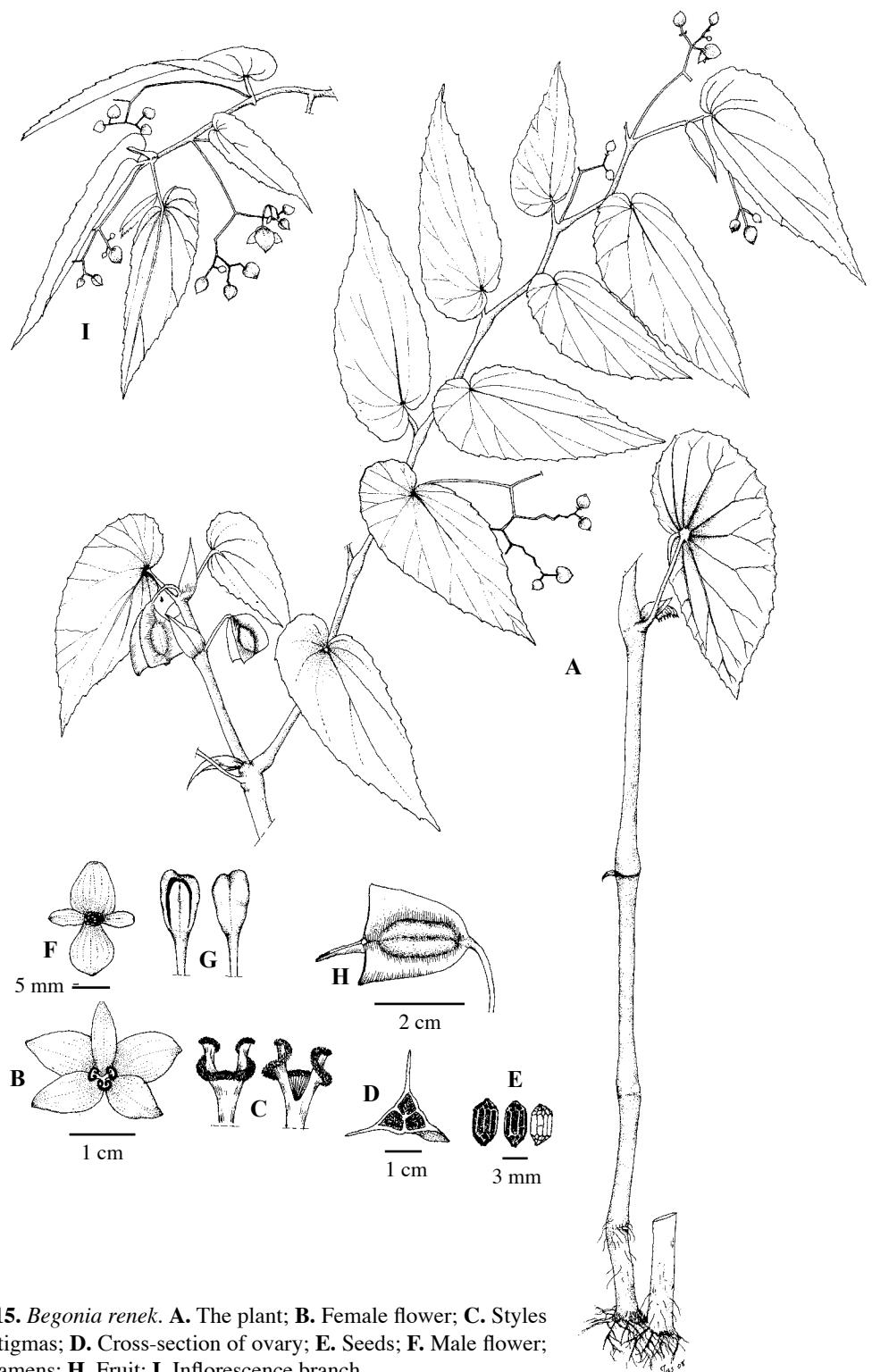


Fig. 15. *Begonia renek*. **A.** The plant; **B.** Female flower; **C.** Styles and stigmas; **D.** Cross-section of ovary; **E.** Seeds; **F.** Male flower; **G.** Stamens; **H.** Fruit; **I.** Inflorescence branch.

