

Eleven new records, three new species and an updated checklist of *Begonia* from Kalimantan, Indonesia

M. Hughes¹, D. Girmansyah², A. Randi³ & H.N.R. Ningsih⁴

¹Royal Botanic Garden Edinburgh, 20A Inverleith Row,
Edinburgh EH3 5LR, Scotland, U.K.
m.hughes@rbge.ac.uk

²Botany Division, Research Center for Biology,
Indonesian Institute of Sciences, Jl. Raya Jakarta Bogor Km. 46,
Cibinong 16911, Bogor, Indonesia

³Faculty of Forestry, Bogor Agricultural University,
Kampus IPB Darmaga PO Box 168, 16001 Bogor, Indonesia

⁴Arboretum Sylva UNTAN, Universitas Tanjungpura, Pontianak,
Kalimantan Barat, Indonesia

ABSTRACT. The *Begonia* flora of Kalimantan is very poorly known, in marked contrast to that of Brunei, Sabah and Sarawak. Here we publish eleven new records and three new species (*B. bawangensis* Girm., Randi & M.Hughes, *B. pendulina* Girm. & M.Hughes and *B. recurvata* Girm. & M.Hughes, all in *Begonia* sect. *Petermannia*) (Klotzsch) A.DC. for Kalimantan. Provisional conservation assessments according to IUCN criteria are provided for the new species.

Keywords. *Begonia bawangensis*, *Begonia pendulina*, *Begonia recurvata*, Borneo, endemism, limestone karst, taxonomy

Introduction

A total of eleven *Begonia* species have been confirmed as occurring in Kalimantan to date, based on specimen records in Hughes (2008) and Hughes et al. (2015, continuously updated), the recent publication of six species by Girmansyah & Susanti (2015), Girmansyah (2017) and Ardi et al. (2019), and a new record by Kiew et al. (2018). This contrasts with 241 species in the area comprising Sarawak, Sabah and Brunei, after intensive taxonomic work by Ruth Kiew, Julia Sang, Rimi Repin and collaborators (e.g. Kiew et al., 2015; Sang et al., 2015a); this gives an average of 1.2 species per 1000 km² for a combined area of 204,000 km². For Kalimantan, with an area of 743,000 km², the average number of species per 1000 km² is 0.01, a difference of 100-fold. These figures also reflect the number of collections of *Begonia* specimens in Borneo, which is 206 specimens in Kalimantan compared to 1705 in Sabah-Sarawak-Brunei combined (Hughes et al., 2015, continuously updated). A recent estimate of the total expected species number for *Begonia* on Borneo is 600, making it the largest genus of plants on the island (Sang & Kiew, 2014). Hence there is obviously a massive taxonomic deficit in the *Begonia* of Kalimantan, which here we take the first small steps to rectify.

The species currently known from Kalimantan are either fairly widespread taxa initially described from outside Kalimantan (*Begonia baramensis* Merr., *B. fuscisetosa* Sands and *B. gueritziana* Gibbs) or narrowly endemic taxa described from deep within the region (*B. dolichobracteata* Girm., *B. duhungensis* Girm., *B. inggitiae* Ardi & Girm., *B. ltahensis* Girm., *B. mentewangensis* Girm. and *B. walteriana* Irmsch.), or near the border (*B. dracopelta* Ardi and *B. promethea* Ridl.). Following expeditions to East Kalimantan in 2016 (the Sangkulirang Mangalihat karst) and to West Kalimantan in 2017 (Gunung Niut and Gunung Bawang) and 2019 (Bengkayang Regency), and further examination of herbarium specimens in BO, E and WAN herbaria, here we publish eleven new records and three new species for Kalimantan, with field photographs where available. These bring the checklist for Kalimantan to 25 species (Appendix 1; excluding records from smaller islands politically belonging to Kalimantan, but not part of Borneo). All cited specimens are available as images from Hughes et al. (2015, continuously updated) and many from the website of the Royal Botanic Garden Edinburgh.

New records

Begonia bayae S.Julia, Phytotaxa 252(1): 22 (2016). – TYPE: Malaysia, Sarawak, Lubok Antu District, Batang Ai National Park, Lubang Baya, Bebiyong Mit trail, adjacent to the Ranger Post, 1°18'00"N 112°04'10"E, 200 m, 2 August 2015, *Julia et al.* SFC 2762 (holotype SAR; isotypes KEP, SNP). (Fig. 1)

Distribution. Batang Ai National Park in Sarawak and Betung Kerihun National Park in West Kalimantan (Fig. 2).

Specimens examined. INDONESIA: **West Kalimantan:** Sungai Tamabaloh, anak Sungai Tekelan, DAS Embaloh, Betung Kerihun National Park, 23 Dec 2011, *Ardiyani et al. s.n.* (photographic voucher); Putussibau, Nanga Pari, Betung Kerihun National Park, 1 Mar 1999, *Sidiyasa 1948* (E [E00313073]); Sungei Obat, 29 Jan 1925, *Winkler 1352* (E [E00885864]); Sungei Obat, 31 Jan 1925, *Winkler 1390* (E [E00885863]).

Notes. The lime green leaves and dark brown veins are distinctive. The specimens *Sidiyasa 1948*, *Winkler 1352* & *1390*, which represent the southernmost localities, have more elongate leaves than the type, but are a good match in terms of venation and fruit shape.

Begonia calcarea Ridl., J. Straits Branch Roy. Asiat. Soc. 46: 260 (1906); Kiew & Geri, Gard. Bull. Singapore 55: 115 (2003); Kiew et al., Guide to Begonias of Borneo 68 (2015); Kiew et al., Gard. Bull. Singapore 68: 241 (2016); Yiing et al., Phytotaxa 381(1): 13 (2018). – TYPE: Malaysia, Sarawak, Gunung Bra'ang, *Haviland s.n.* (type not located). (Fig. 3)



Fig. 1. Habit of *Begonia bayae* S. Julia & Kiew, photographed in Betung Kerihun National Park, West Kalimantan, with male flower shown in the inset. (Photos: M. Ardiyani).

Distribution. Widespread in Sarawak in the Bau, Bintulu, Kapit, Kuching and Tatau districts, and in Kalimantan in the Bengkayang Regency; found on limestone and sandstone (Fig. 2).

Specimens examined. INDONESIA: **West Kalimantan:** Bengkayang Regency, Tikalong District, Tunang Village, Tikalong Waterfall, 2 Dec 2017, *Girmansyah et al.* WEKBOE3 (BO, E [E00959307]); Bengkayang Regency, Umbo, base of Gunung Niut, 7 Dec 2017, *Girmansyah et al.* WEKBOE52 (BO, E [E00959308]).

Notes. Following the key in Kiew et al. (2016) the hairs on the upper leaf surface of our Kalimantan collections diagnose them as belonging to the quite widespread and variable *Begonia calcarea*.

Begonia congesta Ridl., J. Straits Branch Roy. Asiat. Soc. 46: 253 (1906); Kiew & Geri, Gard. Bull. Singapore 55: 116 (2003); Kiew et al., Guide to Begonias of Borneo 82 (2015). – TYPE: Malaysia, Sarawak, Bau, *H.N. Ridley s.n.* (not located). (Fig. 4)

Distribution. The Kuching limestone in Sarawak (Kiew & Geri, 2003) and Berawat'n Waterfall in West Kalimantan (Fig. 2).