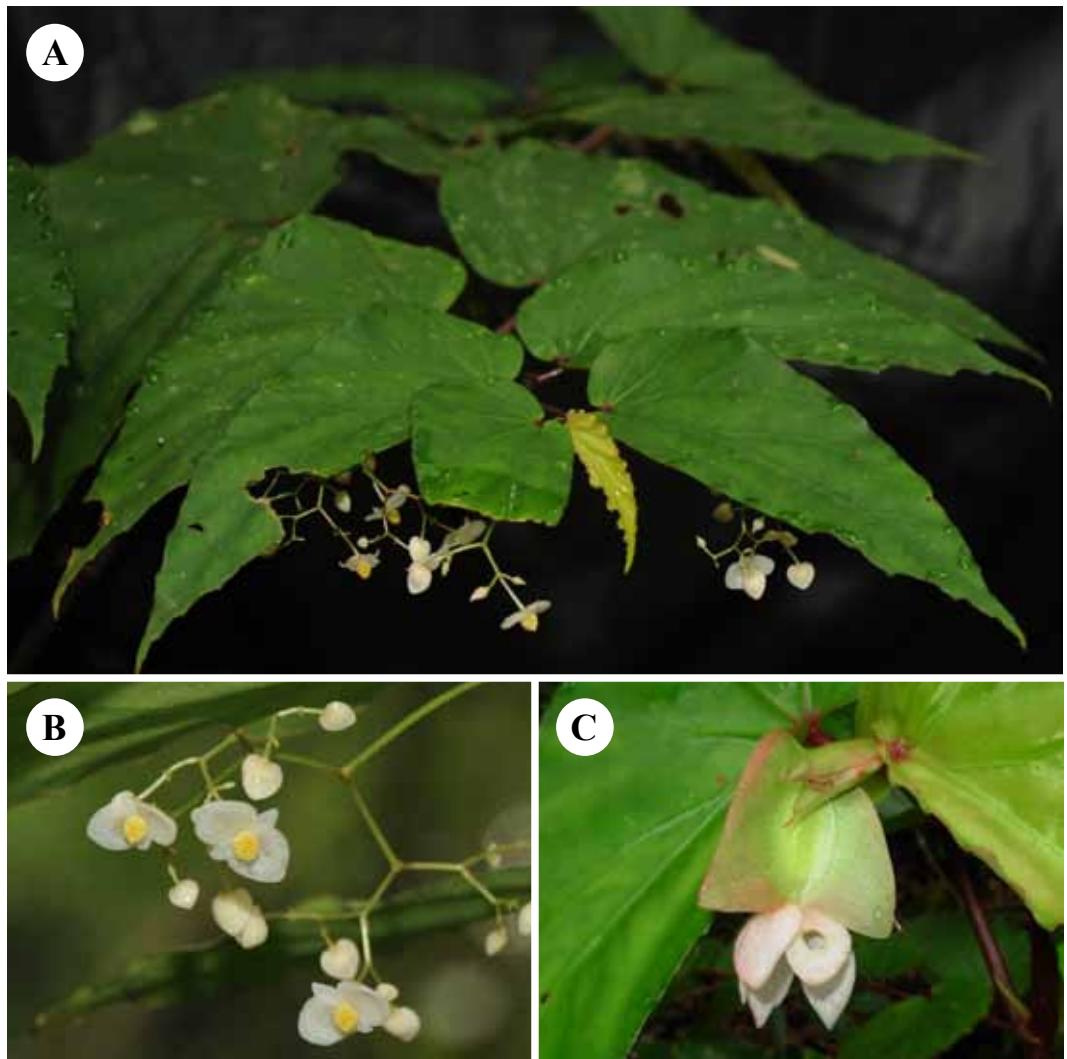


Fig. 16. *Begonia renek*. **A.** Habit; **B.** Close-up of male flower (side view); **C.** Female flower (side view). All photos by Rimi Repin.

spots between the veins and with a white or pink line around the margin, adult leaves plain light green above, pale green beneath, slightly fleshy in life, papery when dry, slightly glossy, broadly ovate, asymmetric, $17\text{--}24 \times 9\text{--}13$ cm, broad side 7.5–11.5 cm wide, base cordate, basal lobes 5–7.5 cm wide, broadly rounded, margin dentate distantly, apex acuminate, acumen 1–1.5 cm long; venation palmate-pinnate, veins green, 3 veins on either side of the midrib, 1 pair at the base, 3 veins in basal lobe, impressed above, prominent beneath. Inflorescences protogynous, terminal on lateral branches, many-flowered glabrous raceme;

male inflorescences 5–7 cm long with a few cymose branches, rachis 1.5–2 cm long; peduncle c. 4 cm long, white. Bracteoles on male flowers overlapping, white translucent to greenish, hemispherical, c. 3 × 2.5 mm, caducous, bracteoles on female flowers white translucent to greenish, bowl-shaped, concave, c. 5 × 4 mm, margin entire, persistent. Male flowers: pedicel pale yellow, 10–15 mm long; tepals 4, pink, glabrous, margin entire, apex rounded, outer 2 tepals, c. 3 × 5 mm, inner 2 tepals, narrowly lanceolate, c. 3 × 1.3 mm; stamens c. 26, cluster conical, c. 3.5 × 2 mm, sessile; filaments pale yellow, c. 0.2 mm long; anthers pale yellow, oblong, c. 1 × 0.2 mm, apex emarginate. Female flowers: pedicel reddish, c. 2.5–4 cm long; ovary rosy pink to reddish green, glabrous, oblong, c. 8 × 3 cm, wings 3, equal, locules 3, placentas 2 per locule with many ovules on both surfaces; tepals 5, isomorphic, c. 12–14 × 5–7 mm, oval to narrowly obovate, rosy pink tinged white towards the margin, margin entire, apex rounded, acute to obtuse; styles 3, pale green, c. 0.5 mm long, divided to base, Y-shaped with twisted tips; stigma pale green to white, papillose. Capsules glabrous, broadly triangular, 2–3.2 × 1.8–2.5 cm, wings equal, narrowed proximally, truncate distally, tip acute, 0.7–1.0 cm wide, thinly fibrous, dehiscence between locule; pedicels thread-like, 2.5–4.5 cm long. Seeds barrel-shaped, c. 0.5 × 0.2 mm, columnar cells more than half the length of seed.

ETYMOLOGY. Named for its characteristic shrubby habit, with many branches and leaves. *Renek* means ‘shrub’ in Malay.

ECOLOGY. Primary forest, under forest canopy, 100–800 m elevation.

DISTRIBUTION. Borneo. Endemic to Sabah (Tawau Hills Park).

CONSERVATION STATUS. Least Concern. It is found in Tawau Hills Park, which is a totally protected area.

SPECIMENS EXAMINED—BORNEO. SABAH: Tawau District: Tawau Hills Park — Balung, route to Hot springs, *Kinahim & Handry*, SNP 25293 (SNP, SAN); Balung, route from Sub-Station Balung 30 m to Permanent Plot, *Dolois Sumbin*, KNP A 17726 (SNP); Balung, route from Sub-Station to Mt. Pyramid, *Rimi et al.* SNP 25216 (SNP); Balung station, route to Hot Springs, *Kinahim & Handry*, SNP 25242 (holotype SNP!); Balung, *Dolois et al.* KP 09017 (SNP, SAN); Trail to Bukit Bombalai, *Rahimah et al.* SP 17930 (SNP); Bukit Bombalai, *Dolois et al.* SP 18021 (SNP, SAN, KEP), *Dolois et al.* SP 18022 (SNP, SAN, KEP); Poreg, Merotai Kanan Kecil, *Dolois et al.* SNP 16783 (SNP, SAN, KEP); Hot Spring area, *Simon et al.* SP 10541 (SNP, SAN).

NOTES. The juvenile plants have bronzy spots, some older leaves on the lower branches retain the spots but most of the older leaves become plain green. Among the species occurring in Tawau Hills Park, this species has large fruits that hang down on fine thread-like stalks.

12. *Begonia simunii* Rimi sp. nov. (Section *Baryandra*)

Similar to *B. bernadusii* V.S. Guanh (2015) in its rhizomotous habit and rosette of succulent leaves but *B. simunii* differs in its broader leaves, 15–18 cm wide (vs. 12.7–15.5 cm wide as in *B. bernadusii*), its entire leaf margin (vs. crenate as in *B. bernadusii*), longer peduncles 25–32 cm long (vs. 15–26 cm long), and large stamen number, 82 (vs. 30 in *B. bernadusii*). Type: *Kinahim S. & Handry M.*, SNP 25246, Borneo, Sabah, Tawau District, Tawau Hills Park, Balung River, 27 April 2012 (holotype SNP!; isotype SAN!). (**Figs. 17 & 18**)



Fig. 17. *Begonia simunii*. **A.** Habit; **B.** Male flower; **C.** Female flower (side view). All photos by Ramlan Miadin.