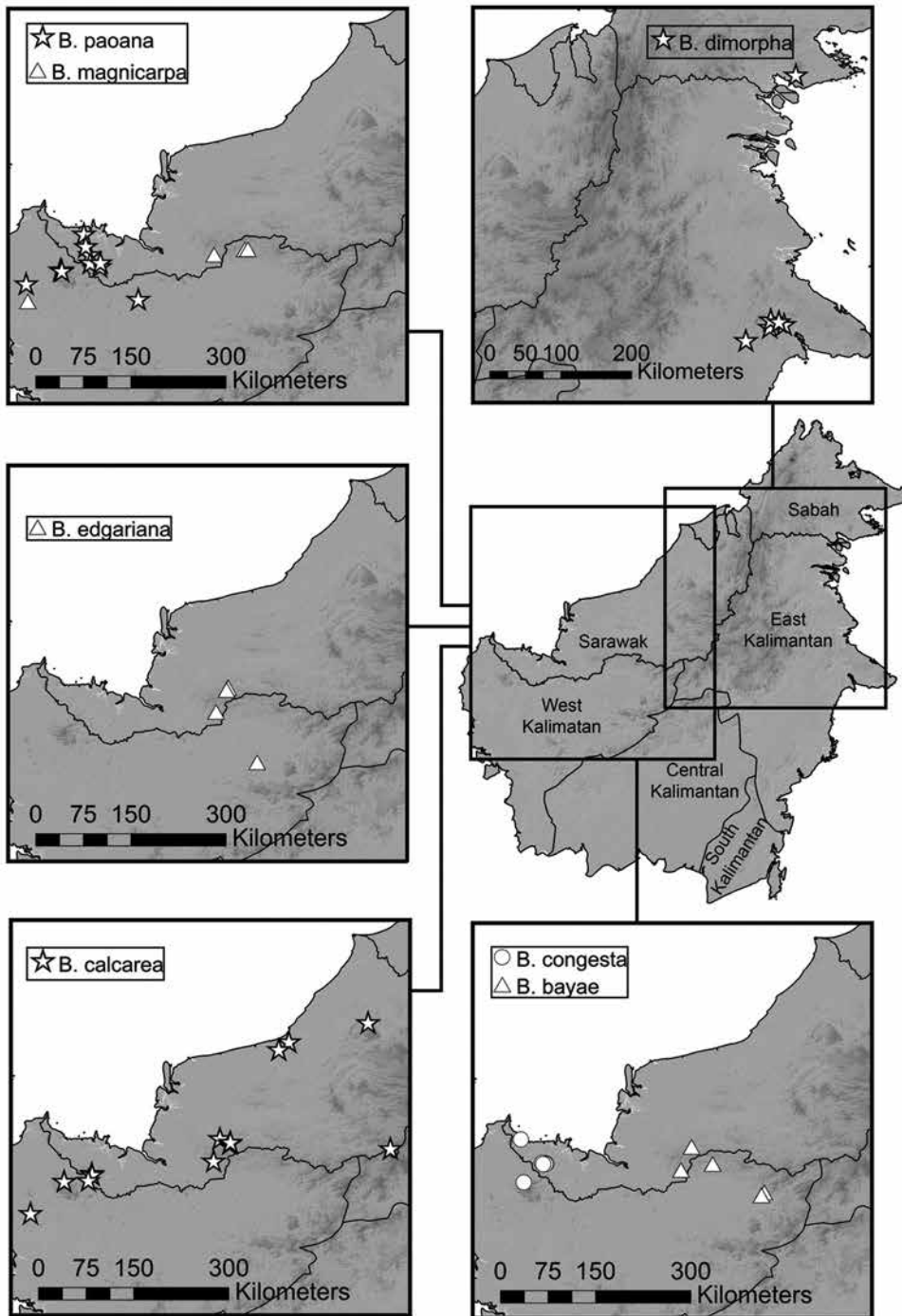


Fig. 2. Distribution of *Begonia bayae* S.Julia & Kiew, *B. calcarea* Ridl., *B. congesta* Ridl., *B. dimorpha* S.Julia, *B. edgariana* S.Julia & Kiew, *B. magnicarpa* C.W.Lin & C.I Peng and *B. paoana* Kiew & S.Julia in Borneo, showing the localities for the new records of these species in Kalimantan. Distribution data available from Hughes et al. (2015, continuously updated).

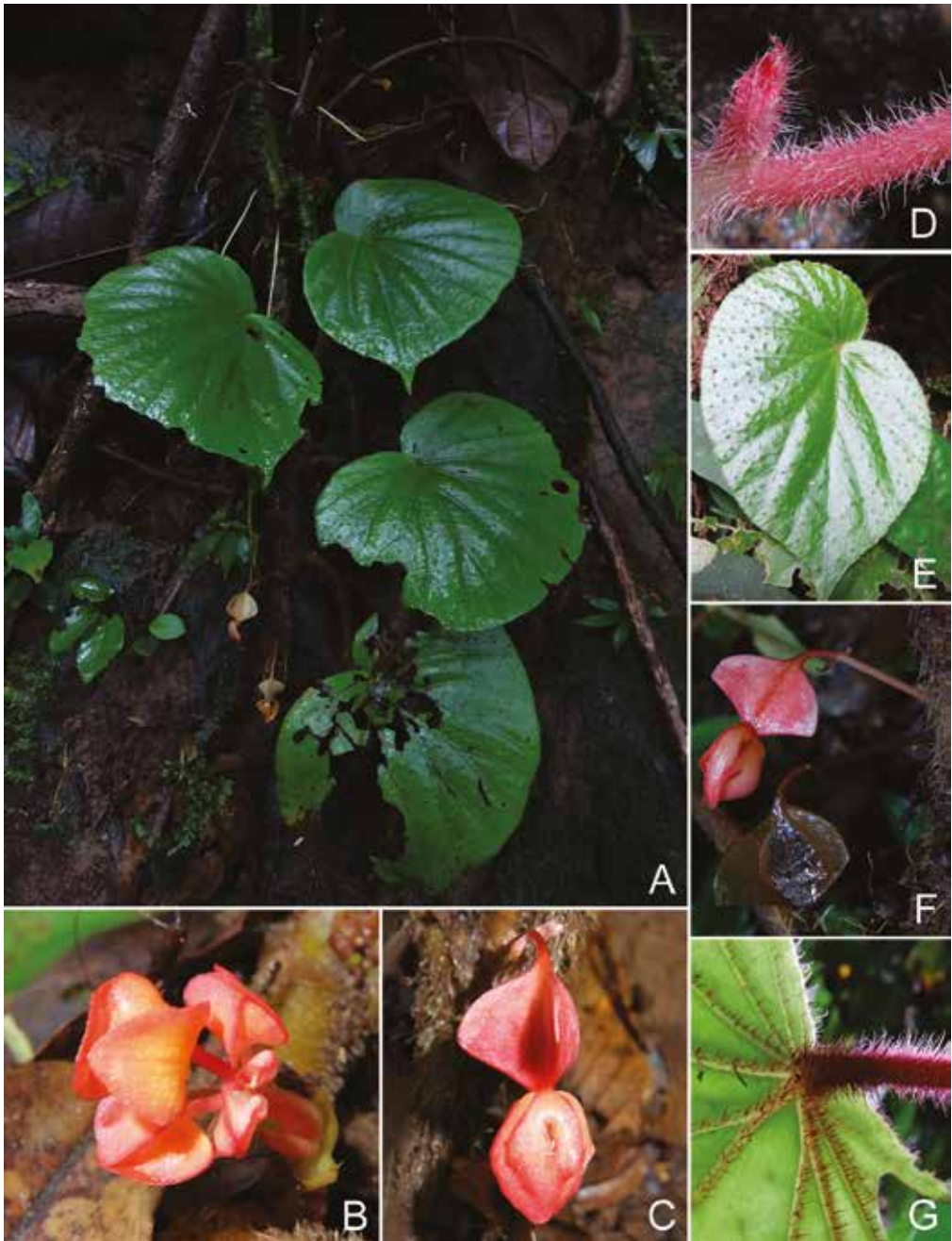


Fig. 3. *Begonia calcarea* Ridl. **A.** Habit. **B.** Male flower buds. **C.** Female flower after pollination. **D.** Petiole and subtending shoot and stipule. **E.** Leaf showing hairs on upper surface. **F.** Pollinated female flower and fruit. **G.** Petiole and lamina underside. A, B, C & F from *WEKBOE52*, Umbo; D, E & G from *WEKBOE3*, Tikalong waterfall. (Photos: M. Hughes).