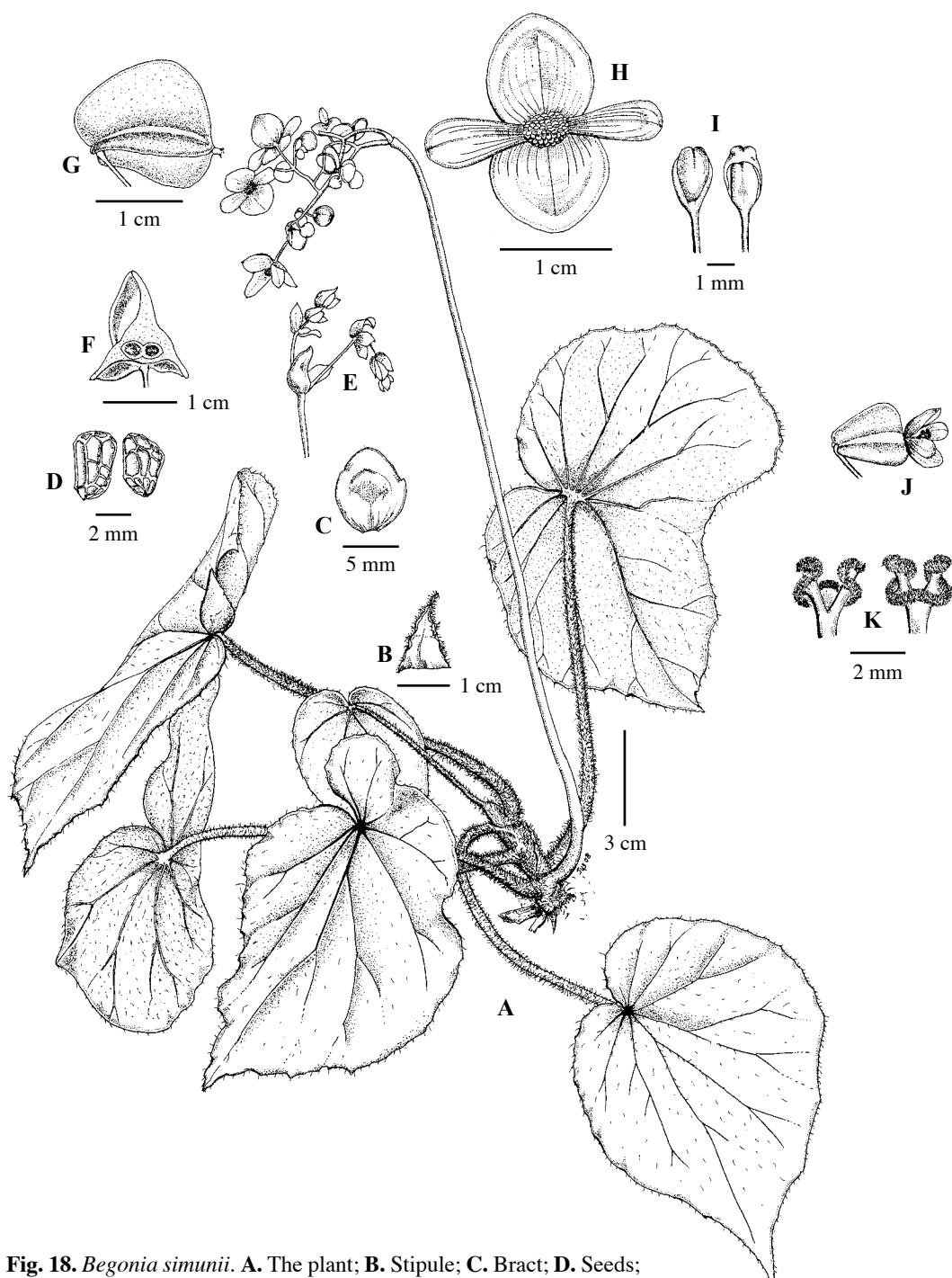


Fig. 18. *Begonia simunii*. A. The plant; B. Stipule; C. Bract; D. Seeds; E. Inflorescence; F. Cross-section of ovary; G. Fruit; H. Male flower; I. Stamens; J. Female flower. K. Styles and stigmas.