Fig. 4. *Begonia congesta* Ridl. **A.** Habit. **B.** Upper leaf lamina. **C.** Mature fruits. **D.** Male portion of the inflorescence. **E.** Female flower. All photos from *WEKBOE184*, Berawan waterfall (Photos: M. Hughes).

Specimen examined. INDONESIA: **West Kalimantan:** Bengkayang Regency, Berawat'n Waterfall, 10 December 2017, *Dilot et al. WEKBOE 184* (BO, E [E00959313]).

Notes. Our collection from Berawan waterfall is a very good match for the illustration in Kiew et al. (2015), showing the diagnostic characters of quite thick tepals on the male flower, and distinct tertiary venation on the upper leaf surface. The male inflorescence is also very compact (Fig. 4D), matching the protologue.

Begonia danumensis Chong, Sandakania 20: 57 (2015). – TYPE: Malaysia, Sabah, Lahad Datu District, Danum Valley Conservation Area, Nature Trail, 26 July 2014, *Chong et al. 156802* (holotype SAN; isotypes K, KEP, SAR, SING, SNP). (Fig. 5)

Distribution. Found in the Danum Valley Conservation Area (DVCA) in Sabah, and also around Gua Tewet in Bengalon, East Kalimantan. It is described as one of the most common *Begonia* in the DVCA by Chong et al. (2015), and we noted it formed quite large colonies near the trails around Gua Tewet (Fig. 8).

Specimens examined. INDONESIA: **East Kalimantan:** Bengalon, Gua Tewet, 61 m, 26 Nov 2016, *Hughes et al. EKBOE84* (BO, E); *ibid.*, 36 m, 27 Nov 2016, *M. Hughes et al. EKBOE115* (BO, E).

Notes. Our field photos and specimens are a good match for material collected from the DVCA, and for the photos in Chong et al. (2015) and Kiew et al. (2015: 94 & 95). The Kalimantan specimens lack dentate tepals in the female flowers, and have slightly more elongate male inflorescences, but we consider this to be acceptable within-species variation as the populations are fairly disjunct.

Begonia dimorpha S.Julia, Sandakania 20: 59 (2015). – TYPE: Malaysia, Sabah, Lahad Datu, Danum Valley, Borneo Rainforest Lodge, Coffin Trail, 27 July 2014, *Chong et al. SAN157257* (holotype SAN; isotypes KEP, SAR, SING, SNP). (Fig. 6)

Distribution. Danum Valley in Sabah on alluvial soils and around Karangan in East Kalimantan on limestone karst (Fig. 2).

Specimens examined. INDONESIA: **East Kalimantan:** Karangan, karst forest on edge of MPI plantation, 19 Nov 2016, *Hughes et al. EKBOE03* (BO, E); Karangan, karst block, 22 Nov 2016, *Hughes et al. EKBOE46* (BO, E); Karangan, isolated karst block, 22 Nov 2016, *Hughes et al. EKBOE49* (BO, E); Karangan, Baay village [cultivated], *Wilkie et al. PWE1124* (BO, E).

Notes. In Kalimantan this species is only recorded from limestone, which differs from the type locality. Our collections and field observations in the Karangan area showed a range of tepal number in the male flowers (2, 3 and 4); the type has 2 tepals. There is a similarity between *Begonia dimorpha* and the earlier described *B. tawaensis* Merr. (also from the Tawau Hills) which requires further investigation.



Fig. 5. *Begonia danumensis* Chong. **A.** Habit. **B.** Female flower. **C.** Male portion of inflorescence. **D.** Female flowers. **E.** Ripe fruit. **F.** Male flower. A & B from *EKBOE115*, C–F from *EKBOE84*, both collections from the trail leading from Gua Tewet basecamp in Bengalon, East Kalimantan. (Photos: M. Hughes).

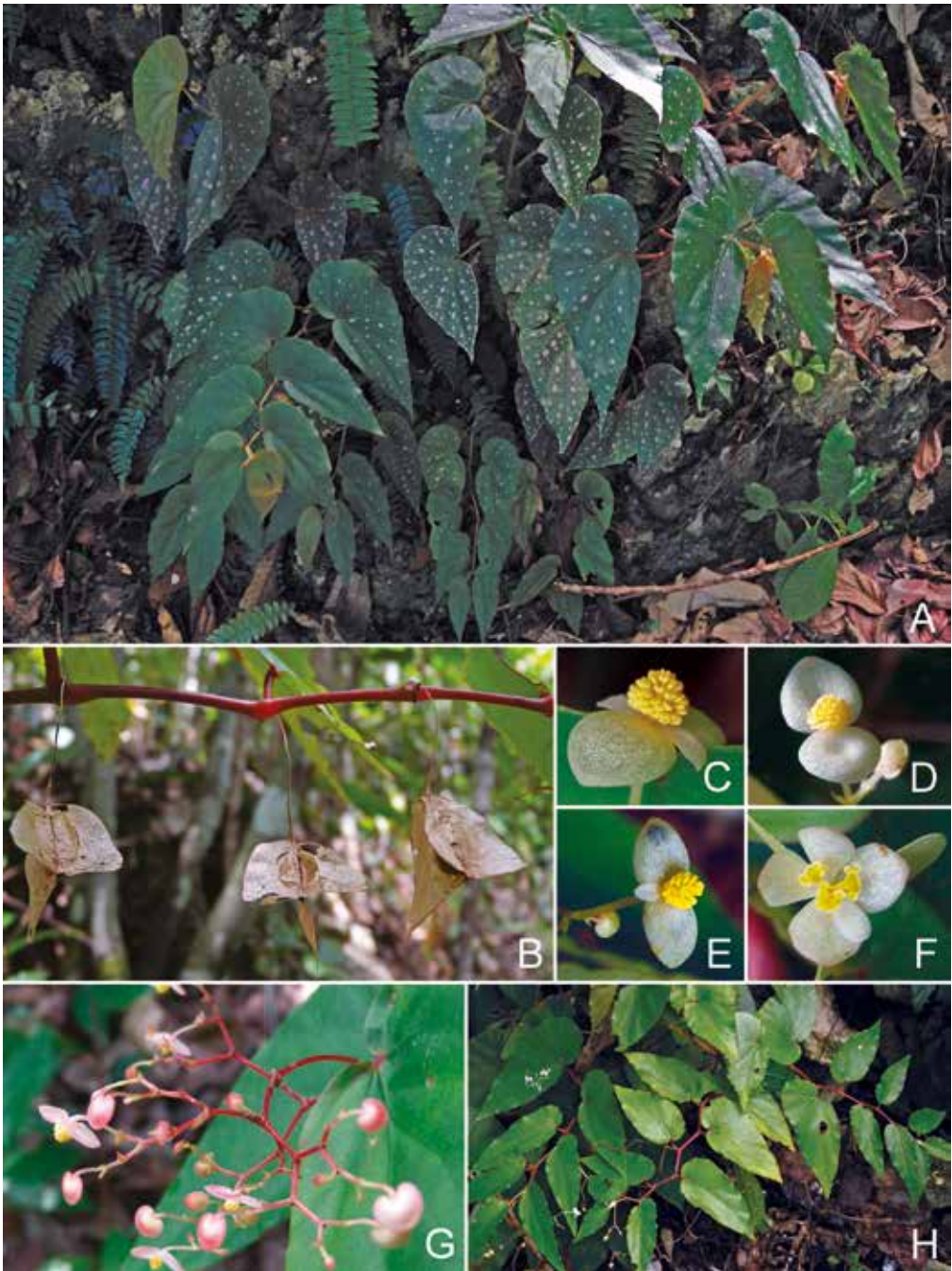


Fig. 6. *Begonia dimorpha* S. Julia. **A.** Habit. **B.** Fruits on thin pedicels. **C–E.** Male flowers showing variation in tepal number. **F.** Female flower. **G.** Male inflorescence. **H.** Habit during flowering phase showing horizontal spreading and smaller leaves. **A & F** from *EKBOE3*, **B, C, D, E, G & H** from *EKBOE46*, all from Karangan, East Kalimantan. (Photos: M. Hughes).