Rhizomotous, rosette begonia, rooting at the nodes. Stems brown-reddish, 6.5–9 cm long, c. 1.8 cm diameter with scattered hairs, succulent, internodes short c. 1 cm long. Stipules translucent, slightly hairy beneath, triangular, c. 11 × 17 mm, margin entire, apex acuminate, acumen c. 5 mm, persistent. Leaves upstanding or semi-erect, c. 1 cm distant, oblique; petiole reddish, 13–20 cm long, terete hairs brown; lamina dark green above, glabrous, pale green with brown hairs below, thinly fleshy in life, slightly matt, broadly ovate, asymmetric, 10.5–11.5 × 15–18 cm, broad side 8–9.2 cm wide, base slightly rounded, basal lobes to 3.5–3.8 cm long, margin entire, apex acute; main veins light green, glabrous above, scattered brown hairy underneath; venation palmate, 4–5 veins in the basal lobe, impressed above, prominent beneath. Inflorescences protandrous, axillary from the upper nodes, reddish brown, glabrous, erect, longer than petioles, cymose, 25–32 cm long, peduncle c. 20–25 cm long with 3 male flowers and 1 female flower. Bracts glabrous, translucent, orbicular, c. 4 × 5 mm, margin entire, caducous. Male flowers: pedicel white tinged pink, c. 5 mm long; tepals 4, glabrous, white tinged pinkish, margin entire, outer 2 tepals orbicular, 13–14 × 12–13 mm, apex rounded, inner 2 tepals narrowly obovate, c. 4 × 10 mm, apex rounded; stamens 82, cluster globose, stalked, c. 2 mm; filaments yellow, c. 1.8 mm, long; anthers yellow, oblong, c. 1 × 0.25 mm, apex rounded. Female flowers: pedicel c. 5 mm long, reddish, glabrous; ovary greenish pink, deltoid, c. 3–4 × 6–12 mm long, pure white or pinkish, wings 3, unequal, splash cup shaped, locules 2, placentas 2 per locule; tepals 5, white or pinkish, slightly oval, margin entire, apex rounded, c. 6–8 × 5–7 mm; styles 3, 2–3 mm long, yellow, widely shallowly Y-shaped; stigma papillose forming a continuous twisted band. Capsules dangling, 16 × 14 mm, glabrous, locules 3, wings unequal, narrowed to the base, pointed distally, 2 shorter wings c. 12 × 4 mm wide, larger one 16 × 10 mm wide, thinly fibrous, dehiscing between locules and wing; pedicel 12–15 mm long. Seeds barrel-shaped, 0.3–0.4 × 0.15–0.2 mm, columnar cells more than half the length of seed.

ETYMOLOGY. Named after Mr Simun Limbawang, the collector and the coordinator of the Tawau Hills Lowland Botanical Garden.

ECOLOGY. Primary forest, growing on boulders near river bank, at 350 m elevation.

DISTRIBUTION. Borneo. Endemic to Sabah (Tawau Hills Park).

CONSERVATION STATUS. Least Concern. It is found in Tawau Hills Park, which is a totally protected area.

SPECIMENS EXAMINED—BORNEO. SABAH: Tawau District: Tawau Hills Park — Tawau Hills Botanical Garden (Lowland Garden), *Rimi R.*, SNP A 16605 (SNP); Tawau Hills Park — Balung River, *Kinahim S. & Handry M.*, SNP 25246 (holotype SNP!; isotype SAN!).

NOTES. It has a very long and erect peduncle with many male but fewer female flowers. This species belongs to section *Baryandra* in having rhizomatous stems, protandrous inflorescences, and the ovary with two locules. Like *B. gueritziana* Gibbs (1914), its fruit has an enlarged wing.

13. *Begonia tindan* Rimi & Kinahim sp. nov. (Section *Petermannia*)

Similar to *B. berhamanii* Kiew (2001: 253) in habit and laminas that are almost symmetric, lanceolate, about $12\text{--}16 \times 2.5\text{--}4$ cm, with short petioles and pinnate venation, but it differs in the inflorescence stalks being longer than petiole (vs. shorter than the petiole as in *B. berhamanii*), the overlapping bracts are pale green or cream, $9\text{--}10 \times 4\text{--}5$ mm (vs. red and $12 \times 3\text{--}4$ mm as in *B. berhamanii*) and its long-stalked female flowers have pedicels $12\text{--}15$ mm long (vs. $2\text{--}3$ mm long). Type: *Rimi Repin et al. KNP 12491*, Borneo, Sabah, Tawau District, Tawau Hills Park, Mt. Lucia, near Waterfall at km 10.5, 23 April 2007 (holotype SNP!; isotype SAN!). (**Figs. 19 & 20**)

Erect begonia, becoming decumbent and rooting at lower nodes. Stems 30–45 cm tall, brownish, 2–4 mm thick, appressed fine hairs, unbranched, woody, internodes c. 1.5–7 cm long, slightly thickened at nodes. Stipules pale green, glabrous, lanceolate, $12\text{--}15 \times 3\text{--}5$ mm long, keeled, margin entire with fine hairs, apex acuminate, acumen 1.5–2 mm long, persistent. Leaves alternate, not oblique, distant, held horizontally to slightly pointing up; petiole brown-greenish, finely hairy, 0.3–0.5 cm long, terete; lamina plain green above, light green beneath, glabrous, slightly fleshy in life and papery when dry, glossy, lanceolate,



Fig. 19. *Begonia tindan*. **A.** Inflorescence; **B.** Close-up of male flower; **C.** Fruit. All photos by Rimi Repin.

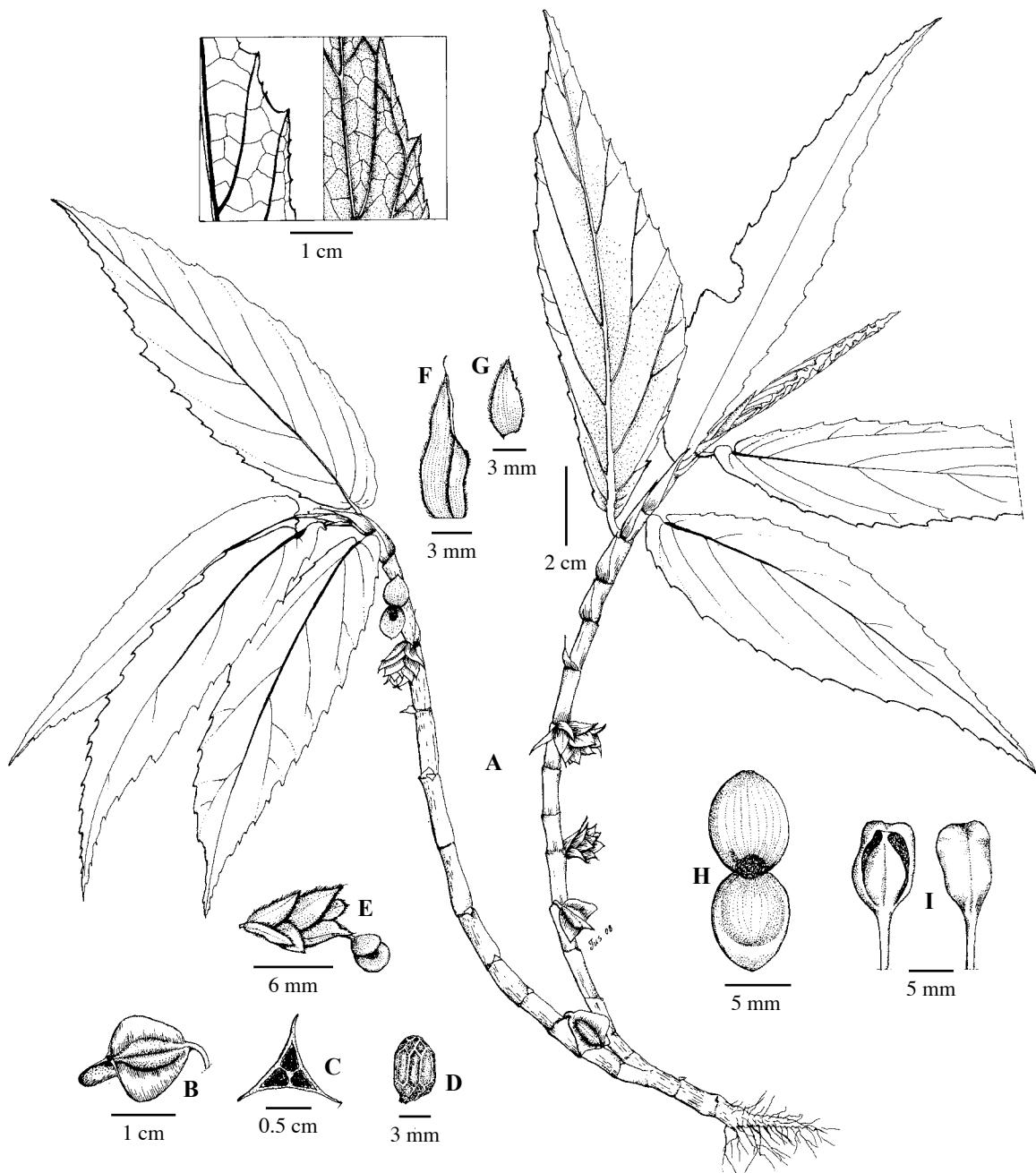


Fig. 20. *Begonia tindan*. **A.** The plant; **B.** Fruit; **C.** Cross-section of ovary; **D.** Seed; **E.** Inflorescence; **F.** Stipule; **G.** Bract; **H.** Male flower; **I.** Stamens.