Begonia edgariana S. Julia & Kiew, *Phytotaxa* 252(1): 25 (2016). – TYPE: Malaysia, Sarawak, Batang Ai, Sungai Bebiyong Besai, 112°4'0"E 1°19'0"N, 2 August 2015, *J. Sang et al.* 2758 (holotype SAR; isotypes BRUN, KEP, SNP).

Distribution. Batang Ai National Park in Sarawak and in Serawai (Sintang Regency) in West Kalimantan (Fig. 2).

Specimen examined. INDONESIA: **West Kalimantan:** Serawai, Uut Labang, 112°38'56"E 0°36'6"N, 6 Oct 1995, *Church et al.* 2227 (E [E00754271]).

Notes. The diagnostic characters for this species are the pseudo-opposite leaves which are densely hairy above; it is illustrated in Sang & Kiew (2016: 26).

Begonia jamiliana Rimi, *Sandakania* 20: 178 (2015). – TYPE: Malaysia, Sabah, Tawau District, Tawau Hills Park, near by the Head Office and along the trail to the Mt. Lucia, 4 March 2004, *Rimi SNP A 16607* (holotype SNP; isotype SAN). (Fig. 7)

Distribution. Tawau Hills National Park, Sabah, and around Karangan in East Kutai, East Kalimantan (Fig. 8).

Specimens examined. INDONESIA: **East Kalimantan:** Karangan, Air Tujun, 1°28'49"N 117°37'32"E, 21 Nov 2016, *Hughes et al.* *EKBOE24* (BO, E); Karangan, Air Tujun, 1°28'57"N 117°37'45"E, 21 Nov 2016, *Hughes et al.* *EKBOE32* (BO, E); Karangan, Segara Indochem logging concession, Km 38, near Sungai Nyuarung, 9 Dec 2016, *Wilkie et al.* *PWE1104* (BO, E [E00973799]) & *PWE1105* (BO); Karangan, Segara Indochem logging concession, Km 0, forest next to entrance to logging concession, 10 Dec 2016, *Wilkie et al.* *PWE1112* (BO, E).

Notes. Our field observations and photographs are a very good match for the images in Kiew et al. (2015: 130), with the fimbriate white bracts with a pink edge at the base of the female flowers being particularly distinctive. The collections from Kalimantan had either all male or all female flowers; species in this group often show a prolonged single gender flowering phase and although may appear dioecious are not (Kiew, pers. comm).

Begonia magnicarpa C.W.Lin & C.I Peng, *Taiwania* 62: 237 (2017). – TYPE: Malaysia, Sarawak, Sri Aman, Lubok Antu, Batang Ai, 120 m, pressed from cultivated plant, 8 July 2014, *C.W. Lin 566* (holotype SAN). (Fig. 9)

Distribution. Batang Ai National Park in Sarawak, and Betun Kerihun National Park and Tikalong waterfall in West Kalimantan (Fig 2).

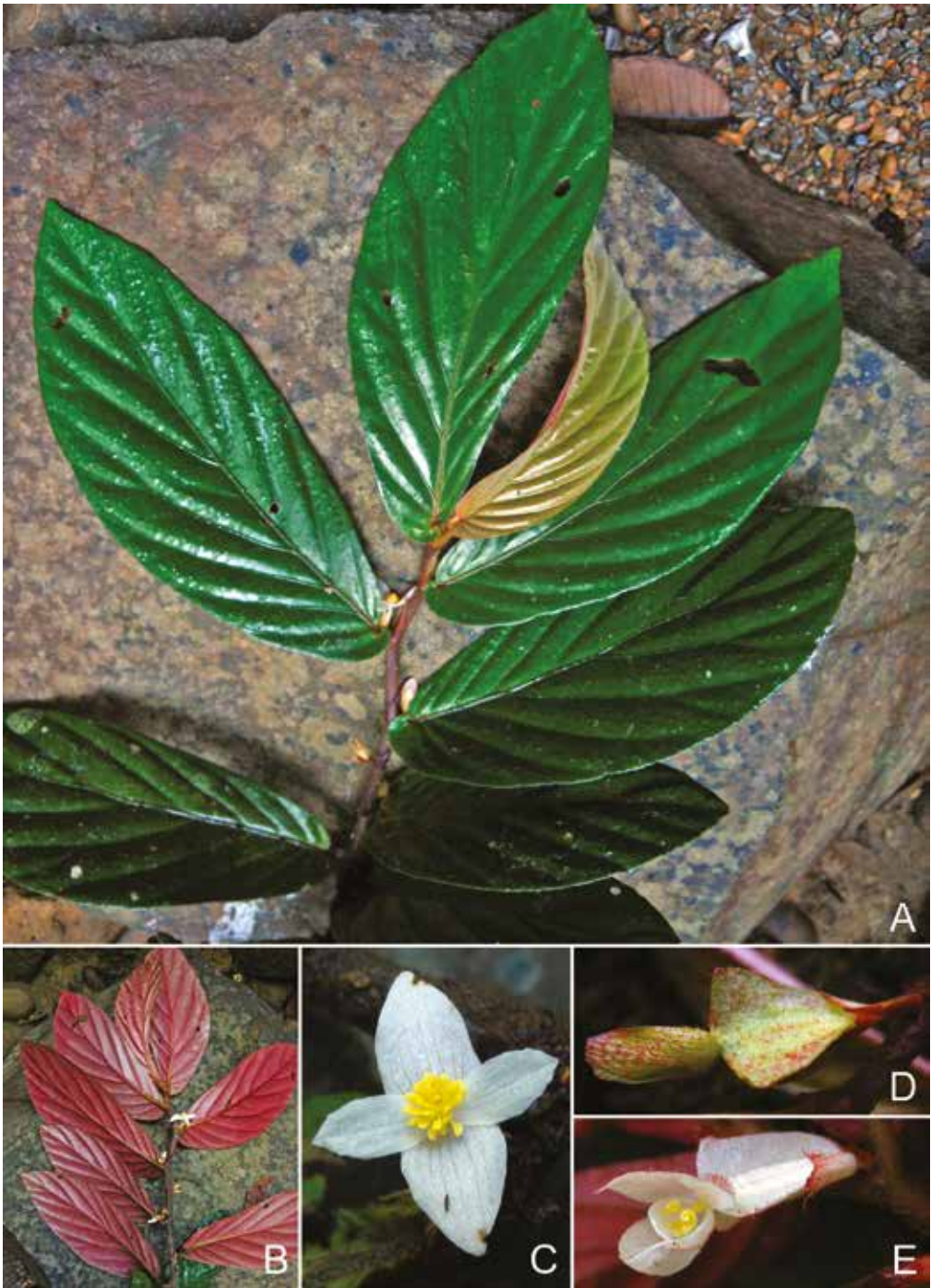


Fig. 7. *Begonia jamiliana* Rimi. **A.** Habit. **B.** Leaf undersides. **C.** Male flower. **D.** Pollinated female flower with persistent tepals. **E.** Female flower. A–C from EKBOE24, D & E from EKBOE32, from the Karangan Air Tujun in East Kalimantan. (Photos: M. Hughes).