asymmetric, 9.5–16.5 × 3–4.5 cm long, broad side 2–3 cm, base acuminate, margin distally serrate, apex acuminate, acumen 1.5–2 cm long; main veins green, glabrous above, hairy beneath; venation pinnate, 4–5 veins on either side of the midrib, branching towards the margin, impressed above, prominent beneath. Inflorescences protogynous, axillary; female inflorescences reduced cymes with one flower each on the lower stem; male inflorescences a flattened spike, 1–2 cm long, peduncle 0.2 cm long, brownish, fine hairs. Bracts overlapping, cream-white to pale green, broadly lanceolate, 9–10 × 4–5 mm, asymmetric, margin serrate, persistent. Bracteole pairs, translucent white, 4–6 × 1 mm, narrowly lanceolate; bracteole lanceolate, c. 3 × 7 mm, margin serrate. Male flowers: pedicel pure white, 4 mm long; tepals 2, pure white, glabrous, ovate, c. 8 × 4 mm, margin entire, apex rounded; stamens c. 23–24, cluster globose, c. 6 × 4 mm across (wider than long), sessile; filaments lemon yellow, c. 0.1 mm long; anthers lemon yellow, obovate, c. 1.5 × 1 mm, apex emarginate. Female flowers: pedicel 1.2–1.5 cm long, pure white; ovary green and white tinged pink when very young, c. 1–1.2 × 1.5 cm long, wings 3, equal, locules 3, placentas 2 per locule with many ovules on both surfaces; tepals 5, isomorphic, broadly lanceolate to ovate, 3 outer tepals c. 14 × 4 mm, 2 inner tepals c. 6 × 1 mm, white or white tinged pink, reddish hairy beneath, margin entire, apex rounded; styles 3, deep yellow, c. 3 mm long, divided to base, deeply Y-shaped with twisted tips; stigma yellow, papillose. Capsules pendent, c. 1.2–1.4 × 1.4–1.9 cm, shortly hairy in life, glabrous when dry, wings 3, equal, narrowed proximally, fibrous, dehiscing between the locule and wing, pedicel c. 0.4 cm long. Seeds barrel-shaped, c. 0.7–0.8 × 0.3–0.4 mm, columnar cells more than half the length of seed.

ETYMOLOGY. It takes name from its characteristic overlapping bracts. *Tindan* in Malay means overlapping.

ECOLOGY. Primary forest, under forest canopy, 100–800 m elevation.

DISTRIBUTION. Borneo. Endemic to Sabah (Tawau Hills Park).

CONSERVATION STATUS. Least Concern. It is found in Tawau Hills Park, which is a totally protected area.

SPECIMENS EXAMINED—BORNEO. SABAH: Tawau District: Tawau Hills Park — Marotai Kanan, waterfall, *Duni & Geofarry*, KNP 14135 (SNP); Trail to Bukit Bombalai, *Masrina et al. SP 10519* (SNP, SAN), *Dolois et al. SP 18023* (SNP, SAN); Balung Hot springs area, *Dolois et al. SP 17420* (SNP), *Kinahim & Handry*, SNP 25245 (SNP, SAN); Poreg River, Marotai kanan, *Dolois et al. SP 16782* (SNP), *Rimi R.*, SNP A 16608 (SNP, SAN); Lowland garden, *Simun & Enroe*, KNP A 14716 (SNP); Mt. Lucia, near Waterfall at km 10.5, *Rimi Repin et al. KNP 12491* (holotype SNP!; isotype SAN!); Trail to Mt. Lucia, *Yabainus & Frederick*, SP 11528 (SNP), *Yabainus & Duni*, SP 11543 (SNP), *Shahidah & Siti Farhana*, BORH 0568 (SNP, BORH); Trail near Headquarters, *Dato Noramly et al. BORH*

0654 (SNP, BORH); Balung Dipterocarp Plot, Dolois *et al.* KNP A 14725 (SNP), Dolois *et al.* KNP A 14726 (SNP); Near Gelas waterfall, Dolois *et al.* KNP 13007 (SNP, SAN, KEP).

NOTES. It is distinct in having distichous, persistent bracts in the male flowers.

DISCUSSION

Prior to the present study, only one named species, *Begonia tawaensis* Merr., had been collected from Tawau District. However, its exact locality was not specified. The earlier report from the Tawau Hills Park Scientific Expedition in 1989, listed only two *Begonia* species identified as *B. beryllae* Ridl. and *B. burbridgei* Stapf (Latiff *et al.*, 1995), but these are misidentifications. Beaman & Beaman (1995) also reported collecting two undetermined begonias.