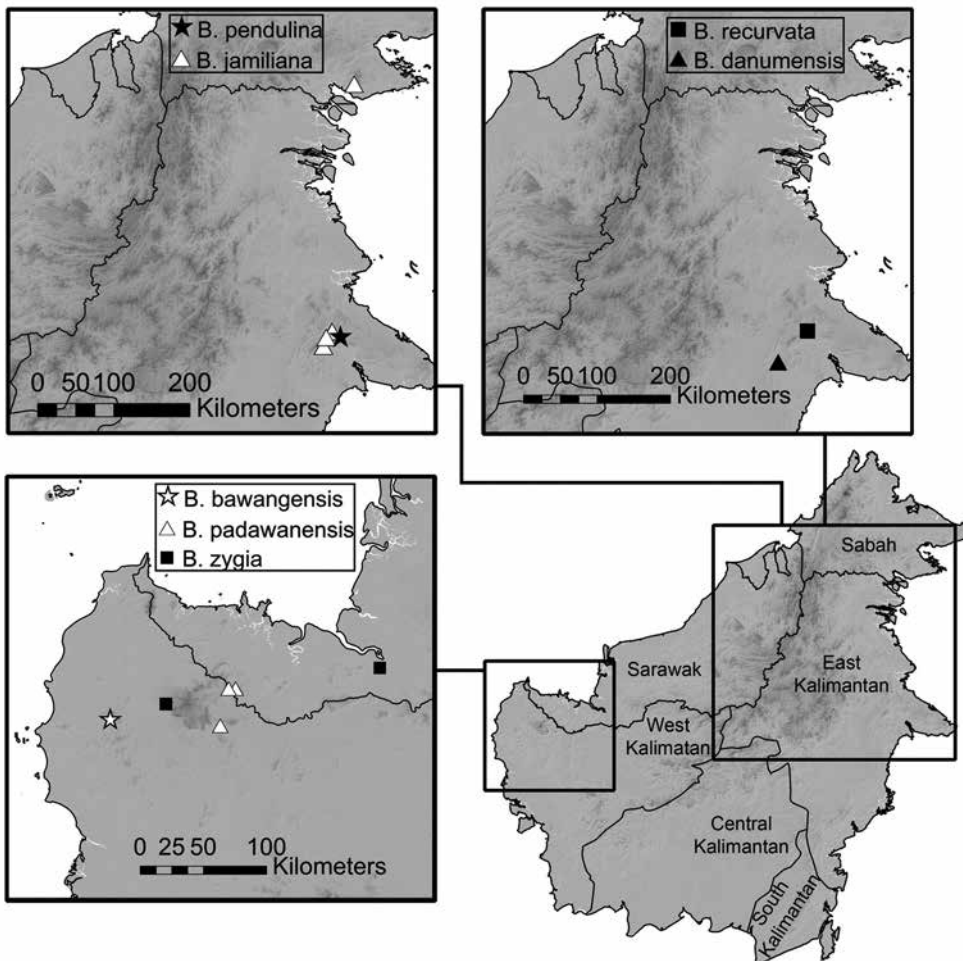


Fig. 8. Distribution of the new species *B. bawangensis* Girm., Randi & M.Hughes., *B. pendulina* Girm. & M.Hughes and *B. recurvata* Girm. & M.Hughes and the distribution of new records for *B. danumensis* Chong, *B. jamiliana* Rimi, *B. padawanensis* C.W.Lin & C.I Peng and *B. zygia* C.W.Lin & C.I Peng in Kalimantan. Distribution data available from Hughes et al. (2015, continuously updated).

Specimens examined. INDONESIA: **West Kalimantan:** Bengkayang Regency, Tikalong District, Tunang Village, Tikalong Waterfall, 2 Dec 2017, *Girmansyah et al.* WEKBOE 2 (BO, E [E00959306]); Betung Kerihun National Park, Sungai Rantaugong, 23 Dec 2011, *Ardiyani et al.* 622 (BO); Betung Kerihun National Park, Sungai Rantaugong, 24 Dec 2011, *Ardiyani et al.* 630 (BO).

Notes. A close relative of *Begonia stenogyna* Sands from Brunei, differing in having larger leaves and fruit (up to c. 6 cm long) and glabrous stems.



Fig. 9. *Begonia magnicarpa* C.W.Lin & C.I Peng. **A.** Habit. **B.** Female flower. **C.** Male inflorescence. **D.** Female flower and ovary. All from WEKBOE2, Tikalong waterfall. (Photos: M. Hughes).

Begonia padawanensis C.W.Lin & C.I Peng, Nord. J. Bot. 33: 558 (2015); Yiing et al., Phytotaxa 381(1): 19 (2018). – TYPE: Malaysia, Sarawak, Kuching District, Padawan, 01°07'N, 110°16'E, 200 m, 28 August 2013, *C.W. Lin 559* (holotype SAR; isotypes HAST, KEP, TAIF).

Distribution. The foothills of Gunung Penrissen in Sarawak, and Serimbu District, Landak Regency, West Kalimantan (Fig. 8).

Specimen examined. INDONESIA: **West Kalimantan:** Serimbu, Tenguwe, en route from Gua Endagah to Gunung Cermin, 600 m, 29 Dec 1991, *Okada & Komara 31748* (L).

Notes. A lithophyte on wet rocks or near waterfalls, with distinctive spatulate leaves.

Begonia paoana Kiew & S.Julia, Gard. Bull. Singapore 58: 217 (2007); Kiew et al., Guide to Begonias of Borneo 198 (2015); Sang et al., Sandakania 20: 97 (2015). – TYPE: Malaysia, Sarawak, Gunung Rimo, 110°16'37"E 1°19'1"N, April 2006, *J. Sang et al. S91390* (holotype SAR; isotypes E, KEP, L, SING). (Fig. 10)

Distribution. Kuching Division, Sarawak, on the Padawan-Serian limestone and Kubah National Park (Sang et al., 2015b), and in the foothills of Gunung Bawang and Gunung Niut in Bengkayang Regency, West Kalimantan (Fig. 2.).

Specimens examined. INDONESIA: **West Kalimantan:** Sintang Regency, Areal Plasma Nutfa Tegua Tibun, 0°40'N 110°58'E, 20 Oct 2000, *Albertus & Sisiyasa 2278* (WAN); Bengkayang Regency, Seluas District, Sahan Village, Umbo, Gunung Niut, 6 Dec 2017, *Girmansyah et al. WEKBOE 25* (BO, E); *ibid.*, 7 Dec 2017, *Girmansyah et al. WEKBOE 47* (BO, E [E00959316]); *ibid.*, 7 Dec 2017, *Girmansyah et al. WEKBOE 50* (BO, E [E00959318]); Bengkayang Regency, Seluas District, Sahan Village, Umbo, Mabeh river, base of Mt. Niut, 8 Dec 2017, *Girmansyah et al. WEKBOE 99* (BO, E [E00959321]); *ibid.*, 8 Dec 2017, *Girmansyah et al. WEKBOE 113* (BO, E [E00959315]); *ibid.*, 8 Dec 2017, *Girmansyah et al. WEKBOE 122* (BO, E); Bengkayang Regency, Sungai Betung District, Suka Bangun Village, along trail to Mt Bawang, 13 Dec 2017, *Girmansyah et al. WEKBOE 122* (BO, E).

Notes. This species is very close to *Begonia lailana* Kiew & Geri, with our collections from Kalimantan blurring the boundaries between the two species hitherto considered endemic to Sarawak. The key couplet in Sang et al. (2015b) differentiates *Begonia lailana* and *B. paoana* in part using leaf venation characters which unfortunately do not hold for the images of the two species in Kiew et al. (2015). We have used the character of truncate versus rounded fruit wings and the larger leaf size to diagnose our collections as *Begonia paoana* (however the fruit wing character also does not differentiate the images of *B. paoana* and *B. lailana* in Sang et al., 2015b). The recently described *Begonia minutitepala* S.Julia & Kiew (Yiing et al., 2018) is also very closely allied to these two species, and a revision of material of all three, including molecular work, would be useful.