This study recorded 13 *Begonia* species from Tawau Hills Park of which ten are new species described here, namely *B. basintaliana* Rimi, *B. gelasensis* Rimi, *B. gusilii* Rimi, *B. lamriana* Rimi, *B. mariaensis* Rimi & Simun, *B. jamiliana* Rimi, *B. paracaulliflora* Rimi *et al.*, *B. renek* Rimi, *B. simunii* Rimi and *B. tindan* Rimi & Kinahim. They are all narrow endemics restricted to Tawau Hills Park. The occurrence of the three other species, *B. gomantongensis* Kiew, *B. postarii* Kiew and *B. fuscisetosa* Sands, represent extensions to their previous known geographical distributions in Sabah. The first two are east coast species, previously known from the Kinabatangan River, but since collected from Lahad Datu and Tawau Districts, while *B. fuscisetosa* has a much wider distribution ranging from Sabah to Brunei Darussalam and Sarawak (Hughes & Pullan, 2007).

Almost all cane-like or erect begonias in Borneo belong to section *Petermannia* and the Tawau Hills begonias are no exception. Out of the 13 species, 12 species belong to section *Petermannia* and only one species, *B. simunii*, belongs to the section *Baryandra* (Rubite *et al.*, 2013).

This study also observed that species such as *B. jamiliana*, *B. gelasensis*, *B. basintaliana*, *B. tindan* and *B. lamriana* grow in the same habitat, either as single plants or in small populations scattered along the trail from Tawau Hills Park Headquarters towards Mt. Lucia and Mt. Magdalena. *Begonia basintaliana* and *B. gelasensis*, however, are mostly found along rivers and at lower elevations, up to 400–600 m. Even species with a wider distribution such as *B. postarii* share a similar lowland habitat with *B. renek* and are restricted to the Balung area on the east side of Tawau Hills Park. The most restricted distributions of any begonia in Tawau Hills are those of *B. mariaensis*, known only from a single population on Mt. Maria peak (1067 m), *B. gusilii* found only on a waterfall boulder along the trail to Mt. Lucia (1189 m) at Km 10, and *B. simunii* that also has a restricted distribution and is known from only one small population.

Most of the Tawau Hills Park begonias are planted *ex situ* in the Tawau Hills Botanical Garden for research purposes and for recreational and environmental education programs, as well as to serve as a gene bank. To date, all 13 species can be seen growing either in the Garden or in the nursery. *Begonia lamriana* and *B. simunii* have the greatest potential as ornamental pot plants. They grow very well within a short period of time but need frequent care by repotting to make sure they regenerate continuously. All the cane-like begonias grow well in the Garden and some are used as ornamental plants around the office compound.

CONCLUSION

The large number of *Begonia* species, encompassed in only a small part of Tawau Hills Park, is an indication of high diversity and the fact that the majority are new species shows how little is known about the ecology and distribution of *Begonia* in Sabah. Thus, this study contributes baseline data for further research related to begonias in the future.

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CONTENTS

	<i>Page</i>
Chong Fung Yun, Veronica Samion Guanih & Rimi Repin <i>Begonia kibambanganensis</i> and <i>B. melanosticta</i> (Begoniaceae), Two New Species from Sabah, Borneo	1
Joffre Ali Ahmad, Ruth Kiew, Julia Sang & Rimi Repin The Begoniaceae of Brunei Darussalam, Borneo, including Two New Species	7
Chong Fung Yun, Veronica S. Guanih, Julia Sang & Ruth Kiew <i>Begonia</i> (Begoniaceae) in the Danum Valley Conservation Area, Sabah, Borneo, including Eleven New Species	51
Julia Sang, Ruth Kiew, Ling Chea Yiing & Connie Geri <i>Begonia</i> (Begoniaceae) from Kubah National Park and Environs, Sarawak, Borneo, including a New Species	87
Julia Sang & Ling Chea Yiing Eight New species of <i>Begonia</i> (Begoniaceae) from Murum Dam, Sarawak, Borneo	107
Julia Sang, Ruth Kiew & Ling Chea Yiing A Decade of <i>Begonia</i> (Begoniaceae) from Sarawak, Borneo	129
Rimi Repin, Rossiti M. Karim & Handry Mujih Three New <i>Begonia</i> (Begoniaceae) Species from Ultramafic Outcrops in Kinabalu Park, Sabah, Malaysia	155
Rimi Repin, Kinahim Sampang & Simun Limbawang <i>Begonia</i> (Begoniaceae) from Tawau Hills Park, Sabah, Malaysia, including Ten New Species	165

Front cover: *Begonia taniiana*, a new species named in honour of Mr Tan Jiew Hoe. Photo: Julia Sang.