Fig. 10. *Begonia paoana* Kiew & S. Julia. **A.** Habit. **B.** Female flower and ovary. **C.** Stem and petioles. **D.** Mature fruits. **E.** Female flower. **F.** Male inflorescence. A, D & F from *WEKBOE25* and B, C & E from *WEKBOE47*, both from Umbo. (Photos: M. Hughes).

Begonia zygia C.W.Lin & C.I Peng, *Taiwania* 64 (2): 135 (2019). – TYPE: Cultivated plant from a nursery in Taiwan, originally collected in Malaysia, Sarawak, Sri Aman Division, near Nanga Entulang, c. 100 m, vouchered and selected as type on 11 July 2018, *C.W. Lin 652* (holotype TAIF; isotype HAST, K). (Fig. 11)

Distribution. Endemic to Borneo, from Sri Aman Division in Sarawak (Lin & Peng, 2019) and Bengkayang Regency in West Kalimantan (Fig. 8).

Specimen examined. INDONESIA: **West Kalimantan:** Bengkayang Regency, Tjujuhbelas District, Riam Manajur Waterfall, 30 Jul 2019, *Randi TCF71* (BO).

Notes. An erect *Begonia* found in forest on sandstone and near streams or waterfalls. Our specimens and field observations show a quite high variation in vegetative characters, with leaves opposite or alternate, the lamina adaxially bullate to nearly flat, and the plants reaching up to 1 m tall. The pinnate venation with the opposite branching of the secondary veins is distinctive.

New species

Begonia bawangensis Girm., Randi & M.Hughes, **sp. nov.** § **Petermannia**

Differs from the two other species in *Begonia* sect. *Petermannia* (Klotzsch) A.DC. from Borneo with peltate leaves (*B. baramensis* Merr. and *B. nothobaramensis* Joffre) in having ovate leaves (not oblong or broadly lanceolate), male flowers with four tepals (not 2) and persistent white bracts (not green or reddish green and caducous). – TYPE: Indonesia, West Kalimantan, Bengkayang Regency, Gunung Bawang, 675 m, 13 December 2017, *D. Girmansyah et al. WEKBOE187* (holotype BO; isotypes E [E00959310, E00959311]). (Fig. 12)

Caulescent herb, erect or scrambling on steep (volcanic) rocks. **Stem** c. 30–50 cm tall, internodes 3–8 cm long. **Stipules** ovate to lanceolate, deciduous, pale green, c. 20 × 9 mm, with scattered miniscule hairs visible with a microscope. **Leaves:** petiole terete, fleshy, pale green, glabrous, 3–15 cm long; lamina peltate, ovate, pale green adaxially and milky green abaxially, with a thin chocolate outline on the margin when young and expanding, bleaching to very pale green in direct sunlight, glabrous on both surfaces, ovate, 10–15 × 6–9 cm, very asymmetric, point of petiole attachment c. 5 mm from the lamina margin; venation palmate-pinnate, main veins 5–8; margin sinuate and very shallowly and broadly dentate, dentition more obvious after drying; apex shortly acuminate, c. 8 mm long. **Inflorescence** terminal erect, 10–15 cm long, slightly zigzag, pale green to whitish, glabrous, female flowers solitary, basal, male flowers 10–15, distal; primary peduncle c. 7 cm long, apical peduncles very short making the male flowers very close together; **bracts** white, translucent, broadly ovate, c. 7 × 6 mm, trip acute. **Female flower** with translucent white bracteoles c. 8 mm away from the base of the ovary; ovary white, with three subequal wings, total size including wings



Fig. 11. *Begonia zygia* C.W.Lin & C.I Peng. **A.** Habit. **B.** Male inflorescence. **C.** Male flower. **D.** Unripe fruit. All from *Randi TCF71*. (Photos: A. Randi).

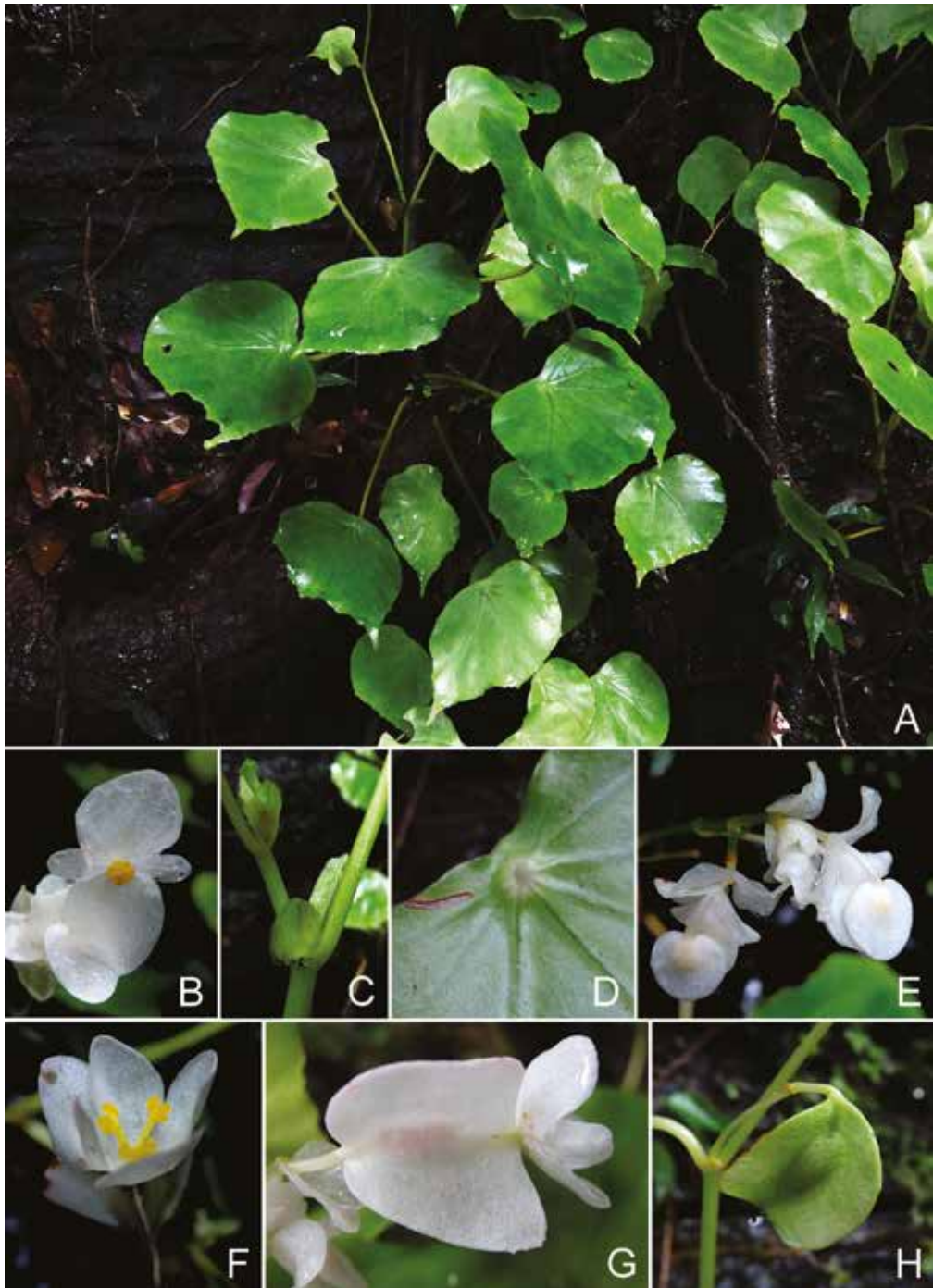


Fig. 12. *B. bawangensis* Girm., Randi & M.Hughes. **A.** Habit. **B.** Male flower. **C.** Stipules. **D.** Peltate leaf base. **E.** Bracts and male inflorescence. **F.** Female flower. **G.** Ovary. **H.** Immature fruit. All from *WEKBOE187*, Gunung Bawang, West Kalimantan. (Photos: M. Hughes).

c. 20 × 23 mm, apex of wings rounded; capsule ellipsoid, white with slightly pale green at apex, three-locular, with bifid placentae; tepals 5, white, glabrous, ovate, c. 8 × 4–7 mm, base and apex rounded, outer 2 larger; styles 3, free to the base, shallowly Y-shaped, yellow, stigmatic surface once spiralled. **Male flower** with 4 white glabrous tepals, outer larger, ovate to sub-orbicular, c. 10 × 8 mm, base cordate, apex rounded, inner elliptic, c. 7 × 2 mm, base and apex obtuse; androecium with c. 13 stamens arranged on a short column, filaments c. 0.25 mm, anther c. 1 mm long, hooded, slits on the abaxial side, c. 0.5 mm. **Fruit** shape as for the ovary, total size c. 23 × 26 mm including wings, pale green and recurved at maturity with the largest wing facing downwards.

Distribution. Endemic to the western flank of Gunung Bawang in Bengkayang Regency, West Kalimantan, where it is found in a narrow altitudinal band of around 675–725 m, growing on a wet near-vertical basalt rock seep face, in dipterocarp forest (Fig. 8).

Etymology. After the type locality of Gunung Bawang, a mountain named after its distinctive shape like a bulb of garlic (*bawang* in Indonesian).

Provisional IUCN conservation assessment. Gunung Bawang has the status of a protection forest and the population of *Begonia bawangensis* is about 1.5 km inside the boundary (data from Salim, 2015). However a logging chute was found constructed at the base of the mountain during our 2017 expedition, and illegal logging is ongoing. The site of the population is so steep that logging is unlikely in the immediate vicinity, however further degradation of the forest could alter the hydrology of the site. Based on the assumption that *Begonia bawangensis* is a single-site endemic, and that ongoing logging indicates a projected decline in the quality of habitat, we consider a category of Critically Endangered to be appropriate, under criteria B2ab(iii) (IUCN Standards and Petitions Subcommittee, 2017).

Notes. Among other Bornean *Begonia*, the leaf shape of *B. bawangensis* is closest to *B. serapatensis* Kiew & S. Julia, although it does not appear to be closely allied (also the leaves of *B. serapatensis* are basifixed). The persistent showy white bracts are unusual, and the affinity of this species is not clear.

Begonia pendulina* Girm. & M. Hughes, sp. nov. § *Petermannia

Similar to *Begonia dimorpha* in having fruits with equal wings pendent on a long thin pedicel from horizontal flowering stems, but differs in having oblong-elliptic leaves (not ovate-lanceolate), ovary capsule globose (not ellipsoid), fruit with a truncate apex (not wings ascending) and petioles with sparse bristles (not glabrous). – TYPE: Indonesia, East Kalimantan, Karangan, Gua Tapah Tangan, 55 m, 20 November 2016, M. Hughes et al. EKBOE8 (holotype BO; isotype E [E00983717]). (Fig. 13)



Fig. 13. *Begonia pendulina* Girm. & M.Hughes. **A.** Habit. **B & C.** Female flowers in pairs. **D.** female flower. **E.** Ripe fruits on thin pedicels. **F.** Unripe fruit. **G.** Male flower. **H.** Male inflorescence. **I.** Lamina sinus. All from EKBOE8, Gua Tapah Tangan in Karangan, East Kalimantan. (Photos: M. Hughes).

Cauliscent erect herb on limestone. **Stems** c. 80 cm tall, many, glabrous, internodes c. 10 cm long at the base, shortening to c. 1 cm near the apex when flowering. **Stipules** oblong-lanceolate, 15–20 × 7 mm, pale green, deciduous, apex caudate. **Leaves**: petiole terete, fleshy, red, with sparse bristles (obvious in living plants, but scarcely visible on dried material), 1.5–4 cm long; lamina basifixed, dark green above, reddish below, glabrous above with sparse bristles on main veins below, oblong-elliptic, 7–18 × 2–6.5 cm, asymmetric, base cordate with a gap in the sinus, lobes overlapping in living material; venation palmate-pinnate, main veins 8–10; margin shallowly and sparsely dentate to denticulate; apex acute to shortly acuminate. **Inflorescence** 8–12 cm long, female flowers borne singly or in pairs, rarely in threes, basal, male flowers c. 50, apical, arranged in cymes from a racemose axis; **bracts** ovate, c. 6 × 4 at the base of the inflorescence, becoming smaller towards the apex, translucent, tip rounded, quickly deciduous. **Female flower** without bracteoles; ovary green to reddish on the wings, wings 3, equal, total size including the wings c. 10 × 23 mm, apex of wings triangular, capsule globose, three-locular, with bifid placentae; tepals 5, glabrous, white with a pink blush at the base, ovate, entire or sparsely denticulate, 6–8 × 11–13 mm, outer 2 larger; styles 3, free to the base, Y-shaped, yellow, stigmatic surface twice spiralled. **Male flower** with 2 tepals, glabrous, orbicular, c. 7 × 7 mm, pink with a white margin, androecium with c. 45–50 stamens on a short column, filaments 1 mm, anther 0.75 mm, hooded, slits on the abaxial side, c. 0.5 mm. **Fruit** shape as for the ovary, total size c. 12 × 30 mm including wings, pendulous on a 3–4 cm hair-like pedicel.

Distribution. Endemic to limestone in the East Kutai Regency in East Kalimantan, known from two localities, Gua Tapah and Batu Tamiang. Grows on steep karst in the shade, at an altitude of 55 to 75 m (Fig. 8).

Etymology. After the fruits which hang on long thin pedicels (Latin *pendulinus*, meaning hanging down).

Provisional IUCN conservation assessment. Both Gua Tapah and Batu Tamiang are outside the network of protection forest sites in the Sankulirang-Mangkalihat karst system (data from Salim, 2015); the sites are karst outcrops in a matrix of disturbed forest and palm oil plantation. Currently, it seems there is no ongoing decline of the vegetation of the karst blocks themselves, and hence the criteria for CR and EN are not met. However, as there is no protection for the locality and only two sites are known, we consider an assessment of Vulnerable (VUD2) to be appropriate, given a future threat (e.g., limestone mining) could drive the species to being critically endangered or extinct in a very short time (IUCN Standards and Petitions Subcommittee, 2017).

Additional specimen examined. INDONESIA: **East Kalimantan:** Karangan, Batu Tamiang, 75 m, 22 Nov 2016, *Hughes et al.* EKBOE44 (BO, E); *ibid.*, 11 Dec 2016, *Wilkie et al.* PWE 1211 (BO).

Notes. When fruiting, the pendulous capsules which are wider than long are instantly distinctive. Vegetatively it is very similar to *Begonia recurvata* Girm. & M.Hughes, but lacks the distinctive soft puberulent indumentum of that species.

Begonia recurvata* Girm. & M.Hughes, sp. nov. § *Petermannia

Similar to *Begonia propinqua* Ridl. in having fruits on stiff, recurved pedicels, differing in having oblong-elliptic leaves (not ovate) and male flowers with 2 tepals (not 4), and lacking a sticky indumentum. – TYPE: Indonesia, East Kalimantan, Karangan, Gunung Madu, 37 m, 20 November 2016, *D. Girmansyah et al. EKBOE12* (holotype BO; isotype E [E00983709]). (Fig. 14)

Caulescent erect herb on limestone. **Stems** c. 30–50 cm tall, puberulent, internodes c. 9 cm long, becoming shorter toward the apex. **Stipules** early deciduous, not seen. **Leaves:** petiole terete, fleshy, red, puberulent, 2–3 cm long; lamina basifixed, dark green above, paler green below with red venation, glabrous above, puberulent on the veins below, ovate-lanceolate, 10–19 × 4.5–8 cm, asymmetric, base cordate with a gap in the sinus; venation palmate-pinnate, main veins c. 9; margin broadly shallowly dentate-sinuate; apex acute to shortly acuminate. **Inflorescence** c. 10 cm long, female flowers basal, borne singly or in pairs along a central axis, with male flowers apical on short cymes; **bracts** not seen. **Female flower** without bracteoles; ovary pale green, wings 3, subequal, total size including the wings c. 15 × 15 mm, apex of wings triangular, capsule ellipsoid, three-locular; tepals 5, glabrous, white with pink venation at the base, entire, elliptic, subequal, c. 14 × 5 mm; styles 3, free to the base, Y-shaped, yellow, stigmatic surface twice spiralled. **Male flower** with 2 tepals, glabrous, suborbicular, c. 7 × 6 mm, white with pink at the base, androecium with c. 30 stamens on a short column, filaments 1 mm, anther 0.75 mm, hooded, slits on the abaxial side, c. 0.5 mm. **Fruit** shape as for the ovary, total size c. 15 × 15 mm including wings, wings 3–4 mm wide, recurved on a 1.5 cm stiff pedicel with the two shorter wings uppermost.

Distribution. Endemic to limestone in the East Kutai Regency in East Kalimantan (Fig. 8), only known from the type locality of Gunung Madu. Grows on steep karst in the shade, at an altitude of c. 40 m.

Etymology. After the fruits which are on stiff recurved pedicels (Latin *recurvatus*, meaning recurved or curved backwards).

Provisional IUCN conservation assessment. Gunung Madu is outside the network of protection forest sites in the Sankulirang-Mangkalihat karst system (data from Salim, 2015); the site is a karst outcrop in a matrix of disturbed forest and palm oil plantation. Currently, it seems there is no ongoing decline of the vegetation of the karst blocks themselves, and hence the criteria for CR and EN are not met. However, as there is no protection for the locality and only two sites are known, we consider an assessment of

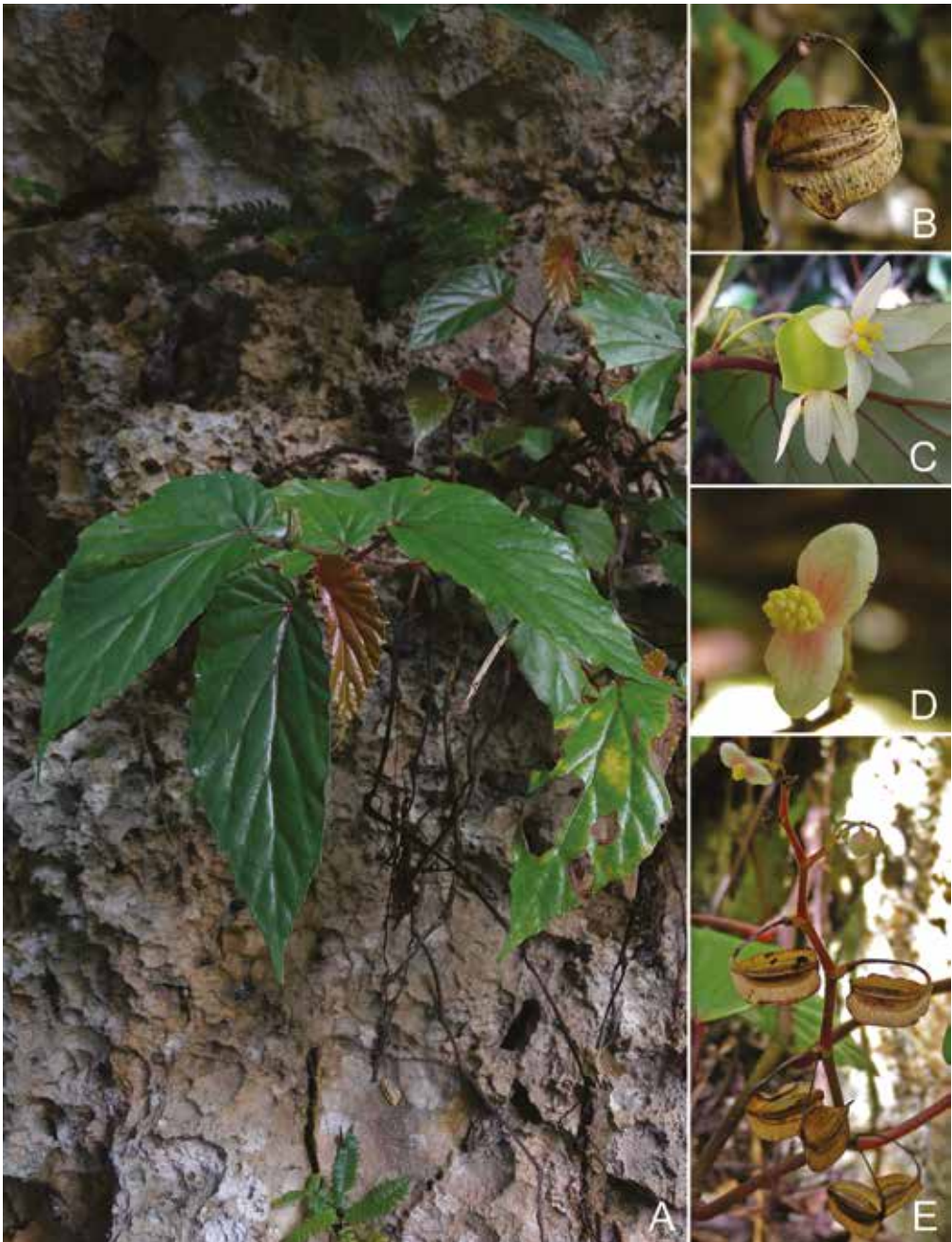


Fig. 14. *Begonia recurvata* Girm. & M.Hughes. **A.** Habit. **B.** Ripe fruit on recurved pedicel. **C.** Female flowers. **D.** Male flower. **E.** Ripe fruits in pairs at the base of the inflorescence. All from *EKBOE12*, Gunung Madu, Karang, East Kalimantan. (Photos: M. Hughes).

Vulnerable (VUD2) to be appropriate, given a future threat (e.g., limestone mining) could drive the species to being critically endangered or extinct in a very short time (IUCN Standards and Petitions Subcommittee, 2017).

Notes. Of the other cane-like *Begonia* in the area, *B. recurvata* is distinct in the softly puberulent indumentum on the stem and petioles; *B. dimorpha* is glabrous, and *B. pendulina* has a few bristle-like hairs on the petioles.

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Appendix 1. A checklist of *Begonia* species recorded from Kalimantan, Borneo (mainland Kalimantan only). Vouchers available from the Begonia Resource Centre (Hughes et al., 2015, continuously updated). In this paper: New record*; new species**.

Begonia baramensis Merr.
B. bawangensis Girm., Randi & M.Hughes **
Begonia bayae S.Julia & Kiew*
Begonia calcarea Ridl.*
Begonia congesta Ridl.*
Begonia danumensis Chong*
Begonia dimorpha S.Julia*
Begonia dolichobracteata Girm.
Begonia dracopelta Ardi
Begonia duhungensis Girm.
Begonia edgariana S.Julia & Kiew*
Begonia fuscisetosa Sands
Begonia inggitiae Ardi & Girm.
Begonia gueritziana Gibbs
Begonia jambiliana Rimi*
Begonia ltahensis Girm.
Begonia magnicarpa C.W.Lin & C.I Peng*
Begonia mentewangensis Girm.
Begonia padawanensis C.W.Lin & C.I Peng*
Begonia paoana Kiew & S.Julia*
Begonia pendulina Girm. & M.Hughes**
Begonia promethea Ridl.
Begonia recurvata Girm. & M.Hughes**
Begonia walteriana Irmsch.
Begonia zygia C.W.Lin & C.I Peng*